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A Survey of the Strategic Alternate Sourcing Program Offices Management of United States Air Force Diminishing Manufacturing Sources and Material Shortages Subject Matter Experts

David E. Portée

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A Survey of the Strategic Alternate Sourcing Program Offices Management of
United States Air Forces Diminishing Manufacturing Sources and Material
Shortages Subject Matter Experts

THESIS

David Edward Portée, Captain, USAF

AFIT-ENS-MS-21-M-179

DEPARTMENT OF THE AIR FORCE
AIR UNIVERSITY

AIR FORCE INSTITUTE OF TECHNOLOGY

Wright-Patterson Air Force Base, Ohio

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A SURVEY OF THE STRATEGIC ALTERNATE SOURCING PROGRAM OFFICES
MANAGEMENT OF UNITED STATES AIR FORCES DIMINISHING
MANUFACTURING SOURCES AND MATERIAL SHORTAGES SUBJECT
MATTER EXPERTS

THESIS

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Captain, USAF

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Abstract

The United States Air Force's aircraft fleet has surpassed its average expected life expectancy; at the same time, original manufacturing sources have closed their doors, technical data to reproduce parts is obsolete or nonexistent, and creating contracts for manufactures to fill these gaps is costly and time consuming. These and other obsolescence related issues are what is known as **"Diminishing Manufacturing Source and Material Shortages"** (DMSMS). The office designated by the Air Force to be DMSMS subject expert program office is known as the Strategic Alternate Sourcing Program Office (SASPO). Aided by the USAF Program Offices and DMSMS Subject Matter Experts, the SASPO is responsible for sourcing DMSMS resolutions as well as the organizing, training, and equipping of the Program Offices DMSMS Programs. Using quantitative research, this study conducts a survey, with the USAF Program Offices as the unit of analysis, to gain insight as to where the SASPO is doing well and where gaps exist in their program management. The analysis and conclusion identify where the SASPO should focus their attention to proactively manage DMSMS resolutions.

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David E. Portée

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A SURVEY OF THE STRATEGIC ALTERNATE SOURCING PROGRAM OFFICES MANAGEMENT OF UNITED STATES AIR FORCES DIMINISHING MANUFACTURING SOURCES AND MATERIAL SHORTAGES SUBJECT MATTER EXPERTS

I. Introduction

Background

"Diminishing Manufacturing Source and Material Shortages will eat your lunch" (SD-22, 2016). In FY18 the United States Air Force's (USAF) overall aircraft Mission Capable (MC) rate dropped to an all-time low of 69.97% (Losey, 2019). The primary reason to this overwhelmingly low MC rate is the advancing age of the fleet which reached 30 years old in FY20 (Venable, 2020). Additionally, the old age of the fleet, which has far surpassed it's expected life time, has led to manufacturing sources that the Air Force has relied on for decades to produce unique spare parts and materials are closing their doors (Losey, 2019). When gaps form because these parts cannot be procured and are contributing to low MC rates, the Air Force turns to contractors to manufacture these parts; which is time consuming and costly (Losey, 2019). All these factors ultimately has led to the deterioration of training for operators and pilots, decreasing the overall mission readiness of the Air Force (Losey, 2019).

The management of Diminishing Manufacturing Source and Material Shortages (DMSMS) and obsolescence is a mandated program at the Department of Defense (DoD) level; DoDI 4140.01, "DoD Supply Chain Materiel Management Policy" (SD-22, 2016). DMSMS related obsolescence revolves around the simple concept of losing the ability to procure system components from the original manufacturer (Sandborn, 2013). With the average age of the USAF aircraft fleet creeping over 30 years old and many aircraft

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approaching 60, the end of product life cycles is dawning quickly on the USAF Supply Chain (Losey, 2019; Zamora & Graham, 2019). This growing issue is an enormous contributor to DMSMS and Obsolescence.

The aging aircraft fleet of the United States Air Force (USAF) contributes to many factors that lead to DMSMS issues including first time failures which leads to lack of data and technical documents for parts that have outlived their expected service life, loss of suppliers, no-bid solicitations, and multiple system configurations (such with the configurations of the C-130 or C-135 air frame) (Zamora & Graham, 2019). DMSMS issues are quickly arising from Original Equipment Manufacturers (OEM) that have either gone out of business or no longer supports, stocks, repairs or produces aircraft or equipment components (Zamora & Graham, 2019). These types of issues are felt across the USAFs air, space, and cyberspace domains and threaten the readiness of the USAFs aircraft fleet and critical contribution to the nuclear triad.

To gain control over the impeding DMSMS issues the USAF faces in its present and immediate future, Air Force Material Command (AFMC) has provided instruction, expectations, roles, and responsibilities for DMSMS management. These specifications are outlined in AFMCI20-105 "DMSMS"; the instructions directs the DMSMS Management Team (DMT), guided by the DMSMS Management Plan (DMP), to proactively manage USAF DMSMS issues (Zamora & Graham, 2019). The DMT utilizes the DMP to oversee obsolescence management through the life cycle of a weapon system or program (Zamora & Graham, 2019).

Furthermore, AFMC has identified the Strategic Alternate Sourcing Program Office (SASPO) as the DMSMS subject expert program office and the DMSMS Center

of Excellence for the USAF (Zamora & Graham, 2019). The SAPSO provides DMSMS training to all USAF program offices, integrates program offices best practices, reviews contract documents containing DMSMS language, and serves as a working member for all program office DMSMS Management Teams (Zamora & Graham, 2019). As part of the DMSMS management program, the SASPO provides the Air Force Predictive Tool (AVCOM) to support all USAF programs (Zamora & Graham, 2019). The SASPO manages the program offices towards proactive DMSMS management and resolution; when no DMSMS resolution is available to the program offices, the SASPO works with industry partners and other government agencies to find alternate sourcing methods to include reverse engineering, repair development, and additive manufacturing (Zamora & Graham, 2019). Ultimately, if managed correctly, proactive DMSMS management can help the Air Force toward affordable long term weapon system life cycles which will help gain the competitive edge against adversaries.

In August of 2020 General Charles Q Brown Jr., CSAF, introduced his charge to the United States Air Force (USAF) "Accelerate Change or Lose". In his document, Gen Brown (2020) identifies that the Air Force needs to regain it's sustained competitive advantage in order to meet the standard the Nation bestows upon the Air Force and says that we, as an Air Force, need accelerate change in order to maintain the control and exploitation of the air domain. Gen Brown (2020) states that the USAF will focus on the Joint Warfighting Concept and that he will move forward with digital, low cost, high tech, warfighting capabilities. Furthermore, he adds that "only through collaboration with and through will we succeed" meaning that the Air Force will need to work closer

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together with DoD stakeholders, Congress, and industry partners to streamline processes and incentivize intelligent risk taking (Brown, 2020).

In Accelerate Change or Lose, Gen Brown highlights that an "uncontested USAF dominance is not assured", that "good enough today will fail tomorrow", that "we must collaborate within and throughout to succeed", that the USAF must "empower Airmen to solve any problem", and that "the consequences of failure – and success – are profound" (Brown, 2020). At the time of this writing, the USAF's current pace of change is insufficient to uphold a sustained competitive advantage against near peer advisories (Brown, 2020).

As the fighting force that will be the first to send Americans in response to an emerging crisis, the USAF needs to integrate and accelerate the necessary changes that are needed to bring about new operational concepts and rapidly develop and employ the capabilities that will help in future fights (Brown, 2020). Gen Brown has established that this is an all-in fight to accelerate change and that collaboration must happen inside of the Air Force as well as with outside partners (Brown, 2020). To make these changes possible, the USAF will need to use defensible analysis and evidence to build a case to Congress, industry partners, and external and internal DoD stakeholders to streamline processes and incentive intelligent risk taking (Brown, 2020). At the same time, the USAF will need to remain good stewards of taxpayer dollars and work within the constraints of the current fiscal environment (Brown, 2020).

Released shortly after Gen Brown's address to the Air Force, Gen Brown (2020) introduced "CSAF Action Orders to Accelerate Change Across the Air Force". Through these action orders, Gen Brown provides Airmen with further direction as to how the Air

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Force, as a whole, is expected to carry out his vision to accelerate change across the USAF. The action orders are Action Order A: Airmen, Action Order B: Bureaucracy, Action Order C: Competition, and Action Order D: Design Implementation (Brown, 2020).

Through these action orders, Gen Brown's (2020) intent is to build a resilient force of Airmen that are ready for future fights, to "tune up" Bureaucratic processes in order to increase speed and efficiency when working internal as well as with industry partners, to increase the competitive understanding of the nations adversaries, and to continue the development (Design) of a lethal and affordable force supported by Congress. Affordability is a tough constraint will need to be accomplished, in part, by enacting affordable capabilities to maintain competitive advantage in a near peer high end fight, giving way to these capabilities by eliminating systems and programs that are outdated and/or unaffordable, and to make decisions now as to how these capabilities will remain affordable (Brown, 2020). Gen Brown (2020) has outlined to the Air Force that it's sustained competitive advantage is not assured, especially when going against a near peer adversary, and that if the USAF does not accelerate change now, the consequences of failure will be profound and felt by the Nation the USAF has sworn to protect.

Finally, enacting the CSAFs vision to "Accelerate Change" is the role and responsibility of every Airmen every day. Proactive DMSMS management may be a small piece to the puzzle but is critical. All Airmen involved in weapon system sustainment and life cycle management need to be aware of DMSMS and obsolescence issues within their respective programs and how it ties into Gen Browns vision. Airmen must seek knowledge sharing and collaboration to enact resolutions and together to

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eliminate repeat work. Airmen must use the tools available to use reduce administrative burden and bureaucratic processes by making analytically informed decisions to work effectively with industry partners with speed and efficiency. Airmen need to enhance their competitive edge by identifying, through collaboration, where to improve their life cycle sustainment capabilities. And finally, Airmen need to contribute to the continued development of a lethal and affordable force that is supportive of Congress by getting involved early in the acquisition phase to establish contract language that will ease possible DMSMS and obsolescence issues of the future force.

Problem Statement

The SASPO is a relatively new office formed in 2017 with a critical role in DMSMS management. As the DMSMS subject expert program office, the SASPO is tasked with effectively managing the organization, training, and equipping of the Program Offices' DMSMS programs, data management, and collaboration, across the Active Duty Air Force. With many Program Offices spread around the country, it is difficult to gain insight from the DMSMS SMEs as to where the SASPO needs to improve to foster proactive DMSMS management and where they are doing well. Furthermore, to better communicate the Program Offices' gaps and limitations to the appropriate levels, the SASPO needs to understand the size and scope of the Program Offices DMSMS management, if they are proactively managing DMSMS and conducting training on their own, and if they are participating in knowledge sharing and collaboration externally to their offices. Currently, there is no feedback mechanism to gather this information.

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Research Objectives/Questions

The objective of this research lies within the overarching research question, "Has HQ AFMC established a proactive DMSMS management program for the United States Air Force in accordance with AFMCI20-105 and the SD-22?" To answer this overarching question, nine bridging questions are listed below. The objective of this research is to gain a perspective of how DMSMS management is doing and to formally document feedback from the USAF Program Offices and DMSMS SMEs. The DMSMS SME is the unit of analysis in this study. This will add the SASPOs repertoire of knowledge and better inform them to where they can do better.

1. Is there a positive level of commitment to proactive DMSMS program management amongst the SMEs?

2. Do SMEs have backing from their own leadership?

3. Have the SMEs established DMSMS program components outlined in the SD-22 and AFMCI20-105?

4. Do the SMEs recognize the SASPO and their roles and responsibilities in proactive DMSMS management as outline by AFMCI20-105?

5. Has the SASPO established a positive relationship with the DMSMS SMEs that foster proactive management of DMSMS?

6. Has the SASPO provided useful tools to the SMEs for proactive DMSMS management?

7. What resource gaps exist amongst the SMEs outside of funding, manpower, and training?

8. Does collaboration and information sharing occur amongst the SMEs?

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9. What level of awareness needs to be raised to Program Offices to gain further buy-in to building a robust DMSMS program?

These questions are answered with a further set of survey questions discussed in the Methodology section.

Research Focus

The focus of this research will be specifically to provide feedback to the SASPO from the Program Offices and DMSMS SMEs and reveal a way forward to better DMSMS management in the future. For DMSMS to be successful, several elements in the program must exist at the program offices. Those elements include management support, a DMSMS program established according to the SD-22's specifications, the use of predictive tools, accurate bills of materials, adequate financial resources, and knowledge sharing and collaboration. This research is focused on discovering if this is happening.

Methodology

This study uses a quantitative research design; research will be conducted through the administration of a web-based survey, which is the most widely accepted way of reaching a population (Leedy & Ormrod, 2015). Data will be collected through a questionnaire which will be administered by the SASPO to the DMSMS SMEs. The survey will directly engage feedback from the field regarding key DMSMS program implementation elements. Survey questions have been derived from the SASPO and coordinated with the researcher. Steps will be taken to ensure the integrity of the surveys administration to protect the views of the target as well as receive the most candid

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feedback possible. To establish validity, survey questions went through multiple iterations of review and pilot testing before the survey was administered (Leedy & Ormrod, 2015).

Assumptions and Limitations

This research assumes that the sample of DMSMS SMEs are representative of the DMSMS SME population. This assumption allows for the generalization of survey results to answer research questions. Another assumption is that a large majority of respondents likely have a lack in interest in proactive DMSMS management. Non-respondents will lose the opportunity to gain data from portion of the population but can potentially help address the first research question. Because this survey was only administered to USAF SMEs, the implications of the results will only allow for the generalization of USAF SMEs and not of all DoD components. Furthermore, as Program Offices switch personal, weapon systems are acquired and retired, and predictive and collaboration tools change, the results of these survey will loss relevancy. Another limitation to this research is the Guard and Reserve. As the Guard and Reserve maintain their own DMSMS programs, they are not subject to the SASPO and their direction on DMSMS management are not represented in this research.

Implications

At the conclusion of this research, it should be identified in what areas the field (unit of analysis) has successfully implemented and is practicing these key elements to DMSMS implementation. The SASPO will be able to use the results of the research to identify any shortfalls in DMSMS management. The SASPO will also be able to provide

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general feedback to AFMC of any gaps that exist between the success of DMSMS management and Program Offices.

Summary

This chapter discussed the background, problem statement, research objectives and questions, assumptions and limitations, as well as implication. Most importantly, the general issues discussed the current state of the Air Force and their need to accelerate change and links those issues to DMSMS management and how proactive management will help achieve the Air Force's long term affordable life cycle sustainment goals. The remainder of this thesis include a literature review where relevant theories related to Supply Chain Management and this thesis are discussed, methodology that describes in detail how the survey was formulated and administered, findings and analysis where the survey questions are used to answer the research questions, and finally the conclusion.

II. Literature Review

Overview

      This chapter conducts a literature review of Supply Chain Management (SCM) theories and Diminishing Manufacturing Sources and Material Shortages (DMSMS). This chapter begins by studying the very diverse array of literature regarding Supply Chain Management theories. Specifically, theories of Transaction Cost Economics, Agency Theory, Resource Based View, Porter's Framework, and Social Exchange Theory are reviewed. The vast majority of SCM research does not include a review of theory; of those that do, the majority only includes one theory (Defee, Williams, Randall, & Thomas, 2010). The researcher decided to do a review of multiple theories to better understand to aspects being examined in this research; sustained competitive advantage, proactive management, DMSMS, and obsolescence. The second half of the chapter concentrates on DMSMS and obsolescence.

Supply Chain Management Theory

      The term Supply Chain Management (SCM) was introduced in 1982 by Oliver and Weber in a series of articles to describe the management of material flows across organizational boundaries (Giannakis & Croom, 2004). SCM can be define as the effective management of materials, information, and finance; together, these three resources can be thought of as complementary (Wu, Chuang, & Hsu, 2014). Supply Chain Management contains a wide array of challenge areas including visibility, cost containment, risk management, fluctuating customer demands, and globalization (Shibin

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et al., 2017). Likewise, SCM extends across several ranging disciplines and its literature and theories are diverse and growing (Giannakis & Croom, 2004).

At the core of these theories, it is recognized that competition does not take place between two firms, but between their supply chains (Giannakis & Croom, 2004). To adapt to market changes, organizations are now competing by managing relationships within the supply chain in order to gain competitive advantage (Wu, Chuang, & Hsu, 2014). Two major concerns in the realm of SCM is information sharing and collaboration (Wu, Chuang, & Hsu, 2014).

When the information shared between the upstream and the downstream portions of the supply chain is inaccurate or incomplete, it causes variation in demand commonly known in the SCM community as the "bull whip effect" (Wu, Chuang, & Hsu, 2014). Wu, Chuang, and Hsu (2014) provide operational, tactical, and strategic information sharing as three ways of mitigating the bull whip effect. Operational information sharing studies the management of the flow of material, components, and finished good in order to strengthen the productions related activities of a supply chain (Wu, Chuang, & Hsu, 2014). Tactical information sharing improves upon decision quality by encouraging collaboration between SCM partners (Wu, Chuang, & Hsu, 2014). While Strategic information sharing helps gain competitive value through the creation of strategic impact amongst supply chain partners (Wu, Chuang, & Hsu, 2014).

Supply chain experts and theorist have approached the subject of SCM theory in many approaches. The "3S" Framework Splits SCM into 3 dimensions; the dimensions of synthesis, synergy, and synchronization. Synthesis related to the physical structure of supply chains. This structure helps tie SCM to the theories of institutional economics and

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network theories. Synergy links to the human interaction and relationship pieces of SCM theory. While synchronization builds upon the coordination and control aspects of SCM (Giannakis & Croom, 2004).

Theory is the basis of good research that has the capability to expand upon scientific understanding of a good SCM structure. However, only about 53% of articles published in the Journal of Business Logistics (JBL) and the Journal of Supply Chain Management (JSCM) are based on at least one type of theoretical construct. The most common and prevalent theories used in SCM research are based on competitive and microeconomic theories. Supply Chain Management bridges together numerous professions to include strategic management, purchasing, manufacturing, marketing, retail, and logistics. (Defee, Williams, Randall, & Thomas, 2010)

The most commonly applied theories in SCM research that are also most relevant to this thesis are those of Transaction Cost Economics (TCE), Resource Based View (RBV), Porter's framework, Agency Theory, and Social Exchange Theory (SET) (Defee, Williams, Randall, & Thomas, 2010). The theories of TCE and Agency theory can both be grouped together under the Microeconomic framework, while RBV and Porter's framework will fall into the Competitive framework (Defee, Williams, Randall, & Thomas, 2010). Social Exchange Theory surprisingly fits well into the Social Exchange framework (Defee, Williams, Randall, & Thomas, 2010).

Competitive theories focus on the unit analysis of the individual firms and they strive to develop competitive advantage in the market. They are very highly used across the five main Logistics and SCM journals, which shows the constructs versatility and applicability across many different strategic management disciplines (Defee, Williams,

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Randall, & Thomas, 2010). The Competitive constructs of theory are very applicable in SCM in that the construct suggests that competition amongst Supply Chain firms has shifted away from inter-firm competition and down the supply chain levels (Defee, Williams, Randall, & Thomas, 2010). This point of view on competition between to separate entities is particularly important because it allows us to analyze the supply chain levels where competitive advantage can either be gain or lost.

Microeconomic theories are the next most used theoretical construct used in literature; they are among the most developed theories in the social sciences and created the framework for theories on the existence of the firm, distribution, management practices, decision for entry into foreign markets, outsourcing, and marketing (Defee, Williams, Randall, & Thomas, 2010). Microeconomic theory helps rationalize how firms will make decisions regarding scarce resource allocation in a given market trend (Defee, Williams, Randall, & Thomas, 2010). Microeconomic theory, like Competitive theory, is applicable to logistics and SCM research because of its focus on the firm as it's unit of analysis (Defee, Williams, Randall, & Thomas, 2010).

Transaction Cost Economics

Transaction Cost Economics (TCE) views firms as a bundle of contracts (Williamson, 1979). Furthermore, TCE uses the "make or buy" decision as it's paradigm in which to view contracts (Williamson, 2008). TCE should be viewed as more than an economic theory, but as a combination of inter-disciplinary law, economics, and organization theory (Ketokivi & Mahoney, 2020). It is through this outsourcing decision that TCE approaches the opportunistic and competitive nature amongst firms and has a

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major impact on strategic management (Yigitbasioglu, 2010; Ketokivi & Mahoney, 2020).

Collaboration among organizations within a supply chain is critical to a firms success and the more integration a firm exhibits, the higher their success rate (Yigitbasioglu, 2010). Uncertainty arises in SCM when supply, demand, new product development, and technology uncertainties exist within the supply chain's manufacturing processes (Yigitbasioglu, 2010). Supply uncertainty occurs when there are unpredictable events that are introduced into the upstream supply chain such as material shortages or late deliveries. Demand uncertainty occurs in the downstream from seasonality, fads, new products, or short product life cycles as is the case with electronics (Yigitbasioglu, 2010).

Through TCE, firms can obtain less biased and more consistent initial cost estimates (Melese, Franck, Angelis, & Dillard, 2007). Cost estimates serve the functions of evaluating military investments and provide the foundation for future defense budgets (Melese, Franck, Angelis, & Dillard, 2007). The "make or buy" decision is generally affected by production costs and the cost of managing transactions (Melese, Franck, Angelis, & Dillard, 2007). Production costs in a competitive market leads firms to debate the cost advantages of outsourcing; leading to the make or buy decision (Melese, Franck, Angelis, & Dillard, 2007). Transaction cost include cost incurred to a firm that involve coordination cost, contracting costs, and monitoring and enforcement cost which can be divided into coordination costs and transaction risks (Yigitbasioglu, 2010).

TCE provides the firm with a solid theoretical framework to make an informed decision about outsourcing (Melese, Franck, Angelis, & Dillard, 2007). TCE theorizes that SCM governance structures, such as contracts, that minimizes transaction costs and

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maximizes profit will be chosen between buyers and sellers (Melese, Franck, Angelis, & Dillard, 2007). Asset specificity and uncertainty can raise transaction cost while frequency and collaboration facilitated by information sharing can lower it (Williamson, 2008).

Of interesting note and relevant to the perspective of the sponsor's view is that defense acquisition is more concerned with how tax payer dollars are spent and mostly focuses on production costs (Melese, Franck, Angelis, & Dillard, 2007). Contracting cost, however, differ from production cost in that production cost exposes the firm to the costs of managing the outsourced relationships and opens up risks of opportunistic behavior from the contractor (Melese, Franck, Angelis, & Dillard, 2007).

Understanding the risks of ''opportunism'' is one of the key insights TCE can offer to improve initial cost estimating (Melese, Franck, Angelis, & Dillard, 2007). In contracts with little complexity and uncertainty, fixed-price type of contracts do well (Melese, Franck, Angelis, & Dillard, 2007). As layers of complexity and uncertainty is added to a contract, firms turn away from fixed-priced contracts and prefer cost-reimbursement contracts (Melese, Franck, Angelis, & Dillard, 2007). The recurrent transactions of high frequency contracts justify setup costs involved in specificity of products (Melese, Franck, Angelis, & Dillard, 2007). Furthermore, recurring transactions often results in the build up of trust and reputation between firms (Melese, Franck, Angelis, & Dillard, 2007).

Trust is the willingness of an individual or firm to rely on an exchange partner that has the confidence of the individual or firm (Yigitbasioglu, 2010). TCE uses trust to approach contracting risks where contractors carry out a cost-benefit analysis to calculate

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risks when an incomplete contract exist (Yigitbasioglu, 2010). Opportunistic behavior can be mitigated when a well crafted contract fosters trust and reputation between firms (Melese, Franck, Angelis, & Dillard, 2007). As a way of combating this uncertainty, TCE offers a solution to uncertainty through information sharing (Yigitbasioglu, 2010). A key concept to TCE is that individuals have bounded rationality and act opportunistically (Yigitbasioglu, 2010). Information can be viewed as an asset (Yigitbasioglu, 2010). Yigitbasioglu (2010) found that uncertainty and dependency have a positive relationship to the amount of key information shared between firms while product life cycle was insignificant.

Agency Theory

A shortfall of TCE is that because it focuses on reducing the cost of transactions, it does not provide explanation for social, political, legal, and behavioral dynamics, of the supply chain relationship (Fayezi, O'loughlin, & Zutshi, 2012). These shortfalls can be offset, to an extent, by Agency theory; which should not be looked at as an extension of TCE but as it's own separate theory (Fayezi, O'loughlin, & Zutshi, 2012). Agency theory also offers a perspective on the management of supply chain risk management (Zsidisin & Ellram, 2003). Using a behavior based and oustcome based management techniques, Agency theory looks at the way top management approaches a relationship and how that approach effect risk management within the supply chain (Zsidisin & Ellram, 2003).

Agency theory considers two parties, the principal and the agent, where the principal has delegated authority to the agent, giving control of certain tasks and the ability make decisions regarding those tasks (Fayezi, O'loughlin, & Zutshi, 2012).

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Generally, the principal can be thought of as the purchasing party and the agent can be thought of as the supplier. Agency theory has been used to explain relations such as in economics, finance, information systems, and management (Fayezi, O'loughlin, & Zutshi, 2012). It has been used in supply chain management to manage risks and incentives, and build relationships (Fayezi, O'loughlin, & Zutshi, 2012).

In examining the relationship between the principal and the agent, Agency theory views the relationship as attempting to find the most optimum governing contract that provides the most benefit to both sides (Fayezi, O'loughlin, & Zutshi, 2012). In these relationships, the principle tries to minimize the cost incurred from the agent while the agent is trying to maximize reward by minimizing the principals control (Fayezi, O'loughlin, & Zutshi, 2012). Cost to be minimized include that of specificity, rewarding, monitoring, and policing the agent (Fayezi, O'loughlin, & Zutshi, 2012). A deeper understanding of the relationships inside a supply chain can be made by paying close attention to the development of organizational relationships both internal and external to a supply chain, by maintaining complex relationships between suppliers and customers, by focusing on the dynamics of risk sharing, capital outlay, power and conflict within a relationship, and by identifying the costs and benefits of supply chain integration. (Fayezi, O'loughlin, & Zutshi, 2012)

Risk management can be approached by two separate managerial techniques, that is from the outcome based and the behavior based management techniques (Zsidisin and Ellram, 2003). Furthermore, Zsidisin and Ellram (2003) define supply risk as when there is a probability that a negative event can occur that has a significant associated negative

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effect or cost on the supply chain. Through Agency theory, a firm can enact a number of measures to mitigate, prevent, or deter risk.

Buffering techniques include the use of multiple sources of supply, the use of safety stock, or requiring suppliers to hold inventory (Zsidisin & Ellram, 2003). This technique is an outcome based management mindset, where the principle has little to no interest in changing the behavior of the agent (Zsidisin & Ellram, 2003). On the other hand, behavior based management implements process improvement techniques that provide the principle and the agent with tools to reduce risk (Zsidisin & Ellram, 2003). Such tools include the certification of agents to ensure their production processes, capacity levels, and quality management meets the requirements of the principle (Zsidisin & Ellram, 2003). The development of target costs helps to ensure that the agents products meet the price that customers are willing to pay (Zsidisin & Ellram, 2003). Lastly, quality controls prevent supply problems from occurring by ensuring the agent can meet the needs of the principle (Zsidisin & Ellram, 2003).

Resource Based View

The Resource Based View (RBV) offers a very interesting look at several components to SCM. Most importantly, however, RBV helps to build a framework for competitive advantage and how a firm can gain and sustain that advantage by explaining the interplay of the organization and capabilities of strategic resources (Shibin et al., 2017). Those resources are categorized by Barney (1991) as physical, human, and organizational capital, and by Grant (1991) as financial, technological, and reputational capital. Furthermore, the internal strengths and weakness of a firm, rather than the

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external opportunities and threats, are the ones that are the most controllable and will lead to the successful accomplishment and sustainment of competitive advantage (Grant, 1991).

Barney (1991) defines competitive advantage as when a firm is able to implement a value creating strategy that no other competing, or potential competitive, firm is able to implement. A sustained competitive advantage is when a firm has a competitive advantage and competing firms are unable to duplicate the benefits of the firm with competitive advantage (Barney, 1991). For a resource to add to a firms' sustained competitive advantage it must possess four attributes (Barney, 1991). That is that the resource is valuable, rare, cannot be imitated, and has no substitutes (Shibin et al., 2017). Important to note is that Barney (1991) also acknowledges that that sustained competitive advantage does not "last forever".

Through the lens of RBV it has been found that top management beliefs and participation are affected by coercive pressures and that these pressures have significant influence on supply chain connectivity and information sharing; that is the resources of the supply chain (Shibin et al., 2017). Additionally, these resources also have significant influence on a firm environmental performance (Shibin et al., 2017). Shibin et al. (2017) further RBVs view of SCM by taking the role of top management, divided into top management beliefs and top management participation, and examining external environmental performance influences on top management. The attitude of top management is a critical factor that decides the strategy of a firms operational management and is influences by coercive pressures such as government rules and

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regulations (Shibin et al., 2017). These coercive pressures are proven by Shigin et al. (2017) to have positive influence the firms performance.

Through their view of SCM through the lens of RBV, Shigin et al. (2017) conclude that supply chain connectivity, information sharing, and top management commitment and belief can maximize the benefits of external and internal factors, which lead to achieving better social, environmental, and economic performance. In fact, unless robust information sharing technologies are invested in and utilized, it becomes more difficult to integrate an end-to-end supply chain as more varieties, quantities, suppliers, and customers and added to it (Shibin et al., 2017).

Information technology is a resource to a firm but by it's nature of relatively low barriers of imitation and acquisition by competing firms, competitive advantage gain by information technology tends to diminish fairly quickly (Wu, Yeniyurt, Kim, & Cavusgil, 2006). Likewise, information technology by itself is difficult to meet the resource-based view of sustained competitive advantage (Wu, Yeniyurt, Kim, & Cavusgil, 2006). However, Wu, Yeniyurt, Kim, and Cavusgil (2006) are able to show, through their research, that when employed holistically information technology can lead to sustained competitive advantage. One way to gain this holistic look is through Supply Chain Analytics (Chae, Olson, & Sheu, 2013).

Supply chain analytics is referred to by Chae, Olson, and Sheu (2013) as the use of data and quantitative tools and techniques to improve operational performance. These analytics are comprised of three different sets of resources and plays an important role in supply chain planning satisfaction and operational performance (Chae, Olson, & Sheu, 2013). Those three resources are data management resources, information technology

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enabled planning resources, and performance management resources (Chae, Olson, & Sheu, 2013).

Data management resources make up a firms information technology resources for activities such as data acquisition, storage, and retrieval (Chae, Olson, & Sheu, 2013). It could potentially be an Enterprise Requirements Planning system that serves as an integrated interface for data management for manufacturing planning and control (Chae, Olson, & Sheu, 2013). Information technology enabled planning resources include mathematical programming, simulation, statistical analysis, and machine learning algorithms that are embedded throughout a supply chain to provide various optimization and predictive analytics (Chae, Olson, & Sheu, 2013). These analytics are foundational for production, material requirements, and capacity planning (Chae, Olson, & Sheu, 2013).

Data management and information technology resources are integral to each other because one houses the other and creates the inputs for necessary for effective supply chain planning (Chae, Olson, & Sheu, 2013). Lastly, information technology enabled planning resources and data management resources provide supply chain planning, while performance, and management resources closes the gap between planning and execution (Chae, Olson, & Sheu, 2013). These resources give top management the ability to think analytically and make fact driven decisions based on data (Chae, Olson, & Sheu, 2013). This portion of supply chain analytics is critical as it creates data backed performance metrics, visualization of quality issues, and analytical methods that help monitor supply chain execution, performance control, and quality (Chae, Olson, & Sheu, 2013). Data management resources, information technology enabled planning resources, and

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performance management resources make up the supply chain analytics system where the three do not perform individually but synergistically perform together to positively affect supply chain plain planning and operational performance (Chae, Olson, & Sheu, 2013).

Through the lens of RBV, data management resources are instrumental to the foundation of a firm's business analytics (Chae, Olson, & Sheu, 2013). When implemented after a solid data management foundation, information technology enabled planning resources further increases supply chain planning and performance (Chae, Olson, & Sheu, 2013). Together, these two resources are a strong predictor of performance management resources that lead to sustained competitive advantage (Chae, Olson, & Sheu, 2013). By embedding information technology into a supply chain system, a firm can increase effective information exchange and better coordination with supply chain partners by integrating knowledge from multiple sources that would not otherwise be available to a firm if it weren't compiled to one source (Wu, Yeniyurt, Kim, & Cavusgil, 2006).

Sustained competitive advantage can by gained through information technology by enabling a firm to learn and respond to market changes more appropriately than competitors (Wu, Yeniyurt, Kim, & Cavusgil, 2006). Since this type of information technology networks are developed over a long period of time and become deeply embedded into a firm, firms with this type of advantage are able to avoid imitation, another viewpoint of RBV (Wu, Yeniyurt, Kim, & Cavusgil, 2006). Likewise, Wu, Yeniyurt, Kim, and Cavusgil (2006) suggest that top management recognize the investment into a robust information technology system and that they ensure such a system, once implemented, be coordinated throughout supply chain partners and

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stakeholders in order to realize the full potential of information technology in SCM (Wu, Yeniyurt, Kim, & Cavusgil, 2006).

Porter's Framework

Porter's framework, also known as "Porter's five forces model" and the value chain, focuses on the strategic notion of networks that involve contracts between coordinated chains of organizations (Giannakis & Croom, 2004; Barney, 1991). The five forces to Porter's framework are competition amongst firms, threats of new entrants, the bargaining power of customers, the bargaining power of suppliers, and the threats of substitute products or service (Porter, 1979). The latter four forces together govern competition in an industry (Porter, 1979).

Porter's framework provides the basis to Barney's 1991 article which introduced Resource Based View by utilizing the suggestion that opportunities will be greater and threats less in an attractive industry (Barney, 1991). The value chain is used to help managers isolate potential resource based advantages for their firms to seize (Barney, 1991). Barney (1991) created his resource based view by examining the attributes that resources identified by a value chain analysis must possess in order to be contribute toward sustained competitive advantage, discussed in the section above. In addition to RBV, Porter's framework is operationalized by the familiar SWOT analysis; which stands for Strengths, Weakness, Opportunities, and Threats (Rugman & Verbeke, 1993).

Porter's framework is over 40 decades old and arguably out dated, but is still relevant with some modernizing tweaks (Isabelle, Horak, Mckinnon, & Palumbo, 2020). Such tweaks must be made to adjust for the increasing value of information technology,

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which in 1979 was a supporting force, not a driving force; and Artificial Intelligence, which is becoming more and more of a reality then science fiction as cloud computing acts as an enabler that is lowering the barrier to entry to AI and software development and distribution (Isabelle, Horak, Mckinnon, & Palumbo, 2020). To keep pace with modern times, additional forces have been added to the framework; that is, the competitor's level of innovativeness, exposure to globalization, threat of digitalization, and industry exposure to regulation and deregulation (Isabelle, Horak, Mckinnon, & Palumbo, 2020).

Social Exchange Theory

The premise behind Social Exchange Theory (SET) is that individual or groups interact with each other with the expectation of receiving some type of reward and that the attitudes and behaviors of those individuals or groups can be assessed as when a particular exchange is rewarded, the individual or group being rewarded is more likely to participate in the exchange over an extended period of time, so long as the relationship continues to be mutually rewarding (Cropanzano & Mitchell, 2005). SET has been used to study information sharing within a firm as well as the collaborative behaviors inside of a supply chain (Wu, Chuang, & Hsu, 2014). As knowledge is viewed as key success factor in gaining sustained competitive advantage, SET offers a different perspective in achieving competitive advantage through knowledge sharing (Liao, 2008). SET has been used to address emerging supply chain fields where a competitive advantage can be gained or lost to include sustainable SCM as well as Research and Development (R&D) (Davis-Sramek, Hopkins, Richey, & Morgan, 2020; Liao, 2008).

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Key issues commonly researched in SET is trust, commitment, reciprocity, and power (Wu, Chuang, & Hsu, 2014). According to Wu, Chuang, and Hsu (2014), SET can be approached in two different manors. That is from information technology integration as well as inter-organizational relationships and how they share information (Wu, Chuang, & Hsu, 2014). It should be noted as well that information technology is required for information sharing to occur (Wu, Chuang, & Hsu, 2014). SET has been used to study many aspects of SCM (Wu, Chuang, & Hsu, 2014).

In SET, power and justice are two prominent determinants of exchange behavior (Wu, Chuang, & Hsu, 2014). Griffith, Harvey, and Lusch (2005) found that two sects of justice policy can enhance a firms long term orientation and relational behavior within SCM. Those policies are procedural justice and distributive justice (Griffith, Harvey, & Lusch, 2005). Procedural justice is described by Griffith, Harvey, and Lusch (2005) as the process, and the fairness of the process perceived by the involved parties, associated with the allocation and distribution of goods and services when resources are scarce in terms of demand. Furthermore, distributive justice is view as an economic policy of SCM and is the perceived fairness of the decision outcome (Griffith, Harvey, & Lusch, 2005). So long as these policies are acceptable to those involved in a SCM relationship, the long term orientation and relational behavior of the relationship will last but will begin to deteriorate as the perception of these policies deteriorate (Griffith, Harvey, & Lusch, 2005).

Commitment and trust are needed prior to the forming of a relationship in order to ensure supply chain performance (Wu, Chuang, & Hsu, 2014). Wu, Chuang, and Hsu (2014) find that trust is the most important determinant to foster positive information

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sharing. Without the initial build up of trust in a supply chain relationship, other factors in SET, to include commitment, reciprocity, and power, would be negated (Wu, Chuang, & Hsu, 2014). These factors, as viewed by SET, are instrumental in the establishment of information sharing and collaborative relationship building amongst supply chain partners (Davis-Sramek, Hopkins, Richey, & Morgan, 2020)

As environmental sustainability becomes more of a factor addressed by supply chains, SET will play an important role in the research behind establishing sustainable SCM (Davis-Sramek, Hopkins, Richey, & Morgan, 2020). As institutions such as the Environmental Protection Agency enact more stringent environmental regulatory pressures on SCM relationships, these relationships will need to adjust the way they are structured and managed so as to meet legislation, regulation, and ordinances regarding the environment (Davis-Sramek, Hopkins, Richey, & Morgan, 2020).

Social Exchange Theory provides another view at the attainment of competitive advantage through relationship building and knowledge sharing on the R&D side of SCM (Liao, 2008). Sharing experiences and knowledge amongst knowledge intensive laborers in the supply chain is an excellent way of building the foundation of a firm (Liao, 2008). Liao (2008) provides that SET can be applied as a managerial power to encourage information sharing and relationship building inside the supply chains R&D departments, furthering the sustainment of competitive advantage (Liao, 2008).

Liao (2008) uses the powers of reward, coerciveness, legitimacy, reference, and expertise to build the framework around the powers held by managers. Reward powers enable the manager to reward employees for desired behavior (Liao, 2008). Coercive power gives managers the ability to administer punishment for non-compliance (Liao,

2008). Legitimate power gives managers power through the employee's belief that the manager has the right to power; the control and administration of behavior (Liao, 2008). Reference power is the employees desire to identify with the manager and seek their approval (Liao, 2008). Lastly, expert power is the subordinate's belief that the manager is knowledgeable and skill in their area of management (Liao, 2008).

Laio, (2008) finds that the managers power of reward and expertise has direct impact on their employee's knowledge sharing behavior. These rewards are effective in motivating employees knowledge sharing behavior (Liao, 2008). Liao (2008) suggests that managers can use incentives to urge employees to share their knowledge with one another. Reference power and expert power were found to have direct impact on trust but indirect effect on knowledge sharing behavior (Liao, 2008). Coercive power was found to have an adverse effect on knowledge sharing (Liao, 2008). As knowledge sharing is usually now an official task, punishing employees for sharing their knowledge will create further resentment to knowledge share (Liao, 2008). Finally, a mangers ability to appropriately apply their powers over their employees can bolster knowledge sharing and collaboration which directly leads to sustained competitive advantage (Liao, 2008).

Diminishing Manufacturing Sources and Material Shortages

In considering all the components that build up a system, it is common that the technologies of certain components have shorter life cycles than the life cycle of the system they make up (Sandborn, Prabhakar, & Ahmad, 2011). These mismatches of life cycle create product obsolescence and results in higher life cycle costs for long fielded life systems when the obsolete products are not managed properly (Sandborn, Prabhakar,

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& Ahmad, 2011). DMSMS specific obsolescence occurs when the ability to procure a systems component from its original manufacture is lost (Sandborn, Prabhakar, & Ahmad, 2011). Electronic parts obsolescence and DMSMS is a major contributor to the life cycle cost of long field life systems, particularly in avionics (Pecht, Sandborn, & Solomon, 2000). Effective management of a proactive DMSMS program is an important enabler of a firms sustained competitive advantage. This section reviews literature of DMSMS and obsolescence management in the Air Force as well as civilian perspectives.

DoD Directed DMSMS Management

The SD-22 (2016) DMSMS "A Guidebook of Best Practices for Implementing a Robust DMSMS Management Program" is the Department of Defenses (DoD) DMSMS management manual created by the Defense Standardization Program Office. It provides all the military branches a manual to effective DMSMS management as well as a consolidation of DOD Instructions and mandates. The SD-22 was cited in the vast majority of DMSMS and obsolescence related literature reviewed by the researcher and plays a very prevalent role in the management of DMSMS around the globe. Guidance given within the SD-22 includes the direction to establish a DMSMS Program which includes a DMSMS Management Plan (DMP) which is carried out by the managing organizations DMSMS Management Team (DMT); also directed in the SD-22 (SD-22, 2016). The SD-22 (2016) also gives a 5-step process to DMSMS management to be followed by established DMTs, as depicted in figure 1. From early technology development to sustainment, each of the 5 steps are to be applied through the entire life cycle of a product (SD-22, 2016).

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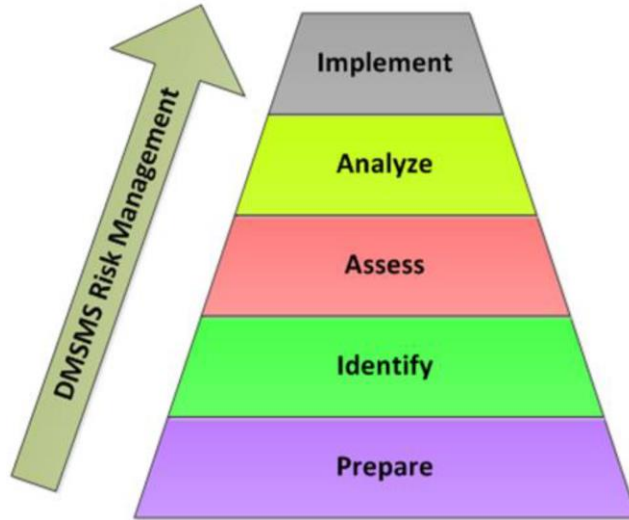
Figure 1. DMSMS 5-Step Process (SD-22, 2016)

The first step in the SD-22 DMSMS management process is to Prepare (SD-22, 2016). In the preparation phase, PMs should develop the strategic vision and focus of a DMSMS Program through the development of a DMP (SD-22, 2016). The DMP will give direction on the formulation of a DMT that is representative of all the stakeholders in the program (SD-22, 2016). Visions the PM should focus in on are the exclusion of obsolete or soon to be obsolete items from the system design, the elimination or at least minimization of the scope of DMSMS related out-of-cycle redesigns throughout a products life cycle, the elimination of DMSMS related production schedule impacts while in the design or production of an item, and the elimination of DMSMS related degradation to readiness during sustainment (SD-22, 2016). It should be noted that in the prepare phase, the management of software obsolescence should be given a high priority; especially if a system is heavily dependents on commercial of the shelf (COTS) software (SD-22, 2016).

In the identification phase, items with immediate or near-term obsolescence issues should be identified by securing access to logistics data, programmatic data, item data,

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and monitoring and surveillance tools (SD-22, 2016). This is accomplished with the establishment of a contract between the Original Equipment Manufacturer (OEM) and the program manager through the appropriate contract language, outlined in the SD-26 "DMSMS Contract Language Guidebook" (SD-22, 2016). The monitoring and surveillance process can be segmented into five areas of, system prioritization, identification and procurement of monitoring and surveillance tools, collection and preparation of item data, analysis of item availability, and collection and update of programmatic and logistics data (SD-22, 2016).

In general, system prioritization, identification and procurement of monitoring and surveillance tools, and collection and preparation of item data are a onetime process only repeated when new data on DMSMS issues might indicate the requirement to reassess program priorities (SD-22, 2016). Any further repetition will cause undue sustainment cost. Likewise, analysis of item availability and collection and update of programmatic and logistics data are recuring processes initiated by the notification of product end of life, the update of predictive tools, or when new market research has been conducted (SD-22, 2016).

In the assessment phase, the population of problem items should be considered (SD-22, 2016). Components and systems that are at the most risk for DMSMS related issues should be identified and prioritized; usually electronic components (SD-22, 2016). At this phase in the management of DMSMS, the potential effects of a DMSMS issue on cost, schedule, availability, and readiness are examined (SD-22, 2016). A decision is made as to whether a DMSMS resolution should be pursued or not, which issues need to

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be addressed first if a resolution is to be pursued, and at what level in the system should a resolution be applied (SD-22, 2016).

In the analytic phase, the items prioritized in the assess phase should be examined (SD-22, 2016). A list of potential DMSMS resolutions is developed which will also determine the most cost-effective resolution (SD-22, 2016). Risks that a DMT should consider when analyzing resolutions are technical (associated with the ability to develop or implement resolutions while still maintaining system specifications), supply chain (associated with capability of the provider of the resolution), financial (associated funds availability during a specific time period that the resolution will be required), and schedule risk which is associated with implementing a resolution before operational availability is affected (SD-22, 2016).

Finally, in the implementation phase, the selected resolutions with the highest priorities are budgeted for, funded, contracted, scheduled, and then executed (SD-22, 2016). Contract language within the SD-26 can be used to ensure the definition of "end of life" is clearly defined with the contractor (SD-22, 2016). This definition of "end of life" is critical as it obligates the contractor until the program has been determined to be finished by the Air Force, not the contractor. Once implementation has begun, the DMT should continue to monitor the DMSMS program to ensure that all stakeholders understand and execute their roles and responsibilities outlined in their DMP (SD-22, 2016). They should verify that appropriate technical actions are carried out by the contractor and then monitor those actions (SD-22, 2016). This 5 step process is a continuous process that is restarted when the 5 step process ends (SD-22, 2016).

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USAF Guidance to Proactive Management of DMSMS

The roles and responsibilities to the Air Forces DMSMS program management is laid out in the Air Force Material Command Instruction (AFMCI) 20-105 (2017) "Diminishing Manufacturing Sources and Material Shortages". According to AFMC policy, an effective DMSMS program is one that is proactive at the identification potential of DMSMS risks while also finding resolutions to those risks (AFMCI20-105, 2017). Relevant roles and responsibilities to this study outlined in AFMCI20-105 are the roles of the Strategic Alternate Sourcing Program Office (SASPO) and the DMSMS Subject Matter Experts (SME).

The SASPO has been designated by AFMC/A4 to serve as the overall and head DMSMS subject expert program office (AFMCI20-105, 2017). The SASPO has been assigned the task of providing a DMSMS predictive tool, case resolution archive, analysis and resolution capabilities, data processing, and training for the effective management of DMSMS to AFLCMC, AFSC, AFNWC, and their Program Offices (AFMCI20-105, 2017). The DMSMS SMEs include those personnel who are responsible for the design control, acquisition, and supply chain support of any item used on a Mission Design Series (MDS) weapon system or equipment through out that items life cycle (AFMCI20-105, 2017). SMEs include the Program Managers (PM), who develops, implements, and maintains DMSMS programs for their designated MDS weapon systems or equipment, as well as engineers, contractors, and logisticians. These SMEs work together as part of a DMSMS Management Team (DMT) as dictated by the PMs DMSMS Management Plan (DMP).

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Obsolescence vs DMSMS

It is important to make a distinction between DMSMS and product obsolescence; the two are not synonymous (SD-22, 2016). Obsolescence is defined by Sandborn (2013) as "the loss or impending loss of original manufacturers of items or suppliers of items or raw materials." Obsolescence is a perspective-based observance where one perspective can view an item as obsolete and the other does not. From the DMSMS perspective, obsolescence occurs when an item is out of date and replaceable by a new item, and when an item is needed for the manufacturing or sustainment of a system (Sandborn, 2013). The SD-22 (2016) provides five causes of the DMSMS view on obsolescence. Obsolescence can be caused by technology, functionality, regulation, supportability, or market demand. Technology is obsolete when new or updated technology becomes preferred over the old technology (SD-22, 2016). When an item no longer functions as intended because of changes in hardware, software, or requirements it is functionally obsolete (SD-22, 2016). The SD-22 (2016) gives the example of a videocassette tape that is obsolete because cassette players are no longer available for purchase. Regulatory obsolescence occurs when an item or a substance or process used in the production of the item becomes banned (SD-22, 2016). Supportability obsolescence is highly common in software when software is no longer supported (SD-22, 2016). Finally, market demand dictates obsolescence when demand for an item no longer exist, thus leading to its end of product life cycle (SD-22, 2016). Figure 2 gives an excellent graphical representation of how DMSMS and obsolescence are related but different.
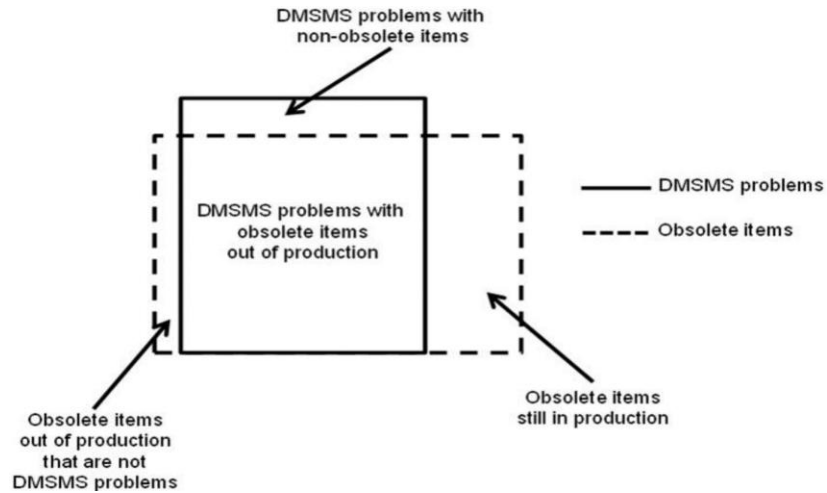
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Figure 2: Notional Relationship between DMSMS and Obsolescence (SD-22, 2016)

It is easy to see in figure 2 how DMSMS and obsolescence overlap and are the same and where they do not overlap and differ. An item may be obsolete but still in production, thus warranting no DMSMS actions or resolution (SD-22, 2016). Furthermore, a non-obsolete item could still present the PM with a DMSMS issue; these type of issues generally occur when a supplier goes out of business, a natural disaster disrupts production, or a buyout of a sole source providers leads to the end of life for a product (SD-22, 2016). It is important for DMSMS managers to note that not all obsolescence leads to a DMSMS issue and that not all DMSMS issues arise from an obsolete item; however, most DMSMS issues do arise from some sort of obsolescence issue (SD-22, 2016). This makes a further review of obsolescence necessary to further understand the causes of DMSMS.

DMSMS and Obsolescence Management

A very pragmatic approach to viewing DMSMS issues and obsolescence is through the lens of Fines' (2009) book "Clockspeed". In his book, Fine (2009) views the evolutionary life cycle of industries, which he defines as their "Clockspeed", as compared

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to the life cycle of biological life forms; specifically the fruit fly. The industries Clockspeed is measured by the rate at which it introduces new products, processes, and organizational structures (Fine, 2009). Like the quick life cycle of the fruit fly as compared to other longer living life forms, the technology sector has a short clockspeed compared to the life cycle of other sectors (Fine, 2009). It is through this concept that Fine (2009) argues that industries can either gain or lose competitive advantage by how well a company is able to manage the dynamic web of relationships that interweave it's supply chains partners.

Complexity is particularly added as a multiple component system is viewed through the lens of Clockspeed; where that system utilizes a combination of hardware and software. It is at this intersection where the effective management of obsolescence is complicated for managers; where sustainment dominated systems with slower Clockspeeds utilize components with faster Clockspeeds (Sandborn, 2013). Here, where fast Clockspeed components are used in slow Clockspeed systems, that managers are unable to afford to replace the system frequently with newer systems, creating the need for effective obsolescence management thus extending the sustained life time of their systems (Sandborn, 2013). Among the most significant problem areas for DMSMS is for electronic parts where the life cycle can sometimes last no more then a year (Sandborn, 2013)

Effective management of a DMSMS program requires management at three different levels of reactive, proactive, and strategic; seen in figure 3 (Sandborn, 2013). In reactive management a resolution to an obsolescence issue is found and implemented after the issue occurs (Sandborn, 2013). In strategic management, obsolescence data,

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logistics data, technology forecasting, and business trending is used to enable strategic planning, life cycle optimization, and long-term business case development for system sustainment (Sandborn, 2013). Proactive management leads to strategic management. In proactive management of obsolescence, critical items are identified that are at risk of obsolescence, have insufficient supply to meet demand, or will become a problem in the future as they become obsolete (Sandborn, 2013). This area of management requires the ability to forecast the risk of an item becoming obsolete (Sandborn, 2013). In the management of DMSMS issues, the DoD cannot afford to be reactive to obsolescence and in most, if not all, situations must use a proactive approach to DMSMS issues (SD-22, 2016).
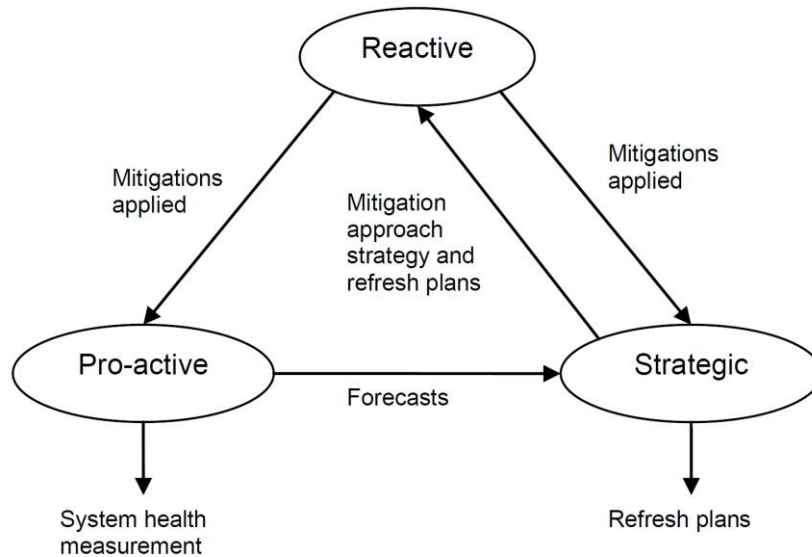

Figure 3: Three Obsolescence Management Levels (Sandborn, 2013)

Obsolescence Forecasting

At the heart of proactive DMSMS management is forecasting. Strategies an obsolescence forecasting model can be conducted to view two time outlooks, either long term or short term (Sandborn, Prabhakar, & Ahmad, 2011). Long term forecasting looks

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at product life one year or more out to enable proactive DMSMS management while short term observes the supply chain for precursors for items becoming obsolete (Sandborn, Prabhakar, & Ahmad, 2011). DMSMS forecast model predict risk of DMSMS occurrences (Starling, Choe, & Mastrangelo, 2020).

While supply chain risk management involves macro risk, demand risk, manufacturing risk, supply risk, and infrastructure risk, DMSMS is largely interested addressing manufacturing and supply related risk (Starling, Choe, & Mastrangelo, 2020). Those are risks involving product obsolescence, design change, and technological change as well as the effects of single sources of supply, respectively (Starling, Choe, & Mastrangelo, 2020). Starling, Choe, and Mastrangelo (2020) identify the risk metrics of "fraction of time with zero vendor parts available" and "the time until obsolescence" as effective variables to quantify risk for use as inputs into DMSMS prediction tools.

DMSMS risk can be measured in a Material Risk Index (MRI) or as technology (or Design) Refresh Planning (DRP) (Starling, Choe, & Mastrangelo, 2020). MRI analysis' are conducted through probabilistic means and calculates a risk score for specified part from a Bill of Material (BOM) while DRP quantifies the cost of proactive management vs the cost of reactive management; DRP can be used to identify the optimal point of technology refresh to minimize cost (Starling, Choe, & Mastrangelo, 2020). Because of the historic nature of the USAFs purchasing practices, the USAF did not buy sufficient quantities or in strategic intervals to keep suppliers interested in maintaining inventory space or manufacturing facilities to enable DRP (Zamora & Graham, 2019). Whatever the approach, a DMSMS forecast must consider system level availability risk, individual part procurement lifetimes, and market size (Starling, Choe, & Mastrangelo,

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2020). Many commercial tools for predicting obsolescence exists. Most electronic item monitoring platforms forecast obsolescence by modeling an items life cycle by using ordinal scales or tracking technology trends through data mining (Sandborn, 2013).

Regardless of the method, most platforms use a systems BOM to avoid the selection of parts that are close to or already have become obsolete (Sandborn, 2013). As mandated in AFMCI20-105 (2017), the SASPO manages the Air Force Predictive Tool (AVCOM) for obsolescence management and information sharing. In addition to the AF Predictive Tool, the AFMCI directs program offices to use multiple predictive tools when possible (AFMCI20-105, 2017). The SASPO is also directed by the AFMCI20-105 (2017) to develop, maintain, and interface with other such predictive tools to monitor the status of systems BOM and assist program offices in the resolution of DMSMS issues. It is important that in the management and forecasting of DMSMS issues, the items engineers are included in the process (Pecht, Sandborn, & Solomon, 2000). Pecht, Sandborn, and Solomon (2000) stress that engineers must be aware of where an item is in its life cycle and how long the systems life cycle is to last, if this does not happen, the engineers may unknowingly include an item in the system that will eventually drive up the life cycle cost of a system. Furthermore, when issues of missing or inadequate data arise, SME knowledge can be used to make decision on life cycle distribution; this is one example of when knowledge sharing becomes crucial (Starling, Choe, & Mastrangelo, 2020).

Collaboration and knowledge sharing amongst the DMSMS SMEs is an important component to proactive DMSMS management (Zamora & Graham, 2019). The identification of common items on BOMs across the program offices is a critical and easy

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way of reducing DMSMS occurrences; by identifying common parts the USAF can avoid spending additional time and resources to the same issues across programs (Zamora & Graham, 2019). It is estimated that there is a 33-35% commonality rate across the program offices (Zamora & Graham, 2019). The AF Predictive Tool is a great way to manage common obsolescence issues, however, if the SMEs are not communicating a lot of information is lost.

Obsolescence Mitigation and Resolution

Obsolescence can be mitigated, or resolved, in many ways (Sandborn, 2013). One technique includes the replacement of obsolete parts with substitute parts; this imposes the risk of the introduction of counterfeit parts into the system (Sandborn, 2013). Lifetime buys are performed by purchasing and inventorying enough parts with potential obsolescence issues for the entire expected life cycle of a system (Sandborn, 2013). This presents the issue of extremely high inventory costs. In the case of the USAF, this technique becomes an issue when many of the planned for systems have far exceeded their expected lifetime since its initial purchase.

Mitigation should begin at the acquisition phase by obtaining technical data (Zamora & Graham, 2019). Data rights need to be secured by the USAF so that production can be duplicated in the event of obsolescence occurrence (Zamora & Graham, 2019). Data rights need to be secure through writing, this is where the proper use of contract language provided in the SD-26 is critical. Collaboration and knowledge sharing needs to be utilized here as well; through sharing the SMEs can gain experience quickly in contract language.

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SCM Sustainability and Obsolescence

An interesting area of research but outside the scope of this literature review is in the area of environmental impact and planned obsolescence. This area has a very shallow review of literature but will be important to study as environmental sustainment becomes more of a key dynamic to sustained competitive advantage. Rivera and Lallmahomed (2015) research environmental impact through planned obsolescence, which is viewed from four different forms: technological or functional, psychological or style, systemic, and product failure or breakdown. Rivera and Lallmahomed (2015) find the research on the impact that planned obsolescence has on the environment is not well documented or studied but suggest that eco friendly designs are considered in the manufacture processes of planned obsolescence items.

Summary

This literature review examines two main components; SCM theory as well as what is obsolescence and DMSMS and their effects on a modern day supply chain. Through the lens of TCE we are able to view the firms economic costs of transactions and how that guides them towards the ability to produce organically (internally) or the contract out their production requirements. Agency theory helps to apply the economic theory of TCE to SCM relationships through outcome based or behavior based decisions. Through understanding these economic relationships, we build an understand of how SCM relationships cannot act alone to secure competitive advantage. RBV highlights the importance of information sharing through the use of integrated information technology platforms to obtain a sustained competitive advantage. RBV builds upon the foundation

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of strong and trustworthy SCM relations to assist top management in making informed, data driven decisions.

Porter's five forces model operationalizes RBV through the SWOT analysis; arguably outdated, Porter's framework has the potential to examine the modern supply chain if more research was to be put into how it applies modern day. With Porter's framework we can see how competition is governed through an industry. In SET, we gain further insight into the relationship of the SCM and the importance of information sharing and collaboration; specifically, SET bring in the engineering side of the supply chain and highlights the importance of the engineers interactions amongst themselves as well as the rest of the supply chain. Finally, SET also highlights the important role of the manager in collaboration and their ability to either foster or inhibit collaboration; a key and common component of theories backing to obtainment and sustainment of competitive advantage.

In the second half of the literature review, DMSMS and obsolescence was addressed. Fine (2009) addresses industry Clockspeed and its role in gaining competitive advantage through relationship management. Furthermore, this review highlights the importance that information technology and knowledge sharing plays in the proactive prevention and management of DMSMS issues and obsolescence. Through proper relationship management, the SASPO has a unique and critical opportunity to effect Gen Browns ACOL vision and create affordable competitive advantage in the USAFs life cycle sustainment programs.

Overview

This chapter explores the selected method of research to answer this studies

research question. The chapter begins with a brief overview of the survey methodology

and links to theory. Then a description of the research components and how they were

adopted is addressed. Lastly, the chapter concludes by describing how the data was

cleaned and interpretated, which will lead into the next chapter, "Chapter IV Data

Analysis".

Survey Methodology

Conducting a survey satisfies the main objective of providing a researcher with

accurate information that reflect the views and experiences of the surveys target

populations (Constantine, 2012). To show validity in the results of a survey, four types of

errors need to be minimized in order to eliminate misrepresentation of the population,

known as bias, as much as possible; these are "Coverage Error", "Sampling Error",

"Non-Response Error", and "Measurement Error" (Constantine, 2012). Additionally,

pilot testing also establishes validity by ensuring that survey is easily understood and that

poor-quality won't prevent participants from taking or completing the survey (Leedy &

Ormrod, 2015).

Coverage error in survey's is a form of non-observation that occurs when there is

an inability of the survey to contact segments of the population; that is to say, there is a

deviation between the sample that has been captured and the population that was targeted

and that there is a non-zero chance that not all members of the population being studied

are included in the sample and when the members of that population who were excluded could have provided a significantly different survey response and result (Lynn, 2005; Alvarez, 2005; Constantine, 2012). The degree to which coverage error is an issue depends on the population that is being generalized (Alvarez, 2005). There are two types of coverage errors: under-coverage and over-coverage. Under-coverage errors occur when a sample size excludes survey members that have relevant attributes to the survey being conducted that vary from those of the members actually included in the survey sample (Lynn, 2005). Likewise, over-coverage error occurs when a sample includes units that are not members of the research population (Lynn, 2005).

Steps should be taken to reduce the possibility of the existence of coverage error when conducting survey research in order to maintain validity and gain accurate data to assess the research's targeted population (Constantine, 2012). Such steps that can be taken include taking consideration for the selected mode and method that the survey will be delivered, whether that be the usage of the internet, conducting telephone surveys, or sending surveys via mail (Constantine, 2012). When selecting a survey delivery method, the researcher should be sure that the survey is applicable and accessible to the entirety of the research population (Constantine, 2012).

If responses are requested via e-mail during a web-based survey, no coverage error exist if the e-mail addresses of the population is known, this is because the e-mail address list can be use as the sampling frame providing 100% coverage of the population (Alvarez, 2005). Take for example the United States military; this is a large population for e-mail addresses of member is known and in use. Here no coverage error will exist.

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Depending on the populations accessibility to internet that is of interest in surveying a large group, the coverage error is a significant concern because not all people have internet access or email, nor is there a list of e-mail addresses for mass populations (Alvarez, 2005). In fact, as of November 2019, 9.7% of civilians in the United States over the age of 15 that have internet access do not have an e-mail address (Clement, 2020). That being said, web-based surveys are considered the most accurate of surveys to administer because of their easy of distribution and ability to reach larger portions of the population (Leedy & Ormrod, 2015). The researcher should also increase validity by ensuring the selected sample includes only members to the research population (Constantine, 2012). Before survey administration is conducted, the survey recipient list should be reviewed and verified to make sure that subjects that are a part of a different population that is not being researcher does not get included in the survey results (Constantine, 2012).

To avoid over-coverage error, the researcher should eliminate the likelihood of survey duplication (Constantine, 2012). Constantine (2012) suggests that this can be accomplished by reviewing the survey recipient list and checking that no one recipient is included twice or that survey recipients do not have a means of conducting the survey more than once. To address the possibility of under-coverage error, the researcher can use the method of "weighting" (Lynn, 2005). Weighting, if used properly, mitigates the impacts of under-coverage error by lowering the significance of an over-covered sample in comparison to the under-covered sample to balance out the two samples (Lynn, 2005). This is done by assigning weights to the different samples that might be thought to have

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the likelihood of correlation to important measures being captured by the survey (Lynn, 2005).

The margin of error in survey research is the level of precision of survey estimates (Constantine, 2012). This margin of error is determined by the number of completed responses or the sample size (Constantine, 2012). Inadequate sample sizes create sampling error (Constantine, 2012). As more survey responses, sample size, is collected in survey research, the statistical power of the survey increases; concurrent with the Central Limit Theorem (Hill, 1998). Larger sample sizes will statistically yield smaller margins of error, moreover, as the number of respondents to a survey increases and reaches the population size, the sampling error decreases and offer a more wholistic view of the population of interest (Constantine, 2012). As is the purpose behind a sample, the entire population does not need to be reached. In many cases, acquiring a large sample is often too costly in terms of budgeted measures such as money, time, space, or energy (Constantine, 2012; Hill, 1998). In fact, there is a point at which enough responses have been collected and acquiring additional responses will add little value to the survey itself (Hill, 1998).

When considering sampling error and choosing a sample size, next to budget, researchers should focus on what they are studying and why (Hill, 1998). Absorbing too much data can result in research straying away from the objective and end up costing more time than is affordable (Hill, 1998). So how does a researcher decide how large of a sample is adequate to conduct research? John Roscoe offers rules of thumb that help a research gain a good idea how much data is enough (Hill, 1998). Through these rules

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researchers can select an adequate sample size that reduces sampling error while meeting their own budgetary constraints.

Of the pertinent rules to survey research from Roscoe's Rules of Thumb is that researchers should not conduct statistical analysis with sample sizes of less than 10 responses, however in simple experimental research with tight controls, research can be successful when conducted with sample sizes between 10 and 20 responses (Hill, 1998). In the case of survey research, 3-4% of the target population is acceptable (Hill, 1998). In the end, Roscoe recognizes and suggests that the selection of a sample size is just as much a concern of budget restraints as it is of statistical significance and when it can be afforded, a larger sample is preferred over a smaller sample; as consistent with the Central Limit Theorem (Hill, 1998; Leedy & Ormrod, 2015). A researcher can also recognize that there is a certain number of responses to be expected over a period of days depending on the type of survey being conducted (Archer, 2008). On average, response rates to survey research can be expected to be about 48%, with a range from 40% to 62% over the course of 14 to 16 days (Archer, 2008).

Non-Response Error becomes an issue in survey research when non-respondents are substantively different from the respondents; at this point, bias is introduced into the survey results (Hill, 1998). About the only means of preventing non-response error is to motivate respondents to reply to the survey as quickly as possible (Archer, 2008). Considerations in the surveys design and deployment can help increase the response rate and reduce non-response error. Including questions that are easily interacted with, such including clear instructions, understandable graphics, and pull downs menus, will

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increase the likeliness of a respondent completing the survey and creating usable data (Archer, 2008).

The method of survey research is grounded in many types of theory, the foremost theory being that of Social Exchange Theory (SET) (Goyder, Boyer, & Martinelli, 2006). SET suggests a lot for the successful completion of survey research, particularly in respect to the reduction of non-response error. The theory suggests that sample members that have been contacted to complete a survey are more likely to respond when they know how long the survey will take and if the survey will not take much of their time (Trouteaud, 2004).

Surveys that are known by respondents to be time consuming and the respondent is still willing to complete the survey, many choose to complete at a later point in time then when they were initially contacted. It is very likely that for these members, they want to complete the survey but doing so may be forgotten about. They are more likely to respond on a second or third reminder, but not likely to a fourth (Trouteaud, 2004). Additionally, the theory of rational choice exchange offers the use of payment delivered after the completion of a survey to reduce non-response error (Goyder, Boyer, & Martinelli, 2006).

Bias that is introduced into the results of a survey as a result of inaccurate answer questions is known as measurement error. Measurement error occurs when a surveys questionnaire is conducted in a way that has poor construction, wording, and design and can also occur when respondents provide incorrect information, whether deliberately or unintentionally, or when an interviewer incorrectly poses a question (Constantine, 2012;

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Biemer, 2010). It is considered one of the most damaging of error sources in survey research (Biemer, 2010).

As highlighted above, the survey methodology is an excellent method of gathering data from a sample of a population to make generalizations about that population which can then be used to answer a research question. Survey methodology was chosen to conduct this research because it is the best way to gather data from the program offices to answer the question of where gaps lie in proactive DMSMS management. With this view provided by this survey, the SASPO will gain an accurate snap shot in time of where areas of improvement can be made.

Research Question Development

This research is being conducted at the request of the research sponsor, the AFMC/SASPO. The research question "Has HQ AFMC established a proactive DMSMS management program for the United States Air Force in accordance with AFMCI20-105 and the SD-22?" was developed by the researcher with the guidance of the SASPO. The question was developed over the course of multiple phone meetings where the sponsor and the researcher's advisor narrowed down an approachable topic of research that will provide benefit to the SASPO and the Air Force as a whole.

The sub questions to the overarching research question were developed by the researcher and approved by the sponsor. The sub questions will directly help the researcher to answer the overarching question. Furthermore, these questions will be answered through the data collected from the survey questionnaire. The research question and sub questions were reviewed in Chapter I.

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Questionnaire Development

   The research questionnaire was developed by the sponsor with close coordination and input from the researcher. The included questions were of particular interest to the sponsor that the sponsor believed would help gain a good perspective to if DMSMS is being managed proactively and accordingly to the guiding regulations. The data collected from the questionnaire results will be used by the researcher to answer the research sub questions and ultimately the overall research question.

Research and Survey Design

   The design of this research is quantitative. The research employs a web-based survey administered from the SASPO office and housed in SurveyMonkey.com. SurveyMonkey is a web-based survey platform that offers an easy-to-use interface for the recipient of the survey (Leedy & Ormrod, 2015). SurveyMonkey was selected over other survey engines because of its respondent-oriented design. As a way of increasing validity and ensuring survey completion, the researcher wanted to use an interface that would be recognizable to the recipient and would pose zero unforeseen useability issues. The final form of the survey included 42 questions, 9 of which are demographic questions and 3 of which are open ended questions. The rest of which are close ended multiple-choice questions with some opportunity to provide further open end style responses. The final questionnaire can be found in Appendix A.

   Demographics

   The demographics captured in this survey were not the focus of the research as such, demographics were included more as an area of interest and possible future

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research. The demographic sought to capture the experience and area of specialty of the program offices. Furthermore, the demographic data collected from the survey cannot be identified to any specific respondent. The demographics can be seen in Table 1.

Table 1: Demographics

DMSMS Management Survey: Demographics		
1. What level of DMSMS management responsibilities are assigned to you?		
Answer Choices	Responses	
Primary responsibility	48.89%	22
Other duties as assigned	44.44%	20
Other (please explain)	6.67%	3
2. What is your current position and title? (Open Ended)		
Answer Choices	Responses	
Configuration Management Lead	2.22%	1
Contractor	2.22%	1
Engineer	17.78%	8
DMSMS SME	8.89%	4
Logistics Manager	51.11%	23
Product Support Manager	2.22%	1
Program Manager	15.56%	7
3. What is your current pay grade or series? (Open Ended)		
Answer Choices	Responses	
A&AS	2.22%	1
Contractor	17.78%	8
GS-09	2.22%	1
GS-11	2.22%	1
GS-12	33.33%	15
GS-13	11.11%	5
GS-14	2.22%	1
NH-03	20.00%	9
NH-04	4.44%	2
NA/Skipped	4.44%	2
4. What is your USAF component/affiliation?		
Answer Choices	Responses	
Active Duty	2.22%	1
National Guard	0.00%	0
Air Force Reserve	0.00%	0
Civilian	73.33%	33

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Contractor	24.44%	11
5. How many years have you worked on DMSMS? (Open Ended)		
Answer Choices	Responses	
Years ≤ 5	64.44%	29
5 < Years ≤ 10	22.22%	10
10 < Years ≤ 15	0.00%	0
15 < Years ≤ 20	2.22%	1
20 < Years ≤ 25	4.44%	2
25 < Years ≤ 30	0.00%	0
Years > 30	4.44%	2
Skipped	2.22%	1
6.How many years have you worked in your current position? (Open Ended)		
Answer Choices	Responses	
Years ≤ 5	71.11%	32
5 < Years ≤ 10	20.00%	9
10 < Years ≤ 15	8.89%	4
7. How many combined years of federal service do you have? (Open Ended)		
Answer Choices	Responses	
Years ≤ 5	15.56%	7
5 < Years ≤ 10	8.89%	4
10 < Years ≤ 15	33.33%	15
15 < Years ≤ 20	2.22%	1
20 < Years ≤ 25	11.11%	5
25 < Years ≤ 30	6.67%	3
Years > 30	20.00%	9
Skipped	2.22%	1
8. What is your MAJCOM/organization? (Open Ended)		
Answer Choices	Responses	
AF Nuclear, Command, Control, and Communications Center	4.44%	2
AFLCMC	60.00%	27
AFMC	22.22%	10
AFNWC	2.22%	1
AFSC	2.22%	1
SCMW	6.67%	3
NA	2.22%	1
9. Which Weapon Systems/Platforms do you manage? (Open Ended)		
See Appendix B		

Population and Sample

The population of interest for this study were the USAF specific DMSMS SMEs. As directed in the SD-22 and AFMCI20-105, the SASPO maintains an email listing of the 171 DMSMS SMEs. This list was current as of 25 September 2020; survey administration began on 27 December 2021. According to the SME listing, the population included Active Duty Officers and Enlisted (SNCOs), GS and NH Civilians, and contractors. The SMEs reside across 12 different Air Force Bases: Barksdale AFB, Eglin AFB, Hanscom AFB, Hill AFB, Kirtland AFB, Los Angeles, AFB, Peterson AFB, Robins AFB, San Antonio-Lackland Joint AFB, Tinker AFB, and Wright Patterson AFB. The entire population was targeted for the sample.

Pre and Pilot Testing

The survey went through layers of scrutinization to find and eliminate questions that were ambiguous, misleading, or that would have resulted in uninterpretable useless responses (Leedy & Ormrod, 2015). Scrutiny was conducted internally between the SASPO and the researcher. During pre-testing, questions were added, removed, and revised through the November to December 2020 time frame. During pilot testing, the survey was administered internally to the SASPO to further reduce any errors that might cause insufficient results.

Survey Administration

Data Collection and Preparation

The survey was administered via the web-based survey application, SurveyMonkey. Administration began on 06 January. Because administration began

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during the holiday season, it was decided to keep the survey open until 30 January to give respondents to catch up from holiday leave. Responses started on 06 January with an initial 19 responses over 11 days. The first reminder e-mail was sent by the SASPO on 20 January and yielded an additional 32 responses over 5 days. One last reminder was sent before the survey closed yielding 0 response.

In all 50 responses were collected with an average completion time of 14 minutes and 39 seconds. A response rate of 29.2% (50/171) was achieved. Out of 50 respondents, 5 answered the demographic section but not the remainder of the survey, yielding a usable response rate of 26.3% (45/171). The non-responses were cleansed from the survey results.

Open Ended Coding

Coding of open ended questions was conducted by hand by the researcher. To remain within the realm of quantitative research, responses were reviewed for common categories, categories where assigned alpha-numeric values, then uploaded to Microsoft Excel (Leedy & Ormrod, 2015). Results were analyzed with the remaining survey data.

Data Analysis

Individual responses were collected into a data summery, a percentage for each response category was then calculated which identified the mode of each question. Where the majority of responses lie determined how that question effected the research sub questions. A cross tabulation was created between the sub questions and survey question to assist in the answering of the research questions.

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Survey Error

Coverage Error

To protect the identities of respondents, no names or other identifying factors were collected in this survey; however, SurveyMonkey includes IP address in individual response data. In cleaning the data, 5 responses were found to come from the same IP address. Because the responses had significantly different demographic answers, particularly in years of service, weapon system managed, and organization, the researcher decided not to eliminate those responses from the results. None of the collected demographic data can be tied to any specific respondent. Reviewing the IP addresses eliminated any possibility of over-coverage to exist in the survey results; the researcher considers highly improbable that the respondents would access the survey twice from different computers.

By nature of the web-based survey, under coverage is unlikely (Lynn, 2005). Additionally, because contact information for the entire population was managed by the SASPO and the survey was distributed to the entire population, is reasonable to assume that no under coverage occurred. Likewise, coverage error is not a factor in this research.

Sampling Error

With 45 usable responses (26.3% response rate), it is reasonable to believe that sampling error is negligible in this research. By applying Roscoe's rules of thumb and the students t-statistic ($t \geq 31$), the portion of the population that completed the survey approaches the Central Limit Theorem (Leedy & Ormrod, 2015).

Non-Response Error

Respondents that did not complete the survey were removed from the data; 5 responses were eliminated. Additionally, the use of SurveyMonkey, an easy to interact with tool, should minimize the effects of non-response error. It is reasonable to believe then that non-response error has not occurred in this survey.

Measurement Error

Measurement error has been minimized in this research by conducting pretesting and pilot testing of the survey. In doing so, the survey received by the respondent should be of excellent construction, wording, and design (Constantine, 2012). The possibility of respondents deliberately providing incorrect information should be negligible. As a group of professional being asked to participate in a survey by their own policy organizer, the SMEs have an opportunity to create positive effects in DMSMS and should have no reason to induce measurement error.

Summary

Discussed in this chapter was the survey methodology, the design of this research, the design of the survey as well as it's administration, how the data is to be analyzed, and lastly, how the researcher minimized error. Through this study and the data obtained from it, the researcher will be able to identify how current DMSMS policies, procedures, and resources are supporting Air Force acquisitions and sustainment, identify best practices the SASPO can expound upon to improve proactive DMSMS management, and understand relationship management, knowledge sharing, and collaboration amongst the SMEs and the SASPO. Furthermore, evaluation of this data will guide the SASPO and the USAF acquisition and sustainment community to be better stewards of USAF resources and highlight a pathway to enact Gen Brown's vision to "Accelerate Change or Lose". The follow chapter, Chapter IV, will discuss how the data from the survey was analyzed.

<center>IV. Analysis and Results</center>

Overview

   Chapter IV will answer the overarching research question to this study, "Has the
HQ AFMC established a proactive DMSMS management program for the United States
Air Force in accordance with AFMCI20-105 and the SD-22?". To do so nine research
sub questions will be examined by providing data analysis of a survey from the SASPO
administered to the DMSMS SMEs to gain insight to how DMSMS management is
progressing at the Program Office level. A cross tabulation, discussed in Chapter III, was
used to link key survey questions to the research sub questions. After each research sub
question is answered, each questions' open ended responses are further reviewed to
search for common trends between questions as well as any specific responses with key
valuable inputs to the SASPO.

**Research Sub Question One: Is there a positive level of commitment to proactive
DMSMS program management amongst the SMEs?**

   To answer research sub question one, the researcher primarily examined survey
question 10 and 12. Survey questions 10 and 12 asks the respondent "Do you believe it is
important to manage DMSMS proactively?" and "Who do you believe is ultimately
responsible for managing DMSMS?" respectively. By looking through the lens of Social
Exchange Theory (SET), the researcher establishes a level of commitment to DMSMS
management through survey question 10 and 12. Most specifically, the researcher looks
to positive commitment in order to establish relationship building between the Program

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Offices, SMEs, and the SASPO to ensure supply chain performance (Wu, Chuang, &
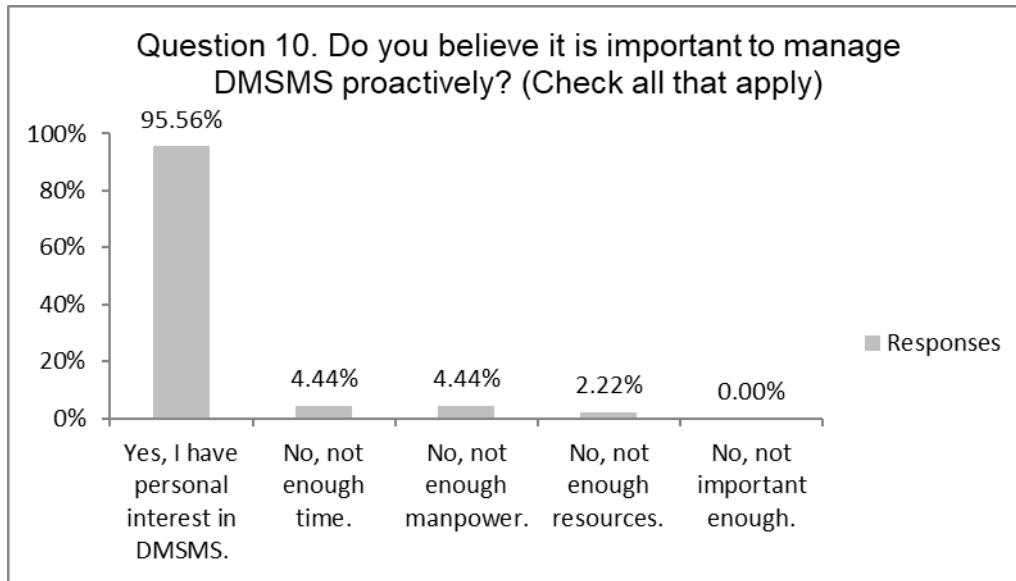
Hsu, 2014).

Figure 4: Do you believe it is important to manage DMSMS proactively?

Question 10 allowed respondents to select more then one answer. Forty-three

respondents answered "Yes". An additional 2 respondents added "No, not time", "No, not

enough manpower", and 1 respondent added "No, not enough resources". No respondents

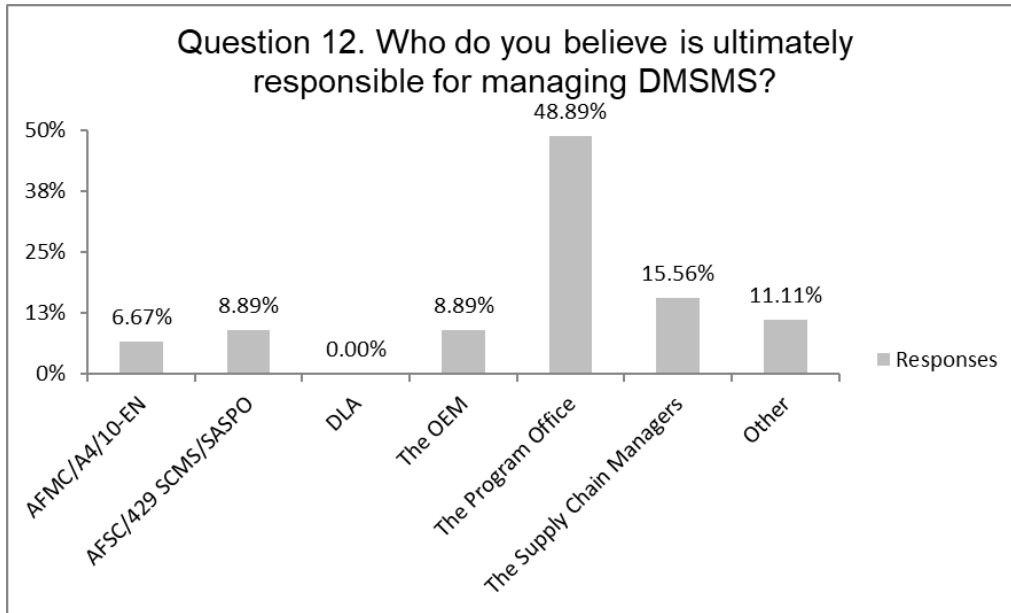added "No not important enough", indicating a positive level of commitment to DMSMS

management.

Figure 5: Who do you believe is ultimately responsible for managing DMSMS?

In question 12, 49% of respondents answered the "Program Office" was ultimately responsible for DMSMS management, while 16% selected the "Supply Chain Managers". Five respondents (11%) provided their answer, each answer indicating that everyone who holds a piece of the DMSMS puzzle is responsible for DMSMS management. With the unit of analysis being at the Program Office level, the researcher interprets the supply chain manager and "everyone" to be included as ownership at the Program Office level. The remainder of the responses ranged from 7% to 16%, believing an organization other than themselves is responsible for DMSMS management. In all 76% of respondents claimed DMSMS ownership while 24% put the onus an outside organization. Of note, 5 of the 11 respondents claiming an outside organization to the Program Office as the office of ultimate responsibility were contractors, the remainder were GS-12, 13, 14, and NH-03 civilians with an average of 4.6 years (ranging from 1 to 15 years and a standard deviation of 5.2 years) in DMSMS management. Ultimately, it is

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the Program Office who is responsible for DMSMS management (Mandelbaum, Patterson, & Brown, 2014).

Research Question One Summary

In all, the survey responses indicate that yes, there is a positive level of commitment to proactive DMSMS program management amongst the SMEs. With nearly 100% of respondents responding positively to survey question 10 and 76% responding positively to survey question 12, it can be inferred from the data that the vast majority of the DMSMS SMEs are committed to managing DMSMS, a key link to establishing a SCM relationship to the SASPO and establishing a sustained competitive advantage through proactive DMSMS management.

Research Sub Question Two: Do SMEs have backing from their own leadership?

Through the lens of Resource Based View (RBV), top management plays a critical role in creating supply chain performance amongst subordinates (Shibin et al., 2017). Top management can have effects on information sharing and collaboration amongst subordinates and in reverse, subordinates help top management make data driven decision when a trusting relationship is established and collaboration is fostered (Shibin et al., 2017; Chae, Olson, & Sheu, 2013). Research sub question two uses survey questions 11 and 20 to determine if SMEs are supported by their own leadership. Survey questions 11 and 20 asks the respondent "Does your organization believe it is important to manage DMSMS proactively?" and "Do you feel your organization's leadership support applied to DMSMS management is: Excessive, Sufficient, Less than sufficient,

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Nonexistent?" respectively. Additionally, open ended responses are reviewed to assist in providing further insight to the research sub question.
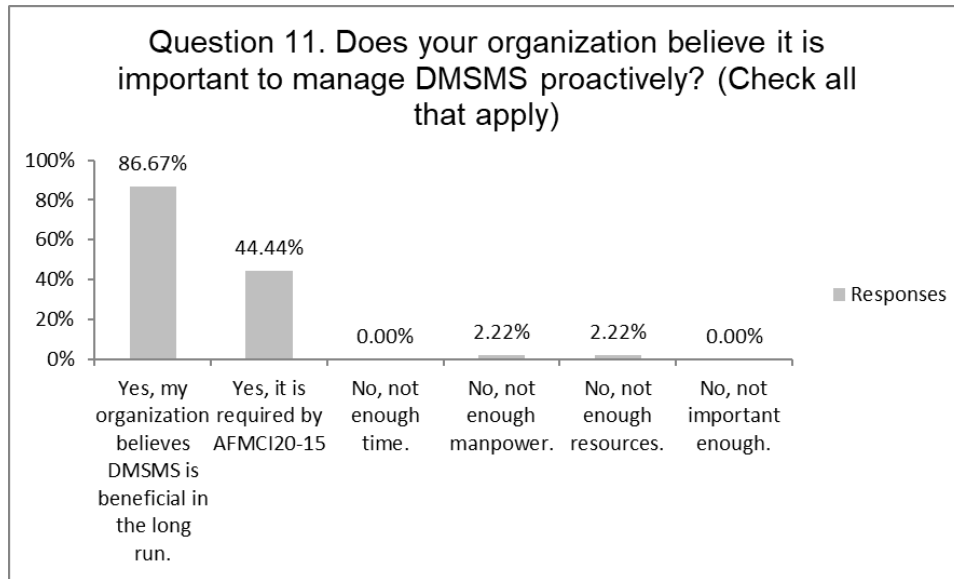

Figure 6: Does your organization believe it is important to manage DMSMS proactively?

Survey question 11 asked respondents to check each answer that they felt applied to their organization. In the final form of the survey, one of the selectable responses was to read "Yes, my organization has vested interest in DMSMS"; because of an error on the researcher's part, the question read "Yes, I have personal interest in DMSMS". Twenty of the survey respondents included this answer choice, 16 of the respondents also checked "Yes, my organization believes DMSMS is beneficial in the long run". Because the wording of the answer choice does not help to answer research sub question two, the 20 responses have been excluded from the analysis.

Thirty-nine respondents selected "Yes, my organization believes DMSMS is beneficial in the long run". Of the 20 respondents to select "Yes, it is required by AFMCI20-105", 19 also selected "Yes, my organization believes DMSMS is beneficial

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in the long run". Two respondents cited lack of time or resources with only one selecting a "yes" option. This indicates that the large majority of organizations do find that the management of DMSMS is important.

Figure 7: Organization's Leadership support applied to DMSMS management.

The majority of respondents believe that their organizations leadership support applied to DMSMS management is sufficient, with 66% of respondents believing a sufficient amount of support exists. In the next category down, 32% of respondents believe their leadership support was less then sufficient. Only one respondent believed support was excessive and zero believed it to be nonexistent.

Interestingly, of the 29 respondents believing support to be sufficient, all but one responded that their organization believed DMSMS management was important in question 11 "Does your organization believe it is important to manage DMSMS proactively?". Four of these 29 respondents indicated that they have not established a DMSMS Program in question 21. Of the 14 respondents that answered leadership support

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"was less then sufficient", 10 had organizations with an established DMSMS Program but 7 of those 10 had not implemented a DMSMS Plan. This is of interest because leadership involvement and support is critical to the establishment of a DMSMS Program. As the program is directed by the SD-22 and established the formation of a DMSMS Plan and a DMSMS Team, leadership interest and involvement is important to the proactive management of DMSMS.

Research Question Two Summary

The survey results indicate that SMEs do have leadership backing in DMSMS management. Leadership involvement is an indicator of the establishment of a DMSMS program. Without a DMSMS Program, the implementation of an effective and proactive DMP and DMT is implausible.

Research Sub Question Three: Have the SMEs established DMSMS program components outlined in the SD-22 and AFMCI20-105?

The key components addressed in Research Sub Question 3 are the establishment and implementation of a DMSMS Program, the DMSMS Plan, and the DMSMS Team. The SD-22 also directs for the use of the 5-step process and training via Defense Acquisition University (DAU) course. The courses suggested by the SD-22 and the SASPO includes CLL 032 "Preventing Counterfeit Electronic Parts from Entering DoD Supply System, CLL 200 "DMSMS: What Program Management Needs to do and Why", CLL 201 "DMSMS Fundamentals", CLL 202 "DMSMS Fundamentals: Executive Summary", CLL 206 "Introduction to Parts Management", and CLL 207 "Basic

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Component Research". Research sub question 3 uses survey question 21-26, 28, 29, and 30.

It should be noted that many of the CLL course have been replaced by LOG course listed in the table 2.

Table 2: Updated DAU DMSMS Course List

Updated DAU DMSMS Course List		
Course	Replaced by	Effective Date
CLL 200	LOG 640	21-Jan-21
CLL 201	LOG 650	29-Jan-21
CLL 202	LOG 660	6-Jan-21
CLL 206	LOG 630	1-Feb-21
CLL 207	LOG 670	8-Feb-21

When viewed through the lens of Transaction Cost Economics, the link between the components outlined in the SD-22 and sustained competitive advantage can be seen. The 5-step process outlines the management of a DMSMS Programs life cycle from end-to-end. TCE can be applied to the 5-step process when considering contracting decision as well as when assigning cost elements to data revisions, the purchase of technical data, start up cost to develop production or repair capability, and design testing of resolutions (SD-22, 2016). When developing a contract to manage DMSMS, the Program Office has a significant opportunity to establish a resolution contract that is bounded by all the critical language to ensure no requirements are missed with a manufacturer (SD-26, 2019). Additionally, when applied by viewing information as a key resource, TCE helps view the DMSMS Program as a keyway of sharing information between stakeholders (Yigitbasioglu, 2010).

Additionally, Agency theory can be applied by using either the outcome-based management approach, the behavior-based approach, or a combination of the two (Zsidisin & Ellram, 2003). In the outcome-based approach, management can reduce obsolescence risk when assigning resolution contracts by considering multiple sources of supply as the principle. As the agent, management can apply tools of risk mitigation such as gaining knowledge through completing DAU training and collaboration through the DMT.
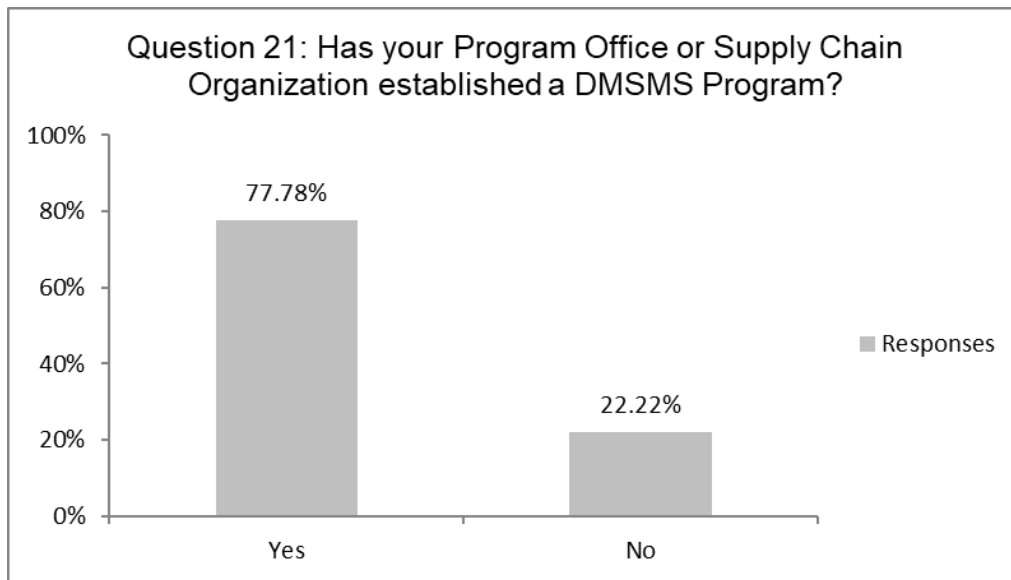

Figure 8: Has your Program Office established a DMSMS Program?
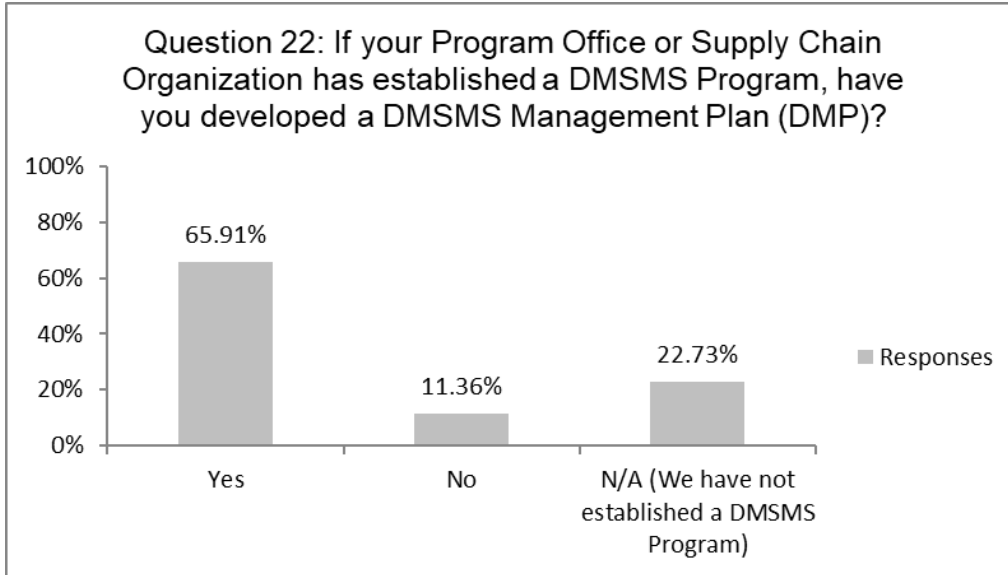
Figure 9: Have you developed a DMSMS Management Plan (DMP)?
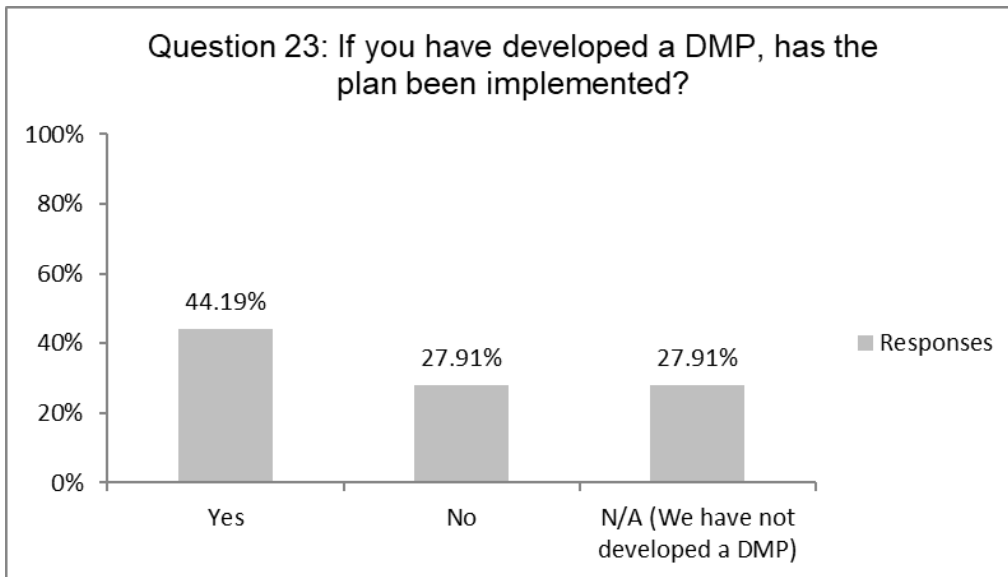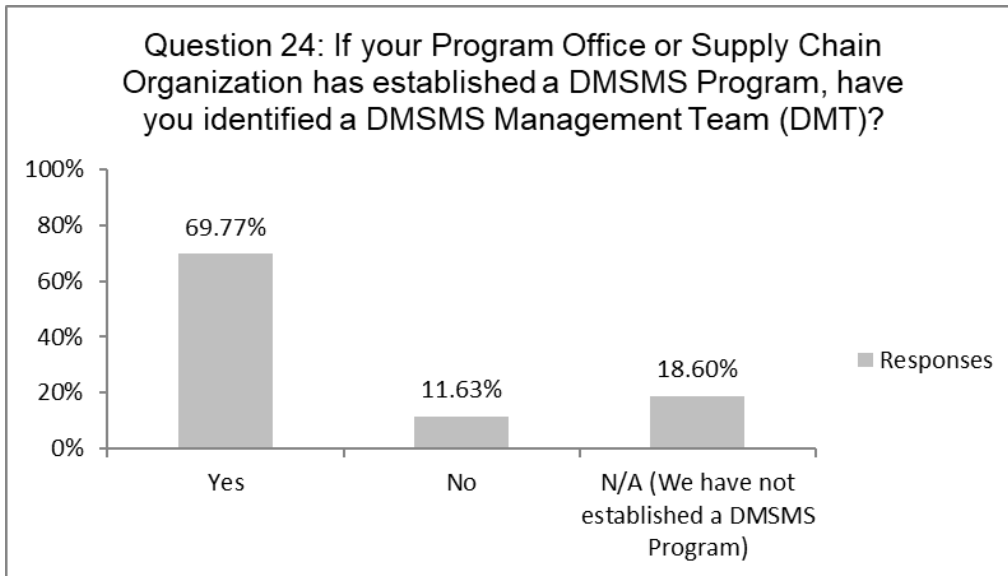

Figure 10: Has the DMP been implemented?

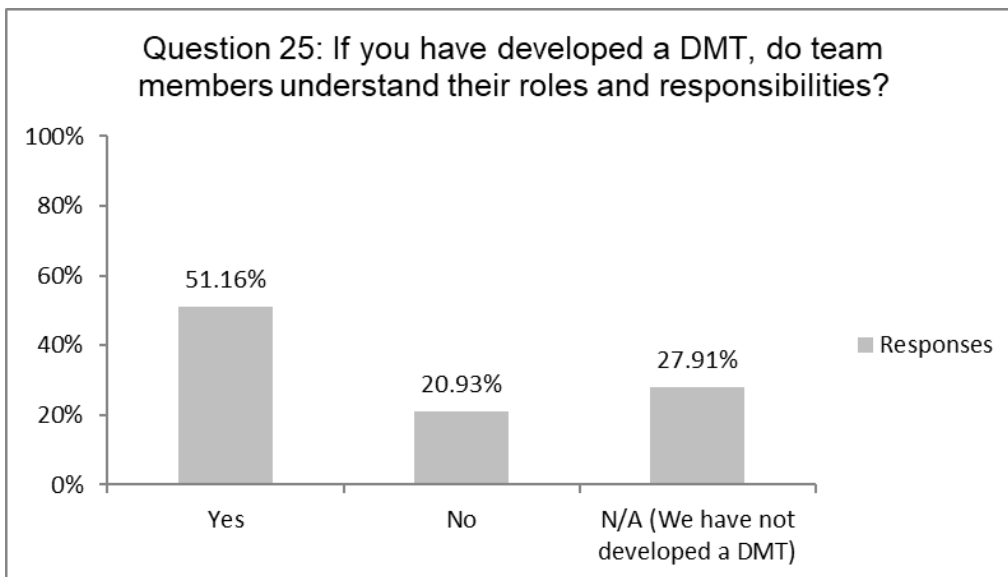Figure 11: Have you identified a DMT?

Figure 12: Do DMT members understand their roles and responsibilities?

The establishment of a DMSMS Program is critical to proactive DMSMS

management. The DMSMS Program includes the establishment of the DMP and the

DMT. Without an established Program, any DMP or DMT that does exist has no

prescribed organizational guidance and would be difficult to be either effective or

proactive. Of the 45 respondents, only 14 respondents answered yes to having established, implemented and understood all components of the DMSMS Program; that is only 31% of respondents that have a full DMSMS Program.

In providing open ended responses as to why Program Offices have not established a DMSMS Program, responses varied. Of the 31 respondents that did not have a fully established and implemented DMSMS Program, six said they had a new DMSMS Program that had either not established all program elements or were not ready. Lack of funding, time, manpower, and higher leadership involvement was also cited.
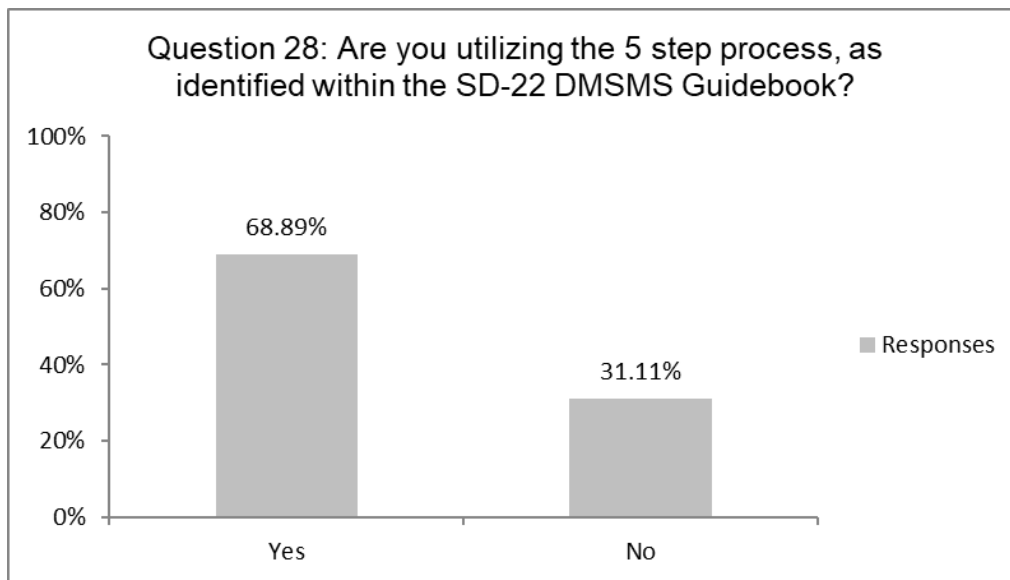

Figure 13: Are you utilizing the 5 step process?

Question 28 asked the respondent if they used the 5-step process described in the SD-22. The 5-step process can be seen in figure 1, Chapter II. Utilization of the 5-step process signals end-to-end management of life cycle DMSMS issues. When all steps are followed the Program Offices reduce risks of not implementing an effective DMSMS resolution. Furthermore, the 5-step process calls for the building of a DMSMS Programs

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infrastructure. Of 45 respondents, 3 skipped question 28, skips were counted as a "No". Thirty-one respondents (69%) utilized the 5-step process. Of the 31 respondents utilizing the 5-step process, 26 have established a DMSMS Program; 14 of which have a full program with DMP and DMT components implemented.
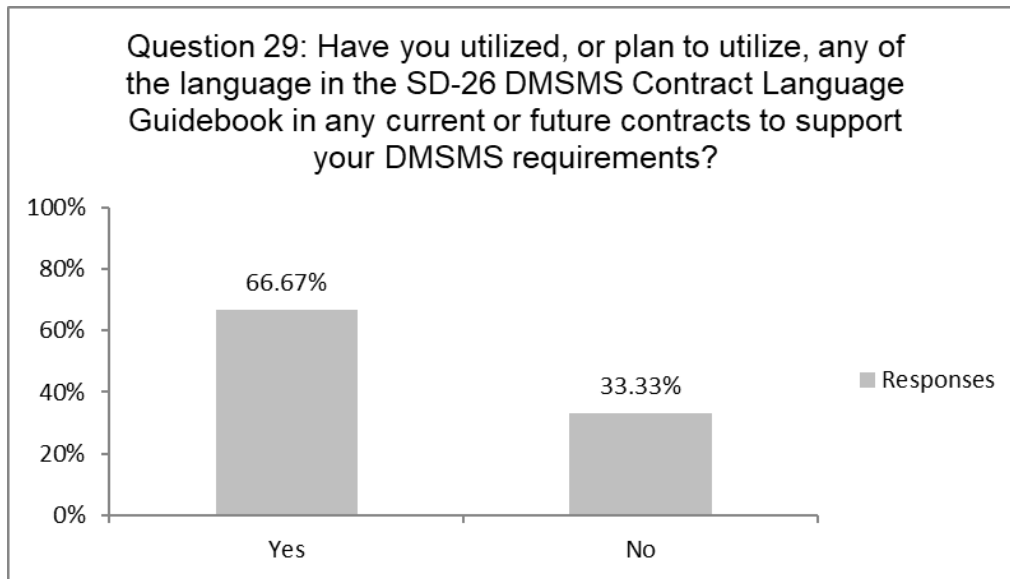

Figure 14: Have you utilized any of the language in the SD-26?

The SD-26 DMSMS Contract Language Guidebook was originally released in October 2019 and is the newest element to DoD DMSMS management. It's use is not directed by the SD-22 or AFMIC20-105; however, it is an important document that should be utilized to create a contract that meets USAF needs. Future version of the SD-22 will likely mention the use of the SD-26. It was expected by the researcher and the sponsor that not many program offices would be using the guidebook at the time of the survey.

Out of 45 respondents, five skipped question 29; skips were counted as "No". Thirty respondents (67%) answered they do or plan to use the SD-26. Eleven of the

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respondents that answer "No" provided an open-ended response as to why they have not utilized the contract language guidebook. Three were starting a new DMSMS Program and were not a yet at a point at which the guidebook could be used. Six did not know about the guidebook.
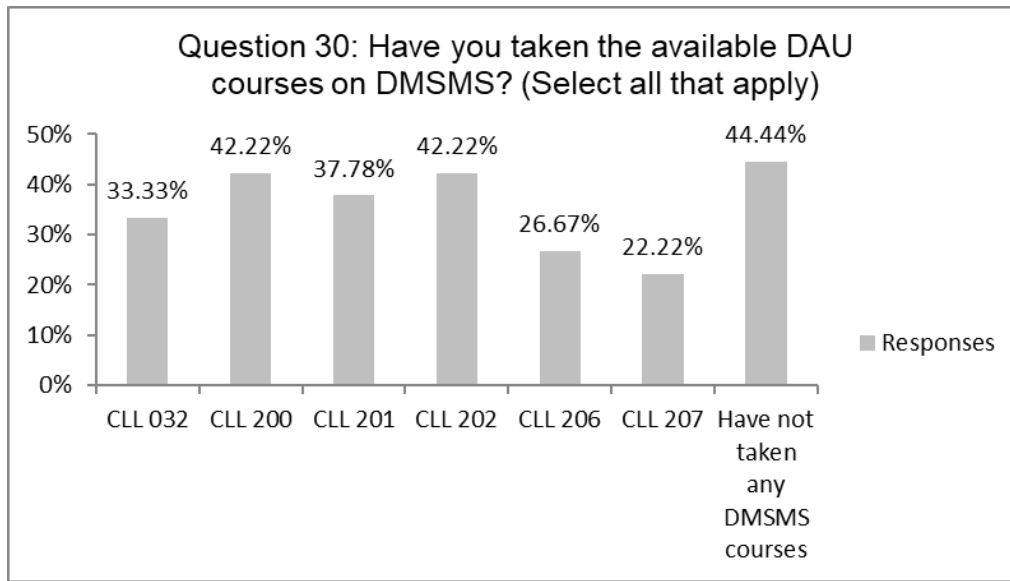

Figure 15: Have you taken the available DAU courses on DMSMS?

The DAU provides DMSMS training to help establish the fundamentals to proactive DMSMS management. Each course ranges 1 to 6 hours to complete and is estimated 12 hours total to complete. Of 45 respondents, 25 (56%) have completed at least one CLL course; 20 (44%) have not. The highest course completion rate was 42% for CLL 200 and 202. Table 3 breaks down question 30, respondents who answered that they have not completed any of the DAU courses on DMSMS in relation to questions 10, 13, 14, 16, 17, and 21.

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Table 3: DMSMS DAU Course Demographic

Has not Completed any DMSMS Course		
	Yes	No
Q10: Has interest in DMSMS	17 (85%)	3 (15%)
Q13: Has resources	7 (35%)	13 (65%)
Q14: Uses Contract Services	5 (25%)	15 (75%)
Q16: Spends less then 10% of their time on DMSMS	11 (55%)	9 (45%)
Q17: Organization has less then suffcient training effort.	9 (45%)	11 (55%)
Q21: Has a DMSMS Program	13 (65%)	7 (35%)

Research Question Three Summary

The results from the survey questions indicate to the researcher that the SMEs have not fully established all components directed by the SD-22. Specifically, in terms of the DMSMS Program, while the majority of respondents have established a DMSMS Program and the DMP and DMT component thereof, they have not fully implemented or understand all the components. Additionally, SMEs have not completed the majority of DMSMS training on DAU. While most SMEs have completed at least one DAU course, not one DAU course was taken by the majority of SMEs. SMEs have however, mostly used or plan to use the SD-26 Contract Language Guidebook; a good indication that SME are aware of contract language that establishes the requirements a DMSMS resolution that is affordable to the USAF and concurrent to their needs.

Research Sub Question Four: Do the SMEs recognize the SASPO and their roles and responsibilities in proactive DMSMS management as outline by AFMCI20-105?

The literature review establishes a trusting relationship between the principle and the agent to be critical to sustained competitive advantage from theoretical lenses. Furthermore, SET establishes the recognition and reciprocity of top management to be important in establishing that trust (Wu, Chuang, & Hsu, 2014). Research sub question four examines whether the SASPO has establish such a view amongst the SMEs by examining questions 27, which asks the respondents if they concur with the responsibilities identified in AFMCI20-105, and 38 which ask if the respondent communicates their DMSMS related questions and issues with the SASPO.
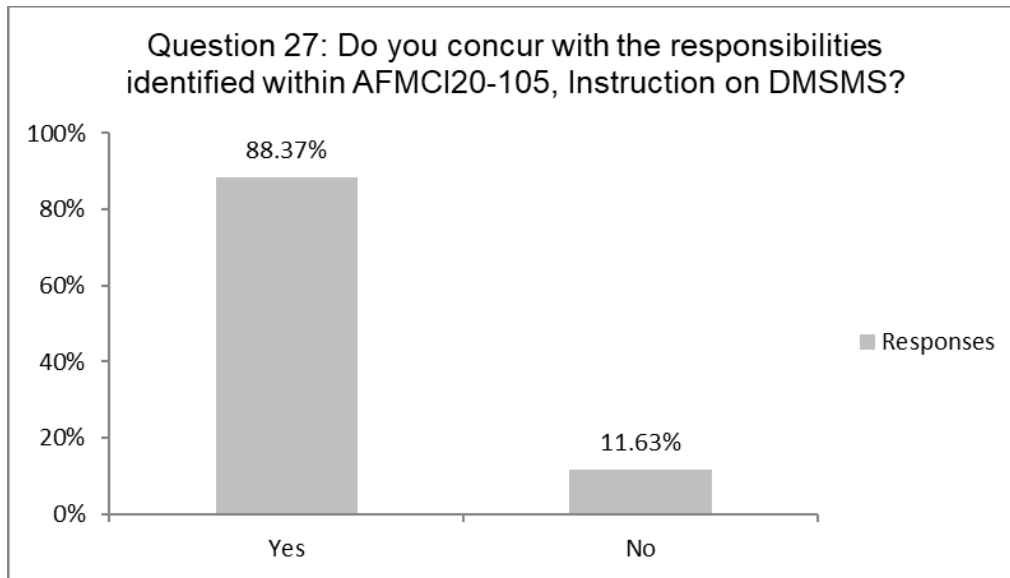

Figure 16: Do you concur with the responsibilities identified within AFMCI20-105?

Most of the respondents agree with the responsibilities identified in AFMCI20-105. Thirty-eight out of 43 respondents (88%) agreed, two respondents skipped the question. This response rate has a twofold significant to the SASPO; one the SASPO has

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a smooth path towards managing the program offices and two, the Program Offices understand their piece in the DMSMS puzzle. This is an important step that leads towards sustained competitive advantage.
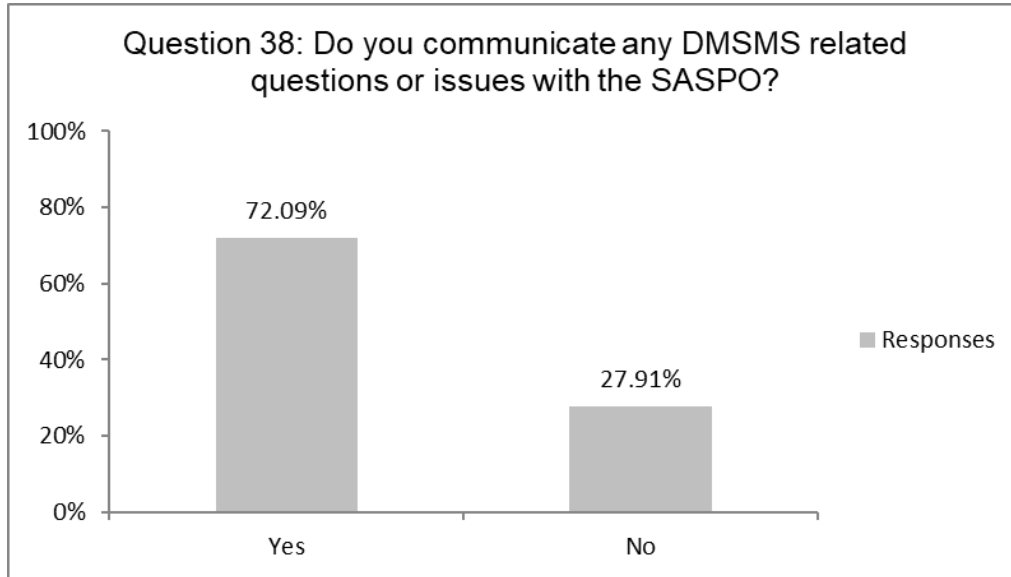

Figure 17: Do you communicate DMSMS questions/issues with the SASPO?

The majority of respondents answered that they communicate their DMSMS related issues and questions to the SASPO. Out of the 45 respondents, 31 (79%) answered that they communicate with the SASPO. This is a significant response to question 27 in that the SMEs agreeing with the SASPOs responsibilities means nothing if they are not communicating their needs with the SASPO. Discuss later in Chapter IV, of the 31 respondents who communicates with the SASPO, 30 of the respondents believe that the SASPO is easy to communicate with.

Research Question Four Summary

The survey results strongly indicate that the DMSMS SMEs agree with the responsibilities assigned in AFMCI20-105. Furthermore, not only do they communicate

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their needs to the SASPO, they also find it easy to communicate with the SASPO.

Research sub question four provides significant impact to the overarching research

question. Only if the SASPO is assisting the SMEs with DMSMS management, can the

SMEs resolve DMSMS issues that they are unable to solve on their own. Furthermore, it

is through the involvement of the SASPO that the SASPO is able to gain insight on issues

they were unaware of or unfamiliar with. With this gained knowledge, the SASPO is able

to assist multiple SMEs that may have a similar issue arise at another point in time. This

being said, open-ended responses requesting more communication with the SASPO are

addressed later in research sub question five.

**Research Sub Question Five: Has the SASPO established a positive relationship
with the DMSMS SMEs that foster proactive management of DMSMS?**

  In research sub question four the researcher established the foundation of a

positive SCM relationship between the SASPO and the SMEs. In Sub question five, the

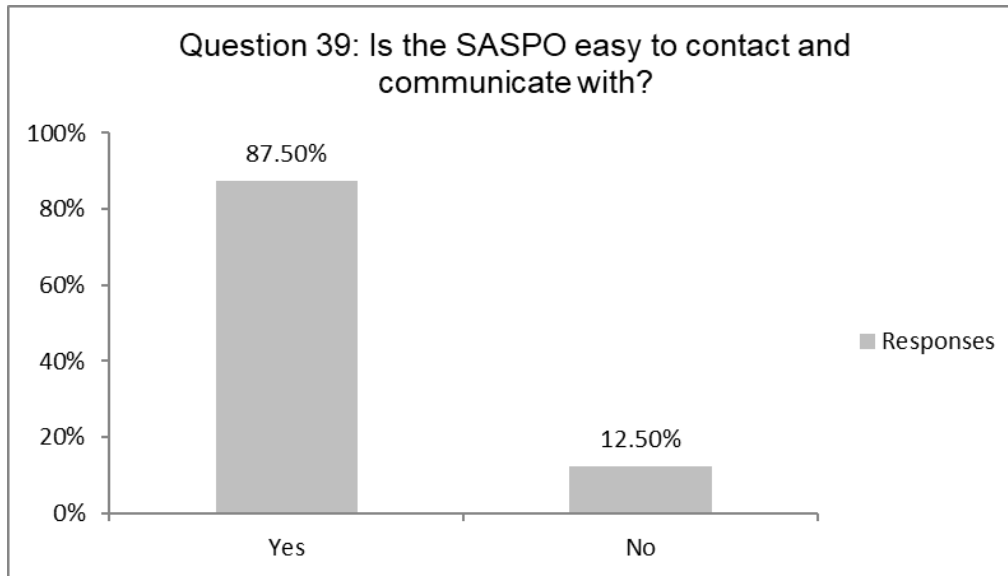researcher will establish that the relationship is positive.

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Figure 18: Is the SASPO easy to contact and communicate with?

Thirty-five of 45 respondents believe that the SASPO is easy to contact. Five respondents did not answer yes or no to question 39 but left open ended response. Those responses included that the respondent either is not involved or uses contract support and does not attempt to contact the SASPO.

Research Sub Question Five Summery

Through question 39, it is evident that the SASPO has create communication line with the SMEs that established a positive relationship with the SMEs. In the open ended questions 41, one respondent stated that continuing to build a relationship with the SASPO would prove to be beneficial. There are, however, some respondents who are having issues contacting the SASPO. Because this survey is anonymous, the SASPO should reexamine their communication lines and ensure that no gaps exist that create a barrier between them and their SMEs.

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Research Sub Question Six: Has the SASPO provided useful tools to the SMEs for proactive DMSMS management?

Through the lens of RBV, research sub question six provides insight to sustained competitive advantage by viewing resources the physical, human and organizational capital that is used to implement strategy that is not able to be duplicated (Grant, 1991; Barney, 1991). Furthermore, information technology, when employed holistically, can lead to sustained competitive advantage (Chae, Olson, & Sheu, 2013). Through these systems, information is shared and collaboration occurs; which has already been established to lead to sustained competitive advantage (Chae, Olson, & Sheu, 2013). In research sub question six, the researcher establishes if the SASPO has provided such tools. Also addressed is if SMEs are using resources made available from a source other than the SASPO.

Questions 34 through 37 address the resources that have been made available to the SMEs by the SASPO. These tools include the AF Predictive Tool, DMSMS Analysis and Resolution resources, and Policy and Training resources. In addition to these tools, the SMEs also have access to other outside resource. Theses resources are those provided by other branches, OEMs, and the DoD to include DMSMS tools provided by NAVAIR, the DAU courses, and other resources. Question 40 addresses what other tools the SMEs are using that have been made available to them through outside sources.
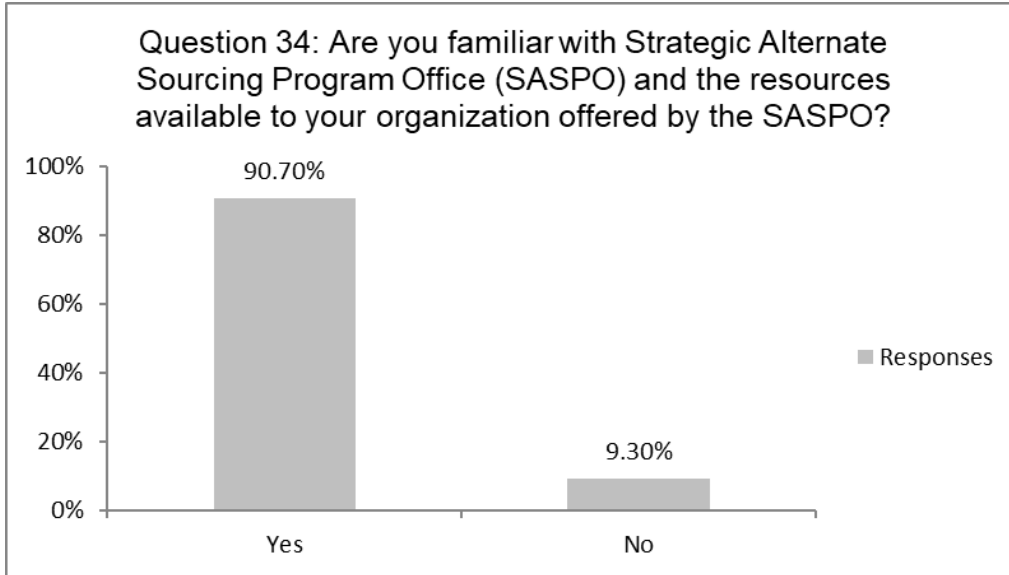
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Figure 19: Are you familiar with resources offered by the SASPO?

Thirty nine of 45 (91%) respondents answered that they are familiar with the

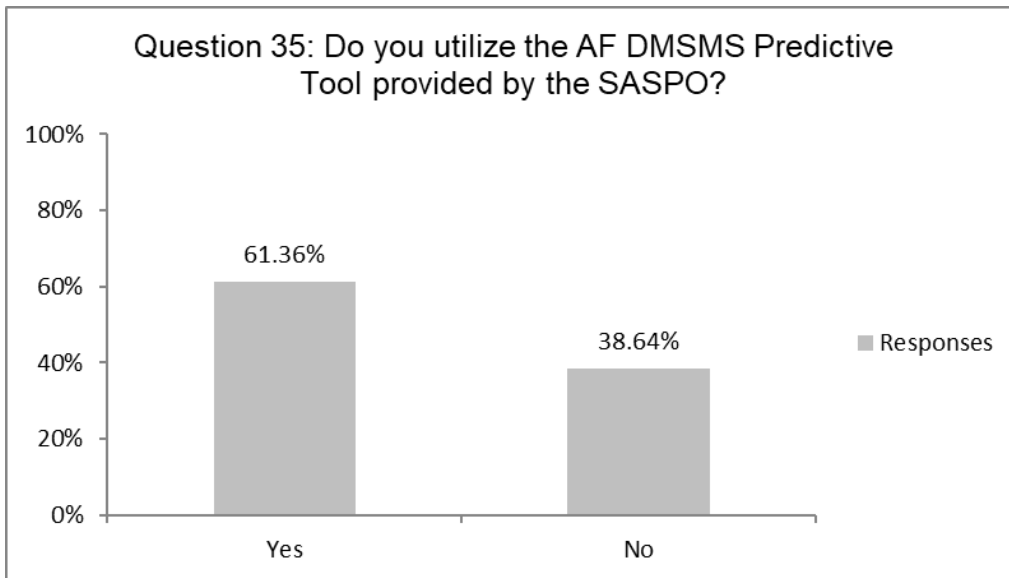SASPO and the resources made available by the SASPO.

Figure 20: Do you utilize the AF DMSMS Predictive Tool provided by the SASPO?

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A smaller percentage of respondents answered that they utilize the AF Predictive Tool. Out of 45 respondents, 27 (61%) are using the AF Predictive Tool. Of the 17 respondents that answered "No", three provided that they use contractor support for DMSMS management, one answered that they are using a Navy system provided through NAVAIR, and another three stated their program to be new and have yet to use the tool.
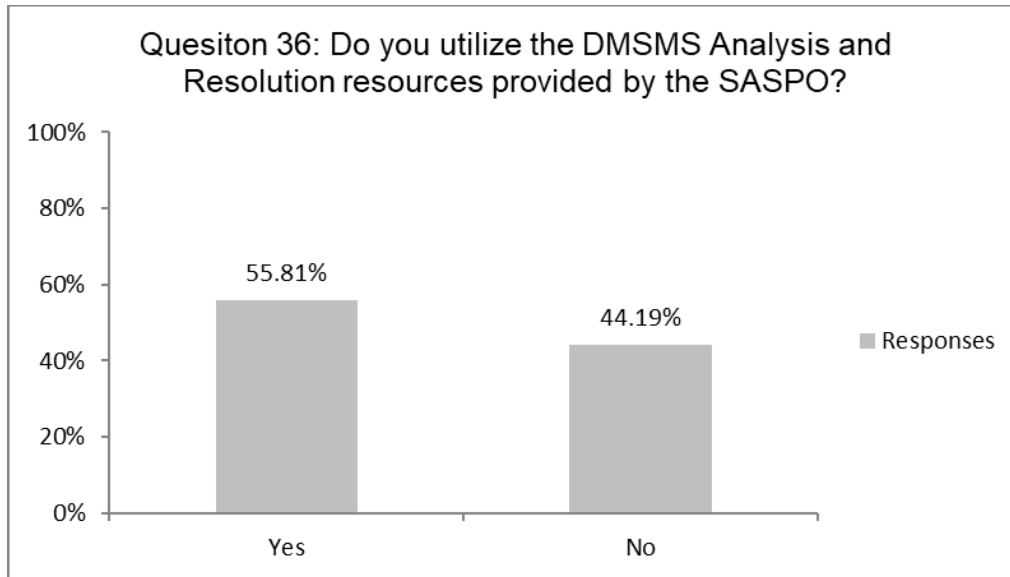

Figure 21: Do you utilize the DMSMS Analysis and Resolution resources?

Twenty-four of 45 respondents (56%) stated that they are using the SASPOs analysis and resolution resources. Six respondents stated having a new program that was not at the point of using these tools, two respondents cited using contractor resources instead of the SASPOs analysis and resolution resource.

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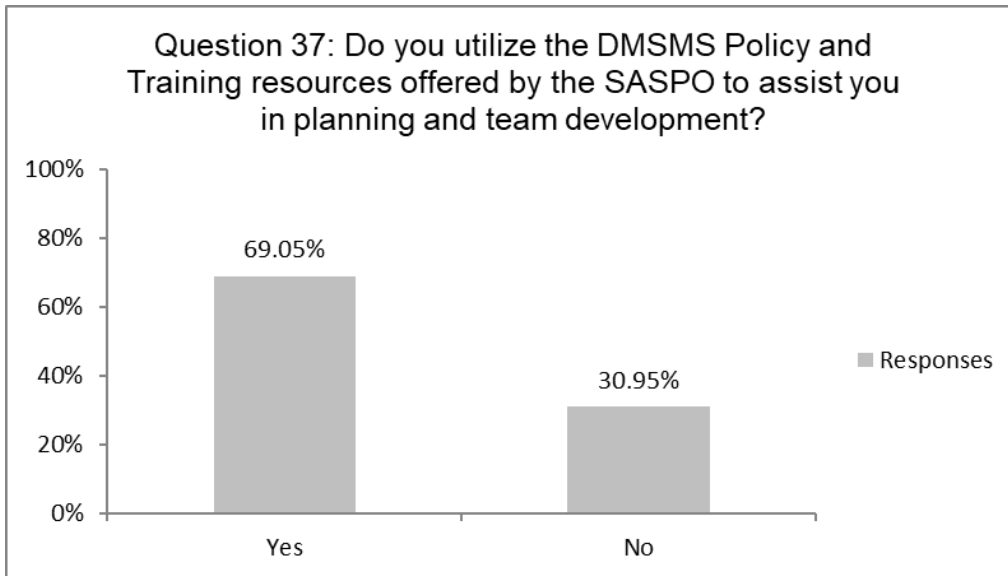
Figure 22: Do you utilize the DMSMS Policy and Training resources?

Twenty-nine respondents (69%) answered "Yes" to utilizing DMSMS policy and training resources. Four respondent answered "No" because they have new programs that are not at the stage were these resources are usable. Three respondents stated they do not use this resource because they use contractor resources.
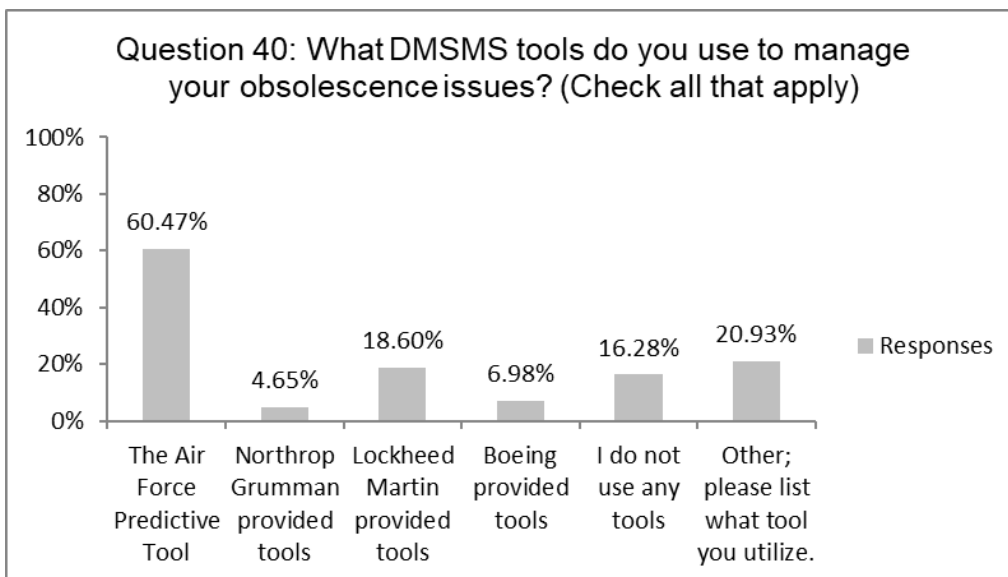

Figure 23: What DMSMS tools do you use to manage your obsolescence issues?

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The majority of SMEs use the AF Predictive Tool; 26 (60%) out of 45 respondents. Nine respondents listed other tools they use to manage DMSMS to include tools provided by Raytheon, Leidos, Haystack Gold. Seven respondents identified that they do not use any tools, with two responding that respondents contract managed DMSMS handler uses their own tools. Two respondents skipped question 40. Seven respondents use the AF Predictive Tool as at least one other tool, namely Lockheed Martin, Boeing, or Haystack Gold provided tools.

Research Sub Question Six Summery

The majority of respondents are utilizing the DMSMS tools provided by the SASPO. This gives a strong indication that the SASPO is providing useful tools to the field. The use of these tools is not only important for the effective and proactive management of DMSMS, but also to lay the foundation for information sharing and collaboration amongst the SMEs.

Of note, a very small number of respondents do not use any DMSMS predictive tool at all; while some did not use any tool because they used contractor managed programs, the SASPO should ensure the field is at least aware of the requirement to use a DMSMS predictive tool and ensure they know the resources available to them. Additionally, a small number of respondents use more then one predictive tool, the SD-22 (2016) suggests that DMSMS managers should utilize at least two predictive tools for level three and four DMSMS Programs. For the more robust programs, the SASPO should encourage SMEs to monitor DMSMS through more then just the AF Predictive Tool.

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Research Sub Question Seven: What resource gaps exist amongst the SMEs outside of funding, manpower, and training?

Like many organizations across the Air Force, funding, manpower, and training is commonly identified as a resource gap. Through research sub question seven, the research will provide the SASPO a pulse of the resource gaps identified by the SMEs to include funding, manpower, and training, but also any gaps that might by present that is not already known. Research sub question seven is answer by examining survey questions 13, 17, 18, and 19. Additionally, the open ended questions, 41 and 42, are examined.

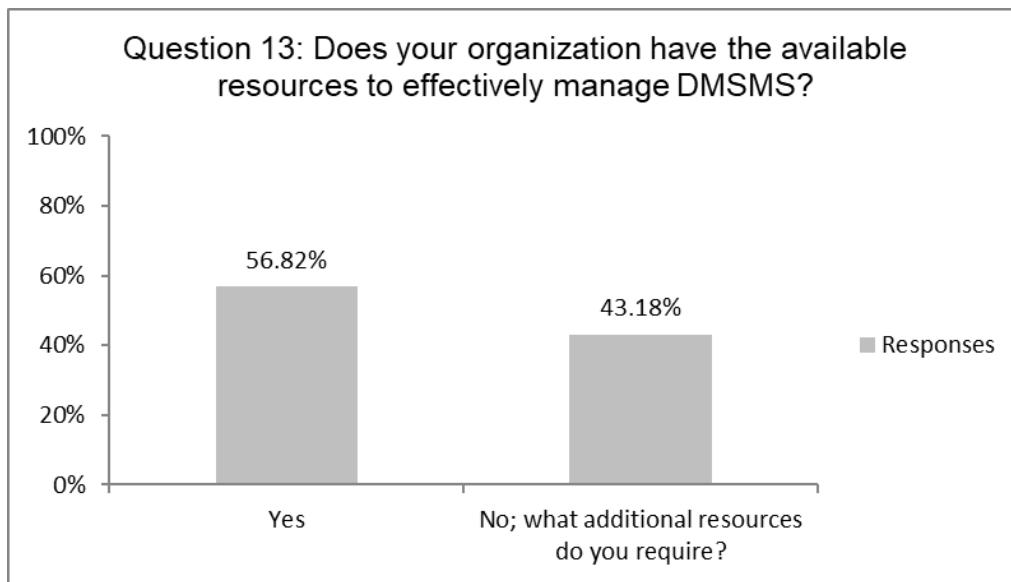Figure 24: Does your organization resources to effectively manage DMSMS?

The majority of respondents, 25 out of 44 (57%), answered "Yes" they do have the available resources to effectively manage DMSMS, although it is a small majority. Of the 19 respondents that answered "No", 14 provided an open-ended response. Nine stated they need more manpower and 5 needed more funding. Outside of funding and

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manpower, two respondents requested a directive from the SASPO for all customers to use one common predictive tool, specifically AVCOM, but possibly another tool such as the Haystack Gold tool. One of these respondents specifically cited that they support a Foreign Military Sales customer that does not have all their Line Replaceable Units loaded in AF Predictive Tool. As stated in the SD-22 (2016), the use of at least two predictive tools is ideal, however, no guidance directs which tools to use. One respondent skipped question 13.
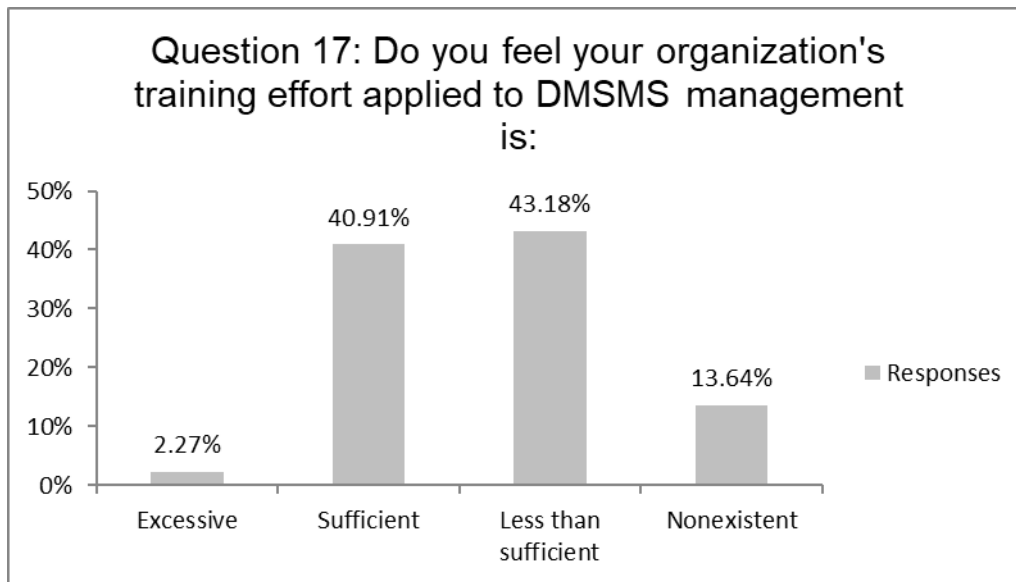
Figure 25: Organization's training effort applied to DMSMS management.

When asked about their organizations training efforts, the majority of respondents felt training was less then sufficient. Nineteen respondents answered "less than sufficient" and six responded that training was "nonexistent". Total, 57% of respondent believe more training is needed. It should be noted that 13 of the 25 (52%) respondents to select "less than sufficient" or "nonexistent" have not completed any DAU courses directed in the SD-22 and by the SASPO. Additionally, 9 of the 25 respondents stated

that do not use the SASPOs policy and training resources. While this is a significant training gap, the SASPO conducts training for the Program Offices, provides training resources, and DAU training is also available for use.
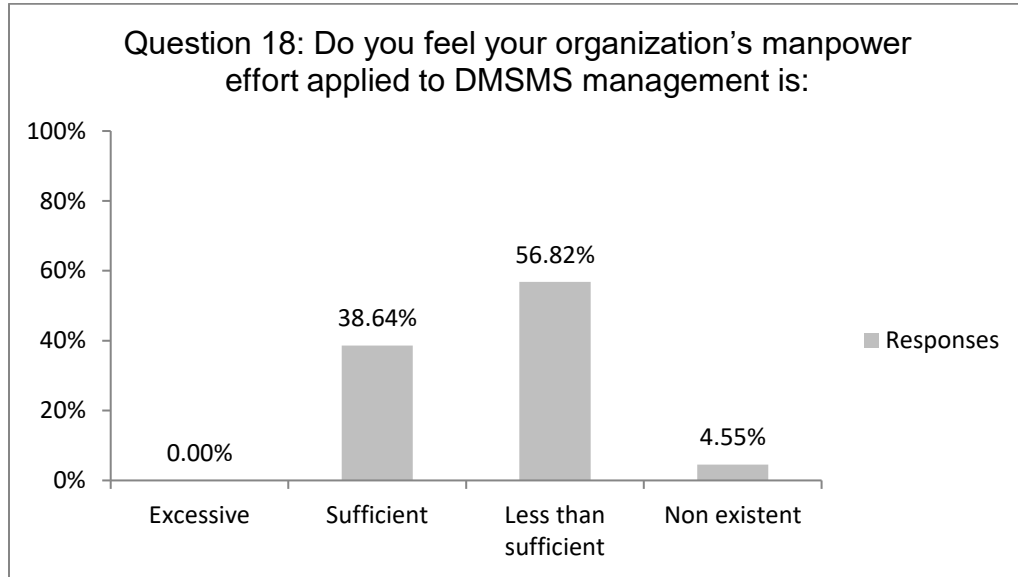

Figure 26: Organization's manpower effort applied to DMSMS management.

When about manpower, 25 respondents answered the manning was "less than sufficient"; 2 answered that it was "nonexistent". Of these respondents, 13 identified that DMSMS is their primary responsibility in their demographic questions.
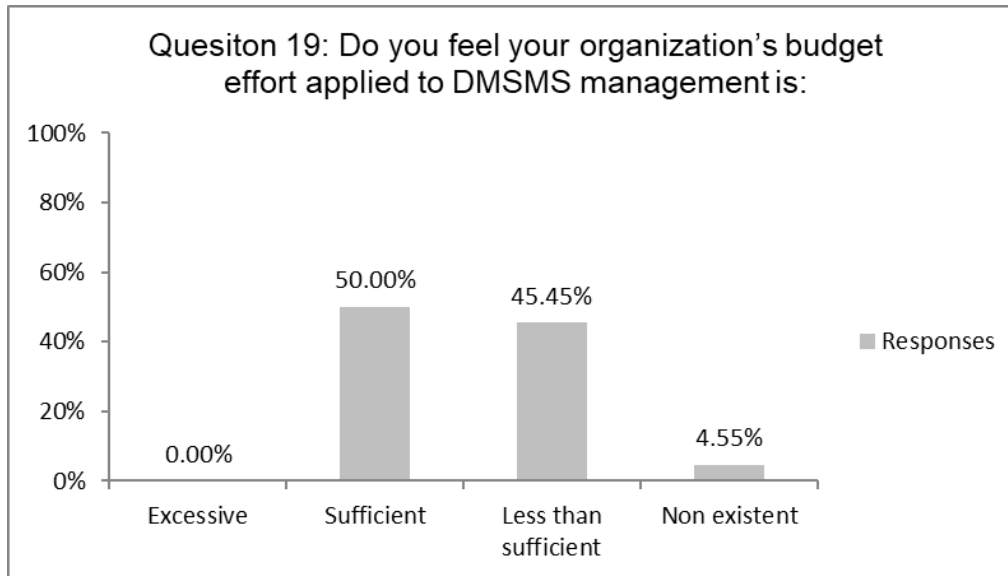
Figure 27: Organization's budget effort applied to DMSMS management.

When asked about budget, respondents were split 50/50.

Research Sub Question Seven Summery

Research sub question seven has given good insight for the SASPO regarding resource gaps in DMSMS. As expected and as with most organizations, training, manpower, and funding is an issue amongst DMSMS SMEs. While manpower and funding is outside of the control of the SASPO, the can advocate for more DMSMS specific manpower billets in the Program Office. Several of the manpower issues brought up in the open ended questions requested DMSMS specific manpower billets. In addition to funding and manpower, two respondents requested more in person training conducted by the SASPO.

While most respondents did not seem to identify many gaps outside of funding, manpower, and training, two respondents made significant suggestions to mandate the use of at least one DMSMS tool, namely AVCOM. Mandating the use of AVCOM could

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have negative implications. As identified in research sub question six, some respondents legitimately do not have a need for a predictive tool at this time. Additionally, mandating AVCOM would require special consideration for contract managed programs, such as Boing or Lockhead, where the Air Force does not own technical data.

For such SMEs, this mandate would be a waist of time; the mandate would not necessarily need to be followed by these SMEs but would have to be identified and approved as non-compliant in the IGEMS or MICT self-inspection checklists. The SD-22 (2016) states the use of at least two predictive tools for high level of DMSMS program management. A SASPO directive to use at least AVCOM would not necessarily benefit smaller programs that either do not have or do not need these higher levels of program management, however, such a directive could result in increased information sharing.

Research Sub Question Eight: Does collaboration and information sharing occur amongst the SMEs?

The importance of information sharing and collaboration has been discussed throughout this study. It is arguably one of the most shared concepts amongst SCM theory and sustaining competitive advantage. Research sub question eight tackles collaboration and information sharing head on to discover if the SMEs are engaging in information sharing and collaboration through survey questions 31, 32, and 33.
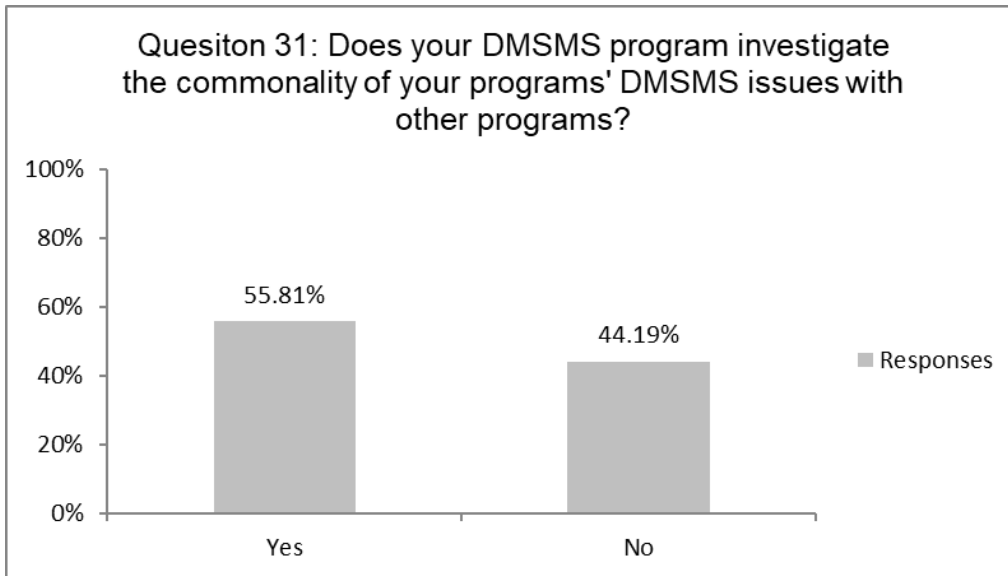
Figure 28: Does your DMSMS program investigate commonality with other programs?
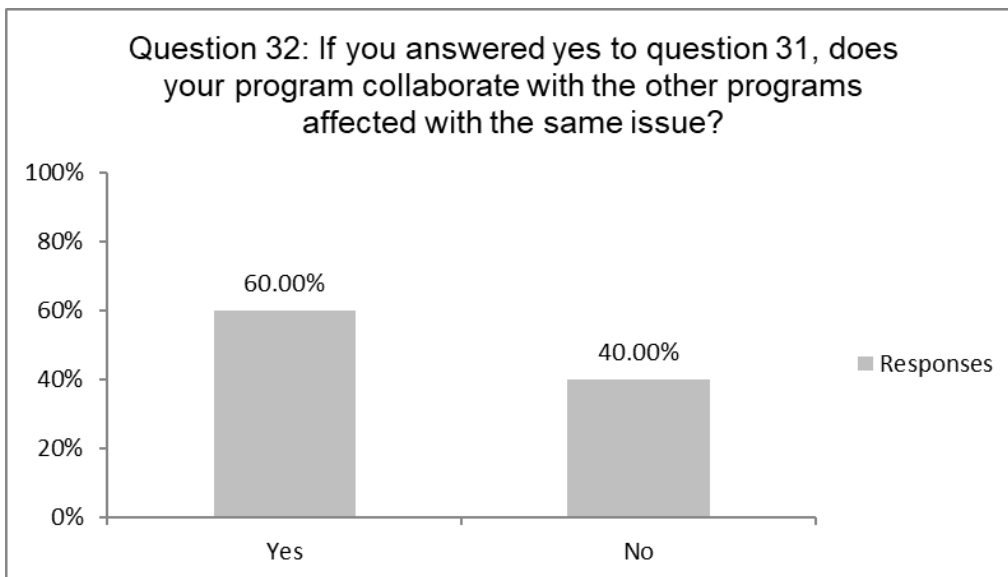
Figure 29: Does your program collaborate with other programs affected with same issues?
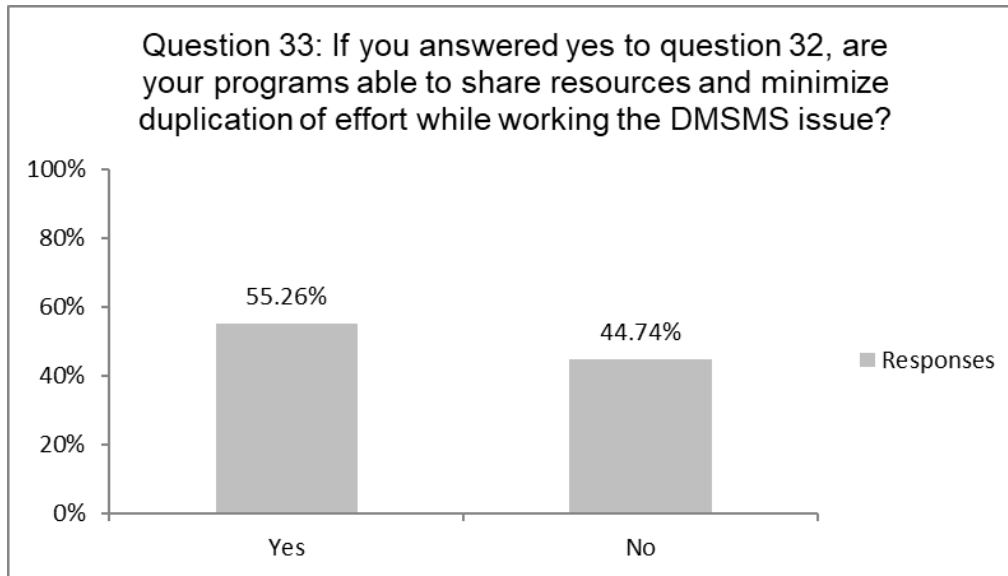
Figure 30: Are programs able to share resources and minimize duplication of effort?

Research Sub Question Eight Summery

The majority of respondents answered that they search for commonalities with other programs, that they collaborate with other offices that share the issues, and that duplication of efforts is reduced when collaboration occurs; however, this is by a small margin. While the survey responses indicate that information sharing and collaboration is occurring at the program office level, it is likely that not enough is occurring. In the open ended survey question 41, a respondent gave more than one specific examples of the use of rare earth metals restricted by DFARS 252.225-7052. In this respondent's point of view, several program offices experienced the issue, conducted very little collaboration, and requested further SASPO involvement. This is an area that the SASPO should focus one. Furthermore, this would be an excellent area for future research, which will be discussed in Chapter V.

Research Sub Question Nine: What level of awareness needs to be raised to Program Offices to gain further buy-in to building a robust DMSMS program?

The DMSMS SMEs raised important and interesting suggestions in their open ended responses. Open ended responses to survey questions 10 through 40 were examined in research sub questions one through eight. In survey question 41 and 42, 38 respondents left open ended questions which will be examined here in research sub question nine.

In addition to comments already addressed above, some respondents stated the need for assistance in obtaining technical data and BOMs as well as clearer lines of communication with other programs. While the most up to date version of the SASPO DMSMS SME listing is available through their SharePoint, respondents did request this information to be shared amongst the SMEs. Furthermore, some respondents suggested more regular meetings, whether it be monthly, quarterly, or semiannually, amongst the whole SME community and the SASPO.

In all, to answer research sub question nine, the SASPO should consider research sub eight, regarding collaboration and information sharing, first. While collaboration is occurring, it is entirely possible that more and better collaboration can occur. To start, the SASPO might consider more regular stakeholder working groups with the community as a whole. Additionally, reexamining available tools, such as the collaboration SharePoint, to ensure the tools are easy to use and known by the SMEs would be beneficial.

Another consideration the SASPO should make is to mandate the use of the AF Predictive Tool, addressed in research sub question seven. Even for the SMEs that don't use or need the predictive tool, their inputs could prove beneficial to other programs;

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their contract managed programs should require contractors to make inputs in AF Predictive Tool. To limit bureaucracy, this requirement should be waiverable and deeply considered before implementing.

Next, the SASPO should look at research sub question three regarding the implementation of a DMSMS Program. While many program elements have been established at the SME level, most programs are not implemented or understood. The SASPO should assist the SMEs to understand the importance of their roles as well implementing program elements. Particularly in the case of young DMSMS Programs, extra attention should be given to establish early on in program management the appropriate skills, tools, and contract language to secure a BOM and implement all aspects of a DMSMS Program and impact the final design of a weapon system early in the acquisition phase.

Chapter IV Summery

In all, to answer the overarching research question, "Has the HQ AFMC established a proactive DMSMS management program for the United States Air Force in accordance with AFMCI20-105 and the SD-22?", yes, HQ AFMC has established a proactive DMSMS management program, however, gaps in the management exists that will need to be addresses as the program progresses. The gaps and suggestions to the SASPO are identified in research sub question nine.

The SASPO has provided the required tools to the DMSMS SMEs to have a successful program. Components outlined in the SD-22 and AFMCI20-105 are being used, SMEs are committed to their program, top management is involved, collaboration

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does occur, and the SASPO is committed to and has created a strong positive relationship with the SMEs. That being said more can be done, but would likely require additionally manpower and funding for the SASPO.

To close the chapter, the researcher would like to share one comment in particular that was made by a respondent for the SASPO that the researcher believes sums up the overall feelings of the DMSMS SMEs. This comment identifies the hard work the SASPO has accomplished and signifies that they have established a relationship concurrent to sustained competitive advantage.

"Keep moving forward, even if inches. Thank you for all you do."

– Unknown Respondent.

V. Conclusions and Recommendations

Chapter Overview

This chapter will conclude the researcher's study. First a presentation of findings will be made. The chapter will then discuss the assumptions and limitations of the study as well as its implications. Recommendations will be made to the SASPO regarding the future management of DMSMS. Last, recommendations for future research will be made.

Research Findings

By asking a series of nine questions, the researcher answers the studies overarching research question "Has the HQ AFMC established a proactive DMSMS management program for the United States Air Force in accordance with AFMCI20-105 and the SD-22?". The researcher determines the answer to this question overall "Yes", HQ AFMC, through the SASPO, has established a proactive DMSMS management program in accordance with the AFMC and the SD-22. There are gaps that exist in DMSMS management and the researcher presents potential areas of improvement for the future of the SASPOs DMSMS Program and the management of Program Offices and DMSMS SMEs.

The researchers first finding is that there is a positive level of commitment to proactive DMSMS program management amongst the DMSMS SMEs. The second finding is that SMEs are supported by their leadership to effectively manage their DMSMS programs. Both of these findings are supportive of establishing foundational framework for a DMSMS Program. Through this knowledge, the SASPO should

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continue their current best practices, leaving more of their attention for areas presented in the following paragraphs.

The researchers third finding is that the DMSMS SMEs have not fully established and implemented the DMSMS program components outlined in the SD-22. The research found that most the of respondents have established a DMSMS Program and that a majority of these programs entails a DMP and DMT as directed in the SD-22. Furthermore, most respondents follow the 5 step process outlined in the SD-22 and plan, or plan to use, the SD-26 "Contract Language Guidebook" which was recently released in October of 2019. However, when asked if the DMP has been implemented and if the DMT understood their responsibilities, many respondents have not. Additionally, while most respondents have completed at least one of the DMSMS courses available via DAU, the courses have a low completion rate by the respondents. Here, the SASPO should consider working with the Program Offices to proceed with program implementation and progress DMSMS program management.

The researchers fourth and fifth finding is that the SASPOs responsibilities are recognized by the Program Offices and the SASPO has established a positive relationship with the DMSMS SMEs. That being said, gaps exist that the SASPO should strive to close. Such gaps includes lapses of communication with some Program Offices where a SME might go a period of time waiting for a response from the SASPO. These comments were few by the respondents, however, the SASPO should strive to identify and remedy any future occurrences.

In the sixth finding, it is found by the researcher that the SASPO does provided useful tools to the SMEs; the SASPOs should however, ensure the Program Offices are

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aware of their available tools and the benefits of each tool. Additionally, the SASPO should direct the use of the AF Predictive Tool at a minimum, with the understanding from the SMEs that the use of a common tool can increase collaboration and information sharing as well as help programs reach higher level of program management discussed in the SD-22. The recommendations are concurrent to the researchers seventh finding of what resource gaps exist outside of funding, manpower, and training. Those findings included the SMEs desires for one tool for all, more DMSMS specific manpower billets, more in person training by the SASPO, and regular meetings with the field guided by the SASPO. These suggestions are also supportive of the third research finding.

The researchers eighth finding is that information sharing and collaboration is occurring amongst the Program Offices but not at the scale that it should be occurring. Arguably, participation in this survey is a form of information sharing that roughly only 26% of a small population of SMEs participated in. Information sharing and collaboration is where the SASPO should focus their initial efforts in driving change in the management of DMSMS. By pooling the SMEs together, SMEs can help answer each other's questions and requirements where the SASPO may not necessarily have time to; this even gives the SASPO an opportunity to learn from the SMEs. By first increasing collaboration, time and money will be saved where it is estimated that 33-35% of programs share commonality.

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Significance of Research

The Chief of Staff of the Air Force has identified the Air Forces need to enact affordable decision for the Air Force today in order to create a sustainable force for tomorrow. Through the proactive management of DMSMS and obsolescence issues, the Program Offices have a significant opportunity to affect the long-term affordability of weapon system sustainment guided by the SASPO. This research provides the SASPO with the current state of the Program Offices DMSMS Programs and the resource, knowledge sharing, and collaboration gaps that exist in the programs. Through this knowledge, the SASPO will be able to make informed decisions regarding where to focus their immediate attention as they address the needs of the Programs Offices and guide the future of weapon system sustainment and the sustained competitive advantage of the USAF.

Recommendations

The researchers first recommendation is for the SASPO to make their initial investments, with knowledge gained by this survey, in the area of information sharing and collaboration. The researcher found that information sharing and collaboration is occurring amongst the SMEs but should be occurring at a larger scale. To bolster collaboration, the researcher adheres to the recommendations made by the Program Offices and suggest that the SASPO mandates the use of AF Predictive Tool to encourage a common knowledge sharing platform. Next the SASPO should conduct regular conferences/working groups with the Program Offices, whether in person or via telecommunication. Topics of discussion could initially include the need for increased

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collaboration and reasoning for a predictive tool mandate. The SASPO should also provide additional training regarding the use of the collaboration platforms available to the SMEs.

The researchers second recommendation is that the SASPO should assist Program Offices in the implementation of their DMSMS Programs. While the researcher found that most Program Offices have a DMSMS Program, some programs are likely ineffective as they are not being implemented or understood by DMT members. In terms of the Air Force's weapon system sustainability, most is not enough. In regard to the creation of a DMSMS Program, this is not something that necessarily needs the SASPOs direct involvement. Through collaboration, Program Offices can assist each other in developing a DMSMS Program and eventually making those programs robust. The SASPO should be involved in implementation, ensuring understanding through training, and overall compliance of the DMSMS Programs. Additionally, the SASPO should encourage SMEs to complete the DAU training to increase understanding the entirety of DMSMS management.

Lastly, the researcher believes that the SASPO has laid solid groundwork for proactive management of the DMSMS SMEs. Program Offices acknowledge the SASPOs responsibilities and the hard work they have accomplished. The researchers last recommendation is for the SASPO to continue research into establishing robust and proactive DMSMS management at the SME level through close and continued work with AFIT. The next section address areas of future research that the researcher believes the SASPO, and AFIT, should focus their attention.

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Areas of Future Research

Concurrent to Gen Browns Accelerate Change or Lose Action Orders, Action Order C: Competition, should be the first area of future research regarding DMSMS; research should be in regards to obsolescence management in China, Russia, and other adversaries. Literature regarding DMSMS and obsolescence is narrow, adversary literature is even tougher to come by. Attention can initially be focused on the current age of the adversaries' fleets, the adversaries military industrial complex, and where gaps may possibly exist between their militaries and industries to determine the potential existence of obsolescence issues. Furthermore, military modernization efforts, particularly in China, should be examined in a way to determine if DMSMS and obsolescence will be a near or far term issue for these countries or not an issue at all.

Next, the SASPO should conduct future research regarding ways to increase collaboration and information sharing amongst the SMEs. Collaboration is commonly identified key step towards sustained competitive advantage in SCM across several logistics related journals, literature, and theory. While collaboration is occurring at the SME level, research can discover how to increase this collaboration. Additionally, program commonalities should be identified. With knowledge of these commonalities, the SASPO can specifically identify where the estimated 33-35% of program commonalities exist and use these commonalities to directly link Program Offices together and ensure that collaboration is not only effective but also efficient.

Much of AFIT research regarding DMSMS is from the early 2000s; a lot has changed since then regarding DMSMS issues and management. First Lieutenant Robert Overstreet wrote an excellent thesis in 2002 titled "Process Mapping a DMSMS Reactive

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Management Strategy". This study shares similarities to 1st Lt Overstreet's thesis in that both search for improvement areas to DMSMS management. The studies differ in that 1st Lt Overstreet conducted process mapping of DMSMS management and addressed bureaucratic pitfalls. In 2011, Major Kenneth Underwood addresses DMSMS management improvement areas in his thesis "Minimizing the Risks of DMSMS: Evaluating Electronic Avionics Lifecycle Sustainment Strategies". Major Underwood uses statistical analysis and long term cost comparison to provide a framework for low cost sustainment strategies. These thesis' conducted great research, different from the research conducted in this study, but is now outdated as much has changed in the last 10 to 20 years. These thesis' can be re-accomplished to find current DMSMS process mapping, bureaucratic pitfalls, and low cost strategic sustainment strategies; which is also concurrent to Gen Brown's Action Order B: Bureaucracy.

Finally, while this study addressed Program Office management it did little to address contract management. Many Program Office's have hired contractors to manage their DMSMS programs and contracts are largely relied on for the implementation of DMSMS resolutions. Research should be conducted to further study both contracts with the Program Offices for management and resolution contracts.

In light of the recently released SD-26 (recently released in relation to the age of the SD-22 and DMSMS issues and management history), research should analyze the utilization and effectiveness of the new guidebook. Contractors should be scrutinized to determine if they are meeting USAF requirements, how rewards and penalties are applied, and if those rewards and penalties are effective or hurtful for the USAF. Additionally, willingness of sources of supply to accept contractors should be examined;

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a cause in of itself of DMSMS issues. To complement the mandate of AVCOM, research should also address how to include contract support to share information in AVCOM.

Chapter Summery

This chapter concluded this research study by providing a recap of research findings, applying significance to those findings, making recommendations to the SASPO for the future of DMSMS management, and finally, addressing areas of future research. Through this study the researcher hopes to bridge the gap between past research conducted a decade ago and future research.

Appendix A

Demographic Questionnaire
1. What level of DMSMS management responsibilities are assigned to you
   a. Primary responsibility
   b. Other duties as assigned
   c. Other, please explain (free form box)
2. What is your current position and title?
3. What is your current pay grade or series?
4. What is your USAF component/affiliation?
   a. Active Duty
   b. National Guard
   c. Air Force Reserve
   d. Civilian
   e. Contractor
   f. Other; please explain
5. How many years have you worked on DMSMS?
6. How many years have you worked in your current position?
7. How many combined years of federal service do you have?
8. What is your MAJCOM/organizations?
9. Which Weapon Systems/Platforms do you manage?

Survey Questions
10. Do you believe it is important to manage DMSMS proactively? (Check all that apply)
    a. Yes, I have personal interest in DMSMS.
    b. No, not enough time.
    c. No, not enough manpower.
    d. No, not enough resources.
    e. No, not important enough.
    f. Other (please explain).

11. Does your organization believe it is important to manage DMSMS proactively? (Check all that apply)
    a. Yes, my organization has vested interest in DMSMS.
    b. Yes, my organization believes DMSMS is beneficial in the long run.
    c. Yes, it is required by AFMCI20-15
    d. No, not enough time.
    e. No, not enough manpower.
    f. No, not enough resources.
    g. No, not important enough.
    h. Other (please explain).

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12. Who do you believe is ultimately responsible for managing DMSMS?
    a. AFMC/A4/10-EN as the DMSMS OPR
    b. AFSC/429 SCMS/SASPO as the DMSMS subject expert program office
    c. DLA
    d. The Original Equipment Manufacture (OEM)
    e. The Program Office
    f. The Supply Chain Managers
    g. Other (please explain).

13. Does your organization have the available resources to effectively manage DMSMS?
    a. Yes
    a. No; what additional resources do you require?

14. What method does your organization utilize to manage DMSMS? (Check all that apply)
    a. Organic Services
    b. Contract Services

15. How much does DMSMS management cost your organization annually?
    a. Less than $100,000
    b. Between $100,000 and $250,000
    c. Between $250,000 and $500,000
    d. Greater than $500,000
    e. Do not know

16. In any month, what percentage of time do you spend on DMSMS management?
    a. More than 50%
    b. 30% to 50%
    c. 10% to 29%
    d. Less than 10%

17. Do you feel your organization's training effort applied to DMSMS management is:
    a. Excessive
    b. Sufficient
    c. Less than sufficient
    d. Nonexistent

18. Do you feel your organization's manpower allocation applied to DMSMS management is:
    a. Excessive
    b. Sufficient
    c. Less than sufficient
    d. Nonexistent

19. Do you feel your organization's budget applied to DMSMS management is:
    a. Excessive
    b. Sufficient
    c. Less than sufficient
    d. Nonexistent

20. Do you feel your organization's leadership support applied to DMSMS management is:
    a. Excessive
    b. Sufficient
    c. Less than sufficient
    d. Nonexistent

21. Has your Program Office or Supply Chain Organization established a DMSMS Program?
    a. Yes
    b. No

22. If your Program Office or Supply Chain Organization has established a DMSMS Program, have you developed a DMSMS Management Plan (DMP)?
    a. Yes
    b. No
    c. N/A (We have not established a DMSMS Program)

23. If you have developed a DMP, has the plan been implemented?
    a. Yes
    b. No
    c. N/A (We have not developed a DMP.)

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24. If your Program Office or Supply Chain Organization has established a DMSMS Program, have you identified a DMSMS Management Team (DMT)?
    a. Yes
    b. No
    c. N/A (We have not developed a DMSMS Program.)

25. If you have developed a DMT, do team members understand their roles and responsibilities?
    a. Yes
    b. No
    c. N/A (We have not developed a DMT)

26. If you answered no to any of questions 21-25 indicating that your program has not established a DMP or DMT, why not?

27. Do you concur with the responsibilities identified within AFMCI20-105, Instruction on DMSMS?
    a. Yes
    b. No
    c. If No, please explain

28. Are you utilizing the 5 step process, as identified within the SD-22 DMSMS Guidebook?
    a. Yes
    b. No
    c. If No, please explain

29. Have you utilized, or plan to utilize, any of the language in the SD-26 DMSMS Contract Language Guidebook in any current or future contracts to support your DMSMS requirements?
    a. Yes
    b. No
    c. If No, please explain.

30. Have you taken any of the available DAU courses on DMSMS? (Select all that apply)
   a. CLL 032
   b. CLL 200
   c. CLL 201
   d. CLL 202
   e. CLL 206
   f. CLL 207
   g. I have not taken any of these DMSMS courses

31. Does your DMSMS program investigate the commonality of your programs' DMSMS issues with other programs?
   a. Yes
   b. No

32. If you answered yes to question 31, does your program collaborate with the other programs affected with the same issue?
   a. Yes
   b. No

33. If you answered yes to question 32, are your programs able to share resources and minimize duplication of effort while working the DMSMS issue?
   a. Yes
   b. No

34. Are you familiar with Strategic Alternate Sourcing Program Office (SASPO) and the resources available to your organization offered by the SASPO?
   a. Yes
   b. No

35. Do you utilize the AF DMSMS Predictive Tool provided by the SASPO?
   a. Yes
   b. No
   c. If No, please explain

36. Do you utilize the DMSMS Analysis and Resolution resources provided by the SASPO?
   a. Yes
   b. No
   c. If No, please explain?

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37. Do you utilize the Policy and Training resources offered by the SASPO to assist you in planning and team development?
    a. Yes
    b. No
    c. If No, please explain

38. Do you communicate any DMSMS related questions or issues with the SASPO?
    a. Yes
    b. No
    c. If No, please explain

39. Is the SASPO easy to contact and communicate with?
    a. Yes
    b. No
    c. If No, please explain

40. What DMSMS tools do you use to manage your obsolescence issues?
    d. The Air Force Predictive Tool
    e. Northrop Grumman provided tools
    f. Lockheed Martin provided tools
    g. Boeing provided tools
    h. I do not use any tools
    i. Other; please list what tool you utilize.

41. What additional resources do you believe your organization needs to effectively manage DMSMS?

42. What additional comments would you like to provide regarding DMSMS management?

Appendix B

Weapon System/Platform
7.62mm & .50 cal guns on CV-22, HH-60G, UH-1N; 25mm, 40mm, 105mm on AC-130
A-10 CICU
A-10C
AC-130W/J
Advanced Radar Threat System
AN/TRC- 214 Remote Radio
AN/TYQ-23A(V)1
AN/USQ-225, E-4, B-2, B-52, KC-153, F-15, F-16
B-2 Secondary Power
Bomb Racks (bomber and fighter)
BQM-167A
C-130
C-17
CRC
E-4B
E-8 (JSTARS)
Electronic Warfare & Avionics
F-16
Global Hawk
HC/MC/AC-103J
HH-60G
ISR Sensors
JASSM
JASSM, SFW
JASSM/JASSM-ER
JSTARS-E8
KC-135, F-16, F-15, A-10, T-38, C-130, C-5, E-3, B-1, B-2
MQ-9
Munitions
NC3
NC3 Weapons System, USQ-225
NCR IADS
QF-16
remote radio
SBIRS Mobiles
Sensors
SOF C-130s
StormBreaker, Small Diameter Bomb II
TPS-75

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Bibliography

Air Force Material Command Instruction (AFMCI) 20-105 (16 November 2017). Diminishing Manufacturing Sources and Material Shortages (DMSMS).

Alvarez, R. M., & Van Beselaere, C. (2005). Web-Based Survey. In 1148758166 863944606 K. Kempf-Leonard (Author), *Encyclopedia of Social Measurement* (pp. 955-962). Amsterdam: Elsevier. doi:https://doi.org/10.1016/B0-12-369398-5/00390-X

Archer, T. M. (2008). Response Rates to Expect from Web-Based Surveys and What to Do About It. *Journal of Extension, 46*(3).

Barney, J. (1991). Firm Resources and Sustained Competitive Advantage. *Journal of Management, 17*(1), 99-120. doi:10.1177/014920639101700108

Biemer, P. P. (2010). Total Survey Error: Design, Implementation, and Evaluation. *Public Opinion Quarterly, 74*(5), 817-848. doi:10.1093/poq/nfq058

Brown, C. Q., Jr. (2020, August 30). Accelerate Change or Lose. Retrieved from https://www.af.mil/Portals/1/documents/2020SAF/ACOL_booklet_FINAL_13_Nov_1006_WEB.pdf

Brown, C. Q., Jr. (2020, December 10). CSAF Action Orders to Accelerate Change Across the Air Force. Retrieved from https://www.af.mil/Portals/1/documents/csaf/CSAF_Action_Orders_Letter_to_the_Force.pdf

Chae, B., Olson, D., & Sheu, C. (2013). The impact of supply chain analytics on operational performance: A resource-based view. *International Journal of Production Research, 52*(16), 4695-4710. doi:10.1080/00207543.2013.861616

Clement, J. (2020, July 02). U.S. e-mail usage by gender 2019. Retrieved January 12, 2021, from https://www.statista.com/statistics/628372/us-email-usage-reach-by-gender/

Cropanzano, R., & Mitchell, M. S. (2005). Social Exchange Theory: An Interdisciplinary Review. *Journal of Management, 31*(6), 874-900. doi:10.1177/0149206305279602

Constantine, Boussalis (2012). *Basic Survey Theory and Design* [PowerPoint slides]. Harvard Law School. http://hnmcp.law.harvard.edu/wp-content/uploads/2012/02/Constantine-Boussalis-Training-on-Basic-Survey-Theory-and-Design.pdf

Davis-Sramek, B., Hopkins, C. D., Richey, R. G., & Morgan, T. R. (2020). Leveraging supplier relationships for sustainable supply chain management: Insights from social exchange theory. *International Journal of Logistics Research and Applications,* 1-18. doi:10.1080/13675567.2020.1797654

Defee, C. C., Williams, B., Randall, W. S., & Thomas, R. (2010). An inventory of theory in logistics and SCM research. *The International Journal of Logistics Management, 21*(3), 404-489. doi:10.1108/09574091011089817

Fayezi, S., O'loughlin, A., & Zutshi, A. (2012). Agency theory and supply chain management: A structured literature review. *Supply Chain Management: An International Journal, 17*(5), 556-570. doi:10.1108/13598541211258618

Fine, C. H. (2009). *Clockspeed: Winning industry control in the age of temporary advantage*. London: Little, Brown.

Giannakis, M., & Croom, S. R. (2004). Toward the Development of a Supply Chain Management Paradigm: A Conceptual Framework. *The Journal of Supply Chain Management, 40*(2), 27-37. doi:10.1111/j.1745-493x.2004.tb00167.x

Goyder, J., Boyer, L., & Martinelli, G. (2006). Integrating Exchange and Heuristic Theories of Survey Nonresponse. *Bulletin of Sociological Methodology/Bulletin De Méthodologie Sociologique, 92*(1), 28-44. doi:10.1177/075910630609200104

Grant, R. M. (1991). The Resource-Based Theory of Competitive Advantage: Implications for Strategy Formulation. *California Management Review, 33*(3), 114-135. doi:10.2307/41166664

Griffith, D. A., Harvey, M. G., & Lusch, R. F. (2005). Social exchange in supply chain relationships: The resulting benefits of procedural and distributive justice. *Journal of Operations Management, 24*(2), 85-98. doi:10.1016/j.jom.2005.03.003

Hill, R., Dr. (1998). What Sample Size is "Enough" in Internet Survey Research? *International Computing and Technology: An Electronic Journal for the 21st Century, 6*(3-4).

Isabelle, D., Horak, K., Mckinnon, S., & Palumbo, C. (2020). Is Porter's Five Forces Framework Still Relevant? A study of the capital/labour intensity continuum via mining and IT industries. *Technology Innovation Management Review, 10*(6), 28-41. doi:10.22215/timreview/1366

Ketokivi, M., & Mahoney, J. T. (2020). Transaction Cost Economics As a Theory of Supply Chain Efficiency. *Productions and Operations Management, 29*(4), 1011-1031. doi:10.1111/poms.13148

Leedy, P. D., & Ormrod, J. E. (2015). Chapter 6 Quantitative Research. In *Practical Research: Planning and Design, Global Edition* (pp. 154-195). Boston: Pearson.

Liao, L. (2008). Knowledge-sharing in R&D departments: A social power and social exchange theory perspective. *The International Journal of Human Resource Management, 19*(10), 1881-1895. doi:10.1080/09585190802324072

Losey, S. (2019, August 01). Aircraft mission-capable rates hit new low in Air Force, despite efforts to improve. Retrieved February 01, 2021, from https://www.airforcetimes.com/news/your-air-force/2019/07/26/aircraft-mission-capable-rates-hit-new-low-in-air-force-despite-efforts-to-improve/#:~:text=VARIDESK-,Aircraft%20mission%2Dcapable%20rates%20hit%20new%20low%20in,Force%2C%20despite%20efforts%20to%20improve&text=The%20Air%20Force's%20aircraft%20readiness,in%20at%20least%20six%20years.

Lynn, P. J. (2005). Weighting. In 1148572827 863827117 K. K. Leonard (Author), *Encyclopedia of Social Measurement* (pp. 967-973). Amsterdam: Elsevier. doi:10.1016/B0-12-369398-5/00061-X

Mandelbaum, J., Patterson, C., & Brown, R. (2014). Program Management Tips for Keeping Obsolescence at Bay. *Institute for Defense Analyses.* doi:10.2307/resrep23647

Melese, F., Franck, R., Angelis, D., & Dillard, J. (2007). Applying Insights from Transaction Cost Economics to Improve Cost Estimates for Public Sector Purchases: The Case of U.S. Military Acquisition. *International Public Management Journal, 10*(4), 357-385. doi:10.1080/10967490701683511

Pecht, M., Sandborn, P., & Solomon, R. (2000). Electronic part life cycle concepts and obsolescence forecasting. *IEEE Transactions on Components and Packaging Technologies, 23*(4), 707-717. doi:10.1109/6144.888857

Porter, M. E. (1979). How Competitive Forces Shape Strategy. *Harvard Business Review,* 137-145.

Rivera, J. L., & Lallmahomed, A. (2015). Environmental implications of planned obsolescence and product lifetime: A literature review. *International Journal of Sustainable Engineering, 9*(2), 119-129. doi:10.1080/19397038.2015.1099757

Rugman, A. M., & Verbeke, A. (1993). How to operationalize porter's diamond of international competitiveness. *The International Executive, 35*(4), 283-299. doi:10.1002/tie.5060350403

Sandborn, P. (2013). Design for Obsolescence Risk Management. *Procedia CIRP, 11*, 15-22. doi:10.1016/j.procir.2013.07.073

Sandborn, P., Prabhakar, V., & Ahmad, O. (2011). Forecasting electronic part procurement lifetimes to enable the management of DMSMS obsolescence. *Microelectronics Reliability, 51*(2), 392-399. doi:10.1016/j.microrel.2010.08.005

SD-22 (January 2016). Diminishing Manufacturing Sources and Material Shortages (DMSMS) A Guidebook of Best Practices for Implementing a Robust DMSMS Management Program

SD-26 (October 2019). Diminishing Manufacturing Sources and Material Shortages (DMSMS) Contract Language Guidebook

Shibin, K. T., Dubey, R., Gunasekaran, A., Hazen, B., Roubaud, D., Gupta, S., & Foropon, C. (2017). Examining sustainable supply chain management of SMEs using resource based view and institutional theory. *Annals of Operations Research, 290*(1-2), 301-326. doi:10.1007/s10479-017-2706-x

Starling, J. K., Choe, Y., & Mastrangelo, C. (2020). Identifying DMSMS availability risk at the system level. *International Journal of Production Research,* 1-21. doi:10.1080/00207543.2020.1743894

Trouteaud, A. R. (2004). How You Ask Counts. *Social Science Computer Review, 22*(3), 385-392. doi:10.1177/0894439304265650

Venable, J. (2020, November 17). U.S. Air Force. Retrieved from https://www.heritage.org/2021-index-us-military-strength/assessment-us-military-power/us-air-force

Williamson, O. E. (1979). Transaction-Cost Economics: The Governance of Contractual Relations. *The Journal of Law and Economics, 22*(2), 233-261. doi:10.1086/466942

Williamson, O. E. (2008). Outsourcing: Transaction Cost Economics and Supply Chain Management. *Journal of Supply Chain Management, 44*(2), 5-18. doi:10.1111/j.1745-493X.2008.00051.x

Wu, F., Yeniyurt, S., Kim, D., & Cavusgil, S. T. (2006). The impact of information technology on supply chain capabilities and firm performance: A resource-based view. *Industrial Marketing Management, 35*(4), 493-504. doi:10.1016/j.indmarman.2005.05.003

Wu, I., Chuang, C., & Hsu, C. (2014). Information sharing and collaborative behaviors in enabling supply chain performance: A social exchange perspective. *International Journal of Production Economics, 148*, 122-132. doi:10.1016/j.ijpe.2013.09.016

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Yigitbasioglu, O. M. (2010). Information sharing with key suppliers: A transaction cost theory perspective. *International Journal of Physical Distribution & Logistics Management, 40*(7), 550-578. doi:10.1108/09600031011072000

Zamora, J., & Graham, M. (2019, July/August). Leveraging Process to Avoid Obsolescence [Editorial]. *Armor & Mobility*, 10-13. Retrieved from tacticaldefensemedia.com

Zsidisin, G. A., & Ellram, L. M. (2003). An Agency Theory Investigation of Supply Risk Management. *The Journal of Supply Chain Management, 39*(3), 15-27. doi:10.1111/j.1745-493x.2003.tb00156.x

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14. ABSTRACT
The office designated by the Air Force to be DMSMS subject expert program office is known as the Strategic Alternate Sourcing Program Office (SASPO). Aided by the USAF Program Offices and DMSMS Subject Matter Experts, the SASPO is responsible for sourcing DMSMS resolutions as well as the organizing, training, and equipping of the Program Offices DMSMS Programs. Using quantitative research, this study conducts a survey, with the USAF Program Offices as the unit of analysis, to gain insight as to where the SASPO is doing well and where gaps exist in their program management. The analysis and conclusion identify where the SASPO should focus their attention to proactively manage DMSMS resolutions.

15. SUBJECT TERMS

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