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Exploring Factors Impacting Obsolescence Risk in Aerospace and Defense

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Exploring Factors Impacting Obsolescence Risk in Aerospace and Defense

Lauren Griffiths—is an accomplished procurement and supply chain leader with almost 20 years in the aerospace and defense industry specializing in global procurement, subcontracts, and supply chain. Griffiths's range of experience includes obsolescence management, international supply chain, risk management, and supplier recovery. Griffiths excels in leading, fostering, and empowering team members to develop innovative and creative solutions. She has a strong track record of driving strategic initiatives, improving operational efficiency, and ensuring successful outcomes across global supply chains. Griffiths holds an MBA, PMP, CPCM, and will graduate from Marymount University with a Doctorate in Business Administration in May 2025. [l0g77691@marymount.edu]

Abstract

This paper explores the impact of obsolescence in the aerospace and defense (A&D) industry, focusing on factors driving the escalation of costs associated with obsolescence mitigation and management. Through a focus group study with A&D professionals, themes emerged, including the costs of redesigns, last-time buys, and securing supply. Participants emphasized the need for proactive planning, risk mitigation, and cross-functional collaboration to manage obsolescence. These findings highlight the complexity of obsolescence and its financial impact on an organization. The results offer valuable insights into improving obsolescence strategies and set the stage for further research on the topic.

Introduction

Obsolescence is the problem of not being able to procure raw material, a component, or a major assembly (product) because the original equipment manufacturer (OEM) and distributors no longer manufacture and distribute the product, or it has been replaced in the market by a newer product (Rojo, 2010). The result of obsolescence can be a shortage in availability to meet current and future demand of the market, which can result in the stopping of a production line and contract fulfillment (Sandborn, 2013).

Key products of the aerospace and defense (A&D) industry typically have long life cycle phases from development through sustainment, and higher risk for obsolescence issues (Del Campo et al., 2022). These products encompass large military systems, aircraft, ships, ground-based vehicles, industrial and medical equipment, and electronics. For this industry, which includes the Department of Defense (DoD), foreign military customers, and A&D companies, unplanned obsolescence issues can become expensive and difficult to identify, avoid, mitigate, and resolve.

The problem of obsolescence can become complicated as multiple products and program areas share materials and parts. In avionics, where components are often shared across multiple aircraft types, obsolescence and parts unavailability can significantly drive up costs (Sandborn et al., 2008). This necessitates a thorough analysis of the root causes of high ownership costs for each aircraft type to mitigate the broader financial impact.

In addition to the high costs related to resolving issues of obsolescence, the consequences of not resolving problems of obsolescence for the A&D industry stakeholders means that materials, components, and major assemblies are at a substantial risk of being unavailable to support requirements (DoD, 2024). This means a soldier or sailor is left vulnerable in the field, inflated costs are required to expedite the resolution of the part, and loss of revenue to the business with higher cost to the taxpayer are a result (DoD, 2024).

Problem Statement

Unplanned parts obsolescence in the A&D industry require significant cost and time to resolve. This causes the unavailability of materials, components, and major assemblies to support contractual requirements and customer needs. The impact of obsolescence can be felt from the individual to entire nations. For defense products, a soldier or sailor is left without a major product or weapons system in the field, an expensive solution is required solve the shortage, the product cost significantly increases, and added costs are passed on to the taxpayer (DoD, 2024). Similarly, for commercial aerospace, revenues to businesses decreases, and costs are passed on to the consumer through airfare increases or other methods (Del Campo et al., 2022).

Statement of Purpose

The purpose of this research is to broadly explore the experiences of A&D industry practitioners managing issues of obsolescence. This research will provide valuable insight into the practitioners' perspectives of the issue of obsolescence, to understand the factors that contribute to increased costs associated with obsolescence mitigation, management, and risk realization.

Significance

The significance of this paper underscores the critical need to address obsolescence challenges in the A&D industry. The insights from this paper are valuable for researchers and practitioners in procurement and supply chain within the A&D industry. Furthermore, these findings can influence A&D procurement and supply chain leaders in making strategic decisions to mitigate and manage obsolescence challenges.

Review of the Literature

A literature review of A&D industry obsolescence was conducted to explore the challenges of the issue, strategies to mitigate and manage the risk, and gaps in obsolescence frameworks to identify the factors that result in key cost drivers. Recurring themes of this literature includes proactive versus reactive response, A&D cross industry participation, misconceptions of the problem of obsolescence, significant cost and time to resolve obsolescence, technology and product life cycle, and product and contractual requirements.

Obsolescence

Obsolescence in A&D refers to the critical components, materials, or technologies becoming unavailable, unsupported, or non-compliant due to various factors (Rojo, 2010). Obsolescence can occur due to a number of reasons including technological, industry driven, and regulatory (Bartels et al., 2012). Technological obsolescence occurs when newer advancements result in older technologies becoming outdated (Bartels et al., 2012). Industry or market-driven obsolescence occurs when a manufacturer discontinues a product line due to shifts in demand from their customers or reduced profitability (Bartels et al., 2012). Regulatory obsolescence occurs when there are changes in operational, safety, or environmental requirements that make the incumbent material, component, or technology non-compliant to meet requirements (Bartels et al., 2012). These classifications highlight the complex challenges in sustaining long-life defense systems while keeping up with rapid technological evolution in A&D.

Causes and Challenges in A&D Obsolescence

The issue of obsolescence in A&D occurs due to the rapid advances in technology of the industry's products, a limited and shrinking supplier base, and the extended life cycles of A&D products (Sandborn, 2013).

Electronic components which are heavily used across the A&D industry are affected by the concept known as Moore's Law. Moore's Law states that the number of transistors on a microchip will double approximately every two years, significantly impacting A&D and the acceleration of obsolescence in electronic components (Schaller, 1997). This short rapid technological progression significantly impacts A&D by accelerating the obsolescence of electronic components, as commercial manufacturers phase out older technologies in favor of newer, more efficient ones (Sandborn, 2013). Defense systems, which are designed for multiple decades of operation, are difficult to manage and keep pace with these advancements, leading to increased sustainment costs and the need for costly system redesigns (Bartels et al, 2012). For example, according to the Electronic Industries Alliance (EIA) an average cost for redesigning electronic components and parts can fall between $26,000 and $2 million dollars (Ozkan & Bulkan, 2016). In addition, it is estimated that 3% of the world's electronic parts become obsolete every month (Jennings et. al., 2016). Furthermore, reliance on legacy components creates supply chain vulnerabilities, as discontinued parts become scarce and harder to source, resulting in issues of obsolescence (Solomon et al., 2000). This cycle often results in the need for frequent and costly redesigns or last-time buys (LTB) to maintain product and system operation and functionality (Schaller, 1997).

The problem of obsolescence is not only related to electronics components and products though. While electronic components have long been susceptible to rapid obsolescence due to fast changing and advancing technology, nonelectronic parts such as mechanical components, materials, and textiles are also increasingly facing the same types of challenge (Howard, 2022). This issue occurs in systems and products of the A&D industry such as aircraft, ships, and tanks that have been operating for more than 20 years and are expected to remain in service for multiple more decades. In avionics, as components, parts, products, and systems are phased out and unavailable due to obsolescence, the costs for maintenance, concerns for safety parts, and risk for operational inefficiencies increases (FAA, 2015). The extended life cycle and service life of these products and systems results in obsolescence issues and require proactive strategies for minimize risk of shortages, ensure stability of supply, readiness, and supportability (Howard, 2022).

In addition, regulatory changes and geopolitical factors can increase the instance of or worsen obsolescence issues as materials or suppliers become non-compliant for use (Bartels et al., 2012). Regulatory and compliance requirements determined both product and contractual specifications that suppliers must meet, influencing component availability and sustainment ability (Blanchard, 2004). Environmental and safety regulations, such as Restriction of Hazardous Substances (RoHS) and Registration, Evaluation, Authorization, and Restriction of Chemicals (REACH), can lead to obsolescence when older materials or components are banned, requiring expensive redesigns (Teixeira et al., 2017). Additionally, defense procurement policies often have specific requirements for parts sourcing and life cycle management, which can further worsen obsolescence risks by limiting the flexibility in selecting alternative suppliers or parts (DoD, 2021).

Another complication in A&D obsolescence risk is the use of the same parts and components across multiple platforms and systems. Component reuse across multiple products is a widely adopted strategy to leverage economies of scale within a product family. While this may reduce initial costs and streamline procurement efforts, it can also lead to significant obsolescence challenges. When obsolescence strikes, the anticipated savings can be

significantly diminished, as supply chain disruptions impact multiple products simultaneously. The competition for limited resources to resolve these issues can further escalate costs and delays. When a component becomes obsolete or discontinued, it affects all systems relying on that part, worsening supply chain disruptions and increasing sustainment costs for multiple platforms (Bartels et al., 2012). Additionally, the widespread use of common components can result in a single point of failure, making it more difficult to find replacement components or parts and maintain system and product integrity over time (Solomon et al., 2000). To mitigate these risks, organizations must maintain visibility across multiple programs and act decisively to address obsolescence challenges before they compound (FAA, 2015).

In the instance of a business or customer having responsibility to build, deliver, or procure multiple products with the same obsolete component issue compounds the problem. When an unplanned obsolescence issue arises, it can result in a negative impact to a program production line as functional stakeholders such as engineering and supply chain personnel work to resolve the issue. In the meantime, a potentially shutdown production line results in unplanned costs incurred for re-planning and resolving the issue, the program failing to meet its contractual obligations, and the customer not receiving a critical delivery on time.

In addition, technological advancements, particularly in electronics, drive rapid innovation cycles that significantly impact component obsolescence. Moore's Law, which predicts the doubling of transistor density approximately every two years, plays a crucial role in determining the life cycle of electronic components (Schaller, 1997). This rapid evolution leads to shorter product life cycles, forcing industries to manage obsolescence proactively through predictive forecasting, last-time buys, and modular design approaches (Solomon et al., 2000). In A&D, where systems must remain operational for decades, the mismatch between commercial electronic advancements and defense acquisition cycles exacerbates obsolescence challenges. Addressing this issue requires an integrated approach that combines life cycle costing with technology refresh strategies to ensure long-term sustainment without excessive redesign costs (Bartels et al., 2012).

Obsolescence Management Standards, Frameworks, and Gaps Identified

Obsolescence management standards and frameworks provide structured approaches to mitigating risks associated with aging components in A&D systems. When parts or materials become obsolete or unavailable, mission-critical systems can suffer. So these standards and frameworks are important to support readiness and reduce risk of schedule delays, and cost increases by promoting best practices to address potential obsolescence issues before they occur. Many of these standards have been established to inform and guide organizations in both domestic and international, as well as government and commercial, applications in A&D. Below are key standards related to obsolescence management with gaps identified.

Though the obsolescence management frameworks do provide structured approaches, there are gaps that remain in procurement flexibility, supply chain risk mitigation, and cost impact assessment. Addressing these issues requires enhanced integration of predictive analytics, agile and flexible contracting, and comprehensive cost models that support long-term sustainment strategies in A&D.

Despite the scope and coverage of these frameworks, there are critical gaps in addressing procurement challenges, supply chain vulnerabilities, and cost impacts in A&D obsolescence (Chellin & Gallegos, 2024). The gaps discussed underscore the need for continued improvement in standards and frameworks to support management of obsolescence in the A&D industry.

Other Approaches to Managing Obsolescence

Proactive versus Reactive Response

One recurring theme found in literature is the proactive instead of reactive approach and methodologies of obsolete component management as identified by Chellin and Miller (2023) and English (2022). Sub themes of this aspect include part prioritization, mitigating risk, planning for costs, complexity of obsolescence, and planning for technology inserts and upgrades. In addition to the DoD standards and guidelines mandate for proactive management, scholars also advise proactive management of obsolescence.

Proactive mitigation strategies for obsolescence fall primarily into three main categories: supply chain, designing for obsolescence, and planning strategies (English, 2022). Supply chain strategies involve actions to mitigate risk in supply and secure inventory for a product or system life cycle which is accomplished within the supply base and through supplier partnerships. Designing for obsolescence puts emphasis on engineering and technical efforts to create adaptable and reproducible designs that prioritize short term needs with allowance for part alternates, changes, and upgrades in the future to mitigate short- and longer-term obsolescence risks (Chellin & Miller, 2023). Planning strategies include proactive methods such as monitoring and forecasting for obsolescence, technology roadmaps, product and system refresh plans, and developing obsolescence management plans (Bartels et al., 2012).

Alternatively, there are implications for a reactive approach to obsolescence. English (2022) concurred that components found to be obsolete without proactive planning can result in additional complexities for resolution. In addition to the increased costs and time constraints from lack of planning, reactive strategies can result in part unavailability from the original manufacturer which can increase the risk of receiving counterfeit parts from brokers (English, 2022).

Cross Industry Participation

Another focus for literature on obsolescence is cross industry participation. The sub theme of this area includes partnership and coordination among DoD divisions, DAU, A&D corporations, original equipment manufacturers (OEMs) and distributors, and other stakeholders across A&D and commercial industries.

Specialized Partnerships Across Industry

Industry-wide participation has been recently implemented in the DoD's collaboration with the commercial industry for microelectronics. The DoD (2022) reports that the Creating Helpful Incentives to Produce Semiconductors (CHIPS) for American Defense Fund was created to fund the work of the Microelectronics Commons. The Commons purpose is to create partnerships in the industry to strengthen the pipeline of workforce talent, expand capabilities, and further technological advancements in the microelectronics industry in the United States (DoD, 2022). Efforts such as this will bridge the gap of obsolescence and availability within the US market for microelectronics.

Collaboration with Sub-tier Suppliers

English (2022) states that while consolidation occurs at the sub-tier supplier level, which reduces parties involved, interaction and proactive collaboration must be in place to ensure that visibility into obsolescence risks are flowed through the supply chain. For example, the U.S. Army Precision Guided Missiles program has seen consolidation of their supply base of rocket motors down to Aerojet Rocketdyne and Northrop Grumman. Without this open dialogue, DoD and A&D industry customers and suppliers are unable to engage in a proactive response that mitigates risk and impact (English, 2022).

Planning for Costs

Chellin and Miller (2023) conducted interviews among government civilian and defense industry partner employees to obtain insight from industry practitioners experience with DMSMS challenges. They found that among the benefits of a proactive approach to DMSMS and obsolescence are long-term affordability, availability of parts, reduction in schedule lead times, and better maintainability in comparison to reactive responses to the issue. The authors also noted that it is critical to fund these activities before there is an issue to ensure teams can work proactively to mitigate and avoid problems (Chellin & Miller, 2023).

Common Misconceptions about Obsolescence

The third theme identified in literature is that there are common misconceptions or myths surrounding how and when obsolescence planning, mitigation, and realization strategies are needed. This includes the belief that obsolescence is a problem, and older products do not require any obsolescence consideration.

Obsolescence is a Problem to Fix if it Occurs

The first subtheme in common myths is that obsolescence is a problem to fix if it occurs. Obsolescence is an inevitability. As technology cycles continue to accelerate, their component cycles have a shorter and shorter life cycle. With the addition of the recent supply chain constraints, a raw material and semiconductor component shortage has resulted for the A&D industry. Along with the high demand for engineering resources programs are experiencing multiple obsolescence issues and cycles at a time (Del Campo et al., 2022). Proactive instead of reactive strategies to obsolescence management must be planned to ensure continuity for a program's ability to maintain delivery obligations to its customers. In addition, systems utilizing electronic parts may be more likely to see DMSMS and obsolescence issues resulting in significant costs and time to resolve.

According to English (2022), obsolescence of electronic components, with microcircuits, is almost always inevitable. In the mid 1990s as the DoD moved to commercial-off-the-shelf (COTS) over military specified components, the shelf life of those components decreased dramatically. This is due to the commercial microcircuit product life cycle rate of 18 to 24 months. With the life cycle of A&D system products having a much longer period, the incidence of an obsolescent component issue is much greater (English, 2022).

Older Products Have No Demand

The second subtheme is that older products have no demand, which is inaccurate. Defense programs, products, subassemblies, parts, components, and material are all used well past what is considered a typical life cycle of a product. In the instance war time, critical missions, or even budget cuts, older equipment is used and must be working properly to support defense and the soldier or sailor. Koczanski states that by not utilizing the DMSMS management and planning practices a program will experience negative impacts to their cost, schedule, and system readiness. Programs must be proactive in their management of DMSMS and obsolescence issues to be prepared when one occurs (Koczanski, 2014). As Porter and Plotkin note, the B-52, Phalanx, and THAAD Missile are examples of defense programs and products that are mission critical for the lives of the servicemember and civilians and are well beyond a standard product life cycle (Porter & Plotkin, 2013).

Summary

To summarize, the prior research has focused across four major research themes in A&D obsolescence including proactive management, financial impact, supply chain, and

strategic forecasting. Prior research has also included understanding the factors that lead to obsolescence and mitigation, where the focus of cost drivers has not been prioritized. This research will differ from the previous studies in that the objective will be to bridge the gaps in understanding the specific factors of costs that result in high dollar obsolescence issues.

Research Question

After identification of a gap in the literature on obsolescence in the A&D industry, the following research question is posed for this study: What factors drive an increase in the cost of A&D obsolescence mitigation, management, and risk realization?

Research Method: Qualitative Study Focus Group

The literature review provided an overview of the current knowledge and prior research on the topic of obsolescence. However, there were still gaps and ambiguities on the issues of obsolescence from the perspective of subject matter experts in this field. For example, timely data and scholarly research on obsolescence costs across all product areas of the aerospace and industry was not covered. The researcher determined that a guided question and discussion about experiences with obsolescence costs with a group of experienced practitioners could reveal nuances, ambiguities, and enhance the validity and relevance of this research.

Sample

The researcher recruited eight individuals through purposeful selection from the researcher's own network. An additional two individuals were identified through other participants and invited to participate in the focus group study. Individuals identified were noted to have varying levels of direct experience in obsolescence management in the A&D industry.

Data Collection and Analysis

The focus group was conducted with seven participants of the original ten invited. Each participant had varied experiences in managing obsolescence issues. Participants had experience in three different companies in the A&D industry. Participants' experience included one with less than 10 years of experience, three with more than 10 years of experience, two with more than 20 years of experience, and one participant with more than 40 years of experience. Appendix A provides the details of the focus group participants roles, years of experience and type of experience in obsolescence.

Participants were asked six questions which are noted in Appendix B to support the research question, "What factors drive an increase in the cost of A&D obsolescence mitigation, management, and risk realization?" The focus group lasted approximately one hour and generated a video recording, audio recording, and transcript of the session.

Through the small focus group with predetermined questions, participants had the opportunity to share their experiences, perspectives, and valuable insights into their roles in risk mitigation, management, and resolution of obsolescence material issues. Creswell and Poth note that focus groups can be beneficial when the interviewees have similar backgrounds, experiences, and can interact with each other (Creswell & Poth, 2018). In addition, a focus group can encourage feedback from individuals who may be reluctant to be interviewed in a one-on-one session (Creswell & Poth, 2018). With this approach of open question and answers the researcher had the opportunity to have a firsthand understanding of the defined processes, undefined gaps, tools, and strategy utilized by these stakeholders in obsolescence management. This focus group found success in the ability of participants to build off of one another's commentary and anecdotal examples, to enable better understanding of the lived experience of managing obsolescence issues.

Discussion of the Focus Group

Prior to beginning the analysis, I read and reread the text of the focus group to ensure I understood the participants' responses, patterns, and could get an initial impression of the recurring themes. The coding was conducted through Atlas.ti, an analysis tool. The initial output resulted in 36 quotations from the focus group that were coded to 156 words and phrases around the questions of obsolescence. Of the 156 codes, 16 were identified as the top applied codes, including risk realization, lifetime buys, and obsolescence as the top applied codes with three quotations each.

Results

Upon review of the output, many of the codes were identified to be duplicated themes and were aggregated. The coded questions were revisited to identify potential overlap with other codes and identify trends within the data. The end result was 17 coded concepts with the top four codes as cost impact, securing supply, risk, and collaboration. Figure 1 identifies the 16 themes and aggregated response count for the full focus group session.

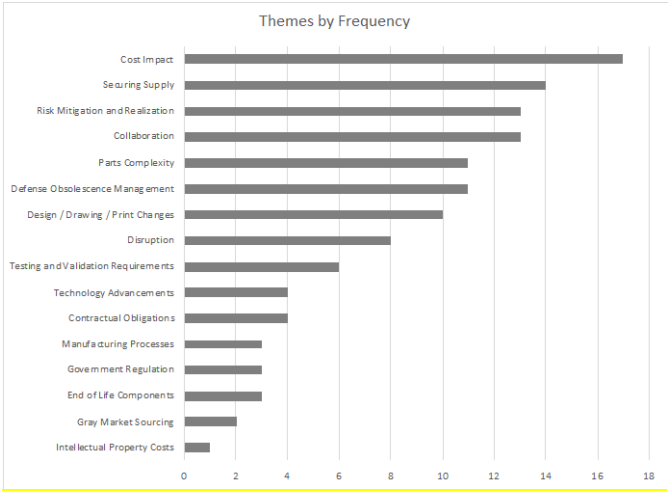

Figure 1. Recurring Themes

The theme of cost impact was identified in the responses of all focus group participants. It was noted that there are different approaches to resolve obsolescence that can be costly and time consuming, including design changes and lifetime buys. One noted comment from one of the participants indicated how obsolescence that requires redesign and involves Intellectual Property (IP) can be pricey. He said:

> We had a situation about a year ago where we actually had a product that had been obsolete for a number of years and the tech IP was acquired by a third party. . . . So, pricing for that material or the alternative to recreate was in the range of about $2,000,000 between the design costs and the material itself to support what was remaining the life of that product. And then we also had the option of the third party that had acquired the IP and was able to go back and produce the original part. In that case. That particular buy I think was roughly $1.5 million. (Respondent x)

In addition to the costs for purchase or design of alternatives, costs can occur from production and factory line down instances while awaiting obsolescence resolution. Figure 2 identifies the top five co-occurrences of concepts with cost impact.

#	Code 1	Code 2	Occurrence
1	Cost Impact	Securing Supply	14
2	Cost Impact	Collaboration	13
3	Cost Impact	Risk Mitigation & Realization	13
4	Cost Impact	Defense Obsolescence Management	11
5	Cost Impact	Part Complexity	11

Figure 2. Cost Impact Co-Occurrences

Next, the importance of securing supply and mitigating risk was noted in multiple responses and coding. One of the focus group study participants described his experience with the complexities of being able to ensure the source of supply and mitigate the risk of obsolescence. He said:

> A lot of times we do find that parts go obsolete not because the supplier can't make it, but because they can't get components or raw materials. I can think of certain instances like in Europe where they're now introducing REACH. A lot of the chemicals used in the manufacturing of a lot of products are no longer going to be available. If suppliers, especially engineered goods suppliers, the ones who own the IP don't get out in front of that, then you know we can have some potential issues in the future. (Respondent x)

Proactive and strategic methods are identified as the best practices to ensure that the impacts of obsolescence can be mitigated. Focus group participants also discussed initiative-taking planning, forecasting, and long-term mitigation actions to reduce the impacts of obsolescence issues and ensure supply continuity. Figure 3 identifies the top five co-occurrences of concepts with risk mitigation and realization.

#	Code 1	Code 2	Occurrence
1	Risk Mitigation & Realization	Cost Impact	17
2	Risk Mitigation & Realization	Securing Supply	14
3	Risk Mitigation & Realization	Collaboration	13
4	Risk Mitigation & Realization	Defense Obsolescence Management	11
5	Risk Mitigation & Realization	Part Complexity	11

Figure 3. Risk Mitigation and Realization Co-Occurrences

Another key theme of this focus group discussion is collaboration. The coding sheet identifies 13 instances of collaboration that includes the importance of coordination between

departments and functions internal and external to their organization. Through this approach, expertise and resources can be shared and leveraged to develop a comprehensive approach for obsolescence management. Figure 4 identifies the top five co-occurrences of concepts with collaboration.

#	Code 1	Code 2	Occurrence
1	Collaboration	Cost Impact	8
2	Collaboration	Risk Mitigation & Realization	6
3	Collaboration	Disruption	4
4	Collaboration	Contractual Obligations	3
5	Collaboration	Part Complexity	3

Figure 4. Collaboration Co-Occurrences

In addition, as identified in Figure 4, collaboration must occur in issues of obsolescence to reduce cost impact, risk, and disruption. Also, issues involving contractual obligations and part complexity can result in the need for more collaborative working engagements to align across functions and resolve the obsolescence problem.

The focus group session provided additional insight to supplement the research in the area of obsolescence and factors of cost. Through this approach of open question and answers the researcher had the opportunity to have a firsthand understanding of the defined processes, undefined gaps, tools, and strategy utilized by these stakeholders in obsolescence management and cost impact.

The results of the focus group and analysis have helped to identify further areas of research and exploration for this dissertation. This session provided a valuable bridge between the background archival information of the literature review and the planned study through interview. The focus group participants noted the significant cost impact associated with obsolescence, which include expenses related to design changes, lifetime buys, and product redesigns. Additionally, cost challenges related to material sourcing and contractual requirements were also identified. Proactive planning and long-term strategy were identified as best practices to minimize impact. In addition, the focus group provided a unique opportunity to tap into the knowledge and insight of experienced individuals that has helped guide the researcher to the more focused interview study that will support the study to determine the cost drivers of obsolescence in A&D.

While prior research has explored themes such as proactive management, financial impact, supply chain risk, and strategic forecasting, it has largely overlooked the specific cost drivers contributing to obsolescence impact. The focus group participants who were professionals from various functional roles across A&D consistently emphasized a lack of clarity around the root causes and traceability of costs in obsolescence. Their input affirmed the need to examine not just the occurrence of obsolescence, but the underlying cost factors that result in impact. However, the focus group findings also revealed that while these problems are widely experienced, systematic knowledge and organizational alignment on the issue remain limited, underscoring the need for a more in-depth investigation.

Summary of the Results

The focus group conducted provided valuable insights into the challenges of obsolescence management in A&D. The key themes identified from the participants' discussions centered on cost impact, securing supply, risk mitigation, and collaboration. Participants emphasized the significant costs associated with obsolescence, particularly when redesigning or purchasing obsolete components, and the complexity of securing supply due to limited sources and regulatory changes. The group also highlighted the importance of risk mitigation strategies and the need for stronger collaboration across internal and external stakeholders to effectively manage obsolescence challenges. The focus group served as an important foundation but the topic of obsolescence cost impact should be explored further.

Themes

The focus group data revealed several prominent themes that shape the understanding of obsolescence management in the A&D industry. The dominant theme was cost impact, where participants discussed how obsolescence led to high costs, including redesign efforts, last-time buys, and the procurement of alternative parts. The theme of securing supply was also critical, as participants noted the challenges posed by the shrinking supplier base and regulatory changes, such as the introduction of REACH in Europe. Risk mitigation and impact emerged as a key theme, with participants advocating for proactive strategies to identify and address obsolescence risks before they disrupt operations. Finally, participants identified collaboration as being essential for managing obsolescence, with the need for more coordination between cross functional teams and parties, such as procurement, engineering, and external suppliers, to ensure effective solutions.

Original Contribution to Knowledge

This study's original contribution lies in its qualitative exploration of the cost drivers associated with obsolescence in A&D, a subject that remains under-researched. The focus group highlighted the significant gaps in existing literature, particularly regarding the direct and indirect costs of obsolescence. By identifying the key themes and challenges faced by procurement and supply chain practitioners, this research contributes a nuanced understanding of the costs involved in managing obsolescence, beyond what is typically addressed in traditional frameworks.

The findings from the focus group have several practical implications for professionals working in procurement and supply chain management within the A&D industry. First, they underscore the need for proactive planning in managing obsolescence risks. Organizations are encouraged to integrate obsolescence management early into their procurement strategies, focusing on long-term sustainment through tools like predictive analytics and technology roadmaps. The importance of cross-functional collaboration also emerged, highlighting the need for coordinated efforts across departments to address obsolescence before it escalates into a major issue. Finally, the study calls for greater visibility and communication with suppliers to mitigate risks associated with component discontinuation and supply chain disruptions.

Limitation of Study

While this study provides valuable insights into obsolescence management, it is not without limitations. The focus group was relatively small, with only seven participants, which may limit the generalizability of the findings. Additionally, the study focused exclusively on procurement and supply chain practitioners in the A&D industry, excluding other functional areas such as engineering, quality, and finance, which may also contribute to obsolescence management. Furthermore, the data collected is qualitative in nature, meaning it is more

subjective and may be influenced by individual biases or recall inaccuracies. These limitations highlight the need for further research with a larger, more diverse sample and additional methods of data collection to strengthen the findings.

Future Research Potential

Future research could expand on this study by incorporating quantitative data to supplement the qualitative insights and provide a more comprehensive understanding of the cost impacts of obsolescence. Further studies could also explore the perspectives of other functional areas, such as engineering and finance, to provide a more holistic view of the challenges faced by organizations in managing obsolescence. Additionally, the integration of digital tools such as AI-driven predictive analytics, which were not fully explored in this study, could be examined as a potential avenue for enhancing obsolescence management strategies. The insights from this study could be tested across different industries and geographical contexts to assess the broader applicability of the findings.

Conclusion

In conclusion, the focus group has provided valuable insights into the factors that drive the cost of obsolescence mitigation, management, and risk realization in A&D. The findings emphasize the need for proactive strategies, cross-functional collaboration, and increased supply chain visibility when managing obsolescence.

This study bridges the gap between existing obsolescence frameworks and the real-world experiences of procurement and supply chain practitioners, offering new insights into the cost drivers involved. These findings will inform next phase of the research, which will employ a grounded theory approach to explore these issues further through interviews with a larger sample of A&D professionals. Ultimately, this research aims to provide practical recommendations for reducing the high costs associated with obsolescence in A&D and contribute to the development of more effective management strategies.

APPENDIX A

Participant Details

#	Name	Company	Role	Previous Involvement with Obsolescence
1	B.L.	1	Sr. Mgr Outsource Procurement Group	17 years at company 1; last 4 managing obsolescence group
2	G.B.	1	Supplier Development Manager	12 years in industry; 2 years working with shortages (some obs related)
3	J.M	1,3	Sr. Tech Fellow in Global Strategic Sourcing	41 years at company 1 and 3; many years of obsolescence experience
4	M.P	1	PBL Contracts Support for Obsolescence	25 years with company 1 in ops roles; currently supporting obsolescence
5	S.S	2	Sr. Mgr Supplier Performance	24 years company 2; primarily on defense end w/issues of obsolescence
6	S.A	1	Mgr Obsolescence Group	10 years supporting obsolescence group in company 1
7	K.R	1	Procurement	6-7 years of obsolescence procurement in company 1

APPENDIX B

Focus Group Protocol

1. What is your experience managing or having responsibility to identify and resolve obsolescence part issues in the aerospace and defense industry? Provide details such as how many years you have worked in this area, instances of your involvement, how you were involved, etc.
2. Describe an occurrence of parts obsolescence that you managed. Provide details of how the issue was identified, what impact it had on production and the program it supported, the year it occurred and how long it took to resolve the obsolescence issue. Provide any details of financial impact including loss of sales, cost of goods, contract penalties, lost time, etc. Was the material obsolescence planned or unplanned? Known beforehand?
3. What stage of the product life cycle did the obsolescent part fall under? What commodity does this part fall under? Were any of the components, material, parts, product, or technology on this item proprietary to the USG, foreign government, or contractor Was this a commercially available item? What was determined to be the root cause of this issue?
4. What were the total costs for resolution of the obsolescence issue?
    a. Procurement of new materials
    b. Engineering and Drawing Revisions
    c. Testing and Validation
    d. Qualification
    e. Tooling, Equipment, and Software
    f. Other associated costs?
5. Describe any other factors, thoughts, comments related to your experience with this issue of obsolescence.
6. Do you, your team, or others in product, part, and supply chain coordinate within their business, with their customer, with others in industry on obsolescence planning and mitigation strategies? (DMSMS, etc.)?

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Acquisition Research Program
Department of Defense Management
Naval Postgraduate School
555 Dyer Road, Ingersoll Hall
Monterey, CA 93943

www.acquisitionresearch.net