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Integration of Digital Tools in the Department of the Air Force Service Acquisition Process

March 2024

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Department of Defense Management

Naval Postgraduate School

Prepared for the Naval Postgraduate School, Monterey, CA 93943.

ACQUISITION RESEARCH PROGRAM
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NAVAL POSTGRADUATE SCHOOL

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ABSTRACT

The Department of the Air Force (DAF) is confronted with the urgent need to adapt its service acquisition processes to the rapidly evolving landscape of information and technology. This necessitates the strategic integration of cutting-edge digital tools, presenting both challenges and opportunities. This study aims to identify the digital tools suitable for integration into the DAF service acquisition process through a systematic literature review and interviews. The findings culminate in a matrix illustrating the merging of digital tools within the DAF service acquisition process. The matrix is developed to map these tools to specific stages of the acquisition process, facilitating strategic alignment. Additionally, the study identifies and discusses the benefits and challenges associated with the adoption of digital tools. By synthesizing insights from literature and interviews, this research contributes to a comprehensive understanding of the opportunities and challenges in integrating digital tools into the DAF acquisition process. It concludes with recommendations for DAF leadership to apply to current and future digital tool and service acquisition decisions.

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TABLE OF CONTENTS

LIST OF FIGURES

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LIST OF TABLES

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LIST OF ACRONYMS AND ABBREVIATIONS

CO	Contracting Officer
COR	Contracting Officer Representative
DAF	Department of the Air Force
DFARS	Defense Federal Acquisition Regulation Supplement
FAR	Federal Acquisition Regulation
MFT	Multifunctional Team
MICT	Management Internal Control Toolset
MRR	Market Research Report
MVP	Minimum Viable Product
QA	Quality Assurance
QASP	Quality Assurance Surveillance Plan

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I. INTRODUCTION

The landscape of the Department of the Air Force (DAF) service acquisition is undergoing a transformative evolution propelled by advancements in digital tools. Numerous terms—such as *digital technology*, *digital tools*, and *digital solutions*—have all been used to describe digital advancements. All these terms have been used interchangeably, which has blurred the distinction between them. The definition of *digital tools* used for this research is "technology-based software, applications, or online platforms that are designed to enhance productivity and efficiency" (Noor, 2023, p.1). A few examples of digital tools that are considered in this research are cloud computing, artificial intelligence (AI), blockchain, internet of things (IoT), and the metaverse.

Information and technological capabilities are advancing at an unprecedented pace, and the DAF faces the imperative to adapt and integrate cutting-edge digital tools into its service acquisition processes. The convergence of traditional defense needs with the possibilities offered by digital tools presents both challenges and opportunities that demand meticulous exploration and strategic integration. The purpose of this research is to identify which digital tools can be integrated into the DAF service acquisition process by conducting a systematic literature review, interviews, and the development of a model illustrating the merging of digital tools within the DAF service acquisition process. This chapter includes the problem statement, a discussion of Hacking for Defense (H4D), research questions, and an outline of the organization of the paper.

A. PROBLEM STATEMENT

DAF senior leaders want more innovation. During his tenure, Chief of Staff of the Air Force (CSAF) Charles Q. Brown Jr. (2020) identified areas of concern in his address to the DAF (Brown, 2020). He stressed the significance of being innovative, reducing bureaucracy, and making continuous improvements, or else the DAF risks falling behind "aggressive and capable global competitors" (Brown, 2020, p. 4). The DAF is not doing enough to stay relevant, which will result in failure unless it can "challenge the status quo" (Brown, 2020, p. 5).

From identifying mission needs to managing contract performance, digital tools can improve bureaucracy and innovate processes in many areas including DAF service acquisition. According to the Defense Acquisition University (DAU; n.d) in "fiscal year (FY) 2018, 49.0% of the Department of Defense (DOD)'s contract spend, or $123.9 million, was spent on acquiring services" (p. 2). The substantial fiscal allocation of $123.9 million in fiscal year 2018 underscores the pivotal role of service acquisition in supporting the DOD's objectives. Assistant Secretary of the Air Force for Acquisition, Technology, and Logistics (AT&L) Dr. Will Roper (2021) emphasized the need for the DAF acquisition community to be innovative and develop digital engineering solutions. DAF acquisitions are merely in the "larval stage of our analog-to-digital metamorphosis" (Roper, 2021, p. 13), and the DAF needs to push forward.

B. HACKING FOR DEFENSE

The Air Force Program Executive Office for Combat and Mission Support (AFPEO/CM) is responsible for "over 140 combat support acquisition programs" (Air Force Acquisition, n.d., p. 1) across the DAF. The AFPEO/CM sponsored an H4D project through the National Security Innovation Network (NSIN) to explore existing and future applications of digital transformation tools for the Air Force service acquisition process.

A student research team in the Enterprise Sourcing class at the Naval Postgraduate School (NPS) conducted the initial research for this project; the team chose the Lean Launchpad model to work on the AFPEO/CM's H4D research design challenge. The Lean Launchpad method is a unique approach to addressing DOD problems (Blank, 2009). The fundamental principles involve rapid iterations and gathering input from end users to ensure that the proposed solutions align effectively with the requirements of the end users (Blank, 2009).The lean startup principles from Eric Ries's (2011) book *The Lean Startup* provided the framework to understand, research, and develop a solution through a Build–Measure–Learn cycle (see Figure 1) and test prototypes of our suggested solutions, commonly referred to as minimum viable products (MVPs).

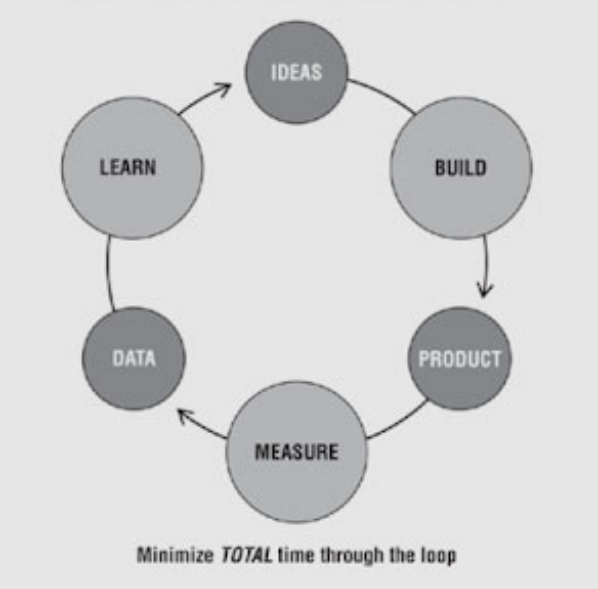

Figure 1. Build–Measure–Learn Feedback Loop. Source: Ries (2011).

The goal of H4D is to develop a solution for a DOD problem. The classroom project concluded with an MVP to address the problem of identifying current and future digital transformation tools that can be used in DAF service acquisition. The MVP was a model that combined the DAF service acquisition process with the Management Internal Control Toolset (MICT) self-inspection checklist contracting officer representatives (CORs) use for quality assurance. Although the MVP delivered in class was useful to the AFPEO/CM sponsor, it did not fully address the initial problem statement. Therein is the gap that this research addresses. Specifically, this capstone research expands on the work in H4D by addressing the AFPEO/CM's problem of identifying digital tool solutions that can aid the DAF service acquisition process.

C. RESEARCH QUESTIONS

This research seeks to answer the following primary research question: "What digital tools are available to be integrated into the DAF's service acquisition process?" The secondary research questions that are addressed are "What are the benefits to integrating digital tools into the DAF service acquisition process?" and "What are the challenges to integrating digital tools into the DAF service acquisition process?"

D. ORGANIZATION OF PROJECT

This research is organized into five sections to understand what digital tools can be integrated into the DAF's service acquisition process. The research includes an introduction, background, methodology, results, recommendations, and future research.

Chapter I is an introduction to the topic of what digital tools are available and how they can be interwoven into the DAF's service acquisition process. It includes the problem statement, a discussion of H4D, research questions, and an outline of the organization of the report.

Chapter II provides a background about the current state of the DAF service acquisition process. The chapter also discusses the limited efforts the DAF has made toward understanding the usefulness of digital tools across the department. This includes initiatives such as the creation of the Digital Transformation Office (DTO).

The research methodology is discussed in Chapter III. The methodology comprises a systematic literature review and semi-structured interviews. This research does not qualify as human subject research. The purpose of the systematic literature review is to provide a foundation for understanding prior research and current trends. The semi-structured interviews are conducted with stakeholders such as digital tool developers and digital tool end users. Digital tool developers are stakeholders at the leadership level, and digital end users are those who will directly interact with the tool. The intent of the interviews is to gain qualitative insights into the strategic considerations, challenges, and opportunities related to digital tool adoption.

Chapter IV presents the findings. It explains the results from the systematic literature review and semi-structured interviews. It provides a structured analysis of existing scholarly works, offering a foundation for understanding the theoretical and empirical dimensions of digital tools in this domain. Complementing the literature review, the interview component seeks to capture nuanced insights, experiences, and perspectives from key stakeholders within the DAF, shedding light on practical implications and contextual considerations.

Recommendations and opportunities for future research are provided in Chapter V, which discusses how digital tools can be an asset in the service acquisition process. It is vitally important to adopt digital tools in the service acquisition process because these tools ensure the warfighter has the proper resources at the proper locations and at the time the resources are needed to defend the nation. The DAF must improve its competitive advantage in the acquisition process, or it will not be able to procure the necessary services to meet mission requirements.

E. SUMMARY

This chapter discusses how the research intends to explore digital tools and how it can be integrated into the DAF's service acquisition process. It describes the problem faced by the DAF: identifying which digital tools are available to integrate into the DAF's service acquisition process. Additionally, it includes an organization of the report. Next, the background of the DAF's service acquisition process and the creation of the DTO are discussed.

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II. BACKGROUND

This chapter provides background information on DAF service acquisition and the intricacies of the service acquisition process. Additionally, this chapter explains the initiative that the DAF has undertaken to integrate digital tools into its service acquisition.

A. DEPARTMENT OF THE AIR FORCE SERVICE ACQUISITION

DAF service acquisition is integral to maintaining the readiness and effectiveness of the DAF. The acquisition of services goes beyond transactions; it is a strategic imperative that involves partnering with industry, fostering innovation, and ensuring the DAF's ability to adapt to evolving threats (OUSD[A&S], 2012).

A *service acquisition* is defined as a contractor performing "an identified task" (Office of the Under Secretary of Defense for Acquisition and Sustainment [OUSD(A&S)], 2012, p. 6), compared to delivering a tangible end item. It requires coordination with a contractor to perform the service and government personnel to provide oversight, evaluation, and technical expertise of the performance. Services acquired by the DAF range from the maintenance and sustainment of aircraft and equipment to advanced cyber capabilities and mission-critical support functions. Grounds maintenance on an Air Force base is one such support function. In the winter, contractors plow roads and salt sidewalks because the air base identified that snow needed to be removed. A contracting officer (CO) followed the service acquisition process, and the result was a contract for the service of snow removal on an Air Force base.

DAF service acquisition is governed by a regulatory environment to ensure accountability and transparency about how taxpayer dollars are spent. Service acquisition is governed by Federal Acquisition Regulation (FAR) 37.101, which states that a service contract "directly engages the time and effort of a contractor whose primary purpose is to perform an identifiable task" (FAR 37.101, 2023). Service acquisition is different than goods procurement, such as buying winter jackets for Airmen because goods procurement "furnish [es] an end item of supply" and requires a different acquisitions strategy (FAR 37.101, 2023).

Defense Federal Acquisition Regulation Supplement (DFARS) Procedures, Guidance and Information (PGI) 237.102-75 (2023) directs acquisition professionals to use the *Defense Acquisition Guidebook*, Chapter 10, "Acquisition of Services." The *Defense Acquisition Guidebook* was replaced by the *Guidebook for the Acquisition of Services* (GAS). The purpose of the GAS is to assist acquisition professionals by providing supplemental guidance to policy documents (OUSD[A&S], 2012). GAS is a helpful reference document that assists in understanding and fulfilling the responsibilities of acquisition professionals. The Department of the Air Force Federal Acquisition Regulation Supplement follows the guidance and procedures included in DFARS and DOD instructions. There are seven steps in the DOD service acquisition process, and they are outlined in DODI 5000.74, titled *Defense Acquisition of Services* (OUSD[A&S], 2021). The steps include forming the team, reviewing current strategy, performing market research, defining requirements, developing acquisition strategy, executing strategy, and managing performance (see Figure 2). The seven-step service acquisition process is broken down into three phases: plan, develop, and execute (OUSD[A&S], 2021). All branches of service follow this acquisition process, making service acquisition a unifying procedure across the DOD.

Figure 2. Seven Steps to the Service Acquisition Process. Source: OUSD(A&S) (2021).

B. THE SEVEN STEPS OF THE SERVICE ACQUISITION PROCESS

This section provides a comprehensive overview of each step, describing the specific objectives, key personnel involved, and essential documents.

1. Step 1: Form the Team

The DAU Service Acquisition Mall provides details about the function of each step of the service acquisition process. "Form the team" is Step 1, and it involves creating a multi-functional team (MFT) that understands the requirement and how it impacts the mission and can create a strategy (Adaptive Acquisition Framework, n.d.). According to guidance from the OUSD(A&S; 2012), the following are members of the MFT:

- CO
- finance/budget officer
- procurement analyst
- legal advisor
- customer/requirements owner
- contracting officer representative (COR)
- cost and price analyst
- small business (SB) specialist
- quality assurance (QA) specialist
- any other stakeholders who have a vested interest in the requirement (p. 2)

The decision about which personnel to include in the MFT varies based on the complexity of the service. If it is a simpler service, such as custodial, then it may only need a CO, requirements owner, quality assurance specialist, and legal advisor. Aircraft maintenance of the E-3 Sentry Airborne Warning and Control System (AWACS) is more complex and would need a more robust MFT. It may include a CO, requirements owner, QA specialist, SB specialist, and cost and price analyst. The four documents developed are the team charter, stakeholder analysis, communication plan, and project plan (OUSD[A&S], 2012).

2. Step 2: Current Strategy

The MFT evaluates the strategy of the service acquisition. It interviews stakeholders and identifies performance outcomes, validates them with stakeholders, and addresses any gaps, ensuring alignment with their needs (OUSD[A&S], 2012). Additionally, the MFT refines desired results, validates them with stakeholders, and ensures compliance with current regulatory requirements and contract terms for the new service acquisition (OUSD[A&S], 2012). Two important personnel are the requirements

owner and the CO. The requirements owner needs to identify the performance outcomes and decide which are the highest priority and which they are willing to trade off. During this step, if there are gaps in knowledge, personnel with the missing knowledge should be added to the MFT. The responsibility matrix (RACI) and risk register documents are created during this step. RACI identifies tasks or procedural activities along with the individuals or positions accountable for their fulfillment. The risk register is a central database for detailing and monitoring risks and for documenting actions authorized by a risk management board or another governing authority (OUSD[A&S], 2012).

3. Step 3: Market Research

The requirements owner conducts market research, following FAR Part 10, to assess the availability of services in the marketplace and existing contract vehicles (OUSD[A&S], 2012). This step is crucial for informing the subsequent stages of defining requirements and developing an acquisition strategy.

Once the data analysis is finished, the conclusions and approach for acquiring the necessary services are detailed within in the market research report (OUSD[A&S], 2012). The market research report encompasses various details, such as the number of businesses offering the service, the availability of commercial services, and the agency's intended use of the service in terms of functions, performance requirements, or essential characteristics, as outlined in FAR Part 12. Articulating the agency's requirements in these specific terms enables potential offerors to propose methodologies that align most effectively with the government's needs.

4. Step 4: Requirements Definition

Requirements definition is a critical and challenging aspect of services acquisitions. A well-crafted requirement document eases the procurement and management of services (OUSD[A&S], 2012). A comprehensive requirements document guides the team in determining the service's significance, the need for industry days, the development of the Quality Assurance Surveillance Plan (QASP), the necessity for multiple CORs, and the optimal contract type (OUSD[A&S], 2012). The MFT creates several principal documents during this step, including a risk analysis, performance objectives list, inspection methods

list, performance work statement, statement of work or statement of objectives, preliminary QASP, and independent government cost estimate.

5. Step 5: Acquisition Strategy

The acquisition strategy outlines the plan to achieve service acquisition life-cycle goals, providing a comprehensive approach encompassing the schedule, structure, risks, funding, and business strategy (OUSD[A&S], 2012). Key outcomes include considerations for competition, small business involvement, contract type selection, performance incentives, contractor selection methods, planning documents, and the nomination of a COR. The strategy should evolve to align with current status and mission outcomes, while incentives should be carefully designed to align contractor behavior with mission results, emphasizing shared goals and risk control for effective performance (OUSD[A&S], 2012).

6. Step 6: Execute Strategy

After completing planning in steps 4 and 5, the functional services manager reviews pre-solicitation documentation before presenting it to the CO for execution. The functional services manager ensures clarity in the requirement, QASP, and incentives, indicating the desired outcomes and performance measurement (OUSD[A&S], 2012). If the documents adequately represent the service acquisition, they are transferred, along with funding, to the CO.

Prior to posting a solicitation, the CO, aided by the contract specialist, creates the solicitation document, such as a request for proposal (RFP) or request for quote (RFQ) ; OUSD[A&S], 2012). The CO ensures the inclusion of relevant clauses and provisions, the PWS or SOO, the QASP, and other attachments. The completed solicitation undergoes review and team validation to confirm Step 5 discussions are accurately reflected. The CO is also responsible for additional documentation, including justifications for sole source actions and designation of the COR (OUSD[A&S], 2012). Posting a draft solicitation on platforms like SAM.gov allows for industry to provide feedback. Once the final solicitation is released, the source selection evaluation team, involving the CO, source selection official, end users, cost/price analyst, and technical specialists, begins the evaluation process. The team's commitment, guided by DOD and agency source selection procedures,

is crucial (OUSD[A&S], 2012). The CO uses these procedures to shape the solicitation and develop the source selection plan.

7. Step 7: Performance Management

Step 7 represents the culmination of the preceding Steps 1 through 6 and serves as the point where performance results are delivered to fulfill the requirements essential for mission support. Rather than a conclusion, it signifies an ongoing engagement with contractors and stakeholders spanning multiple years (OUSD[A&S], 2012). The step involves two primary aspects: administering the contract's basic functions, such as validating invoices and managing changes, and fostering a positive relationship between customers, stakeholders, and the contractor (OUSD[A&S], 2012). The QASP documents the incentive arrangements and focuses on delivering performance results that support the mission over the period of performance. Administering basic contract functions includes validating invoices and managing changes, as well as cultivating a trust-based relationship between customers, stakeholders, and the contractor (OUSD[A&S], 2012). Performance assessment, documentation of incentives, and fair evaluations in the Contractor Performance Assessment Reporting System (CPARS) are crucial components in achieving intended mission results.

The effectiveness of the DAF service acquisition process hinges on the seamless progression of each step. Success is contingent on the proper execution of the planning phase. This initial stage encompasses team formation, strategy development, and thorough market research, and the results are paramount. A robust foundation established during the planning phase is imperative for subsequent steps to unfold successfully. The development phase, involving requirements definition and acquisition strategy, relies heavily on the meticulous execution of the planning phase. Any shortcomings in the development stage can adversely impact the execution phase, encompassing strategy implementation and performance management. Recognizing that each procured service is integral to mission success for both the requirements owner and the DAF underscores the critical importance of a well-executed and comprehensive acquisition process.

C. DIGITAL TOOLS IN DEPARTMENT OF THE AIR FORCE SERVICE ACQUISITION

Technology can be a powerful tool to enhance cost savings, increase productivity, and improve efficiency in the service acquisition process. *Forbes* highlighted the growth a business experiences when they adopt digital technology (Brown, 2021). The DOD is lagging significantly behind the private sector in the adoption of digital technology (Brown, 2021). Contained within digital technology are *digital tools*, which, for the purpose of this research, means "technology-based software, applications, or online platforms that are designed to enhance productivity and efficiency" (Noor, 2023, p. 1). Digital tools have become a common part of daily life. For example, there are computers, cellphones, and digital watches in the offices of acquisition professionals across the DAF. However, it is crucial to integrate the latest and most advanced digital tools into service acquisition such as cloud computing, blockchain, internet of things (IoT), and the metaverse.

The digital technology landscape is continuously evolving and growing, and there is a diverse range of digital tools in existence. Leadership needs to understand the functionalities, advantages, and limitations of digital tools because these tools can lead to cost savings, increased productivity, and improved efficiency (Forbes Technology Council, 2023). The DAF recognizes the need to adopt digital tools and created the DTO in 2021.

The concept of combining digital tools and acquisition is the foundation for the DTO (n.d.). The DTO instructs the acquisition community on the integration of digital solutions to achieve *digital transformation*. Digital transformation is defined as the application of digital technologies to innovate or alter existing business processes, culture, and customer experiences (DTO, n.d.). The DTO (n.d.) identified five strategic priorities for the DAF: architecture, tools, culture, training, and standards. They argued that in order for the DAF to maintain its preeminent position, it must expedite decision-making by embracing cutting-edge technologies, tools, and processes (DTO, n.d). Despite the DTO's focus on the importance of digital tools in the acquisition process, there has not been an emphasis on digital transformation or digital tools in the DAF service acquisition process. This represents a gap that this research intends to address. Next is a discussion about the

two methodologies used for this research: a systematic literature review and semi-structured interviews.

III. METHODOLOGY

As the landscape of service acquisition evolves, the integration of digital tools plays a pivotal role in enhancing efficiency, cost savings, and overall effectiveness. To better understand how digital tools best support the service acquisition process, this research employs two complementary methodological approaches. This chapter describes the two approaches and how they collectively derive insights that address the research questions. The first methodological approach is a systematic literature review. The insights derived from that review support the semi-structured interviews.

The systematic literature review provides a foundation for understanding the theoretical and empirical dimensions of digital tools in this domain. Complementing this, the interview component seeks to capture insights, experiences, and perspectives from key stakeholders within the Air Force, shedding light on practical implications and contextual considerations. Together, these methodologies aim to contribute valuable insights that can inform strategies for optimizing digital tools in the dynamic realm of DAF service acquisition.

A. SYSTEMATIC LITERATURE REVIEW

The purpose of a systematic literature review is to establish a structured and rigorous approach to collecting, analyzing, and synthesizing existing research on a specific topic (Guida et al., 2023). It is based on the approach taken by Guida et al. (2023), which explored the relationship between AI and the procurement process. The systematic literature review on digital tools in DAF service acquisition serves as a comprehensive examination of existing scholarly works within this critical domain. This review analyzes a spectrum of academic contributions, ranging from theoretical frameworks to empirical studies, to provide a nuanced understanding of the role and impact of digital tools in DAF service acquisition. The goal of this review is to synthesize and critically evaluate the available literature to distill key insights, identify trends, and contribute to the collective knowledge base, informing strategic decisions and best practices. The knowledge gained can then be applied to leveraging digital tools in the dynamic and evolving context of DAF

service acquisition. Following Guida et al. (2023), the systematic literature review consists of three phases. The three phases are planning the review, conducting the review, and reporting and disseminating the findings of the literature review process (see Figure 3).

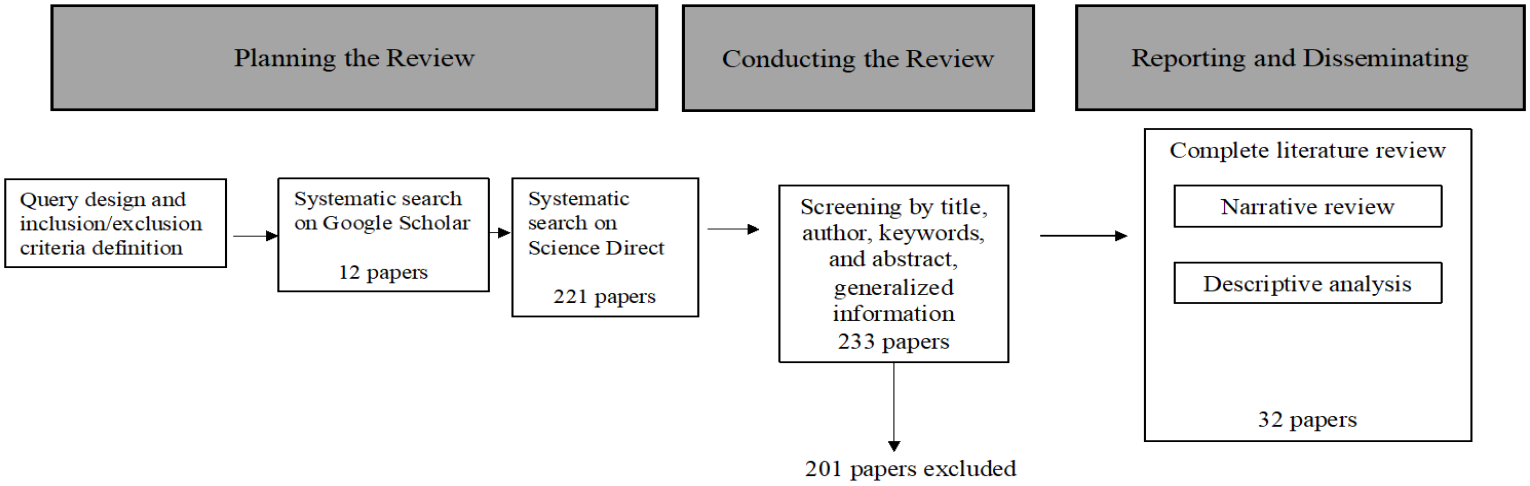

Figure 3. The Literature Review Process. Adapted from Guida et al. (2023).

Planning the review began with determining what keywords to include and exclude. Multiple keywords were used because the term digital tools are sometimes interchangeably used with other terms. We followed the systematic literature procedures employed by Guida et al. (2023). The search strategy is designed for a systematic exploration on ScienceDirect and Google Scholar using the identification of pertinent keywords (Guida et al., 2023). ScienceDirect was used because it hosts over 2,650 peer-reviewed sources of academic research from 500 journals, allowing for a large pool of academic sources from which to gather information (Elsevier, n.d.). Google Scholar was used because it is a large database of broad topics that helped ensure all subjects related to digital tools were considered.

Acknowledging the broad subject of digital tools, the search strategy adopted a broader perspective by encompassing the larger domain of digital technology, which includes digital tools (Guida et al., 2023). This inclusive approach is motivated by the recognition that although some papers emphasize digital technology over digital tools in their titles and keywords, their content remains valuable for understanding the role of digital tools in DAF service acquisition (Wang et al., 2016). In addition, there is a limited amount of academic research on DAF service acquisition; thus, private service acquisition was included to gain additional insights. Overall, the keywords used to search for literature include "public procurement," "business to government," "purchase," "procurement," "digital tools," "digital technology," and "digital solutions" because these terms were developed during the review phase.

In conducting the review phase, the keywords identified in the planning the review phase were used. The keywords (["public procurement" OR "digital tools" OR "digital technology" OR "digital solutions"]) AND (["procurement" OR "public procurement" OR "business to government" or "purchase"]) were used to generate a corpus of potential articles. Other criteria to narrow the search included sources written in English and published in 2020 or earlier. The time frame for literature was limited to 2020 and later to capture the most current information about digital tools. The exclusion and inclusion criteria were applied to the papers from ScienceDirect and Google Scholar and were

analyzed by title, abstract, and author keywords to determine if they should be included in the analysis.

The results of the systematic literature review were formatted into three visuals. The first visual was a matrix identifying digital tools that were discussed in the procurement process and mapped the digital tool(s) to one or more steps of the DAF service acquisition process. The second and third visuals were graphical representations of the frequency that the benefits and challenges of digital tools were discussed in the articles. The purpose was to create a strategic guide for integrating digital tools into the DAF service acquisition process and understanding the benefits and challenges of digital tools.

B. INTERVIEWS

The primary purposes of the interviews are to understand user needs and preferences, identify challenges and opportunities for improvement in existing tools, evaluate the effectiveness of current technologies, explore workflow and processes, gauge user satisfaction, and inform policy and strategy formulation.

The interviewees provided firsthand insights from two perspectives: those of digital tool developers and digital tool end users. Digital tool developers comprises DAF leaders who consider the strategic benefits and challenges of digital tool adoption and include Air Force Installation Contracting Center service acquisition policy professionals, branch chiefs, and program managers. Conversely, digital tool end users are those who are focused on the functionality and operational use of digital tools and include quality assurance program coordinators, CORs, and COs.

The format of the interviews was semi-structured, which allowed the conversations to flow from the questions to participant responses. The questions were divided into four topics: functionalities, benefits, challenges, and discussions of the matrix. The interviews were recorded and transcribed. The interview results were interpreted into one final matrix that incorporated the interviewees recommendations for the placement of digital tools into the service acquisition process step(s). Next, two visual representations were created to show the frequency of the benefits and challenges the interviewees reported about digital

tools. Finally, there is a table showing the benefits and challenges identified in literature and revealed from the interviews.

To summarize, this chapter explores the role of digital tools in DAF service acquisition, employing a dual-method approach comprising a systematic literature review and semi-structured interviews. The insights gleaned from this methodology provide a foundational understanding of current challenges, opportunities for enhancement, and the potential trajectory of technological integration within DAF service acquisition.

IV. RESULTS

A. INTRODUCTION

This chapter summarizes the results of the research. The research was conducted in two phases. Phase one was the systematic literature review of digital tools in service acquisitions. It revealed the academic perspective about how private and public service acquisitions can integrate digital tools. The results were used to create a matrix that integrates digital tools discussed in the procurement process and maps the digital tool(s) to one or more steps of the DAF service acquisition process. Next, benefits and challenges of digital tool adoption were identified. Academic research lacked a discussion about public procurement. It was focused on private procurement. To mitigate the lack of sources addressing the public procurement perspectives, interviews were conducted. Phase two consisted of interviews with digital tools end users and digital tool developers about their experience with digital tools. These interviews were necessary because the available research primarily focused on private procurement and largely overlooked public procurement.

The analysis of the results is reported in alignment with the primary and secondary research questions. The results are presented in three categories: digital tools matrix, benefits of digital tools, and challenges of digital tools.

B. SYSTEMATIC LITERATURE REVIEW RESULTS

The systematic literature review includes a discussion of about four areas: the digital tool matrix procedure, explaining the digital tool matrix, and describing the benefits and challenges of digital tool adoption.

1. Digital Tool Matrix Procedure

The procedure for the systematic literature review was developed to identify digital tools and map a connection to the DAF service acquisition process. The corpus of research included 32 sources. Each source was reviewed for relevance to the digital tools discussion in this research. When a digital tool was discussed in a source, two attributes were

extracted: the name of the digital tool and its functionality. Next, the functionality of the digital tool in private service acquisition was compared to the purpose of a step(s) in the DAF service acquisition process (see Appendix B) to determine if that digital tool aligned with one or more steps in the DAF service acquisition process (see Figure 4).

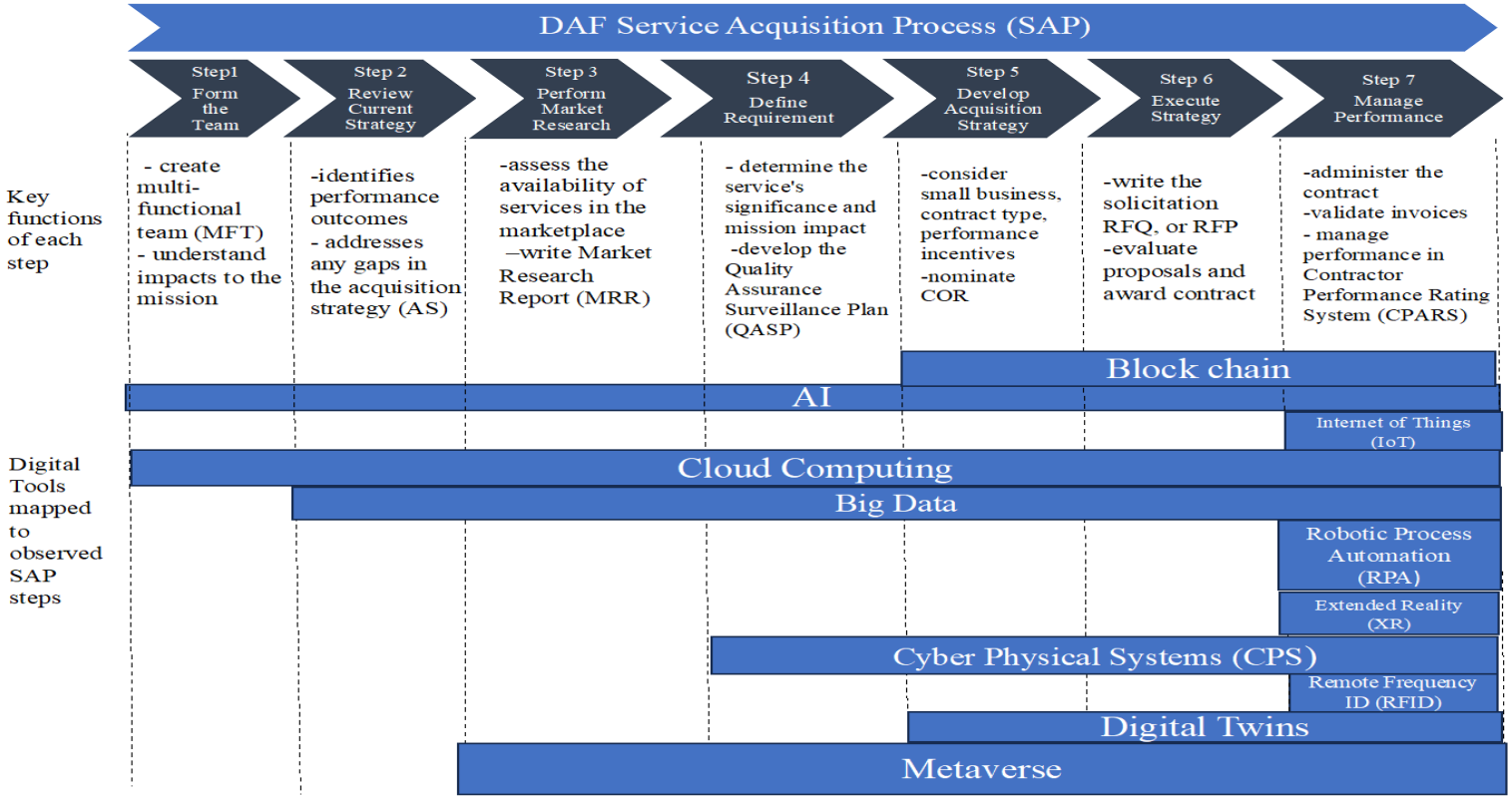

Figure 4. Matrix of DAF Service Acquisition Process and Digital Tools. Adapted from Toukola et al. (2023).

2. Digital Tool Matrix

A matrix was created to show how the digital tools discussed in the systematic literature review could fit into the DAF service acquisition process (see Figure 4). For example, one digital tool, artificial intelligence (AI), was described as a research aid to gain insights into manufacturers' supply chains (Siciliani et al., 2023). This tool is connected to step three of the DAF service acquisition process, market research. Another article addressed beginning procurement planning with AI and cloud computing (Annarelli et al., 2021). Step one, form the team, is the starting point of the DAF procurement process. Therefore, AI was affiliated with steps one and three, and cloud computing was affiliated with step one. Overall, 11 digital tools were mentioned a total of 74 times in the literature. Many digital tools were mentioned by more than one paper. Table 1 shows an example of one digital tool's frequency of discussion, literature references, and relation to the DAF service acquisition process.

Table 1. Excerpt from Appendix B

Digital Tool	Frequency	Description of Digital Tool	Proposed Function in DAF Service Acquisition Process
Blockchain	13	Blockchain is a network of decentralized and distributed data called "ledgers" (Budhi, n.d.) Each segment of data is a block. The blocks connect to form a chain.	Blockchain is discussed in steps five, six, and seven. **Step 5**: Acquisition planning documents such as Acquisition strategy (AS), market research report (MRR), and quality assurance surveillance report (QASP) can be stored and protected in blockchain. It will protect the integrity of the information in solicitation by only allowing authorized parties to view the solicitation and supporting acquisition documents. **Step 6**: Verify the information in the proposals matches the solicitation. **Step 7**: Issue secure invoice payments.

The literature review revealed 11 digital tools: blockchain, AI, Internet of Things (IoT), cloud computing, robotic processing automation (RPA), big data, extended reality (XR), cyber-physical systems (CPSs), radio frequency identification (RFID), digital twins, and metaverse. Blockchain, AI, and IoT emerged as the top three digital tools discussed in the literature and are therefore addressed first. Next, an overview of cloud computing, big data, RPA, XR, CPSs, RFID, digital twins, and metaverse is provided. Finally, the connection between all 11 digital tools and the service acquisition process is discussed (see Appendix B).

a. AI

AI is designed to duplicate "problem solving and decision-making capabilities" of humans (Britannica, n.d.) In addition to generative AI, natural language processing, and machine learning, AI encompasses a diverse array of functionalities. The landscape of AI is rapidly evolving, and its applications are expanding to various domains, including the development of acquisition strategies and contractual documents. Particularly noteworthy is AI's role as a research aid within the supply chain, offering valuable capabilities for gaining market insights. By leveraging AI algorithms, supply chain professionals can analyze vast datasets, identify patterns, and extract actionable intelligence to inform strategic decision-making. This application of AI not only enhances efficiency and accuracy but also empowers organizations to anticipate market trends, optimize procurement processes, and gain a competitive edge in dynamic business environments (Siciliani et al., 2023). Service acquisition relies on writing and research key documents such as the performance work statement, acquisition strategy and market research report. AI can play a decisive role by comparing acquisition service specific language, incorporating into natural language processing then write paragraphs (Oliveira-Dias et al., 2022). The paragraphs generated can be incorporated into the performance work statement, market research report and acquisition strategy ultimately saving time to create key documents.

b. Blockchain

Blockchain technology operates as a network of decentralized and distributed data, often referred to as "ledgers," as described by Budhi (n.d., p. 1) Each piece of data within this network is encapsulated within an immutable block. These blocks are sequentially linked together to form a chronological chain, hence the name blockchain. As highlighted by Yu et al. (2022), his digital tool is widely recognized for its strong security features and its ability to protect sensitive documents such as contractual and financial records. The decentralized nature of blockchain ensures that data stored within the network is resistant to tampering and unauthorized alterations, thereby enhancing trust and transparency in digital transactions (Nodehi et al., 2022). Moreover, the cryptographic algorithms employed in blockchain technology further fortify its security, making it an invaluable tool for protecting critical documents and facilitating secure transactions (Nodehi et al., 2022; Oliveira-Dias et al., 2022). One significant hurdle lies in guaranteeing the immutable and secure record-keeping and sharing of information among public organizations, all while adhering to current rules and regulations regarding data privacy, ownership, and control (Shahaab et al., 2023). The risk lies in ensuring compliance and avoiding breaches of existing data regulations when handling historical data on the blockchain (Deloitte U.S., n.d.). Secure information sharing involves implementing encryption, access controls, and authentication mechanisms to protect sensitive data from unauthorized access or disclosure (UCI Information Security, n.d.). Public organizations such as the DAF can utilize secure communication protocols and data encryption techniques to safeguard information while facilitating secure sharing among authorized parties.

c. IoT

The IoT encompasses physical objects equipped with sensors, which allow them to monitor parameters such as temperature, motion, and environmental changes within the physical world. These sensors, in conjunction with actuators, facilitate communication through the internet with computing systems. This interconnected network of objects and machinery forms the foundation of the IoT, as explained by (McKinsey, n.d.b,). The IoT emerged as a prominent topic of discussion, particularly due to its integration with

numerous digital tools like AI, blockchain, and cloud computing, as highlighted by de Paula Ferreira et al. (2022)This integration allows IoT devices to serve as data sensors, collecting valuable information that can be transmitted to other digital tools for further analysis and utilization. For example, IoT devices can gather data from sensors and provide it to cloud computing platforms for secure storage or transmit it to AI systems for market analysis, demonstrating the versatility and potential of the IoT in enhancing operational efficiency and driving innovation across various industries.

d. Cloud computing, big data, RPA, XR, CPS, RFID, digital twins, and metaverse

The remaining eight digital tools discovered in the literature were cloud computing, big data, RPA, XR, CPS, RFID, digital twins, and metaverse. Cloud computing includes servers, storage, databases, networking, software, analytics, and intelligence stored on the internet instead of on hardware (Microsoft Azure, n.d.). Cloud computing can be useful for making more accurate decisions and improving supply chain integration (Oliveira-Dias et al., 2022). Big data is "structured, semi-structured, and unstructured data accumulation" (BasuMallick, n.d., p. 1). The data can be used for "insights and employed in advanced analytical applications such as predictive modeling and machine learning" (BasuMallick, n.d., p. 1). Robotic process automation is commonly referred to as a *bot*. Bots are software applications "designed to perform repetitive automated tasks" (Heckman, 2023, p. 1). The bots can "imitate and replicate specific tasks, streamlining processes effectively" (Gartner, n.d.). XR blends augmented reality and virtual reality to merge the physical and virtual worlds. XR can be used to increase supply chain agility by speeding up warehousing activities and learning about logistics processes (Oliveira-Dias et al., 2022). CPSs capture data using sensors and compute and communicate alerts to the systems (ScienceDirect, n.d., p. 1). Intelligent process planning can be assisted by "deep learning, real-time production logistics" based on the IoT and cyber-physical process monitoring systems (da Silva et al., 2023, p. 1). RFID technology uses radio waves for the identification of individuals or objects. A reading device can gather information from a wireless device "without the need for physical contact or a direct line of sight" (Department of Homeland Security, n.d., p. 2). Digital twins are a virtual representation of a "physical entity, whether

it be an object, individual, or a process, within a digital environment that replicates its real-world context" (McKinsey, n.d.a, p. 1). Digital twins serve as valuable tools for organizations, "enabling them to simulate real scenarios and their corresponding results, thereby enhancing their decision-making capabilities" (McKinsey, n.d.a, p. 1). The metaverse is the emerging 3D-enabled digital space that uses virtual reality, augmented reality, and other advanced internet and semiconductor technology to allow people to have " lifelike personal and business experiences online" (McKinsey, n.d.c, p. 1).

Appendix B provides definitions of all 11 digital tools and their connections to the service acquisition process. Blockchain, for instance, is described as a network of decentralized and distributed data called ledgers (Budhi, n.d.). Each segment of data is a block that connects to form a chain. This function connects to steps five, six and seven of the DAF service acquisition process. In step five, Develop Acquisition Strategy, blockchain can be used in storing and protecting acquisition planning documents such as the acquisition strategy (AS), market research report (MRR) and quality assurance surveillance report (QASP). Blockchain protects the integrity of the information in a solicitation by only allowing authorized parties to view the solicitation and supporting acquisition documents. Step six, Execute Strategy, could involve verifying that the information presented in the proposals matches the specification in the solicitation. Step seven, Managing Performance, could involve utilizing blockchain to issue secure invoice payments.

Table 2. Systematic Literature Review: Digital Tools Identified in Service Acquisition

Digital Tool	Frequency	Literature	Journal
Artificial Intelligence (AI)	50	Alshahrani et al., 2022	Government Information Quarterly
		Annarelli et al., 2021	Technological Forecasting and Social Change
		Aoun et al., 2021	Computers & Industrial Engineering
		Chen et al., 2023	Resource Policy
		de Paula Ferreira et al., 2022	Journal of Manufacturing Systems
		Guida et al., 2022 (SLR[1] of 38 papers)	Journal of Purchasing and Supply Management
		Nodehi et al., 2022	Computers & Industrial Engineering
		Rustholllkarhu et al., 2022	Industrial Marketing Management
		Shi et al., 2022	Journal of Digital Economy
		Siciliani et al., 2023	Information Systems
		Toukola et al., 2023	Project Leadership and Society
		van Noordt & Tangi, 2023	Government Information Quarterly

[1] Systematic Literature Review (SLR)

Digital Tool	Frequency	Literature	Journal
Blockchain	13	Chen et al., 2023	Resource Policy
		Coşkun & Kazan, 2023	Computers & Industrial Engineering
		da Silva et al., 2023	Multidisciplinary Digital Publishing Institute (MDPI)
		de Paula Ferreira et al., 2022	Journal of Manufacturing Systems
		Govindan et al., 2024	Transportation Research Part E: Logistics and Transportation Review
		Klievink et al., 2016	Government Information Quarterly
		Nodehi et al., 2022	Computers & Industrial Engineering
		Núñez-Merino et al., 2022	Technological Forecasting and Social Change
		Oliveira-Dias et al., 2022	Computers & Industrial Engineering
		Schmidt & Wagner, 2019	Journal of Purchasing and Supply Management
		Shahaab et al., 2023	Government Information Quarterly
		Sunio et al., 2023	Journal of Digital Economy
		Yu et al., 2022	Computers & Industrial Engineering

Digital Tool	Frequency	Literature	Journal
Internet of Things (IoT)	12	Annarelli et al., 2021	Technological Forecasting and Social Change
		Aoun et al., 2021	Computers & Industrial Engineering
		Bag et al., 2020	Resources, Conservation, and Recycling
		Benitez et al., 2022	International Journal of Production Economics
		Coşkun & Kazan, 2023	Computers & Industrial Engineering
		da Silva et al., 2023	Multidisciplinary Digital Publishing Institute (MDPI)
		de Paula Ferreira et al., 2022	Journal of Manufacturing Systems
		Kosmol et al., 2019	Journal of Purchasing and Supply Management
		Nodehi et al., 2022	Computers & Industrial Engineering
		Núñez-Merino et al., 2022	Technological Forecasting and Social Change
		Oliveira-Dias et al., 2022	Computers & Industrial Engineering
		Yu et al., 2022	Computers & Industrial Engineering
Cloud Computing	9	Annarelli et al., 2021	Technological Forecasting and Social Change
		da Silva et al., 2023	Multidisciplinary Digital Publishing Institute (MDPI)
		Klievink et al., 2016	

Digital Tool	Frequency	Literature	Journal
		Kosmol et al., 2019	Government Information Quarterly
		Nodehi et al., 2022	Journal of Purchasing and Supply Management
		Oliveira-Dias et al., 2022	Computers & Industrial Engineering
		Shi et al., 2022	Computers & Industrial Engineering
		Sunio et al., 2023	Journal of Digital Economy
		Toukola et al., 2023	Journal of Digital Economy
			Project Leadership and Society
Big Data	6	Annarelli et al., 2021	Technological Forecasting and Social Change
		Benitez et al., 2020	International Journal of Production Economics
		de Paula Ferreira et al., 2022	Journal of Manufacturing Systems
		Klievink et al., 2016	Government Information Quarterly
		Kosmol et al., 2019	Journal of Purchasing and Supply Management
		Nodehi et al., 2022	Computers & Industrial Engineering

Digital Tool	Frequency	Literature	Journal
Robotic Process Automation (RPA)	6	Andersson et al., 2022	Government Information Quarterly
		Annarelli et al., 2021	Technological Forecasting and Social Change
		Benitez et al., 2020	International Journal of Production Economics
		Coşkun & Kazan, 2023	Computers & Industrial Engineering
		da Silva et al., 2023	Multidisciplinary Digital Publishing Institute (MDPI)
		de Paula Ferreira et al., 2022	Journal of Manufacturing Systems
		Núñez-Merino et al., 2022	Technological Forecasting and Social Change
		Toukola et al., 2023	Project Leadership and Society
Extended Reality (XR)	5	Benitez et al., 2020	International Journal of Production Economics
		Chen et al., 2023	Resource Policy
		da Silva et al., 2023	Multidisciplinary Digital Publishing Institute (MDPI)
		de Paula Ferreira et al., 2022	Journal of Manufacturing Systems
		Wilson & Mergel, 2022	Government Information Quarterly
Cyber-Physical	4	Aoun et al., 2021	Computers & Industrial Engineering
		Coşkun & Kazan, 2023	Computers & Industrial Engineering

Digital Tool	Frequency	Literature	Journal
System (CPS)		da Silva et al., 2023 de Paula Ferreira et al., 2022	Multidisciplinary Digital Publishing Institute (MDPI) Journal of Manufacturing Systems
Radio Frequency Identification (RFID)	3	Benitez et al., 2020 da Silva et al., 2023 Núñez-Merino et al., 2022	International Journal of Production Economics Multidisciplinary Digital Publishing Institute (MDPI) Technological Forecasting and Social Change
Digital twins	2	Maheshwari et al., 2023 Meyer & Henke, 2023	Technology Forecasting and social change Journal of Purchasing and Supply Management
Metaverse	1	Chen et al., 2023	Resource Policy

3. Benefits Revealed in the Literature Review

The literature review yielded the discovery of 24 benefits of utilizing digital tools in service acquisitions (see Figure 5). Appendix C provides a discussion of the benefits of digital tools, frequency with which they were mentioned, and the literature reviewed. The most cited benefits were visibility, management decision-making, and operational effectiveness.

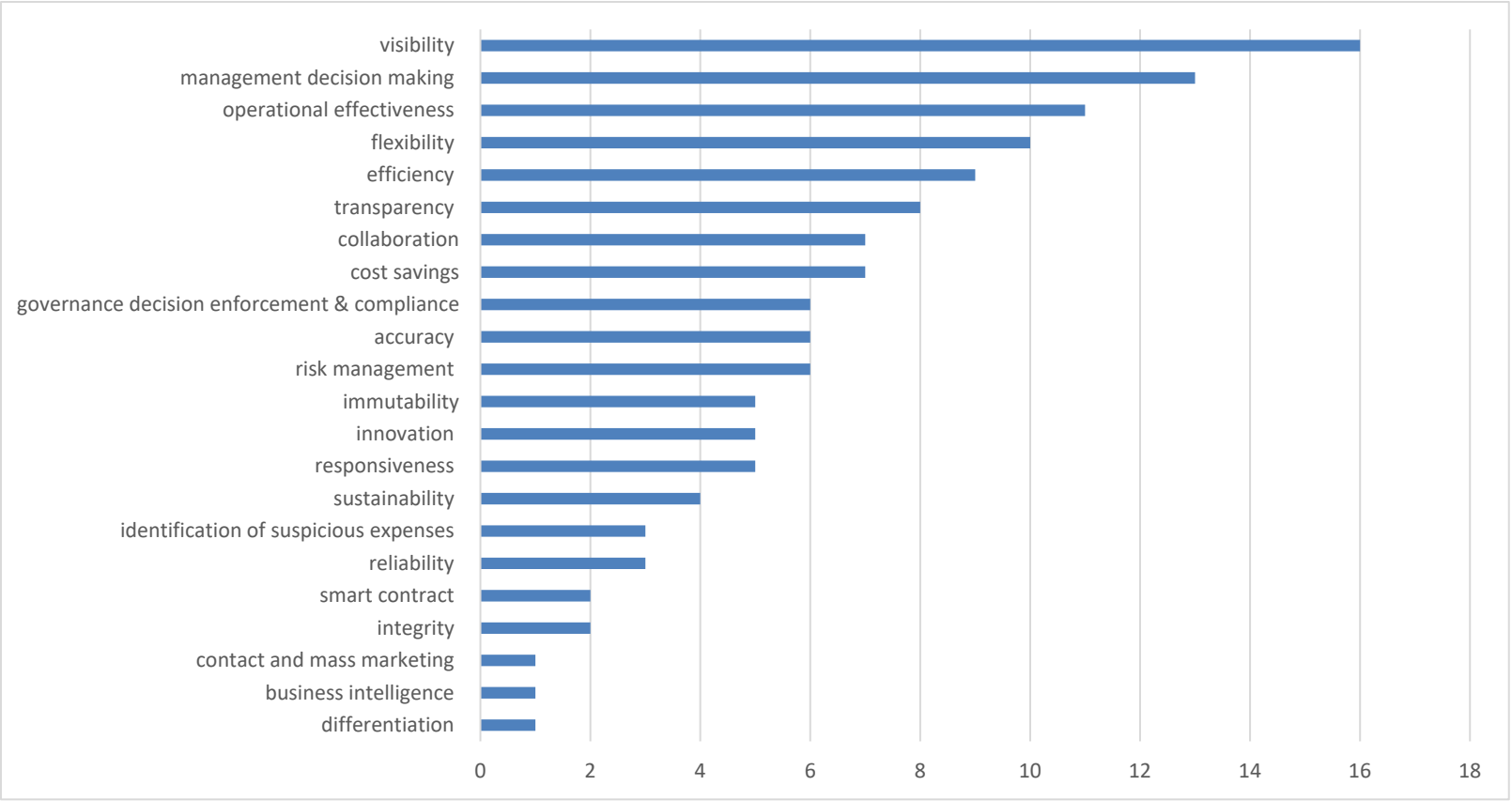

Figure 5. Systematic Literature Review: Benefits of Digital Tools. Adapted from Guida et al. (2023).

Visibility is vital to service acquisitions because monitoring and evaluating performance is a key task of the acquisition. Núñez-Merino et al. (2022) analyzed digital tools that work together in a smart logistics network, utilizing a combination of big data, cloud computing, IoT and CPSs to improve warehousing, transportation, deliveries, and sustainability. This application of digital tools brings the benefits of visibility to a product's life cycle (Núñez-Merino et al., 2022). Sharing information in real-time allows changes to be made to the physical flow of productions in the supply chain. Visibility over the physical movement of products provides adaptability and flexibility to changes in the demand for products (da Silva et al., 2023; Guida et al., 2023; Kamble et al., 2020). For example, if a vehicle maintenance contract requires an inventory of spare parts to make repairs, visibility may provide insight into the number of spare parts in the inventory at any given time.

Managers rely on digital tools to help make decisions for their organizations. For example, in the DAF, leaders often must make post-award modifications to service acquisition contracts. These modifications may be the result of changing mission requirements, shifts in operational needs, or unforeseen challenges during contract pre-award. Govindan et al. (2024) highlight the importance of decision-making support from blockchain, big data, IoT and RFID. Data stored in a secure platform with access to integrated architecture gives decision-makers a repository of information to incorporate into current and future procurement strategies (Núñez-Merino et al., 2022; Shi et al., 2022). In addition, shifting data collection tasks away from managers and personnel allows them to focus on other high-value tasks (Shi et al., 2022).

Digital tools can improve the operational effectiveness of the DAF's mission by helping to use resources more efficiently. According to Shi et al. (2022), digital tools aid in operational effectiveness by providing a "mirror of realistic industrial systems" with digital twins (p. 4). The digital tools support the simulation and optimization of management by enhancing operations and running scenarios of the changes to the logistics network or pricing of suppliers. Kamble et al. (2020) discussed a framework that uses blockchain technology for managing procurement and yielding cost savings, quality assurance monitoring, and self-optimization.

4. Challenges Revealed in the Literature Review

The literature review revealed 25 challenges (see Figure 6). Appendix C provides a discussion of the challenges, frequency, and literature reviewed. The most cited challenges were data quality, cost, and system interoperability.

Without high-quality data, decision-making is flawed, analysis is skewed, and the overall effectiveness of operations dramatically falls. In the DAF, ineffectual operations lead to aircraft flying the wrong missions, resources being wasted on mis-prioritized tasks, and national security overall becoming weak and ineffective. According to Guida et al. (2023), AI can be a powerful tool for procurement if the challenges of data availability and quality are overcome. Benitez et al. (2020) discussed utilizing cloud computing, IoT, big data, AI, and CPS as digital solutions, highlighting the reliance on quality data. Low-quality data includes inaccuracies, incompleteness, outdated information, and a lack of standardization (Drenik, n.d.), and it impedes the digital tool from working properly. Data availability is limited by data protection and information security (da Silva et al., 2023; Sunio et al., 2023). Digital tools require a vast amount of data to create a foundation about the service acquisition they are supporting. It is therefore critical to ensure accuracy of the data being used to guarantee informed decision-making. For example, if a company was using an AI digital tool, the data would need to be in the proper format for AI to create an algorithm to learn about the trends of the data. Generative AI has started to create tools for assisting in data cleansing, such as Open AI's code interpreter, but their reliability is still being evaluated.

The cost of investing in digital tool adoption redirects funds from the budget and potentially reduces resources available for other initiatives. Budget constraints are a significant challenge to the DAF (Lopez, 2023). All of the DAF's funding is allocated for specific purposes, tracked, and monitored to ensure that it is spent to the best advantage of the American taxpayer. According to Govindan et al. (2024), digital tool adoption in procurement has a high cost in the implementation phase. There are additional costs relating to maintenance, technical support, and training, as discussed by da Silva et al. (2023). Introducing a new digital tool to the procurement process requires consideration of the human capital cost to create and manage plans to transfer data and test the security and

compliance of the digital tool with audits. The costs related to transitioning to new technology are significant, and the decision to adopt digital tools is impacted by the relationship between costs and benefits (Govindan et al., 2024; Guida et al., 2023).

System interoperability, the final significant challenge noted in the literature review, is a challenge in service acquisitions because businesses have legacy systems that need to be integrated with new digital tools. When new digital tools do not function with the existing digital tools, efficiency decreases and operations slow down. In regard to system interoperability, Benitez et al. (2020) described an elaborate network of interlinked digital tools that require "high interdependency of competencies and technological complementarity" (p. 2). As some digital tools are adopted, they serve as the platform for new digital tools to be added to the organization and create a digital "ecosystem" (Benitez et al., 2020, p. 2). The goal of a digital tool is to improve the existing functionality of an organization. In acquisitions, there are legacy systems in place that have been writing, storing, and creating contracts. If the DAF wants to take advantage of modern digital tools, it will need to consider system interoperability along with the other challenges presented in this research.

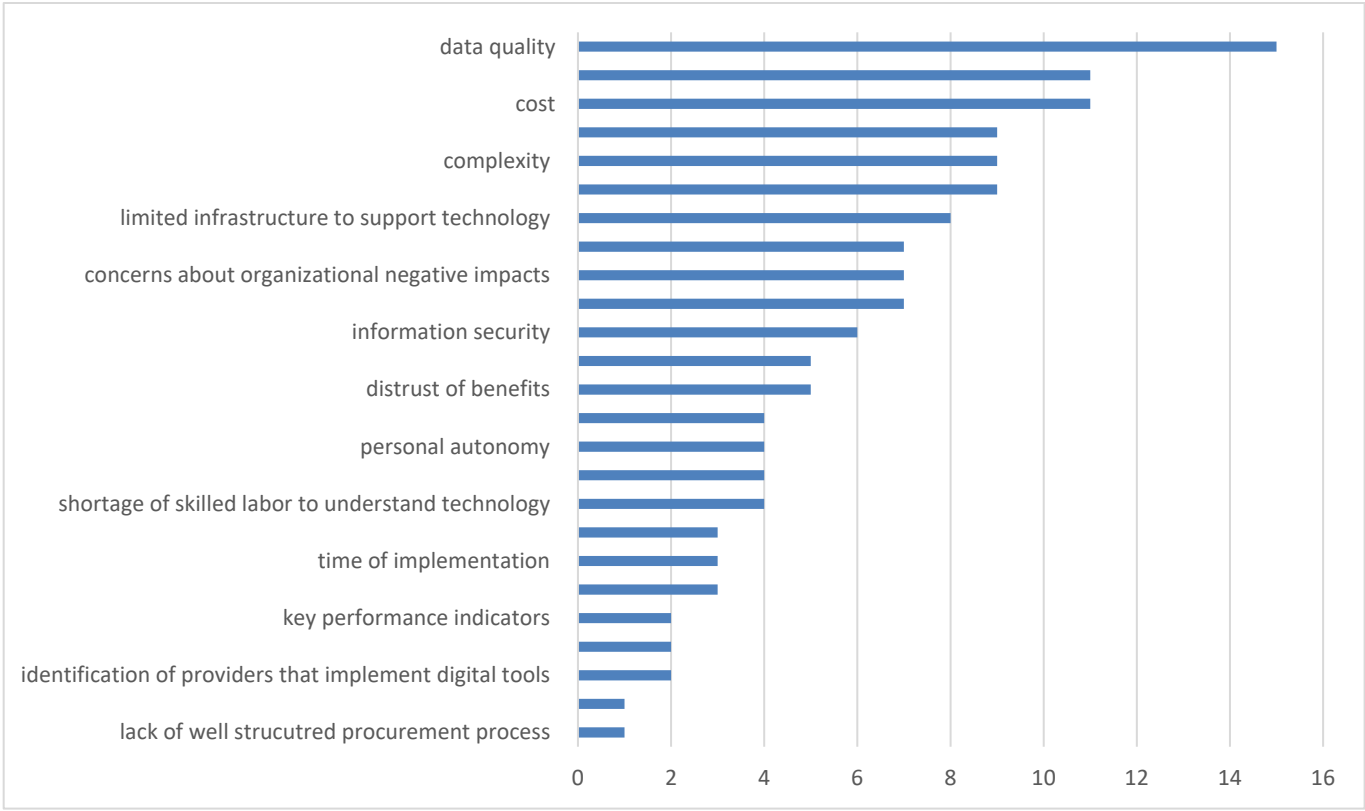

Figure 6. Systematic Literature Review: Challenges of Digital Tools. Adapted from Guida et al. (2023).

C. INTERVIEWS

The interviewees provided firsthand insights from two perspectives: digital tool end users and digital tool developers. Table32 shows the interviewee demographics; it includes years of acquisition experience, categorization as either a digital tool end user or digital tool developer, and job title. A total of eight digital tool end users and eight digital tool developers were interviewed. Digital tool end user acquisition experience ranged from 2–18 years. Digital tool developer acquisition experience ranged from 10–21 years. The average amount of experience was 8.5 years for digital tool end users and 15.1 years for digital tool developers.

Table 3. Interviewee Demographics

	Years of Acquisition Experience	Job Title
Digital Tool End User 1	4	Contracting Officer (CO)
Digital Tool End User 2	2	Contract Specialist
Digital Tool End User 3	5	Contracting Officer Representative (COR)
Digital Tool End User 4	6	Quality Assurance Program Coordinator (QAPC)
Digital Tool End User 5	5	Contracting Officer (CO)
Digital Tool End User 6	17	Contracting Officer Representative (COR)
Digital Tool End User 7	11	Contracting Officer Representative (COR)
Digital Tool End User 8	18	Contracting Officer Representative (COR)
Digital Tool Developer 1	16	Technical Director
Digital Tool Developer 2	21	Deputy Director of Contracting
Digital Tool Developer 3	11	Program Manager
Digital Tool Developer 4	15	Program Manager
Digital Tool Developer 5	10	Acquisition Team Lead
Digital Tool Developer 6	19	Branch Chief
Digital Tool Developer 7	14	Division Chief
Digital Tool Developer 8	15	Section Chief

1. Digital Tool Identification

The interviews revealed that the participants had experience working with three digital tools. The most prevalent digital tools were web servers. Of the 16 interviewees, 15 were familiar with web servers. Web servers refer to computer systems with the capability to deliver web content to end users via the internet through a web browser (SolarWinds, n.d.). Web server solutions include Contracting Information Technology (CON-IT) and KT file share. Table 4 shows the digital tools the interviews are currently utilizing in DAF service acquisition.

Table 4. Interview: Digital Tools Identified in Service Acquisition

Digital Tool	Count	Sources
Web server software solutions	15	digital tool developer 1, digital tool developer 2, digital tool developer 3 digital tool developer 4, digital tool developer 5, digital tool developer 7, digital tool developer 8. digital tool end user 1, digital tool end user 2, digital tool end user 3, digital tool end user 5, digital tool end user 6, digital tool end user 7, digital tool end user 8
Cloud Computing	2	digital tool developer 2, digital tool developer 6
Robotic Process Automation (RPA)	2	digital tool developer 3, digital tool developer 7

CON-IT is the DAF's internet-based contract writing system. It was developed to transition the DAF to a "uniform internet-based contract writing system" from separate and incompatible legacy contract systems, including Procurement Defense Desktop (PD2) and ConWrite (Sarmiento & Owen, 2022, p. 2). Prior to the adoption of CON-IT as a digital tool, DAF contracting professionals relied on software installed on individual users' assigned desktops or laptop computers (Sarmiento & Owen, 2022). Contract products were then uploaded to local on-site servers. The adoption of the CON-IT's cloud-based contracting approach was described as the DAF reaping the benefits of a system that allows for transparent financial audit and procure-to-pay processes (Sarmiento & Owen, 2022). As of November 2022, there are over "5,000 [new] users and 8,000 contracting personnel" using CON-IT (Sarmiento & Owen, 2022, p. 1).The portfolio supported by CON-IT in 2022 totaled "67,909 contract actions and obligated $20.4B [billion] versus FY21 [fiscal year 2021] $15.6B" (Sarmiento & Owen, 2022, p. 1).

2. Digital Tool Matrix Inputs

The interviewees were shown the matrix (see Figure 4) and asked for their suggested changes to the matrix to accurately reflect the perspective of DAF acquisition professionals. Changes were incorporated if four or more interviewees provided the same input. As a result of the interviewees' inputs, the following three ideas were incorporated into the matrix (see Figure 7):

- Added web servers as a digital tool. All but one of the interviewees discussed using the web servers CON-IT and KT file share in their daily service acquisition and suggested adding it into the matrix as a digital tool. Digital tool end user 1 remarked, “CON-IT and KT file share are the digital tools I use the most working to draft and review contracting documents.”

- Expanded RPA into steps four, five and six and included bots in the terminology. Eight out of the 16 interviewees were familiar with bots but had not heard them referred to as RPAs. DORA bots are in use to assist with checking vendor representations in SAM.GOV (digital tool end user 2, 5). In addition, eight interviewees suggested the use of bot technology to support the automation of contract action beginning in step four, Define the Requirement, and continuing until step seven, Manage Performance.

- Integrated XR into steps three and four. Four of the interviewees stated that XR would be a useful part of industry days. Digital end users 6 and 7 noted that XR can help explain the application of a service, such as a prototype contract to apply a visual representation to the piece of technology that is being developed. This provides a baseline for the design features of the prototype and essential elements of the mission requirement.

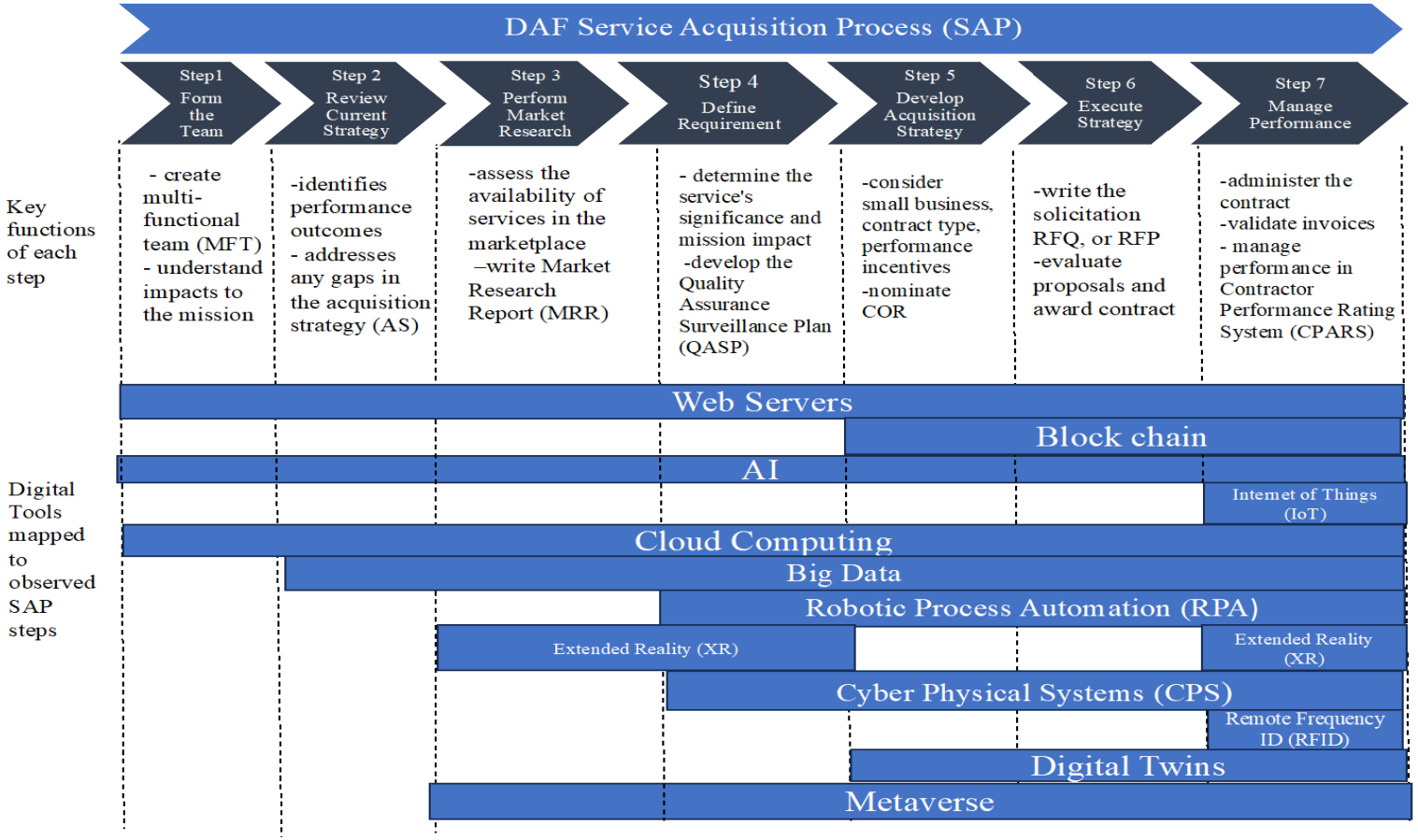

Figure 7. Final Matrix of Service Acquisitions Process and Digital Tools. Adapted from Toukola et al. (2023).

3. Benefits Revealed in Interviews

The interviews identified 10 benefits. The highest ranked benefits were flexibility, collaboration, and operational effectiveness (see Figure 8).

The flexibility to conduct meetings and coordinate with MFT members such as those from the finance and legal departments is an important part of service acquisition because the service impacts all members of the MFT, and having their input is critical. Digital tool end user 4 stated that it was "vital to be able to work on the acquisition strategy, make changes, and host virtual discussions to bring everyone on the MFT up to speed." Digital tool developer 6 emphasized the importance of flexibility "to prepare a market analysis of a possible business opportunity in 2 hours. Having a detailed look at how interconnected our organization was with multiple businesses was essential."

Contract documents such as the acquisition strategy (AS), market research report (MRR), and QASP are created with the collaboration of the MFT. Digital tools help members of the MFT who are geographically separated contribute and share ideas. Multiple interviewees discussed needing to meet with members of the MFT who were working across various time zones, and digital tools allowed them to view the same acquisition documents and provide feedback (digital tool end user 3, 6; digital tool developer 3, 5).

Operational effectiveness in DAF acquisition includes being prepared for self-inspections and audits. Digital tool end users 4 and 6 and digital tool developers 5 and 8 stated that compliance with self-inspections became simpler and faster after switching to KT file share. Digital tool developer 8 remarked, "inspections occur simultaneously while contracting officers are able to access their files. Prior to the transition, we would have to prepare the paper copies of the contract file for the inspection."

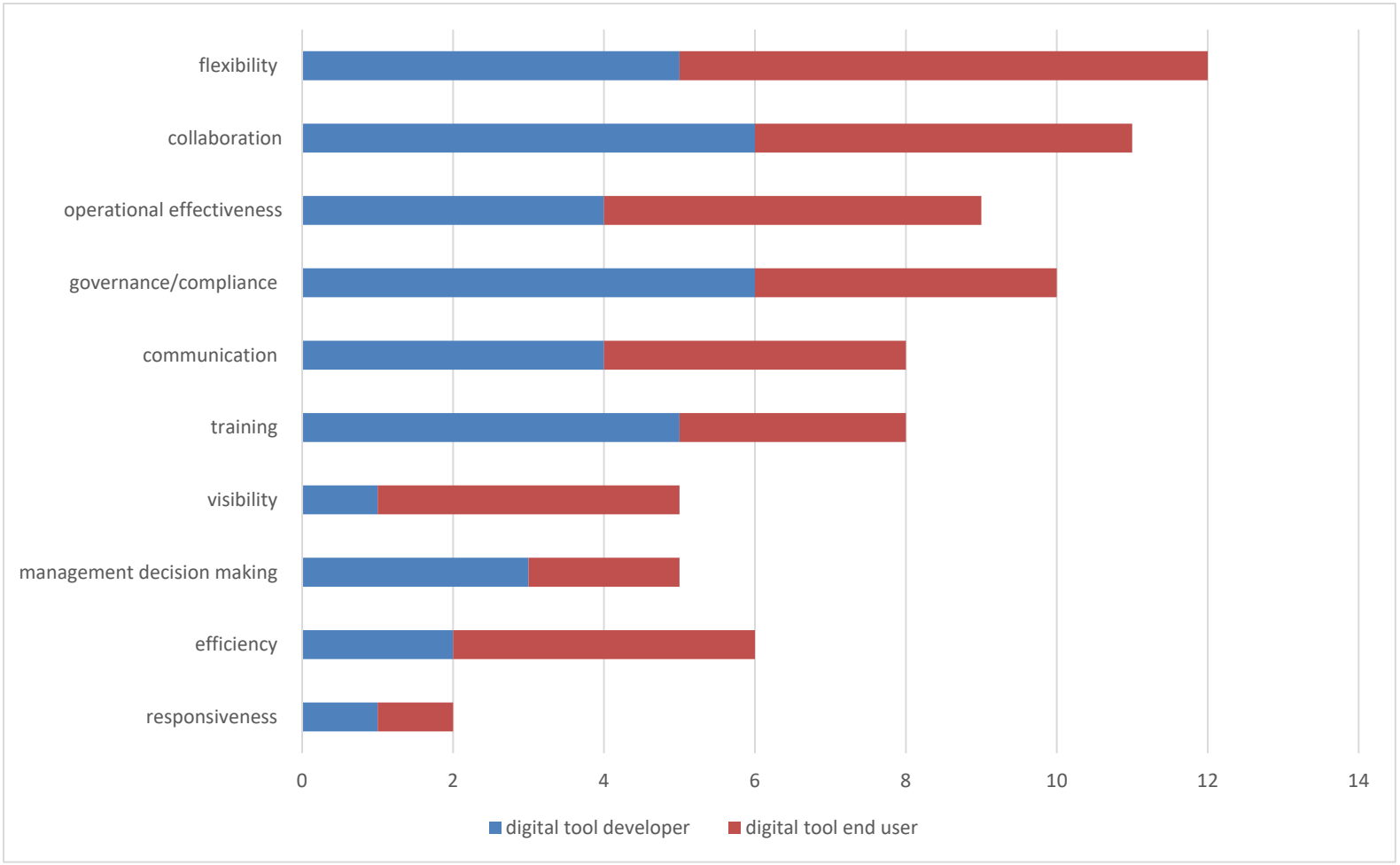

Figure 8. Interviewees: Benefits of Digital Tools. Adapted from Guida et al. (2023).

4. Interviewees' Digital Tool Benefits Inputs

The interviewees were asked about what benefits they experienced working with digital tools. Benefits were added to the list of benefits from the systematic literature review if the interviewees identified the benefit. As a result of the inputs, the following two benefits were incorporated into the final benefits list (see Table 5):

- Added communication. Acquisition professionals described improved communication capabilities as a benefit of digital tools. One improvement is the ability to conduct efficient and effective communication through features such as screen sharing. Digital tool end users highlighted the practicality and benefits of this functionality, particularly when collaborating on contract documents. For example, digital tool developer 4 stated, "we hosted weekly meetings to provide updates to members of the team about changes to acquisition strategy."

- Added training. Training members of the MFT and less experienced acquisition professionals is a common part of the acquisition process. Training sessions are a common component of acquisition activities, serving to enhance proficiency, foster continuous learning, and ensure compliance with regulatory requirements. Digital tools aided in this training, such as teaching team members how to complete contract documents. For example, digital tool developer 6 stated, "training my less experienced contract specialists is important, and we used digital tools to make training accessible to more people."

Table 5. Final Benefits of Digital Tools

Benefit	Systematic Literature Review	Interviews
visibility	x	x
management decision making	x	x
operational effectiveness	x	x
flexibility	x	x
efficiency	x	x
transparency	x	
training		x
communication		x
cost savings	x	
collaboration	x	x
risk management	x	
accuracy	x	
data governance & compliance	x	x
responsiveness	x	x
innovation	x	
immutability	x	
sustainability	x	
reliability	x	
identification of suspicious expenses	x	
integrity	x	
smart contract	x	
differentiation	x	
business intelligence	x	
contact and mass marketing	x	

5. Challenges Revealed in Interviews

The interviews identified 12 challenges. The three highest ranked challenges were system interoperability, training, and data quality (see Figure 9).

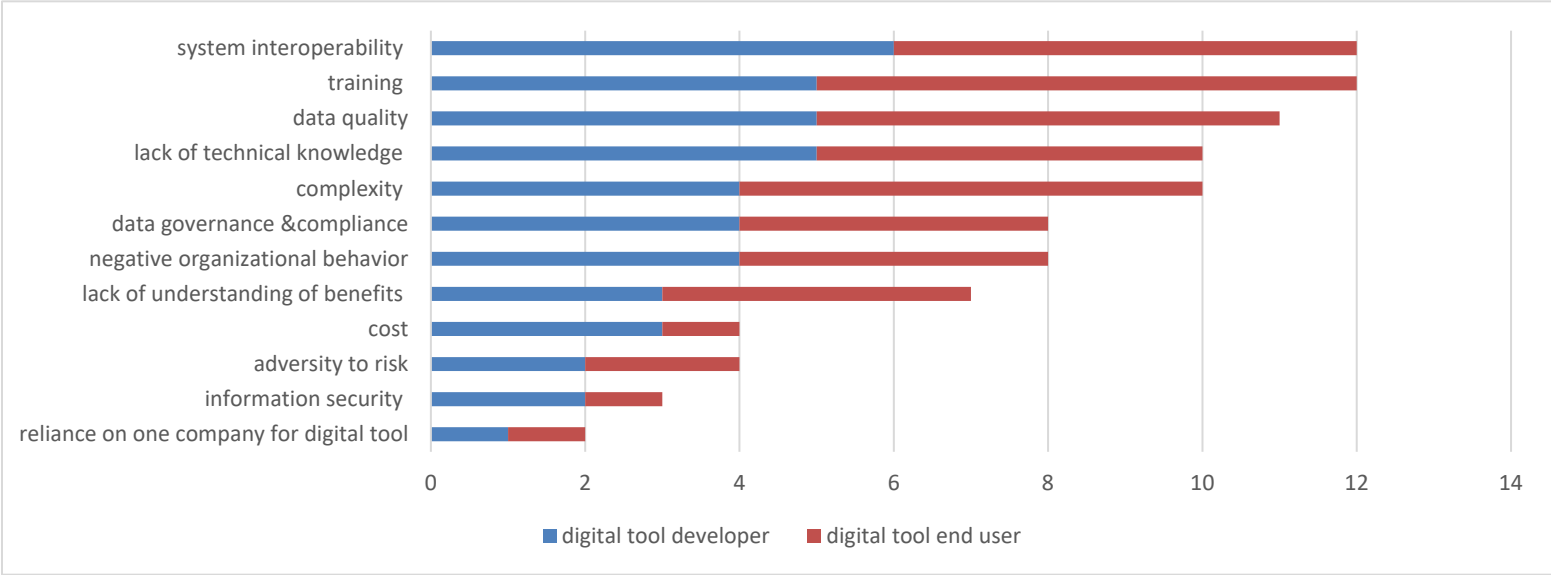

Figure 9. Challenges with Incorporation of Digital Tools. Adapted from Guida et al. (2023).

System interoperability was a top concern among the interviewees, especially in transitioning from CONWrite, the legacy contract writing system, to CON-IT, the web server contract writing system. The data in CONWrite did not match the format needed for CON-IT. "It required making over 30 new contract line-item numbers" (digital tool developer 7). Some of the contracts were especially challenging to integrate into CON-IT because the contracts' DOD Activity Address Codes were no longer valid (digital tool developer 6). The solution was to manually input data from the old contracts into CON-IT to have versions of the contract files that were compatible with CON-IT (digital tool developer 6, 7; digital tool ender user 1, 4).

Training acquisition professionals about a digital tool requires time and knowledgeable teachers. Digital tool developer 5 remarked, "It took hours to become familiar with CON-IT and felt like the practice sessions were unhelpful, because we ran into questions and couldn't get answers." A CON-IT trainer was designated in every organization to assist with training. However, when the trainers did not know an answer, they would send the question to another individual at another installation to get the answer. The delay in receiving an answer caused a delay in productivity until there was a solution. In addition, training included teaching customers and members of the MFT the capabilities that were included in the digital tool. Several customers displayed a lack of understanding regarding the full range of features included in CON-IT (digital tool developer 7, digital tool end user 4). Convincing them to explore unfamiliar capabilities required persuading them to step outside of their comfort zone and embrace the new technology (digital tool developer 7).

Data quality encompasses both accuracy and reliability, which are crucial aspects in service acquisition (Aoun et al., 2021). Time is lost due to correcting errors and fixing inaccurate data. One digital tool end user stated that they experience problems with lines of accounting in a purchase request transferring completely within modifications. The solution was to validate the lines of accounting with finance and then input each number manually. Specifically, they stated, "I was worried about this mistake happening again and losing time. I decided to check every number in the LOAs with finance for all my future contracts" (digital tool end user 3). Another example demonstrates the negative effects of

inaccurate data requests, resulting in the inability to effectively analyze the data. A customer requested data from Cloud One, the DAF's cloud computing enterprise, But failed to specify the type of data they needed. The requester received "about 60 gigabytes [of data] before it broke the model being used for analysis" (digital tool developer 4). The analysis was halted because the requester could not accurately determine the context for their data.

6. Interviewees' Digital Tool Challenges Inputs

Questions were presented to the interviewees about what challenges they experienced working with digital tools. Challenges were added to the list of challenges from the systematic literature review if interviewees identified the challenge. As a result of the inputs, the following two challenges were incorporated into the final benefits list (see Table 6):

- Added vendor lock-in. Vendor lock-in occurs when a customer becomes heavily dependent on a particular vendor for products, services, or technologies and switching to an alternative vendor becomes impractical or costly. Vendor lock-in for a digital tool can lead to pricing and negotiation disadvantages. Interviewees highlighted the difficult situation of being limited to one vendor, resulting in less bargaining power and reduced motivation to efficiently address issues. With limited competition from multiple vendors, the organization may have less leverage in negotiating contract terms and pricing structures. For example, digital tool developer 2 said, "We do not want to be locked in to one company. We need to be able to work with multiple companies."

- Added adversity to risk. During the interviews, acquisition professionals highlighted the challenge of reluctance to take risks when adopting new digital tools. Specifically, digital tool end users expressed hesitance to transition their work to a new digital tool due to the fear of potential tool failure and the subsequent need to redo their tasks. In addition, discussions touched upon lack of awareness and resistance to change as contributing

> factors to this challenge. For example, digital tool developer 8 remarked, "There were numerous people on my team who would keep a copy of all their contract files on their computer and transfer them only when necessary because they were worried their work would not transfer into CON-IT."

The challenges posed by vendor lock-in and adversity to risk are worthwhile additions to the list of challenges identified in digital tool integration. These challenges show the importance of the skills and expertise of DAF acquisition professionals. Given the unique environment of the DAF, it is crucial to recognize and address these challenges.

Table 6. Final Challenges of Digital Tools

Challenges	Systematic Literature Review	Interviews
complexity	x	x
lack of technological knowledge	x	x
cost	x	x
system interoperability	x	x
data quality	x	x
vendor lock-in		x
adversity to risk		x
lack of well-structured procurement process	x	
political coordination	x	
identification of providers that implement digital tools	x	
capacity of managers	x	
key performance indicators	x	
change management	x	
time of implementation	x	
social and environmental concerns	x	
shortage of skilled labor to understand technology	x	
poor understanding of the real benefits	x	x
personal autonomy	x	
people worried about losing their job	x	
distrust of benefits	x	
training	x	x
information security	x	
endorsement and prioritization of leadership	x	
concerns about organizational negative impacts	x	
data governance & compliance	x	x
limited infrastructure to support technology	x	
technology longevity	x	

D. SUMMARY

This chapter provided a discussion and analysis of the systematic literature review and interviews. It presented the findings in three areas: the matrix showing the mapping of digital tools to the service acquisition process, the benefits of digital tools, and the challenges of digital tools. The following chapter provides a summary of the findings, presents recommendations, and includes areas of further research.

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V. SUMMARY, RECOMMENDATIONS, AND FURTHER RESEARCH

This chapter provides a summary of the findings and recommendations based on the research conducted and answers to the primary and secondary research questions. Limitations of this research are discussed. Additionally, areas of further research are presented.

A. ANSWERS TO RESEARCH QUESTIONS

There is one primary research question and two secondary research questions. Each question will be addressed individually and include a discussion about the findings and recommendations.

1. Primary Research Question

The primary research question was, "What digital tools are available to be integrated into the DAF's service acquisition process?"

a. Findings

The findings from the research encompassed a total of 12 digital tools from a systematic literature review and interviews. An examination of scholarly sources, established trends, and recommendations within the service acquisitions field led to the identification of 11 digital tools; one additional digital tool was identified from the interviews. There was an overlap of two digital tools between the systematic literature review and the interviews. These digital tools provided a foundation for understanding the landscape of digital technology adoption. The interviews highlighted three digital tools, web servers, cloud computing, and RPA/bots, that are currently being used by acquisition professionals. These digital tools show the DAF's current digital tool adoption in service acquisitions. The interviewees had limited familiarity with the digital tools discussed solely in the systematic literature review: blockchain, AI, IoT, big data, XR, CPS, RFID, digital twins, and metaverse. The DAF can utilize these findings as a basis for evaluating their

needs and goals, then strategically select and implement the most suitable digital tools to support and advance the service acquisition process.

b. Recommendations

Ideally, acquisition professionals are exposed to various digital tools to assist them with service acquisitions. While DAF acquisition professionals currently use cloud computing and RPA/bots, the majority of interviewees commented that the transition to adopting web servers was difficult due to their lack of familiarity with the new digital tools. It is imperative that all DAF acquisition professionals receive training on the utilization of cloud computing and RPAs/bots. Additionally, new digital tools should be incorporated into the training curriculum. There are nine digital tools—blockchain, AI, IoT, big data, XR, CPS, RFID, digital twins and metaverse—with which acquisition professionals are not yet familiar. Education and exposure campaigns, tests, and sandboxes can aid in getting the workforce up to speed. In addition, implementing a phased rollout strategy that prioritizes upcoming digital tools the DAF has slated for deployment will effectively prepare the DAF acquisition workforce. This approach ensures that the workforce gains familiarity with the new digital tools before their mandatory implementation. For instance, if AI is the next digital tool scheduled for integration into DAF service acquisition operations, initiating a training program now will familiarize the workforce with AI's capabilities. The DAF has been making progress to enhance familiarity with digital tools and promote digital literacy. The latest Air Force Installation Contracting Center Flight Plan underscores the importance of improving education on AI and machine learning. Nonetheless, there remains a notable gap that needs to be addressed.

2. Secondary Research Questions

The secondary research questions are focused on understanding the benefits and challenges of integrating digital tools in DAF service acquisition.

a. The second research question was, "What are the benefits to integrating digital tools into the DAF service acquisition process?"

(1) Findings

The systematic literature review and interviews demonstrated numerous benefits to integrating digital tools in the DAF service acquisition process. The literature highlighted improved visibility, enhanced management decision-making, and increased operational effectiveness as main advantages. The interviews further supported increased operational effectiveness as a benefit. Additionally, the interviews revealed that digital tools can promote more flexibility and collaboration in the acquisition process. The top benefit cited by digital tool developers was collaboration, while digital tool end users identified flexibility as the top advantage of digital tools. In summary, integrating digital tools facilitates visibility, informed decision-making, flexibility, collaboration, and overall effectiveness for DAF acquisitions. Both existing literature and current perspectives from those involved in acquisitions validate that digital integration offers multiple advantages in modernizing and streamlining the procurement of essential services. Moving forward, these identified benefits provide a compelling case for advancing digitalization to optimize the DAF's acquisition service process.

(2) Recommendations

Digital tool integration can offer significant benefits to the DAF service acquisition process, and there should be a prioritization and acceleration of digital tools across the DAF service acquisition process. The emphasis should be placed on the benefits identified by digital tool end users. Flexibility was the top advantage of digital tools noted by digital tool end users. Because these individuals interact with digital tools daily, it is crucial that these tools provide digital tool end users with the flexibility needed to perform their tasks effectively. Both the literature and the perspectives of acquisition professionals validate that digital tool integration offers benefits in modernizing and streamlining the service acquisition process. Moving forward, these benefits provide justification for advancing digital tool integration to improve the DAF's service acquisition process.

Another recommendation is to develop and implement a comprehensive change management plan for the integration of digital tools into DAF service acquistion. This plan should focus on ensuring that the benefits of enhanced operational effectiveness and informed management decision-making are fully realized. Key components of the change management plan may include: stake holder engagement, process alignment, training and skill development and performance measures. By implementing a robust change management plan, the DAF can ensure that the integration of digital tools throughout the service acquisition process is successful and delivers tangible benefits in terms of operational efficiency, decision-making capability, and collaboration.

b. The third research question was, "What are the challenges to integrating digital tools into the DAF service acquisition process?"

(1) Findings

The research revealed several challenges that must be addressed for successful digital integration into the DAF service acquisition community. Both the literature review and interviews pointed to system interoperability as a consistent barrier, highlighting existing platform and interface incompatibilities that would hinder the adoption of newer innovations. Additionally, the interviewees raised concerns around inadequate user training, suggesting current skill gaps among the acquisition workforce in leveraging digital tools. Finally, data quality was an obstacle that could undermine decision-making. These challenges interrelate and compound one another. For example, poor data quality feeds analytical models that generate misleading insights and recommendations. Additionally, limited training on interfacing with new cross-platform digital systems restricts user adoption. Users who want to incorporate new digital tools may find that they are unable to do so if the tools do not comply with Federal Risk and Authorization Management Program standards or have Authorities to Operate to be integrated into the DAF network. Without interoperability standards in place, complex custom integrations that strain budgets and resources are required. DAF service acquisition digital transformation cannot happen without addressing the challenges of data quality, cost, and system interoperability.

(2) Recommendations

DAF senior leadership could allocate funding toward technical upgrades aimed at addressing interoperability gaps. System interoperability improvements will begin laying the infrastructure groundwork for technological adoption. Next, implementing mandatory digital skill training across various acquisition roles could help improve technical knowledge about digital tools. Another recommendation is to ensure any new tools developed through avenues like SBIRS are built within an approved cloud environment such as Amazon Web Services or Azure. This guarantees that if these tools are selected for further development, they are already being constructed in a deployable cloud environment. Finally, instituting formal data governance and management protocols on an enterprise-wide scale would improve the challenge of data quality.

Another recommendation to expedite the implementation of digital tools within the DAF acquisition process is to develop a standardized Authority to Operate (ATO) template tailored to specific digital tools. This blanket ATO would streamline the approval process by incorporating pre-approved elements and best practices, thereby reducing the time required for new organizations interested in adopting these tools. For instance, if creating a blanket ATO for artificial intelligence (AI), it would encompass a comprehensive set of precautions and steps that have proven successful in expediting the implementation timeline. This may include security protocols, compliance framework, data governance policies, training and education and continuous monitoring and evaluation. By implementing a blanket ATO tailored to specific digital tools like AI, the Air Force can provide a standardized framework that expedites the approval process for new organizations seeking to integrate these tools into their operations. This approach would save time and resources while also ensuring consistency, security, and compliance across the adoption of digital tools within the DAF network.

B. LIMITATIONS OF THE RESEARCH

The choice of keywords used in the systematic literature review and the size of the interviewee sample represent the prominent limitations of the research. The effectiveness of a literature review heavily relies on the selection of appropriate keywords to ensure

comprehensive coverage of relevant studies. Limitations in the choice of keywords may result in overlooking potentially valuable sources of information, leading to bias in the review process. This limitation was not overcome, because the key words selected, were based on the scoping studying and may be influenced by selection bias of the sources. Conducting further research with more keywords which encompass a broader pool of terminology will overcome this limitation.

The size of the interviewee sample directly impacts the robustness and generalizability of qualitative findings. A small sample size limited the diversity of perspectives captured, potentially compromising the validity of the study's results and findings. The sample size was limited due to the time available to complete the research and the small number of acquisition professional available for interviews. This is a beneficial avenue for more research and is discussed further in areas for further research. Despite the limitations of the research, the outcomes provide great opportunities for implementing digital tools into the service acquisition process.

C. AREAS FOR FURTHER RESEARCH

The research for this project revealed four areas for further research related to contract digital tool integration and the DAF service acquisition process.

1. Conduct Interviews with a Larger Sample Size

Expanding the research to include a larger sample size could enhance the research's scope and depth. One approach would be to start by interviewing all DAF digital tool developers and end users at a single major command. Additionally, another sample could be drawn from across all DAF digital tool developers and end users. The insights gained from these interviews may uncover additional digital tools as well as provide valuable insights into the benefits and challenges associated with their integration.

2. Research the Combination of Digital Tools

One theme identified in the systematic literature review was the integration of multiple digital tools within service acquisition processes. The systematic literature review explored the concept of leveraging each digital tool's specialized functionality and then

sharing relevant information with another digital tool specialized in subsequent steps of the service acquisition process. By combining various digital tools throughout the DAF service acquisition process, this approach has the potential to reduce reliance on a single digital tool and bridge gaps across the entire process. A mixed methods approach combining qualitative and quantitative methods could be used to research the effectiveness of combining digital tools in service acquisition. Qualitative methods could include interviews with acquisition professionals focusing on their satisfaction levels, benefits and drawbacks of digital tools, and strategies for overcoming obstacles. In addition, researchers could review case studies about organizations that utilized multiple digital tools and consider their implementation processes, challenges, and outcomes. Quantitative methods could include surveys with acquisition professionals about their satisfaction with and frequency of digital tool usage, perceived benefits and drawbacks, and overall effectiveness of digital tool combinations.

3. Explore How the Integration of Digital Tools Might Evolve in Tandem with Reconceptualization of the Service Acquisition Process

Future researchers could explore how the integration of digital tools might evolve in tandem with potential changes to the service acquisition process. At the program executive office level how the service acquisition process could be reconceptualized. For instance, if we conceptualize the service acquisition process as circular, where step seven, Manage Performance seamlessly, transitions into step one, Form the Team, it prompts consideration of how digital tools would be strategically arranged. The intent to reconceptualize the service acquisition process from linear to circular. Revisiting the process and its perspective could also influence the composition of digital toolsets supporting the service acquisition process. Viewing the process in a non-linear manner may reveal new insights, such as the need for market research within multiple stages, including step seven. In such cases, tools tailored for market research could vary depending on the stage. For example, while exercising an option typically occurs in step seven, conducting market research beforehand using tools like the IoT could provide valuable insights into performance needs and capacity requirements. Thus, future research could seek to

understand the interplay between process evolution and the strategic deployment of digital tools to optimize service acquisition outcomes.

4. Evaluate DAF Policies about Digital Tools

DAF policies shape the way DAF acquisition professionals can utilize digital tools. To facilitate the adoption of a broader range of digital tools, it is important to assess the policies governing the usage of digital tools on DAF networks. One such policy is the ATO. This policy mandates that any technology must undergo review and approval before connecting to the DAF network. A potential solution discussed in the interviews involves implanting blanket ATO compliance. Under this approach, new users would receive up to 40% coverage under the ATO for the desired digital tool. The remaining 60% requires providing details regarding security protocols and an implementation plan for the organization's use of the digital tool. The implementation of blanket ATO has the potential to speed up the integration timeline for new digital tools.

D. CONCLUSION

This research sheds light on the critical role of digital tools in enhancing DAF service acquisitions. Through a systematic literature review and insightful interviews, a total of 12 digital tools were identified. The interviews indicated acquisition professionals had familiarity with a few but not all of the digital tools mentioned in the literature. Blockchain, AI, IoT, cloud computing, big data, RPAs/bots XR, CPS, RFID, digital twins, metaverse, and web servers have the potential to revolutionize acquisition processes by offering increased visibility, informed decision-making capabilities, flexibility, collaboration opportunities, and overall effectiveness for the DAF. However, despite their potential benefits, challenges persist. The DAF's digital transformation journey must confront issues surrounding data quality, cost considerations, and system interoperability to fully realize the potential of these digital tools. Addressing these challenges is essential for ensuring the success of DAF acquisition efforts in the evolving digital landscape. Acquisition professionals should consider the untapped potential offered by leveraging blockchain, AI, or XR technologies from the beginning of acquisition planning. By embracing innovation and overcoming obstacles, the DAF can leverage digital tools to

streamline acquisitions, enhance operational efficiency, and ultimately fulfill its mission with excellence in the years to come. This is an opportunity to embark on a transformative journey, where challenges are viewed as steppingstones to progress and innovation serves as the driving force propelling DAF toward success.

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APPENDIX

A. INTERVIEW QUESTIONS

User experience and background questions

1.Can you briefly describe your role and responsibilities in service acquisition?

2.How often do you use digital tools in the service acquisition process?

3. What are the main objectives of your organization when using digital tools for service acquisition?

Functionality (usability and user experience), integration and compatibility

1 When I say digital tools what comes to mind?

2 When I say service acquisition what comes to mind?

3 What digital tools does your organization currently use for service acquisition?

4 Are there any aspects of these tools that your organization finds challenging or frustrating to use?

5 Can you share a recent experience where a digital tool made the service acquisition process easier or more efficient for your organization?

6 How well do the digital tools your organization uses integrate with your existing systems or software?

7 Does your organization encounter any compatibility issues when using these tools with other organizational tools or platforms?

8 If your organization could make any improvements to the digital tools for service acquisition, what would they be?

9 Can you list any attributes that your organization would consider to be exciters (would make a DT delightful to use)? How about killers (would make a DT unusable by the organization)? What attributes would your organization require as mandatory?

7 What is a complete killer for your organization to use a digital tool?

Benefits, collaboration, communication, training, and support

1 If your org field uses any DT, did they provide effective training across the organization?

2 How easy is it for your organization to access support or troubleshooting assistance when your organization encounters issues with these tools?

3 How do these digital tools facilitate collaboration and communication among team members or stakeholders during the service acquisition process?

4 Are there any improvements that could be made to enhance collaboration within these tools?

Challenges, data security and privacy

1 What does your organization foresee as the future trends in digital tools for service acquisition?

2 Are there emerging technologies or capabilities your organization thinks would be valuable in this context?

3 Does your organization believe that the cost of using these digital tools is justified by the benefits they provide in service acquisition?

4 Are there any examples of cost savings or increased efficiency attributed to these tools?

5 How is the security of the data shared or stored within these digital tools during service acquisition?

6 What measures or features does your organization think are essential to ensure the privacy and security of sensitive information in these tools?

Final Thoughts

1 Is there anything else to share about your organization's experiences with digital tools in service acquisition?

2 Does your organization have any recommendations for how digital tools can better support your role?

3 Does your organization have any recommendations about the proposed matrix mapping digital tools and the Air Force service acquisition process?

B. SYSTEMATIC LITERATURE REVIEW DIGITAL TOOLS

Digital Tool	Frequency	Description of Digital Tool	Propose Function in DAF Service Acquisition Process
Artificial Intelligence (AI)	50	AI is designed to duplicate "problem solving and decision-making capabilities" of humans (Britannica n.d.). This includes generative AI, natural language processing and machine learning. Artificial Intelligence includes a variety of functionality and natural language processing.	AI is discussed in every step of the service acquisition process. **Step 1** Review the technical experience need for the acquisition and match to the background of the members of the MFT. **Step 2** Analyze the previous acquisition strategy and compare to the current strategy with natural language processing. **Step 3** Review companies currently capable of meeting the specifications in the performance work statement (PWS) and developing a strategy for the best fit for the North American Industry Classification System (NAICS) code for the MRR. **Step 4** Aid in writing the QASP to ensure the important performance criteria are included. **Step 5** Determine the protentional risks and benefits from selecting contract types. **Step 6** Negotiation support based on an analysis of market trends, previous history

Digital Tool	Frequency	Description of Digital Tool	Propose Function in DAF Service Acquisition Process
			and pricing data to create a strategy and make adjustment in real time during the negotiation. **Step 7** Assisting to gather data for monthly and quarterly surveillance to tracking the contractor's performance rating in CPARS
Blockchain	13	Blockchain is a network of decentralized and distributed data called "ledgers" (Budhi, n.d.) Each segment of data is a block. The blocks connect to form a chain.	Blockchain is discussed in steps five, six and seven. **Step 5** Acquisition planning documents such as Acquisition strategy(AS), market research report (MRR) and quality assurance surveillance report (QASP) can be stored and protected in blockchain. It will protect the integrity of the information in solicitation by only allowing authorized parties to view the solicitation and supporting acquisition documents. **Step 6** Verify the information in the proposals matches the solicitation **Step 7** Issue secure invoice payments

Digital Tool	Frequency	Description of Digital Tool	Propose Function in DAF Service Acquisition Process
Internet of Things (IoT)	12	Objects in the physical world are equipped with sensors, which can "track parameters like temperature or motion, as well as any alterations in their surroundings" (McKinsey, n.d.b). The sensors and actuators establish "communication via the internet computing systems that can effectively monitor and manage the well-being and functioning of the interconnected objects and machinery" (McKinsey, n.d.b)	IoT can be used in step seven performance management step to monitor the performance of aircraft maintenance. **Step 7** For example if there is a maintenance contract that requires the ensure the quality assurance of the maintenance. IoT could be used for predictive maintenance with sensors collecting data on temperature, pressure, vibration. The data is analyzed and used to anticipate when to schedule maintenance.
Cloud Computing	9	Computing services includes servers, storage, databases, networking, software, analytics, and intelligence on the internet opposed to stored on hardware (Microsoft Azure n.d.)	Cloud Computing is discussed in all the steps of the service acquisition process. **Step1** The MFT writes the charter and acquisition planning documents in a shared workspace stored on the cloud. **Step 2** All members of the MFT can access the acquisition strategy documents and work simultaneously making edits and sharing ideas. **Step 3** Previous MRR are stored and analyzed to write requests for information (RFI).

Digital Tool	Frequency	Description of Digital Tool	Propose Function in DAF Service Acquisition Process
			Step 4 Analyze previous service contracts and current business leaders to derive the independent government cost estimate (IGCE). **Step 5** Tracking workload assignments and progress for each member of the MFT. **Step 6** Storing and synthesizing the proposals to debrief the unsuccessful offerors. **Step 7** Compiling and analyzing the feedback collected from customer about the contractor's performance. Present the findings at the performance review meeting.
Big Data	6	Big data is "structured, semi-structured, and unstructured data accumulation" (BasuMallick, 2022). The data can be used for "insights and employed in advanced analytical applications such as predictive modeling and machine learning" (BasuMallick, 2022).	Big data is discussed in steps two thru seven. **Step 2** Reviewing the current acquisition strategy by evaluating past performance data and highlighting areas of weakness. **Step 3** Accumulating data from companies that specialize in the service and compare to the current performance metrics to identify the gaps between both sources of information.

Digital Tool	Frequency	Description of Digital Tool	Propose Function in DAF Service Acquisition Process
			Step 4 Define the requirement based on the current data describing the capabilities from industry leaders. **Step 5** Write the performance incentives with synthesis of data collected from market research. **Step 6** Finalize the QASP with assessment metrics that include collecting data during each monitoring period. **Step 7** Use the data collected to determine the CPARS rating.
Robotic Process Automation (RPA)	6	Robotic process automation is commonly referred to as a "bot." It is software applications "designed to perform repetitive automated tasks" (DOD Builds AI Tool to Speed up 'Antiquated Process' for Contract Writing, 2023). The bots can "imitate and replicate specific tasks, streamlining processes effectively" (Gartner. (n.d.).	RPAs are discussed in step seven. **Step 7** A bot could compare invoices to the amount on the contract and speed up the validation and approval of invoices.

Digital Tool	Frequency	Description of Digital Tool	Propose Function in DAF Service Acquisition Process
Extended Reality(XR)	5	Blends Augmented Reality (AR) and virtual reality (VR) to merge the physical and virtual world.	XR is described in step seven managing performance. **Step 7** Verify the completion of performance. For example, on an aircraft maintenance contract. Create a 3D rendering of an aircraft after inspection. Review the 3D model, record the findings and compare to the inspection report.
CPS (cyber-physical system)	4	It captures the data using sensors, computes and communicates alerts to the systems *(*ScienceDirect n.d.)	Cyber-physical systems are discussed in steps four thru seven. **Step 4** Gather data on the prospective contractor's technical risk by assessing the maturity of their technology. **Step 5** Create a supply chain model tracing the logistics for operations and sustainment of the service. **Step 6** Debriefing the successful and unsuccessful offerors with the data collected from the CPS. **Step 7** Post award monitoring and performance analysis of the service.
Radio Frequency Identification (RFID)	3	Radio Frequency Identification (RFID) technology employs radio waves for the	RFID is discussed in step seven.

Digital Tool	Frequency	Description of Digital Tool	Propose Function in DAF Service Acquisition Process
		identification of individuals or objects. A reading device can extract information from a wireless device or "tag" remotely, without the need for physical contact or a direct line of sight (Department of Homeland Security, n.d.)	**Step 7** Tracking the location of government furnished property (GFP) and assisting with the return of the GFP at the conclusion of the contract.
Digital twins	2	Digital twins are a virtual representation of a "physical entity, whether it be an object, individual, or a process, within a digital environment that replicates its real-world context" (McKinsey, n.d.a.). Digital twins serve as valuable tools for organizations, "enabling them to simulate real scenarios and their corresponding results, thereby enhancing their decision-making capabilities" (McKinsey, n.d.a.)	Digital twins were discussed steps five thru seven. **Step 5** Run scenarios with multiple incentive structures. Determine which incentive structure would yield the desired objectives. **Step 6** Evaluate the strength and weakness in proposals to determine the successful offeror. **Step 7** Physical assets can have a virtual duplicate for real time analysis and monitoring of the performance.
Metaverse	1	The metaverse is the emerging 3-D-enabled digital space that uses virtual reality, augmented reality, and other advanced internet and semiconductor technology to allow people to	The metaverse was mentioned in steps three thru seven. **Step 3** host an industry day in the virtual environment with a 3D representation of the contract details.

Digital Tool	Frequency	Description of Digital Tool	Propose Function in DAF Service Acquisition Process
		have "lifelike personal and business experiences online" (McKinsey, n.d.c)	**Step 4** Developing prototypes of the design features the DAF is interested in including **Step 5** Release a draft solicitation with prototypes submission in the metaverse **Step 6** proposal evaluation with contractors submitting their virtual prototypes and evaluators interacting with the prototypes to create a greater understanding of implications. **Step 7** analyzing the performance in the metaverse displaying the progress in 3D image to demonstrate work that is completed

Adapted from Abels and Hahn (2006), Abdollahnejadbarough et al. (2020), Bag et al. (2020), BasuMallick (2022), Bienhaus and Haddud (2018), Brinch, M. (2018). Chehbi-Gamouran et al. (2020), Chowdhary et al. (2011), Chu et al. (2020). De Mauro et al. (2016). Handfield et al. (2019). Hazen et al. (2014), Heckman (2023). Hofmann (2017). Huang and Handfield (2015). Kache and Seuring (2017), Liu et al. (2011), Pitchipoo et al. (2013), Pournader et al. (2019), Roberts et al. (2014), Rusthollkarhu et al. (2022), Sanders and Ganeshan (2018), Schoenherr and Speier-Pero (2015), Shore and Venkatachalam (2003), Singh et al. (2015), Singh et al. (2018), Singh and Singh (2019), Sodero et al. (2019), Tan et al. (2015), Waller and Fawcett (2013), Zou et al. (2020).

C. BENEFITS FROM SYSTEMATIC LITERATURE REVIEW

Benefit	Frequency	Literature Reviewed
Visibility	16	Andersson et al., 2022 Aoun et al., 2021 de Paula Ferreira et al., 2022 Govindan et al., 2024 Guida et al., 2023 Kosmol et al., 2019 Mahlamäki et al., 2020 Maheshwari et al., 2023 Meyer & Henke, 2023 Núñez-Merino et al., 2022 Rusthollkarhu et al., 2022 Schmidt & Wagner, 2019 Shahaab et al., 2023 Siciliani et al., 2023 Toukola et al., 2023 van Noordt & Tangi, 2023

Benefit	Frequency	Literature Reviewed
Management Decision Making	13	Alshahrani et al., 2022 Benitez et al., 2020 Coşkun & Kazan, 2023 Govindan et al., 2024 Guida et al., 2023 Klievink et al., 2016 Maheshwari et al., 2023 Núñez-Merino et al., 2022 Rusthollkarhu et al., 2022 Schmidt & Wagner, 2019 Siciliani et al., 2023 Sunio et al., 2023 Wilson & Mergel, 2022
Operational Effectiveness	11	Andersson et al., 2022 Chen et al., 2023 Coşkun & Kazan, 2023 de Paula Ferreira et al., 2022 Govindan et al., 2024 Maheshwari et al., 2023 Mahlamäki et al., 2020 Núñez-Merino et al., 2022

Benefit	Frequency	Literature Reviewed
		Shahaab et al., 2023 Toukola et al., 2023 Wilson & Mergel, 2022
Flexibility	10	Alshahrani et al., 2022 Aoun et al., 2021 Benitez et al., 2020 da Silva et al., 2023 de Paula Ferreira et al., 2022 Maheshwari et al., 2023 Mahlamäki et al., 2020 Meyer & Henke, 2023 Shi et al., 2022 van Noordt & Tangi, 2023
Efficiency	9	Aoun et al., 2021 Andersson et al., 2022 Chen et al., 2023 Coşkun & Kazan, 2023 da Silva et al., 2023 de Paula Ferreira et al., 2022 Núñez-Merino et al., 2022 Shahaab et al., 2023 Yu et al., 2022
Transparency	8	Chen et al., 2023

Benefit	Frequency	Literature Reviewed
		de Paula Ferreira et al., 2022 Govindan et al., 2024 Nodehi et al., 2022 Núñez-Merino et al., 2022 Schmidt & Wagner, 2019 Siciliani et al., 2023 Toukola et al., 2023
Cost savings	7	Benitez et al., 2020 Govindan et al., 2024 Guida et al., 2023 Meyer & Henke, 2023 Nodehi et al., 2022 Schmidt & Wagner, 2019 Yu et al., 2022
Collaboration	7	Benitez et al., 2020 Klievink et al., 2016 Núñez-Merino et al., 2022 Rusthollkarhu et al., 2022 Shahaab et al., 2023 Shi et al., 2022 Siciliani et al., 2023
Risk Management	6	Chen et al., 2023 de Paula Ferreira et al., 2022

Benefit	Frequency	Literature Reviewed
		Maheshwari et al., 2023 Rusthollkarhu et al., 2022 Shi et al., 2022 Siciliani et al., 2023
Accuracy	6	Govindan et al., 2024 Maheshwari et al., 2023 Nodehi et al., 2022 Shahaab et al., 2023 Siciliani et al., 2023 Wilson & Mergel, 2022
Data Governance & Compliance	6	Annarelli et al., 2021 de Paula Ferreira et al., 2022 Kosmol et al., 2019 Nodehi et al., 2022 Núñez-Merino et al., 2022 Shahaab et al., 2023
Responsiveness	5	de Paula Ferreira et al., 2022 Guida et al., 2023 Nodehi et al., 2022 Oliveira-Dias et al., 2022 Schmidt & Wagner, 2019
Innovation	5	Annarelli et al., 2021 Benitez et al., 2020

Benefit	Frequency	Literature Reviewed
		Meyer & Henke, 2023 Rusthollkarhu et al., 2022 Sunio et al., 2023
Immutability	5	Aoun et al., 2021 de Paula Ferreira et al., 2022 Nodehi et al., 2022 Schmidt & Wagner, 2019 Shahaab et al., 2023
Sustainability	4	Bag et al., 2020 Núñez-Merino et al., 2022 Sunio et al., 2023 Yu et al., 2022
Reliability	3	da Silva et al., 2023 de Paula Ferreira et al., 2022 Schmidt & Wagner, 2019
Identification of suspicious expenses	3	de Paula Ferreira et al., 2022 Guida et al., 2023 Yu et al., 2022
Integrity	2	Govindan et al., 2024 Shahaab et al., 2023
Smart Contracts	2	Aoun et al., 2021 Govindan et al., 2024
Differentiation	1	da Silva et al., 2023

Benefit	Frequency	Literature Reviewed
Business Intelligence	1	Govindan et al., 2024
Contact and Mass Marketing	1	Rustholllkarhu et al., 2022

D. CHALLENGES SYSTEMATIC LITERATURE REVIEW

Challenge	Frequency	Literature Reviewed
Data Quality	15	Alshahrani et al., 2022 Annarelli et al., 2021 Aoun et al., 2021 Bag et al., 2020 Chen et al., 2023 da Silva et al., 2023 de Paula Ferreira et al., 2022 Guida et al., 2023 Klievink et al., 2016 Kosmol et al., 2019 Maheshwari et al., 2023 Meyer & Henke, 2023 Nodehi et al., 2022 Shahaab et al., 2023 van Noordt & Tangi, 2023
Cost	11	Andersson et al., 2022 Benitez et al., 2020 Govindan et al., 2024 Guida et al., 2023 Klievink et al., 2016 Maheshwari et al., 2023 Rusthollkarhu et al., 2022

Challenge	Frequency	Literature Reviewed
		Schmidt & Wagner, 2019 Sunio et al., 2023 Toukola et al., 2023 Wilson & Mergel, 2022
System Interoperability	11	Benitez et al., 2020 da Silva et al., 2023 de Paula Ferreira et al., 2022 Govindan et al., 2024 Guida et al., 2023 Mahlamäki et al., 2020 Nodehi et al., 2022 Núñez-Merino et al., 2022 Rusthollkarhu et al., 2022 Shi et al., 2022 van Noordt & Tangi, 2023
Technology Longevity	9	Alshahrani et al., 2022 Annarelli et al., 2021 Bag et al., 2020 de Paula Ferreira et al., 2022 Oliveira-Dias et al., 2022 Shahaab et al., 2023 van Noordt & Tangi, 2023 Yu et al., 2022

Challenge	Frequency	Literature Reviewed
Complexity	9	de Paula Ferreira et al., 2022 Govindan et al., 2024 Mahlamäki et al., 2020 Meyer & Henke, 2023 Núñez-Merino et al., 2022 Oliveira-Dias et al., 2022 Rustholllkarhu et al., 2022 Siciliani et al., 2023 Wilson & Mergel, 2022
Lack of Technical Knowledge	9	de Paula Ferreira et al., 2022 Govindan et al., 2024 Meyer & Henke, 2023 Núñez-Merino et al., 2022 Oliveira-Dias et al., 2022 Shi et al., 2022 Siciliani et al., 2023 Wilson & Mergel, 2022 Yu et al., 2022
Limited Infrastructure to Support Technology	8	Alshahrani et al., 2022 Benitez et al., 2020 Govindan et al., 2024 Klievink et al., 2016 Rustholllkarhu et al., 2022

Challenge	Frequency	Literature Reviewed
		Sunio et al., 2023 van Noordt & Tangi, 2023 Wilson & Mergel, 2022
Endorsement and Prioritization of Leadership	7	Benitez et al., 2020 Chen et al., 2023 da Silva et al., 2023 Kosmol et al., 2019 Oliveira-Dias et al., 2022 Shahaab et al., 2023 Wilson & Mergel, 2022
Organizational negative impacts	7	Alshahrani et al., 2022 Annarelli et al., 2021 Benitez et al., 2020 de Paula Ferreira et al., 2022 Guida et al., 2023 Wilson & Mergel, 2022 Yu et al., 2022
Data Governance & Compliance	7	Alshahrani et al., 2022 Aoun et al., 2021 Klievink et al., 2016 Maheshwari et al., 2023

Challenge	Frequency	Literature Reviewed
		Meyer & Henke, 2023 Oliveira-Dias et al., 2022 Sunio et al., 2023
Information Security	6	Benitez et al., 2020 Guida et al., 2023 Maheshwari et al., 2023 Nodehi et al., 2022 Shahaab et al., 2023 Wilson & Mergel, 2022
Distrust of Benefits	5	Coşkun & Kazan, 2023 Guida et al., 2023 Shi et al., 2022 van Noordt & Tangi, 2023 Wilson & Mergel, 2022
Training	5	Coşkun & Kazan, 2023 da Silva et al., 2023 Núñez-Merino et al., 2022 Rusthollkarhu et al., 2022 Yu et al., 2022
Skilled Labor to Understand Technology	4	Andersson et al., 2022 Benitez et al., 2020 Guida et al., 2023

Challenge	Frequency	Literature Reviewed
		Wilson & Mergel, 2022
Personal Autonomy	4	Alshahrani et al., 2022 Andersson et al., 2022 da Silva et al., 2023 Toukola et al., 2023
People Worried about Losing their Job	4	Andersson et al., 2022 Govindan et al., 2024 Meyer & Henke, 2023 Shi et al., 2022
Change Management	3	Guida et al., 2023 Shahaab et al., 2023 van Noordt & Tangi, 2023
Time of Implementation	3	de Paula Ferreira et al., 2022 Guida et al., 2023 Maheshwari et al., 2023
Social and Environmental concerns	3	Govindan et al., 2024 Núñez-Merino et al., 2022 Yu et al., 2022
Identification of Providers that Implement Digital Tools	2	Aoun et al., 2021 Guida et al., 2023
Capacity of Managers	2	de Paula Ferreira et al., 2022

Challenge	Frequency	Literature Reviewed
		Wilson & Mergel, 2022
Key Performance Indicators	2	Chen et al., 2023 Núñez-Merino et al., 2022
Lack of well-structured procurement process	1	Guida et al., 2023
Political coordination	1	Wilson & Mergel, 2022

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