AIRC ACQUISITION INNOVATION RESEARCH CENTER

DoD Budget Justification Book Keyword Search Association: A Proof-of-Concept Demonstration

EXECUTIVE SUMMARY AND REPORT

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ACRONYMS AND ABBREVIATIONS

AI	Artificial Intelligence
BA	Budget Activity
DoD	Department of Defense
FY	Fiscal Year
JADC2	Joint All Domain Command and Control
J-Books	Justification Books
JSON	JavaScript Object Notation
LLM(s)	Large Language Model(s)
ML	Machine Learning
NDAA(s)	National Defense Authorization Act
NLP	Natural Language Processing
OCR	Optical Character Recognition
PB	President's Budget
PPBE	Planning, Programming, Budgeting, and Execution
RDT&E	Research, Development, Test & Evaluation
SAR(s)	Selected Acquisition Report(s)
TacAir	Tactical Aircraft
XML	eXtensible Markup Language

ABSTRACT

When the yearly President's Budget (PB) is submitted to Congress for authorization and appropriations, the Department of Defense (DoD) Comptroller submits several Budget Documents, also called "Justification Books" or "J-Books." These are detailed documents that justify the budgetary requests for specific programs, projects, or activities within the DoD. These documents, currently provided only in PDF format, are individually submitted by each of the military services and the various agencies. Each service and agency submitting their own requests results in disjointed information that can be hard to read and follow.

Further, the Section 809 panel[1] recommendations include that the DoD implement a portfolio-based capability framework (see Section 809 Panel link in the references under the Volume 3 tab, Recommendations 36-39). This recommendation and our intent to make these documents easier to read for all personnel drives the following research question: *Can the existing J-Books be restructured to facilitate a portfolio view and allow the utilization of Artificial Intelligence/Machine Learning (AI/ML) techniques including Large Language Models (LLMs) to answer questions about DoD spending without changing the existing layout and document delivery approach?*

This is the first of two reports to address our results from the investigation of two initial exploratory research approaches. It is an initial proof-of-concept approach that uses a key word search across multiple J-Books to extract the content associated with the key word. For the purposes of this proof-of-concept demonstration, we chose to simply extract the sentences associated with the key word "JADC2" (Joint All Domain Command and Control).[2] JADC2 was chosen as this DoD strategy spans multiple service's Research, Development, Test & Evaluation (RDT&E) J-Book volumes. Subsequent (2nd and 3rd tier) associated acronyms were then extracted using a ChatGPT query of the initial results.

The research documented in this report is rudimentary and is meant to only provide an initial proof-of-concept. A more advanced capability would not only extract all the information associated with the region of the J-Books document but also provide historical analysis across the fiscal years (FY) and budgetary materials, including each FY's National Defense Authorization Act (NDAA). We were able to successfully extract tables from PDF files after putting them through Adobe's® optical character recognition (OCR) algorithm. Hence, we were able to associate cost data across the fiscal years as documented in the FY24 J-Book files. Further, we successfully integrated an LLM (ChatGPT) to provide summaries of the sections of each document and used it to demonstrate simple text queries into a MongoDB. Overall, we feel the results of this initial research are promising and adequately demonstrate the merit of the approach.

[1] For information about the Section 809 Panel statute and what it was empowered to do, see *FY 2016 National Defense Authorization Act (Public Law 114-92)*. The link is provided in the reference section at the end of this report.

[2] For information about JADC2, download and read the DoD's *SUMMARY OF THE JOINT ALL-DOMAIN COMMAND & CONTROL (JADC2) STRATEGY* document. The link is provided in the reference section at the end of this report.

The research team proposes the following recommendations:

- **Discontinue the use of images of tables in budget documents:** While using optical character recognition (OCR) is a viable approach for our demonstration purposes, it is known to introduce errors during the conversion process. The services should stop providing PDF files with embedded images of tables.
- **Provide data in XML[3] or JSON[4] formats:** Although we have described a process for converting PDF documents into either XML or JSON structured data formats, we believe the user would benefit from at least one of these machine-readable formats being provided by the services and the comptroller in addition to the PDF documents.[5, 6]
- **Provide reference tools for parsing and visualizing the data:** In addition to machine-readable XML or JSON, reference tools for parsing and visualization can provide a baseline context for the development of more advanced capabilities.

[3] Online descriptions on what the XML (Extensible Markup Language) format is can be found at: https://www.w3schools.com/xml/default.asp, and https://en.wikipedia.org/wiki/XML.

[4] Online descriptions on what the JSON (JavaScript Object Notation) format is can be found at: https://www.w3schools.com/js/js_json.asp, and https://en.wikipedia.org/wiki/JSON.

[5] This recommendation is consistent with Title LVII, the Financial Data Transparency Act in the FY23 National Defense Authorization Act (https://www.govinfo.gov/content/pkg/PLAW-117publ263/pdf/PLAW-117publ263.pdf).

[6] Requirements for providing budget materials in machine readable format can also be traced to: https://obamawhitehouse.archives.gov/the-press-office/2013/05/09/executive-order-making-open-and-machine-readable-new-default-government-, https://www.whitehouse.gov/wp-content/uploads/2018/06/a11.pdf, and https://comptroller.defense.gov/Portals/45/documents/fmr/Volume_02b.pdf.

JUSTIFICATION BOOKS (J-BOOKS) CONTENT SEARCH AND ASSOCIATION

BACKGROUND

The Department of Defense (DoD) Budget Documents, also called "Justification Books" or "J-Books" are detailed documents that justify their budgetary requests and resource allocation for specific programs, projects, or activities within the DoD. These documents are typically produced as part of the President's Budget (PB) request to Congress in the U.S. federal budgeting process and serve several essential purposes, such as:

Resource Justification: J-Books provide a comprehensive rationale for allocating resources, including funds, personnel, and equipment, for specific defense-related activities. This justification is essential for decision-makers in Congress who assess and approve the DoD budget.

Transparency: J-Books are designed to enhance transparency in the budgeting process. They help the public, Congress, and other stakeholders understand the DoD's financial needs, the objectives of various programs, and how to utilize resources.

Accountability: They hold the DoD accountable for how it spends taxpayer dollars. By detailing each program's expected outcomes and benefits, J-Books allows Congress to assess whether the proposed expenditures align with national defense priorities.

Program Evaluation: These documents with other associated materials (e.g., National Defense Authorization Acts (NDAAs), Selective Acquisition Reports (SARs)) help evaluate the performance and effectiveness of DoD programs. They often include metrics and performance measures, allowing Congress to gauge the success of these programs.

Program Planning: J-Books assist in program planning by outlining goals, objectives, and expected milestones for various DoD initiatives. This information is critical for managing and tracking the progress of these programs.

Congressional Approval: J-Books play a crucial role in the congressional approval process. They are used by Congress to make informed decisions regarding the allocation of defense funds and to ensure that the DoD budget aligns with national defense and security priorities.

PROBLEM STATEMENT

A comprehensive understanding of the complexities and interdependencies of DoD programs, viewed through J-Books, ultimately advances national defense capabilities, and helps in formulating sound budgetary strategies. However, understanding the budgetary implications of various DoD acquisition programs through J-Books is daunting, especially for complex cross-domain strategies like Joint All Domain Command and Control (JADC2). JADC2, which is woven throughout the different branches of the DoD, is challenging. Tools present within the DoD's Advana[7] environment (e.g., GAMECHANGER[8]), and potentially specialized tools built external to the DoD can support human-based analysis.

We provide a conceptual Portfolio Analysis Dashboard using Tactical Aircraft below in Figure 1.[9]

Figure 1: Conceptual Portfolio Analysis Dashboard using Notional Tactical Aircraft (TacAir)

[7] Advana is the Department of Defense's (DoD's) enterprise-wide, multi-domain data, analytics, and artificial intelligence (AI) platform that provides military and civilian decision makers, analysts, and builders with unprecedented access to enterprise tools and capabilities—all in a scalable, reliable, and secure environment.

[8] For additional information on GAMECHANGER, see for example, https://www.dia.mil/News-Features/Articles/Article-View/Article/2926343/gamechanger-where-policy-meets-ai/

[9] Note that OpenAI's ChatGPT and DALL-E terms of service can be found here, https://openai.com/policies/terms-of-use, with their publication policy found here, https://openai.com/policies/sharing-publication-policy. Stock language provided by OpenAI is amended to be the following: *The authors generated this content in part with GPT-3.5 and GPT-4, OpenAI's large-scale language-generation model. Upon generating draft language and DALL-E concept art, the authors reviewed, edited, and revised the language to their own liking and take ultimate responsibility for the content of this publication.*

The primary analyst workstation would allow menu access to various portfolios managed by the Department of Defense (top dual monitor layout in Figure 1 with notional analytical charts and graphs). The arrow depicts a conceptual roller-wheel mouse interface to allow the analyst to select among the various aircraft managed for click-through deep-dives. An alternative concept is the overall TacAir chart on the bottom-left ranking the aircraft by funding in the rows and the Fiscal Year (FY) in the columns with a rolled-up portfolio funding view at the bottom.

The following list describes additional monitor-specific analytical concepts:

Left Monitor:

1. **Newly Proposed Spending Analysis:**
   - **Visual Representation:** Charts and graphs displaying the newly proposed spending.
   - **Details:** Data shows service system contributions, e.g., Air Force, Army, Navy, and Space Force.
   - **Interactivity:** Users can hover over sections of the charts to view exact figures and percentages.
2. **Lines of Effort Details:**
   - **Drill-Down Section:** Interactive selection that allows users to explore various lines of effort.
   - **Information Display:** Provides project names, services involved, and allocated budgets.
   - **User Interaction:** (L/R) clicking on a graph reveals additional information and historical data.
3. **Large Language Model (LLM) Interface:**
   - **Summarization:** An LLM interface support for requesting a quick summarization of the observed trends.
   - **New Queries:** Interface to the back-end database to create normal language data queries to populate selected charts and figures.

Right Monitor:

1. **Past Budget Submissions:**
   - **Tabular Format:** Information on past budget submissions allowing FY-after-FY comparisons.
   - **Graphical Data:** Line graph with trends in budget submissions over time.
   - **Accessibility:** Users can sort and filter this data based on different parameters.
2. **Latest (Real-Time/Monthly/Weekly) Cost/Schedule Performance Data:**
   - **Visual Indicators:** Latest data from the EVMS, cost, schedule, and performance risks.
   - **Color-Coded Alerts:** Risks are indicated using color-coded alerts, providing an immediate sense of any issues. (Further drill-down with the latest SPO risk management updates for details.)
   - **Detailed Metrics:** Information on cost overruns, schedule delays, and other metrics.
3. **User Interface and Navigation:**
   - **Navigation Panel:** Monitors feature intuitive navigation panels for easy access to different sections.
   - **Customization:** Users can customize the views and prioritize the information they find relevant.

APPROACH

Figure 2 shows the overall proof-of-concept flow for our proposed approach. We will discuss in this section the approach taken to implement this analysis flow.

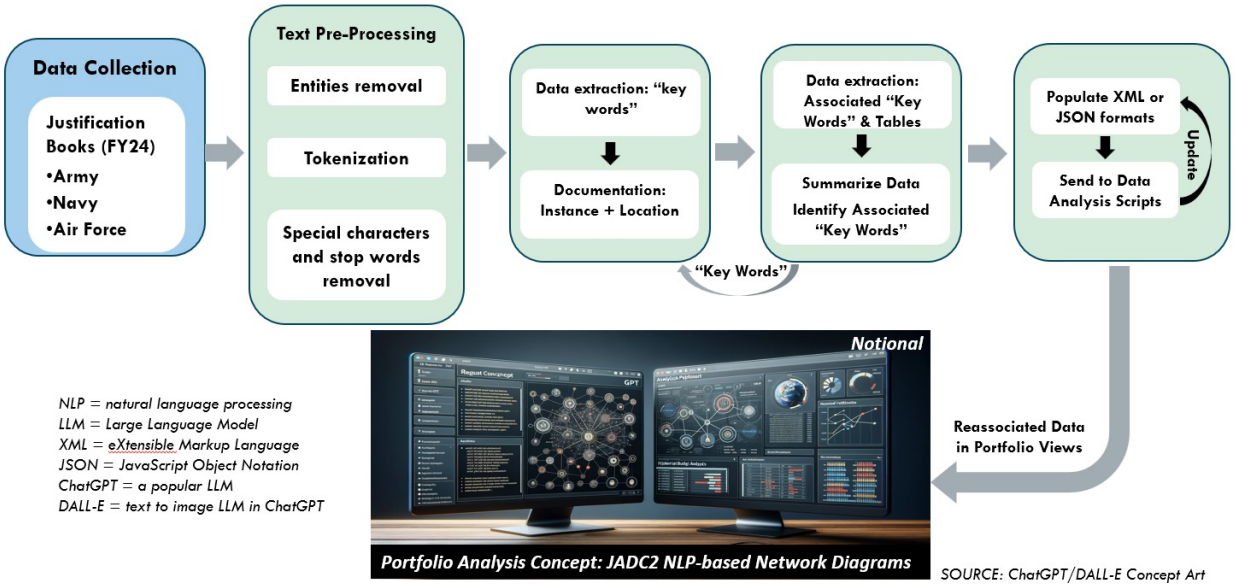

Figure 2: Proof-of-Concept Portfolio Analysis Flow using JADC2 Keyword Search of FY24 J-Books

Our proposed approach provides an initial proof-of-concept for accumulating programs into "portfolio-like" groupings, leading to a clearer representation of budgetary implications across DoD programs. It is important to note that the information accumulated using this NLP approach on J-Books does not result in a true portfolio (as there is information that will be lacking) but is a step towards restructuring the existing content as elements in a portfolio.[10] For this reason, the approach using JADC2 demonstrates a "portfolio-like" representation of these budget materials.

Hence, we believe it will help in the following areas:

Inter-Service Synergy: What are the fundamental mechanisms or strategies to enhance synergy and coordination among the Army, Navy, and Air Force regarding related programs to maximize their effectiveness and interoperability?

Technological Integration: Technology integration should be considered a core component of J-Books analysis. It would clarify how emerging technologies are incorporated into different programs and how they intersect across the various branches.

[10] A true portfolio would include numerous other elements that are not present in the publicly available J-Books, such as resource allocation, strategic value, risk assessments, and mitigation costs, among others.

Resource Allocation: How do allocating resources and budgetary decisions within each branch affect the development and implementation of related programs? What are the trade-offs and challenges associated with resource allocation? How have resource allocation and budget requests changed over time? Can we correlate these temporal fluctuations with risk management behaviors of DoD decision makers?

Operational Implications: Within the J-Books framework, it's essential to understand the functional implications of programs like JADC2 on the specific missions and functions of the Army, Navy, and Air Force. Moreover, it delves into how these branches adapt to accommodate changes to ensure the success of their missions.

This project aims to eventually leverage the promise of Natural Language Processing (NLP) techniques to accumulate data associated with programs (or instances) and strategies within J-Books. Moreover, by harnessing the power of NLP and generative artificial intelligence (AI), the project aims to enhance the understanding of budgetary implications across J-Books.

The overall objectives of this project are described in two phases:

Phase 1. Demonstrate NLP J-Books "portfolio-like" accumulation: After identifying J-Book sections associated with keywords (acronyms) through NLP pattern matching, we plan to associate other materials (e.g., NDAAs, SARs, etc.), thus demonstrating "portfolio-like" budgets and displaying their context in a network diagram.[11]

Phase 2. Add analytics: The project will then prototype an analytical front-end of the information for algorithmic approaches to facilitate a deep understanding of the portfolio's trends. The prototype includes an OpenAI Large Language Model (LLM) front-end to provide responses to chat-like questions regarding the data and text, with visual displays.

METHOD USED TO DEMONSTRATE J-BOOKS KEY WORD EXTRACTION

The efficient processing of large volumes of text-based documents presents a significant contemporary challenge in information management. This section introduces an inventive framework designed to simplify content extraction and the identification of content placement within documents. These processes hold immense importance across diverse domains, including academic research and corporate decision-making, as they facilitate rapid and efficient information retrieval while preparing text for decision support.

Prior to following the process as depicted in Figure 1, the researchers utilized Adobe Acrobat in a pre-processing step to apply optical character recognition (OCR) to convert each image in these documents to provide extractable data. OCR can introduce errors into this analytical process (see for example, Lamba and Madhusdhan). Requiring the Services to not use images in their budget justification documents is our first recommendation to avoid this timely and potentially error prone step.

The framework depicted in Figure 2 contains two key phases: Phase 1, which involves Text Extraction and Summarization, and Phase 2, which focuses on Analytics Extraction.

[11] Network diagrams are used as a graphical depiction of the data. See for example Crane, Hevey, and Widom for some of the benefits from this kind of analysis.

PHASE 1 TEXT EXTRACTION AND SUMMARIZATION

The framework (see Figure 3) that we implemented in our initial Phase 1 script offers a rudimentary but versatile initial toolset for keyword identification, instance location, and associated content extraction.

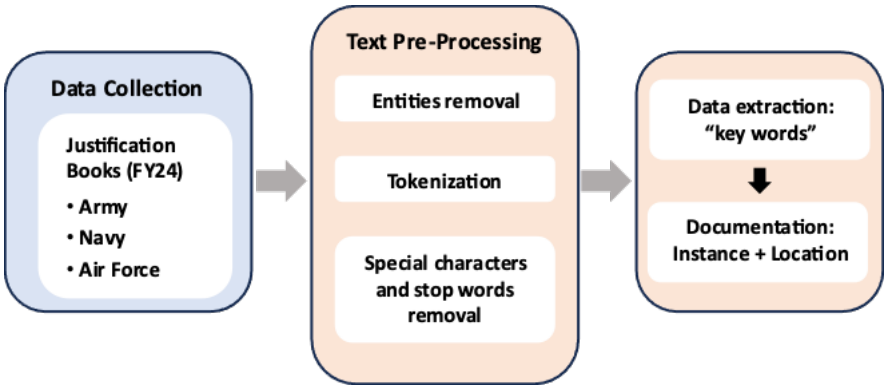

Figure 3: Instance Identification Framework For Phase 1

By automating these processes, the framework enhances the efficiency and effectiveness of information management, allowing users to quickly obtain keyword context and insights from the J-Books.

SCRIPT DESCRIPTION FOR AUTOMATED TEXT IDENTIFICATION AND REPORTING

The following is a summary and explanation of the Python script designed to efficiently process text-based PDF documents within a ZIP archive. The script can process large volumes of text-based PDF documents as it extracts relevant sentences containing specified keywords with their location in these documents. The script then creates a new structured PDF document for subsequent processing.

The Python script has several sections, each serving a specific purpose in the text analysis and report generation process. The main tasks performed by the script include:

Table 1: Python Script Description

Processing Step	Functions or Logic Flow	Function Purpose
Text Analysis	load_pdf(file_path)	Attempts to open and return the contents of a PDF document. It includes error handling for broken records.
	extract_sentences_with_words(doc, words)	Extracts sentences containing specific words from the PDF.
Define Search Words	Configure the script to search for “JADC2”	
Process PDF Files	For each PDF file found in a zip archive:	
	Extract the PDF file to a temporary directory.	
	Load the extracted PDF file and identify sentences containing the specified search words.	
	Prepare content for a report (in PDF format) that contains relevant sentences or a message indicating no sentences were found.	
	Add the relevant sentences or the ‘no sentences found’ message to a contents buffer for the report.	
Create PDF Report	Script prepares a PDF report named "search_results.pdf" for the contents buffer.	
Notify Completion	Script concludes by printing a “PDF report saved as search_results.pdf” message confirming that the PDF report has been saved and the script has completed.	

PHASE 2 PROTOTYPED ANALYTICS FRONT-END

Phase 2 of the framework is intended to provide a prototype of a versatile toolkit for developing analytics, data, text, and visuals. These processes contribute significantly to information organization, retrieval, and insight generation. Figure 4 provides a graphical view of the overall demonstrated capability accomplished prior to the end of the contract.

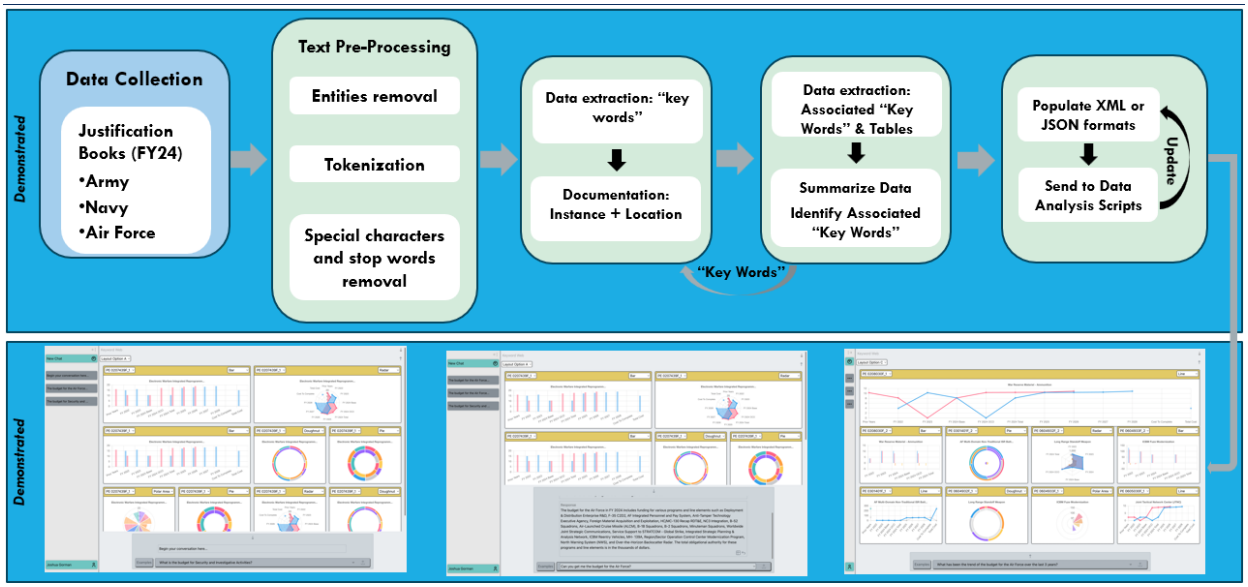

Figure 4: Completed Prototype Work from Phase 1 and Phase 2

Shown in Figure 4 are the completed/demonstrated aspects of the prototype. The top blue box in the figure demonstrates scripts that can extract key words (phase 1). We were then able to send those results into ChatGPT to extract additional keywords to search for, illustrated as the "Key Words" feedback loop in the top-row of the figure. The output was processed to extract Tables from the PDF J-Books files, and successfully associated in the feedback loop of key word search results to create an associated network diagram (Figure 5 on the next page). We also successfully populated JSON files using the extracted tables from these search results and subsequently used those JSON files in a prototyped front-end (the bottom blue box in Figure 4).

The prototyped front-end (the bottom half of Figure 4) includes a ChatGPT interface to query a MongoDB back-end database server containing the J-Books extracted JSON information. The current implementation only includes FY24 Air Force RDT&E volumes I, II, IIIa, and IIIb, but could easily be extended to include all the J-Books' contents. Further work is required to fully integrate the NLP processing in the top half of Figure 4 with the front-end and back-end implementation with the ChatGPT/ LLM interface shown in the bottom half.

Figure 6 (on page 19) provides a larger screengrab demonstrating a changed layout with new tables feeding into the graphics based on the most recent LLM query with its response.

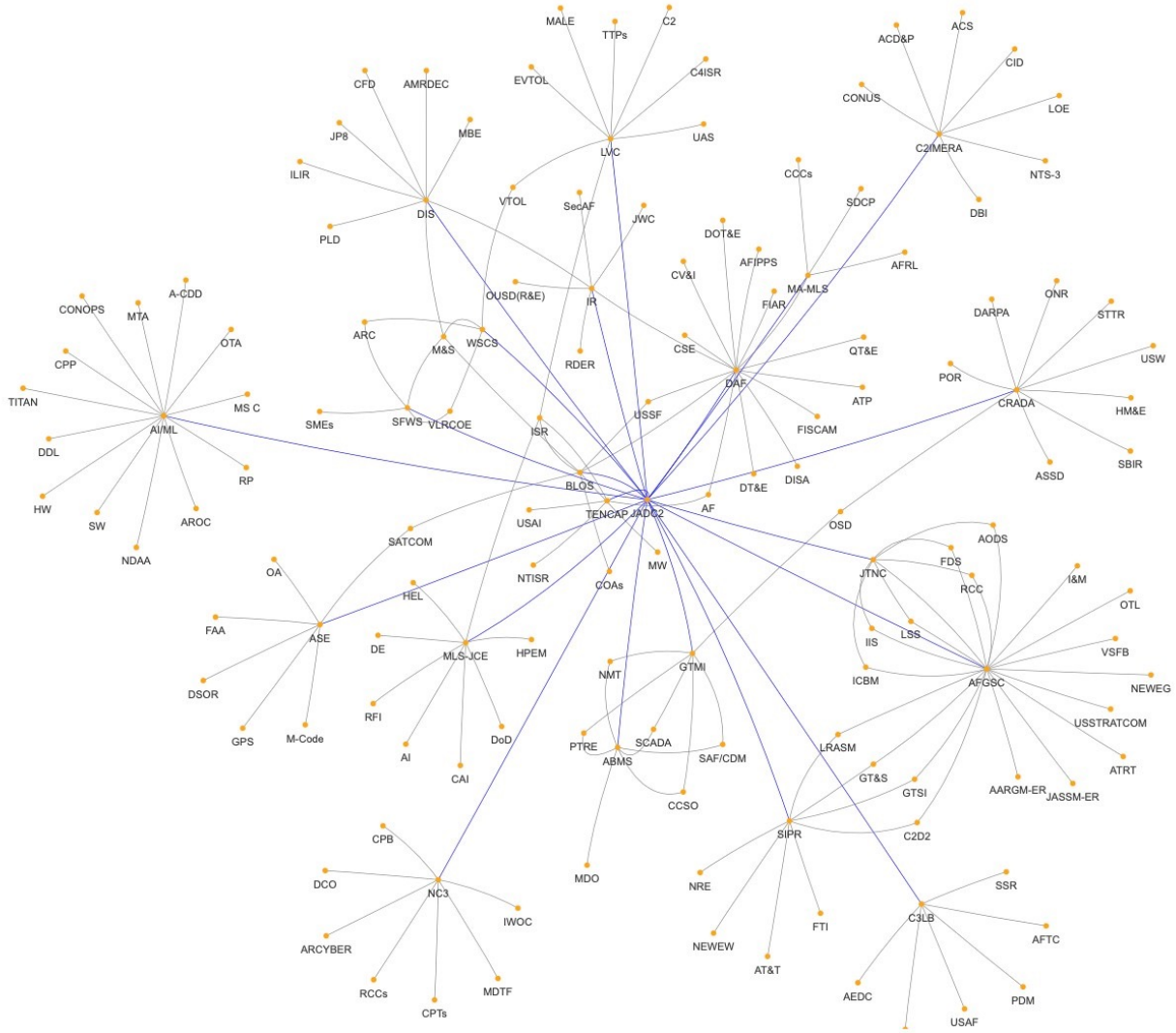

Figure 5: Network Diagram Results from Key Word Processing FY24 J-Books for "JADC2" and Associated Acronyms[12]

[12] We have made no attempt to identify all the acronyms found by the feedback loop for this proof-of-concept report (i.e., all of these acronyms will not be found in the acronym definition section of this report). Future functionality should define acronym categories and use other contextual syntax-based "key words" for correlating concepts and terms for association.

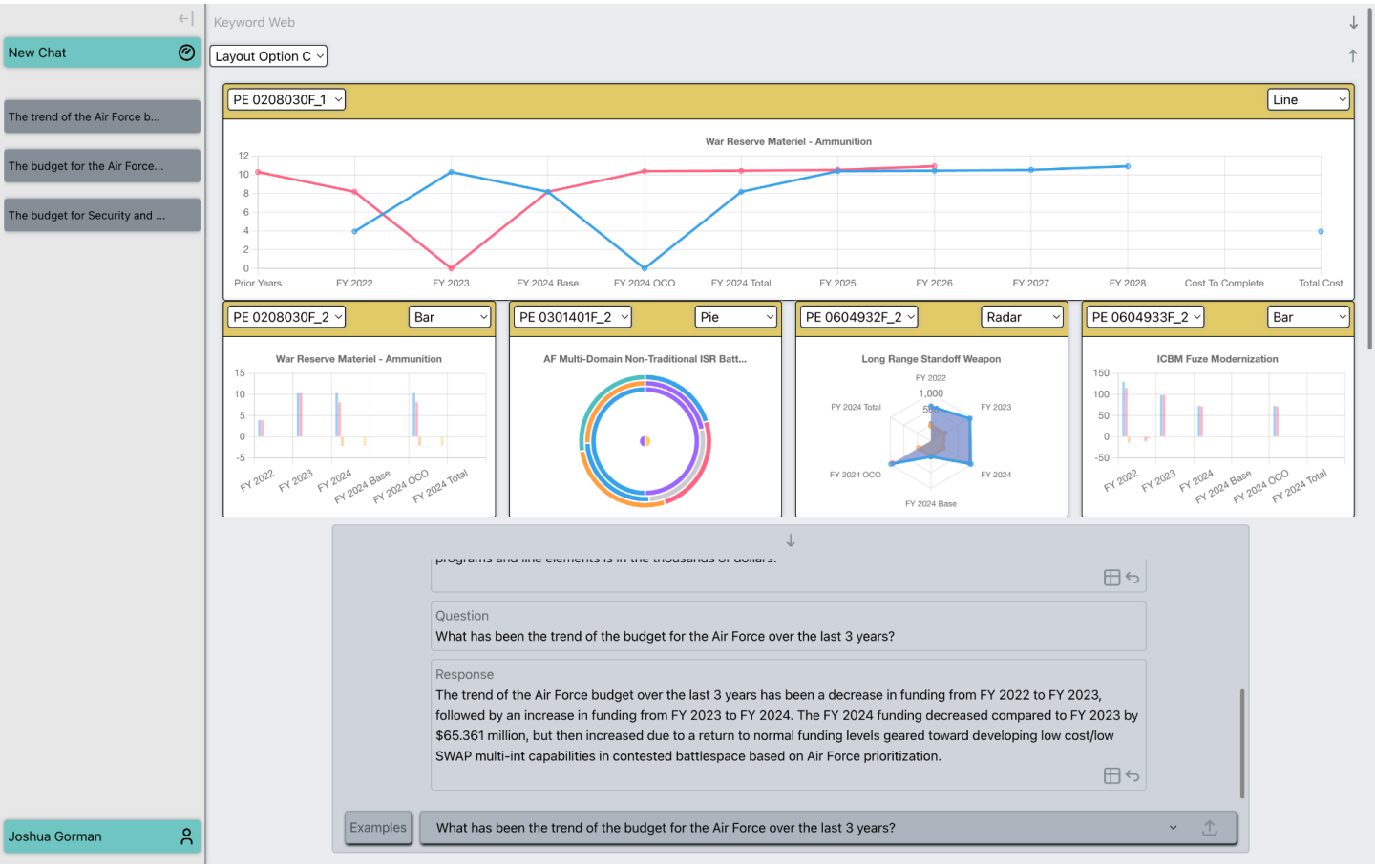

Figure 6: Screengrab Demonstrating a Changed Layout with New Tables Based on the Recent LLM Query with the Response

Finally, since the Phase 2 implementation significantly expanded the Phase 1 codebase, we have elected to provide the code separately from this report.

RECOMMENDED FUTURE WORK

To address the questions specified in the Problem Statement section, future work on this research would address the following:

Integrate the NLP Python and Front-end: The proof-of-concept text extraction script leveraged well-formatted J-Books to extract important contextual information, such as cost data and used other acronyms found in these sections to identify connections. We would demonstrate additional concepts to integrate the NLP scripting approach into the implemented Front-end to populate the back-end database for additional analytical capabilities.

Expand Front-end and Back-end Functionality: The existing capabilities would be expanded to provide additional useful analytical processing.

Extend Processed Capabilities: Include processed J-Books across fiscal year boundaries with the addition of other resources, such as including the National Defense Authorization Act (NDAA) in the files processed.

Full-Context Extraction and Portfolio Reformatting: Expand this proof-of-concept text extraction script to leverage these well-formatted J-Books to extract other important contextual information, such as cost data. We would then demonstrate restricting the data into representative portfolios.

Inter-Service Synergy: Implement semantic network analysis to identify critical nodes and their relationships.[13] Analyze links between these nodes based on their proximity within the text.

Apply community detection algorithms like the Louvain or Leiden algorithms[14] to identify clusters of related content. This approach can reveal the synergy and coordination among the Army, Navy, and Air Force regarding associated programs. Figure 7 (below) illustrates this type of analysis for a project to identify skills within the acquisition community.

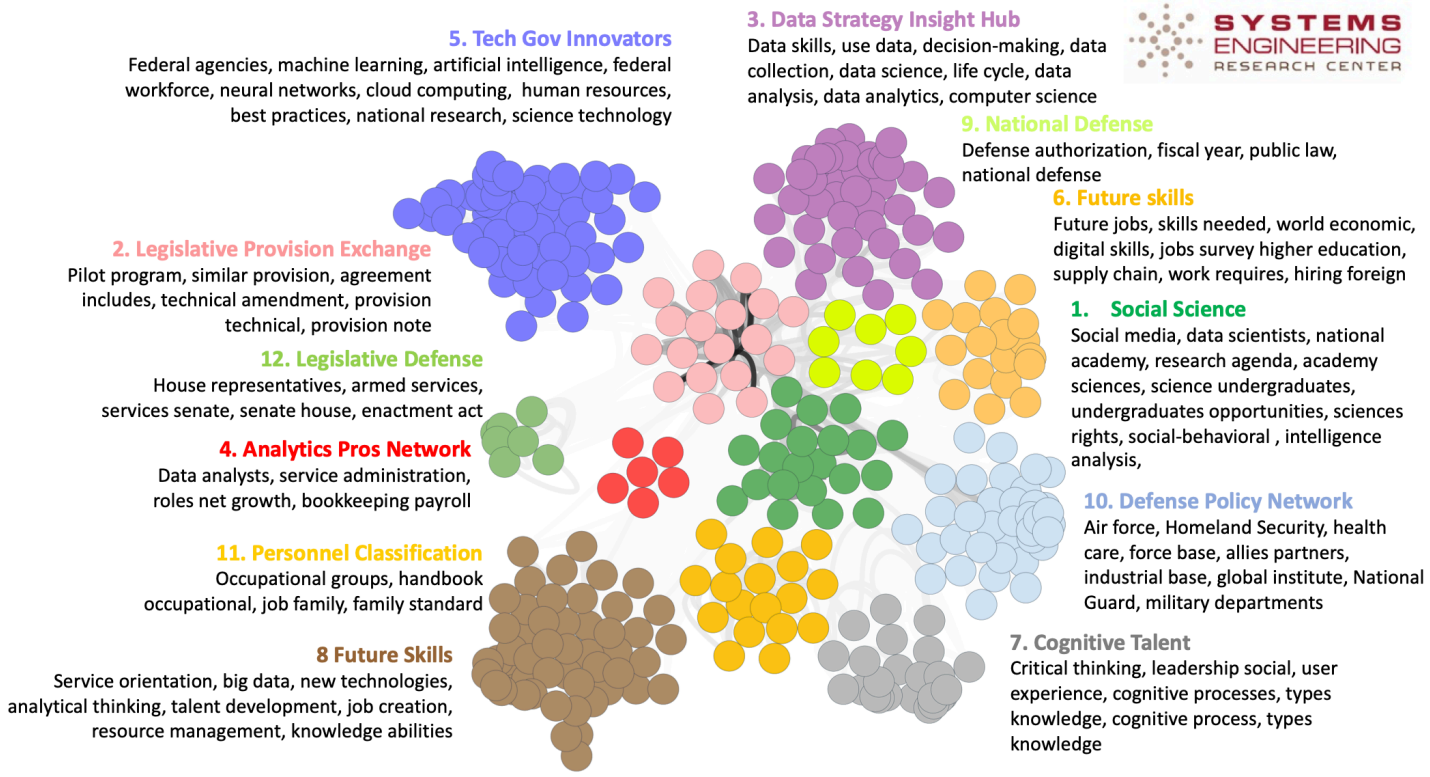

Figure 7: Network Analytics Description Based on Text Extraction

[13] Lalou et al define critical nodes as "those the deletion of which disconnects the network according to some predefined connectivity metrics, such as: maximizing the number of connected components, minimizing pairwise connectivity in the network, minimizing the largest component size, etc."

[14] The benefits of the Leiden cluster identification algorithm are found in Tragg et al. A link to their paper is provided in the references. Further, the researchers have made their code available on a GitHub site.

Technological Integration: Analyze text data to identify trends (trend analysis) and patterns in technological integration within the Army, Navy, and Air Force programs through time and programs. Investigate the adoption of emerging technologies across different programs and how these technologies intersect across various branches.

Resource Allocation: Develop models to simulate and analyze resource allocation scenarios within each branch and assess their impact on program development and implementation. Investigate the trade-offs and challenges of different resource allocation strategies.

Operational Implications: Analyze the text data to understand the operational implications of programs like JADC2 on the specific missions and functions of the Army, Navy, and Air Force. Investigate how these branches adapt to accommodate changes and ensure the success of their missions.

Temporal Association and Differencing: Analyze the data across multiple years to identify trends in changes to the budget values and an ability to analyze the specific syntactic meaning of the wording associated with key areas from year to year.

DISCUSSION

For our proof-of-concept and its framework, we provided a roadmap to address the challenge of developing a concise data set and methodology for associating and analyzing the program elements now managed as programs spread across DoD Justification Books (J-Books). This research can be used as a first step to not only associate programs and their elements into portfolios, but it also provides a powerful LLM-based tool to facilitate understanding the contents of the J-Books program elements and their overall context.

The research outlined in Phase 2 can significantly advance comprehension of programs within the context of numerous disjointed J-Books. Possible strategies for future research include semantic network analysis, trend analysis, resource allocation modeling, temporal modeling, and operational implications assessment, which offer a holistic approach to dissecting and comprehending a program's dynamics. These methods can provide deep insight into inter-service synergy, technological integration, resource allocation, and operational implications.

Ultimately, this research empowers the DoD to understand the complexities and interdependencies of these programs, how they can begin to associate programs into portfolios, and contribute to a more comprehensive understanding. Such insights enhance the capabilities and effectiveness of military programs and inform more efficient resource allocation, bolstering the overall decision-making processes. This research can significantly influence program development and implementation, ultimately advancing national defense and military strategies.

The research team proposes the following recommendations,

- **Discontinue the use of images of tables in budget documents:** While using optical character recognition (OCR) is a viable approach for our demonstration purposes, it is known to introduce errors during the conversion process. The services should stop providing PDF files with embedded images of tables.
- **Provide data in XML[15] or JSON[16] formats:** Although we have described a process for converting PDF documents into either XML or JSON structured data formats, we believe the user would benefit from at least one of these machine-readable formats being provided by the services and the comptroller in addition to the PDF documents.[17, 18]
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[16] Online descriptions on what the JSON (JavaScript Object Notation) format is can be found at: https://www.w3schools.com/js/js_json.asp, and https://en.wikipedia.org/wiki/JSON.

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[18] Requirements for providing budget materials in machine readable format can also be traced to: https://obamawhitehouse.archives.gov/the-press-office/2013/05/09/executive-order-making-open-and-machine-readable-new-default-government-, https://www.whitehouse.gov/wp-content/uploads/2018/06/a11.pdf, and https://comptroller.defense.gov/Portals/45/documents/fmr/Volume_02b.pdf.

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APPENDIX A. INITIAL (PHASE 1) PYTHON CODE

The Python code used in this demonstration is provided below:

```
# Import libraries required by this script
import os
import ssl
import certifi
import fitz  # PyMuPDF
from nltk.tokenize import sent_tokenize, word_tokenize
from nltk.stem import WordNetLemmatizer, PorterStemmer
from termcolor import colored
from zipfile import ZipFile
from reportlab.lib.pagesizes import letter
from reportlab.platypus import SimpleDocTemplate, Paragraph, Spacer
from reportlab.lib.styles import getSampleStyleSheet
from reportlab.lib.enums import TA_LEFT

# Set the SSL certificate verification
ssl._create_default_https_context = ssl.create_default_context(cafile=certifi.where())
def load_pdf(file_path):
    try:
        doc = fitz.open(file_path)
        return doc
    except fitz.FileDataError:
        print(f"Cannot open a broken document: {file_path}")
        return None

# Define the function to extract the sentences from the PDF documents "doc" that contain
# the words we specify in "words"
def extract_sentences_with_words(doc, words):
    sentences_with_words = []
    lemmatizer = WordNetLemmatizer()
    stemmer = PorterStemmer()

    # Iterate through the pages in the PDF document
    for page_number, page in enumerate(doc, start=1):
        text = page.get_text()
        sentences = sent_tokenize(text)

        # Extract sentences with the specified words
        for sentence in sentences:
            tokens = word_tokenize(sentence)
            lemmas = [lemmatizer.lemmatize(token) for token in tokens]
            stems = [stemmer.stem(token) for token in tokens]
```

```
            if any(word in tokens or word in lemmas or word in stems for word in words):
                highlighted_sentence = highlight_words(sentence, tokens, lemmas, stems, words)
                sentences_with_words.append((page_number, highlighted_sentence))
    return sentences_with_words

# Define the word highlighting function to highlight the searched for words in the
# sentence with the word in it
def highlight_words(sentence, tokens, lemmas, stems, search_words):
    highlighted_tokens = []
    for token in tokens:
        if token in search_words:
            highlighted_tokens.append(f'<font color="yellow">{token}</font>')
        else:
            highlighted_tokens.append(token)

    highlighted_sentence = ' '.join(highlighted_tokens)
    return highlighted_sentence

# Specify the list of words you want to search for
words = ["JADC2"]

# Set the path to the ZIP archive containing the PDF files
zip_archive_path = '/Users/Pollac/Desktop/Tests/archive.zip'

# Initialize a list to store the names of problematic files
problematic_files = []

# Create a PDF report
pdf_report_file = 'search_results.pdf'
pdf_doc = SimpleDocTemplate(pdf_report_file, pagesize=letter)
styles = getSampleStyleSheet()  # Define styles for the report
style_heading1 = styles['Heading1']
style_normal = styles['Normal']
style_normal.alignment = TA_LEFT  # Align text to the left
style_normal.leading = 12  # Line spacing
story = []

# Open the ZIP archive
with ZipFile(zip_archive_path, 'r') as archive:
    # Iterate through the files in the archive
    for file_name in archive.namelist():
        # Check if the file is a PDF and not a "__MACOSX" file
        if file_name.endswith('.pdf') and not file_name.startswith('__MACOSX'):
            # Extract the PDF file from the archive
            archive.extract(file_name, '/tmp')  # Extract to a temporary directory
```

```
            # Load the PDF file from the temporary directory using PyMuPDF
            pdf_file_path = os.path.join('/tmp', file_name)
            doc = load_pdf(pdf_file_path)

            if doc:
                # Extract sentences with the specified words
                sentences = extract_sentences_with_words(doc, words)

                # Prepare the content for the report
                if sentences:
                    report_content = []
                    report_content.append(Paragraph(f"Sentences in '{file_name}' with the specified
words:", style_heading1))
                    for page_number, sentence in sentences:
                        formatted_sentence = sentence.replace('<br/>', ' ')  # Replace line breaks
for clarity
                        formatted_sentence = formatted_sentence.replace('\n', ' ')  # Replace
newline characters
                        paragraph = Paragraph(f"Page {page_number}: {formatted_sentence}", style_
normal, encoding='utf-8')
                        paragraph.keepWithNext = True  # Keep paragraphs together
                        report_content.append(paragraph)
                        report_content.append(Spacer(1, 12))  # Add a Spacer for line break
                    report_content.append(Spacer(1, 12))  # Add an extra Spacer after the page
                else:
                    report_content = [Paragraph(f"No sentences found in '{file_name}' with the
specified words.", style_normal)]

                # Add the content to the PDF report
                story.extend(report_content)
            else:
                problematic_files.append(file_name)

# Generate the PDF report
pdf_doc.build(story)

# Print the names of any problematic files
if problematic_files:
    print("Problematic files:")
    for file_name in problematic_files:
        print(file_name)

print(f"PDF report saved as '{pdf_report_file}'")
```

APPENDIX B. AIR FORCE J-BOOK PHASE 1 KEY WORD EXTRACTIONS

Figure B-1 below is the proof-of-concept extraction from the Python script for Air Force J-Books. This figure shows the formatting as viewed in the Air Force's processed BA1-3 J-Book.

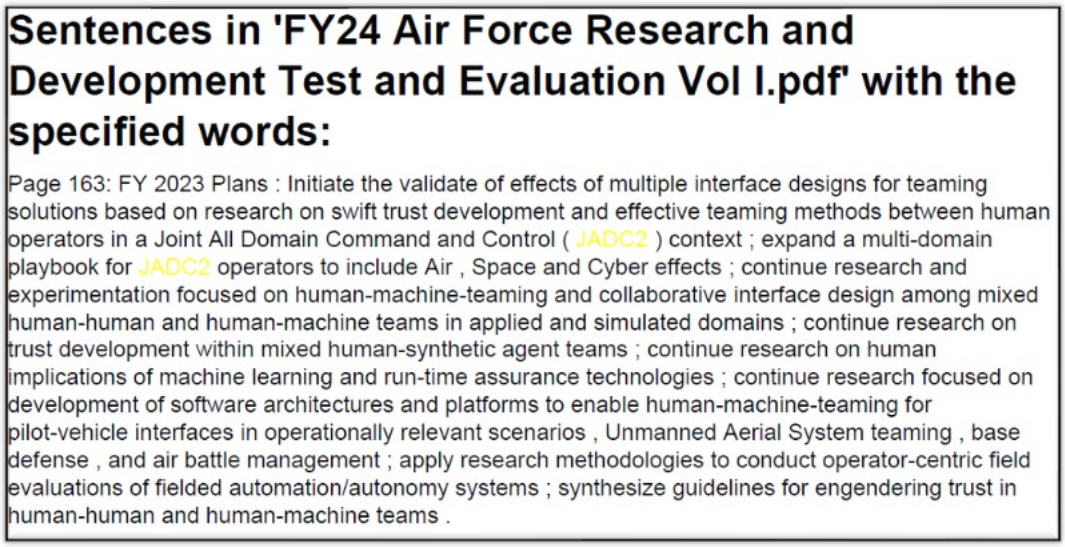

Figure B-1: Image of a section of the Air Force FY24 J-Books Key Word Search Results

These have been replaced by bold characters "**JADC2**" to make these occurrences stand out in this report. This was accomplished by exporting each PDF file into a Word document, then using the MS Word Find and Replace capability for readability. Section headers are maintained at the same font size.

SENTENCES IN 'AIR FORCE JBOOKS/FY24 AIR FORCE RESEARCH AND DEVELOPMENT TEST AND EVALUATION VOL I.PDF' WITH THE SPECIFIED WORDS:

Page 163: FY 2023 Plans : Initiate the validate of effects of multiple interface designs for teaming solutions based on research on swift trust development and effective teaming methods between human operators in a Joint All Domain Command and Control (**JADC2**) context ; expand a multi-domain playbook for **JADC2** operators to include Air , Space and Cyber effects ; continue research and experimentation focused on human-machine-teaming and collaborative interface design among mixed human-human and human-machine teams in applied and simulated domains ; continue research on trust development within mixed human-synthetic agent teams ; continue research on human implications of machine learning and run-time assurance technologies ; continue research focused on development of software architectures and platforms to enable human-machine-teaming for pilot-vehicle interfaces in operationally relevant scenarios , Unmanned Aerial System teaming , base defense , and air battle management ; apply research methodologies to conduct operator-centric field evaluations of fielded automation/autonomy systems ; synthesize guidelines for engendering trust in human-human and human-machine teams .

SENTENCES IN 'AIR FORCE JBOOKS/FY24 AIR FORCE RESEARCH AND DEVELOPMENT TEST AND EVALUATION VOL IIIB.PDF' WITH THE SPECIFIED WORDS:

Page 101: SWAT is responsible for the execution of tasks employing STITCHES outlined in NDAA 2021 Section 804 and supports Joint All Domain Command and Control (**JADC2**) tasking and integration efforts in support of **JADC2** .

Page 109: The ASOC will tie into the Theater Deployable Communications (TDC) Program Management Directive (PMD) ; provide Joint All Domain Command and Control (**JADC2**) capabilities that will be leader-centric , network enabled , and ready to operate in complex and degraded information environments ; and support/execute air taskings should the AOC require assistance during periods of degraded operations .

Page 110: Funding supports Dismounted , Vehicle Mounted , and ASOC/TOC software and hardware to address : interfaces with new Dismounted requirements , evolution of existing Tactical Assault Kit (TAK) /SWAK software which provides a framework for the TACP software interfaces , ASOC-Mod (interoperability and hardware/software interfaces) , changes to Army fires support systems , changes to AOC Theater Battle Management Core Systems , updates for fielded versions , new USAF and Army future **JADC2** capabilities , EMS (Electro-Magnetic Spectrum) Awareness and defensive/offensive capabilities , C2 shelter/trailer development , Small Unmanned Aerial System (SUAS) relaying and targeting equipment development , MCS connectivity , new joint DACAS standards , technical support to operators employing the software , and system prototyping for required future ASOC/TOC/Vehicle Mounted system capabilities .

Page 113: UNCLASSIFIED PE 0207444F : Tactical Air Control Party-Mod UNCLASSIFIED Air Force Page 5 of 12 R-1 Line # 188 Exhibit R-2A , RDT & E Project Justification : PB 2024 Air Force Date : March 2023 Appropriation/Budget Activity 3600 / 7 R-1 Program Element (Number/Name) PE 0207444F / Tactical Air Control Party-M od Project (Number/Name) 676013 / Equipment Modernization Command and Control (**JADC2**) capabilities that will be leader-centric , network enabled , and ready to operate in complex and degraded information environments ; to include the ability to support/execute air taskings should the AOC require assistance during periods of degraded operations .

Page 113: Funding supports Dismounted , Vehicle Mounted , and ASOC/TOC software and hardware to address : interfaces with new Dismounted requirements , evolution of existing Tactical Assault Kit (TAK) /SWAK software which provides a framework for the TACP software interfaces , ASOC-Mod (interoperability and hardware/software interfaces) , changes to Army fires support systems , changes to AOC Theater Battle Management Core Systems , updates for fielded versions , new USAF and Army future **JADC2** capabilities , EMS (Electro-Magnetic Spectrum) Awareness and defensive/offensive capabilities , C2 shelter/trailer development , Small Unmanned Aerial System (SUAS) Volume 4 - 35

Page 173: Mission Description and Budget Item Justification The Distributed Mission Operations Center (DMOC) provides comprehensive Live , Virtual , and Constructive (LVC) simulation capabilities which prepare warfighters to conduct Joint All-Domain Command & Control (**JADC2**) operations in air , land , sea , space , and cyber domains for theater-level , full spectrum combat training for Air Force , joint service , and coalition partners .

Page 348: MSI may also be used to execute test bed activities and exercise participation related to Advanced Battle Management System (ABMS) and **JADC2** demonstrations and execute contracts in support of next generation NC3 systems and sub-systems FY 2023 Plans : - Complete MSI Summary Report - Perform analysis of engineering issues and technology insertion - Evaluate integrated technology , representative modes , and prototype systems - Perform analysis , integration , and testing activities - Conduct NC3 Connectivity Performances updates 0.971 1.023 1.047 Volume 4 – 270

Page 376: FY 2023 Plans : - Establish and conduct multiple contract award activities using a pre-existing , pre-competed contract vehicle ; efforts include crypto for Network Enabled Weapons , Strategic Deterrence , High Speed networks , Software Mods , Multi-Function Encryption , Beyond Line of Sight Comms , Crypto Situational Awareness , Remote ReKey-NexGen , and Space COMSEC ground operating equipment to enable quantum resilience - Work with NSA on implementation of new algorithms standards to share with defense contractors on CM2 efforts - Enable artificial intelligence and machine learning capabilities for the Joint All Domain Command and Control (**JADC2**) by developing and delivering NSA cryptologic solutions to secure communications and data for tactical and strategic level data - Conduct architectural modeling and simulation efforts that drive rapid algorithm and capability evolution to defend against evolving threats ; these digital engineering efforts will provide the standardization across the AF - Begin Crypto Enterprise Management Software Acquisition Pathway Phase 0 (Planning Phase) , conduct efforts to design , architect and define user stories for a Minimum Viable Product (MVP) that will enhance traceability , accountability , status and situational awareness of CCI FY 2024 Plans : -Will execute development contract activities for Network Enabled Weapons , Strategic Deterrence , High Speed networks , software mods , Multi-Function Encryption , Crypto Situational Awareness and Space COMSEC ground operating equipment - Will award contract for Remote ReKey-NexGen for crypto development - Will continue to work with NSA on implementation of new algorithms standards to share with defense contractors on CM2 efforts - Will continue to further enable artificial intelligence and machine learning capabilities for the Joint All Domain Command and Control (**JADC2**) by developing and delivering NSA cryptologic solutions to secure communications and data for tactical and strategic level data - Will establish development contracts for incorporating quantum resilience for additional Network Enabled Weapons , Beyond Line-of-Sight Comms , and High Speed Crypto - Will execute Crypto Enterprise Management program to build infrastructure for crypto situational awareness FY 2023 to FY 2024 Increase/Decrease Statement : Funding decreased to support other higher priority Air Force requirements .

Page 385: UNCLASSIFIED PE 0303140F : Information Systems Security Program UNCLASSIFIED Air Force Page 13 of 16 R-1 Line # 224 Exhibit R-2A , RDT & E Project Justification : PB 2024 Air Force Date : March 2023 Appropriation/Budget Activity 3600 / 7 R-1 Program Element (Number/Name) PE 0303140F / Information Systems Securi ty Program Project (Number/ Name) 675200 / Cryptographic Modernization 2 (CM2) B. Accomplishments/Planned Programs ($ in Millions) FY 2022 FY 2023 FY 2024 -Will execute development contract activities for Network Enabled Weapons , Strategic Deterrence , High Speed networks , software mods , Multi-Function Encryption , Crypto Situational Awareness and Space COMSEC ground operating equipment - Will award contract for Remote ReKey-NexGen for crypto development - Will continue to work with NSA on implementation of new algorithms standards to share with defense contractors on CM2 efforts - Will continue to further enable artificial intelligence and machine learning capabilities for the Joint All Domain Command and Control (**JADC2**) by developing and delivering NSA cryptologic solutions to secure communications and data for tactical and strategic level data - Will establish development contracts for incorporating quantum resilience for additional Network Enabled Weapons , Beyond Line-of-Sight Comms , and High Speed Crypto - Will execute Crypto Enterprise Management program to build infrastructure for crypto situational awareness FY 2023 to FY 2024 Increase/Decrease Statement : Funding increased from FY2023 to FY2024 by $ 32.483M to focus on Crypto Modernization 2 (CM2) efforts .

Page 395: ADCP is USAF ‘s contributing platform to Joint All-Domain Command and Control (**JADC2**) for user-facing C2 capability with the resiliency requirements met through the escalating phases of warfare .

Page 397: ADCP is USAF ‘s contributing platform to **JADC2** for user-facing C2 capability with the resiliency requirements met through the escalating phases of warfare .

Page 404: ADCP is USAF ‘s contributing platform to **JADC2** for user-facing C2 capability with the resiliency requirements met through the escalating phases of warfare .

Page 464: FY 2023 Plans : Activities supported with FY23 funding include , but are not limited to the following : -Will develop Advanced Battle Management System (ABMS) /Joint All Domain Command and Control (**JADC2**) integrations and capabilities .

Page 505: To ensure greater performance and affordability for the Department of the AF , AFWS sensors and information systems are being modernized through improvements to architecture and system efficiency , cybersecurity , joint all-domain command and control [**JADC2**] and sensing grid integration , migration to cloud computing , artificial intelligence and machine learning [AI/ML] initiatives , and expanding agile software development , rapid delivery , and integration practices .

Page 507: Program Change Summary ($ in Millions) FY 2022 FY 2023 FY 2024 Base FY 2024 OCO FY 2024 Total Previous President 's Budget 39.228 11.716 13.318 0.000 13.318 Current President 's Budget 36.524 56.457 26.329 0.000 26.329 Total Adjustments -2.704 44.741 13.011 0.000 13.011 • Congressional General Reductions 0.000 0.000 • Congressional Directed Reductions 0.000 0.000 • Congressional Rescissions 0.000 0.000 • Congressional Adds 0.000 31.000 • Congressional Directed Transfers 0.000 0.000 • Reprogrammings -1.390 13.741 • SBIR/STTR Transfer -1.314 0.000 • Other Adjustments 0.000 0.000 13.011 0.000 13.011 Congressional Add Details ($ in Millions , and Includes General Reductions) FY 2022 FY 2023 Project : 672738 : Weather Service Congressional Add : Commercial Weather Data Pilot (CWDP) Program 9.634 10.000 Congressional Add : Research on Atmospheric Rivers 1.500 5.000 Congressional Add : Dust Emission Forecasting - 5.000 Congressional Add : Air Force Weather Transformation - 8.000 Congressional Add : Machine Learning Weather Forecast - 3.000 Congressional Add Subtotals for Project : 672738 11.134 31.000 Congressional Add Totals for all Projects 11.134 31.000 C. Accomplishments/Planned Programs ($ in Millions) FY 2022 FY 2023 FY 2024 Base FY 2024 OCO FY 2024 Total Title : Expeditionary Weather - MTA Rapid Fielding (ExMet - MTA RF) Description : Funding enables rapid fielding of Air Force Weather 's Joint All-Domain Command and Control (**JADC2**) system of systems solution that supports mission specific launch and recovery operations via multi and single person UTCs .

Page 553: Additionally , IBS is a critical data information provider supporting Joint All Domain Command and Control (**JADC2**) and the emerging requirements for Advanced Battle Management System information exchange requirements .

Page 563: - mission planning software and quick reaction capabilities [QRCs] Additionally , the U-2 program will continue to support emergent and/or experimental RDT & E efforts in support of Joint All-Domain Command and Control [**JADC2**] and Advanced Battle Management System [ABMS] as a platform surrogate for risk reduction in support of SECAF 's Operational Imperative-2 .

Page 579: Mission Description and Budget Item Justification The Agile ISR BPAC matures , develops , and deploys projects started under the Imaging & Targeting Support (I & TS) program in support of current and future platform agnostic , non-proprietary , autonomous , multi-INT cross cueing ISR solutions based on Advanced Battle Management System (ABMS) and Joint All-domain Command and Control (**JADC2**) mission requirements .

Page 627: AF DCGS is also a major component of the DoD DCGS , the system is designed to complement and interoperate with the other Services ' DCGS systems (Army , Navy and Marine Corps) , and a key provider/consumer of the sensing grid and Joint All Domain Command and Control (C2) (**JADC2**) & Advanced Battle Management System (ABMS) efforts .

Page 647: Additionally , FY23 funding is continuing development on airborne moving target indication (AMTI) to SIGINT data fusion algorithms , and is supporting rapid iteration across the enterprise with Joint All-Domain Command and Control (**JADC2**) platforms/systems , enabling the Air Force Sensing Grid .

Page 649: Additionally , FY23 funding is continuing development on airborne moving target indication (AMTI) to SIGINT data fusion algorithms , and is supporting rapid iteration across the enterprise with Joint All-Domain Command and Control (**JADC2**) platforms/systems , enabling the Air Force Sensing Grid .

SENTENCES IN 'AIR FORCE JBOOKS/FY24 SPACE FORCE RESEARCH AND DEVELOPMENT TEST AND EVALUATION. PDF' WITH THE SPECIFIED WORDS:

Page 83: This transport layer will provide the space-based connectivity backbone for Joint All-Domain Command and Control (**JADC2**) .

Page 105: To ensure greater performance and affordability for the AF and SF , SFWS systems are being modernized through improvements to architecture and system efficiency , cybersecurity , joint all-domain command and control (**JADC2**) and sensing grid integration , migration to cloud computing , and expanding agile software development practices .

Page 667: Space-based GMTI system will provide actionable information on adversary surface targets to the warfighter through the Advanced Battle Management System (ABMS) as an integral part of Joint All-Domain Command and Control (**JADC2**) concept .

Page 792: To ensure greater performance and affordability for the Department of the AF , SF Weather Services Research sensors and information systems are being modernized through improvements to architecture and system efficiency , cybersecurity , joint all-domain command and control (**JADC2**) and sensing grid integration , migration to cloud computing , artificial intelligence and machine learning (AI/ML) initiatives , and expanding agile software development , delivery , and integration practices .

SENTENCES IN 'AIR FORCE JBOOKS/FY24 AIR FORCE RESEARCH AND DEVELOPMENT TEST AND EVALUATION VOL IIIA.PDF' WITH THE SPECIFIED WORDS:

Page 91: FY 2023 Plans : Equip the cyberspace facility and continue the planning and execution of the Weapon System Cybersecurity (WSCS) Program tool development ; Advanced Battle Management System Test Capability (ABMS) /Joint All Domain C2 (**JADC2**) Test Capability ; Enterprise Cross Platform Data Center , Multi-Level Security - Joint Collaborative Environment (MLS-JCE) .

Page 92: UNCLASSIFIED PE 0604759F : Major T & E Investment UNCLASSIFIED Air Force Page 6 of 7 R-1 Line # 108 Exhibit R-2 , RDT & E Budget Item Justification : PB 2024 Air Force Date : March 2023 Appropriation/Budget Activity 3600 : Research , Development , Test & Evaluation , Air Force / BA 6 : RDT & E Management Support R-1 Program Element (Number/Name) PE 0604759F / Major T & E Investment C. Accomplishments/Planned Programs ($ in Millions) FY 2022 FY 2023 FY 2024 Equip the cyberspace facility and continue the planning and execution of the Weapon System Cybersecurity (WSCS) Program tool development ; Advanced Battle Management System Test Capability (ABMS) /Joint All Domain C2 (**JADC2**) Test Capability ; Enterprise Cross Platform Data Center , Multi-Level Security - Joint Collaborative Environment (MLS-JCE) .

Page 189: - Will continue enabling DevSecOps efforts at the warfighting edge supporting DoD CIO priorities , especially to support expanded Joint All-Domain Command and Control (**JADC2**) and coalition capabilities .

Page 257: DAF EMIS requirements support SecAF operational imperatives , the AF/A4 Basing and Logistics Enterprise Strategy (BLES) , the Air Force Advanced Battle Management System (ABMS) , and the Joint All Domain Command and Control (**JADC2**) construct .

Page 259: - Continue with the extension of cross-domain capabilities to support full data synchronization between the Non-Secure Internet Protocol Router (NIPR) (unclassified) and Secure Internet Protocol Router (SIPR) (classified) C2IMERA instances to facilitate sharing of threat data , plans , and ultimately the Joint All Domain Command and Control (**JADC2**) construct . Page 260: - Continue with the extension of cross-domain capabilities to support full data synchronization between the NIPR and SIPR C2IMERA instances to facilitate the **JADC2** construct .

Page 422: UNCLASSIFIED PE 0606018F : NC3 Integration UNCLASSIFIED Air Force Page 2 of 8 R-1 Line # 144 Exhibit R-2 , RDT & E Budget Item Justification : PB 2024 Air Force Date : March 2023 Appropriation/Budget Activity 3600 : Research , Development , Test & Evaluation , Air Force / BA 7 : Operational Systems Development R-1 Program Element (Number/Name) PE 0606018F / NC3 Integration program also supports capability gap analysis , modernization and integration activities associated with AFGSC 's Force Development Concept vignette analyses , Joint All Domain Command and Control (**JADC2**) and Advanced Battle Management System (ABMS) initiatives .

Page 423: UNCLASSIFIED PE 0606018F : NC3 Integration UNCLASSIFIED Air Force Page 3 of 8 R-1 Line # 144 Exhibit R-2 , RDT & E Budget Item Justification : PB 2024 Air Force Date : March 2023 Appropriation/Budget Activity 3600 : Research , Development , Test & Evaluation , Air Force / BA 7 : Operational Systems Development R-1 Program Element (Number/ Name) PE 0606018F / NC3 Integration C. Accomplishments/Planned Programs ($ in Millions) FY 2022 FY 2023 FY 2024 - Conducting capability gap and trade-space analyses - Establishing NC3 capability recapitalization and modernization plans - Developing and conducting the AF NC3 WS health & mission worthiness assessments , as well as , expanding existing High Frequency (HF) and other frequency testbeds utilizing a phased approach - Conducting NC3 system component verification - Implementing and employing program and material management controls for the AF NC3 WS including configuration management , change management , risk management , supply chain supportability and risk management , maintenance data collection and reporting capabilities and AF NC3 WS health monitoring solutions - Issue tracking and resolution , assessments and analysis , and governance - Providing data-driven system of system solutions , and shaping NC3 component program acquisition strategies for AF NC3 WS sustainment and performance capability improvements - Initiating and implementing new capability programs/systems and changes to existing programs to align with AF NC3 WS requirements , test and certification , and future capabilities - Interfacing with **JADC2** & ABMS leadership to ensure NC3 modernization efforts are synchronized with larger AF modernization efforts and identifying risk areas where advanced tech demonstrations may be required FY 2023 Plans: NC3 weapon system integration efforts including , but not limited to : - Continue to expand existing communication spectrum and cyber assessment test bed utilizing a phased approach - Continue to perform NC3 physics , communication and networking analysis - Continue to develop and evolve technical framework of the NC3 WS to meet mission threats of 2030 and beyond - Continue to conduct WS analysis , develop WS capability model , plan WS updates , and implement WS updates - Continue to evaluate options for system-of-system performance improvements within constraints of NC3 WS strategic vision and roadmap - Continue to advance capability gap analysis efforts through modeling , simulation , visualization , trade space analysis , and prototyping of emerging NC3 technologies - Continue to develop and implement AF NC3 WS program and materiel management control processes including risk management , configuration management , change management , supply chain management , maintenance data collection and reporting and NC3 WS health assessment application ,integrated scheduling , change management , and budgeting and cost controls , etc .

Page 517: Requirements include but are not limited to , Secure Beyond-Line-of-Sight (BLOS) communications , Line-of-Sight (LOS) communications , and the ability communicate and operate in the Joint All-Domain Command and Control (**JADC2**) environment throughout all mission phases .

Page 520: Requirements include but are not limited to , Secure Beyond-Line-of-Sight (BLOS) communications , Line-of-Sight (LOS) communications , and the ability communicate and operate in the Joint All-Domain Command and Control (**JADC2**) environment throughout all mission phases .

Page 833: Integration of advanced antennas and waveforms , development efforts enabling integration of ABMS/ **JADC2** capabilities , enhancements to ground support capabilities .

Page 846: TENCAP will develop architectures for blue force location and status data to inform decision makers on the AF **JADC2** Awareness and Battle Management operational and tactical pictures .

SENTENCES IN 'AIR FORCE JBOOKS/FY24 AIR FORCE RESEARCH AND DEVELOPMENT TEST AND EVALUATION VOL II.PDF' WITH THE SPECIFIED WORDS:

Page 159: To ensure greater performance and affordability for the AF , AFWS systems are being modernized through improvements to architecture and system efficiency , cybersecurity , joint all-domain command and control (**JADC2**) and sensing grid integration , migration to cloud computing , and expanding agile software development practices .

Page 167: Mission Description and Budget Item Justification ABMS is the primary program element funding architecture , digital infrastructure and software development for the Department of the Air Force 's (DAF) primary contribution towards meeting the Joint All-Domain Command and Control (**JADC2**) warfighting concept .

Page 167: **JADC2** requires individual military activities not simply be deconflicted , but integrated (i.e. , activities in one domain must enhance the effectiveness of those in other domains and compensate for vulnerabilities) .

Page 167: ABMS PE programs will therefore connect sensors , battle management C2 systems (BMC2) , and weapons across both the U.S. Space Force (USSF) and U.S. Air Force (USAF) through the delivery of aligned infrastructure and secure data to enable global battle management for **JADC2** .

Page 167: The DAF formally refers to its integrated **JADC2** deliverable as the `` DAF BATTLE NETWORK . ''

Page 171: This amount significantly ramps up funding from FY23 to FY24 in order to support execution of ongoing acquisition strategies and develop new efforts that are needed to deliver ABMS capability , SecAF directed initiatives for accelerated delivery of ABMS and **JADC2** capability (consistent with the SecAF 's Operational Imperatives (OI) efforts initiated in December 2021) , and Architecture and Systems Engineering (ASE) work previously conducted under PEO 0604006F and evolved under DAF PEO C3BM .

Page 172: UNCLASSIFIED PE 0604003F : Advanced Battle Management System (ABMS) UNCLASSIFIED Air Force Page 6 of 19 R-1 Line # 37 Exhibit R-2 , RDT & E Budget Item Justification : PB 2024 Air Force Date : March 2023 Appropriation/ Budget Activity 3600 : Research , Development , Test & Evaluation , Air Force / BA 4 : Advanced Component Development & Prototypes (ACD & P) R-1 Program Element (Number/Name) PE 0604003F / Advanced Battle Management System (ABMS) C. Accomplishments/Planned Programs ($ in Millions) FY 2022 FY 2023 FY 2024 Description : DAF PEO C3BM combined the roles of the Chief Architect and the Chief Engineer into a single office called the Architecture and Systems Engineering (ASE) office , which is responsible for the technical integrity of the DAF BATTLE NETWORK as we integrate ABMS capabilities , the rest of the DAF 's C2 systems, and other Services 's capabilities under **JADC2** .

Page 180: Though the program employs the full range of contracting authorities , ABMS is currently utilizing , but not limited to , the following contracting vehicles to execute requirements : 1) **JADC2** Multiple-Award , Multi-Level Security (MA-MLS) Indefinite Delivery/Indefinite Quantity (ID/IQ) vehicle ; 2) **JADC2** Broad Agency Announcement with Calls to Volume 2 102

Page 181: UNCLASSIFIED PE 0604003F : Advanced Battle Management System (ABMS) UNCLASSIFIED Air Force Page 15 of 19 R-1 Line # 37 Exhibit R-2 , RDT & E Budget Item Justification : PB 2024 Air Force Date : March 2023 Appropriation/ Budget Activity 3600 : Research , Development , Test & Evaluation , Air Force / BA 4 : Advanced Component Development & Prototypes (ACD & P) R-1 Program Element (Number/Name) PE 0604003F / Advanced Battle Management System (ABMS) include a Call soliciting sources to participate in Cooperative Research and Development Agreements (CRADAs) ; 3) **JADC2** Commercial Solutions Opening ; 4) Small Business Innovation Research Phase III efforts ; and 5) already existing contract vehicles where ABMS acquisition efforts are within scope .

Page 461: UNCLASSIFIED PE 0604858F : Tech Transition Program UNCLASSIFIED Air Force Page 43 of 47 R-1 Line # 57 Exhibit R-2A , RDT & E Project Justification : PB 2024 Air Force Date : March 2023 Appropriation/Budget Activity 3600 / 4 R-1 Program Element (Number/Name) PE 0604858F / Tech Transition Program Project (Number/Name) 645352 / Architecture Design and Evaluation B. Accomplishments/Planned Programs ($ in Millions) FY 2022 FY 2023 FY 2024 Base FY 2024 OCO FY 2024 Total and other Services 's capabilities under **JADC2** .

Page 538: The Medusa C2 system supports Joint All-Domain Command & Control (**JADC2**) development and employs electronic warfare capabilities , artificial intelligence for operator task automation , a closed-loop training system for operator certification and proficiency , and track fusion .

Page 547: The tool is focused on integration of capabilities from ABMS into the **JADC2** environment within a single open Modelling and Simulation (M & S) Engagement Framework to provide capabilities to the tactical edge .

Page 563: The CDL specifications permit current and future ISR asset operations worldwide by providing sensor data directly via point-to-point and air-to-air or compatible satellite broadcast links to ground sites , airborne platforms , and dismounted users to support Joint All-Domain Command and Control (**JADC2**) warfare .

Page 687: ABMS is an integral component to transition to the Joint All Domain Command and Control (**JADC2**) concept at the tactical level of warfare .

Page 805: Current JTNC directed requirements , outlined by the C3LB , consist of the CTWWG , Joint All-Domain Command and Control (**JADC2**) support , development/maturation of the DoD IR framework & Cloud migration , and development of the Joint Communications Marketplace (JCM) to meet DoD and Industry requirements in conjunction with DoD Instruction 4630.09 .

Page 807: The JTNC remained engaged in Joint All Domain Command and Control (**JADC2**) Operational Planning Teams/ systems engineering support across the Services .

Page 807: The JTNC will remain engaged in Joint All Domain Command and Control (**JADC2**) Operational Planning Teams/ systems engineering support across the Services .[19]

[19] The researchers are aware of an occasional duplication of content and expect to determine the correct manner for resolving this potential error at a later date.

Page 913: UNCLASSIFIED PE 0207701F : Full Combat Mission Training UNCLASSIFIED Air Force Page 9 of 14 R-1 Line # 99 Exhibit R-4 , RDT & E Schedule Profile : PB 2024 Air Force Date : March 2023 Appropriation/Budget Activity 3600 / 5 R-1 Program Element (Number/Name) PE 0207701F / Full Combat Mission Traini ng Project (Number/Name) 655012 / Full Combat Mission Training FY 2022 FY 2023 FY 2024 FY 2025 FY 2026 FY 2027 FY 2028 1 2 3 4 1 2 3 4 1 2 3 4 1 2 3 4 1 2 3 4 1 2 3 4 1 2 3 4 Develop gateways and CDS to integrate high-fidelity trainers with Air Force , joint , and coalition networks Evaluate compressed DIS network standards for CDS in DMO/Blended training Integrate and evaluate multi-domain operations and kill-chain training strategies for JSE/Blended training Evaluate multi-national mission planning and debrief technologies in research training events Implement , evaluate , and field technologies aligned with future training strategies for LVC Develop specifications for live data harvesting using encrypted systems and tools Update Five Eyes (FVEY) rule sets for full 4th , 5th and autonomous tactical employment training Create Secure LVC testbed environment for kill chain and **JADC2** ops training via DMO/ JSE Joint Simulation Environment Phase 2 Release Request For Proposal (RFP) Award Development Contract Begin initial design and development efforts Joint simulation enironment Phase 3 Develop Multi-Level Security testbed and support testing on 5th Gen systems Volume 2 - 835

Page 915: UNCLASSIFIED PE 0207701F : Full Combat Mission Training UNCLASSIFIED Air Force Page 11 of 14 R-1 Line # 99 Exhibit R-4 , RDT & E Schedule Profile : PB 2024 Air Force Date : March 2023 Appropriation/Budget Activity 3600 / 5 R-1 Program Element (Number/Name) PE 0207701F / Full Combat Mission Traini ng Project (Number/Name) 655012 / Full Combat Mission Training FY 2022 FY 2023 FY 2024 FY 2025 FY 2026 FY 2027 FY 2028 1 2 3 4 1 2 3 4 1 2 3 4 1 2 3 4 1 2 3 4 1 2 3 4 1 2 3 4 Develop gateways and CDS to integrate high-fidelity trainers with Air Force , joint and coalition networks Evaluate compressed DIS networtk standards for CDS in DMO ; evaluate JSE alternatives Integrate and evaluate multi-domain operations and kill-chain training scenariosfor contested environments Evaluate multi-national mission planning and debrief technologies in research training events Implement , evaluate and field technologies aligned with future training strategies for LVC Develop specifications for live data harvesting using encrypted systems and tools Update Five Eyes (FVEY) rule sets for full 4th , 5th and collaborative combat aircraft tacyical employment training Create Secure testbed environment for kill chain and **JADC2** ops training via DMO/JSE and blended training Joint Simulation Environment Phase 4 Release Request For Proposal (RFP) Award Development Contract Begin initial Design and Development efforts Volume 2 - 837

Page 917: UNCLASSIFIED PE 0207701F : Full Combat Mission Training UNCLASSIFIED Air Force Page 13 of 14 R-1 Line # 99 Exhibit R-4A , RDT & E Schedule Details : PB 2024 Air Force Date : March 2023 Appropriation/Budget Activity 3600 / 5 R-1 Program Element (Number/Name) PE 0207701F / Full Combat Mission Traini ng Project (Number/Name) 655012 / Full Combat Mission Training Start End Events by Sub Project Quarter Year Quarter Year Implement , evaluate , and field technologies aligned with future training strategies for LVC 1 2022 2 2025 Develop specifications for live data harvesting using encrypted systems and tools 2 2023 4 2026 Update Five Eyes (FVEY) rule sets for full 4th , 5th and autonomous tactical employment training 4 2024 4 2026 Create Secure LVC testbed environment for kill chain and **JADC2** ops training via DMO/JSE 3 2022 2 2026 Joint Simulation Environment Phase 2 Release Request For Proposal (RFP) 3 2022 3 2022 Award Development Contract 2 2023 2 2023 Begin initial design and development efforts 2 2023 2 2024 Joint simulation enironment Phase 3 Develop Multi-Level Security testbed and support testing on 5th Gen systems 1 2022 2 2022 Develop 4th and 5th Generation rule sets for coalition integration 1 2022 2 2022 Develop metrics for routine proficiency evaluations and determine standard format for storing/analyzing proficiency data 1 2022 2 2022 Create and evaluate alternative data formats for routinely tracking and storing performance and proficiency data 1 2022 1 2025 Refine learning managed scenario and integrate with DMO/JSE/Blended training events 1 2022 2 2025 Develop and integrate After Action Review tools for Mission Training Centers 1 2022 4 2023 Develop metrics and tools to measure training proficiency gained during blended training events /standardize implementation at Distributed Training Centers (DTCs) 1 2022 4 2022 Conduct interoperability studies to evaluate the training value of 5th Gen interoperable coalition training on the Combat Air Forces (CAF) DMO network and in JSE events 1 2022 3 2023 Develop joint and coalition data standards and evaluate data management methods to support blended training events 1 2022 3 2026 Volume 2 - 839

Page 918: UNCLASSIFIED PE 0207701F : Full Combat Mission Training UNCLASSIFIED Air Force Page 14 of 14 R-1 Line # 99 Exhibit R-4A , RDT & E Schedule Details : PB 2024 Air Force Date : March 2023 Appropriation/Budget Activity 3600 / 5 R-1 Program Element (Number/Name) PE 0207701F / Full Combat Mission Traini ng Project (Number/Name) 655012 / Full Combat Mission Training Start End Events by Sub Project Quarter Year Quarter Year Demonstrate persistent performance measurement and readiness assessment in fouth and 5th Gen JSE and blended training events 1 2022 1 2024 Develop gateways and CDS to integrate high-fidelity trainers with Air Force , joint and coalition networks 1 2022 3 2025 Evaluate compressed DIS networtk standards for CDS in DMO ; evaluate JSE alternatives 1 2022 2 2024 Integrate and evaluate multi-domain operations and kill-chain training scenariosfor contested environments 1 2022 4 2024 Evaluate multi-national mission planning and debrief technologies in research training events 1 2022 4 2024 Implement , evaluate and field technologies aligned with future training strategies for LVC 1 2022 2 2025 Develop specifications for live data harvesting using encrypted systems and tools 2 2023 4 2026 Update Five Eyes (FVEY) rule sets for full 4th , 5th and collaborative combat aircraft tacyical employment training 4 2024 4 2026 Create Secure testbed environment for kill chain and **JADC2** ops training via DMO/JSE and blended training 3 2022 2 2026 Joint Simulation Environment Phase 4 Release Request For Proposal (RFP) 2 2022 3 2022 Award Development Contract 2 2023 2 2023 Begin initial Design and Development efforts 2 2023 2 2024 Volume 2 - 840

APPENDIX C. ARMY J-BOOK KEY WORD EXTRACTIONS

SENTENCES IN 'ARMY 2024 J-BOOKS RDTE/RDTE-VOL 2-BUDGET ACTIVITY 4A.PDF' WITH THE SPECIFIED WORDS:

Page 411: PNTAX provides the Army 's sole large scale , open air , threat informed Radio Frequency/Global Positioning System denied environment for assessments and experiments necessary to ensure evolution of Multi-Domain Operations and Joint All Domain Command and Control (**JADC2**) capabilities .

SENTENCES IN 'ARMY 2024 J-BOOKS RDTE/RDTE-VOL 2-BUDGET ACTIVITY 5D/PDF' WITH THE SPECIFIED WORDS:

Page 176: Military service branches at echelon will utilize the functions within JTIC2S for a synchronized targeting tactical picture with Army and Joint Fires COP to support Joint All Domain Command and Control (**JADC2**) and Multi Domain Operations (MDO) against a near-peer adversary .

Page 178: Military service branches at echelon will utilize the functions within JTIC2S for a synchronized targeting tactical picture with Army and Joint Fires COP to support Joint All Domain Command and Control (**JADC2**) and Multi Domain Operations (MDO) against a near-peer adversary .

Page 179: JTIC2S is a software only program that will replace the legacy Joint Automated Deep Operations Coordination System (JADOCS) and provide a data-centric targeting capability that will meet increasing Joint interoperability demands , additional data types , and emerging artificial intelligence/machine learning capabilities to enable joint and coalition targeting support to Joint All Domain Command and Control (**JADC2**) and Multi Domain Operations (MDO) .

SENTENCES IN 'ARMY 2024 J-BOOKS RDTE/RDTE-VOL 2-BUDGET ACTIVITY 4B.PDF' WITH THE SPECIFIED WORDS:

Page 43: These capabilities are enabled by emerging Artificial Intelligence/Machine Learning (AI/ML) processing and automated target recognition , autonomous sensor cross-cueing , sensor data correlation and resilient Joint All-Domain Command and Control (**JADC2**) compliant communications which shorten the sensor to shooter kill chain .

Page 45: These capabilities are enabled by emerging Artificial Intelligence/Machine Learning (AI/ML) processing and automated target recognition , autonomous sensor cross-cueing , sensor data correlation and resilient Joint All-Domain Command and Control (**JADC2**) compliant communications which shorten the sensor to shooter kill chain .

Page 349: Unified Network Transport provides the ground domain network connectivity of Joint All Domain Command and Control (**JADC2**) and enables Unified Action Partner interoperability through integration with the Mission Partner Environment (MPE) .

SENTENCES IN 'ARMY 2024 J-BOOKS RDTE/TDTE-VOL 2-BUDGET ACTIVITY 5C.PDF' WITH THE SPECIFIED WORDS:

Page 232: Current JTNC directed requirements , outlined by the C3LB , consist of the CTWWG , Joint All-Domain Command and Control (**JADC2**) support , development/maturation of the DoD IR framework & Cloud migration , and development of the Joint Communications Marketplace (JCM) to meet DoD and Industry requirements in conjunction with DoD Instruction 4630.09 .

Page 234: Current JTNC directed requirements , outlined by the C3LB , consist of the CTWWG , Joint All-Domain Command and Control (**JADC2**) support , development/maturation of the DoD IR framework & Cloud migration , and development of the Joint Communications Marketplace (JCM) to meet DoD and Industry requirements in conjunction with DoD Instruction 4630.09 .

Page 235: The JTNC will remain engaged in Joint All Domain Command and Control (**JADC2**) Operational Planning Teams/ systems engineering support across the Services .

Page 236: The JTNC will remain engaged in Joint All Domain Command and Control (**JADC2**) Operational Planning Teams/ systems engineering support across the Services .

SENTENCES IN 'ARMY 2024 J-BOOKS RDTE/TDTE-VOL 2-BUDGET ACTIVITY 5B.PDF' WITH THE SPECIFIED WORDS:

Page 47: OSCE supports the ASA (ALT) Data Steward and performs the duties as the Functional Data Manager in Army Data Governance Forums including the Army Data Board (ADB) , Army Analytics Board (AAB) and **JADC2** Working Groups .

Page 49: UNCLASSIFIED PE 0604798A : Brigade Analysis , Integration and Evalua ...UNCLASSIFIED Army Page 7 of 26 R-1 Line # 107 Exhibit R-2A , RDT & E Project Justification : PB 2024 Army Date : March 2023 Appropriation/Budget Activity 2040 / 5 R-1 Program Element (Number/Name) PE 0604798A / Brigade Analysis , Integratio n and Evaluation Project (Number/Name) DY7 / Army Systems Engineering , Architecture & Analysis B. Accomplishments/Planned Programs ($ in Millions) FY 2022 FY 2023 FY 2024 This Project includes specific efforts in support of the Army 's Data plan that has lines of effort working towards the Joint All Domain Command and Control (**JADC2**) concept via Data , Systems Engineering , and Software governance , emerging Multi- Domain Operations (MDO) concepts requirements generation , resource allocation , experimentation , acquisition , logistics , and technology components of the Army 's Modernization Strategy .

Page 49: It will flatten the Army 's data architecture across its echelons for effective and efficient data-driven decision-making as envisioned by Joint All Domain Command and Control (**JADC2**) and the Army 's multi-domain operations (MDO) concept and supporting doctrine.Software Development Acquisition Support and Oversight - Ensure programs implement agile software development and DevSecOps to deliver better capability faster .

Page 52: OCSE will serve as the ASA (ALT) staff lead for **JADC2** / Multi Partner Environment (MPE) Technical Standards by providing ASA (ALT) technical representation on Joint Staff J6 and Army **JADC2** technical governance forums .

Page 53: FY 2024 Plans : This Project supports the ASA (ALT) Data Steward and performs the duties as the Functional Data Manager in Army Data Environment Governance Forums including the Army Data Board (ADB) , Army Analytics Board (AAB) and **JADC2** Working Groups .

Page 55: Provide continued Mission Engineering , **JADC2** , and MDO analysis as it pertains to system development and ASA (ALT) equities .

Page 55: Continue to analyze **JADC2** impact on Army modernization strategy and the Army 's role in MDO supporting ASA (ALT) with quick turn , independent , first-order engineering analysis to support leadership decision making to enable the Army Modernization Strategy .

Page 55: Continue to support Project Convergence 23 and 24 planning , design , and execution , **JADC2** planning and design , DE efforts at the Office of the Secretary of Defense , (OSD) , Army , and ASA (ALT) levels , and Army architecture governance efforts.OSCE will serve as the Army focal in the Office of the Under Secretary of Defense for Research and Engineering (OUSD (R & E)) Mission Engineering Community of Practice (CoP) to facilitate the development of recommendations , polic OCSE will continue to expand Critical Criteria and Convergence Learning (C3L) tool use at the PEO and PM level .

Page 62: OSCE supports the ASA (ALT) Data Steward and performs the duties as the Functional Data Manager in Army Data Governance Forums including the Army Data Board (ADB) , Army Analytics Board (AAB) and Joint All Domain Command and Control (**JADC2**) Working Groups .

Page 397: Efforts support Army Modernization priorities including Army Unified Network Plan , Multi-Domain Operations , Joint All Domain Command and Control (**JADC2**) , Data Modernization and emerging data-centric requirements .

SENTENCES IN 'ARMY 2024 J-BOOKS RDTE/TDTE-VOL 2-BUDGET ACTIVITY 5A.PDF' WITH THE SPECIFIED WORDS:

Page 222: This will facilitate AC capabilities , enhance situational understanding , reduce risks , and provide more effective Air-Ground Integration to enable Multi-Domain Operations (MDO) , Joint All Domain Operations (JADO) , and Joint All Domain Command and Control (**JADC2**) .

Page 224: This will facilitate AC capabilities , enhance situational understanding , reduce risks , and provide more effective Air-Ground Integration to enable Multi-Domain Operations (MDO) , Joint All Domain Operations (JADO) , and Joint All Domain Command and Control (**JADC2**) .

Page 225: This will facilitate AC capabilities , enhance situational understanding , reduce risks , and provide more effective Air-Ground Integration to enable Multi-Domain Operations (MDO) , Joint All Domain Operations (JADO) , and Joint All Domain Command and Control (**JADC2**) .

Page 225: Develop Integrated Mission Planning and Airspace Control Tools (IMPACT) to meet Capability Drop (CD) Operational Needs Requirements , Joint All Domain Command and Control (**JADC2**) Airspace Control (AC) capabilities and AC service extension using MCIS and Tactical Assault Kit (TAK) frameworks , plugins and services .

Page 225: Continue to develop **JADC2** AC capabilities and AC service extension using MCIS and TAK frameworks , plugins , and services .

No sentences found in 'Army 2024 J-Books RDTE/RDTE-Vol 1-Budget Activity 1.pdf' with the specified words.

No sentences found in 'Army 2024 J-Books RDTE/RDTE-Vol 3-Budget Activity 6.pdf' with the specified words.

No sentences found in 'Army 2024 J-Books RDTE/RDTE-Vol 3-Budget Activity 7.pdf' with the specified words.

SENTENCES IN 'ARMY 2024 J-BOOKS RDTE/RDTE-VOL 1- BUDGET ACTIVITY 2.PDF' WITH THE SPECIFIED WORDS:

Page 412: Mission Description and Budget Item Justification This Project will design and develop various technologies to augment human intelligence analysts with artificial intelligence (AI) and machine learning (ML) -enabled decision support , workflow automation , and recommendation tools to modernize how the Intelligence Warfighting Function supports Multi-Domain Operations and Joint All Domain Command and Control (**JADC2**) .

No sentences found in 'Army 2024 J-Books RDTE/RDTE-Vol 1-Budget Activity 3.pdf' with the specified words.

No sentences found in 'Army 2024 J-Books RDTE/RDTE-Vol 3-Budget Activity 8.pdf' with the specified words.

APPENDIX D. NAVY J-BOOK KEY WORD EXTRACTIONS

SENTENCES IN 'NAVY 2024 J-BOOKS RDTE/RDTEN_BA1-3_BOOK.PDF' WITH THE SPECIFIED WORDS:

Page 509: - Continue the development of persistent satellite communications (SATCOM) point-of-presence to enable Expeditionary Advanced Base (EAB) , Distributed Maritime Operations (DMO) , and Joint All-Domain C2 (**JADC2**) experimentation .

Page 510: - Continue the development of persistent satellite communications (SATCOM) point-of-presence to enable Expeditionary Advanced Base (EAB) , Distributed Maritime Operations (DMO) , and Joint All-Domain C2 (**JADC2**) experimentation .

Page 518: Technology will be demonstrated across the globe in support of Joint All Domain Command and Control **JADC2** .

SENTENCES IN 'NAVY 2024 J-BOOKS RDTE/RDTEN_BA7-8_BOOK - OCR.PDF' WITH THE SPECIFIED WORDS:

Page 844: Marine Air-Ground Task Force (MAGTF) Command and Control (C2) Systems (MAGTF C2) Tactical Service Oriented Architecture (TSOA) alignment and development of Artificial Intelligence (AI) /Machine Learning (ML) within Joint All-Domain Command and Control (**JADC2**) capabilities and continuing efforts of funding to support the addition of operation within a Development , Security , and Operations (DevSecOps) environment requirements and system engineering support .

Page 846: Program Office will research , assess , and integrate resilient and assured PNT alternative capabilities which will mitigate threats from peer and near peer adversaries to meet Force Design 2030 , EABO , and Joint All-Domain Command and Control (**JADC2**) construct .

Page 848: - Initiate alignment of TSOA capabilities focused on AI/ML within **JADC2** .

Page 849: UNCLASSIFIED PE 0206313M : Marine Corps Comms Systems UNCLASSIFIED Navy Page 7 of 143 R-1 Line # 218 Exhibit R-2A , RDT & E Project Justification : PB 2024 Navy Date : March 2023 Appropriation/Budget Activity 1319 / 7 R-1 Program Element (Number/Name) PE 0206313M / Marine Corps Comms Syste ms Project (Number/Name) 2270 / Exp Indirect Fire Gen Supt Wpn Sys B. Accomplishments/Planned Programs ($ in Millions , Article Quantities in Each) FY 2022 FY 2023 FY 2024 Base FY 2024 OCO FY 2024 Total Increase from FY 2023 to FY 2024 supports TSOA alignment and development of AI/ML within **JADC2** capabilities and continuing efforts of funding to support the addition of operation within a DevSecOps environment requirements and system engineering support .

Page 849: -Initiate engineering support TSOA capabilities focused on AI/ML within **JADC2** .

Page 849: FY 2024 OCO Plans : N/A FY 2023 to FY 2024 Increase/Decrease Statement : Increase from FY 2023 to FY 2024 supports engineering support related to AI/ML within **JADC2** .

Page 850: - Initiate test and evaluation of TSOA capabilities within the **JADC2** construct .

Page 850: FY 2024 OCO Plans : N/A FY 2023 to FY 2024 Increase/Decrease Statement : Increase from FY 2023 to FY 2024 supports additional test and evaluation of TSOA capabilities within the **JADC2** construct .

Page 861: UNCLASSIFIED PE 0206313M : Marine Corps Comms Systems UNCLASSIFIED Navy Page 19 of 143 R-1 Line # 218 Exhibit R-3 , RDT & E Project Cost Analysis : PB 2024 Navy Date : March 2023 Appropriation/Budget Activity 1319 / 7 R-1 Program Element (Number/Name) PE 0206313M / Marine Corps Comms Syste ms Project (Number/Name) 2270 / Exp Indirect Fire Gen Supt Wpn Sys Product Development ($ in Millions) FY 2022 FY 2023 FY 2024 Base FY 2024 OCO FY 2024 Total Cost Category Item Contract Method & Type Performing Activity & Location Prior Years Cost Award Date Cost Award Date Cost Award Date Cost Award Date Cost Cost To Complete Total Cost Target Value of Contract MAGTF C2 (TSOA) alignment and development of AI/ML within **JADC2** capabilities and continuing efforts of funding to support the addition of operation within a DevSecOps environment requirements and system engineering support .

Page 1208: Spectrum Services Framework (SSF) enabling the Electromagnetic Operations Cell to perform its mission by providing a critical open backend framework for rapid development of software services and applications across real-time and historical Electromagnetic Spectrum (EMS) data to support mission planning and execution of Electromagnetic Spectrum Operations (EMSO) and Cyberspace Operations across the FMF ‘s Operational Environment utilizing Joint All Domain Command and Control (**JADC2**) information exchanges .

Page 1210: TCS sensors identify location , disposition , movement , and direction of enemy activity using all-weather multi-modal sensor systems to provide indications and warning of enemy activity for dissemination through Joint All Domain Command and Control (**JADC2**) using DCGS-MC and the Minotaur Ecosystem for ingestion into a Joint Common Intelligence/ Operating Picture .

Page 1386: MTC-X aligns with the Joint All Domain Command and Control (**JADC2**) integration with Air Force and Army initiatives .

Page 1565: The delivery will include extended Maritime Planning Tools to support resilient Line of Sight (LoS) and Beyond Line of Sight (BLoS) communications networks , as well as Joint All-Domain Command and Control (**JADC2**) interfaces .

Page 1566: FY 2023 funding provides iterative development and delivery to targeted platforms necessary for the completion of the Navy special project , the delivery includes extended Maritime Planning Tools to support resilient Line of Sight (LoS) and Beyond Line of Sight (BLoS) communications networks , as well as Joint All-Domain Command and Control (**JADC2**) interfaces .

Page 1566: FY 2024 funding will provide iterative development and delivery to targeted platforms necessary for the completion of the Navy special project , The delivery will include extended Maritime Planning Tools to support resilient Line of Sight (LoS) and Beyond Line of Sight (BLoS) communications networks Navy Tactical Grid (NTG) interfaces and capabilities , as well as Joint All- Domain Command and Control (**JADC2**) interfaces .

SENTENCES IN ‘NAVY 2024 J-BOOKS RDTE/RDTEN_BA6_BOOK.PDF’ WITH THE SPECIFIED WORDS:

Page 319: This reduction will also eliminate the advancement and maturation of all digital engineering efforts needed to implement a model-based system engineering across NAVWAR programs and result in the delay of development and delivery of information warfare capabilities in addition to delaying the development of the Enterprise architecture efforts that show a direct tie to the **JADC2** Enterprise ; building the foundational architecture modeling that is driving the future state for Naval Network Modernization .

SENTENCES IN 'NAVY 2024 J-BOOKS RDTE/RDTEN_BA6_BOOK - OCR.PDF' WITH THE SPECIFIED WORDS:

Page 319: This reduction will also eliminate the advancement and maturation of all digital engineering efforts needed to implement a model-based system engineering across NAVWAR programs and result in the delay of development and delivery of information warfare capabilities in addition to delaying the development of the Enterprise architecture efforts that show a direct tie to the **JADC2** Enterprise ; building the foundational architecture modeling that is driving the future state for Naval Network Modernization .

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Page 844: Marine Air-Ground Task Force (MAGTF) Command and Control (C2) Systems (MAGTF C2) Tactical Service Oriented Architecture (TSOA) alignment and development of Artificial Intelligence (AI) /Machine Learning (ML) within Joint All-Domain Command and Control (**JADC2**) capabilities and continuing efforts of funding to support the addition of operation within a Development , Security , and Operations (DevSecOps) environment requirements and system engineering support .

Page 846: Program Office will research , assess , and integrate resilient and assured PNT alternative capabilities which will mitigate threats from peer and near peer adversaries to meet Force Design 2030 , EABO , and Joint All-Domain Command and Control (**JADC2**) construct .

Page 848: - Initiate alignment of TSOA capabilities focused on AI/ML within **JADC2** .

Page 849: UNCLASSIFIED PE 0206313M : Marine Corps Comms Systems UNCLASSIFIED Navy Page 7 of 143 R-1 Line # 218 Exhibit R-2A , RDT & E Project Justification : PB 2024 Navy Date : March 2023 Appropriation/Budget Activity 1319 / 7 R-1 Program Element (Number/Name) PE 0206313M / Marine Corps Comms Syste ms Project (Number/Name) 2270 / Exp Indirect Fire Gen Supt Wpn Sys B. Accomplishments/Planned Programs ($ in Millions , Article Quantities in Each) FY 2022 FY 2023 FY 2024 Base FY 2024 OCO FY 2024 Total Increase from FY 2023 to FY 2024 supports TSOA alignment and development of AI/ML within **JADC2** capabilities and continuing efforts of funding to support the addition of operation within a DevSecOps environment requirements and system engineering support .

Page 849: -Initiate engineering support TSOA capabilities focused on AI/ML within **JADC2** .

Page 849: FY 2024 OCO Plans : N/A FY 2023 to FY 2024 Increase/Decrease Statement : Increase from FY 2023 to FY 2024 supports engineering support related to AI/ML within **JADC2** .

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Page 1208: Spectrum Services Framework (SSF) enabling the Electromagnetic Operations Cell to perform its mission by providing a critical open backend framework for rapid development of software services and applications across real-time and historical Electromagnetic Spectrum (EMS) data to support mission planning and execution of Electromagnetic Spectrum Operations (EMSO) and Cyberspace Operations across the FMF 's Operational Environment utilizing Joint All Domain Command and Control (**JADC2**) information exchanges .

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SENTENCES IN 'NAVY 2024 J-BOOKS RDTE/RDTEN_BA5_BOOK - OCR.PDF' WITH THE SPECIFIED WORDS:

Page 289: Work has begun on upgrading the 25-year old computing architecture of the AHE that will allow the Navy to lead the Joint All Domain Command and Control (**JADC2**) efforts in any theater .

Page 289: TCID is the key to establishing the CNO 's vision for the Naval Operational Architecture and the Joint Chiefs ' vision for **JADC2** .

Page 1705: In September 2020 , Navy leadership directed the MQ-25 program to transition to an already mature , industry-developed GCS solution that supports Joint All Domain Command and Control (**JADC2**) interoperability and multi-level security requirements .

Page 1724: In September 2020 , Navy leadership directed the MQ-25 program to transition to a mature , industry-developed GCS capable of Joint All Domain Command and Control (**JADC2**) interoperability and meeting multi-level security requirements .

Page 1877: Current JTNC directed requirements , outlined by the C3LB , consist of the CTWWG , Joint All-Domain Command and Control (**JADC2**) support , development/maturation of the DoD IR framework & Cloud migration , and development of the Joint Communications Marketplace (JCM) to meet DoD and Industry requirements in conjunction with DoD Instruction 4630.09 .

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Page 1877: Current JTNC directed requirements , outlined by the C3LB , consist of the CTWWG , Joint All-Domain Command and Control (**JADC2**) support , development/maturation of the DoD IR framework & Cloud migration , and development of the Joint Communications Marketplace (JCM) to meet DoD and Industry requirements in conjunction with DoD Instruction 4630.09 .

SENTENCES IN 'NAVY 2024 J-BOOKS RDTE/RDTEN_BA4_BOOK.PDF' WITH THE SPECIFIED WORDS:

Page 1160: This effort is not a new start and builds upon FY22 and FY23 **JADC2** efforts .

SENTENCES IN 'NAVY 2024 J-BOOKS RDTE/RDTEN_BA4_BOOK - OCR.PDF' WITH THE SPECIFIED WORDS:[20]

Page 1160: This effort is not a new start and builds upon FY22 and FY23 **JADC2** efforts .

[20] The researchers are aware of this section being repeated in the results output file. As this software bug does not affect the recommendations found in this report, a decision was made to have Stevens Institute computer science students fix this issue as they work to complete our initial prototype. The initial prototype will be documented in the version of this report that will be posted on AIRC's website after March.

APPENDIX E. PHASE 2 DASHBOARD "README.MD" FILE FOR THE PROJECT

```
# Task 3 Dashboard Project

## Overview

This project was aimed at creating an AI powered dashboard using tools like OpenAI's
ChatGPT and other LLMs. This version allows asking the
database (which is currently locally stored) questions and receiving a text response along
with optional tables to use in accordance with it.
As of 2/20/2024, only Air Force J-Book volumes 1-4 are included in this prototype.
Expansion to all is certainly possible and is simply a matter of
adding them to the filebase.

## Getting started

### How to run

#### Frontend - React (Located in "./client")

- To run the frontend, you need to first run `npm i` and wait for everything
  to install
- Then run `npm run start` and it will show up in your browser

#### Backend - Node and Express (Located in "./server")

- First, you need to add a .env file with an OpenAI key with the variable
  name `OPENAI_API_KEY`
  - An example .env file is given, just remove `.example` and add your API
    key
- Then run `npm i` and wait for everything to download
- Make sure your MongoDB server is running and make an account using the post
  route to `/users` with `name`, `employeeId`, and `password` fields
  - This can be done using Postman or anything like it since the page for
    registering is not implemented
- Lastly, run `npm run start` to start the server

### How to navigate

The interface follows very closely to that of ChatGPT to invoke similar intutive feelings.
They are many collapsable components as will as text
fields and buttons. Each one does what is expected due to either hover tooltips explaining
or helpful icons that attempt to portray the actions.
```

- Click on `New Query` and you should have in your text field examples to choose from, clicking on `Example` to the left will switch to `Ask` and then custom prompts can be given.
- Hitting the _Enter_ key or the send button will make your request and then capture your response.
- On the response there should be a text summary along with 2 more buttons in the bottom right corner. Hovering will reveal that they are `Use Tables` and `Requery` buttons.
- Pressing `Use Tables` will populate the above charts with the tables related to your question.
- Pressing `Requery` will attempt to provide you with a new response to your original question.
- Tables are not populated automatically to insure anything being visualized is not lost unless you want it too.
  - In the future there could be a selection of a couple tables instead of all.
- There are currently 3 table layouts, each attempting to follow a different pattern of both shapes and types of charts.
- There is an included keyword web but the feature, atleast for the dashboard itself, is not completely implemented. Though all it needs is a way to get data to populate it and it will work as intended.

How to add more pdfs

The main driving force of the application is the ability to save and retreive in memory vector stores from HNSWLib. Without this, there would be a
cost to re-embed everything everytime the server is ran. So once the application starts, it retrieves the vectorstores `pe_vectorstore` and
`vectorstore`, one for gettong PEs for tables and the other to answer any questions. Below I will detail how to add more PDFs and modify all files
needed to expand the capabilities.

Adding more PDFs for querying

 Before getting started, I will warn you that recreating vectorstores use the OpenAI embeddings thus it will incure a cost,
this goes for the querying as well. The embeddings for the 4 PDFs used, Air Force vols 1-4, incured a cost of $0.16 everytime I would redo the
embeddings. So I can assume it is around $0.04 per one PDF document of similar size.

- First you want to add every PDF you want to include but make sure they are OCR'd beforehand or else they cannot be read from.
- Then go to the `/tasks` folder and there will be `createVectorStoreFromDir.js` and `createVectorStoreFromText.js`. You want to go into the `FromDir` one, uncomment the console.log at the bottom, comment out the export, and then run that file in the terminal using `node createVectorStoreFromDir.js`.
  - Alternatively, you can run this file from another one by importing it.
- Once this is done, a new vectorstore for the PDFs should be created and querying should include these new files.

Now that the PDF vectorstore for questions is complete, the list of PEs for tables must be updated as well. This means that you must acquire the
JSON equivalent of the PDF and put it into the `json_pdfs` folder following the naming convetions detailed here.

- For each new PDF, the folder housing the JSON must be called: "`<PDF Name>_JSON`".
- I would recommend creating an easier process to do this, just make sure the JSON created follows the schema of the ones already there.
- Once that is done, the `pe_and_desc.txt` file must be updated.
  - To do this, from the `extractTables.js` file, you want to import the function `turnAllPeAndDescIntoTxt`.
  - Then you want to run this function which will recreate the `pe_and_desc.txt` with the new JSON data.
- Once that is updated, run the other vectorstore file `createVectorStoreFromText.js` by either importing it or following the same steps as the previous vectorstore.
- Now that both of these vectorstores are updated, the querying should now reflect the changes.

Additional Info

- For specific info on the API documentation, go to the `README.md` in the `./server` directory.
- For specifc info on Frontend components, go to the `README.md` located in the `./client/src` directory. The base folder's readme is about getting started with React in case that is needed.

APPENDIX F. PHASE 2 DATABASE SERVER "README.MD" FILE: API DOCUMENTATION

```
# Documentation for the API.

## <span style="color:lightblue">Making Queries</span>

### GET /query/:id/queries

- Returns a list of all queries for the specified user

### GET /query/:id/queries/:queryId

- Returns the query object with the specified ID for the specified user

### POST /query/:id/queries

- Creates a new query for the specified user

### PUT /query/:id/queries/:queryId

- Updates the specified query for the specified user

### DELETE /query/:id/queries/:queryId

- Deletes the specified query for the specified user

## <span style="color:lightblue">Getting Tables</span>

### GET /tables

- Returns a list of all tables in the database

### GET /tables/:id

- Returns the table object with the specified ID

### POST /tables

- Creates a new table in the database, and returns the new table object

### PUT /tables/:id

- Updates the specified table in the database, and returns the new table object
```

```
### DELETE /tables/:id

- Deletes the specified table from the database, and returns the new table object

## <span style="color:lightblue">Working With Users</span>

### GET /users

- Returns a list of all users in the database

### GET /users/:id

- Returns the user object with the specified ID

### GET /users/check-session

- Checks if the user is logged in

### POST /users

- Creates a new user in the database, and returns the new user object

### POST /users/login

- Logs in the user with the specified username and password

### POST /users/logout

- Logs out the user with the specified username and password

### PUT /users/:id

- Updates the specified user in the database, and returns the new user object

### DELETE /users/:id

- Deletes the specified user from the database, and returns the new user object

## Packages

- `@langchain/community` is for using non-core packages from LangChain
- `@langchain/core` is for using core packages from LangChain
- `@langchain/openai` is for using the OpenAI API with LangChain
- `bcrypt` is the main package for hashing passwords
- `cors` is the main package for cross-origin resource sharing
- `dotenv` is the main package for environment variables
```

```
- `express` is the main package for the server
- `express-session` is the main package for session management
- `langchain` is the main package for using older LangChain specific packages
- `mongodb` is the main package for the database
- `nodemon` is the main package for hot-reloading the server
- `openai` is the main package for the OpenAI API
- `pdf-parse` is the main package for parsing PDFs
```

APPENDIX G. PHASE 2 CLIENT "README.MD" FILE: CREATE REACT APP

```
# Getting Started with Create React App

This project was bootstrapped with [Create React App](https://github.com/facebook/
create-react-app).

## Available Scripts

In the project directory, you can run:

### `npm start`

Runs the app in the development mode.\
Open [http://localhost:3000](http://localhost:3000) to view it in your browser.

The page will reload when you make changes.\
You may also see any lint errors in the console.

### `npm test`

Launches the test runner in the interactive watch mode.\
See the section about [running tests](https://facebook.github.io/create-react-app/docs/
running-tests) for more information.

### `npm run build`

Builds the app for production to the `build` folder.\
It correctly bundles React in production mode and optimizes the build for the best
performance.

The build is minified and the filenames include the hashes.\
Your app is ready to be deployed!

See the section about [deployment](https://facebook.github.io/create-react-app/docs/
deployment) for more information.

### `npm run eject`

**Note: this is a one-way operation. Once you `eject`, you can't go back!**

If you aren't satisfied with the build tool and configuration choices, you can `eject` at
any time. This command will remove the single build dependency from your project.
```

```
Instead, it will copy all the configuration files and the transitive dependencies (webpack,
Babel, ESLint, etc) right into your project so you have full control over them. All of the
commands except `eject` will still work, but they will point to the copied scripts so you
can tweak them. At this point you're on your own.

You don't have to ever use `eject`. The curated feature set is suitable for small and
middle deployments, and you shouldn't feel obligated to use this feature. However, we
understand that this tool wouldn't be useful if you couldn't customize it when you are
ready for it.

## Learn More

You can learn more in the [Create React App documentation] (https://facebook.github.io/
create-react-app/docs/getting-started).

To learn React, check out the [React documentation] (https://reactjs.org/).

### Code Splitting

This section has moved here: [https://facebook.github.io/create-react-app/docs/
code-splitting] (https://facebook.github.io/create-react-app/docs/code-splitting)

### Analyzing the Bundle Size

This section has moved here: [https://facebook.github.io/create-react-app/docs/analyz-
ing-the-bundle-size] (https://facebook.github.io/create-react-app/docs/analyzing-the-bun-
dle-size)

### Making a Progressive Web App

This section has moved here: [https://facebook.github.io/create-react-app/docs/making-a-
progressive-web-app] (https://facebook.github.io/create-react-app/docs/making-a-progres-
sive-web-app)

### Advanced Configuration

This section has moved here: [https://facebook.github.io/create-react-app/
docs/advanced-configuration] (https://facebook.github.io/create-react-app/docs/
advanced-configuration)

### Deployment

This section has moved here: [https://facebook.github.io/create-react-app/docs/deployment]
(https://facebook.github.io/create-react-app/docs/deployment)
```

```
### `npm run build` fails to minify

This section has moved here: [https://facebook.github.io/create-react-app/docs/trouble-
shooting#npm-run-build-fails-to-minify] (https://facebook.github.io/create-react-app/docs/
troubleshooting#npm-run-build-fails-to-minify)
```

APPENDIX H. PHASE 2 CLIENT SOURCE "README.MD" FILE: CREATE REACT APP

```
# Getting started with `./client`

## General File Structure

- `./client` is the main folder for the frontend of the application
- `./client/src` is the main folder for the source code of the frontend
- `./client/src/components` is the main folder for the components of the frontend
- `./client/src/components/ChartLayouts` has the files for the different layouts of the
tables as will as the layout container
- `./client/src/components/Charts` has the files for the different types of charts as will
as a standardize chart container
- `./client/src/components/UI` has the files for the different UI components such as the
navigation bar and the collapsable components
- `./client/src/hooks` has the files for the different hooks used in the application
- `./client/src/pages`is the main folder for the different pages of the application
- `./client/src/stores` is the main folder for the different stores used in the
application utilizing Zustand
- `./client/src/App.js` is the main file for the application
- `./client/src/index.js` is the main file for the React DOM

## Packages

- `@mantine/core` is the main package for the UI components
- `@mantine/hooks` is the main package for the hooks used in the application that deal
with mantine
- `@tabler/icons-react` is the main package for the icons used in the application
- `zustand` is the main package for the state management of the application
- `axios` is the main package for the HTTP requests made in the application
- `charts.js` and `react-chartjs-2` are the main packages used for the charts
- `d3` is the package used for the keyword web
- `react-router-dom` is the package used for the routing of the application

The rest of the packages are default for a `create-react-app` application.
```

```
## Additional Notes

- The _bubble_ and _scatter_ charts are available but will not work as intended due to the difference in how data is used in these charts.
  - They both need x and y values to be arrays of objects with the keys `x` and `y` respectively along with the `r` for radius if it is a bubble chart (in pixels).

```json
{
  "x": 1,
  "y": 2,
  "r": 3 // Only for bubble charts
}
```

So to utilize these charts, the data will need to be transformed to fit this format. This was not implemented simply because transforming the current data would look like bar charts but with dots.
```

APPENDIX I. PHASE 2 NETWORK DIAGRAM SOURCE INSTALLATION STEPS

The following commands provide the installation steps for the installation steps (the two "pip install commands," followed by the Python source code to build the network diagrams.

```
<prompt> pip install pyvis
<prompt> pip install --upgrade xlrd

# Python source code starts here!
import pandas as pd
from pyvis.network import Network

# Ask the user for the Excel file path
excel_file_path = input("Please enter the path to the Excel file: ")

# Load data from Excel
data = pd.read_excel(excel_file_path)

# Create a Network instance
net = Network(notebook=True, cdn_resources='in_line')

# Set to store unique node IDs
unique_nodes = set()

# Add nodes from the data, excluding rows with missing or NaN values in 'Source' column
for _, row in data.dropna(subset=['Source']).iterrows():
    source = str(row['Source']).strip()  # Ensure source is a string and strip leading/
trailing spaces
    unique_nodes.add(source)  # Add source node to unique_nodes set

    # Add nodes from 'Adjacent Targets' column
    adjacent_targets = str(row['Adjacent Targets']).split(',')
    for target in adjacent_targets:
        unique_nodes.add(target.strip())  # Add adjacent target node to unique_nodes set

    # Add nodes from 'Third Targets' column
    third_targets = str(row['Third Targets']).split(',')
    for target in third_targets:
        unique_nodes.add(target.strip())  # Add third target node to unique_nodes set
```

```
# Add unique nodes to the network
for node in unique_nodes:
    node_type = data[data['Source'].str.strip() == node]['Type'].values[0] if node in
data['Source'].str.strip().values else 'Unknown'
    color = 'green' if node_type == 'Positive' else ('red' if node_type == 'Negative' else
'orange')
    net.add_node(node, label=node, color=color, font={'size': 150})

# Add edges from the data
for _, row in data.iterrows():
    source = str(row['Source']).strip()
    adjacent_targets = str(row['Adjacent Targets']).split(',')

    # Add edge between source and adjacent targets
    for target in adjacent_targets:
        net.add_edge(source, target.strip(), width=2, color='blue')

    # Add edge between the last node added (from 'Adjacent Targets') and the nodes in
'Third Targets'
    last_adjacent_node = adjacent_targets[-1].strip()
    third_targets = str(row['Third Targets']).split(',')
    for target in third_targets:
        net.add_edge(last_adjacent_node, target.strip(), width=1, color='gray')

# Set the layout algorithm to hierarchical
net.barnes_hut()

# Save the network visualization to an HTML file
output_file_path = 'network_visualization.html'
net.show(output_file_path)

# Print the unique set of all network nodes
print(«Unique Nodes:», unique_nodes)
```

APPENDIX J. PHASE 2 NETWORK DIAGRAM SOURCE INPUT EXCEL® FILE FORMAT

The following table contains the contents of "Sheet1" in the Excel file on which the Python Network Diagram code is dependent.

Table J-1. Network Diagram Source Input Excel File Format

Source	Adjacent Targets	Third Targets	Type
JADC2	ABMS	CCSO, MDO, NMT, PTRE, SAF/CDM, SCADA	positive
JADC2	AFGSC	AARGM-ER, AODS, ATRT, C2D2, FDS, GTSI, GT&S, I&M, ICBM, IIS, JASSM-ER, LRASM, LSS, NEWEG, OTL, RCC, USSTRATCOM, VSFB	positive
JADC2	AI/ML	A-CDD, AROC, CONOPS, CPP, DDL, HW, MTA, MS C, NDAA, OTA, RP, SW, TITAN	positive
JADC2	ASE	DSOR, FAA, GPS, M-Code, OA, SATCOM	positive
JADC2	BLOS	M&S, COAs, USSF, MW, ISR, SATCOM, DAF	positive
JADC2	C2IMERA	ACD&P, ACS, CID, CONUS, DBI, LOE, NTS-3	positive
JADC2	C3LB	AEDC, AFTC, FHP, PDM, SSR, USAF	positive
JADC2	CRADA	ASSD, DARPA, HM&E, ONR, OSD, POR, SBIR, STTR, USW	positive
JADC2	DAF	AF, AFIPPS, ATP, CSE, CV&I, DISA, DOT&E, DT&E, FIAR, FISCAM, QT&E, USSF	positive
JADC2	DIS	AMRDEC, CFD, ILIR, IR, JP8, MBE, M&S, PLD	positive
JADC2	GTMI	CCSO, NMT, OSD, PTRE, SAF/CDM, SCADA	positive
JADC2	IR	DAF, JWC, OUSD(R&E), RDER, SecAF	positive
JADC2	JTNC	AFGSC, AODS, FDS, ICBM, IIS, LSS, RCC	positive
JADC2	LVC	C2, C4ISR, EVTOL, ISR, MALE, TTPs, UAS, VTOL	positive
JADC2	MA-MLS	AFRL, CCCs, DAF, SDCP	positive
JADC2	MLS-JCE	AI, CAI, DE, DoD, HEL, HPEM, ISR, RFI	positive
JADC2	NC3	ARCYBER, CPTs, CPB, DCO, IWOC, MDTF, RCCs	positive
JADC2	SIPR	AT&T, C2D2, FTI, GTSI, GT&S, LRASM, NEWEW, NRE	positive
JADC2	SFWS	ARC, M&S, SMEs, VLRCOE	positive
JADC2	TENCAP	AF, ISR, NTISR, USAI	positive
JADC2	WSCS	ARC, M&S, VLRCOE, VTOL	positive

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