Ground Vehicles - Analysis Summary and Key Findings

FY16-FY20 Federal Contract Data - Analysis and Key Findings

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Executive Summary

Analyzing Federal Investments in Ground Combat Systems Programs

This case study focuses on providing support and insights to the Deputy Program Executive Officer for Ground Combat Systems within the Department of Defense (DoD). The objective is to examine prior federal investments in various ground combat systems (GCS) programs, specifically the Abrams tank (M1A1), Bradley fighting vehicle (M2A1), and Stryker armored personnel carrier (M1130), to identify contracting inefficiencies, opportunities for future investments, and potential risks associated with program management.

Addressing Data Pain Points:

1. **Vendor Name Normalization:** To address the issue of vendor name normalization, this study ensured consistency in vendor identification across contracts. This involved standardizing vendor names, and mapping those names to the original data set. This helps in reducing redundancy and improving data accuracy.
2. **Misidentified or Unidentified GCS Contracts and Vendors:** A comprehensive review of the dataset was completed to identify and rectify any misidentified or unidentified GCS contracts and vendors, ensuring a more complete and accurate analysis. To do this, GCS titles were categorized using their program name in various forms and their code.

Methodology:
Our approach involved data cleaning, normalization, and organization to ensure data accuracy and consistency. We used Python code-based methods and data transformation techniques to

enhance data quality and relevancy. Python data visualization libraries were used including **Matplotlib and Seaborn.**

Assessment of Spending Trends and Key Insights:
In this analysis, federal contract data from FY16 to FY20 uncovered several key insights and trends:

- **Prominent Vendors:** We identified the major vendors involved in GCS programs, highlighting their roles and contributions.
- **Funding/Contracting Offices:** We examined the funding and contracting offices responsible for these programs, providing clarity on the financial and administrative aspects.
- **Agencies:** We analyzed the agencies overseeing these contracts, shedding light on the interagency landscape.

Introduction

Analyzing Federal Investments in Ground Combat Systems Programs

The modernization and efficient management of the United States Department of Defense's (DoD) ground combat systems (GCS) program portfolio are essential for maintaining national security. The Deputy Program Executive Officer for Ground Combat Systems has undertaken an initiative to evaluate the federal government's previous investments in major GCS programs. This evaluation seeks to uncover potential contracting inefficiencies, identify opportunities for future investments, and assess potential risks associated with program management.

The focus of this engagement is on analyzing federal contract data spanning from Fiscal Year 2016 through Fiscal Year 2020, particularly related to three prominent GCS programs: the Abrams tank (M1A1), the Bradley fighting vehicle (M2A1), and the Stryker armored personnel carrier (M1130). The aim is to provide the Deputy Program Executive Officer with a comprehensive understanding of these programs, shedding light on various dimensions of the GCS market and offering actionable insights to inform strategic decisions.

This report outlines our approach to addressing critical data pain points, including vendor name normalization and the identification of misidentified or unidentified GCS contracts and vendors. We then present a detailed assessment of spending trends, key technologies, key market players, funding and contracting offices, and relevant agencies involved in these programs.

In this context, we also explore the alignment of federal budgets within each program, offering a glimpse into financial commitments and resource allocation. We conclude by providing an analysis of future acquisitions for these GCS programs and highlighting potential risks associated with program management.

Methodology

Analyzing Federal Investments in Ground Combat Systems Programs

The analysis of federal investments in Ground Combat Systems (GCS) programs encompassed a multifaceted approach, combining data preprocessing, normalization, and visualization techniques using Python libraries such as Pandas, Matplotlib, Seaborn, NumPy, and Matplotlib.colors. Additionally, Excel was employed to create a mapping dataset for the normalization of vendor names. The methodology can be broken down into the following key steps:

1. Data Collection and Preparation:

- Data preprocessing was performed using Pandas to clean, organize, and prepare the dataset for analysis.

2. Vendor Name Normalization:

- Vendor name normalization was a crucial step to ensure data consistency. Vendor names often had variations and discrepancies that needed to be addressed.
- A mapping dataset was created in Excel to standardize vendor names. This dataset served as a reference to convert vendor names into a common format, enabling more accurate and meaningful analysis.

3. Data Cleaning and Transformation:

- Data cleaning involved the identification and rectification of missing, inconsistent, or erroneous data points, specifically in GCS Program names. This process was conducted using Pandas, which allowed for efficient data manipulation.
- Unidentified or misidentified GCS contracts and vendors were diligently reviewed and corrected to enhance data quality.

4. Data Analysis:

- Pandas was employed to conduct an in-depth analysis of federal contract data related to GCS programs during Fiscal Years 2016 through 2020. Key analyses included:
    - Assessment of spending trends
    - Identification of prominent vendors
    - Evaluation of funding and contracting offices
    - Agency oversight analysis
    - Documentation of key technologies, products, and services acquired

5. Visualization and Insights:

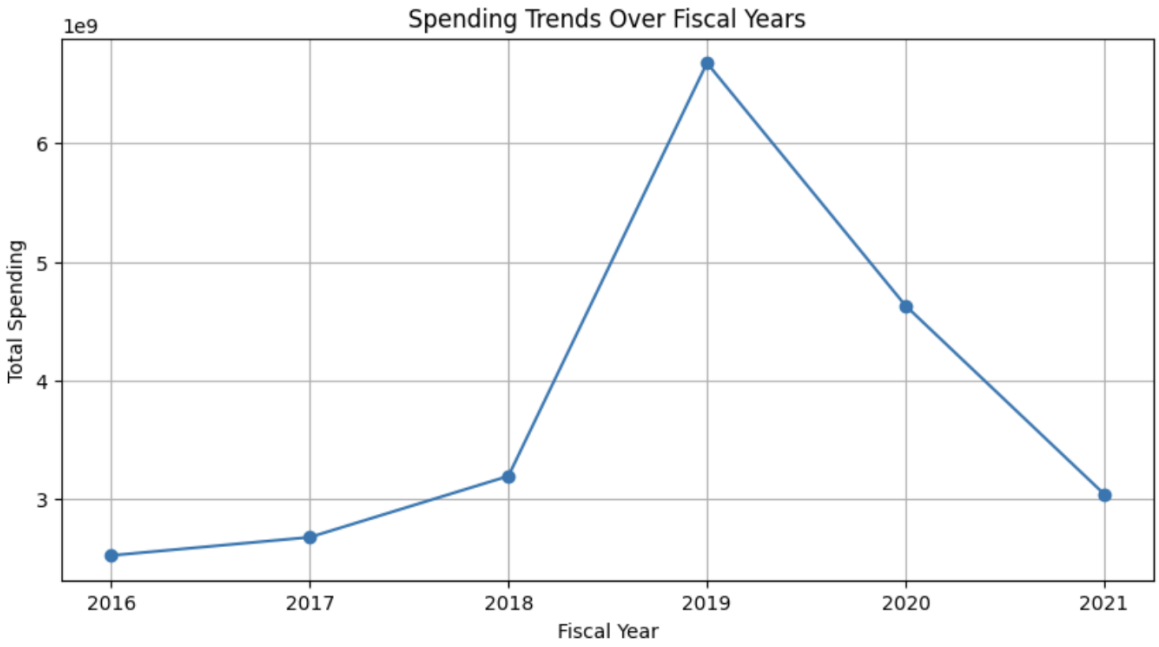
- Data visualization was achieved using Matplotlib and Seaborn. These libraries allowed for the creation of visually informative bar plots and other graphics that enhanced the presentation of data-driven insights.
- The choice of colors for the visualizations was carefully selected from the Matplotlib.colors library to ensure clarity and distinction, aiding in the presentation of information.

By employing these methodologies, we were able to provide the Deputy Program Executive Officer for Ground Combat Systems with valuable insights into the federal government's investments in GCS programs, helping to support data-driven decision-making and enhance the efficiency of these vital defense programs.

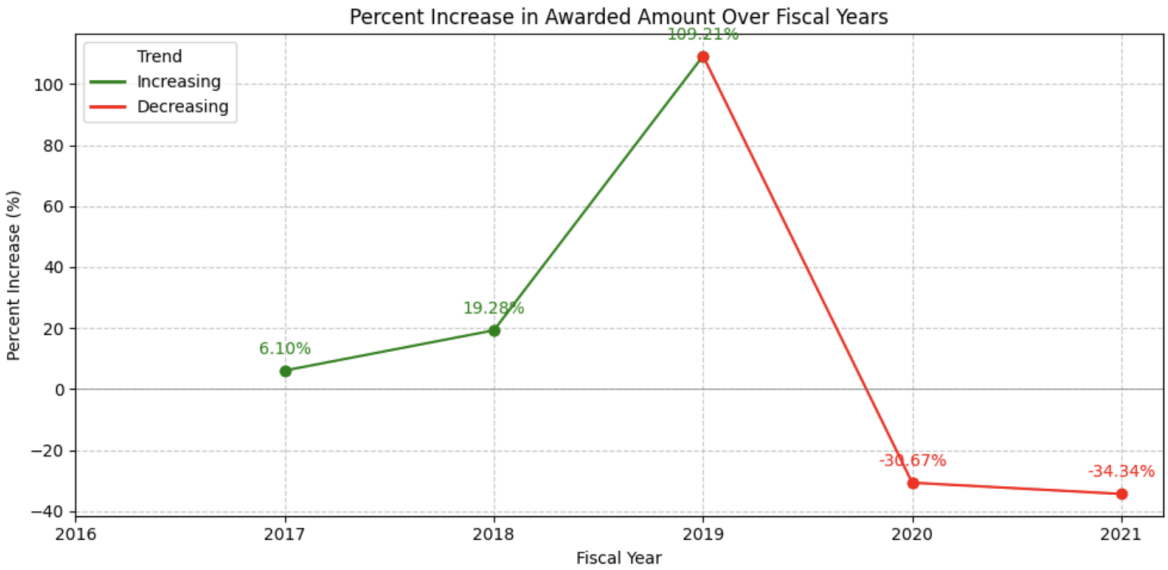
Data Visualization & Insight

In this section, we presented a series of visualizations that offer a visual summary of our findings. Each visualization is accompanied by insights that shed light on federal investments in GCS programs, as well as the overall dataset. These visual representations allow for a comprehensive understanding of the GCS market, enabling data-driven decision-making.

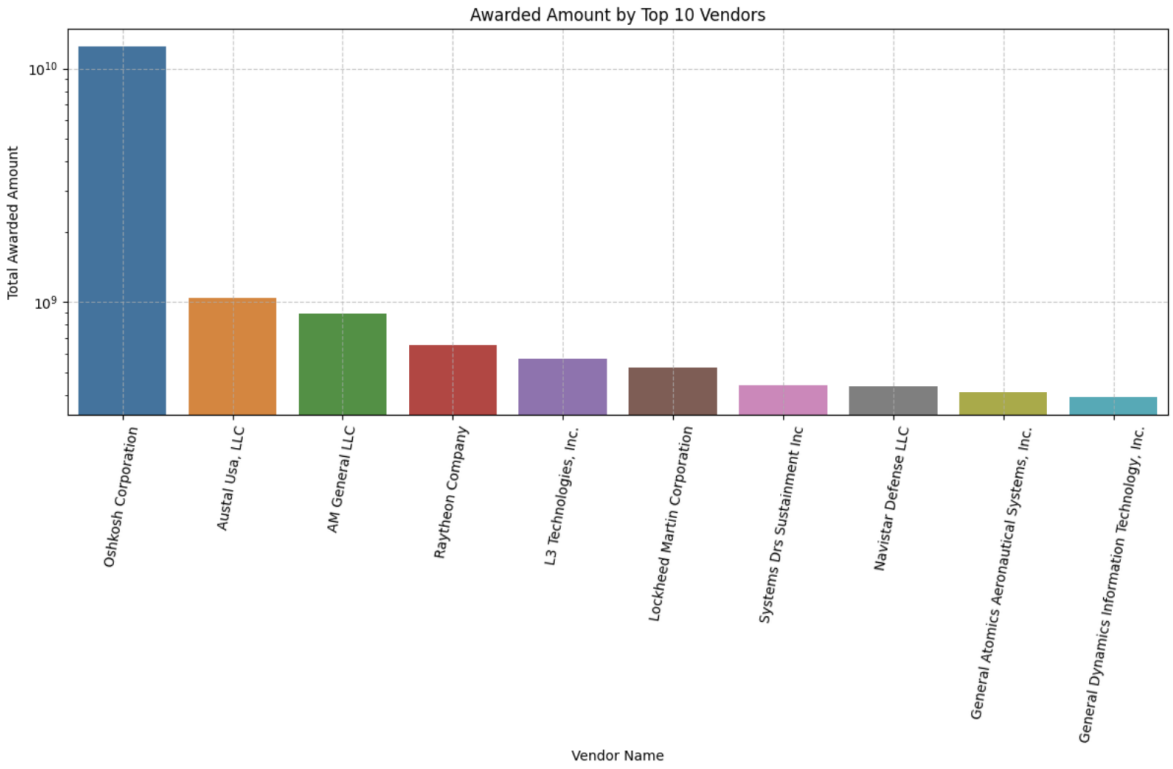
Overall Spending Trends Over Time



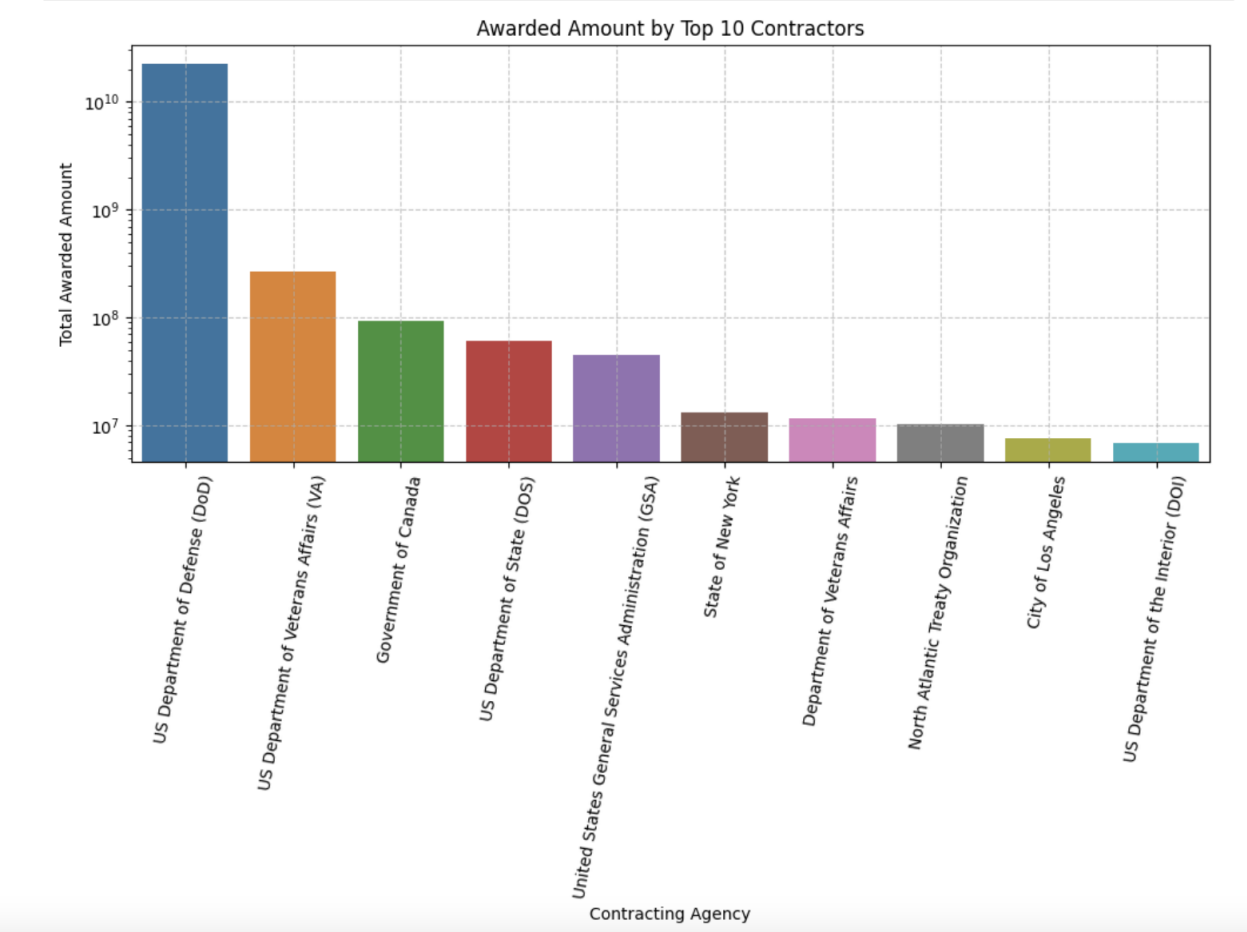
Percentage Difference of Overall Spending Trends Over Time



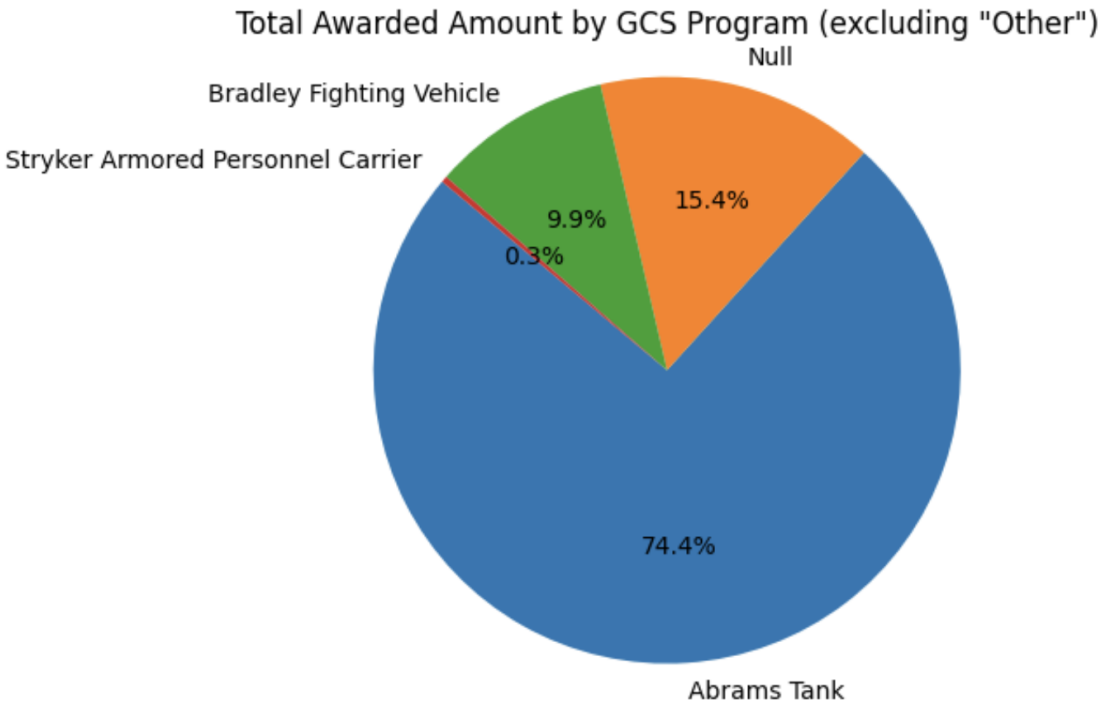
Overall Awarded Amount by Top Vendors



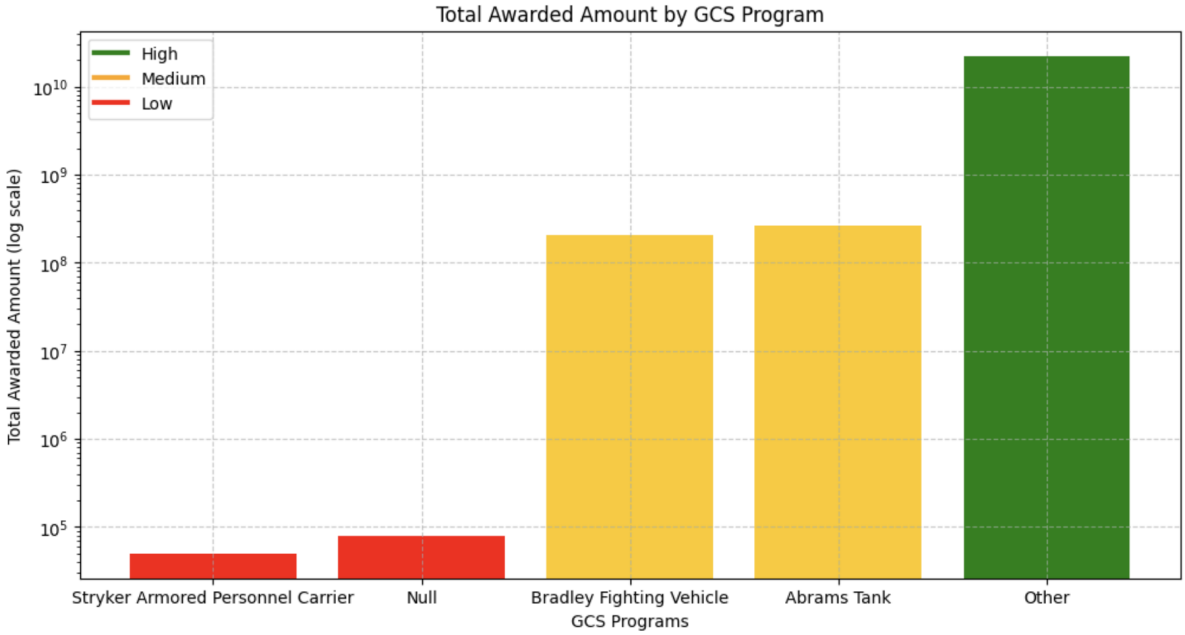
Overall Awarded Amount by Top Contract Agencies



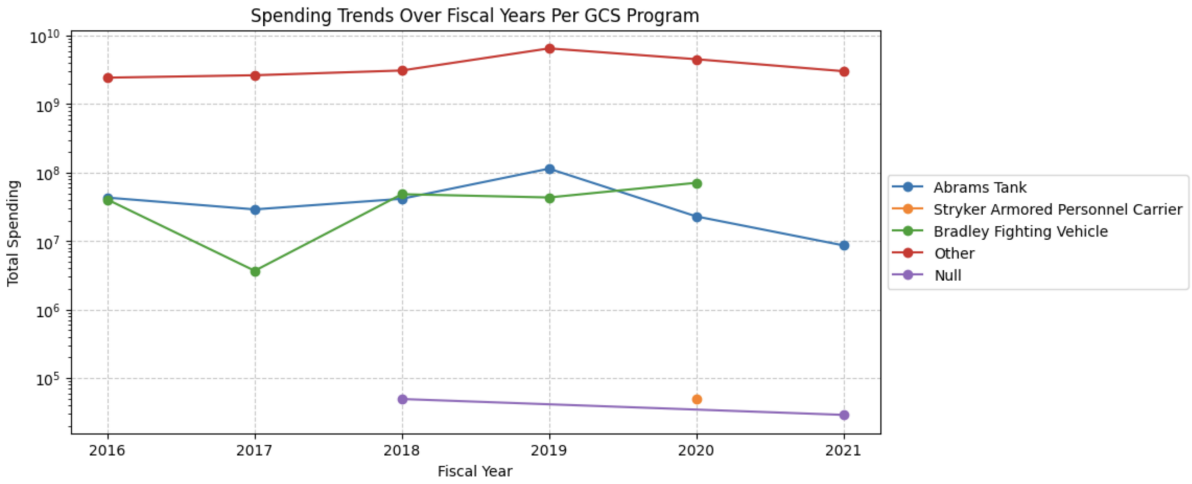
GCS Program Overall Spending Trends by Percentage



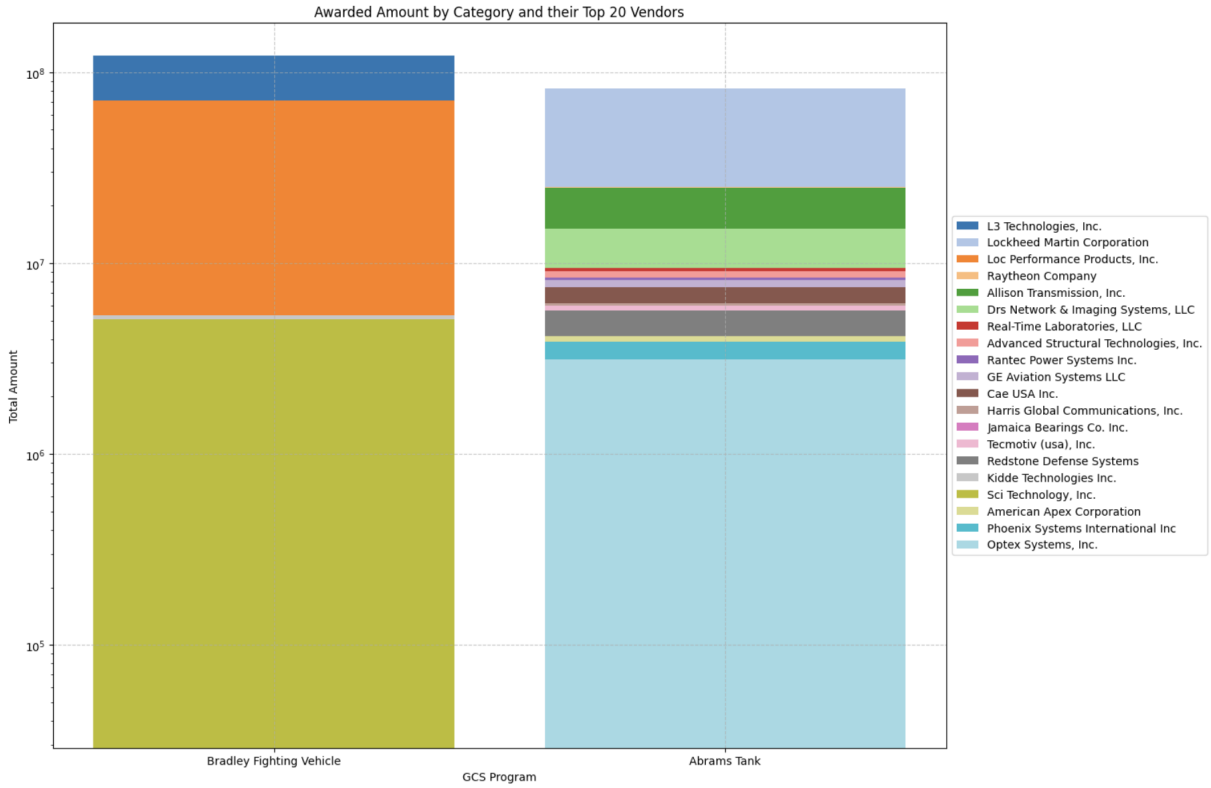
GCS Program Spending



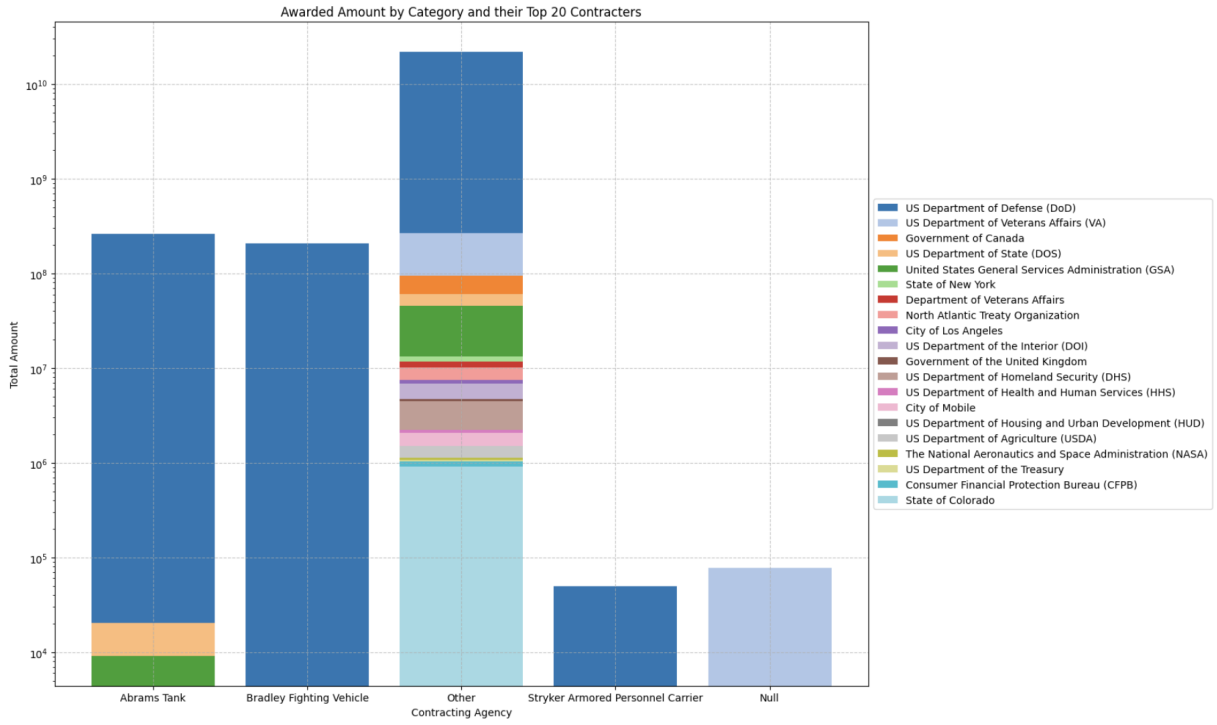
GCS Spending Trends Over Time



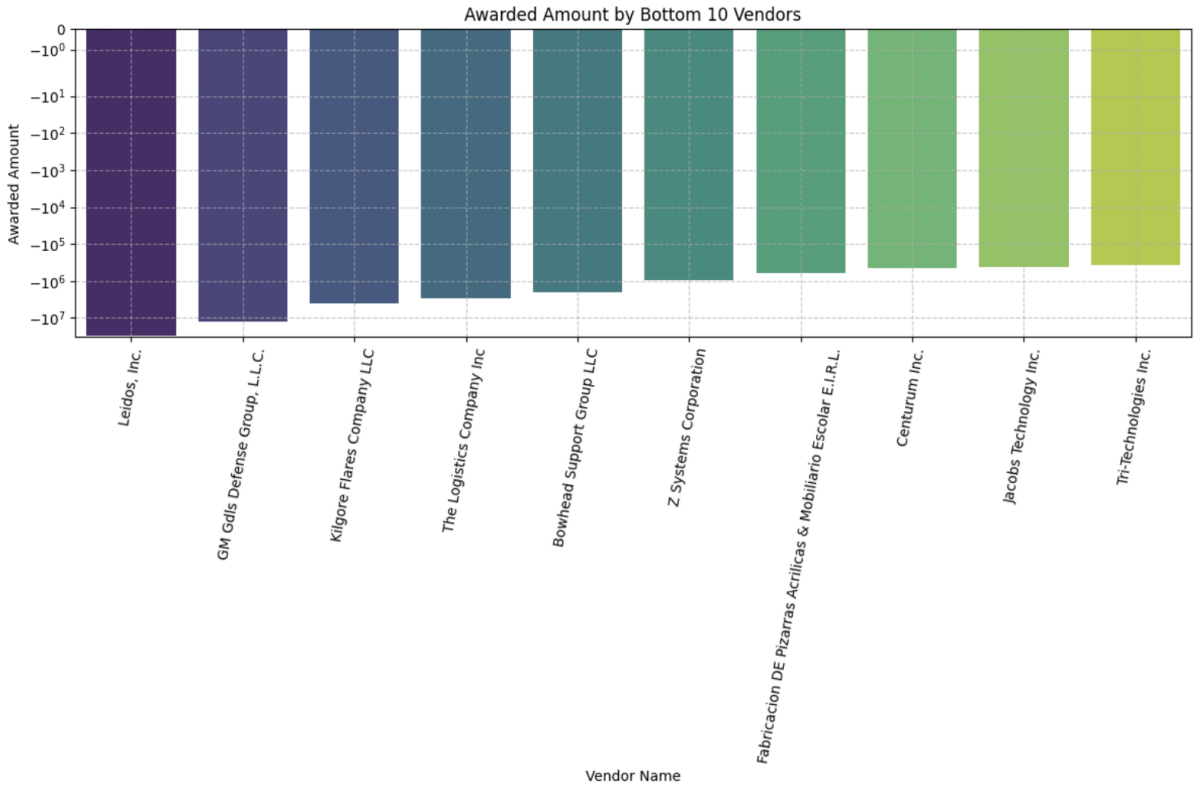
GCS Program Overall Spending Trends by Top Vendors

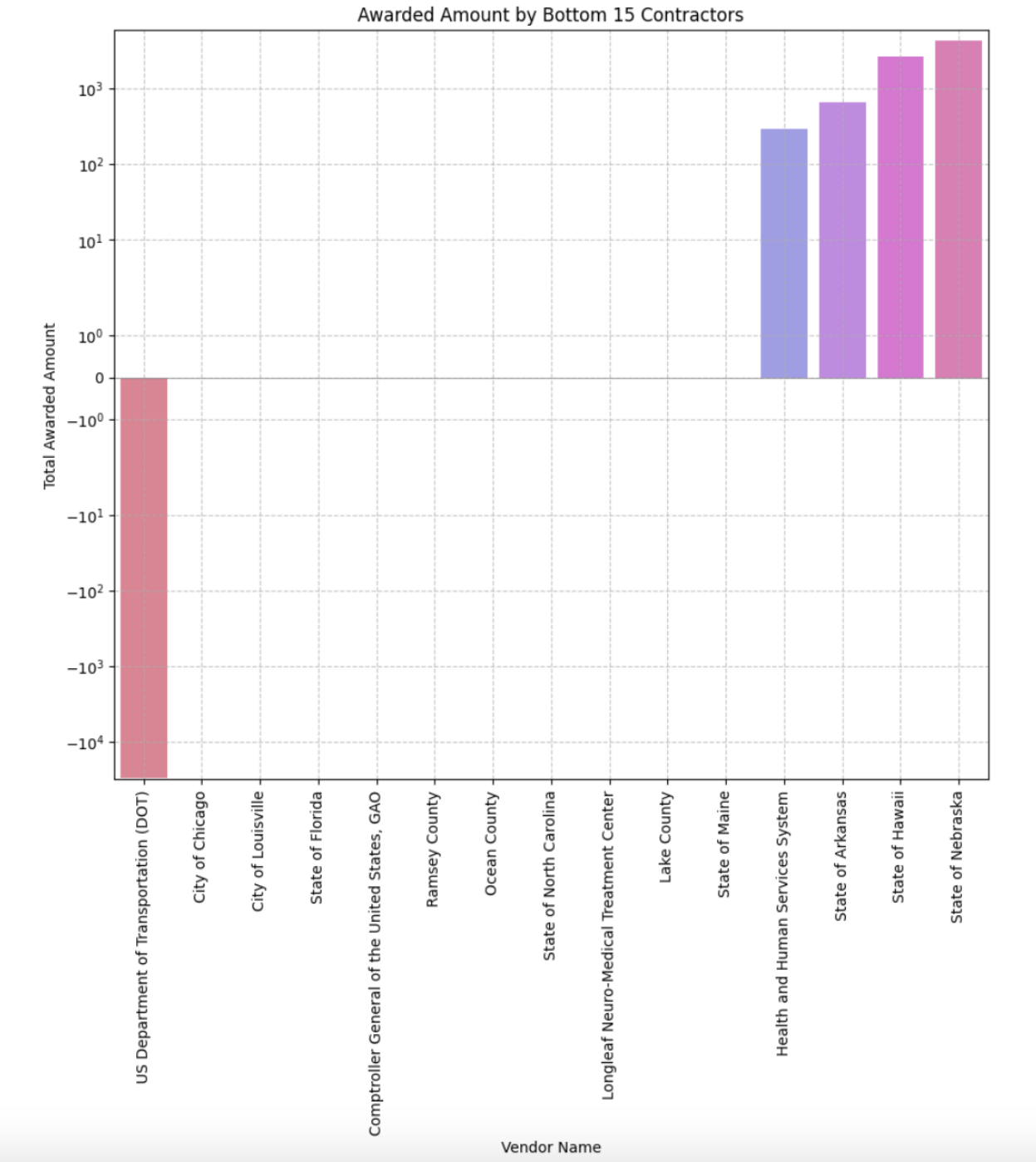


GCS Program Overall Spending Trends by Top Agencies



Non-Prominent Vendors and Contract Agencies to Consider





Additional Analytics

In [24]:
```
# Load the vendor name mapping table
mapping = pd.read_csv('mapping.csv')
```

In [25]:
```
mapping
```

Out[25]:

	Variation	Standardized Name
0	1st American Medical Distributors, Inc.	1st American Medical Distributors, Inc.
1	313 Industries, Inc.	313 Industries, Inc.
2	666126 Ontario Inc	666126 Ontario Inc
3	A Company, Inc.	A Company, Inc.
4	A P U Inc	A P U Inc
...	...	...
1123	Z Systems Corporation	Z Systems Corporation
1124	Zepoli International INC	Zepoli International INC
1125	Zimmer Us, Inc.	Zimmer Us, Inc.
1126	Zivaro, Inc.	Zivaro, Inc.
1127	Zumar Industries, Inc.	Zumar Industries, Inc.

1128 rows × 2 columns

In [12]:
```
# Get summary information about the DataFrame
print(data.info())
```

```
<class 'pandas.core.frame.DataFrame'>
RangeIndex: 48228 entries, 0 to 48227
Data columns (total 14 columns):
 #   Column                       Non-Null Count  Dtype
---  ------                       --------------  -----
 0   ID                           48186 non-null  float64
 1   Contract Number (IDVPIID)    37257 non-null  object
 2   Award Number (PIID)          48131 non-null  object
 3   Modification Number          47016 non-null  object
 4   Fiscal Year                  48186 non-null  float64
 5   Title                        48183 non-null  object
 6   Awarded Amount               47115 non-null  float64
 7   Contracting Office           48186 non-null  object
 8   Contracting Agency           48186 non-null  object
 9   Place of Performance State   46138 non-null  object
 10  Place of Performance City    46138 non-null  object
 11  Vendor  Top Name             48186 non-null  object
 12  PSC Name                     47546 non-null  object
 13  New Vendor Name              48228 non-null  object
dtypes: float64(3), object(11)
memory usage: 5.2+ MB
None
```

In [13]:
```
# Generate summary statistics for numerical columns
print(data.describe())
```

```
                 ID   Fiscal Year  Awarded Amount
count  4.818600e+04  48186.000000    4.711500e+04
mean   4.474374e+08   2017.998278    4.826502e+05
std    1.527162e+08      1.594551    1.494919e+07
min    2.619012e+08   2016.000000   -5.392089e+07
25%    2.988345e+08   2017.000000    1.434970e+03
50%    4.565367e+08   2018.000000    6.012360e+03
75%    5.977130e+08   2019.000000    1.000000e+04
max    6.764041e+08   2021.000000    1.698640e+09
```

Key Findings

1. **Highest Amount Awarded in 2019:** The year 2019 recorded the highest amount awarded in federal contracts for Ground Combat Systems (GCS) programs. This year marked a significant increase, with a substantial 109.21% difference from the preceding year in 2018. This indicates a peak in investment during this period.
2. **Prominent Vendor - Oshkosh Corporation:** Oshkosh Corporation emerged as the leading vendor with the highest amount awarded among all vendors in GCS programs. Their contributions played a crucial role in the federal investment landscape.
3. **Vendor with Negative Amount Awarded - Leidos:** In contrast to the highest-awarded vendor, Leidos had a negative amount awarded. This implies that Leidos faced financial adjustments or a decline in contract value during the analyzed period.
4. **Top Contracting Agency - DoD:** The Department of Defense (DoD) stands as the top contracting agency overall, playing a pivotal role in funding and managing GCS programs. This underscores the significance of DoD's role in these programs.
5. **Contracting Agency with Negative Award Amount - US Department of Transportation:** The US Department of Transportation displayed a negative award amount, indicating that their GCS program contracts may have faced budgetary constraints or adjustments.

Based on GCS Data

1. **High Awarded Amount in Abrams Tank Program:** Among the GCS programs, the Abrams Tank program recorded the highest awarded amount, capturing a substantial share,

representing 74.4% of the collected title data. This underlines the significance of the Abrams Tank program in federal investments.

2. **Heat Map of Total Awarded Amount by GCS Program:** A heat map visualizing the total awarded amount by GCS program indicated that the Stryker program had the lowest investment, while the Abrams program received the highest funding, particularly after considering "Other" category programs.
3. **Spending Trends Per GCS Program:** Analyzing spending trends per GCS program revealed that the Abrams program exhibited consistency in its spending pattern, with the highest amount awarded recorded in 2019. In contrast, the Stryker program experienced a noticeable fluctuation in funding, with only one award recorded in 2020.

These key findings provide a comprehensive understanding of the federal investment landscape in GCS programs. They highlight trends, significant vendors, contracting agencies, and the varying financial dynamics among GCS programs, offering valuable insights for strategic decision-making within the Department of Defense.

Conclusion

The analysis of federal investments in Ground Combat Systems (GCS) programs offers a comprehensive perspective on financial trends, major stakeholders, and strategic insights. Our findings reveal crucial aspects of the GCS landscape, both in terms of overall data and specific GCS programs.

Conclusion - **Overall Data:**

1. **2019 Investment Peak:** The year 2019 marked a significant peak in federal investments, with the highest amount awarded. The 109.21% increase compared to 2018 indicates a substantial upswing in funding for GCS programs during this period.
2. **Oshkosh Corporation Dominance:** Oshkosh Corporation emerged as the preeminent vendor, commanding the highest amount awarded among all GCS program stakeholders. Their substantial contributions underscore their vital role in shaping the federal investment landscape.
3. **Leidos' Decline:** In contrast, Leidos experienced a negative amount awarded, indicative of financial adjustments or a decline in contract value. This finding draws attention to the potential challenges faced by this vendor during the analyzed period.

4. **DoD's Key Role:** The Department of Defense (DoD) emerged as the top contracting agency, signifying its central role in funding and overseeing GCS programs. DoD's involvement underscores its significance in shaping the GCS landscape.
5. **US Department of Transportation's Budget Constraints:** The US Department of Transportation displayed a negative award amount, suggesting budgetary constraints or adjustments within their GCS program contracts.

Conclusion - **Based on GCS Data:**

1. **Abrams Tank Significance:** The Abrams Tank program stood out with the highest awarded amount, capturing a substantial share, representing 74.4% of the collected title data. This highlights the Abrams program's critical role in federal investments.
2. **Varying Program Investments:** A heat map showcasing the total awarded amount by GCS program revealed that the Stryker program received the lowest investment, while the Abrams program dominated, particularly when considering the "Other" category programs.
3. **Spending Trends:** Examination of spending trends per GCS program highlighted the Abrams program's consistent funding pattern, with the highest amount awarded in 2019. In contrast, the Stryker program experienced notable funding fluctuations, with only one award recorded in 2020.

These insights offer a robust foundation for strategic decision-making within the Department of Defense. They provide a clear understanding of financial dynamics, key players, and program-specific trends within the GCS landscape. The data-driven findings serve as a valuable resource for shaping future investments and enhancing the efficiency of GCS programs.

References:

1. Govini. (n.d.). Defense. Govini. https://govini.com/clients/defense/
2. PyData. (n.d.). Seaborn: Statistical Data Visualization. Seaborn. https://seaborn.pydata.org/tutorial/function_overview.html