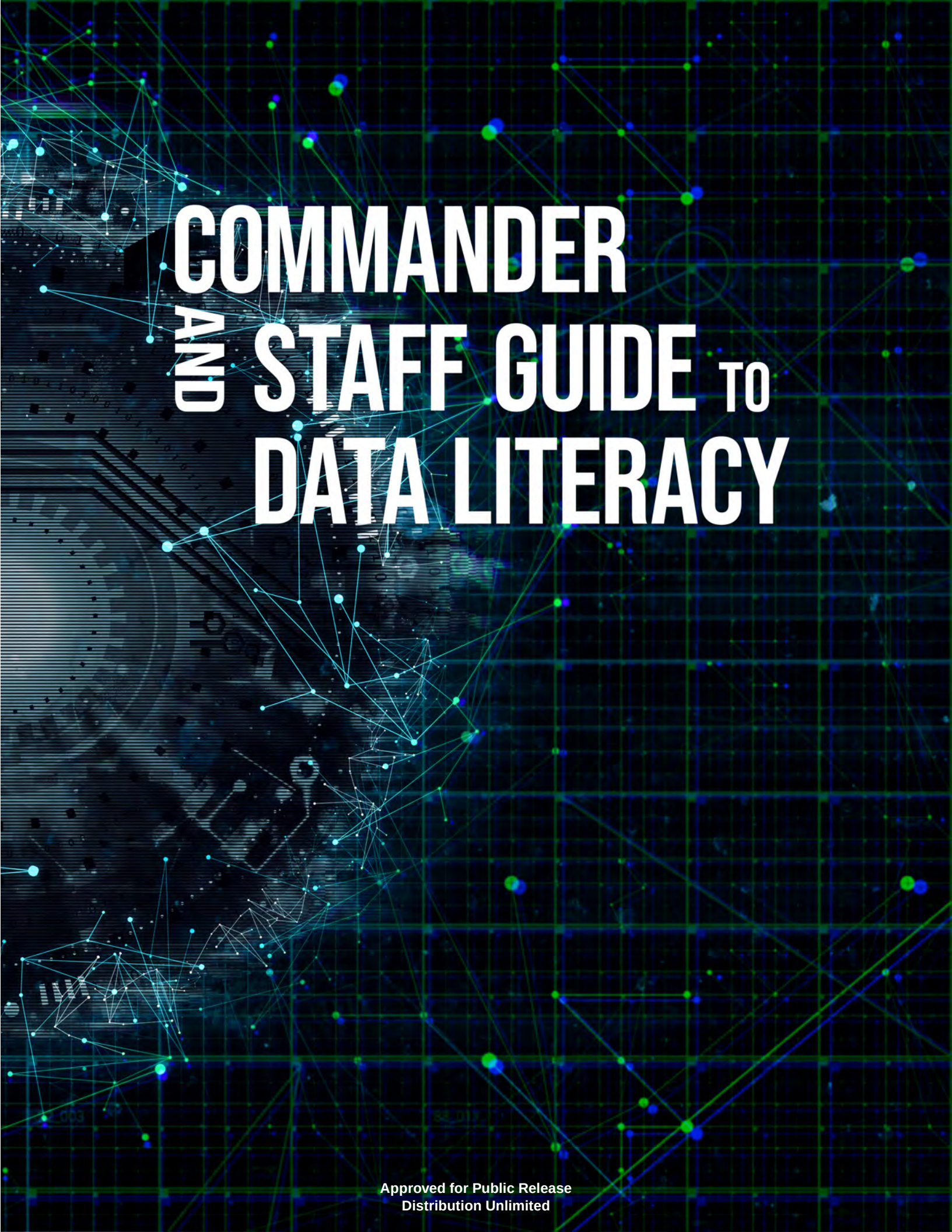
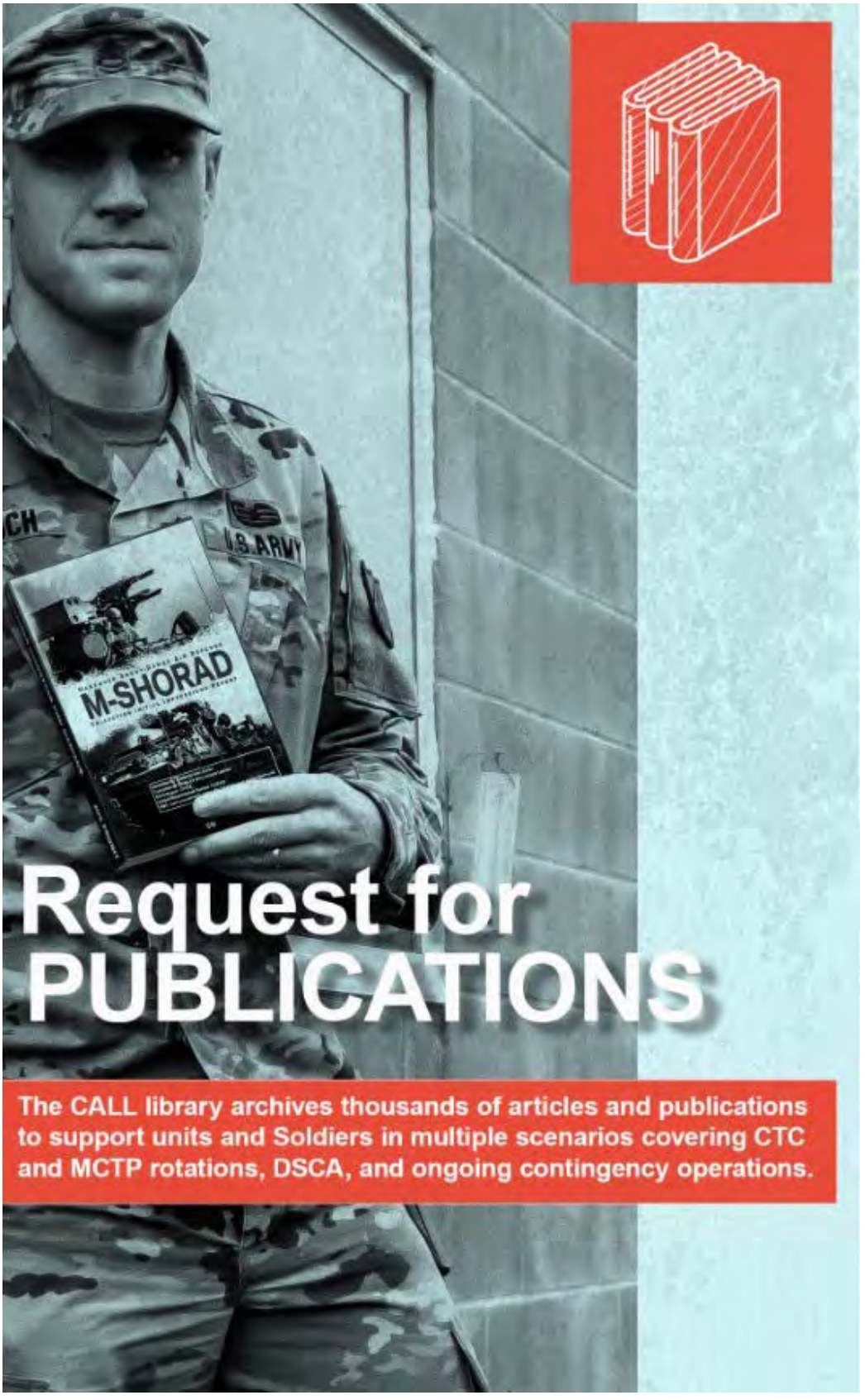


COMMANDER AND STAFF GUIDE TO DATA LITERACY



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Foreword

Data has become a cornerstone of decision making in modern military operations. As the complexity and speed of operations increases, commanders and staff must navigate an ever-growing stream of information to make timely, informed, and effective decisions. The ability to interpret, analyze, and apply data has transformed from a technical specialty to a critical skill set for leaders at all levels.

The purpose of this guide is to provide an accessible introduction to data literacy, tailored specifically for commanders and staff. It bridges the gap between technical expertise and operational needs, helping military leaders understand how to leverage data as a strategic asset. While this guide does not aim to turn readers into data scientists, it equips them with the foundational knowledge required to collaborate effectively with analysts and make data-informed decisions with confidence.

This guide emphasizes the practical application of data literacy within the unique context of military operations. From intelligence analysis to operational planning, data plays a vital role in enhancing situational awareness, assessing risks, and evaluating outcomes. By understanding the fundamentals of data and its potential applications, commanders and staff can unlock new opportunities to gain a decisive edge on the battlefield.

Each chapter builds on the previous one, starting with basic concepts and progressing to real-world applications. Readers will learn how to interpret different types of data, recognize common pitfalls, and use data tools effectively. They will also explore strategies for fostering a data-driven culture within their teams, ensuring that every Soldier contributes to mission success.

In an era defined by rapid technological advancements and information dominance, the ability to harness data is no longer optional, but is essential. This guide serves as a starting point for military leaders to develop the skills, mindsets, and strategies necessary to thrive in this data-driven landscape.

Contents

Chapter 1
Understanding Data Literacy

> What does it mean to be data literate?
>
> Data literacy is the ability to read, work with, analyze, and communicate with data to describe, diagnose, predict, and prescribe.
>
> Jordan Morrow, "Be Data Literate"

Data literacy refers to the ability to read, manipulate (work with), analyze, and communicate data effectively. In the context of military operations, it is more than just a technical skill, it is a critical competency that enhances decision-making, operational planning, and mission outcomes. As modern conflicts increasingly rely on information dominance, the capacity to extract actionable insights from data has become indispensable for commanders and staff alike. The ten data literacy principles outlined below serve as a guide to formations as they train and develop data literate Soldiers and Staff Members that embrace a culture of data literacy. The following list was created using CAMOGPT:

- **Data fundamentals.** Know basic data concepts, types, and structures, including qualitative vs. quantitative data.
- **Data-driven decision making:** Utilize data to support conclusions, identify trends, and support decision making.
- **Data management and quality:** Establish standards for data collection, organization, and storage, consistently scrub data to correct errors and inconsistencies.
- **Data interpretation:** Develop proficiency in reading, manipulating, analyzing, and interpreting charts, graphs, and dashboards to extract meaningful insights.
- **Collaborative and current data systems:** Create collaborative data collection systems that provide real-time updates, avoid stale data, and duplication of effort.
- **Effective data communication:** Clearly present data insights through storytelling, visualization, and reports tailored to the audience that effectively conveys the "so what."
- **Data tool proficiency:** Train Soldiers to develop practical skills using spreadsheets, databases, mission command systems, and analytics software for effective data management.
- **Continuous learning and adaptation:** Stay updated on new data techniques & technologies (AI, LLM, ML) to understand their capabilities and limitations.
- **Ethical data handling:** Respect data ownership, comply with regulations, prioritize data privacy and responsible use.
- **Data literacy culture:** Develop an environment within your formation where data is routinely used to inform decisions and Soldiers have a basic understanding of how to read, manipulate, analyze, and communicate with data.

In many cases, Soldiers, noncommissioned officers (NCOs), and Officers are already applying the principles and elements associated with data literacy in the course of their work. However,

increased training and emphasis is warranted based on the exponential increase in available data and information and the matching increase in the number of systems used to store, process, and interpret it. The emergence of easily accessible artificial intelligence programs has added another dimension to this rapidly evolving information environment. Clearly not every Solider needs to be a data scientist, but commanders and their staff must be able to read, work with, and communicate data. While every Soldier should be data literate, the concepts and principles associated with data literacy may have different implications based on duty position and the echelon of command where they work. The following examples illustrate how the application of data literacy principles and concepts may vary based on these factors.

- For an Army Recruiter, data literacy facilitates working with information systems that provide details about their recruiting area of operations and include applicant contact information, population demographics, and local labor market data. Additionally, once an applicant commits to joining the Army, documentation related to their enlistment application will be uploaded to a central repository and accessed by Army career counselors, administrative, and medical personnel at the Military Entrance Processing Stations (MEPS). With many of these documents including elements of personally identifiable information (PII), the recruiter must be familiar with the concepts of Data Governance and Security outlined later in Chapter 6.
- A 420A specialty, human resources technician will routinely use personnel databases and systems such as IPERMS, IPPS-A, and DEERs while accomplishing their daily tasks. To operate effectively they must understand how to download and display reports from these personnel information systems, along with having a working knowledge of how the systems interact to share data, and how long it takes for a personnel action to update the central repository, while also "cleaning" or "scrubbing" rosters for accuracy.
- For a brigade current operations officer or NCO (battle captain/NCO), being data literate can facilitate development of efficient systems to gather and share reports, this could include qualitative data such as subordinate unit's weekly situation reports (SITREPs) or the consolidation and presentation of weapons qualification rates at a quarterly training brief (QTB). While deployed or during a field training exercise (FTX), CUOPS officers manage the unit's digital common operating picture (COP) and must have a working knowledge of the various inputs that feed the display to ensure it is accurate and up to date. In garrison, battle captains are routinely asked to manage "data calls" and track task compliance which involves execution of the steps in the data lifecycle discussed in Chapter 3 of this publication.
- For a lieutenant colonel working in a corps level fire support element, data literacy will involve many of the aspects outlined above but may also include the incorporation of cutting-edge capabilities such as MAVEN Smart Systems (MSS) that "combines sensors,

artificial intelligence, and machine learning"[1] to assist in targeting and executing strikes. While MSS can greatly enable the decision-making process, staff members will need to have a cursory understanding of how these emerging systems function to fully appreciate their capabilities and limitations.

- A general officer commanding a corps, division, or center of excellence will likely be the recipient of products and processes developed by a data literate staff to assist in decision making. While providing direction and guidance on how, when, and what information is required, Army senior leaders can also ensure their organizations create a culture of data literacy by developing policies and guidance towards that end, as discussed later in Chapter 7.

Note: While junior enlisted Soldiers and junior officers may not routinely work with large amounts of data, unit leaders should seek out and identify members of their formation that possess a talent for coding, data sorting, and data management based on previous experience or personal interest. These Soldiers can be a tremendous asset when units internally develop innovative approaches to working with data.

At its core, data literacy involves understanding the lifecycle of data from its collection to its application in decision making. This includes recognizing patterns, identifying trends, and discerning relationships within data sets. More importantly, it requires the ability to critically assess the reliability and relevance of data in various operational contexts. Data literacy is not confined to a specific role or rank. Rather, it is a skill set that should be embraced across all levels of leadership (see Figure 1-1).

[1] https://military.news/u-s-army-s-maven-smart-system-revolutionizes-battlefield-targeting-with-advanced-ai/

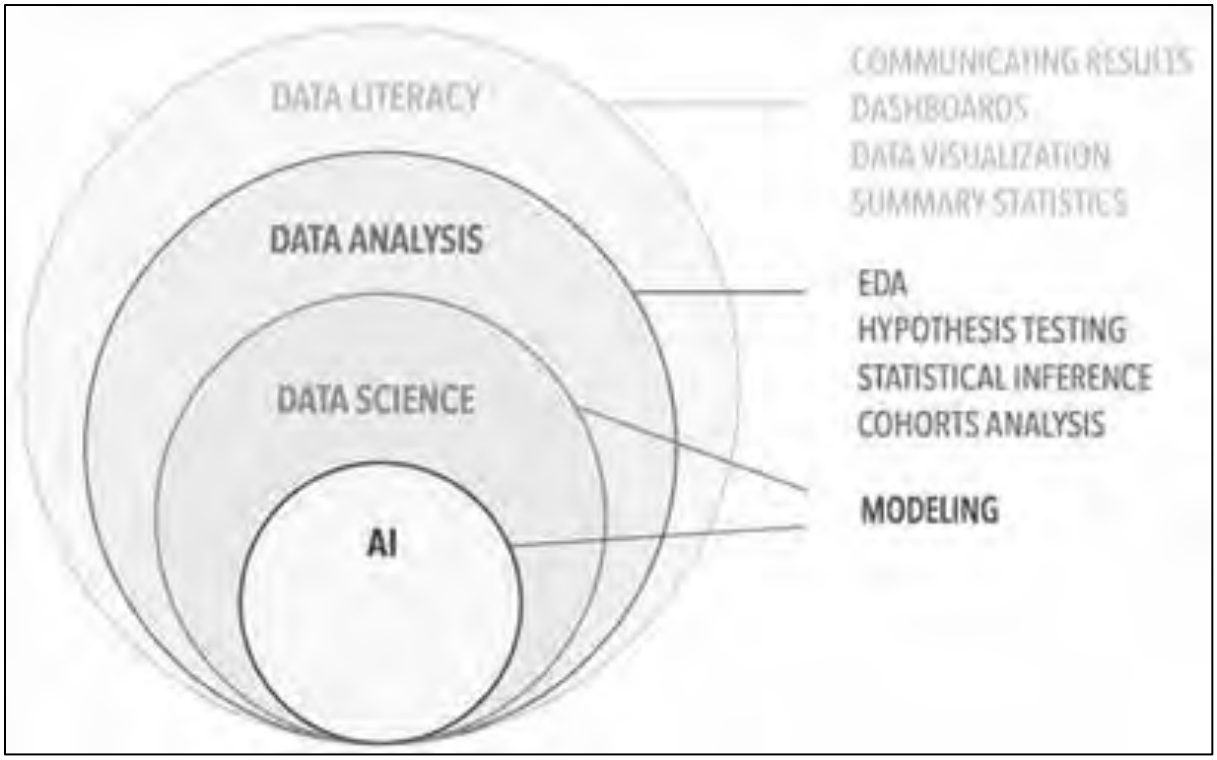

Figure 1-1. Model comparing the Different Levels of Data Literacy[2]

Commanders and staff operate in environments where decisions often need to be made quickly and under conditions of uncertainty. Data serves as a force multiplier, providing clarity and structure in chaotic situations. However, for data to be effective, it must be understood and applied correctly. Misinterpretation or misuse of data can lead to flawed conclusions, operational missteps, and even mission failure. Therefore, developing data literacy is not merely a technical endeavor but a strategic imperative.

The role of data in decision making has expanded dramatically with the advent of advanced technologies. Artificial intelligence, machine learning, and big data analytics are transforming how information is processed and utilized. Commanders and staff must adapt to this evolving landscape by cultivating a deeper understanding of these tools and their implications. This does not mean they need to become experts in coding or data science (see Figure 1-2). Instead, they must develop the ability to ask the right questions, understand analytical outputs, and make informed decisions based on the insights provided by data professionals.

[2] Model comparing the different levels of data literacy. How are Data Science, Data Literacy, and AI different? https://www.correlation-one.com/faq/how-are-data-science-data-literacy-and-ai-different

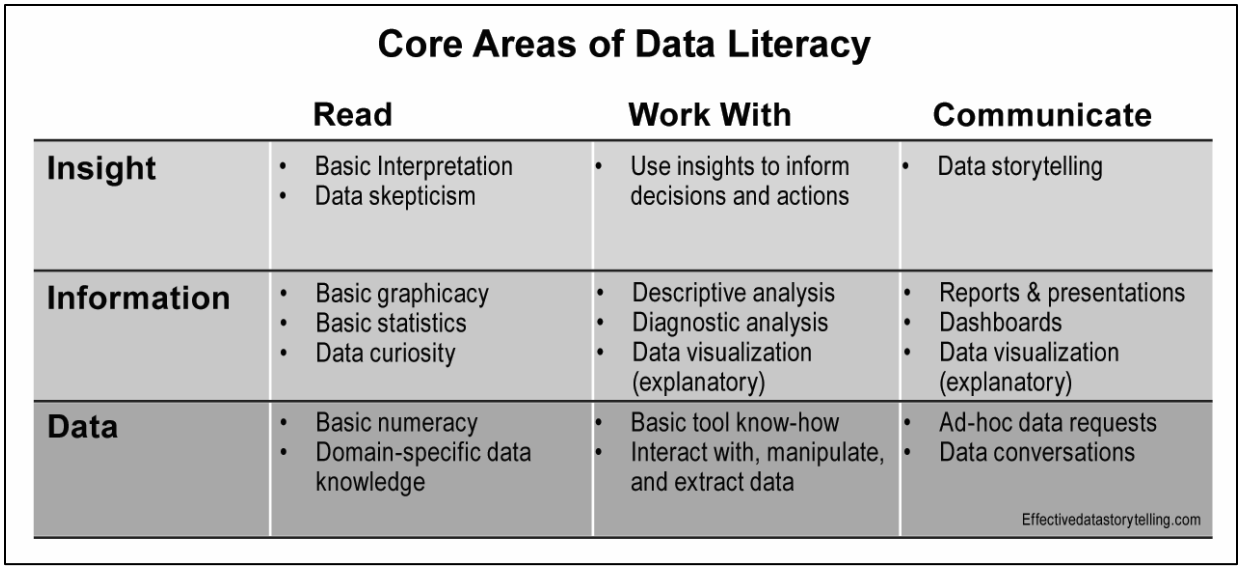

Figure 1-2. Core Areas of Data Literacy[3]

The importance of data literacy extends beyond the individual level. It is essential for fostering a shared understanding within teams and organizations. When all members of a command or staff possess a baseline-level of data literacy, they can collaborate more effectively, share insights efficiently, and align their efforts toward achieving mission objectives. This shared competency also facilitates communication between technical specialists and operational leaders, bridging the gap between data analysis and practical application. The list below highlights additional benefits that data literate Soldiers and formations can leverage.[4]

1. **Informed decision making:** Data analytics can provide empirical evidence for making decisions, reducing reliance on intuition.
2. **Real-time insights**: Advanced analytical tools enable real-time data analysis, enabling units to make informed decisions swiftly.
3. **Enhanced efficiency and productivity:** Analytics can automate repetitive tasks, freeing up personnel for more complex tasks.
4. **Process optimization:** Data analytics helps identify bottlenecks and inefficiencies in operational processes, leading to more efficient workflows.
5. **Risk management**: Data literacy allows organizations to identify potential risks and vulnerabilities by forecasting future trends and outcomes using predictive analytics.
6. **Innovation and development:** Insights derived from data analytics can lead to the development of innovative material solutions, processes, and services.

[3] Core areas of data literacy. Data Literacy and Data Storytelling: How Do They Fit Together? 12 May 2022. https://www.effectivedatastorytelling.com/post/data-literacy-and-data-storytelling-how-do-they-fit-together

[4] This list is derived from U.S. Army Training and Doctrine Command (TRADOC) course at https://rise.articulate.com/share/Qor6dXkc0XoYDTK9O09ScArFXc-G-vy6#/

7. **Data governance and compliance**: Data Analytics can help ensure that data practices comply with regulatory requirements, reducing administrative, legal, and regulatory risks.
8. **Data quality management**: Regular data analysis improves data quality and integrity, ensuring reliable data for decision-making.
9. **Empowered commanders and staff**: Cultivating a data-driven culture empowers commanders and their staff by providing them with valuable insights for their work.
10. **Skill development:** Exposure to data analytics fosters skill development and encourages innovative thinking among commanders and their staff.

Data literacy also requires an awareness of its limitations. Not all data is created equal, and not all conclusions drawn from data are valid. Commanders and staff must be vigilant in questioning the sources, quality, and biases inherent in the data they use. They must also understand the ethical considerations associated with data collection and application, ensuring that their actions align with legal and moral standards.

Chapter 2
The Fundamentals of Data

Data is the raw material that fuels decision-making processes in modern military operations. To leverage its full potential, it is essential to understand the fundamental aspects of data to include its types, sources, formats, and the ethical considerations that govern its use. This chapter delves into these foundational concepts providing a comprehensive understanding of data and its critical role in operational contexts.

One of the first steps in developing data literacy is recognizing the different types of data (see Figure 2-1). Broadly, data can be categorized as structured or unstructured (see Figure 2-2). Structured data is highly organized and stored in predefined formats, such as rows and columns in a database. Examples include personnel records, logistics inventories, and sensor readings. Unstructured data, on the other hand, lacks a predefined format and is often more complex to process. Examples include emails, video feeds, social media content, and intelligence reports. Understanding the distinctions between these types is essential for selecting the appropriate tools and methodologies for analysis.

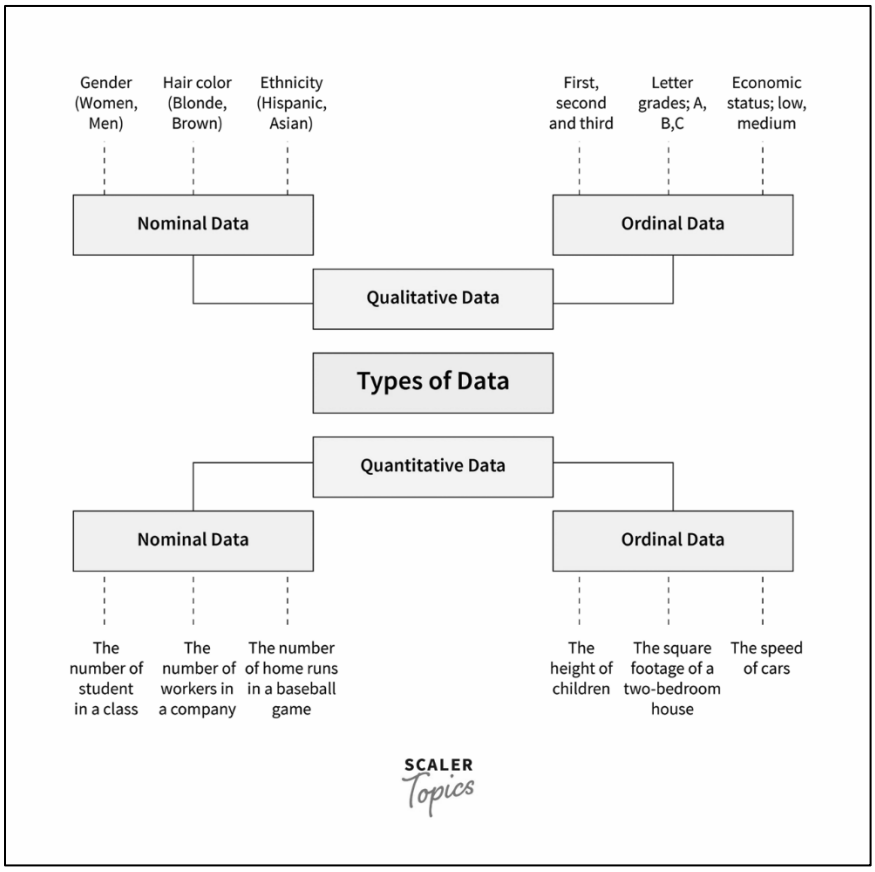

Figure 2-1. Differentiating Qualitative and Quantitative Data[5]

[5] Differentiating qualitative and quantitative data, "Statistics for Machine Learning," 4 October 2023. https://www.scaler.com/topics/statistics-for-machine-learning/

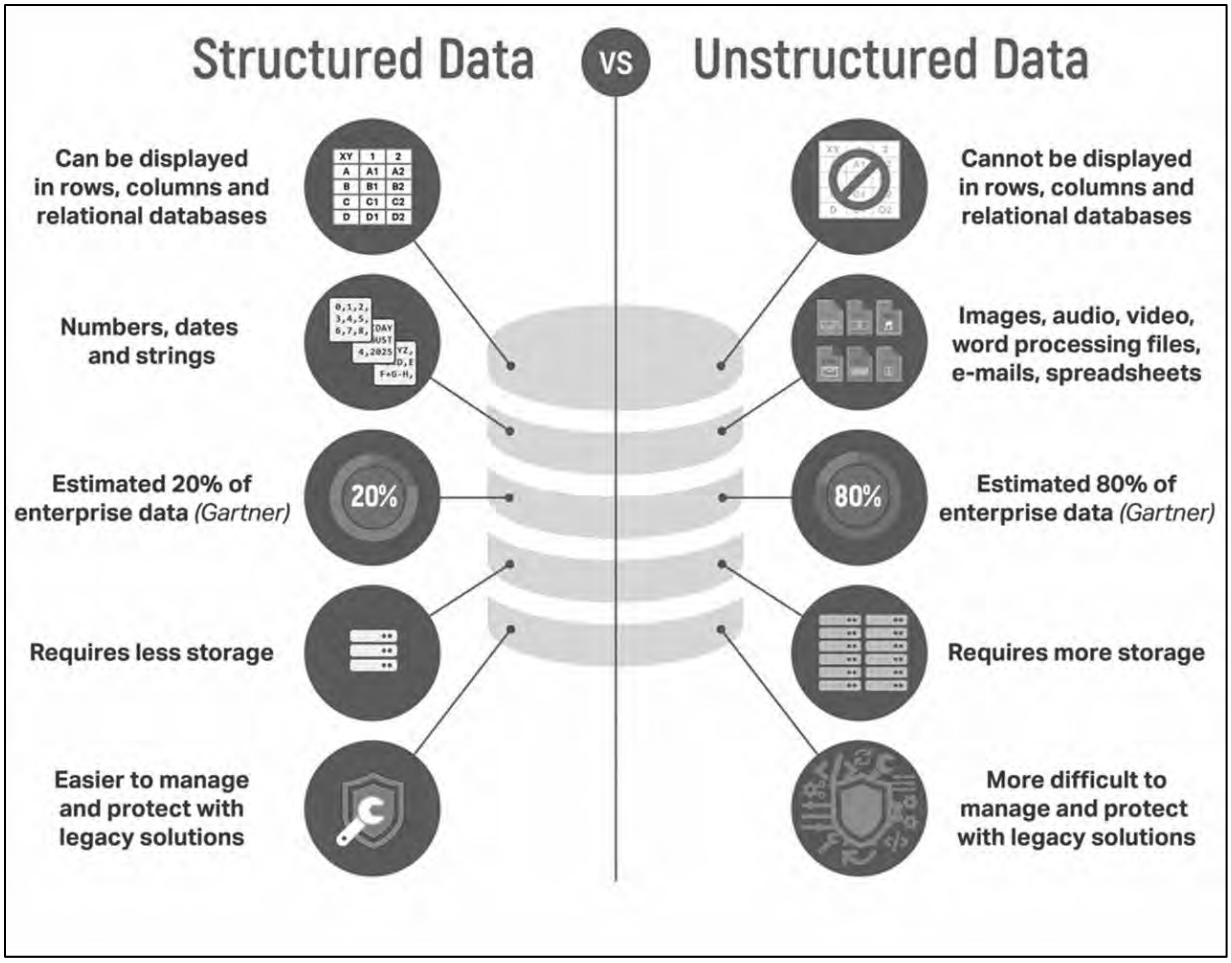

Figure 2-2. Comparison between Structured and Unstructured Data[6]

Military operations generate and rely on data from diverse sources. Internal sources include operational logs, after-action reviews, and intelligence gathered by units in the field. External sources encompass data from allied forces, commercial providers, open-source intelligence, and governmental agencies. Each source comes with its own set of strengths and limitations. For example, while internal data may be highly relevant and timely, external data often provides broader context and insights that complement operational planning. Below are highlights of a selection of common data sources that commanders and staff officers routinely use to generate situational awareness and make decisions (see Figure 2-3).

[6] Comparison between structure and unstructured data, "Structured Data vs. Unstructured Data: What Are They and Why Care?", 7 April 2019, https://lawtomated.com/structured-data-vs-unstructured-data-what-are-they-and-why-care/

Figure 2-3. Common Army Data Sources

Format and standardization of data are critical for its effective use (see Figure 2-4). Data formats refer to how information is stored and represented, ranging from simple text files to complex geospatial datasets. Standardization ensures that data from different sources can be integrated and compared without ambiguity. For instance, standardizing coordinate systems for geospatial data or adopting common classification schemes for intelligence reports can significantly enhance interoperability and usability. Without proper standardization, the integration of data from multiple sources can become a time-consuming and error-prone process.

LST_NM	FRST_NM	DOC_NBR	DOC_EXPR_DT	PHN_NBR	EMAIL_ID	CTZNSHIP
Afg	aqa	66323572	3/13/2028	791851888	XZSGNHV@gmail.com	U. S. A.
SAT	afa	66162260	12/13/2028	93702054108	QASKCQO@gmail.com	afg
Rah	ab	065-140-152	8/2/2027	799987377	VQUAYUJ@gmail.com	afg
sar	lma	65147245	7/27/2029	704389382	KQSYBYR@gmail.com	usa
Ras	rif	65561372	1/1/2028	731123227	VVZZKYE@gmail.com	afg
Azi	d A	64990169	2/28/2026	705540142	NCFPZBX@gmail.com	us
Sha	hah	063-300-153	11/30/2026	93777787202	JOOQFUC@gmail.com	afg
Mir	ora	68195276	1/26/2030	5162975532	QKAHKAA@gmail.com	afg
pam	zoo	64464504	8/6/2026	704389382	DPNMYIH@gmail.com	usa
Yaz	ha	066-992-121	7/25/2029	93782535557	BCTRYSI@gmail.com	afg
Sad	ema	066-321-123	10/10/2027	93764645760	HYKWVOI@gmail.com	pak
Bak	ria	66873861	8/29/2029	93786700322	QIKIIRH@gmail.com	plz usa
Mas	ary	64435384	8/19/2021	776112636	FZSNHWC@gmail.com	America
Moh	ima	80304685	2/26/2028	771092561	JSAQREH@gmail.com	afg
Alo	Gul	63327682	9/30/2026	783180430	NWJAKUJ@gmail.com	plz usa
Akb	an	063-308-010	12/1/2024	780436358	HFWIRVG@gmail.com	ind
Azi	lah	209471822	6/23/2021	603-858-5583	MJHMBLY@gmail.com	afg
Jar	im	65662103	3/1/2027	0744932934 or +19162189802	WNENAKV@gmail.com	AFG
Hab	ja	062-121-123	3/2/2030	706536747	HMXTLEW@gmail.com	afg
Say	lal	67307788	11/29/2029	078 507 0077	WHYTDVT@gmail.com	America

Figure 2-4. Example of a Noncombatant Evacuation Operation Dataset

Are there any issues with this data?

Ethics and security are integral to the responsible use of data in military operations. Data collection and utilization must adhere to legal and moral standards, ensuring compliance with regulations and respect for privacy. Ethical considerations include avoiding the misuse of data, such as bias in analysis or the inappropriate targeting of individuals or groups. Security considerations involve safeguarding data against unauthorized access, tampering, or breaches that could compromise operational integrity. Commanders and staff must remain vigilant in upholding these principles to maintain trust and operational effectiveness.

The lifecycle of data encompasses several stages starting with collection and progressing through processing, analysis, and dissemination. Data collection involves gathering information from various sources whether through sensors, human intelligence, or digital platforms. Processing ensures that raw data is cleaned, organized, and prepared for analysis. Analysis involves extracting meaningful insights to support decision making, while dissemination ensures that these insights reach the right people at the right time. Each stage requires careful attention to detail to avoid errors or misinterpretations that could undermine the mission.

Note: Can you trust your data? Is your data accurate, complete, consistent, unique, and timely?

In military operations, the effective use of data hinges on understanding its context. Data rarely speaks for itself as its significance is shaped by the operational environment and the questions being asked. For example, sensor readings from a surveillance drone may be meaningless without context about the terrain, weather conditions, and enemy activity. Contextualizing data allows commanders and staff to derive actionable insights and avoid the pitfalls of making decisions based on incomplete or misleading information.

Chapter 3
The Data Lifecycle

The data lifecycle is a comprehensive framework that outlines the stages through which data passes, from initial collection to final utilization (see Figure 3-1). Understanding the data lifecycle is essential for commanders and staff as it enables them to effectively manage and leverage data in military operations. Each stage of the data lifecycle is interrelated and a thorough understanding of this process allows military leaders to optimize data usage and enhance decision making. This chapter will explore the key phases of the data lifecycle including data collection, data processing, data analysis, data interpretation, and data presentation.

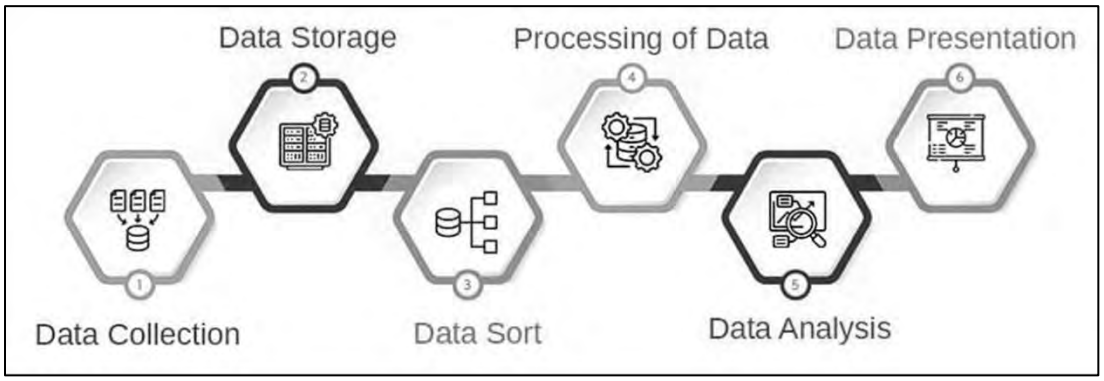

Figure 3-1. Data Lifecycle[7]

The first phase of the data lifecycle is data collection, which involves gathering information from a variety of sources. In military operations, data can be collected from numerous avenues to include intelligence reports, surveillance systems, sensor data, logistical records, and operational logs. The reliability and accuracy of collected data are critical, as decisions made based on flawed or incomplete information can have significant consequences. Commanders and staff must prioritize quality in data collection, establishing protocols to ensure that data is gathered systematically and consistently. Appendix A provides a list of considerations staff officers and noncommissioned officers can use to assist with developing a plan well thought out for data collection that provides clear direction to subordinate units while enabling development of the product.

Note: Operational data encompasses information generated during the execution of military missions. This data includes real-time updates on troop movements, logistical support, mission outcomes, and environmental conditions.
Intelligence data is another vital type of information in military operations, encompassing data collected for the purpose of understanding adversaries, threats, and operational environments.
Administrative data, while often overlooked, is also important for military operations. This type of data includes information related to personnel management, training records, resource allocation, and compliance with regulations.

[7] Data lifecycle, "What is Data Processing?" https://www.educba.com/what-is-data-processing/.

In military contexts, data collection can be both quantitative and qualitative. Quantitative data involves numerical information that can be measured and analyzed statistically, while qualitative data encompasses descriptive information that provides insights into human experiences and behaviors. Using both data types enables a more comprehensive understanding of operational scenarios, allowing commanders to make informed decisions based on a well-rounded perspective.

Note: Qualitative data can be invaluable for understanding the perspectives of personnel, assessing morale, and evaluating the impact of leadership decisions. For example, after an operation, qualitative feedback from Soldiers can highlight areas for improvement in training or logistics, which may not be evident through quantitative metrics alone. Qualitative data helps commanders gain a deeper understanding of the human elements involved in military operations, contributing to more informed decision making.

Quantitative data plays a crucial role in assessing performance, measuring outcomes, and identifying trends. Metrics such as troop readiness, mission success rates, and equipment performance are examples of quantitative data that provide objective measures of operational effectiveness. Commanders can use this data to make evidence-based decisions regarding resource allocation, training requirements, and operational data encompassing information generated during the execution of military missions. This data includes real-time updates on troop movements, logistical support, mission outcomes, and environmental conditions.

Intelligence data is another vital type of information in military operations, encompassing data collected for the purpose of understanding adversaries, threats, and operational environments.

Administrative data, while often overlooked, is also important for military operations. This type of data includes information related to personnel management, training records, resource allocation, and compliance with regulations.

Once data is collected, it enters the next phase of data processing. This stage involves cleaning, organizing, and transforming raw data into a usable format (see Figure 3-2). Data processing may include tasks such as removing duplicates, correcting inaccuracies, and categorizing information for easier access. In military operations, effective data processing is crucial for managing the large volumes of information generated during missions. By applying techniques such as data wrangling and normalization, commanders can ensure that data is coherent and structured making it ready for analysis. Appendix B Tips for Scrubbing Army Data provides considerations for how to identify data discrepancies and errors and determine the source.

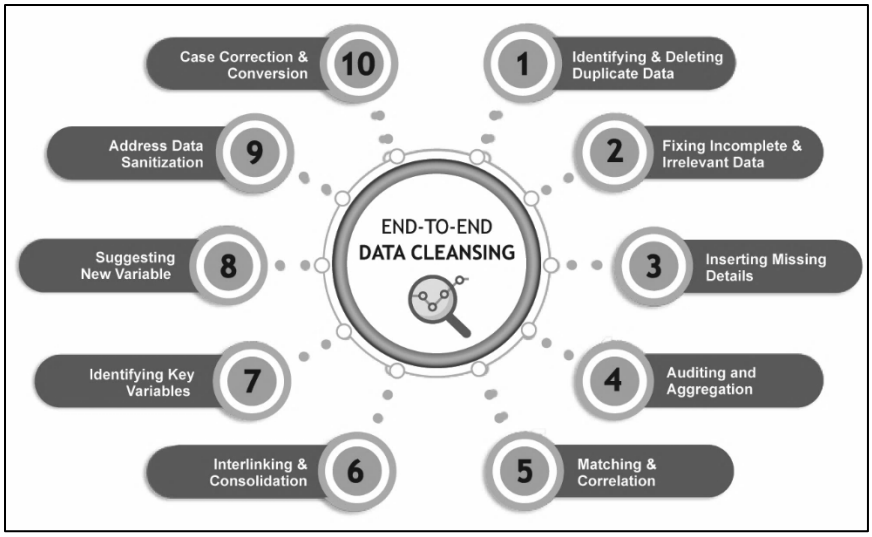

Figure 3-2. Data Cleaning Process Map[8]

The analysis phase follows data collection and processing and involves scrutinizing the organized data to uncover patterns, trends, and insights that can inform decision making. Effective data analysis encompasses a range of methodologies and the choice of method depends on the specific questions being addressed and the nature of the data. Among the most used analytical methods in military contexts are descriptive statistics, inferential statistics, and predictive analytics (see Figure 3-3).

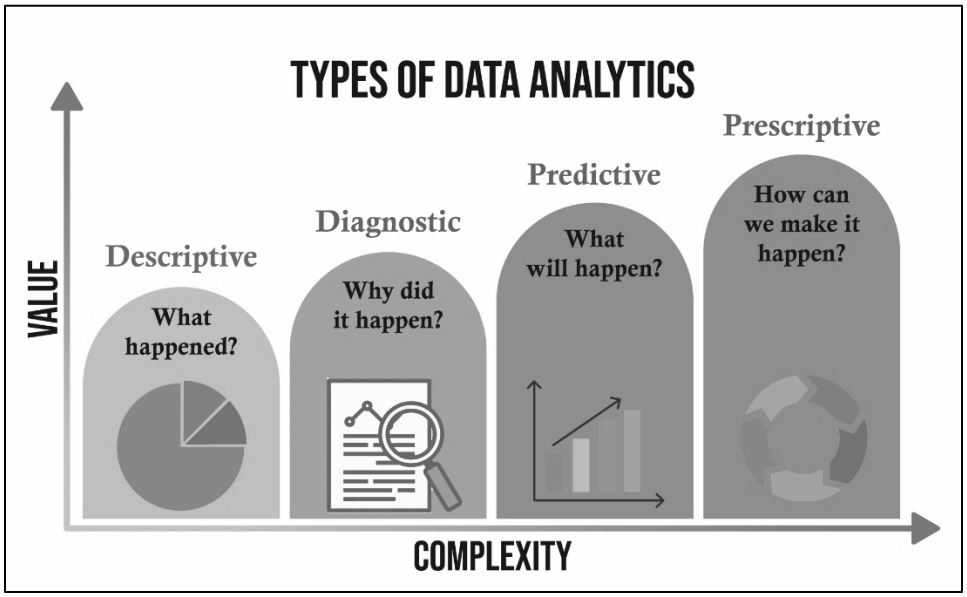

Figure 3-3. Types of Data Analytics[9]

[8] Data cleaning process map,." A Comprehensive Guide to Data Cleaning. 8 March 2024." https://www.astera.com/type/blog/data-cleansing/.

[9] Types of data analytics, "Types of Data Analytics in Data Science and Its Applications," 6 November 2023, https://www.almabetter.com/bytes/articles/four-types-of-data-analysis.

Descriptive statistics provide a summary of the main characteristics of a dataset, enabling military leaders to understand the basic features of the data briefly. This method includes measures such as mean, median, mode, range, and standard deviation. For example, a commander may utilize descriptive statistics to analyze troop performance metrics, such as average response times or mission success rates. By summarizing this data, commanders can identify areas of strength and weakness, helping them make informed decisions about resource allocation and training needs.

Inferential statistics take the analysis a step further by allowing commanders to draw conclusions about a larger population based on a sample of data. This method involves hypothesis testing, confidence intervals, and regression analysis. For instance, if a commander wants to assess the effectiveness of a new training program, they may collect performance data from a sample of Soldiers who participated in the program and compare it to a control group. By analyzing this data, the commander can infer whether the training program has a statistically significant impact on performance across the broader unit.

Predictive analytics leverage historical data to forecast future events, making it a powerful tool for military planning and decision making. This method utilizes statistical algorithms and machine-learning techniques to identify trends and predict outcomes. For example, commanders may use predictive analytics to anticipate equipment maintenance needs based on historical usage patterns or to forecast potential troop movements based on intelligence data. By employing predictive analytics, military leaders can proactively address challenges and allocate resources more effectively thereby ultimately enhancing operational readiness.

Vignette 1
Data Analytics and Stryker Brigade Gunnery

One Brigade's approach to Stryker vehicle gunnery highlights how a data-centric approach can improve a tactical unit's training program. During live fire training, the 1st Brigade, 4th Infantry Division gathered and analyzed data on their Stryker crew's performance in the gunnery tables leading up to the final crew qualification (Gunnery Table VI - GTVI) and coupled this with a quantitative score derived from a survey designed to measure small unit culture at the company level to project which crews would be challenged to qualify on their first GTVI iteration. At the program's conclusion the Brigade identified a correlation between positive unit culture combined with performance on GTIII (MILES simulation table) as an indicator for first time success on the crew qualification table. With this information, the Brigade's leadership can set minimum GTIII performance thresholds for crews before they progress to the final qualification table. This should not only increase crew proficiency and confidence but also save ammunition and time by achieving more first time GOs for the culminating live fire event. Going forward the Brigade plans to expand the data collection effort and refine the modeling used. This example highlights the impact that applying data literacy principles can have at the tactical level.

Critical thinking plays a vital role in effective data analysis. Commanders and staff must approach data analysis with a questioning mindset, considering the implications of the findings and the assumptions underlying their analyses. This involves evaluating the quality and reliability of the data, as well as recognizing potential biases that may influence interpretations. For instance, data collected under specific conditions or from limited sources may not be representative of broader operational contexts. By critically assessing the data and its limitations, military leaders can avoid drawing erroneous conclusions and make more informed decisions.

Additionally, collaboration and interdisciplinary approaches can enhance the data analysis process. In military operations, leveraging the expertise of personnel from various fields such as intelligence, logistics, and operations can lead to more comprehensive analyses. Commanders should encourage teamwork and open dialogue, fostering an environment where different perspectives are valued. This collaborative approach can result in richer insights and more robust recommendations, ultimately benefiting mission success.

Best practices for data visualization include knowing your audience, choosing the right chart type, simplifying complexity, using color intelligently, using annotations and context, and storytelling through sequencing.

Data visualization is another critical aspect of effective data analysis (see Figure 3-4). Presenting data in visual formats such as charts, graphs, and dashboards can facilitate understanding and communication of complex information. Visualizations enable commanders to identify patterns and trends quickly, making it easier to convey findings to stakeholders. For instance, a heat map displaying troop movement patterns can provide valuable insights into operational strategies, while a line graph illustrating mission success rates over time can highlight performance trends. By using data visualization techniques, military leaders can enhance their analytical capabilities and improve decision-making processes. Appendix B provides additional information to assist with selecting the right method for data visualization.

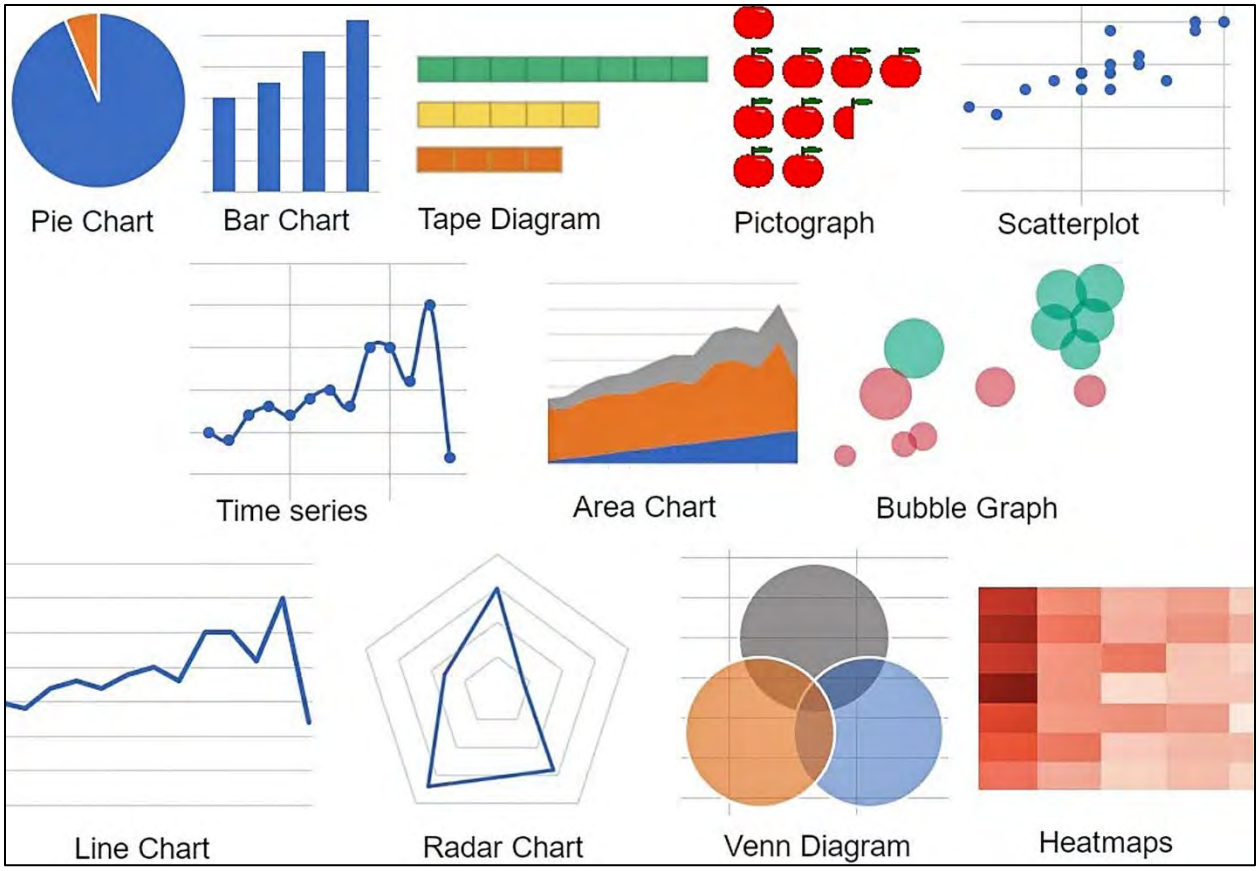

Figure 3-4. Comparison of Different Types of Visualizations[10]

It is also essential for commanders and staff to stay informed about emerging analytical tools and technologies that can enhance data analysis. Advances in data analytics software and machine-learning algorithms provide new opportunities for extracting insights from complex datasets. By investing in training and resources, military organizations can empower their personnel to harness these tools effectively, improving overall analytical capabilities.

Note: While data provides valuable insights, it is not a substitute for leadership and judgment. Commanders must balance quantitative analysis with qualitative factors including intuition, experience, and the input of their teams.

After analysis, the next stage is data interpretation where findings are assessed in the context of the operational environment. This phase involves drawing conclusions from the analyzed data and determining their implications for decision making. Commanders must consider the broader context in which the data was collected, including potential biases and limitations. For example, data sourced from a specific operational area may not accurately reflect the conditions across the entire theater, leading to skewed interpretations. Engaging in critical thinking and collaboration during this phase is vital, as different perspectives can help ensure a more comprehensive understanding of the data and its implications.

[10] Comparison of different types of visualizations, "15 Data Visualization Techniques (for Analysis and Presentation)," 13 December 2021, https://www.polymersearch.com/blog/data-visualization.

Data interpretation also requires an awareness of ethical considerations surrounding data use. Commanders and staff must navigate issues related to data privacy, consent, and the ethical implications of their decisions based on data findings. A transparent approach to data interpretation fosters trust among team members and stakeholders, reinforcing the importance of accountability in military operations.

Dashboards have become a popular method with commanders and staff to display real-time updates that provide situational awareness and assist with decision making. Use the steps below to assist with dashboard development:[11]

1. Define the audience and purpose: Will this be used as a staff running estimate or to inform the senior leader on decision making.
2. Choose the right metrics: Identify data points that contribute to maintaining situational awareness and enable decision making.
3. Select the right visualization method: What best enables the reader to quickly identify trends, patterns, and relationships.
4. Eliminate clutter and noise: Review the draft dashboard and only keep the most critical items. Strive for clarity and brevity.
5. Use layout to focus attention: Use positioning, size, and color to highlight key elements, develop a logical flow, and group relate items together.
6. Add chart titles and data labels: Use these to establish the context and meaning behind the figures, graphs, and charts.

Appendix C provides additional considerations for developing dashboards.

The final phase of the data lifecycle is data presentation, which involves effectively communicating data findings to stakeholders. Commanders and staff must be skilled at creating clear and concise reports, presentations, and visualizations that highlight key insights and recommendations. Data visualization techniques such as charts, graphs, and dashboards enhance the clarity of communication and facilitate discussions around data-driven decisions.

Moreover, effective communication requires tailoring the message to the audience. Different stakeholders including senior leadership, operational units, and support staff, may have varying levels of expertise and different informational needs. By understanding the needs and expectations of the audience, commanders can present data in a manner that resonates and drives action.

In summary, the data lifecycle encompasses the stages of data collection, processing, analysis, interpretation, and presentation. For commanders and staff in the U.S. Army, mastering each phase of the data lifecycle is essential for effectively leveraging data in military operations. By systematically managing data throughout its lifecycle, military leaders can make informed decisions that enhance operational effectiveness, foster collaboration, and promote a culture of data-driven decision making. This understanding of the data lifecycle serves as a foundation for

[11] Built using information derived from: https://www.youtube.com/watch?v=OYbPOhK0wPo&list=PLGAnLqlBhx1FwsiWr4gFhIa20YBQdUGnc&index=11"Telling a Story with Data | Dashboard Build Demo.

developing the skills necessary for effective data utilization in command and staff roles, ultimately contributing to mission success and improved outcomes in military operations.

Chapter 4
Tools and Technologies

The modern military landscape is shaped by an increasing reliance on tools and technologies that enable the effective use of data. From command-and-control systems to advanced analytics platforms, these tools empower commanders and staff to process vast amounts of information, derive actionable insights, and make informed decisions. This chapter provides an overview of key data tools and technologies, focusing on their applications in military contexts and the foundational knowledge needed to integrate them effectively into operations.

Command-and-control systems represent one of the most critical categories of data tools for military operations. These systems facilitate the collection, processing, and dissemination of information in real time and enable leaders to maintain situational awareness and coordinate actions effectively. For example, systems like the Advanced Field Artillery Tactical Data System (AFATDS) and the Joint Operational Planning and Execution System (JOPES) are designed to manage specific operational functions such as targeting or logistics planning. By integrating data from multiple sources, these platforms provide a comprehensive picture of the battlespace, ensuring that decisions are based on accurate and timely information.

Analytical software and platforms play a vital role in transforming raw data into meaningful insights. Tools such as Microsoft Power BI (see Figure 4-1), Excel, Tableau, and Python-based libraries like Pandas and NumPy are commonly used for data analysis and visualization. For more advanced applications, platforms like Palantir and ArcGIS offer robust capabilities for geospatial analysis, predictive modeling, and intelligence integration. These tools enable users to identify trends, assess risks, and evaluate potential courses of action. While not every member of a command or staff needs to be proficient in these tools, a basic understanding of their capabilities and outputs is essential for effective collaboration with data specialists.

Figure 4-1. PowerBI Overview[12]

Geospatial tools and technologies are particularly valuable in military operations where location-based data often forms the foundation of planning and execution. Geographic Information System (GIS) platforms such as ArcGIS and QGIS allow users to analyze and visualize spatial data in the form of maps, overlays, and three-dimensional models (see Figure 4-2). These tools are invaluable for tasks such as terrain analysis, route planning, and target identification. Additionally, satellite imagery and drone data can be integrated into GIS platforms to provide

[12] Power BI overview. Microsoft Introduction to Power BI. https://learn.microsoft.com/en-us/training/modules/get-started-with-power-bi/1-introduction

real-time updates and enhance situational awareness. The ability to leverage geospatial tools effectively can significantly improve the precision and efficiency of military operations.

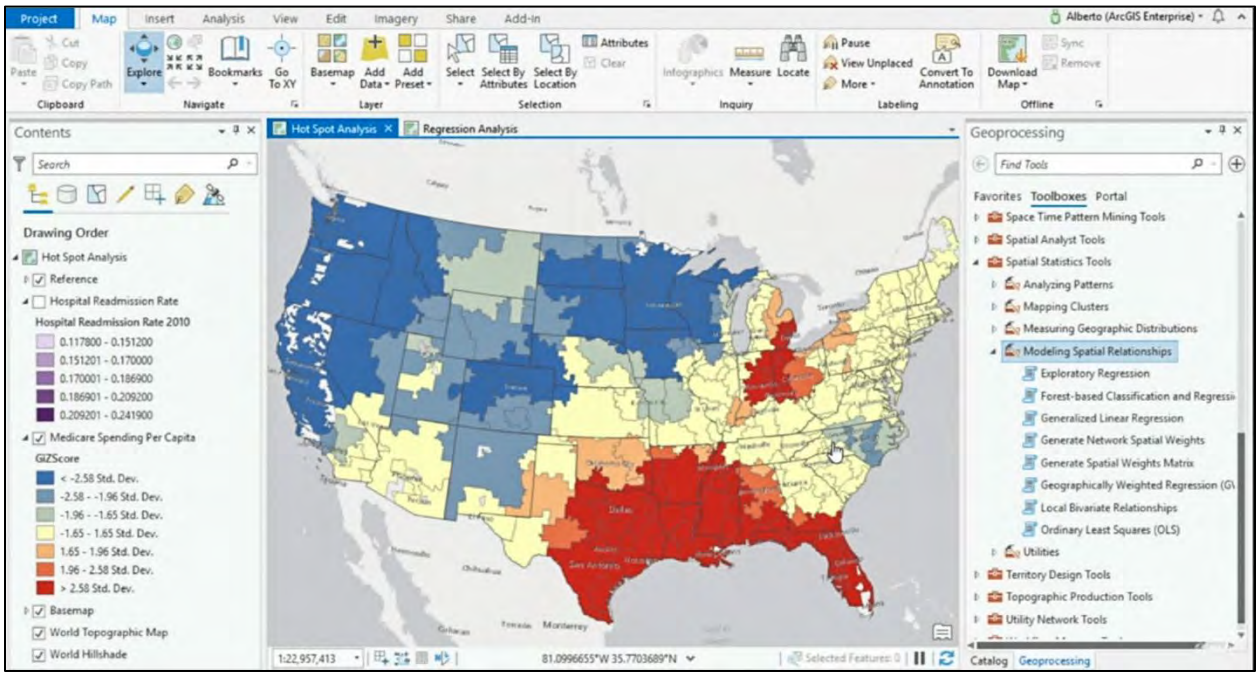

Figure 4-2. Example of ArcGIS Data Visualization[13]

Emerging technologies to include artificial intelligence (AI), machine learning (ML), and big-data analytics, are revolutionizing how data is processed and utilized in military contexts. AI and ML algorithms can analyze vast datasets at unprecedented speeds, uncovering patterns and relationships that might otherwise go unnoticed. For example, AI-driven tools can enhance intelligence analysis by identifying anomalies in surveillance data or predicting enemy movements based on historical trends. Similarly, big data platforms enable the integration and analysis of information from multiple sources such as social media, sensor networks, and operational logs. While these technologies hold immense potential, their adoption also requires careful consideration of ethical, operational, and security implications.

[13] Example of ArcGIS data visualization. Modeling Spatial Relationships with ArcGIS Pro. 18 November 2019. https://geospatialtraining.com/modeling-spatial-relationships-with-arcgis-pro/

Figure 4-3. Army Version of Generative Artificial Intelligence[14]

Successful integration of data tools and technologies into military operations requires a supportive infrastructure and a culture of data-driven decision making. This includes ensuring that systems are interoperable, data is standardized, and personnel are adequately trained. Interoperability allows different tools and platforms to share information seamlessly, enabling a unified approach to data analysis and decision making. Standardization ensures consistency in how data is collected, processed, and interpreted thereby reducing the risk of errors or miscommunication. Training programs should be designed to equip commanders and staff with the skills needed to understand and utilize data tools effectively, fostering confidence in their ability to leverage technology as a strategic asset.

[14] Army version of generative artificial intelligence. CAMOGPT. https://camogpt.army.mil/camogpt

The rapid pace of technological advancement underscores the need for continuous learning and adaptation. Commanders and staff must stay informed about emerging tools and trends, assessing their potential impact on operations and identifying opportunities for innovation. By embracing a proactive approach to technology adoption, military organizations can maintain a competitive edge and ensure that data remains a force multiplier in achieving mission success.

Vignette 2[15]
XVIII Airborne Corps and Maven Smart Systems

In June 2023 the XVIII Airborne Corps developed and tested the Maven Smart System (MSS) during a series of exercises known as Scarlet Dragon, a collaborative effort with a coalition of technology companies to enhance the Corps' targeting capability. MSS operationalized software and artificial intelligence to streamline and improve its targeting processes, making it more efficient and effective. These efficiencies resulted in their ability to match the performance of a 2,000 staff member targeting cell from Operation Iraqi Freedom and achieve comparable results with roughly 20 personnel. To accomplish this, MSS accesses "sensor data from diverse sources" then applies "computer vision algorithms to help soldiers identify and choose military targets and then provide workflow support that enables a request to be approved by the chain of command in order to strike a target." While Scarlet Dragon and the incorporation of MSS involved resources not widely available to formations across the Army, it highlights the tremendous potential of a data literate organization leveraging currently available systems and technology to exponentially speed analysis and decision making.

[15] Based on the articles: "Building the Tech Coalition How Project Maven and the U.S. 18th Airborne Corps" and "Take Ownership of Your Formation's Data Literacy."

Chapter 5
Ethical Considerations in Data Use

As data becomes increasingly central to military operations, ethical considerations surrounding its use have taken on greater significance. Commanders and staff must navigate complex ethical dilemmas to ensure that data is collected, analyzed, and applied responsibly. Ethical data practices are not just about compliance with laws and regulations, they are about upholding the moral integrity of military operations and maintaining trust with stakeholders internal and external. This chapter examines the principles of ethical data use and explores their application in operational contexts.

The foundation of ethical data use lies in respect for privacy and individual rights. Military operations often involve the collection of sensitive information whether through surveillance, intelligence gathering, or interactions with civilian populations. Commanders and staff must ensure that data collection efforts are conducted with a clear purpose and within the boundaries of legal and moral frameworks. For example, surveillance activities should be limited to what is necessary for the mission and avoid infringing on the rights of individuals who are not directly involved in the conflict.

Transparency is another critical ethical principle. Stakeholders include allied forces, civilian authorities, and the public have a vested interest in understanding how data is being used and for what purpose. While operational security often requires discretion, maintaining transparency to the extent possible fosters trust and accountability. This can involve clearly communicating data policies, adhering to established protocols, and providing avenues for oversight and review.

Data accuracy and integrity are fundamental to ethical decision making. Misleading or incomplete data can lead to flawed conclusions and potentially harmful outcomes. Commanders and staff have a responsibility to validate the quality of the data they rely on and to be vigilant against errors, biases, and manipulations. For instance, if an intelligence report is based on unreliable sources or skewed interpretations, it can compromise mission planning and execution. Ethical data practices involve rigorous validation and a commitment to presenting findings honestly and objectively.

Bias mitigation is a particularly challenging aspect of ethical data use (see Figure 5-1). All data is subject to biases whether stemming from the methods of collection, the composition of datasets, or the interpretations made during analysis. These biases can inadvertently reinforce stereotypes, perpetuate inequities, or skew decision making. For example, reliance on historical data reflecting past discriminatory practices may lead to biased conclusions in personnel assignments or resource allocation. Addressing this issue requires a conscious effort to identify and correct biases at every stage of the data lifecycle, from collection to application.

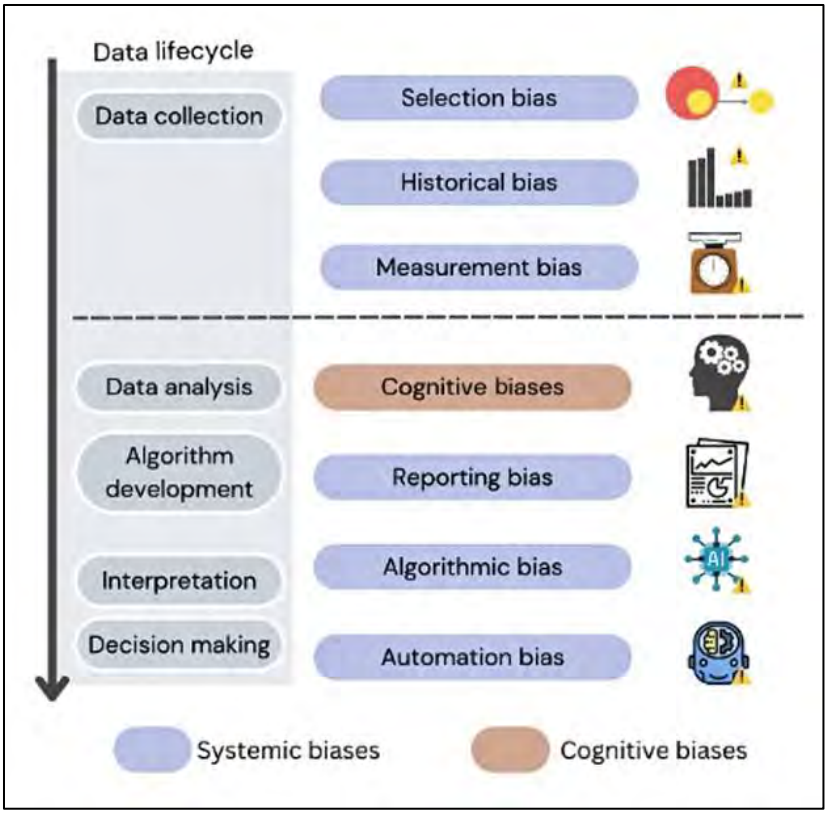

Figure 5-1. Types of Data Bias[16]

The ethical use of data also extends to the principles of necessity and proportionality. In military operations, data-driven actions must be justified by their relevance to the mission and their potential to achieve desired outcomes. For example, the deployment of predictive analytics to identify potential threats should be balanced against the risks of false positives and the potential harm to innocent individuals. Proportionality ensures that the scope and intensity of data use are aligned with the objectives of the operation, avoiding overreach or unnecessary invasions of privacy.

Accountability is a cornerstone of ethical data practices. Commanders and staff must take responsibility for the consequences of their data-related decisions and actions. This involves documenting processes, maintaining records, and being prepared to explain and justify decisions based on data. Accountability also includes establishing mechanisms for addressing ethical breaches such as unauthorized access, misuse of data, or failure to adhere to established guidelines. By fostering a culture of accountability, military organizations can reinforce ethical behavior and ensure that data is used responsibly.

Finally, the ethical considerations of data use must account for the broader implications of military actions. Data-driven decisions can have far-reaching consequences, affecting not only immediate operational outcomes but also long-term relationships with communities, allies, and adversaries. For example, the use of data in targeting operations must consider the potential for collateral damage and the impact on civilian populations. Ethical decision making requires a holistic perspective that weighs the benefits of data use against its potential harms.

[16] "Types of Data Bias," https://campus.datacamp.com/courses/conquering-data-bias/understanding-data-bias?ex=7.

Chapter 6
Data Governance and Security in the Army

In the digital age, the Army operates in an environment where data is a critical asset. From mission planning and execution to logistics and intelligence, data fuels every aspect of military operations. However, the immense value of data comes with significant responsibilities. Effective data governance and robust security measures are essential to ensure that information remains accurate, accessible, and protected. This chapter explores the principles of data governance, the importance of data security, and the steps necessary to safeguard critical military information.

Data governance refers to the framework of policies, processes, and standards that guide how data is managed within an organization. For the Army, data governance ensures that information is collected, stored, and used in a way that supports operational goals while maintaining compliance with legal and ethical standards. It establishes clear guidelines for data ownership, quality, accessibility, and lifecycle management.

The foundation of effective data governance lies in accountability. Every piece of data must have a designated owner responsible for its accuracy, security, and appropriate use. This ownership structure helps prevent data from being neglected or misused. Additionally, data governance requires standardized procedures for data entry, storage, and sharing to ensure consistency and reliability across the organization.

As an example, in a combat scenario, real-time intelligence must be accurate and trustworthy to update critical decisions. Poor data governance, such as duplicate or outdated information, could lead to operational inefficiencies or even jeopardize mission success. By implementing robust governance practices, the Army can ensure that its data remains a reliable asset.

While data governance establishes the rules for managing information, data security focuses on protecting it from unauthorized access, corruption, and theft. The Army's reliance on digital systems makes it a prime target for cyberattacks and other security threats. Safeguarding data is not just a technical challenge but a strategic necessity to maintain operational integrity and national security.

Data security encompasses a range of practices and technologies designed to protect information at every stage of its lifecycle. Encryption is a fundamental tool that ensures data remains unreadable to unauthorized individuals, both in transit and at rest. Multi-factor authentication (MFA) adds an additional layer of protection by requiring multiple forms of verification to access systems and data.

Network security is another critical component. Firewalls, intrusion detection systems, and secure communication protocols help prevent unauthorized access to the Army's networks. Regular vulnerability assessments and penetration testing identify potential weaknesses, allowing for proactive measures to address them.

In addition to external threats, data security must address internal risks. Insider threats, whether intentional or accidental, can compromise sensitive information. Implementing role-based access controls ensures that personnel only have access to the data they need to perform their duties. Regular training and awareness programs help mitigate the risk of human error, such as falling victim to phishing attacks or mishandling classified information.

One of the central challenges of data governance and security is striking the right balance between accessibility and protection. On the one hand, data must be readily available to

authorized personnel to support timely and informed decision making. On the other hand, excessive accessibility can increase the risk of unauthorized access and data breaches.

To address this challenge, the Army employs principles such as the “least privilege” model, which restricts access to the minimum level required for a specific role or task. This approach minimizes the exposure of sensitive data while ensuring that personnel have the information they need to perform their duties effectively.

Data classification systems also play a vital role in balancing accessibility and security. By categorizing information based on its sensitivity, the Army can apply appropriate security measures to each category. For instance, classified data may require higher levels of encryption and stricter access controls than unclassified information.

Leadership is a critical factor in the success of data governance and security initiatives. Commanders and senior officers set the tone for the organization’s approach to data management, emphasizing its importance and ensuring compliance with established policies. By fostering a culture of accountability and vigilance, leaders can instill a sense of responsibility for data security at every level of the Army.

Effective leadership also involves staying informed about emerging threats and technologies. Cybersecurity is a constantly evolving field, with adversaries developing new tactics to exploit vulnerabilities. Leaders must ensure that their teams remain up to date with the latest training, tools, and strategies to counter these threats. Additionally, investing in research and development helps the Army stay ahead of potential risks and capitalize on technological advancements.

The complexity of modern military operations presents several challenges for data governance and security. One significant issue is the integration of legacy systems with newer technologies. Older systems may lack the security features required to protect data in today’s threat environment, creating potential vulnerabilities. Addressing this challenge requires a comprehensive modernization strategy that includes upgrading infrastructure and phasing out outdated systems.

Another challenge is the increasing volume and variety of data generated by military operations. Managing and securing this data requires scalable solutions capable of handling large datasets. Cloud computing and advanced analytics platforms offer potential solutions, providing the capacity and tools needed to process and protect vast amounts of information.

Interoperability is also a critical concern, particularly in joint operations with allied forces. Ensuring that data can be securely shared across different systems and organizations requires standardized protocols and mutual trust. Collaborative efforts, such as joint training exercises and shared cybersecurity frameworks, help build the necessary foundations for interoperability.

As the Army continues to adapt to an increasingly data-driven world, the importance of governance and security will only grow. Emerging technologies such as artificial intelligence, quantum computing, and blockchain (distributed database across a network's nodes, maintaining a record of transactions to make data immutable [cannot be altered]) have the potential to revolutionize data management and protection. For example, quantum encryption offers unparalleled security while blockchain can provide tamper-proof records of data transactions.

This brings new challenges. The Army must remain vigilant in assessing the risks and implications of new technologies, ensuring that they are integrated responsibly and effectively. Continuous education and training will be essential to equip personnel with the skills needed to navigate the evolving landscape of data governance and security.

Chapter 7
Building a Culture of Data Literacy in Army Formations

In contemporary warfare, data flows in real time from a multitude of sources such as unmanned aerial systems, satellites, and sensors embedded in equipment and vehicles. Soldiers who are data literate can analyze this information to identify patterns, predict enemy movements, and allocate resources effectively. Furthermore, data literacy enhances collaboration by ensuring that all levels of command operate with a shared understanding of the information driving decisions. This alignment reduces misunderstandings, minimizes errors, and strengthens operational coherence.

Despite its importance, several barriers hinder the development of data literacy within Army formations. One significant challenge is the varying levels of familiarity with data concepts among personnel. While some Soldiers may have advanced technical expertise, others may feel intimidated by the complexity of data analysis tools and processes. This disparity can create gaps in capability that undermine the effectiveness of operations.

Another obstacle is the perception that data literacy is solely the responsibility of specialized roles, such as intelligence analysts or cybersecurity experts. This narrow view overlooks the fact that data informs decisions across all functions, from supply chain management to battlefield strategy. Building a culture of data literacy requires breaking down these silos and emphasizing its relevance to every Soldier, regardless of rank or role.

Cultural resistance to change can also impede progress. In a hierarchical organization like the Army, traditional decision-making processes often prioritize intuition and experience over data-driven analysis. While these qualities remain invaluable, they must be complemented by a willingness to incorporate empirical evidence into planning and execution.

Creating a culture of data literacy begins with leadership. Commanders and senior officers play a pivotal role in setting the tone for their formations, demonstrating the value of data-driven approaches, and encouraging their teams to embrace these practices. Leaders who prioritize data literacy by integrating it into training, evaluations, and decision-making processes send a clear message about its importance.

Education and training are foundational to fostering data literacy. Comprehensive programs should be developed to teach Soldiers the fundamentals of data interpretation, analysis, and visualization. These programs should be tailored to different levels of expertise, ensuring that both novices and advanced users can build their skills. Interactive workshops, simulations, and hands-on exercises can make learning more engaging and relevant to operational contexts.

Vignette 3[17]
Brigade Level Data Literacy Training and Education

Assessing that our adversaries are increasingly using data to operate at "unprecedented speeds on the battlefield" the 513th Military Intelligence Brigade set out to increase data literacy across their formation to improve their ability to collect, manipulate, analyze, and communicate data. As a component of a brigade-wide program to increase Innovation, Modernization, and Experimentation (INMODEX) the 513th partnered with instructors from the United States Military Academy to train over 400 individuals with their Data Literacy 101

[17] Based on the articles: "Building the Tech Coalition How Project Maven and the U.S. 18th Airborne Corps" and "Take Ownership of Your Formation's Data Literacy."

course. Using a proven curriculum and designating team members to lead the initiative proved to be key components in the successful execution of this initiative and transform the formation's culture to become more data-centric and competitive on the modern battlefield. This example highlights how a formation can take measures to enhance their data literary and develop a culture that embraces data literacy within their ranks rather than waiting for top-down directives.

Technology also plays a critical role in promoting data literacy. Providing Soldiers with user-friendly tools and platforms reduces the barriers to entry and enables them to work with data more confidently. For instance, intuitive dashboards that aggregate and display mission-critical information allow personnel to focus on analysis rather than grappling with complex interfaces. Interoperable systems that seamlessly integrate data from various sources further enhance accessibility and usability.

Establishing mentorship and peer learning programs can accelerate the adoption of data literacy within formations. Pairing experienced data users with less experienced personnel fosters knowledge sharing and creates a supportive environment for learning. Peer networks also encourage collaboration, enabling Soldiers to tackle data challenges collectively and develop innovative solutions.

Building a culture of data literacy is not a one-time effort but an ongoing process that requires consistent evaluation and adaptation. Establishing metrics to measure progress is essential for identifying areas of improvement and celebrating successes. These metrics may include the number of personnel trained, the frequency of data-driven decision making in operations, and improvements in mission outcomes attributable to data analysis.

Feedback loops are crucial for refining data literacy initiatives. Regularly soliciting input from Soldiers about their experiences with data tools and training programs ensures that these resources remain relevant and effective. This feedback should update curricula, the development of new tools, and allow adjustments to policies that support data-driven practices.

Leadership must remain committed to sustaining a culture of data literacy over the long term. This commitment includes allocating resources for ongoing training, staying abreast of technological advancements, and addressing emerging challenges. By institutionalizing data literacy as a core competency, the Army can ensure that it remains embedded in its organizational fabric.

A culture of data literacy transforms Army formations into agile and informed units capable of responding to the demands of modern warfare. Soldiers equipped with the skills to analyze and interpret data can identify opportunities, mitigate risks, and make decisions with confidence. This capability enhances operational effectiveness and contributes to mission success.

Moreover, data literacy fosters a culture of critical thinking and innovation. Soldiers who understand how to work with data are more likely to question assumptions, propose evidence-based solutions, and identify areas for improvement. This mindset not only strengthens individual performance but also drives collective progress across the organization.

In an increasingly complex and data-rich operational environment, the Army’s ability to build and sustain a culture of data literacy will define its strategic advantage. By investing in education, technology, and leadership, the Army can empower its formations to harness the full potential of data and ensure that it remains a decisive force on the battlefield.

Chapter 8
Data Literacy Best Practices and Lessons Learned

As the Army increasingly integrates data-driven decision making into its operations, developing and maintaining data literacy across all levels of personnel has become a vital priority. The experiences of military organizations and other institutions that have embarked on similar journeys provide valuable insights into effective practices and common pitfalls. By applying these lessons, the Army can build a resilient and adaptable culture of data literacy that supports mission success in diverse operational contexts. This chapter outlines the key best practices for fostering data literacy and highlights lessons learned from past efforts to institutionalize these capabilities.

Best Practices for Building Data Literacy

One of the most effective approaches to fostering data literacy is to integrate it seamlessly into daily military activities. Data literacy should not be seen as an additional responsibility but as an inherent component of operational planning, decision making, and execution. To achieve this, training programs must be designed to align with the specific roles and missions of Army personnel. For instance, a logistics officer may require a deep understanding of supply chain data analysis, while the commander might focus on interpreting real-time intelligence feeds. Tailoring instruction to these varied needs ensures that personnel can immediately apply their skills in their respective contexts.

Establishing a clear and consistent framework for data literacy is another critical practice. This framework should define the core competencies and knowledge areas required for data proficiency such as data interpretation, statistical reasoning, and visualization techniques. By standardizing these expectations, the Army can create a shared language around data that facilitates collaboration across units and functions. This framework also serves as a foundation for developing curricula, assessment tools, and career progression pathways that prioritize data literacy.

Another best practice is leveraging technology to support learning and application. Modern tools and platforms such as user-friendly dashboards, data visualization software, and collaborative analytics systems can make it easier for personnel to engage with data. Training programs should familiarize Soldiers with these tools, enabling them to work confidently and efficiently. The integration of artificial intelligence and machine-learning tools into these platforms further enhances their usability by automating repetitive tasks and providing actionable insights.

Leadership engagement is essential to the success of data-literacy initiatives. Commanders and senior officers must lead by example, demonstrating the value of data-driven approaches in their decision-making processes. When leaders prioritize data literacy and actively participate in training programs, they send a powerful message about its importance. Leadership involvement also ensures that data literacy initiatives receive the necessary resources and support to thrive.

Lessons Learned from Past Efforts

One of the most important lessons learned from previous data-literacy initiatives is the need for a comprehensive and sustained approach. Short-term training programs or one-off workshops, while helpful, are insufficient to instill lasting skills and habits. Instead, data literacy must be treated as a continuous learning process with opportunities for refresher courses, advanced instruction, and real-world application. Creating a culture of lifelong learning ensures that personnel remain adept at using data even as technologies and operational requirements evolve.

Another key lesson is the importance of addressing cultural resistance to change. In many organizations, including the Army, there may be skepticism or discomfort with new data-driven practices particularly among personnel who are accustomed to traditional decision-making methods. Overcoming this resistance requires clear communication about the benefits of data literacy and its alignment with the Army's values and mission. Success stories and case studies can be powerful tools for illustrating the tangible impact of data-driven approaches, helping to build trust and buy in across the organization.

It is also critical to recognize and address the diverse skill levels within the organization. While some personnel may have advanced technical expertise, others may have limited experience with data concepts. A one-size-fits-all approach to training is unlikely to be effective. Instead, programs should be designed to meet personnel at their current level of proficiency and provide clear pathways for progression. For example, introductory courses can focus on fundamental concepts such as understanding data types and interpreting basic charts, while advanced modules can delve into predictive analytics and machine learning.

Another lesson learned is the need to prioritize data quality and accessibility. Even the most data-literate personnel cannot operate effectively if the data they rely on is incomplete, inaccurate, or siloed. Ensuring that data is consistently collected, validated, and made accessible to authorized users is a foundational requirement for any data literacy initiative. Establishing clear governance policies and investing in robust data infrastructure are critical steps in this process.

Finally, feedback and evaluation are crucial for the success of data literacy programs. Regular assessments allow the Army to measure progress, identify gaps, and make necessary adjustments. Gathering input from participants provides valuable insights into the strengths and weaknesses of training programs, enabling continuous improvement. Establishing metrics to track the impact of data literacy on operational outcomes ensures that these initiatives remain aligned with organizational goals and priorities.

The long-term success of data literacy initiatives depends on the Army's ability to institutionalize these practices and adapt to changing circumstances. Building a network of data champions within the organization can help sustain momentum. These champions, who are highly skilled in data literacy and passionate about its value can serve as mentors, advocates, and resources for their peers. By creating a community of practice, the Army can foster collaboration and knowledge sharing, ensuring that data literacy becomes an integral part of its culture.

Keeping pace with technological advancements is another essential aspect of sustaining data literacy. As new tools and methodologies emerge, the Army must remain agile and responsive, updating its training programs and resources accordingly. Partnerships with academic institutions, industry leaders, and other government agencies can provide access to cutting-edge knowledge and expertise, enhancing the Army's ability to stay ahead of the curve.

Finally, leadership must remain committed to prioritizing data literacy as a strategic objective. This commitment includes allocating resources for training and infrastructure, integrating data literacy into performance evaluations and promotion criteria, and maintaining a focus on its importance in operational planning. By embedding data literacy into the fabric of the organization, the Army can ensure that it remains a core competency for generations to come.

Appendix A
Tips for Data Collection

Whether it's a request for information with short suspense or development of a system to track and provide reoccurring updates on a new program rolling out over the course of multiple years, doing analysis to clearly identify what data is required, when its needed, and how it will be presented will save time and effort for all parties concerned. Nothing is more frustrating than expending tremendous energy compiling a report only to find it did not "answer the mail." The questions below can assist with developing a well thought out plan for data collection and provide clear direction to subordinate units while facilitating development of the final product.

1. What is the purpose/context?
2. Who is the audience and what is their preferred method for receiving information?
3. Is the data/information already available using an Army information system (Integrated Personnel and Pay System-Army [IPPS-A], Digital Training Management System [DTMS], Medical Protection System [MEDPROS]) or through a previously collected report?
4. When is the data/information due or required?
    - How long will it take to gather/submit the data/information?
    - How much time do you need to compile submissions and conduct analysis?
    - How much time will your commander want/need to review the data/analysis?
    - Will units submit raw data or is analysis expected?
5. How can you facilitate data collection and submission?
    - Are the required data points clearly defined?
    - What format should the data be submitted in (if using PowerPoint or Excel consider mandating no changes authorized to the slide format or locking the format for Excel cells to ensure entries are uniform. This will aid in compiling, sorting, and analyzing data later)?
    - Can SharePoint, Microsoft Teams, or other collaborative applications be used to automate the process?
6. How will the data/information be received or presented?
    - Verbal update
    - E-Mail report
    - Formal briefing
    - Rolling estimate
    - Dashboard
    - Common operating picture

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Appendix B
Tips for Scrubbing Army Data

Commanders and staff routinely review data and cross-check it to ensure accuracy and identify discrepancies or errors that could impact decision making. One of the examples listed below may be an indicator there is an issue with a data set:

- Outliers in the data across subordinate units (e.g. all units are 90 percent complete with weapons qualification, but one is at 50 percent)
- Digital data conflicts with verbal reporting/on-the-ground assessments
- Results much greater/faster than expected or much lower/slower than expected
- Data does not match or conflict with data derived from other sources (e.g., unit indicates 100 percent complete with Army Combat Fitness Test (ACFT) but number in Digital Training Management System (DTMS) does not match assigned strength in Integrated Personnel and Pay System-Army [IPPS-A])
- Unit(s) not at expected position on common operational picture (COP)
- Enemy units on the COP do not match templated order of battle (OOB)

When commanders or staff members identify a discrepancy with data, they work to determine the reason why and provide additional context to aid in decision making. Potential reasons for data errors include:

- Manual reporting error (typo, computational error)
- Data entry error
- Data base update/refresh lag (e.g., personnel transactions take 24 hours to post in IPPS-A)
- Data old or stale (training records not uploaded, data entry not completed)
- Connection errors between systems or databases that feed or “talk” to each other
- Enemy jamming or spoofing

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Appendix C
Data Visualization Basics[18]

Choosing the right chart, graph or table when conveying data is a critical step to ensure the reader can quickly process and understand the information while allowing them to identify trends and patterns. However, choosing the wrong method can have the exact opposite impact. This appendix provides considerations when choosing a visualization method and an overview of the various methods available and what their best used for:

- Selecting the right visualization method depends on:
  - Who is your audience?
  - What type of data do you have?
  - Are there relationships in the data?
  - Is the data changing over time?
  - Are you making comparisons?
  - Are you showing the composition of something?
  - Are differences by geographic location important?
  - What story are you trying to tell?
  - How much precision is required?
  - Is the visualization to inform or to make decisions or for situational awareness?
- Types of Data Visualization:
  - **Scatter plot graph**: Shows the relationship between two values
  - **Line graph**: Shows how something changes over time
  - **Bar chart**: Shows comparison between different groups of things
  - **Pie chart:** Shows the composition of a whole or the distribution of something
  - **Maps**: Puts data into a geographical context
  - **Tables**: Used to show several categories and provide more detail and precision than other data visualization methods
  - **Pictographs**: Representation of data using images in a simple and instantly interpretable format (however generally not precise)
  - **Infographics**: Several data visualizations put together to tell a comprehensive story
  - **Dashboards**: Used to inform decision making and update on regular intervals and color, size, and position of different aspects are used deliberately

[18] "Data Visualization, An Introduction," 2 June 2022, https://www.youtube.com/watch?v=gewM4balOek&list=PLhDwnGYSFgBG9cVueSo8fcth3VkUJUfcp&index=13.

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Appendix D
Dashboard Considerations[19]

With tools such as Power-Bi, dashboards have become easier to develop and more popular with commanders and staff as a method to display real-time updates that provide situational awareness and assist with decision making. With fields that update at regular intervals dashboards can simplify the process of developing and maintaining running estimates for staff members – saving time and preventing the presentation of "stale data" that comes with using static presentation methods such as Power Point charts. However, as with any data presentation, staff members must understand what sources are feeding the dashboard, how current the information is, and be able to identify when/if the dashboard is displaying incorrect data. The following sections provide some basic considerations for developing a dashboard:

- **Know the audience and purpose:** In many cases, defining the purpose starts with understanding who the audiences are and what their assigned missions and tasks include. Will this dashboard serve as a staff running estimate that requires considerable detail or is it for a senior general officer that needs a broad overview? Will it be tailored to assist with decision making by monitoring enemy conditions (priority if intelligence requirement [PIR]) and friendly conditions (friendly forces intelligence requirement [FFIR]) or provide a more general situation update on the progress made towards completing a tasking? Before starting a complex and time-consuming development process, taking a rough outline of the dashboard to the user and verifying the intent is a best practice preventing wasted effort.
- **Include only the most important content:** Just as with an oral briefing or information paper, being concise is a key element to the value your dashboard provides. Fight the urge to overload the dashboard with too many charts/statistics. This will require some analysis as to key elements of information needed and making tough calls about what is excluded.
- **Reduce and eliminate clutter:** Fight the urge to add graphics or content that does not directly convey the intended message. While unit logos, infographics, and slogans might make the dashboard more visually appealing, they can become distracting and make the dashboard cluttered and harder to read in time. Likewise, unneeded gridlines, labels, and colors can draw attention from the key pieces of information the dashboard should convey.
- **Round your numbers and aggregate icons:** When developing a dashboard, striking the correct balance between being precise and concise will greatly impact its utility. Figures displayed should be rounded to the point where the difference substantially impacts decision making. Consider how to display unobligated funds from the unit's budget:

[19] This section was built using videos and webpages at the following links:

https://www.youtube.com/watch?v=OYbPOhK0wPo&list=PLGAnLqlBhx1FwsiWr4gFhIa20YBQdUGnc&index=11"Telling a Story with Data | Dashboard Build Demo

https://www.geckoboard.com/best-practice/dashboard-design/"Effective dashboard design | A step-by-step guide | Geckoboard

https://www.toucantoco.com/en/blog/how-to-build-user-friendly-efficient-dashboards"A 6-step process to design business dashboards

https://www.youtube.com/watch?v=t3cAUt7sOQg

  - Does the commander need to know if $120,000 remain for the fiscal year or $120, 511 are left, or should they know $120,511.25 remains. Likely the first option is best for a routine or daily update on a dashboard and illustrates how the use of abbreviations and shorthand can assist in keeping the display simple and concise ($120K versus $120,000). Likewise, for a division-level common operating picture, if unit icons are displayed at the individual vehicle, platoon, company, or battalion level. Likely the latter is appropriate to prevent excess clutter on the map.
- **Use the most efficient visualization.** When determining how to display performance indicators and metrics consider how the method will help the user to quickly process and understand trends, patterns, and relationships. Consider whether the requirement is to show changes over time, compare multiple related metrics, or chart the progress made toward a goal. Repetition should not be an overarching concern when choosing a visualization method if that is the best and most efficient (e.g., using bar charts to display 7 out of 8 metrics). Spatial comparison (e.g., pie charts) can be challenging for most dashboard users as such the best mediums for displaying key metrics are normally numbers, bars, lines and tables. For more information on choosing a display method see Appendix C (Data Visualization Basics), which provides an overview of visualization techniques and use.
- **Group-related metrics.** Putting items adjacent to each other on the dashboard helps the reader establish relationships within the data, make useful comparisons, and more rapidly digest the information. For example, if developing a dashboard for Soldier readiness, it would be beneficial to group data related to medical readiness (periodic health assessment [PHA], dental, profiles) while placing individual training items together in another section (weapons qualification; Army Combat Fitness Test (ACFT); and nuclear, biological, and chemical [NBC] defense training) and devoting another portion to personnel aspects (Servicemember's Group Life Insurance [SGLI], Department of Defense [DD] form 93, wills, power of attorney).
- **Be consistent.** When displaying related key performance indicators or metrics, use the same style of visualization to make it easier for the reader to compare the figures. For example, if displaying the on-hand quantity of 155-millimeter ammunition next to the controlled supply rate (CSR), and required supply rate (RSR), using a bar chart for all three helps the viewer make an easy comparison between the three figures. Whereas using a bar chart for one and a pie chart for the other two could have the opposite effect.
- **Establish hierarchy within the data**. Select locations on a dashboard naturally garner more attention than others, with the upper left corner generally considered most prominent followed by the three remaining corners. When designing a dashboard, carefully consider what data and metrics are placed in these prominent areas and reserve those locations for elements that are critical for situational awareness and decision making. Increasing the size and scale of a figure or table relative to other data point is useful for drawing a viewer's attention to a critical element of the display.
- **Give numbers context**. When displaying figures, graphs, charts and tables use colors, arrows, or a brief explanation to provide the viewer with an indication how to one should interpret the data. Does it represent an increase or decrease when compared to previous time periods and is this a positive or negative development or simply neutral? However, be mindful of providing too many indicators and cluttering the display.
- **Use clear labels**. Use titles and labels to convey the meaning of figures, graphs, charts and tables. Strive to keep these short, concise, and easily understood. Key elements for

consideration include the time frame represented, units of measure, unit designations or locations, and the "as of" date. If additional information is required to place the data in proper context and aid in understanding, consider providing this when the user "hovers" a cursor over the table or table title.

- **Continue to gather feedback and improve.** Once a dashboard is built, the developer should invest time to ensure it meets the intended purpose. This can be accomplished by directly soliciting feedback or by noting what elements of the dashboard require clarification during briefings and meetings when it is displayed. If an element consistently requires additional explanation to viewers or it drives a user to the wrong conclusion, it likely requires further refinement or a different style of visualization.

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Appendix E
Enhancing Military Operational Effectiveness Through the Integration of CAMO and NIPR GPT

The United States Army is poised to revolutionize its planning and operations by leveraging the capabilities of two cutting-edge tools: CamoGPT (Generative Pre-trained Transformer) and non-secure internet protocol router (NIPR) GPT. This appendix provides an examination of the benefits and limitations of these tools as well as guidance on how to effectively integrate them into military planning and operations.

Introduction to CamoGPT and NIPRGPT

The increasing complexity of modern military operations necessitates the development and implementation of innovative solutions to enhance operational effectiveness. CamoGPT and NIPRGPT are two such tools that have the potential to transform the way the Army approaches planning and operations. CamoGPT is a machine-learning platform that optimizes equipment maintenance, logistics, and supply chain management using data analytics and algorithms. NIPRGPT is a natural language processing tool that analyzes and generates text to support planning and operations using a GPT model.

It is essential that CamoGPT and NIPRGPT responses always be reviewed and validated by a subject matter expert and they should not be blindly trusted. These artificial intelligence (AI) models have limitations, including the following:

- **Lack of human judgment:** AI models like CamoGPT and NIPRGPT rely on patterns and associations in the data they were trained on, but they do not possess human judgment or critical thinking skills.
- **Limited domain knowledge:** While CamoGPT and NIPRGPT have been trained on vast amounts of text data, their knowledge is limited to the data they have been given.
- **Bias and error encounters:** AI models can perpetuate biases and errors present in the training data.
- **Lack of common sense:** CamoGPT and NIPRGPT may not always possess the same level of common sense or real-world experience as a human expert.

To mitigate these limitations, it is crucial to have a subject matter expert review and validate the responses generated by CamoGPT and NIPRGPT. This ensures that the information is accurate, up to date, and relevant to the specific context or application.

Benefits of CamoGPT and NIPRGPT

The integration of CamoGPT and NIPRGPT into military planning and operations offers several benefits, including:

- **Predictive maintenance:** Users can analyze maintenance records to predict equipment failures and optimize sustainment operations.
- **Logistics optimization:** CamoGPT can be used to optimize supply convoy routing and reduce fuel consumption.
- **Adversary communication analysis:** NIPRGPT can be used to analyze social media activity and identify trends in adversary communication.
- **Course of action analysis:** NIPRGPT can be used to analyze and compare proposed courses of action.

Crafting Effective Prompts

To get the most out of CamoGPT and NIPRGPT, it is essential to craft effective prompts that guide the analysis efforts of these tools. A well-written prompt should do the following:

- **Clearly define the problem or task:** Specify the objective of the analysis.
- **Provide relevant context and background information:** Include any relevant data or information that may affect the analysis.
- **Specify the desired output or outcome:** Define what the user wants to achieve or learn from the analysis.
- **Define any assumptions or constraints:** Identify any limitations or constraints that may affect the analysis.

Here are some examples of well-written prompts for each of the warfighting functions:

- **Command and control:** Analyze the maintenance records of the brigade's communication equipment and identify potential failures that could affect the ability to maintain command and control during a 30-day operation. Provide recommendations for prioritizing maintenance and minimizing downtime.
- **Movement and maneuver:** Develop a route planning strategy for a battalion-sized element conducting a movement-to-contact operation in a mountainous terrain. Consider terrain constraints, enemy activity, and logistics.
- **Intelligence:** Analyze social media activity in a specific region to identify trends and anomalies in communication that could indicate adversary planning or operations. Provide recommendations for further investigation and potential courses of action.
- **Fires:** Optimize the ammunition allocation for a division-sized operation and identify high-value targets for a fires operation. Provide recommendations for prioritizing targets and allocating ammunition to maximize the effectiveness of fires.
- **Protection:** Analyze the force protection measures in place for a brigade-sized element conducting a defensive operation and identify potential vulnerabilities. Provide recommendations for enhancing force protection and mitigating potential threats.

Limitations and Potential Drawbacks

Although CamoGPT and NIPRGPT offer significant benefits, there are also potential limitations and drawbacks to consider, including:

- Data quality and availability may not be complete. Users must ensure accurate and complete data to support analysis.
- Users must mitigate algorithmic biases in CamoGPT and NIPRGPT.
- Users must protect these tools and the data they use from cyber threats.

To mitigate these risks, it is essential to implement robust data validation and verification processes, regularly update and refine the algorithms used by CamoGPT and NIPRGPT and implement robust cybersecurity measures to protect these tools and the data they use.

Implementation and Integration

To effectively integrate CamoGPT and NIPRGPT into military planning and operations, the following steps should be taken:

- **Develop a comprehensive training program:** Educate military commanders and staff on the capabilities and limitations of CamoGPT and NIPRGPT.

- **Establish a prompt development framework:** Develop a framework for crafting effective prompts that guide the analysis efforts of these tools.
- **Conduct regular exercises:** Test the effectiveness of CamoGPT and NIPRGPT in various military scenarios to identify areas for improvement and optimize their use.
- **Continuously monitor and evaluate:** Regularly evaluate the performance of CamoGPT and NIPRGPT to identify areas for improvement and optimize their use.

By following these steps and addressing the potential limitations and drawbacks of CamoGPT and NIPRGPT, the U.S. Army can effectively integrate these tools into military planning and operations and enhance its operational effectiveness.

Conclusion

In conclusion, the integration of CamoGPT and NIPRGPT into military planning and operations has the potential to significantly enhance operational effectiveness. The U.S. Army can unlock the full potential of these tools and maintain a competitive edge on the battlefield by crafting effective prompts, addressing potential limitations and drawbacks, and implementing a comprehensive training program. With the ability to quickly analyze vast amounts of data, predict equipment failures, and optimize logistics and supply chain management, CamoGPT and NIPRGPT are essential tools for modern military operations. However, it is crucial to remember that these AI models should always be used in conjunction with human expertise and judgment to ensure the accuracy and validity of the information.

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Appendix F
Glossary

ACFT	Army Combat Fitness Test
AFATDS	Artillery Field Artillery Tactical Data System
AI	artificial intelligence
COP	common operational picture
CSR	controlled supply rate
DD	Department of Defense (form)
DEERS	Defense Enrollment Eligibility Reporting System
DTMS	Digital Training Management System
FFIR	friendly forces intelligence requirement
IPERMS	Interactive Personnel Electronic Records Management System
IPPS-A	Integrated Personnel and Pay System-Army
JOPES	Joint Operational Planning and Execution System
MEDPROS	Medical Protection System
MEPS	military entrance processing station
MFA	multi-factor authentication
ML	machine learning
MSS	MAVEN Smart Systems
NBC	nuclear, biological, and chemical
NCO	noncommissioned officer
NIPR	non-secure internet protocol router
OOB	order of battle
PHA	periodic health assessment
PII	personally identifiable information
PIR	priority if intelligence requirement
RSR	required supply rate
SGLI	Servicemember's Group Life Insurance

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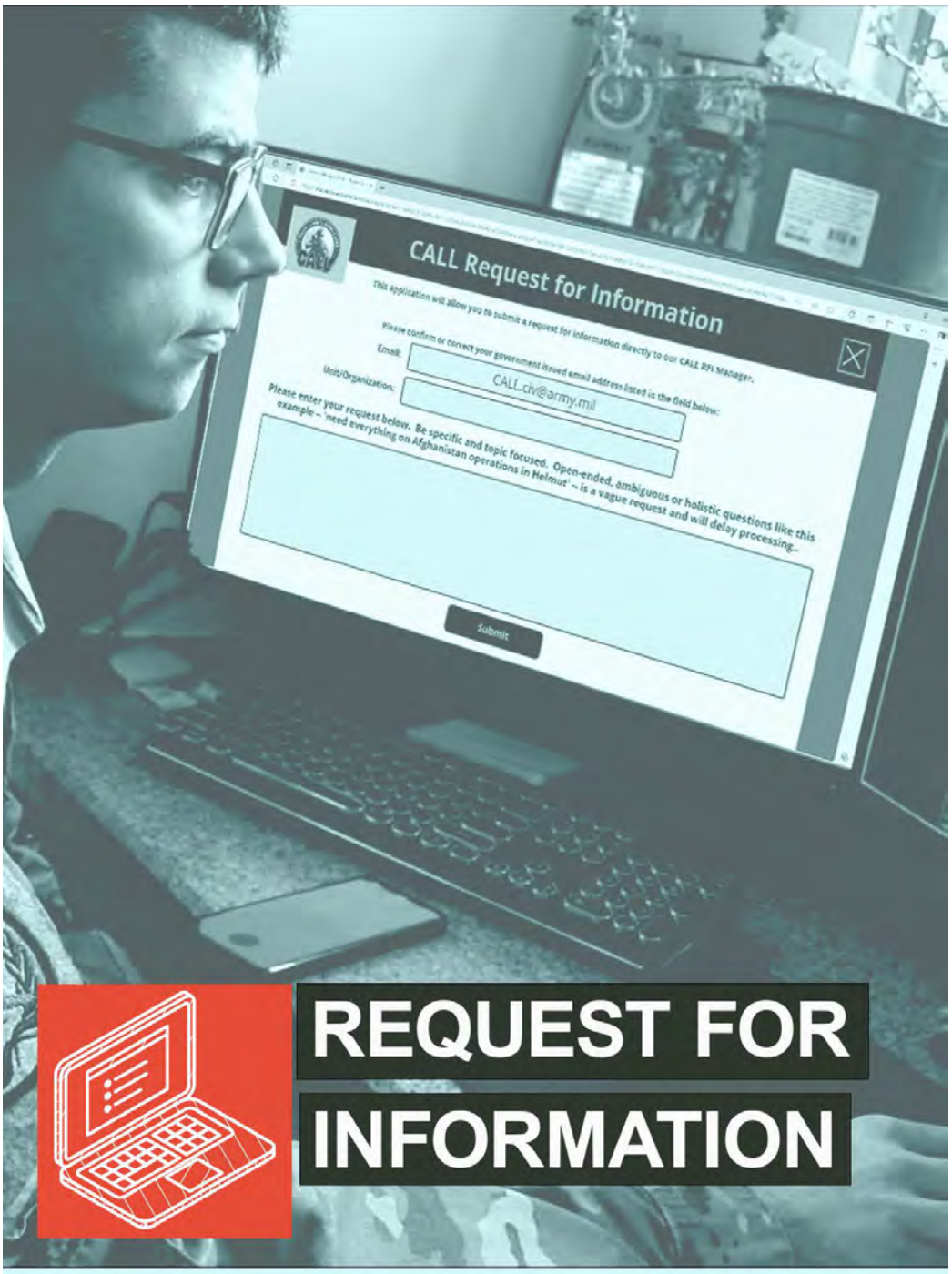

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