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   Director
   Center for Army Analysis
   ATTN: CSCA-OA-R3
   6001 Goethals Road
   Fort Belvoir, VA  22060-5230
**Deployed Analyst Handbook (DAHB)**

**Authors:** Wendy L. Bradbury, Vern J. Bahm, Gale Collins, Jim Dzwonchyk, Ron Kollhoff, Christina M. Krause, Joseph M. Lindquist, and Michael F. Stollenwerk

**Abstract:**
Center for Army Analysis (CAA) has provided Operations Research /Systems Analysis (ORSA) support to forward deploying headquarters with both personnel and reach-back project execution for over ten years. Changes over time in the operational environment have prompted the revision of the Deployed Analyst Handbook to prepare analysts (ORSAs) for deployments in support of the warfighter. This handbook highlights ORSA methods and techniques that are expected to be used by ORSAs into the foreseeable future.
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DEPLOYED ANALYST HANDBOOK
( DAHB )
FEBRUARY 2013

SUMMARY

THE PROJECT PURPOSE: This handbook is intended to be a quick reference guide for all deploying Operations Research/ Systems Analysts (ORSAs), both military and civilian.

THE PROJECT SPONSOR: FA 49 Proponency Office.

THE PROJECT OBJECTIVES:

(1) Present ORSAs with a wide range of topics from specific analytical products to ways to prepare and communicate analyses.

(2) Present examples of analyses, developed in theater and through reach-back support.

(3) Present examples of analyses that ORSAs can expect to execute in a combat theater.

(4) Provide references for ORSAs who are interested in additional resources and examples.

THE SCOPE OF THE PROJECT: The information contained in this handbook was developed from the experiences of ORSAs who deployed into operational theaters in Iraq, Afghanistan, the Philippines, the Horn of Africa, and elsewhere in the past ten-plus years.

COMMENTS AND QUESTIONS may be sent to the Director, Center for Army Analysis, ATTN: CSCA-OA-R3, 6001 Goethals Road, Suite 102, Fort Belvoir, VA 22060-5230
PREFACE

The Center for Army Analysis (CAA) would like to thank their Operations Research/ Systems Analysts (ORSAs) who contributed to the development of the Deployed Analyst Handbook (DAHB), and reviewing agencies, to include Army Materiel Systems Analysis Activity (AMSAA), Marine Corps Combat Development Command (MCCDC), TRADOC Analysis Center (TRAC), and the FA 49 Proponency Office.

**Intended Audience.** Military FA 49s, civilian CP36/1515s, and ORSA contractors who directly support the warfighter at brigade and higher levels of command.

**Reference Guide.** The DAHB is intended as a quick reference guide for all deploying ORSAs and contains a wide range of techniques and analytical products that ORSAs have developed in theater and through reach-back support, and have used in operational theaters. The lessons learned and best practices contained in the DAHB were consolidated from numerous ORSAs who have deployed in support of Operations Iraqi Freedom (OIF) and New Dawn (OND) in Iraq; Operation Enduring Freedom (OEF) in Afghanistan; and other Overseas Contingency Operations (OCOs) in the Philippines, the Horn of Africa, and elsewhere around the world over the past ten-plus years. The DAHB is informative, relevant, and full of information—not easily obtained elsewhere—that will prepare deploying ORSAs for their unique and highly critical assignments at the tactical, operational, and strategic levels of war.

**Topic Selections.** The information and examples presented in this handbook highlight the types of analyses that ORSAs can expect to conduct in the future. CAA thoughtfully chose these specific examples through working groups and advice received from experts throughout the analytical community.

**Motivation for Using Handbook.** The Deploying Analyst Course (DAC) requires a companion text that assists deploying ORSAs who are junior military officers or young civilian analysts in contributing their abilities and talents in support of the warfighter. This handbook better prepares ORSAs to provide analytical support to their respective commands and staffs by increasing their knowledge of best practices and lessons learned, and informing them of the reach-back process.
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1  CHAPTER I:  COMMUNICATING ORSA CAPABILITIES

1.1  What is Operations Research?

General. What is Operations Research/Systems Analysis? It is difficult to answer this question concisely without using words like stochastic, combinatorial, and heteroscedasticity. However, effectively communicating one’s unique ORSA capabilities to the command is as critical to one’s success as is the quality of one’s work.

In a deployed environment, ORSAs often do not have the luxury of external resources to assist in communicating their skill set to the command and others who would benefit from their assistance. Most ORSAs are introverted by nature. More often than not, socializing one’s skill set does not come naturally. However, it is a talent that can be developed with practice.

This chapter offers techniques for ORSAs to use: (1) in explaining their profession concisely to others, (2) in applying their skills in a deployed environment, and (3) in effectively presenting their work. Much of the content of this chapter parallels information from the Institute for Operations Research and the Management Sciences (INFORMS) on communicating the ORSA profession.

1.2  Concisely Communicating the ORSA Profession to Others

ORSA Defined. ORSA is a commonly used acronym for "Operations Research Analyst” or more formally "Operations Research/Systems Analysis analyst.” Introducing oneself as an “ORSA” peaks the attention of others and leads to further inquiry. As senior leaders become familiar with the highly skilled, academic nature of an ORSA’s work, they gain a sober appreciation for the tremendous value ORSAs bring to the fight. In short order, senior leaders associate ORSAs with insight and solutions for solving complex problems at the tactical, operational, and strategic levels of war.

Responsibilities of a deployed ORSA:

[ORSAs use] analytical methods and mathematically based procedures to enable leadership decisions in a constantly changing global environment. [ORSAs] introduce quantitative and qualitative analysis to the military’s decision-making processes by developing and applying probability models, statistical inference, simulations, optimization, and economic models. [ORSAs work in] diverse disciplines that include personnel management, doctrine and force development, training management, system testing, system acquisition, decision analysis, and resource management, as well as tactical, operational and strategic planning from division through combatant command, and from Army Command (ACOM) through the highest levels of the [Department of Defense] DOD (Department of the Army Pamphlet [DA PAM] 600-3, 2010, p. 286).

The ORSA Skill Set. ORSAs: (1) investigate essential factors that illuminate understanding; (2) communicate complex ideas to decision makers at brigade and higher levels of command; and (3) recommend solutions to complex problems.
ORSAs apply their skill set through: (1) problem analysis, using various analytical techniques; (2) probability and statistics analysis to gain valuable insight; and (3) optimization analysis to quantify options and select the best option for a complex problem that has multiple solution sets. Application examples include:

- analyzing significant event data in order to identify spatial and temporal trends;
- developing strategies to effectively allocate or employ limited resources;
- improving supply chain and logistics operations;
- conducting qualitative and quantitative assessments of current operations;
- measuring risk and uncovering factors critical to managing and reducing risk; and
- evaluating the potential benefit of changes to tactics, techniques, and procedures (TTPs).

1.3 How to Recognize When Others Would Benefit from ORSA

- They have a large amount of data but do not know what is important or how to use it.
- They are responsible for inputting and storing their data in Excel but do not have the skills to do so.
- They do not know how to display their data to senior leaders.
- They are dealing with a complex problem with many decision points. They need a method to analytically evaluate their options and choose the best one.
- They are risk-averse. They do not have effective strategies for limiting/reducing risk.
- They have variables they want to measure but do not know how to measure them.

1.4 Valuable Applications of the ORSA Skill Set in a Deployed Environment

Most ORSAs do not have the time required to use advanced ORSA techniques in a deployed environment; however, there are less complex applications that are highly valuable to theater commands. These include:

- managing, analyzing, and displaying data;
- organizing large amounts of data;
- communicating technical information to commanders and senior leaders;
- thinking critically (i.e., ‘outside the box’) and developing strategies to solve complex problems;
- advocating change and providing clear answers to problems others are reluctant to tackle;
- developing metrics to measure campaign progress;
- providing recommendations that are tactically, operationally, and strategically relevant; and
- teaching basic and advanced Excel and PowerPoint skills.

In the ORSA community, these tools are often taken for granted (e.g., pivot tables and charts; linking PowerPoint data to external statistical databases; using Visual Basic for Applications [VBA] to automate tasks). The ORSA skill set is in high demand and pays huge dividends for theater commanders. For example, teaching staff members Excel technical shortcuts saves them a great deal of time (the most highly valued asset in theater). There is a saying, "If you give a man a fish, you feed him for a day. If you teach a man to fish, you feed him for a lifetime" (author unknown).
1.5 Ensuring One’s Relevancy

Write charters. The purpose of a charter is to clarify one’s purpose and explain when and how it is useful. ORSAs should limit their charters to one page, using the ideas presented in this chapter. ORSAs should pass out their charter like a business card to new people they meet.

Keep others informed. ORSAs should not become isolationists. They should be excited about their work and share it with others. Products improve when one collaborates with others and involves them in the process. No matter the level of expertise, others have opinions, unique histories and backgrounds, and "an extra set of eyes" to enhance the process. Others cannot help solve a problem or assist with a project unless they are aware of it.

Make time for face-to-face interaction with others. In today's digital world, staff work can keep professionals at their desks for hours on end. ORSAs should get out and mingle with their counterparts. This is the best way for everyone to get to know each other and share problems, issues, concerns, and ideas. Before one can influence others, one must gain their trust and respect. ORSA is a quiet profession. ORSAs have to get out and make a little noise if they want to be utilized. As a rule-of-thumb, one should spend more time interacting with others face-to-face than interacting with others over the computer.

Do not emphasize problems. Emphasize solutions.

Create the opportunity for follow-on interaction. When an ORSA meets people face-to-face to discuss issues, he or she should set a time to meet again. This helps keep the momentum going so others do not lose interest or become sidetracked. One should say something like, "When we meet again at 1000 on Thursday, we can discuss progress on x, y, and z."

Actively seek out resources (e.g., colleagues, mentors, and "believers"). There are people in the command who have ORSA background and/or are aware of the value ORSAs bring to the table. One should develop a strong rapport with these people, keep them informed of current work, and ask these people if they are willing to collaborate on projects. This is especially important if one is a "lone" deployed ORSA. ORSAs should find others who appreciate groundbreaking ideas and support “out of the box” projects.

Familiarize others with ORSA work. The following technique can increase one’s exposure: When briefing or describing one’s work to others, say, "Do you think Colonel Smith would like to see this analysis?" When one receives an affirmative answer, one has a perfectly good reason to walk into Colonel Smith's office and show off one’s great work. When possible, an ORSA should bring along his or her supervisor or counterpart. This builds relationships within an ORSA’s circle of influence.

Start with projects most applicable and important to the command. ORSAs could spend months simply mining through data sets. As a deployed ORSA, one does not have the luxury of time. Deployed ORSAs need to produce results in days (or sometimes hours). Good work completed quickly is better than great work completed late. People need to receive answers while they still remember their questions. Conducting timely analysis that is most applicable and
important to the command creates a healthy respect for the ORSA profession. Once senior leaders understand and appreciate the ORSA skill set, they will seek out ORSA assistance on complex problems. By solving problems quickly and well, one becomes the go-to person in the command for advice and for solutions.

**Answer the question.** ORSAs should resist the temptation to over promise. When presented with a specific question, one should always answer that question first. If time permits, one can conduct further analysis and provide alternative solutions and recommendations.

**Prepare concise reports and clean presentations.** Two or three pages or slides are usually sufficient. When possible, an ORSA should present his or her results in one page or slide. One should write in Standard English so everyone can understand. Presentations should be brief and direct. One should highlight or **bold** the insights/results of the analysis.

**Do not sell the algorithm; sell the results.** Hardly anyone cares that one performed a Chi-Squared test with 41 degrees of freedom or a logistic regression with 12 independent variables with interactions. An ORSA should present findings/results of the analysis and their significance to the mission. Too many ORSAs spend too much time writing and talking about how they did the analysis. Senior leaders do not need the process; they need the results. One should share his or her conclusions and make recommendations.

### 1.6 Summary

This chapter was designed to teach a deploying ORSA how to (1) communicate his or her profession to others; (2) apply his or her skill set in a deployed environment; and (3) become the go-to person in his or her command. Good communication skills are vital to one’s success as a deployed ORSA. Effective communication does not replace sound analytical work; both are required in a deployed environment.
CHAPTER II: DATA MANAGEMENT METHODS

2.1 Why Data Management?

Data Management is the process of planning, coordinating, and controlling an organization’s data resources. Data management is generally a Chief Information Office (CIO)/G-6 function; however, in a deployed environment, ORSAs play a significant role in data management. Key responsibilities associated with data management include data acquisition/collection, data indexing/cataloging/storage, and data verification/validation.

This chapter provides an overview of data management methods. It is not a cookbook of detailed procedures or an exploration of abstract, conceptual techniques. Rather, it provides an analytical approach that is responsive to the needs of decision makers at the highest levels of military command. It includes data management topics ranging from general data considerations to specific data requirements: data collection, data entry, data reporting, and data analysis.

2.2 Data Management Goals and Objectives

ORSAs seldom render advice based on perfect information. An ORSA’s task is to discern which data are pertinent and meaningful and then use this data in the problem solving process. Inappropriate, inaccurate, and invalid data are sources of fruitless analytical effort (sound study efforts based on sound analytical designs are of little value without valid data). It is a rookie mistake to base judgments on the unchallenged use of official figures. One must challenge his or her sources of information. One must examine the data that researchers used to reach their conclusions. One must determine how researchers derived their findings, and one must check data for accuracy. A key function of analysis is to reject bad data and inaccurate information. Ensuring and maintaining data integrity is fundamental to the military mission and requires a considerable investment of time and energy.

2.3 Data Management Process Overview

Data Flow Model. A simple data flow model provides a good starting point for understanding how to carry out data handling procedures. Figure 1 identifies five key steps in data flow: acquisition, verification, validation, analysis, and dissemination. These steps—plus additional procedural details—are described in the following pages. Additionally, storage, maintenance, and security issues apply at all stages of data flow.

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Figure 1. Steps in Data Flow Model
**Data Acquisition.** Acquiring and collecting data from many internal and external sources is critical and often complicated. Sometimes there is a need to collect raw data in the field, such as post blast details from an improvised explosive device (IED) event. Other times, there is a need to elicit data from other people (e.g., polling/survey data). Data may be acquired through data mining or field studies conducted personally or by other analysts. Regardless of one’s method of collection, one must filter and validate the data to avoid *garbage in, garbage out.* Data quality is an extremely important issue.

### 2.4 Three Common Characteristics of Data Collection

**Data Population for Measurement (Who?)** In order to choose the most appropriate statistical methods of analysis, one must precisely define the population he or she wishes to measure. The specific segments of the general population one samples are called *sampling units.* Sampling units must be unique, easily identifiable, and selectable. For instance, if a poll involves Soldiers from multiple units, the researcher must capture certain criteria associated with each Soldier (e.g., rank, branch, duties, and responsibilities) so he or she can easily identify all measurements from this population. If the measured population includes Private Jones, an Infantry Soldier with the 101st Airborne Division who served in Afghanistan from May 2010 to May 2011, the researcher must identify measurements associated with this Soldier (i.e., personal characteristics and professional activities). *Sampling units* must be both discrete (countable) and measurable using standardized methodologies.

**Items for Measurement (What?)** After one defines the population and sampling units, one must define and select the *specific* data he or she wishes to measure. Measured data must have clear definitions, recognizable characteristics, a clearly defined set of observable measurement parameters (qualification standards), and a discrete name. For example, when a Soldier submits an initial spot report, he or she describes enemy activity, gives a clear description of what the friendly forces were doing at the time of the incident (patrol, recon, etc.), pinpoints where the incident took place (grid location), how many Soldiers were involved in the incident, what kind of incident occurred (e.g., IED explosion), and what the outcome of the incident was (e.g., battle damage assessment). One should treat each of these data points as discrete pieces of the event to facilitate further analysis and comparison with future or past events that are similar.

**Methods of Performing the Measurement (How?)** Data is generally classified as *objective* or *subjective,* depending on the amount of human judgment involved with measuring them. Objective data have physical/tangible properties (e.g., grid location, speed of a vehicle, number of vehicles in a convoy) and require little or no human judgment. On the other hand, subjective data (e.g., lessons learned captured from surveys submitted by redeploying Soldiers) require human judgment. For some aspects of data collection, objective data may ultimately give sensitive, reliable, and valid results. Other data, such as Soldier feedback and assessments, require subjective measurements and interpretation. A researcher must evaluate, score, and assign a rating to each subjective measurement. He or she must assess and measure the validity of each. In every case—to the greatest extent possible—a researcher must minimize his or her personal biases in order to ensure valid and reliable data collection.
2.5 High Quality Data Attributes

**Sensitivity.** Sensitivity means the extent to which a small change in a parameter results in a relatively large change in the outcome. If a small change in a parameter results in a relatively large change in the outcome, the outcome is said to be *sensitive* to that parameter.

**Reliability.** Reliability means free from random error in the final measurement, usually indicated by consistency among items or stability in the measurements over time. Both sampling and non-sampling errors affect reliability. Sampling errors are the inevitable result of basing an inference on a random sample rather than on the entire population. Non-sampling errors occur from non-response, coding errors, computer processing errors, errors in the sampling frame, reporting errors, etc.

**Validity.** Validity means that the data accurately represent what they are intended to represent. Data validity depends partly on having adequate sensitivity and reliability of the measures; however, even with adequate sensitivity and reliability, the data may represent something other than what they appear to represent. For example, a poorly worded survey question may yield results that do not accurately answer the desired question (invalid results). Vague data definitions, insufficient interviewer training, casual data collection methods, and operator discretion weaken or reduce data validity.

**Standardization.** Standardization means ensuring uniformity in data collection procedures. Standardization ensures that data differences are not procedural differences. The standardization attribute is very sensitive to non-sampling errors associated with quality of data, collection techniques, and the stability of established data collection procedures.

**Completeness.** Completeness means that all the expected data elements, records, observations, etc. are present. Non-sampling errors affect completeness. Common causes of incomplete data include: (a) failure to enforce data collection standards outlined in the standardized data entry report, (b) failure to report all of the required information, (c) failure to secure records from which the data are to be collected, (e) inability to read/scan the data collection form, and (f) corrupted files.

2.6 Data Entry

Data entry is the initial set of operations used to transcribe the raw source data (survey results, initial spot reports, etc.) into a computerized format (i.e., database). Data entry begins when data collection is complete. Data entry forms and quality control features are extremely important in minimizing error. One should standardize data entry forms across all levels of command to ensure consistency in data collection. Standardized forms should contain logical formats that include discrete data entry choices (e.g., drop down menus) to reduce transcription errors. Inevitably, the process of transcribing data from field forms to a digital format introduces error. To minimize errors, one must standardize data entry forms and quality control measures throughout the data management process. For example, data entry forms reduce transcription errors through pick lists, value limits, and controlled access to the database. Forms set for "data entry only" prevent accidental deletion or alteration of existing data. One can also set key fields to prevent duplicate entries such as variations of a unit's name. With standardized forms, one
can also control the sequence of data entry. A well developed data entry format enables users to search for and retrieve consistent results that are free from duplicate entries.

### 2.7 Data Verification

Irrespective of how one acquires the data, one must import the data into the database using a process that ensures verification. Data verification immediately follows data entry and involves checking the accuracy of source data. While one rarely achieves 100 percent error-free data entry, one can minimize transcription errors by using a layered approach to data verification. One should use quality control measures throughout the data management process, from the entry of an initial report, to the consolidation of massed reports into an official database, to retrieval at higher headquarters where one uses the data for analysis and decision making. A good *rule of thumb* is for one to verify 10 percent of all records for a specified period, focusing on key aspects of the report (e.g., event location, event category, etc). One should compare these audited records with the existing record and include this information in the finalized report. If one finds reporting errors, he or she should review and re-verify the entire data set. Once one verifies that the computerized data accurately reflect the original field data, he or she can index and archive the reports for later retrieval.

### 2.8 Data Validation

Data validation ensures the accuracy of the original source field reports. Data should be accurate and logical. For example, a report stating the convoy speed was 150 mph is illogical and almost certainly incorrect, whether or not the original recorder properly transcribed the data from field reports. As another example of validated data, spatial data collected within a certain boundary should appear within that boundary when viewed in a geographic information system (GIS) environment. The process of reviewing computerized data for range and logic errors is the validation stage.

Database developers build certain components of data validation into their programs (e.g., range limits). ORSAs can perform additional data validation during verification if they are sufficiently knowledgeable about the data. During data validation, an ORSA should identify generic errors (e.g., missing, mismatched, or duplicate records) as well as errors specific to particular items and types of activities. For example, validation of enemy threat data includes database queries and comparison of data over different years. One query may detect records of specific location identification (ID) and a certain type of enemy activity (e.g., IED attack). Another query may count the number of IED attack plots per sample site to ensure that personnel entered all plots correctly. Additionally, an ORSA can compare current data with previous years to identify gross differences. One should ensure consistency between field forms and the database by noting how and why personnel made changes to the data on the original field forms. Once data validation is complete, the data can be archived for later retrieval.

### 2.9 Data Analysis

As described by Albright, Winston, and Zappe (2011), there are seven basic steps to data analysis: (1) define the problem, (2) collect and summarize the data, (3) formulate a model, (4)
verify the model, (5) select one or more suitable decisions, (6) present results, and (7) update the model as new data become available. These steps aid in planning the proper course of data analysis. Simply put, there are a myriad of statistical tests, optimization methods, and simulation methods, and one must determine which technique is appropriate for a given situation. Analytical tools used to assist in the process include Excel and Access, ESRI Arc Geographical Information Package (ArcGIS), SAS Institute Statistical Analysis System (SAS), and IBM's Statistical Package for the Social Sciences (SPSS). All data analysis techniques should comport to scientific and professional standards. One should analyze results for statistical significant.

### 2.10 Data Dissemination

One should follow the appropriate review process and share results with all identified users. One should display data in a logical and consistent format and follow ownership protocol guidelines. To accomplish this goal, one should use standardized procedures to quality-check, analyze, document, catalogue, archive, and make data available for further analysis and decision making. It is especially important to provide well-documented data in a timely manner to those who depend on readily accessible, accurate, and complete data. One should consider the following advice:

- Data should be easily discoverable and obtainable.
- Data results should not be released until appropriate authorities have granted permissions.
- Complete metadata (characteristics of information-bearing entities) that clearly establish the source and content of the data should be included.
- Data should be properly identified and protected from unauthorized access and inappropriate use (e.g., sensitive data in reports, metadata, raw and manipulated spatial and non-spatial data, maps, etc). One should clearly identify classified data and follow all rules of use and distribution.

At times, one may need to export data from one database to another (e.g., from Access to SPSS, ArcGIS, or FalconView) for further analysis. Data integrity must be maintained when transferring data between software tools. One can most easily control the field order (i.e., order of variables in the resulting ‘flat’ file) while the data is still in the relational database. One should determine field types early on in the database development process. One should keep data type changes to a minimum in order to minimize risk to data loss. This handbook recommends using the American Standard Code for Information Interchange (ASCII) text for its nearly universal readability across applications. ASCII text typically delimits fields by commas, tabs or spaces, and encloses text strings by single or double quotes. ASCII text requires extra steps to transfer data between applications and extra care regarding data formatting. The preferred alternatives are data exports directly from an Access .mdb file (such as ArcGIS) or link to an .mdb file by way of a database connection such as OLE DB or ODBC data link.

### 2.11 Data Organization

The various databases, reports, GIS coverages, etc. create a large number of files and folders to manage. For example, databases are occasionally stored in two versions of Access in order to accommodate data users with different software versions. Additionally, GIS data are sometimes
CHAPTER II: DATA MANAGEMENT METHODS

2.12 Data Maintenance

Data sets are rarely static. They often change through additions, corrections, and improvements following the archival of a data set. There are three main caveats to this process:

- One should only make changes that improve or update the data and maintain data integrity.
- When archiving the data set, one should document change versions made to the data set.
- One should prepare backup files to recover from mistakes made during editing.

2.13 Version Control

Secure data archiving is essential for protecting data files from corruption. Version control of records is a critical piece of the data management process. Prior to making any major changes to the dataset, one should save the data set using a unique version number. This facilitates tracking changes over time. With proper controls and communication, versioning ensures that one uses only the most current version in analysis. One should use a logical numbering system and assign each additional version a sequentially higher number. When one makes new versions to the data set, one should provide all frequent users with the most recently archived version.

2.14 Operational Competence

ORSAs must remain operationally competent across the full spectrum of resident skills. One becomes operationally competent by integrating oneself into the staff process early in the planning process and by remaining engaged all the way through to the execution of operations. One’s ability to access and utilize multiple data sources ensures that the commander has the most accurate, relevant, and timely information available. For example, ORSAs deployed with the International Security Assistance Force – Afghanistan (ISAF-A), the Combined Joint Special Operations Task Force – Afghanistan (CJSOTF-A), the Joint Special Operations Task Force – Philippines (JSOTF-P), and the Combined Joint Task Force – Horn of Africa (CJTF-HOA) have utilized multiple data sources to:

- analyze the projected size of the Afghanistan National Security Forces (ANSF);
- develop a process to locate, validate, store, and distribute polling data for analytical use to support strategic and operational issues in OEF;
- analyze poll results of counterinsurgency operations to gauge the success of efforts to win the hearts and minds of the local population;
- develop assessment frameworks to inform commanders and future campaign planners;
- consolidate and format unusable, individual unit reports into a single database using text extraction techniques;
- assess the effectiveness of combat and security operations on enemy activities; and
- establish robust database systems to better facilitate analysis of assessments.
2.15 Way Ahead

Data for decision making comes from a variety of sources, both internal and external. Because the database management system is one of the major components of most decision management support systems, it is important for ORSAs to be familiar with the latest developments in the field. Organizations are recognizing that their data contain a gold mine of information. Consequently, they are warehousing and mining data for users to obtain information on their own (through a variety of multidimensional analytical tools and new enterprise-wide system architectures) and establish relationships (through data extraction techniques) that were previously unknown. New emerging tools, such as Online Analytical Processing (OLAP), provide on-the-fly data analysis that is invaluable to analysts. Moreover, a wide variety of data formats are becoming available through innovative networked database management systems. One can use any or all of these methods to enhance data analysis and assist commanders at all levels of command in making highly informed decisions.
3 CHAPTER III: DATA ANALYSIS TECHNIQUES

3.1 Introduction

**Definition.** Data analysis is the act of transforming and modeling data to extract useful information and facilitate conclusions that support decision making.

**Purpose.** This chapter highlights several good data analysis techniques used by previously deployed ORSAs. As a deployed ORSA, one makes inferences from data to recommend courses of action (COAs), assess specified activities, identify trends, etc.

Data analysis is an objective method for determining whether alternative COAs are significantly different from each other and for providing the commander with resource allocation recommendations. Data analysis underpins operational assessments (e.g., analysis of enemy and friendly activities) that identify changes and trends in the operational environment. It is an ORSA’s responsibility to determine which data analysis technique will provide commanders with the most accurate findings to assist them in their decision making process. Commonly used analytical techniques include statistical analysis, simulation, optimization, network flow models, and geospatial analysis.

3.2 Data Cleaning

Prior to beginning analysis, one may need to mine and clean the dataset. Typically, datasets contain missing data, multiple entries of the same event, and duplicate events entered with different terminology, all of which one must identify and correct prior to analysis. Furthermore, the necessary data may be located in "text" fields that require one to mine the data and extract the information. In a deployed environment, "dirty data" is quite common. ORSAs must not use "dirty data" in their analyses. These analyses are not trivial; they often become part of larger studies. Data cleaning is a labor-intensive task.

3.3 Statistical Analysis

Accurate analyses necessitate selection of the most appropriate technique for a given complex problem. One should consider events that may have an impact on the graphed data (e.g., major operations, elections, battlespace transition, and/or significant changes in the political environment, such as ratification of a constitution/seating of a parliament). These events can explain spikes or dips in the data and place the data in context.

**Descriptive Statistics.** This handbook recommends visually inspecting the data set using a graph (e.g., scatter-plot, histogram, or time series chart) prior to conducting the analysis. Statistics textbooks provide examples of descriptive statistics (e.g., Devore, 2012), and many online resources outline techniques for calculating numerical measures and developing graphs.

**Statistical Techniques.** One can find the most relevant trend-analysis examples by referencing the work of recently deployed ORSAs. Several statistical techniques used in recent projects conducted in theater and as part of the analytical reach-back process include t-test, regression
(e.g., linear, multiple, and logistic), and time series forecasting (e.g., moving average, weighted moving average, and Holt-Winters method). This handbook also recommends "Forecasting: Methods and Applications" by Makridakis, Wheelright, and Hyndman (1998).

3.4 Other Analytical Methods

Deployed ORSAs may find that the following analytical methods exceed combat-theater resources (i.e., time, skill, software); however, one can still use these methods through the reach-back program.

**Forecasting.** Forecasting is the process of developing estimates for future outcomes that are likely to occur. Modern forecasting falls into one of two broad categories: causal forecasting or time series analysis. Causal forecasting predicts how an uncertain quantity relates to other quantities. Time series forecasting predicts future values of an uncertain quantity based on past values of a known quantity. Forecasting (i.e., predicting) future events is important as the United States continues the fight against terrorism. Senior leaders may ask ORSAs to develop tools and models to forecast enemy activity, both temporally and spatially.

One comprehensive forecasting resource is "Forecasting Principles: Evidence-based Forecasting" (2012), available from http://www.forecastingprinciples.com. Makridakis, Wheelwright, and Hyndman's "Forecasting: Methods and Applications" (1998) is also a good resource. Makridakis et al. provide descriptions and examples of basic forecasting tools, time series decomposition, simple regression, etc. Additionally, Sam L. Savage's "Decision Making with Insight" (2003) provides good explanations of causal and time series forecasting.

**Simulation.** Simulation is a mathematical model for recreating a situation repeatedly to more accurately estimate the likelihood of various outcomes. One can use simulation to show the eventual real effects of alternative conditions and COAs. Analysts widely use Monte Carlo computational algorithms for simulating the behavior of various physical and mathematical systems, and for other computations. One can use simulation in forecasting as well (for example, developing recommendations for resource allocation). Albright et al. (2011) include descriptions and examples of the simulation process. Additionally, add-ins, such as Excel’s @Risk, are designed to conduct simulations.

**Optimization.** One can use optimization (i.e., math programming) to minimize or maximize a real function by systematically choosing the values of real or integer variables from within an allowed set. One can use several different methods to conduct optimization, to include linear programming, network flow models, and critical path models. Over the past several years, commanders and senior leaders have asked ORSAs for optimal methods of employing technology, transporting technology and personnel to theater, optimizing coverage of specific assets (e.g., medical evacuation [MEDEVAC] and Intelligence, Surveillance, & Reconnaissance [ISR] technology). One can conduct simple optimization problems using the built-in "Solver" of Excel. Additional Excel software tools are available for sensitivity analysis to determine how the optimal solution changes as one or more input variables change. Albright et al. (2011) include detailed descriptions of optimization models using linear programming.
Sensitivity Analysis. Sensitivity analysis is the procedure for determining the sensitivity of alternative outcomes to changes in one or more parameters. If a small change in a parameter results in a relatively large change in the outcome, the outcome is sensitive to that parameter. This may mean that one has to determine the parameter very accurately or redesign the outcome to be less sensitive. One should incorporate sensitivity analysis into the decision making process to determine how sensitive the recommended solution is to various parameters of the model. Albright et al. (2011) provide a good example using Excel to conduct sensitivity analysis. Additionally, the Precision Tree add-in discussed below is a good tool for conducting this type of analysis.

Gap Analysis. ORSAs—more often than not—have only incomplete data to answer specific questions. Where there are incomplete data, there are potential gaps in the analysis. One should identify these gaps in the "limitations" section of one’s final written report. There are several ways to approach missing data, to include (1) deleting incomplete entries, (2) filling in incomplete entries based upon the most similar complete entry ("hot deck imputation"), (3) simulation, (4) filling in complete entries with the sample mean ("mean substitution"), or (5) using a learning algorithm (e.g., maximum likelihood) to infer a missing entry. In one’s written reports, one should annotate the methods used to overcome the gaps in data. As additional data become available, one should conduct gap analysis to "fill in the blanks" or run another iteration of the analysis to determine how the additional data change the results.

3.5 Software Utilization

This section summarizes software packages available to assist in the execution of data analysis. Senior leaders do not expect ORSAs to be experts in all of them; however, they do expect ORSAs to know the differences between them.

Excel built-in Functions. Several built-in functions in Excel improve the efficiency of analysis. In particular, the following three features are very powerful: pivot tables, sort options, and filtering. These features allow one to manipulate and visualize data quickly. Moreover, Excel has "add-ins" such as Analysis ToolPak for statistical analysis.

Excel add-in Software. The following Excel add-in software capabilities are available for purchase:

- **@Risk** for risk analysis. With this feature, one can define probability distributions and run simulations for input and output variables within Excel.

- **Precision Tree** is a decision analysis add-in. One may find it useful in optimization when one is dealing with a set of alternatives such as decisions on using new weapons or factoring in decisions at each stage of contracting and development.

- **Crystal Ball** performs Monte Carlo simulations in spreadsheets that automatically calculate thousands of different "what if" scenarios and save the inputs and results of each calculation as an individual scenario. Analysis of these scenarios reveals the range of possible outcomes, the probability of each occurring, which inputs have the greatest effect on the model, and where one should focus one’s efforts.
Macros. One can create a Macro to automate repetitive actions (i.e., a series of recorded actions). One can write Macros using the built-in toolbar or visual basic for applications (VBA) code in the VBA editor.

3.6 Examples of Available Software Packages

- **SPSS** is used for statistical analysis, data management, and data documentation.
- **Stata** is used for data management, statistical analysis, graphics, simulations, and custom programming.
- **TRAC’s Free Data Visualization Tools** have been updated with a MUAT capability.¹
- **DECMAT** is a well-known multi-criteria decision matrix (i.e., preference matrix) used in the military decision making process (MDMP).
- **JMP** is visual software from SAS that sets itself apart by linking robust statistics with graphics on the desktop, producing visual representations of data that reveal context and insight impossible to see in a table of numbers. JMP allows one to be more efficient, tackle difficult statistical problems, and bring one’s data analysis to a whole new level. Data and information visualization, design of experiments, and statistical modeling techniques from simple to advanced are all within one’s grasp with this powerful platform. And when one makes JMP one’s analytic hub, one can use other favorite tools: SAS, Excel, and R.²
- **MATLAB** is used for algorithm development, data analysis, visualization, and numerical computation.
- **Minitab** is used to analyze one’s data and improve one’s products and services with the leading statistical software used to implement Six Sigma worldwide.³
- **GAMS** is used for mathematical programming and optimization.
- **R** (free software) is used for statistical computing and graphics.

3.7 Summary

There are numerous analytical techniques one can use to execute analysis. One does not have to be an expert in every technique, but one should know which technique is appropriate for a given problem. If a deployed ORSA finds that a problem requires a specific technique where time, skill, or software availability is at issue, he or she can request analytical support from a reach-back agency such as CAA.

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² JMP software is available from http://www.jmp.com/software/jmp10/
³ Minitab software is available from http://www.minitab.com/en-US/Products
CHAPTER IV: COMMUNICATING CLEARLY

4.1 Purpose

The purpose of this chapter is to provide ORSAs with best practices for representing data and associated analyses in a clear, accurate, and understandable way.

4.2 Constraints, Limitations, and Assumptions

CLA bound (scope) a study effort by identifying what must (or must not) and can (or cannot) be accomplished; they frame the study space and set the stage for the study team’s methodology development; they serve as a ‘contract’ between the study sponsor and the study team; and they provide a basis for the sponsor to reconcile the study results. CLA[s] provide the framework for both the study team and the study sponsor to understand the conditions under which a study’s results are applicable. Although commonly misrepresented or used interchangeably, these three terms are distinctly different in meaning and use in the context of a study (TRADOC Regulation 71-20, p. 52).

4.2.1 Constraints

Constraints are restrictions imposed by the study sponsor that limit the study team’s options in conducting the analysis and/or study. The study tasker and sponsor’s guidance may place bounds on the study by specifying the:

- date by which the study must be completed;
- organizations to participate in the study;
- force structure(s) and force year(s) to consider;
- type(s) of combat operations to consider; and
- scenario(s), threats, and environments to consider.

These bounds may limit one’s ability to conduct a full investigation and analysis of the issues at hand. One needs to discuss changes to any constraint with the study sponsor prior to removing or adjusting the constraint.

4.2.2 Limitations

Limitations are restrictions that limit one’s ability to meet the study objectives or fully investigate/analyze the study issues within the bounds of the study's sponsor. Limitations may consist of the following:

- concept immaturity;
- access to study information (e.g., information that requires special clearances);
- availability of data;
- number and type of available scenarios; and
- available models and their capabilities.
One should not label something as a limitation that one imposes on oneself. If one can overcome a limitation by having the study sponsor change a constraint, one should recommend that change to the sponsor and identify how it benefits the analysis/study.

4.2.3 Assumptions

Assumptions are statements related to the analysis/study that are taken as true in the absence of facts, often to accommodate limitations.

**Clearly define assumptions used in one’s analysis.** Assumptions are an integral part of any analysis. One needs to clearly define and state all assumptions associated with the analysis. Higher headquarters or written plans provide the assumptions associated with the analysis. One usually identifies these assumptions up-front to help shape the method of analysis. One may also discover other needed assumptions as the analysis progresses. When one discovers additional assumptions during the analysis, one needs to discuss these assumptions with the sponsor to determine their relevance or to obtain additional data that would eliminate them. Whether stated up-front or determined over the course of analysis, one needs to make all recipients of the final analytical product aware of all assumptions by incorporating them into the final presentation or report.

**State how the assumptions will affect analysis results.** It is important to state how each assumption will affect one’s analysis and study results. One should only include those assumptions that have an impact on the analysis and results. If one cannot explain the effect—or there is no effect on the results—one should not include the assumption. One should explain all assumptions during one’s presentation or in the notes section of the final product or report. The following are examples of relevant assumptions made in past analyses conducted in theater:

- Assumed specific sensor system had line of sight to view significant activities
- Assumed attrition rate of 6.4%
- Assumed international funds would continue at the same level for the next x number of years

Based on the available data at the time of the analysis, one makes assumptions to allow analysis to continue. If additional data become available during the analysis, one should include them to provide greater fidelity and insight. Assumptions, such as those listed above, assist in the development of a data collection plan and enhance future iterations of the analysis.

4.3 Roles and Tenets of CLAs

**CLAs are critical to a successful study. They:**

- bound (scope) a study effort by identifying what must (or must not) or can (or cannot) be accomplished;
- frame the study space and set the stage for the study team’s method-development;
- serve as a contract between the study sponsor and the study team; and
- provide a basis for the sponsor to reconcile the study results.
CLAs must be:
- acceptable (i.e., generally agreed upon by all study participants);
- evolving (i.e., continually reviewed and adjusted as the study effort matures);
- necessary (i.e., enable the study effort); and
- valid (i.e., sound and supportable).

### 4.3.1 State all Caveats

One must clearly state all caveats associated with the data and analysis. Caveats are warnings or cautions that may include one’s interpretation of data, interpretation of terminology, and one’s graphical representation of results. One may address caveats in the form of limitations. One should address caveats up-front to give one’s audience a greater perspective while they are reviewing the analysis and results. For example, one should include a caveat associated with a specific graphical representation of results as a text box or bullet on the same slide as the graphic to avoid misrepresentation and/or misunderstanding of the results.

The following are examples of caveats from OIF and OEF:

- Population data was extrapolated from the census conducted in 1975.
- All levels of armoring (1, 2, & 3) were included in the Up-armored HMMWV category.
- Only coalition forces (CF) casualty data was included.
- Responses for Afghan National Development Poll (ANDP) 4.0 were worded differently from previous surveys. Responses were binned to compare with ANDP surveys 1.0 - 3.0.

Caveats such as these inform the sponsor to begin collection on specific data requirements to enhance future iterations of the analysis.

### 4.3.2 Presenting Results

**Know the audience.** Before one presents a brief on analytical results, he or she needs to know his or her audience. Knowing one’s audience assists one in knowing what level of discussion to have on the analytical techniques used in the analysis.

**Avoid becoming too technical.** If one wants senior leaders to accept one’s technical study results at the highest levels, one must communicate insights as simple statements, without becoming too technical. One should not assume that the decision maker will sift through briefing data to find the answers. The purpose of a briefing is not to show the decision maker all the data and expect him or her to find the answer. One must realize that most decision makers are not technical experts. If one displays too much technical data, one further complicates an already complex issue. One must **package** one’s results to provide insight and recommendations to decision makers. Decision makers focus on decision making, not technical fascination.

**Present bottom line up front.** One should clearly state the purpose of one’s brief/presentation at the beginning in the form of a purpose statement or problem statement. One should make these statements concise and develop them jointly with the study sponsor/study director.

**Use a logical presentation methodology.** One’s presentation should have a logical flow to allow one’s audience to understand the purpose, problem, analysis, and results. One should
begin one’s presentations with the purpose and/or problem statement (i.e., "bottom line up front"). This technique enables one’s audience to understand the end state and results while the discussion is unfolding. Any graphical representation of data or analysis should include a "take away" bullet. One should include a bullet comment on the most important reason for displaying the data/results in a given manner. This bullet should stand out using a color scheme, larger bold text, or some type of symbol to draw the audience’s attention to this important fact.

If there is specific information that should remain displayed throughout the brief (e.g., a map of the operational area or a legend of a color scheme), one should create separate visual displays to make this possible.

The delivery of one’s brief is just as important as the brief itself. One should rehearse one’s brief to increase one’s confidence, correct one’s mistakes, and make changes to the flow of one’s presentation. One should take the time to ensure all technology is operating properly (including replacing the batteries in the remote, the bulbs in the projector, the length of extension cords for the computer equipment, the volume on the sound, etc). If a remote is not available, one should arrange for someone else to work the slide show presentation (if one has time to rehearse, this is always a good idea because it limits one’s distractions and keeps one’s audience focused on the presentation). One can have the best analytical product in the world, but if one’s delivery is poor, the decision maker may discount one’s efforts.

After giving the presentation, one should re-assess the overall briefing and determine if one achieved one’s stated goals. One should determine if follow-on presentations or meetings are necessary and appropriate.

**Prepare slides to stand alone.** One’s slides should contain backup notes and potentially stand alone. Commanders and staffs at all levels may extract specific slides from one’s presentation for other presentations/meetings/working groups, etc. Providing backup notes with one’s slides limits misuse and misinterpretation.

**Include the appropriate classification with each bullet.** One should not classify one’s entire presentation with one classification, unless all information is of one classification. Each slide/bullet should be clearly marked with its own classification. For example, when one’s entire presentation is marked as secret because one bullet is secret, others must assume that the entire brief is secret. This limits others’ ability to share information with coalition partners. The process of classifying each bullet avoids misinterpretation by other people who may use the presentation or pull certain slides from the presentation.

**Use the best method of presentation.** Consider one’s audience in determining the best method to display one’s results. One should remember one is conducting the analysis for the customer. In some cases, this method is command-driven. If it is not, the following are helpful hints on best practices used in theater.

**Present information in the clearest manner.** One should not make slides so complex that the audience has difficulty understanding the main point of one’s slides.
Use a combination of graphs or tables with accompanying bullets. One should highlight the "take away" of the slide. One should use colored text boxes and larger fonts to make important points stand out from other information on the slide. When one uses a common color scheme throughout the presentation, one’s audience quickly recognizes the main point of each slide.

Properly label graphical representation of results. One should label all aspects of each graph (i.e., x-axis, y-axis, title, and legend). One should clearly define data table columns and rows. One should include the data source with all graphs and tables to enable one’s audience to find the original data for follow-on analysis and/or validation.

Simplify mathematical concepts. One should know one’s audience when explaining the mathematical concepts behind the analysis. As a rule, one should present concepts simply and have the mathematical computations available in one’s back-up slides to present to senior leaders who request additional information.

Graphically display results and conclusions. Graphical displays are often more powerful than the technical analysis behind them. One should take extra time to display one’s information in such a way that one’s audience easily grasps the main points. When one incorporates tables, charts, or graphs into a PowerPoint presentation, one should paste them as pictures. One does this by using the Edit, Paste Special command in PowerPoint. This prevents anyone else from manipulating one’s data and charts. It also reduces the size of one’s presentation and makes it easier to send electronically. The following are some helpful hints for displaying results:

- Visuals are more powerful in color. One should use a specific color for the critical points or "take-a-ways" that require audience attention. One should limit the number of colors per graphic and keep colors consistent across one’s entire presentation. Each graphic must contain a detailed legend that defines one’s color-coding methodology.
- One should avoid confusing one’s audience; one should keep scales constant across multiple charts on the same topic.
- After completing the analysis, one should determine the type of graphic that best communicates the results and main "take-a-way" points (e.g., text charts, tables, line charts, dual-axis charts, surface charts, vertical bar or column charts, and pie charts).
- Text charts are the easiest type of graphic to prepare. However, one should remember that words or bullets are not visuals. Pictures, clouds, and arrows used in conjunction with words create visual effects that communicate the information or results better. Text charts are effective for introducing topics, such as the methods one used in the analysis and important ideas or results. One should keep one’s text charts as concise as possible; one should use bullet statements rather than entire sentences and paragraphs.
Figure 2. ANDP Survey Model

Figure 2 is a text chart displaying the survey model of the ANDP. One can use tables to display raw data or study results; however, there are better methods for displaying comparisons or trends. One can use a table in conjunction with other graphics if the exact numbers are relevant to the "take-a-way" one wants to achieve on a particular slide. When one uses tables, one should clearly label all columns and rows (see Figure 3).

<table>
<thead>
<tr>
<th>Tables Show Specific Data</th>
</tr>
</thead>
<tbody>
<tr>
<td>Annual Spending ($B)</td>
</tr>
<tr>
<td>Fiscal Year</td>
</tr>
<tr>
<td>Procurement and RDTE</td>
</tr>
<tr>
<td>Personal Costs</td>
</tr>
<tr>
<td>Other</td>
</tr>
</tbody>
</table>

Figure 3. Annual ANDP Spending per Fiscal Year
Line or curve charts effectively show trends and time series data. Line charts display multiple lines on a single graph. One should clearly distinguish each line with differing colors or patterns (solid, dashed, etc). One should include a legend that defines colors and patterns.

Figure 4 is a sample line chart of notional attack and casualty data. The chart defines the x- and y-axes, and includes a legend to specify the representation of each line. The title specifies the exact category of the data (e.g., attacks and casualties).
Figure 5. Casualties per Attack

Dual axis charts show different data with a varying degree of magnitude between the data sets. In Figure 5, the ORSA uses a red line to display *notional* casualties per attack. The dual-axis chart presents all pertinent information in a clear and understandable way.
Figure 6. Numbers of Participating ISF/US/CF Security Forces

In Figure 6, the ORSA uses a surface chart to display data for the Iraqi Security Forces (ISF) Update conducted by Multi-National Forces-Iraq (MNF-I). A surface chart is a single line chart with the area shaded under the line. The shading emphasizes the size of the total amount rather than the differences or changes in the amounts.
Figure 7. The answer “Road Improvements would most improve our lives?”

Figure 7 is a column chart used to display the results of the answer "road improvements" to the question—in ANDP 2.0 and 3.0—"What is the one thing that would most improve your life?"

A vertical bar or column chart displays values and series groups as sets of vertical columns grouped by category. The height of each column represents each respective quantity and its variation across different categories (e.g., time intervals or geographic regions). Excel offers different variations of this type of chart, to include the stack column chart, the percentage column chart, and the option to graph multiple categories across the same intervals of time or geographic regions by displaying each as a different-colored column. Each graph should include a legend that defines the visual coding.
Figure 8. The Age-percentages of ANDP 3.0 Survey Respondents

Figure 8 displays age category percentages for ANDP 3.0. A pie chart is used to show a composite whole and its proportions. Pie slices are compared with each other and with the whole. Each slice is represented with color and a legend is used to explain the color-coding methodology.
Figure 9. MEDEVAC Helicopter Response Times and Number of Events

Figure 9 shows notional Afghanistan MEDEVAC data and helicopter response times created with ArcGIS. Shading represents the various response times and red dots represent MEDEVAC events.
Figure 10. Security Situation by Province

Figure 10 is an example of a quad chart that summarizes and highlights trends on a specific question from the ANDP. Across all four iterations of the ANDP survey, pollsters asked: "How is the security situation in your village/city?" This information fed indicators and measures of effectiveness (MOEs) to determine if U.S./host nation (HN)/CF were meeting campaign plan objectives.

As a deployed ORSA, one most commonly uses the "Quad" chart to summarize project status. The Quad chart divides a slide into four sections that usually consist of (1) the purpose/problem statement, (2) methods, (3) timeline, and (4) results/insights. One can adjust these sections to fit one's specific projects or quickly summarize one's current work effort. One can share these charts with agencies and other analysts who are interested in this work or collaborating on a reach-back project. One can use Quad charts to show relationships. For example, in the assessment process, one may find this type of chart helpful in highlighting relationships between different indicators and MOEs, or increases/decreases in a specific MOE. One can amend the "Quad" chart (e.g., "Tri" or "Bi" chart) as the situation requires.

4.4 Summary

This chapter presented best practices for representing data and associated analyses in a clear, accurate, and understandable way. It presented the differences between constraints, limitations,
and assumptions, and the importance of each. And finally, it highlighted the importance of using geospatial analysis as a powerful tool to complement other visual tools for displaying one’s analysis.
5 CHAPTER V: SURVEY DEVELOPMENT AND ANALYSIS

5.1 Introduction

The Purpose of Conducting Surveys. The United States military uses a myriad of operational data. Multiple systems and databases record many aspects of the operating environment. In operations where the indigenous population is the center of gravity, decision makers consider the population’s perspective in their decision making process. Commanders continually make decisions to address, persuade, and change populace perceptions of key aspects and focus areas of the nation-building process. These key aspects and focus areas include reconstruction, governance, security, justice, etc. Surveys play an integral role in determining populace perceptions on each of these aspects. The results of surveys allow the commander to conduct assessments and develop action plans to address populace concerns and maintain positive gains. This chapter addresses the importance of using surveys in the assessment process, from survey development, to survey fielding, to operations analysis.

<table>
<thead>
<tr>
<th>EFFECT</th>
<th>• Host Nation populace accepts judicial system</th>
</tr>
</thead>
<tbody>
<tr>
<td>MOEs</td>
<td>• Increase/decrease in populace perception of judicial system</td>
</tr>
<tr>
<td></td>
<td>• Increase/decrease in populace access to judicial system</td>
</tr>
<tr>
<td>INDICATORs</td>
<td>• Percent of populace with access to judicial system</td>
</tr>
<tr>
<td></td>
<td>• Percent of populace using judicial system</td>
</tr>
<tr>
<td></td>
<td>• Number of people seeking judicial-related degree</td>
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Figure 11. Subjective Assessment Metrics

Assessment. The assessment process begins with the development of the campaign plan to outline ways and means of achieving the desired objectives and end state of various focus areas. Deployed ORSAs are major contributors to the assessment process. One develops assessment metrics to provide a measurable way to determine progress toward mission objectives. Often, the assessment metrics include effects, MOEs, measures of performance (MOPs), and indicators. Figure 11 provides examples.

As part of the assessments team, ORSAs submit requests to obtain data to assess these subjective metrics. For example, asking the Staff Judge Advocate to provide the number of people using the judicial system, the number of courts established, and the number of judges trained. Data analysis alone, although helpful, does not provide a complete assessment of whether the indicator is achieving the desired effect. Surveys, in conjunction with other data analyses, do offer this. A survey provides a means to measure and assess the subjective metrics. Survey results play a significant role in the assessment process and in the development of action plans and tasks. One constructs surveys to provide data that directly supports the measurement and assessment of subjective metrics. Figure 12 lists Afghanistan survey questions asked to obtain populace perceptions in specific areas to assess several subjective metrics.
5.2 Development of Action Plans

Senior leaders usually develop Action plans at the completion of the assessment process. Action plans evolve based on analysis of the survey results. Commanders use survey results to make decisions and allocate resources (e.g., The Commanders Emergency Response Program [CERP], United States Agency for International Development [USAID] projects, and force structure). Decision makers use survey results as a source of data to determine the best allocation of resources to maintain successes and/or improve in areas identified as shortfalls. This process includes the adjustment of current action plans or identification of new plans to achieve desired effects and/or positively change populace perceptions. For example, ORSAs provided reconstruction-related results to Combined Forces Command – Afghanistan (CFC-A) CJ7 and USAID, which, in turn, incorporated results into future project planning to meet the needs of the people.

5.3 Survey Development Process

ORSAs have used their years of experience in developing surveys to support assessments in Iraq, Afghanistan, and, more recently, as part of OEF – Philippines. Due to language, culture, and access barriers associated with gaining unbiased public perceptions, the United States government often contracts their surveys out to local polling agencies that use indigenous interviewers to reduce response bias by looking, speaking, and acting like those they interview. Figure 13 provides a quick reference checklist of some of the important steps in the process of developing and conducting a survey.
Figure 13. Steps in the Survey Process

Survey Objectives – Purpose and Stakeholders. Nearly every unit, coalition, and interagency has gaps in its public perception situational awareness. With this said, unless controlled for, it is easy for a survey to undergo a version of "mission creep." Simply stated, unless the objectives of the survey are clearly articulated, the survey quickly becomes a tool for asking too many questions in insufficient depth, thus failing to inform the intended metrics.

Before one begins the actual survey work, one should clearly identify the purpose of the survey and its key stakeholders. For example, in the Philippines, there are multiple surveys conducted by the U.S. Country team. Each survey has a different purpose (see Figure 14). Each survey asks for input from multiple offices. Ultimately, the identified stakeholders are the decision makers and determine which survey questions make the "final cut."
If one is involved in survey development, one should work with the study sponsors to develop the initial model concept prior to the contracting phase to ensure the scope of the survey is included in the contract. This scope may include (1) objective(s) of survey, (2) number of surveys, (3) time frame for implementation, (4) number of questions, and (5) type of final report/analysis required of the contracted agency. Once stakeholders finalize the contract, they can further refine the survey model. This refinement includes the identification of specific areas of focus based on the commander’s campaign plan and assessment metrics developed to measure mission success or failure.

In order to determine the best time to conduct the surveys and the primary focus area(s) for each survey, one should consider significant events that may occur during the span of the survey contract, to include (1) elections, (2) major operations, (3) significant political events (e.g., seating of parliament, ratification of constitution), and (4) any significant change in force posture. By aligning the surveys with key events, the surveys provide greater insight on the specific focus areas. Figure 15 shows the model used for the ANDP conducted in Afghanistan between June 2005 and November 2006. The model incorporates several focus areas from the campaign plan, to include (1) security, (2) reconstruction, (3) governance, (4) justice, (5) democracy, and (6) the ANSF consisting of the Afghan National Army (ANA) and the Afghan National Police (ANP).

<table>
<thead>
<tr>
<th>Surveyor</th>
<th>Time Horizon</th>
<th>Sampling Area</th>
<th>Purpose</th>
</tr>
</thead>
<tbody>
<tr>
<td>Department of State, Office of Opinion Research</td>
<td>Longitudinal</td>
<td>National</td>
<td>Broad topics including Visiting Forces Agreement, Military Engagement and Development efforts</td>
</tr>
<tr>
<td>US Embassy</td>
<td>Temporal</td>
<td>National</td>
<td>Perceptions on topics of &quot;immediate&quot; interest to include major events that have occurred within the previous three to six months</td>
</tr>
<tr>
<td>Southern Philippines Public Perception Survey</td>
<td>Longitudinal (80%)</td>
<td>Mindanao and Sulu Archipelago</td>
<td>Security sector improvements, Philippine Security Forces, Governance and rule of law perceptions</td>
</tr>
<tr>
<td></td>
<td>Temporal (20%)</td>
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<td></td>
<td>Initiated in 2011</td>
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Figure 14. Summary of Survey Efforts by the U.S. Government in the Philippines

<table>
<thead>
<tr>
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<th>Sampling Area</th>
<th>Purpose</th>
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</thead>
<tbody>
<tr>
<td>Department of State, Office of Opinion Research</td>
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<td>National</td>
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<td>Perceptions on topics of &quot;immediate&quot; interest to include major events that have occurred within the previous three to six months</td>
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<td></td>
<td>Initiated in 2011</td>
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The timeline for the model was driven by the National Assembly and Provincial Council of Elections (NAPCE) held in September 2005. The North Atlantic Treaty Organization (NATO) Training Mission - A/Combined Security Transition Command-Afghanistan (NTM-A/CSTC-A) conducted the first survey (ANDP 1.0) prior to the NAPCE to obtain pre-election perceptions. Senior leadership then conducted follow-on surveys to obtain perceptions on the deliverables of the Government of Afghanistan. This is just one example of how to incorporate focus areas and establish a timeline for surveys based on significant events occurring within the country.

5.4 Sample Design – Determine Methods of Surveying

There are several good survey methods. Researchers refer to the most commonly used method as an opinion poll. Using this technique, pollsters interview individuals on various focus areas. Stakeholders predetermine all questions and interviewers ask all questions in the same order and in the same manner. The interviewer has a list of all questions and possible responses to help prompt the respondent.

Other possible techniques used to conduct surveys include sensing sessions and town hall meetings. These techniques usually have predetermined topics and/or question sets to assist in promoting discussion. Researchers/interviewers randomly select city/village residents to attend these sessions/meetings to gain their perspectives on predetermined issues. While these types of techniques provide valuable information that assists the assessment process, their unstructured

Figure 15. Afghan National Development Poll (ANDP) Model

Security theme is link between surveys to allow for trend analysis.

CFC-A assists in shaping of next survey
nature and open-ended discussions may result in disparate data sets that are not identical. More significantly, these sensing sessions/town hall meetings may not allow sufficient time for all attendees to voice their opinions. Furthermore, certain attendees may dominate these venues and influence the comments of others. Other attendees may be uncomfortable voicing their true opinions in a public forum. Additionally, these techniques require one to conduct significant post processing of the data to compare analyses across the various regions or provinces in which the sensing sessions or town hall meetings occur.

After one chooses the survey technique, one should choose a sampling methodology. Professional polling personnel have the expertise to recommend the best polling methodology based on the survey's purpose. In all cases, interviewers should reduce their personal biases to the greatest extent possible. Whether or not one participates as a technical advisor, one should be knowledgeable on the process to ensure that the contracted agency is using the best method for the specific survey. Sampling considerations include:

**Demographics.** In conducting a survey, one should consider multiple demographic factors (e.g., gender, ethnicity, religion, age, sex, tribe, rural versus urban, etc.) in developing one’s survey method. One should determine the desired breakdown for each factor and the correct sample size for statistical significance. Once one determines demographic factors, one should keep the factors the same throughout the entire survey process. This allows one to make comparisons across multiple surveys and avoid complex translations due to varying demographics. If, however, one determines along the way that changing particular demographics would improve the statistical analysis/survey objectives for future iterations, one should make the change(s).

**Random Sampling.** In order to limit the bias associated with surveys, random sampling needs to occur at every level of the survey process, from the selection of towns and cities to the actual people one will interview. Standard selection methods usually suffice; however, there may be times when one needs to consider "non-standard" selection methods, as highlighted in Figure 16 showing a photo of a Badjao (Philippine Sea Gypsy) community. In this instance, standard sampling methods would not capture this community (or other densely populated communities where designated routes/articulated boundaries do not exist).
5.5 Non-standard Sampling Methods

If one uses a contracting agency, one should inspect the survey prior to fieldwork to ensure that the plan comports to the highest standards of analysis.

**Sample Size.** As one would expect, even when a survey controls for demographics and random sampling, there is a trade-space between the sample size and margins of error associated with any opinion poll. This trade-space data (e.g., a 5% margin of error at a 95% confidence level) becomes part of the final report. This means, in non-technical language, that one is 95% confident that the true population proportion lies within a 5% margin of the stated value. While there are many methods for calculating this margin of error (each with underlying assumptions), the most common involves sample size and confidence level, calculated as follows:

\[
\% \text{ Error} = \frac{t_{CL,\infty}}{2\sqrt{\text{sample size}}}\]

where \(t_{CL,\infty}\) is the critical t-value at the desired confidence level with infinite degrees of freedom. For example, consider a sample of 1200 adults, split evenly between males and females. The overall margin of error at a 95% confidence level is:

\[
\frac{1.96}{2\sqrt{1200}} = \pm 2.83\%.
\]

The margin of error for either males or females (assuming a 50% split)
is: \[
\frac{1.96}{\sqrt{600}} = \pm 4\%.
\]
The margin of error for the entire sample of adults – but at the 90% confidence level, is: \[
\frac{1.645}{\sqrt{1200}} = \pm 2.37\%.
\]

5.6 Survey Questionnaire Development

The development of the questionnaire can be the most time consuming process. However, if all members of one’s team hold to the developed model, one can complete this process efficiently and with great success.

ORSAs primarily use surveys to assist in the assessment process of the campaign plan or major operations order. As a result, one should develop the questionnaire based on the assessment metrics of the specific focus area(s) for that survey. One should determine which metrics can best assess survey results and then develop questions to obtain these metrics. One should word each question carefully to ensure the data will provide the desired insights.

One should involve all stakeholders in the question development process. One can use a working group concept to accomplish this. The working group includes all staff members who have a stake in the specific focus area(s) of the survey. Staff members are the subject matter experts in the various focus area(s) and are often responsible for the assessments, objectives, and effects in a given area. One can use brainstorming sessions to develop questions, and the working group can prioritize which questions to include in the survey.

Where possible, one should take advantage of the contracted agency's expertise (e.g., question development, question wording, question construction of various types, and an understanding of relevant cultural considerations). Based on the model selection and the ORSA’s guidance, the contracted agency uses the focus areas to develop a parallel set of questions to that of the working group. The ORSA and the contracted agency then compare and discuss both sets of questions and choose the best questions from each set to include in the final polling model. This process facilitates inclusion of a wide range of questions from both a military and a civilian perspective.

Examples of different types of questions include (1) rank the following from 1 to 10, (2) choose "yes" or "no," (3) single versus multiple response(s), and (4) prompted versus unprompted responses (on a cautionary note, one risks introducing bias into the survey process when one "prompts" answers to questions).

Cultural considerations play a role in the types of questions one includes and the particular words one uses to phrase questions. The contracted agency usually employs HN citizens to assist with cultural considerations. The words one uses to ask a question can make the difference between a majority of "Don’t know" responses and a majority of more useful responses that assist in solving a problem/addressing an issue. For example, the ANDP originally used the word "village" in several of its questions. In the first three iterations of the ANDP, the common response from a majority of females was "Don’t know." During preparation for ANDP 4.0, a member of the contracted agency suggested replacing the word "village" with "Mantaqa" (the
Afghan translation of "Mantaqa" is the "local area around your house"). This small but significant change reduced "Don't know" responses from females.

Reliability and consistency are important factors to consider when developing the survey questionnaire. Question construction should facilitate consistency in responses over a series of topics and survey iterations.

5.7 Survey Implementation and Fielding Process

After one finalizes the survey questionnaire, one should initiate a field test before the actual fieldwork begins. A field test sheds light on the understandability of the questions, determines if any cultural issues are present, isolates questions that provide non-significant insight (e.g., 100% of field test respondents answered "Don’t know" to a specific question), and allows the survey team to adjust, delete, or add questions based on field test results.

Where possible, one should observe and monitor the training of interviewers. Through one’s observations, one increases one’s understanding of cultural issues and survey construction. Additionally, where possible, one should monitor fieldwork to ensure field workers adhere to prescribed standards and methodologies. By monitoring fieldwork, one gains additional information and intelligence; however, one must consider the sensitivity associated with training observation and fieldwork monitoring (a survey agency’s association with CF or groups involved with nation building may place their employees at risk).

5.8 Data Analysis and Report Preparation

One should discuss software requirements with the contracted agency during the initial phase of survey development. This gives one time to acquire additional software if needed. Typically, Excel and SPSS are the primary software programs used in survey analysis. However, the contracted agency may have a software preference (an issue that one should address early in the process).

After the survey takes place and one receives the results, one should begin the analysis. Requests for information (RFIs) from the staff or command may dictate the type of one’s primary analysis. This handbook recommends a basic graphical representation of question responses (both national and provincial) where possible. Figure 17 shows the provincial response (Sulu Island in the Philippines) to the question "What is your primary source of information?" from the second wave of the Southern Philippines Public Perception Survey (SPPPS).
Figure 17. Basic Graphical Representation of Provincial Response

Figure 17 provides an overview of survey results and identifies specific areas that may require further analysis (for example, one may wish to focus on why television responses are high and radio responses are low at the provincial level). One's graphical representation should include a self-explanatory summary of "what the data is saying." For example, in Figure 17 a majority of respondents (63%) rely on word of mouth as their primary source of information.

**Cross Tabulation and Correlation.** One should use cross tabulation and correlation to determine relationships between two or more factors. Cross tabulation is a useful way to partition the data to understand how certain demographic considerations (Question \(x\)) affect others (Question \(y\)). Figure 18 shows an example of cross tabulation conducted to show differences between perceptions of the Government of the Philippines contingent on the confidence in the electoral system. It is an example of cross tabbing used in the SPPPS (March 2012).
Correlation. Correlation quantifies the degree to which two or more factors show a tendency to vary together. In a survey construct, it is useful to see how closely responses to one question follow responses to another. For example, respondents who have strong distrust for the government may also have strong distrust for security sector institutions. Most statistics textbooks include examples of standard and non-standard parametrics to quantify the strength of this relationship.

Comparative Analysis. One should conduct comparative analysis of the findings from one’s survey with the findings of surveys or studies conducted by other agencies/commands (i.e., Provincial Reconstruction Teams [PRTs], Military Training Teams [MTTs], the Asia Foundation, Iraq and Afghanistan HNs, and NATO CF). The Internet is an additional source of country-specific survey results.

By comparing the results of one’s survey with the surveys of others, one validates particular findings and/or determines areas of emphasis that need further analysis due to differing results. Differing results may prompt the need to include additional questions in a follow-on survey for further clarification.

5.9 Summary of Importance of Surveys

Surveys play an instrumental role in the assessment process. They provide an additional data point to help measure the effectiveness of action plans and—more importantly—they are essential in assessing the subjective metrics that one inherently finds in the metric hierarchy associated with campaign plans.

Not all commands fund surveys. If one’s command asks for an assessment of various aspects of the current campaign plan but does not have the necessary funding to accomplish this, one can request support from an ORSA reach-back agency or use open-source data to analyze and compare previous studies conducted by other agencies. Fellow ORSAs are also a great resource.
6 CHAPTER VI: PLANS AND ESTIMATES OF THE SITUATION

6.1 Introduction

Definition. Joint Publication 1-02 (2010) defines plans and estimates of the situation as "a logical process of reasoning by which a commander considers all the circumstances affecting the military situation and arrives at a decision as to a course of action to be taken to accomplish the mission" (p. 103). The estimate of the situation is an ongoing process that begins at the inception of the planning phase and ends at the conclusion of operations. Six principal steps comprise the estimate of the situation:

- Joint Intelligence Preparation of the Battlespace and Mission Analysis
- Development of Friendly Courses of Action
- Analysis of Friendly Courses of Action
- Comparison of Friendly Courses of Action and the Decision
- Development of Plans/Orders
- Transition

Military commanders must continually make decisions. Day in and day out, they and their staffs resolve simple, routine, and complex problems. They apply their knowledge, experience, and judgment using a decision making tool called the Commander’s Estimate of the Situation (CES) (JP 1-02, 2010, p. 57).

General. This chapter highlights specific areas of plans and estimates of the situation where ORSAs can have the greatest impact. ORSAs have a unique skill set to enhance the results.

6.2 Joint Intelligence Preparation of the Battlespace

JIPB is the analytical process used by Joint Intelligence organizations to produce intelligence assessments, estimates, and other intelligence products in support of the Joint Force Commander’s decision making process. Figure 19 illustrates the four steps of JIPB. These steps build upon each other until one has a complete picture of the adversary and battlespace. ORSAs contribute to this process from the onset. During Step 1, one assists with defining the battlespace by determining which databases are available, how reporting feeds into these databases, and how data cycles back for analysis. Assessment tools range from internal databases within the Joint Staff to external HN and government agency reporting systems.
Figure 19. Joint Intelligence Preparation of the Battlefield (JIPB)

During step 2, one can assist with database access and data analysis to help build a Political, Military, Economic, Social, Information, Infrastructure, Physical Environment, and Time (PMESII)/Area, Structure, Capabilities, Organization, People, and Event (ASCOPE) Matrix, as shown in Figure 20. The development of a PMESII/ASCOPE Matrix helps one establish battlespace effects on the population and infrastructure. In step 2, detailed data collection is essential to one’s building a complete battlespace picture for later steps. During Step 3, one’s contributions are crucial to evaluating: (a) the enemy threat, (b) how the enemy uses the civilian population, and (c) enemy threat capabilities. Steps 1 through 3 build upon each other.
The biggest impact an ORSA can have is likely to occur in Step 4. Steps 1 through 3 contribute to Step 4. One should collect information in sufficient detail during steps 1 through 3 to develop feasible enemy COAs in Step 4. From these COAs come priority intelligence requirements (PIRs), intelligence requirements (IRs), and specific intelligence requests (SIRs) that all combine into an intelligence, surveillance, and reconnaissance (ISR) synchronization matrix.

### 6.3 ORSA Contributions

ORSAs play a critical role in this process. Their contributions in evaluating, answering, and assessing PIRs, IRs, and SIRs lay the foundation for the Commander’s Critical Information Requirements (CCIRs).

Once manageable and answerable, one should place PIRs, IRs, and SIRs into an ISR synch worksheet as part of the collection plan (Figure 21). One’s contributions with ISR synchronization and collection management ensure: (a) leaders are using the proper asset, (b) leaders are addressing the correct requirements, (c) leaders are providing the proper format for information reporting, and (d) leaders are using the right databases, e.g., the Common Information Data Network Exchange (CIDNE) or the Distributed Common Ground Station-Army (DCGS-A), to assess whether the intelligence requirements are being satisfied or if there is a need to develop additional PIRs.
CHAPTER VI: PLANS AND ESTIMATES OF THE SITUATION

6.4 The ORSA Role in Mission Analysis

There are eight primary steps to mission analysis (outlined in the sections below). Based on one’s operational background, one can play a significant role in this process. For example, in recent conflicts, ORSAs have conducted analyses to assist in the determination of force allocation. Even with limited operational background, one can contribute in the following ways:

- Identify available forces, assets, and noted shortfalls
- Conduct initial risk assessments
- Measure attitudes of indigenous populations

Based on the intelligence estimate and the objectives of the operations, one can provide comparative analyses on different force selections. These analyses incorporate enemy, friendly, HN, and indigenous force historical data to determine which forces should participate in future operations for the greatest positive gains in each sector. Comparing different force allocations highlights initial risk levels. Comparative analyses highlight the risks associated with the different constructs of the task force employment in future operations.

Joint Publication 2-01.3 (2009) identifies attitudes of indigenous populations as a key factor to consider during mission analysis. This is a key ORSA task.
6.5 Development and Analysis of Friendly Courses of Action

**Development.** Analytical opportunities are limited during this phase; however, one can provide input based on one’s perspective of this process. The analysis conducted in JIPB and during the mission analysis phase impact the development process of friendly COAs.

**Analysis.** One should apply modeling techniques and contribute to the wargaming efforts during this phase. One should contribute to the development, set-up, and conduct of the wargame. Once the wargame is complete, one should conduct post-analysis of the results and provide greater insight to the proposed COA. One should contribute to the analysis of relative combat power during the wargame. This process requires one’s assessment of both tangible and intangible factors, as well as consideration of an inordinate number of those factors, either directly or indirectly affecting the potential outcome of the battle. By analyzing relative force ratios, and determining and comparing each force’s most significant strengths and weaknesses as a function of combat power, one gains insight into friendly capabilities pertaining to the operations, variations in the types of operations from both friendly and enemy perspectives, and the vulnerabilities of the enemy. One should deploy with software and hardware configurations that facilitate wargaming.

In large-scale operations, one can request reach-back support to conduct more detailed computer modeling. The particular reach-back one requests depends on whether or not one has time to use capabilities that are more extensive. CAA uses the Joint Integrated Computer Model (JICM) to conduct analysis of large-scale operations. This capability is available in the COA analysis phase as time permits. Detailed analysis helps identify COA strengths and weaknesses.

6.6 Comparison of Friendly COAs and Decision Making

**Comparison.** During the comparison step, the commander and staff develop and evaluate a list of important governing factors, consider each COA’s advantages and disadvantages, identify actions to overcome disadvantages, make final tests for feasibility and acceptability, and weigh the relative merits of each COA. This step ends with the commander’s selection of a specific COA for further concept of operation (CONOP) development. One can influence this process by:

- identifying governing factors;
- prioritizing governing factors;
- weighting governing factors;
- determining range of values of assigned scores for each governing factor;
- measuring advantages and disadvantages; and
- assessing effects-based operations, i.e.,
  - What are the desired effects?
  - How do we measure them?

**Decision.** Techniques for conducting the comparison vary but all must assist the commander in reaching a sound decision. Planners often use a decision matrix to facilitate this process. This matrix numerically portrays the subjectively chosen and weighted governing factors. One can
influence this process by ensuring that planners use sound principles in applying the range of values and appropriately weighting them.

### 6.7 Development of Plans/Orders

ORSAs can influence this process by ensuring that the desired objectives and effects of the plan are measurable. One should work with planners during this phase to develop metrics (e.g., effects, MOEs, MOPs, and indicators) and assist planners in developing an annex detailing metrics as part of the published order. The published order should also contain an annex detailing the collection plan and the responsible unit/combat element. Planners develop the collection plan in conjunction with the metrics and tie it to the ISR plan. To effectively participate in the planning process and development of the operations order (OPORD), one must understand the commander’s CCIRs, the decision support template, and other planning factors that relate to information gathering, metrics development, and the commander’s decision making process. Once the data are collected, ORSAs play a critical role in conducting the analyses and assessments to determine whether the campaign plan is achieving the desired effects.

It is during this phase that one should develop assessments that will support plans/orders (see chapter 7 for more detail). The assessment (or at least a framework of one) should be created in conjunction with the operational plan during the planning process in order to ensure it is integrated and the operators acknowledge ownership. If this is not done as part of the planning process, the assessment will be regarded as simply another reporting requirement rather than a tool to help the operator assess progress toward his or her objectives.

### 6.8 Transition

Transition is the orderly transfer of a plan or order to those tasked with its execution. An effective transition provides information, direction, and guidance relative to the plan or order, and facilitates situational awareness. Successful transition ensures that those charged with executing the order have a full understanding of the plan. As an ORSA at the strategic command level, one should inform ORSAs at other levels of command of the assessment metrics and the collection plan. Coordination between ORSAs at all levels of command facilitates collaboration, prevents duplication, and enhances sound decision making.

### 6.9 Summary

ORSAs are major contributors to the planning process and estimation of the situation. They assist commanders in their preparation for and execution of combat operations. ORSAs bring a unique skill set and perspective to this process and provide in-depth information to commanders to assist them in their decision making process.
CHAPTER VII: OPERATIONS ASSESSMENTS

7.1 Introduction

The conduct and management of military operations implies the need for assessments. In this context, assessment is a "judgment about something based on an understanding of the situation." In a business context, an assessment might pertain to what an asset is presently worth, whether ongoing business activities are developing as planned, or whether a business venture will achieve a specified goal by some future date. In a military context, an assessment might pertain to the status of friendly and enemy forces, whether friendly forces are performing missions as planned, and whether campaign objectives are achievable.

Joint and Combined Military Campaign Assessments. In the context of a joint and combined military campaign, an assessment is a "process that evaluates changes in the environment and measures the progress of the joint force toward mission accomplishment" (DA Joint Publication 3-0, 2011, p. II-9). Assessments provide commanders with insights to help them make major campaign decisions (e.g., adjust resources, trigger a branch or sequel to an operational plan, or modify operational plans).

When operational and strategic headquarters perform assessments, they often obtain input from a wide range of stakeholders, to include HNs, coalition embassies, and non-governmental organizations (NGOs). As well as informing the commander, these high-level assessments support strategic communications and political decisions relating to national participation in the campaign.

7.2 Performing Assessments in a Combat Theater of Operations

The ORSA Role in Assessments. As stated in DA ATTP 5-0.1 (2011, September 14):

The operations research and system analysis officer conducts analysis in support of operations, across staff elements and forces employed. This officer’s responsibilities include:

- managing, analyzing, and visualizing data using statistical, geospatial, spreadsheets and graphics software;
- developing customized tools for staff elements;
- providing quality control capability;
- supporting course of action analyses and operations planning;
- conducting assessments to determine effectiveness of an operation; and
- conducting analyses to support the military decision-making process (p. 2-23).

As an ORSA on a deployment to a joint or combined command, one usually falls in on an existing assessment staff process and is not required to "invent" an assessment process from scratch. One may find oneself assigned to any of a number of staff sections, including ad hoc inter-agency staff sections where one may or may not participate in a formal assessment process, or one may find oneself in an organization that lacks a necessary assessment process.

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4 Bing.com.
Regardless of one’s assignment, senior leaders expect an ORSA (even if of relatively junior rank) to be the science-minded person in the room who informs the group about things like the scientific process, correlation does not equal causation, etc. Senior leaders expect ORSAs to provide sound military judgment, "put mud on the numbers," and use scientific expertise to provide analytical rigor to and logically organize processes, briefings, and reports.

One should keep in mind that assessments should support the commander’s decision making process. One should take the time to understand what decisions he or she must make, and how assessments can support those decisions.

A joint or combined command often makes incremental changes to its assessment process after completing major periodic assessments (and can make significant or even revolutionary changes when a new commander arrives). Routinely, commanders consult with ORSAs or ask them to prepare these changes in assessment paradigms.

Senior leaders expect ORSAs to be master communicators and play a critical role in communicating assessments effectively. For starters, one must tailor charts and narratives to inform one’s audience (e.g., military leaders, political leaders, or members of the global media). Additionally, one must answer—clearly and in plain English—"after the fact" assessment questions and RFIs from all quarters around the globe.

**Assessment Terminology.** The U.S. military and its NATO/ISAF partners use assessment terminology, to include:

- **Line of Operations (LOO).** "A logical line that connects actions on nodes and/or decisive points related in time and purpose with an objective(s)" (Department of the Army Field Manual [DA FM] 3-24, 2006, p. GL 6).
- **Measures of Performance (MOP).** "A criterion used to assess friendly actions that are tied to measuring task accomplishment" (Department of Defense Joint Publication [DD JP] 3-0, 2011, p. GL 13).
- **Measure of Effectiveness (MOE).** "A metric used to measure a current system state . . . [to help] answer the question 'Are we on track to achieve the intended new system state within the planned timescale'" (NATO Operations Assessment Handbook, 2011, p. 8-34).
- **Indicators.** "[Q]ualitative or quantitative factors/variables that provide simple and reliable means to measure achievement to reflect the changes connected to a campaign intervention, or to help assess the performance of an actor. Indicators describe what is to be measured and enable the commander and his staff to see if progress is being made."

Additionally, each headquarters has its own unique organizational culture and personality. Each headquarters localizes its assessments processes/products and uses terms specific to that headquarters. One has to adapt quickly to local staff processes, procedures, and language in order to be effective. Once one is conversant in the local way of doing things, one assesses the assessment paradigm and works to incrementally improve or even radically change it during one’s tour.

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5 UK Ministry of Defense Joint Doctrine Note 2/12 (Assessment), 3-22 at n.8 (February 2012).
7.3 Sample Assessment Product

In 2011, the ISAF Quarterly Campaign Assessment process focused on six lines of operations (LOOs):

- **LOO 1.** Protect the Population
- **LOO 2.** Develop the Afghan National Security Force
- **LOO 3.** Neutralize Insurgent Networks
- **LOO 4.** Neutralize Criminal Patronage Networks
- **LOO 5.** Support Legitimate Governance
- **LOO 6.** Enable Socio-Economic Development

Each LOO was further broken down into intermediate campaign objectives that included a date by which the coalition/Afghan Security Forces (ASF) should achieve the objective. The ISAF Afghan Assessment Group (AAG) assigned one ORSA per LOO to continuously monitor the LOO progress and draft mid-quarter and quarterly assessments. Various working groups from a variety of ISAF subordinate commands and staff sections staffed and revised these assessment drafts.

The quarterly assessment product consisted of a single standardized PowerPoint chart that presented a color-coded assessment for each intermediate objective within that LOO and for the LOO overall. Each intermediate objective assessment was hyperlinked to one or more back-up charts.

Figures 22 through 29 show some of the LOO 2 assessment products presented at the October 2011 ISAF Quarterly Strategic Campaign Assessment Conference (QSCAC). At the QSCAC, the Commander of ISAF (COMISAF) received and discussed each chart with key leaders. These charts and relevant discussions became the basis for the subsequent Quarterly Strategic Assessment Report (QSAR) submitted up and out of ISAF through the NATO chain of command to the North Atlantic Council (NAC).
Figure 22. Campaign Design Summary
Figure 23. Assessment Framework and Methodology

1. **Is the population safeguarded within security zones?** – Positive
   - Enemy initiated attacks are below (-4%) the seasonal trend pattern in Q2 2011 compared to Q2 2010, while security incidents (+2%) are relatively even to last year; Complex/Coordinated down (-17%)
   - Notable improvements shown in RC-S/RC-SW (TPOR sec ratings); RC-E continues to rise as expected in Q2 2011

2. **Is movement of illicit goods disrupted at priority Border Crossing Points?** – Mixed
   - ABP effectiveness steadily increasing; ABP end strength for Nov 11 target with Q1 2011 attrition rate not achievable
   - BCP cargo inspection capability is the same; current tashkil and current cargo scanning equipment still inadequate

3. **Can people and commerce move freely between the major communities?** – Negative
   - FOM Perception data opposite: Negative trend along ring road/outside mantaq, slight positive trend within district
Figure 24. Develop Afghanistan National Security Forces (ANSF)
Figure 25. Afghanistan National Security Forces (ANSF) Endstrength (1 of 2)
Figure 26. Afghanistan National Security Forces (ANSF) Endstrength (2 of 2)
Figure 27. Growing Pro Afghanistan National Army (ANA) Perception (1 of 3)
Figure 28. Growing Pro Afghanistan National Army (ANA) Perception (2 of 3)
Figure 29. Growing Pro Afghanistan National Army (ANA) Perception (3 of 3)

The QSCAC processes and products used at ISAF in 2011 originally bore resemblance to other assessment processes employed by multi-national commands in Iraq; however, these assessment processes and products had received some military and academic criticism over time. Commentators derided color-coded PowerPoint charts products as "weighted-average ‘roll-ups’ of metrics into . . . ‘stoplight chart[s]’" (Schroden, 2011, p. 95). Additionally, the reliance on "aggregated data" (e.g., color-averaged maps or averaged unit readiness definition levels) to draw insight on overall campaign progress was said to obfuscate the context needed to make useful campaign assessments (Downes-Martin, 2011, p. 105).

Exemplifying the occasion of revolutionary changes to assessments after a new commander assumes command, subsequent to the October 2011 QSCAC, General John R. Allen, apparently agreeing that it was "time for a reset," ordered substantial changes to ISAF assessment processes and products (Schroden, 2011, p. 99). These changes included scrapping the PowerPoint LOO products, and focusing the assessment on progress toward major campaign objectives.

The new decentralized process required major subordinate commands and the Office of the NATO Senior Civilian Representative (SCR) to provide independent assessments and narratives. A 2012 RAND study notes that "importantly, the ISAF in Afghanistan has completely revamped its assessment process, adopting many of the recommendations suggested in this monograph and in other subject-matter expert reports on [Counter-Insurgency] COIN assessment" (Connable, 2012, p. iii).
7.4 Assessment Doctrine

Despite the fact that one typically falls in on existing assessment processes and products, senior military leaders expect ORSAs to be conversant in current official doctrine and academic criticism regarding assessments. The list below, though not exhaustive, comprises a "top 15" list of the most current authorities regarding military campaign assessment and practice:

- **NATO Operations Assessment Handbook** (29 January 2011).
- **UK Ministry of Defense Joint Doctrine Note 2/12** (Assessment) (February 2012).
- **US Army FM 3-24** (Counterinsurgency) (15 December 2006).
- **US ARMY ATTP 5-0.1** (Commander and Staff Officer Guide) (14 September 2011).
- **USAID, Tactical Conflict Assessment and Planning Framework.** (May 2010)
- **Stephen Downes-Martin, Operations Assessment in Afghanistan is Broken** (Naval War College Review, Autumn 2011).
- **Ben Connable, Embracing the Fog of War: Assessment and Metrics in Counterinsurgency** (RAND, 2012).

7.5 Lessons learned from Deployed ORSA Experiences

- The commander must be involved in all aspects of the assessment process, to include review/approval of Effects, MOEs, and the associated indicator list. One should develop the scope and framework with commanders to ensure they get the information in a manner that best allows them to make decisions.
- Consider the right balance between "art" and "science."
- Commanders make decisions regarding risk. The commander should understand (1) what the risk assessment is based on and (2) what relevant data one was not able to collect.
- Staffs must have a plan to record and implement commander decisions. Staff officers should codify results into fragmentary orders (FRAGOs), changes to CCIRs, etc.
- Coordinating the execution of an assessment is hard work. Data collection, database management, and review of indicators require a substantial and long-term time commitment from the staff.
- Including external information in the assessment adds depth.
- Multiple presentation techniques exist. One should study academic critiques of assessments and look at what other commands are currently doing. Ultimately, it is a commander’s
assessment; therefore, one should engage the commander early on and find out what the commander wants to see.

- Deployed ORSA participation in assessments varies widely. Some ORSAs have led the process for their commands. Others have performed database management roles. Most have participated in evaluating MOEs and MOPs for their commands.
- A commander’s area of interest is larger than his or her area of influence. The U.S. Department of Defense (DOD) will not have the lead on creating all of the effects necessary to achieve strategic objectives. Interagency, multi-national, HN officials, and NGOs should participate as required.
- One’s collection plan identifies what blue, green, and red information is required.
- One should maintain consistency in both what one collects and how one collects it over time.
- Assessments require permanent, dedicated cells; one cannot do this with ad hoc teams.
- Employ contextual assessment approaches to hedge the risk of data aggregation obscuring local insights relevant to the overall campaign (Connable, 2012).
- Consider including lower headquarters’ and especially contrarian’ narratives from within or outside the command in the command’s published assessments (Connable, 2012).
- How does one know that the assessment is useful?
  - It passed the "so what" test;
  - The process continued;
  - The leadership provided their input into the development of the process;
  - The leadership attended the assessment presentation;
  - Commanders issued directives and orders as a result;
  - One was able to get out in front of events; and
  - One provided timely analysis.
- ORSAs should continually emphasize the importance of command and staff responsibilities in the development and execution of the assessment plan, to include the provisioning of data and reporting of progress toward achieving respective objectives assigned by the commander.
- The assessment process should be developed incrementally, interactively, and iteratively.
- A terms of reference list should be developed early in the assessment process for clarity of metrics.
8 CHAPTER VIII: GEOSPATIAL ANALYSIS

8.1 Introduction

Definition. Geospatial analysis is an approach for applying statistical analysis and other informational techniques to geographically based data. Simply put, geospatial analysis is the use of maps and map-like graphics to portray statistical analysis.

The Purpose of Geospatial Analysis. Geospatial analysis can be an effective method for showing data (pictures are often easier to understand than complicated tables, charts, and graphs). Used appropriately, geospatial analysis can summarize large quantities of data clearly and concisely. One should consider using a map-based view of data whenever it would add value to the analysis and improve understanding. This chapter includes several examples to show the advantages of this technique.

8.2 Geospatial Software and Its Uses

Geospatial analysis is a powerful tool that complements other types of analysis. There are several geospatial software packages currently used by ORSAs, to include (1) ArcGIS, (2) FalconView, and (3) Web-Enabled Temporal Analysis System (WEBTAS; commonly used with the Combined Information Data Network Exchange [CIDNE] database). These tools allow one to plot data to obtain a spatial relationship between the data. Each of the aforementioned software programs has different capabilities, strengths, and weaknesses, and one can use any combination of them to conduct geospatial analysis effectively. As long as one has at least one of these software programs available, one has sufficient tools to conduct geospatial analysis. These software packages enable one to plot densities, conduct clustering of specific incidents, and create impressive presentations. For example, WEBTAS allows one to create a "video" of incidents. By specifying the type of incident to plot spatially and specifying amount of time for the icon to remain on the screen, WEBTAS presents the change in incident pattern both spatially and over time. This technique requires a fair amount of expertise but is very useful in analysis.

8.3 Examples of Geospatial Analysis

Geospatial analysis has played an important role in analysis and assessments in Iraq, Afghanistan, the Philippines, the Horn of Africa, and elsewhere. Common themes used in-theater include density of attacks, density of populations, MEDEVAC response times, trafficability of routes, district assessments (security, governance, development, and overall), and polling data representation. One can display the data geospatially to improve the commander's situational awareness. The following are examples of real-world geospatial analysis:

Napoleon’s march to Moscow. Figure 30 shows how Charles Minard used geospatial analysis in 1869 to portray Napoleon's 1812 Russian campaign: troop losses, troop movements, and even ambient temperature.
Minard represents the numbers of men present by the widths of the colored zones at a rate of one millimeter for every ten-thousand men. Minard uses the color brown to designate the men who entered into Russia and the color black to designate the men who leave Russia. Minard includes a scale on the center-right, in "lieues communes de France" (common French league), which is 4,444m (2.75 miles). Minard clearly shows the attrition of Napoleon’s force over time, beginning with a starting strength of 422,000 men crossing the Neman River in June 1812 and ending with a final strength of 10,000 men who survive to cross back over the Neman in December 1812.

Minard has the lower portion of the graph read from right to left. He shows the temperature during the army's return from Russia in degrees below freezing on the Réaumur scale (multiply Réaumur temperatures by 1¼ to get Celsius, e.g. −30°R = −37.5 °C). The entire return march across Russia takes place in sub-zero temperatures.

All together, Minard uses six separate variables: (1) line width continuously marks the size of the army; (2) latitude and (3) longitude of the army as it moves; (4) lines showing the direction the army travels—both in advance and in retreat—including terrain obstacles encountered; (5) location of the army with respect to certain dates (including the battles fought); and (6) temperature along the path of retreat. While very difficult to construct, this figurative map clearly shows the attrition of Napoleon’s force between 24 June 1812 and 14 December 1812. The variables depicted (distance, terrain, combat, and temperature) were each instrumental in the force’s failure. Together, Minard uses these variables to tell the story of Napoleon’s force-attribution over the 6 months of the campaign.

MEDEVAC Coverage in Afghanistan. Figure 31 shows notional MEDEVAC event data and helicopter response times created with ArcGIS. The shading represents the various response times, and the red dots represent the notional MEDEVAC events. This depiction allows the

6 See http://en.wikipedia.org/wiki/Napoleon%27s_invasion_of_Russia#March_on_Moscow
commander to identify quickly where there is coverage saturation as well as where coverage is non-existent.

Figure 31. MEDEVAC Coverage

Figure 31 depicts medical treatment facilities, aircraft bases, and locations for MEDEVAC events during a specified period. The colored ovals depict the helicopter response times in (1) less than 60 minutes, (2) 60-90 minutes, (3) 90-119 minutes, and (4) greater than 120 minutes. Every minute is critical for the injured patients, and this map provides a great snapshot of the MEDEVAC challenge.

This type of representation is especially useful to a planner who is considering a large operation that requires significant MEDEVAC. By identifying potential areas of inadequate coverage, the planner can work with MEDEVAC units to reposition assets for the operation in a way that ensures timely MEDEVAC.

District Assessments. Deployed ORSAs have used geospatial analysis extensively in Afghanistan, especially for the District assessments. As of this writing, the ISAF Joint Command (IJC) continues to assess progress in the Afghan districts to determine the success or failure of the campaign.
Figure 32. District Assessments in Afghanistan

In Figure 32, the briefer shows the district overall ratings on a terrain map of Afghanistan. The districts that are not colored are areas that the IJC does not currently assess. This map depicts the major road network (black line) and key border crossings (small orange circles) to help identify potential areas of concern for transportation/commerce and border security.

One can use maps like this one to display data to give one’s commander a quick snapshot of the overall situation to assist him or her in identifying successes and areas of concern. A similar map could also be used to show the governance, development, or security rating for the districts (the three areas that the IJC assessed in 2010). While a simple map does not explain the entire situation, it does provide the commander with a clear picture of the current assessment in his or her area of responsibility (AOR). It is highly recommended that more detailed, narrative assessments are completed and briefed to the commander in addition to graphics like this. While this graphic gives a snapshot of the AOR, it does not explain the situation behind the rating. It is best used as a supplement to the more complete narrative explanation.

Polling Data. Geospatial analysis can show public perceptions, changes in perceptions over time, areas where polling is used, etc.
Figure 33. Map of Areas Polled in the Philippines

Figure 33 highlights the Basilan Island areas that contractors polled for waves 1 and 2 of the SPPPS. In this example, the deployed ORSA uses this map to show the commander which areas were polled so that he can analyze the areas, ask questions as to why or why not a particular area was included in the poll, and make decisions about future iterations of the poll. Geospatial products like this one are easy to construct (from skills taught in the ArcGIS fundamentals course for ORSAs) and are very easy to understand (for ORSAs and non-ORSAs alike).

8.4 Summary

Geospatial analysis is an essential tool to add to one’s toolkit. It is an effective visual way to display multiple kinds of data in a multi-dimensional format. Used creatively, one can display multiple variables to facilitate better situational awareness for his or her commander and staff. The examples used here are only several in a range of applications. For additional examples or further assistance, one can contact the Geospatial Intelligence section of his or her command or the CAA Operations Analysis (OA) reach-back team.
CHAPTER IX: A REAL-WORLD EXAMPLE OF STATISTICAL ANALYSIS

9.1 Purpose

This chapter provides an example of descriptive statistics and a t-test to analyze aspects of battlespace transition.

9.2 Background

In both OEF and OIF, CF have turned battlespace over to HN security forces. ORSAs have conducted assessments prior to these transitions to determine if conditions were favorable for this to occur. ORSAs have conducted follow-on analyses and assessments to determine the effectiveness of the battlespace transition. The following example uses a real-world situation with notional data to present the use of statistical analysis in conducting battlespace transition assessment.

9.3 Problem

Senior leaders made an assertion that there were fewer attacks after battlespace transition. The commander asked the ORSAs for analysis to provide insight in reference to this assertion.

9.4 Formulation

The ORSAs began the analysis by conducting data mining and cleaning to obtain the average monthly attack data for the specified battlespace (province). Once mining and cleaning of the data was complete, ORSAs calculated the descriptive statistics for two periods: (1) before the transition of battlespace, and (2) after the transition of battlespace. Figure 34 shows the "descriptive statistics" results from Excel for the number of attacks in both periods.

<table>
<thead>
<tr>
<th></th>
<th>Before Transition</th>
<th>After Transition</th>
</tr>
</thead>
<tbody>
<tr>
<td>Mean</td>
<td>127.92</td>
<td>101.11</td>
</tr>
<tr>
<td>Standard Error</td>
<td>2.41</td>
<td>2.38</td>
</tr>
<tr>
<td>Median</td>
<td>128.4</td>
<td>100.99</td>
</tr>
<tr>
<td>Mode</td>
<td>NA</td>
<td>NA</td>
</tr>
<tr>
<td>Standard Deviation</td>
<td>12.27</td>
<td>12.13</td>
</tr>
<tr>
<td>Sample Variance</td>
<td>150.56</td>
<td>147.04</td>
</tr>
<tr>
<td>Kurtosis</td>
<td>-1.19</td>
<td>-1.29</td>
</tr>
<tr>
<td>Skewness</td>
<td>-0.29</td>
<td>0.11</td>
</tr>
<tr>
<td>Range</td>
<td>38.46</td>
<td>37.49</td>
</tr>
<tr>
<td>Minimum</td>
<td>106.2</td>
<td>83.94</td>
</tr>
<tr>
<td>Maximum</td>
<td>144.66</td>
<td>121.43</td>
</tr>
<tr>
<td>Sum</td>
<td>3325.86</td>
<td>2628.75</td>
</tr>
<tr>
<td>Count</td>
<td>26</td>
<td>26</td>
</tr>
</tbody>
</table>

Figure 34. Descriptive Statistics for Two Periods
The difference in the means provides insight that the stated assertion might be true, but the ORSAs need to conduct an appropriate test to determine whether there is statistical significance between the observed means for the two periods (understand that this is automatic output from the Analysis ToolPak). Data analysis does not always have hard and fast rules. In particular, ORSAs look at whether or not the data are skewed; whether — given the data presented — the range is large; whether the median is close to the mean; whether the sample size is large enough to imply a normal distribution; and, whether the data appear normal. ORSAs may claim that the test for normality is met when, in fact, verification of that claim requires additional rigor, e.g., Anderson-Darling Test and Empirical Distribution Function.)

In this case, based on the underlying normal distribution for the datasets, one appropriately uses a t-test to determine the statistical significance of the mean comparison (if the underlying distribution does not appear to be normal, one should conduct a non-parametric test). Figure 35 provides a guideline concerning when to apply parametric versus non-parametric tests.

<table>
<thead>
<tr>
<th>Level of Measure</th>
<th>Sample Characteristics</th>
<th>Correlation</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>1 Sample</td>
<td>2 Sample</td>
</tr>
<tr>
<td></td>
<td>Independent</td>
<td>Dependent</td>
</tr>
<tr>
<td>Categorical or Nominal</td>
<td>$\chi^2$ or binomial</td>
<td>$\chi^2$</td>
</tr>
<tr>
<td>Rank or Ordinal</td>
<td>Mann Whitney U</td>
<td>Wilcoxon Matched Pairs Signed Ranks</td>
</tr>
<tr>
<td>Parametric (Interval &amp; Ratio)</td>
<td>z test or t test</td>
<td>t test between groups</td>
</tr>
<tr>
<td></td>
<td>Factorial (2 way) ANOVA</td>
<td></td>
</tr>
</tbody>
</table>

**Figure 35. Parametric vs. Non-Parametric Tests**

### 9.5 Statistical Test

**T-test (hypothesis testing).** The t-test considers the null hypothesis that the means of two normally distributed populations are equal. Given two data sets, ORSAs use a t-test to determine whether the means are different or whether one is less or greater than the other.

**Analysis.** Using the Excel built-in functions in the Analysis ToolPak add-in is a simple and quick way to conduct different t-tests. In this case, ORSAs conduct a "two-sample t-test with unequal variances" (with variances previously calculated in the descriptive statistics). In choosing to use this test, ORSAs assume that the sample sizes from both periods are sufficiently large. In some statistics texts, this number is subject to interpretation, but for this example, 26 is large enough. Figure 36 shows the Analysis ToolPak output.
### Figure 36. Excel Output for t-test

The small probability value (p-value) of the two-tailed t-test indicates that there is strong evidence that the means of the two periods are different. In the context of this example, there is significant evidence that the monthly average number of attacks is different after transition. To prove that the monthly average number of attacks is less than the hypothesized mean, ORSAs look at the one-tailed p-value. In this case, there is significant evidence that the monthly average number of attacks is less after transition. The p-value of a statistical hypothesis test is the probability that the monthly average number of attacks is the same in a random sample of the population. In this case, the likelihood of getting the same averages is extremely small.

Based on the results of the t-test in this example, ORSAs conclude that there is a statistical difference between the means for the two periods. This analysis supports the commander’s assertion that there are fewer attacks after the transition of battlespace.

### 9.6 Summary

The example in this chapter provides a method to conduct a statistical analysis project. One begins with descriptive statistics and often includes some type of graphical representation of the data to gain insights prior to conducting analysis. This example uses notional data of a real-world project conducted in theater that provided analytical rigor to an assertion made about battlespace transition. Other RFIs generated in theater that prompted the use of a statistical test included: counter-IED activity; forward operating base (FOB) closures with respect to attack activity; ISR assets; effect of physical obstacles; and the ‘surge’ of forces.
10  CHAPTER X:  REACH-BACK CAPABILITIES

10.1  Why Reach-back?

Generating Force (i.e., Institutional Army) analytical organizations provide analyses through an integrated combination of embedded ORSAs—either assigned or attached to Army, Joint, and Multi-National headquarters—and through analytical reach-back support (also known simply as "reach-back"). Operations Research/Systems Analysis is vital in reducing commanders' uncertainty through sound reasoning and well constructed analytical models. Reach-back allows ORSAs serving at Division, Corps, Army Service Component Commands (ASCCs), and Multi-National Command headquarters in deployed environments to draw upon resources and capabilities of Generating Force organizations and institutions whose primary mission is to generate and sustain the Operational Army’s capabilities for employment by Joint Force commanders (DA FM 1-01).

As a deployed ORSA, one applies logical reasoning and sound processes to solve highly complex problems at the operational and strategic levels when no readily apparent solutions exist. One applies analytical methods to perform trade-off analysis, compare courses of action, allocate critical resources, and assess operational effectiveness. These methods are an integral part of Army and Joint leadership decision making processes to organize, staff, train, equip, sustain, and resource current and future forces. One conducts analyses using one’s personal talents and skill set unless the complexity and scope of a given problem require additional resources (Department of Defense Directive [DoDD] No. 2000.19E).

10.2  Motivational Factors for Reach-back

Integration of Analytical Effort. Reach-back connects Operational Army analytical efforts to Generating Force organizations. This connectivity ensures analytical relevance along with greater capability within the operational headquarters. Specifically, reach-back provides visibility of critical analytical requirements to Generating Force organizations. Additionally, this connectivity captures institutional knowledge for future deploying ORSAs.

Subject Matter Expertise. Generating Force organizations possess a wide array of expertise. Given the limited number of deployed ORSAs and the complexity of emerging issues, reach-back provides one with a valuable mechanism for expanding one’s expertise and analytical capabilities. Furthermore, organizations that provide reach-back are frequently staffed with ORSAs who have or will deploy. This provides important continuity for analytical support to theater commanders.

Additional Data. Reach-back expands available data and offers contextual reference for theater-specific analytical problems.

Analytical Review Process. Reach-back provides a natural review process for analytical efforts. Through collaborative reach-back and Generating Force organizational capabilities, multiple personnel and organizations review reach-back analytical products. While the review process requires more time, it ensures high quality products.
Analytical Tools. Reach-back provides one with access to sophisticated tools and additional expertise. Figure 37 is an example of a charting and mapping tool developed by a reach-back team — the Afghanistan Consolidated Knowledge System (ACK-SYS) Polling Analysis Tool (ASPAT) — used to perform analysis across waves of a single survey (longitudinal). This tool enables one to select a question and corresponding answer choice at multiple geographic resolutions (e.g., National, Regional Command, and Provincial).

![Charting and Mapping Tool](image)

**Figure 37. Specialized Reach-back Tool**

Required Surge Capability. The connection between Operational Army commands and Generating Force organizations, enabled by reach-back, allows for analytical surge capability as required. For example, from the onset of OIF and OEF, CAA, TRAC, AMSAA, and the United States Military Academy (USMA) provided Deployed Analyst Support Teams (DASTs) to ASCCs in Iraq and Afghanistan. A recent change in U.S. military operational focus has resulted in these organizations expanding their analytical support to commands located in additional geographic locations (e.g., the Philippines and Africa).

**10.3 Reach-back Considerations**

Timeliness. Deployed Operational Army and Joint Headquarters (HQ) generally operate 7 days a week/12-14 hours a day. An analytical request to/from these headquarters often has a quick-turn suspense that requires an answer within a few hours or days. Generating Force organizations must adapt to these "quick-turn" requirements. Deployed ORSAs must adapt to
the environment within which Generating Force organizations operate. This environment requires a detailed, time-intensive, review process to ensure a high quality product.

**Confidentiality of Derived Analysis.** Generating Force organizations are customer-focused. They must obtain Operational Army Command release authority before disseminating derived analytical products. This release protocol ensures customer confidentiality in what often concerns contentious issues.

**Organizational Capabilities.** One should become familiar with the capabilities of Generating Force organizations. This familiarity enables one to incorporate current organizational efforts and understand where a problem solution may reside.

**Contextual Reference.** One must clearly articulate one’s analytical requirements when requesting reach-back support. A well-articulated request ensures that reach-back personnel address the problem within the context of other competing issues such as time constraints, level of model sophistication, and the essential elements of analysis.

### 10.4 Reach-back Support Topics

Generating Force analytical support to the current fight has thus far included campaign plan assessments, casualty analyses, theater campaign modeling and analyses, force-on-force analyses, stability and support operations analyses, and weapon systems analyses. ORSA topics span doctrine, organizations, training, materiel, leadership, personnel, and facilities (DOTMLPF). Examples of reach-back support topics include:

- **Campaign plan assessments.** Campaign plan assessments include the development of appropriate MOEs and MOPs.
- **Casualty analyses.** Casualty analyses include efficacy of personal equipment and implications for operating force TTPs.
- **Theater campaign modeling and analysis.** Theater campaign modeling focuses on the Joint and Combined operational/strategic environment. These models incorporate weapons effectiveness data, unit formations, and current war plans in support of campaign analyses. Additionally, air and missile defenses, along with weapons of mass destruction (chemical, biological, radiological, and nuclear), are analyzed at the tactical, operational, and strategic levels of war. The Total Army Analysis (TAA) process uses analytical output to determine future force requirements for the Army.
- **Force-on-force modeling and simulation.** Generating Force ORSAs develop and maintain a class of warfighting force-on-force models and simulations (M&S) ranging from individual objects (e.g., Soldiers, weapons, terrain features) to theater level models that often aggregate objects (e.g., battalions) at Corps level. AMSAA leads Army efforts in modeling platform performance parameters. TRAC focuses on Corps and below force-on-force combat models while CAA conducts theater-level campaign analysis. Collectively, these models are widely used by DOD, industry, and allied nations.
- **Stability and support operations.** Generating Force Operations Research/Systems Analysis organizations contribute to stability operations with a variety of analytical products (e.g., campaign plan assessment methods development, convoy protection analysis, sensor
placement recommendations, basing analysis, medical asset allocation recommendations, new materiel fielding and utilization analysis, Intelligence Preparation of the Battlefield [IPB] assistance, attack pattern analysis, economic forecasting, and force structure/size recommendations). The foregoing ORSA capabilities assist in promoting a secure environment and aid in diplomatic and economic programs designed to eliminate root causes of instability. These contributions complement and reinforce overall Stability and Support Operations (SASO).

- **Weapon Systems analysis.** Weapons Systems analysis enables an understanding of the system, its functions, performance and effectiveness measures, and operational criteria. The ORSA community can provide a comprehensive assessment of the impact of a given friendly or enemy weapons system on the operational environment. The Army Test and Evaluation (ATEC) Command is one Generating Force organization with keen weapon systems insights.

- **Programmatic analysis.** The cost of campaigns and major operations strongly affects domestic support and helps determine success or failure of a given mission. ORSAs aid in decision making with analysis of logistics, force structure, and mobilization/deployment simulation modeling. These projects include force closure estimates, resources for mobilization/deployment data, lift asset requirements, pre-positioning recommendations, and high-level quick-turn COA analysis. ORSAs conduct estimations of support forces (i.e., combat support and combat service support) requirements and casualty analysis, develop wartime Class V and Class VII requirements, and compare theater logistics requirements with capabilities.

### 10.5 The Reach-back Process

**General.** Each Generating Force organization manages its respective reach-back mechanisms independently. CAA conducts an informal biweekly interagency meeting with deployed ORSAs in an effort to coordinate reach-back efforts. While there is an effort to consolidate and formalize reach-back contributions from Generating Force organizations, this chapter focuses on the overall reach-back process.

**Communication Methods.** Deployed ORSAs and Generating Force organizations communicate using the Defense Switched Network (DSN), commercial telephone, Non-secure Internet Protocol Router Network (NIPRNET), Secret Internet Protocol Router Network (SIPRNET), Video Telephone Conference (VTC), Information Work Space (IWS), and other means beyond the scope of this chapter. Periodic communications ensure established relationships between deployed ORSAs and their respective organizations. Unclassified contact information for the most commonly requested reach-back Generating Force organizations follows:

- **Army Logistics University (ALU) College of Professional and Continuing Education/Department of Systems Engineering.** Available from http://www.almc.army.mil; Commercial: (804) 765-4710/4991/4553 or DSN (539) 4710.

- **Army Materiel Systems Analysis Activity (AMSAA).** Available from http://web.amsaa.army.mil; Commercial (410) 278-6614 or DSN (298) 6614.

- **Army Test and Evaluation Command (ATEC).** Available from http://www.atec.army.mil; Commercial (443) 861-9999 or DSN (848) 9999.
10.6 Knowledge Management

Concept. The U.S. Army ORSA community provides a centralized reach-back Team, trained and equipped to coordinate effective and timely analytical contributions to U.S. Army ORSAs who are serving within deployed elements of an operational headquarters (e.g., Division/Corps/ASCC/Echelons above Corps [EAC]/Joint/Combined). CAA OA Division—with participating Generating Force organization assistance—maintains a website (focused on current operations) on Army Knowledge Online – Secret (AKO-S) to facilitate deployed ORSA operations and analytical reach-back support. This website is available to anyone possessing an AKO-S account.

Vision. The CAA OA Division Current Operations Team website identifies, creates, represents, and distributes knowledge for reuse, thereby enabling awareness and learning—with specific emphasis on current operations support—across the ORSA community. Key objectives of this site include shared intelligence, improved performance, competitive advantage over adversaries, and higher levels of innovation.

Structure. Figure 38 shows the general structure of the CAA Current Operations Team AKO-S website, available from https://www.caa.army.smil.mil/OCA/index.htm. CAA designed this website to facilitate coordination between analytical agencies and deployed ORSAs regarding reach-back and Irregular Warfare (IW) projects and data issues. Featured information includes CAA biweekly Current Operations meeting agendas, DAC details, organization points of contact (POCs), request forms for reach-back support, and contact information for all known deployed ORSAs.
10.7 Formulating Reach-back Problems

In general, Generating Force organizations should adapt to the requirements of deployed ORSAs, especially in terms of the timeliness of derived products. To aid Generating Force organization endeavors, inquiries for reach-back support should include the following information in as much detail as possible:

- **Problem Statement.** One should provide a clear definition of the problem along with essential elements of analysis. In particular, what question should reach-back answer? One should provide a description of all assumptions related to the problem. If possible, one should describe potential modeling methods.

- **Problem Background.** One should explain factors/issues bearing on the problem. This guides one’s literature review and provides insight to reach-back personnel. One should describe the ultimate customers and how this reach-back effort supports their decision.

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7 Available at https://caa.army.smil.mil/OA/index.htm
making process and how it relates to other theater efforts (i.e., issues surrounding the analysis).

- **Data.** One should provide data or recommendations on how to generate/obtain the data necessary for the analysis.

- **Timeline and suspense.** One should specify desired completion dates and the impact of delayed analysis (details on intermediate milestones aid in project management and ensure customer satisfaction).

- **Communications.** One should establish recurrent communication with the supporting agency via the CAA Current Operations Team website on AKO-S and other communication tools (e.g., SIPRNET).

- **Releasability.** One should specify how and when the customer may release derived analytical products. Analytical organizations must maintain customer confidentiality; however, release of analytical products of current issues and trends—where possible—furthers understanding within the ORSA community.

### 10.8 Coordinating Intra-/Inter-Theater Reach-back Efforts

**Documenting Analyses.** Proper documentation of ongoing and completed analyses provides an initial start point for new analysis and reduces duplication of efforts. The CAA Current Operations Team asks deployed ORSAs to provide a concise briefing (normally 1 or 2 slides) on a biweekly basis to the CAA Current Operations meeting. This meeting focuses on current ORSA projects, ongoing reach-back projects, and other miscellaneous activities that support the warfighter. One should post one’s updates on the CAA OA Current Operations AKO-S website prior to each biweekly meeting, thus providing an efficient mechanism to inform other Generating Force organizations and deployed ORSAs on current efforts.

**Sharing Data.** The collaborative site on AKO-S provides a mechanism for sharing data sources. Expertise within Generating Force organizations alleviates many of the issues with data storage and analysis. Data management and analysis continue to be a source of reach-back contributions.

**Recurrent Coordination Meetings.** Recurrent meetings provide coordination and collaboration between Generating Force organizations and deployed ORSAs. Continued support of formal and informal coordination meetings enables effective collaboration.

**Knowledge Management.** The CAA OA Division Current Operations website provides a mechanism to manage creation, identification, accumulation, and application of knowledge for the Operations Research (OR) community. This effort brings together inherent intellectual capital.

### 10.9 Generating Force Reach-back Organizations and Their Respective Missions

**Army Materiel System Analysis Agency (AMSAA).** AMSAA provides responsive systems analysis to inform decision making for equipping and sustaining weapons and material for Army Soldiers in the field as well as for future Army forces. AMSAA is committed to giving the Soldier decisive capability to win across the spectrum of future military operations, providing
analytical expertise to help guide the Army in selecting, acquiring, fielding, and sustaining new technologies, and developing the ORSA workforce of the future.

**Army Test and Evaluation Command (ATEC).** ATEC plans, conducts, and integrates developmental testing, independent operational testing, independent evaluations, assessments, and experiments to provide essential information to Soldiers and acquisition decision makers supporting the U.S. military warfighter.

**Center for Army Analysis (CAA).** CAA supports DA and its major subordinate commands with analyses of Army forces and systems within the context of joint and combined warfighting. CAA analyzes strategic concepts and military options and estimates requirements to support Army input to the Planning, Programming, Budgeting, and Execution System (PPBES). CAA evaluates: (1) the Army’s ability to mobilize and deploy forces, (2) Army force capabilities, (3) force alternatives, and (4) theater force level scenarios and resource analyses.

**Marine Corps Combat Development Command (MCCDC).** MCCDC develops fully integrated Marine Corps warfighting capabilities, including doctrine, organization, training and education, materiel, leadership, personnel, and facilities, to enable the Marine Corps to field combat-ready forces.

**Training and Doctrine Command Analysis Center (TRAC).** TRAC serves as the principal analytical organization of TRADOC and provides centralized leadership and management of analysis for combat, training, and doctrinal developments, while unaligned with TRADOC proponents. TRAC conducts studies and analyses for TRADOC and Headquarters, Department of the Army (HQDA); conducts studies of the integrated battlefield related to doctrine, organization, training, materiel, personnel, and leadership; designs and develops models and simulations (M&S) for capabilities development; participates in technical exchange programs at the national and international levels; provides analytical support to Army Capabilities Integration Center (ARCIC), Centers of Excellence (CoEs) and schools; directs research related to methods, models, tools, and analysis; establishes, maintains, and manages the databases, scenarios, models, and wargaming tools required to support analyses and studies; and reviews and ensures, as directed, the quality of TRADOC studies before their approval.

**Non-ORSA Generating Force organizations.** The following Generating Force organizations also provide relevant information to many ORSA efforts:

- **National Ground Intelligence Center (NGIC).** NGIC produces all-source integrated intelligence on foreign ground forces and supports combat technologies to ensure that U.S. military forces and other decision makers always have a decisive edge on the battlefield.

- **Joint Improvised Explosive Device Defeat Organization (JIEDDO; available from https://www.jieddo.dod.mil).** JIEDDO focuses (i.e., leads, advocates, coordinates) all Department of Defense (DOD) actions in support of Combatant Commanders and their respective Joint Task Forces to defeat Improvised Explosive Devices (IEDs) as weapons of strategic influence (DoDD No. 2000.19E).
10.10 Summary of Reach-back

Reach-back augments deployed ORSA productivity and skills by providing greater resources and capabilities. Formalization of the reach-back process captures best practices and increases coordination between Generating Force organizations.
## APPENDIX A  LIST OF ACRONYMS

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<tr>
<th>Acronym</th>
<th>Description</th>
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<tbody>
<tr>
<td>AAG</td>
<td>Afghan Assessment Group</td>
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<tr>
<td>ACK-SYS</td>
<td>Afghanistan Consolidated Knowledge System</td>
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<td>ACOM</td>
<td>Army Command</td>
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<tr>
<td>AKO-S</td>
<td>Army Knowledge Online - SIPRNET</td>
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<tr>
<td>AMSAA</td>
<td>Army Materiel Systems Analysis Activity</td>
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<td>ANA</td>
<td>Afghanistan National Army</td>
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<td>ANDP</td>
<td>Afghan National Development Poll</td>
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<td>ANP</td>
<td>Afghanistan National Police</td>
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<tr>
<td>ANSF</td>
<td>Afghanistan National Security Forces</td>
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<td>AO</td>
<td>Area of Operations</td>
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<td>AOR</td>
<td>Area of Responsibility</td>
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<tr>
<td>ArcGIS</td>
<td>Arc Geographic Information System</td>
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<td>ASCC</td>
<td>Army Service Component Commands</td>
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<tr>
<td>ASCII</td>
<td>American Standard Code for Information Interchange</td>
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<tr>
<td>ASCOPE</td>
<td>Area, Structure, Capabilities, Organization, People, and Event</td>
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<td>ASF</td>
<td>Afghanistan Security Forces</td>
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<td>ASPAT</td>
<td>Afghanistan Consolidated Knowledge System Polling Analysis Tool</td>
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<td>ATEC</td>
<td>Army Testing and Evaluation Command</td>
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<td>CAA</td>
<td>Center for Army Analysis</td>
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<tr>
<td>CCIR</td>
<td>Commander's Critical Information Requirements</td>
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<td>CERP</td>
<td>Commanders Emergency Response Program</td>
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<tr>
<td>CES</td>
<td>Commander’s Estimate of the Situation</td>
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<td>CF</td>
<td>Coalition Forces</td>
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<td>CFC-A</td>
<td>Combined Forces Command – Afghanistan</td>
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<td>CIDNE</td>
<td>Combined Information Data Network Exchange</td>
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<td>CIO</td>
<td>Chief Information Office</td>
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<tr>
<td>CJSOTF-A</td>
<td>Combined Joint Special Operations Task Force - Afghanistan</td>
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<td>CJTF-HOA</td>
<td>Combined Joint Task Force – Horn of Africa</td>
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<tr>
<td>CLA</td>
<td>Constraints, Limitations, and Assumptions</td>
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<tr>
<td>COA</td>
<td>Course of Action</td>
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<td>COEs</td>
<td>Centers of Excellence</td>
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<td>COIN</td>
<td>Counter Insurgency</td>
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<td>COMISAF</td>
<td>Commander of International Security Assistance Force</td>
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<tr>
<td>CONOP</td>
<td>Concept of Operation</td>
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<td>CSTC-A</td>
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<td>DA</td>
<td>Department of the Army</td>
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<td>DA FM</td>
<td>Department of the Army Field Manual</td>
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<td>DA PAM</td>
<td>Department of the Army Pamphlet</td>
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<td>DAC</td>
<td>Deploying Analyst Course</td>
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<td>Abbreviation</td>
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<td>Deployed Analyst Support Team</td>
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<td>Distributed Common Ground Station – Army</td>
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<td>DD JP</td>
<td>Department of Defense Joint Publication</td>
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<td>DOD</td>
<td>Department of Defense</td>
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<tr>
<td>DODD</td>
<td>Department of Defense Directive</td>
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<tr>
<td>DOTMLPF</td>
<td>Doctrine, Organizations, Training, Materiel, Leadership, Personnel, and Facilities</td>
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<td>DSN</td>
<td>Defense Switched Network</td>
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<tr>
<td>EAC</td>
<td>Echelons Above Corps</td>
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<td>FA</td>
<td>Functional Area</td>
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<td>FM</td>
<td>Field Manual</td>
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<td>FOB</td>
<td>Forward Operating Base</td>
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<td>FRAGO</td>
<td>Fragmentary Order</td>
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<td>GIS</td>
<td>Geospatial Information System</td>
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<td>HN</td>
<td>Host Nation</td>
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<td>HOA</td>
<td>Horn of Africa</td>
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<tr>
<td>HQ</td>
<td>Headquarters</td>
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<tr>
<td>HQDA</td>
<td>Headquarters Department of Army</td>
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<tr>
<td>ID</td>
<td>Identification</td>
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<tr>
<td>IED</td>
<td>Improvised Explosive Device</td>
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<tr>
<td>IJC</td>
<td>ISAF Joint Command</td>
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<tr>
<td>INFORMS</td>
<td>Institute for Operations Research and the Management Sciences</td>
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<tr>
<td>IPB</td>
<td>Intelligence Preparation of the Battlefield</td>
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<tr>
<td>IR</td>
<td>Intelligence Requirement</td>
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<tr>
<td>ISF</td>
<td>International Security Force</td>
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<tr>
<td>ISAF</td>
<td>International Security Assistance Force</td>
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<td>ISAF-A</td>
<td>International Security Assistance Force - Afghanistan</td>
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<td>ISF</td>
<td>Iraqi Security Forces</td>
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<td>ISR</td>
<td>Intelligence, Surveillance, and Reconnaissance</td>
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<td>IW</td>
<td>Irregular Warfare</td>
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<td>IWS</td>
<td>Information Work Space</td>
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<td>JICM</td>
<td>Joint Integrated Computer Model</td>
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<td>JIEDDO</td>
<td>Joint Improvised Explosive Device Defeat Organization</td>
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<td>JIPB</td>
<td>Joint Intelligence Preparation of the Battlefield</td>
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<td>JSOTF-P</td>
<td>Joint Special Operations Task Force – Philippines</td>
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<tr>
<td>LOO</td>
<td>Line of Operation</td>
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<tr>
<td>M&amp;S</td>
<td>Models and Simulations</td>
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<td>MCCDC</td>
<td>Marine Corps Combat Development Command</td>
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<td>MDMP</td>
<td>Military Decision Making Process</td>
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<td>MEDEVAC</td>
<td>Medical Evacuation</td>
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<td>MNF-I</td>
<td>Multi-National Forces – Iraq</td>
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<td>Acronym</td>
<td>Description</td>
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<tr>
<td>MOE</td>
<td>Measure of Effectiveness</td>
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<td>MOP</td>
<td>Measure of Performance</td>
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<td>MTT</td>
<td>Military Training Team</td>
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<td>NAC</td>
<td>North Atlantic Council</td>
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<td>NAPCE</td>
<td>National Assembly and Provincial Council of Elections</td>
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<td>NATO</td>
<td>North Atlantic Treaty Organization</td>
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<td>NGIC</td>
<td>National Ground Intelligence Center</td>
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<td>NGO</td>
<td>Non-Governmental Organization</td>
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<td>NIPRNET</td>
<td>Non-secure Internet Protocol Router Network</td>
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<td>NTM-A</td>
<td>NATO Training Mission – Afghanistan</td>
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<td>OA</td>
<td>Operations Analysis</td>
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<td>OCO</td>
<td>Overseas Contingency Operation</td>
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<td>Operation Iraqi Freedom</td>
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<td>Online Analytical Processing</td>
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<td>Office of Management and Budget</td>
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<td>OND</td>
<td>Operation New Dawn</td>
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<td>OPORD</td>
<td>Operations Order</td>
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<td>OR</td>
<td>Operations Research</td>
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<tr>
<td>PIR</td>
<td>Priority Intelligence Requirement</td>
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<td>PMESII</td>
<td>Political, Military, Economic, Social, Information, Infrastructure</td>
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<td>POC</td>
<td>Point of Contact</td>
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<tr>
<td>PPBES</td>
<td>Planning, Programming, Budgeting, and Execution System</td>
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<td>Provincial Reconstruction Team</td>
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<td>P-Value</td>
<td>Probability Value</td>
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<td>QSAR</td>
<td>Quarterly Strategic Assessment Report</td>
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<td>QSCAC</td>
<td>Quarterly Strategic Campaign Assessment Conference (QSCAC)</td>
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<td>RFIs</td>
<td>Requests for Information</td>
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<td>Statistical Analysis System</td>
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<td>Security and Stability Operations</td>
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<td>Total Army Analysis</td>
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<td>TRADOC Analysis Center</td>
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<td>TRADOC</td>
<td>Training and Doctrine Command</td>
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<tr>
<td>TTPs</td>
<td>Tactics, Techniques, and Procedures</td>
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<td>Abbreviation</td>
<td>Full Name</td>
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<td>U.S.</td>
<td>United States</td>
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<td>United States Agency for International Development</td>
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<td>USMA</td>
<td>United States Military Academy</td>
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<td>VBA</td>
<td>Visual Basic for Applications</td>
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<td>VTC</td>
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</tr>
<tr>
<td>WebTAS</td>
<td>Web-Enabled Temporal Analysis System</td>
</tr>
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APPENDIX B       REFERENCES


http://www.rand.org/content/dam/rand/pubs/monographs/2012/RAND_MG1086.pdf


