Study Directors' Course
Study Process Overview

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Purpose and Outline

- **Purpose: To provide an overview of the study process and to describe the study director's role in the process.**

- **Outline:**
  - **Relevant References.**
  - **Key Terms and Definitions.**
  - **Study Process Overview.**
  - **Study Director's Role.**
  - **The Study Director and the Study Process.**
  - **Cautions & Considerations.**

Relevant References

> **Many references exist for informing a study director in study planning; others are more study type specific.**

- **References related to the study process (irrespective of study type).**

  - TRADOC Pam 11-8, *Army Programs Studies and Analysis Handbook*, 19 July 1985. (old, but very good)

  - Policy Memorandum 70-1, *TRAC Study Project Leadership Guide*, March 1990. (also old, but very good)

  - Field Manual (FM) 3-0: *Operations*, February 2008. (great, after substituting "study director" for "commander")

  - FM 5-0: *Army Planning and Orders Production*, Jan 2005. (contains a great analog to the study planning process)

  - *Constraints, Limitations, and Assumptions Guide*, TRAC-TD-05-011, May 2005. (a TRAC standard)

  - *TRADOC Analysis Center's Definitions for Analysts*, TRAC-TD-05-010, May 2005. (a handy reference with arguable definitions)

  - Any description of the scientific method. (find these on line or in operations research-related textbooks, for example)

Relevant References

- **Capabilities-Based Assessment (CBA) references.**
  - CJCSI 3170.01G: *Joint Capabilities Integration and Development System (JCIDS)*, 1 March 2009. **(not much help for planning and execution)**
  - *JCIDS Manual*, Feb 2009. **(companion document to CJCSI 3170.01G)**
  - *Joint Capabilities Integration and Development Systems (JCIDS) Analysis Code of Best Practice (COBP),* TRAC-TD-05-012, June 2005. **(a bit dated given JCIDS changes, but still valuable)**

- **Analyses of Alternatives (AoA).**
  - Department of Defense Instruction (DoDI) 5000.02: *Operation of the Defense Acquisition System,* December 8, 2008. **(not much help for planning and execution)**
  - Defense Acquisition Guidebook, https://akss.dau.mil/dag/. **(lots of good acquisition information – helps with identifying the big picture)**

- **Other.**
  - CCRP Publication Series, *Code of Best Practice –Experimentation*, July 2002.
  - TRADOC Reg 71-4, TRADOC Standard Scenarios for Capability Developments, 23 September 2008.

> ⚠ **Know and apply TRAC's standards and quality principles!**

Key Terms and Definitions
(listed generally in the order encountered)

- **Study Director**. The individual who has the overall lead for planning, performing, and reporting a study.

- **Study Issues**. The set of questions that a study sponsor tasks a study director to investigate. Seeking answers to these questions, combined with the study's established scope, focuses analysis efforts.

- **Essential Elements of Analysis (EEA)**. Specific questions that the analysis must answer to fully address the study issues. By fully answering the study issues, the analysis should achieve the objectives of the overall effort.

- **Constraint.** A restriction imposed by the study sponsor that limits the study team's options in conducting the study.

- **Limitation.** An inability of the study team to fully meet the study objectives or fully investigate the study issues.

- **Assumption.** A statement related to the study that is taken as true in the absence of facts, often to accommodate a limitation.

- **Scope**. The bounds placed on the context, analytic space, or operational environment for a study. The bounds are typically derived from study guidance, constraints, and limitations.

Source: TRAC's Definitions for Analysts

Key Terms and Definitions
(listed generally in the order encountered)

- **Measure of Performance (MOP).** A measure of a system's technical performance expressed as speed, payload, range, time on station, frequency, or other distinctly quantifiable performance features.

- **Measure of Effectiveness (MOE).** A special-use metric used to obtain a measure of an aspect, e.g., lethality, of military operations. MOE are metrics that lead to measures of force attributes.

- **Measure of Merit (MOM).** A term used to indicate either a measure of effectiveness (MOE) or a measure of performance (MOP) without specifying MOE or MOP specifically.

- **Methodology.** A logical sequence of steps that describes inputs, outputs, and analysis techniques to be employed to answer a decision maker's study issue(s). [Definition developed for Study Directors' Course]

- **Study Plan.** The outline of the technical and administrative procedures the study will follow to achieve the objectives of the study directive.

- **Analysis Plan.** A plan that describes the context and conduct of an analytic effort.

  ⚠️ **Don't get caught up in arguing the difference between a study plan and an analysis plan; the key point to remember is that the "plan" must describe what has to be done.**

Source: TRAC's Definitions for Analysts [Except where noted]

Study Process Overview

The TRAC study process is similar to the Army's operations process.

The _commander_ drives the operations process

SD Course Topics	Plan	Prepare	Execute	Assess
	Planning Phase (Part 1)	Planning Phase (Part 2)	• Analysis Phase • Reporting/ Documentation Phase	Assess

⚠️ **The _study director_ drives the study process**
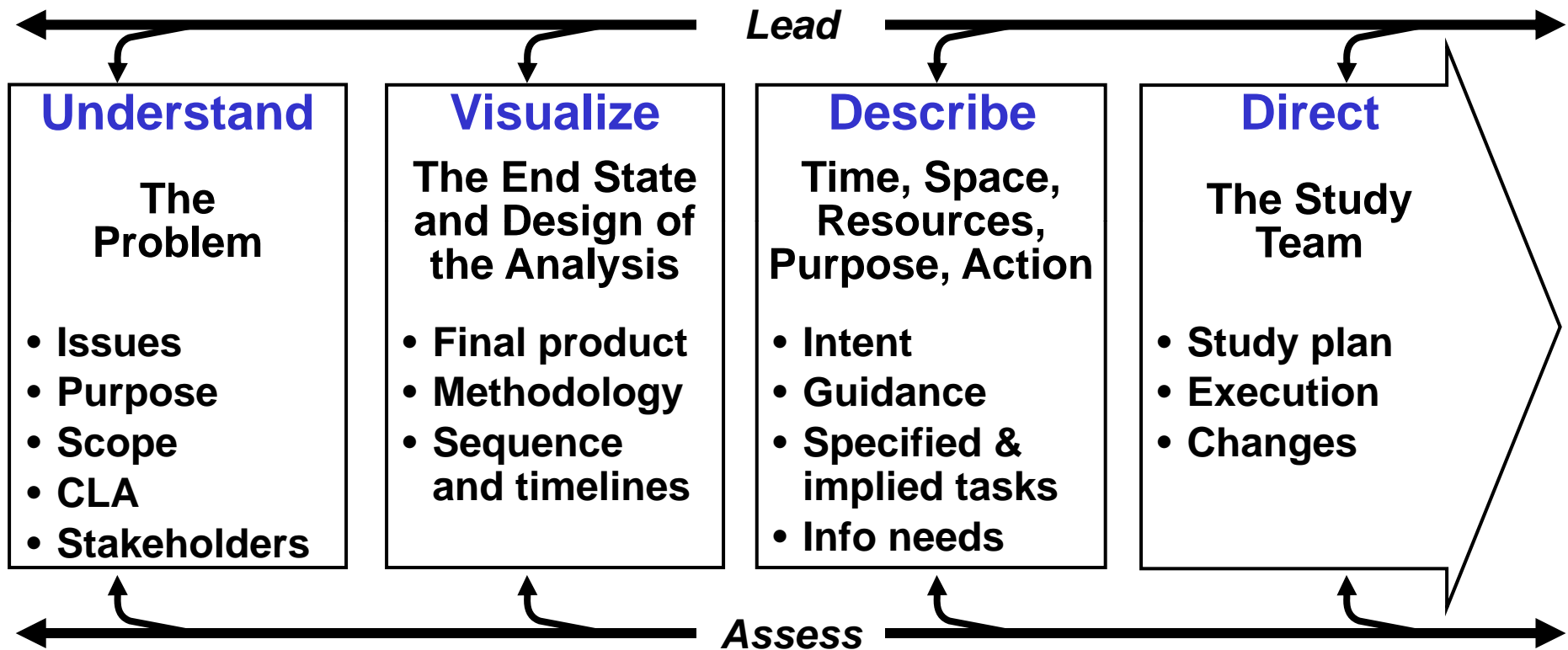
As with the operations process, activities in the study process:

• May occur sequentially or simultaneously.

• Overlap and recur as circumstances demand.

• Vary in length depending on the study complexity and resources (principally time) available.

Study Director's Role

> **The study director's role is similar to that of a commander in exercising battle command.**

Lead

Understand	**Visualize**	**Describe**	**Direct**
The Problem	**The End State and Design of the Analysis**	**Time, Space, Resources, Purpose, Action**	**The Study Team**
• **Issues** • **Purpose** • **Scope** • **CLA** • **Stakeholders**	• **Final product** • **Methodology** • **Sequence and timelines**	• **Intent** • **Guidance** • **Specified & implied tasks** • **Info needs**	• **Study plan** • **Execution** • **Changes**

Assess

Adapted from Figure 5-1: "Battle Command," in FM 3-0.

> **Unlike a commander, a study director does not have command authority, this often introduces leadership challenges.**

CLA = Constraints, limitations, assumptions

The Study Director and the Study Process

- **Understand:**
  - The problem, the background on the problem, the scope, etc., and how the results will be used.
  - More about the topic you're studying than the so-called "experts" (e.g., a program manager or TRADOC capabilities manager).
  - The type of study being conducted and where it fits in the JCIDS and acquisition systems.
  - Who the stakeholders and potential critics are.
- **Visualize:**
  - What the final product (e.g., results charts) will look like; do this as early in the study process as possible – it helps immensely.
  - The activities associated with the analysis, their sequence, and potential challenges.
- **Describe (to team members):**
  - As much as possible about what you know and what direction you're headed; the plan *will* survive "first contact," provided you've given a clear intent and plan for the study.
    - In developing the plan, include team members and their ideas to cement a common understanding and shared vision among the team.

The Study Director and the Study Process

- **Direct:**
  - Study team members in day-to-day activities and prioritize their efforts.

- **Assess:**
  - Constantly; be thinking about how to improve on what's being done.
  - Everything about the study's progress (including resource usage); always be looking for potential branches and sequels (but don't execute them unless necessary).
  - And report the assessment to team members (continuously) and TRAC leadership (at least monthly).

- **Lead by:**
  - Identifying challenges and overcoming them.
  - Getting involved; roll up your sleeves and do some work!
  - Recognizing and *doing* what needs to be done (without being told).
  - Recognizing your limitations and knowing when to ask for help.
  - Setting an example for the other analysts on the team.
  - Taking responsibility for every aspect of the study.

⚠ Cautions & Considerations ⚠

- **Know and apply TRAC's standards and quality principles!** **(Do this throughout; don't apply the lipstick to the pig at the last minute.)**

- **Don't get caught up in arguing the difference between a study plan and an analysis plan.** **(The "plan" has to be executable and must enable achieving the required result.)**

- **The study director drives the study process** **(and TRAC leadership helps the study director navigate turbulent waters.)**

- **Understand the problem, the background on the problem, the scope, etc., and how the results will be used.** **(Lack of understanding leads to a rough, frustrating effort.)**

- **Visualize what the final product will look like; do this as early in the study process as possible.** **(Know what you're going after).**

- **In developing the plan, include team members and their ideas to cement a common understanding and shared vision among the team.** **(Active participation fosters understanding, direction, initiative, and teamwork.)**

- *Lead!* **TRAC expects a lot from you.**

…and avoid the seven deadly sins!

Study Directors' Course
Planning Phase, Part 1
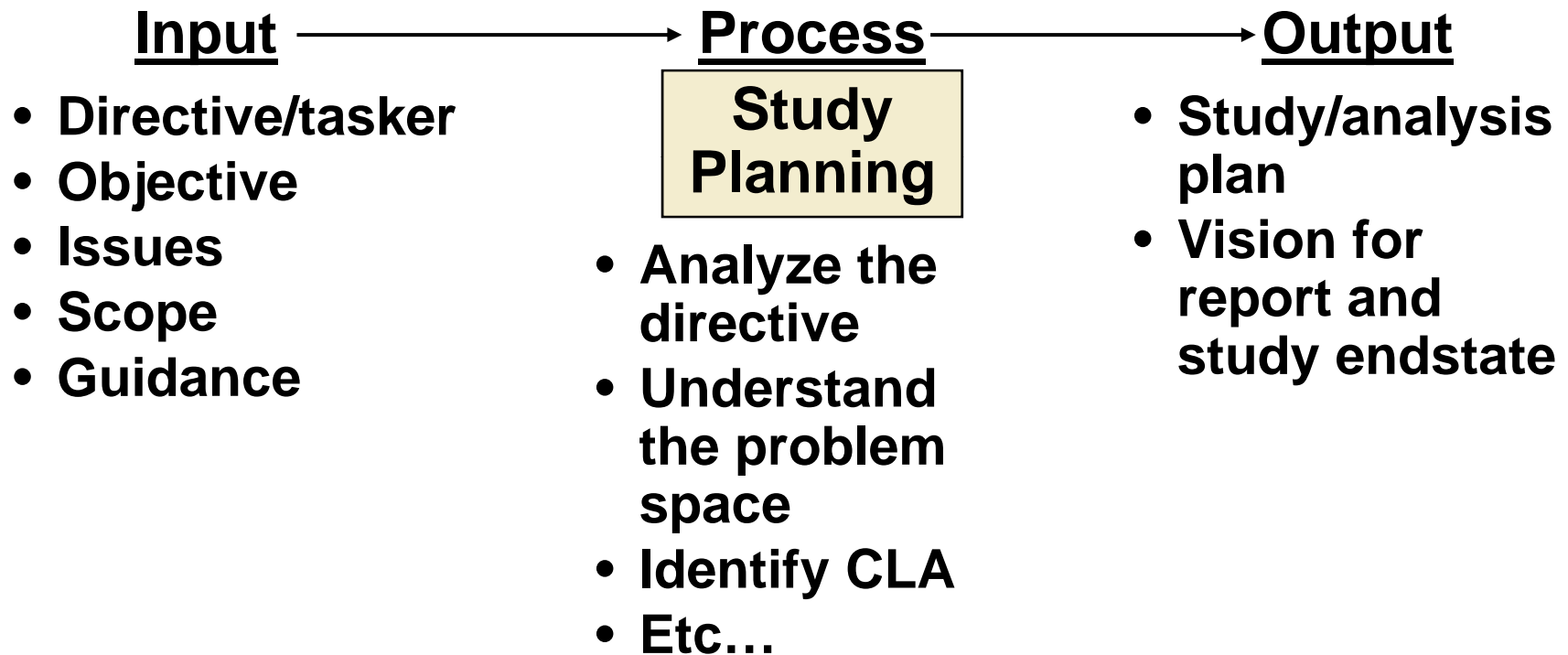

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Purpose and Outline

- **Purpose: To describe elements of the study planning process, their sequence, and some items for study directors to consider in the planning process.**

- **Outline:**
  - **Study Planning Phase Part 1 Overview.**
  - **Study Planning "Starting Conditions."**
  - **Study Planning and the MDMP.**
  - **Planning Sequence and Considerations.**
  - **Administrative Tasks.**
  - ⚠️ **Cautions & Major Considerations.**
  - **Practical Exercise.**

> **No amount of math will overcome an initial error in logic!**
> ⚠️ **In the study planning process and in the plan itself, know what you're doing and why you're doing it.** ⚠️

Study Planning Phase Part 1 Overview

This portion of the Study Directors' Course focuses on study planning inputs, processes, and outputs.

Input → **Process** → **Output**

Input
- Directive/tasker
- Objective
- Issues
- Scope
- Guidance

Process

Study Planning
- Analyze the directive
- Understand the problem space
- Identify CLA
- Etc…

Output
- Study/analysis plan
- Vision for report and study endstate

A **good** study plan facilitates successful study execution; don't skimp on this phase of the study process.

Study Planning "Starting Conditions"

Not all studies have the same initial conditions.

"Ideal" Conditions	"Usual" Conditions	"Bad" Conditions
• Written directive or MOA.	• Written directive, MOA, email, or VOCO.	• No, or unclear, directive, etc.
• Clearly identified decision to inform.	• Some understanding of decision to inform.	• No evident decision to inform.
• Clearly-identified decision maker.	• General idea of decision maker.	• Unspecified decision maker.
• Clearly-written, understandable issues.	• Written issues with undefined words or phrases.	• Broad description of some undefined "analysis" required.
• Distinct, well-defined alternatives.	• Broad description of alternatives.	• No alternatives or comparison basis.
• Team & authorities established.	• Team ID'd, but authorities not clear.	• Team ID'd, but little/no authority.

Examples

IFPC AoA	• HC3 AoA • Most CBAs	Omni Fusion '08

MOA = Memorandum of Agreement   VOCO = Vocal Command

Study Planning "Starting Conditions"

TRAC leadership or PRD will do initial study coordination. The study director will not be starting from "scratch."

The study director will typically get:

- The directive or tasking, which will/may contain:
  - The study purpose (maybe).
  - Study issues (that may have undefined terms).
  - A suspense for when the analysis needs to be completed.
  - Guidance on the timeframe and scenarios to use.
  - Alternatives to address (depending on the type of analysis).
  - Direction on methods or venues to use (unfortunately).
  - Constraints (though the study director needs to identify these).
  - Other organizations' roles and responsibilities.
- A team of TRAC analysts and some level of support from other organizations.
- Guidance from TRAC leadership, which includes initial scoping for the analysis.

Study Planning and the MDMP

> **Study planning parallels the Military Decision Making Process (MDMP) and is vital to mission accomplishment.**

Study Planning Process	MDMP Corollary
• **Analyze the study directive/tasking.** →	• **Analyze the higher HQ order.**
• **Conduct background research.** →	• **Perform initial IPB.**
• **Determine specified, implied, and essential tasks.** →	• **Determine specified, implied, and essential tasks.**
• **Review analysis assets.** →	• **Review available assets.**
• **ID constraints, limitations, assumptions.** – **Determine constraints (including timelines).** – **Identify critical facts, info needs, and assumptions.**	• **Determine constraints.** • **Identify critical facts and assumptions.** • **Determine initial CCIR.** • **Update operational timelines.**
• **Write the restated "mission."** → – **Study objectives.** – **Study issues/EEA.**	• **Write the restated mission.**

Blue text = Study planning process outline
MDMP Source: FM 5-0.
Note: Limitations not included in MDMP.
IPB = Intelligence Preparation of the Battlefield.

Study Planning and the MDMP

Study Planning Process

- **Develop the study concept, i.e., the "major muscle moves."** → **• Generate options (for COAs).**
- **Determine methodology.**
  - **Develop MOMs.**
  - **Identify scenario (to include Blue forces & Threat.)**
  - **Identify specific assumptions.**
  - **Select tools.**
  - **Develop run/experiment design.**
- **Assign responsibilities and coordinate for additional resources.**
- **Write/publish study plan with annexes.** →

MDMP Corollary

- **Generate options (for COAs).**
- **Assign headquarters.**
- **Develop COA statements and sketches.**
- **Gather the tools.**
- **List all friendly forces.**
- **List assumptions and known critical events and decision points.**
- **Determine evaluation criteria.**
- **Conduct a COA advantage and disadvantage analysis.**
- **Compare COAs.**
- **Develop a recommended COA.**
- **Produce and publish OPLAN/ OPORD with annexes.**

Note: Study directors usually consider multiple COAs for each step in methodology development.

Analyze the Study Directive/Tasking

- **Task: Analyze the study directive/tasking.**
- **Endstate:**
  - **Your own initial statement of the study's purpose, objective, alternatives (if any), timeline, participating organizations, and responsibilities.**
- **Considerations (generally in the order they should be addressed):**
  - **The study directive is only a start to understanding what needs to be done; virtually no directive or tasking will provide all the answers.**
  - **Start three lists: 1) facts from the directive, 2) questions you need answered, and 3) things you know can't be done or question doing.**
  - **Focus initially on the directive's stated objective (or purpose) for the study, the issues, alternatives, suspense, and scoping guidance.**
  - **Try to figure out what decision ultimately has to be informed; the decision being informed isn't always clear in the directive.**
  - **Know where your study fits in the "big picture," i.e., figure out where in the JCIDS, acquisition, or PPBES process your study falls.**
  - **Find out if anyone in TRAC (e.g., PRD or PMD) had a hand in the directive's development and get any background they may have.**

Analyze the Study Directive/Tasking

- **Considerations (Cont'd):**
  - Identify the potential stakeholders, i.e., those people or organizations that have a vested interest in the outcome of the study effort.
  - Identify the other organizations involved in the study and determine their role.
  - ⚠ Don't discount anything from the directive, no matter how inane; add these items to your "things that can't or shouldn't be done list."
  - Be prepared to contact the study sponsor for further guidance; you'll probably need routine contact until you settle on the "restated mission."
  - ⚠ Be sure you understand *everything* in the directive/tasking; add unanswered questions to your list.

    > **Example from DCGS-A Directive (2006): What are the operational effectiveness differences between DCGS-A and the status quo…?**
    >
    > **What is "status quo?"**

> **End the initial (you'll refer back to it often) directive analysis with statements addressing the elements described in the endstate.**

Conduct Background Research

- **Task: Conduct research to begin developing an understanding of the issues, their background, and the "analysis environment."**

- **Endstate:**
  - **Understanding of the sponsor 's underlying requirement.**
  - **Identification of the vital elements to account for in the study.**
  - **Understanding of the study team's abilities and limitations.**
  - **Identification of potential study critics (and their agendas).**

- **Considerations associated with understanding the sponsor. Ask (and answer for yourself) the following:**
  - **Why is the sponsor asking this question (study issue)?**
  - **What is the sponsor trying to achieve? (What's on his support form?)**
  - **What concerns does the sponsor have that are related to the study?**
  - **Does the sponsor have any particular likes or dislikes?**
  - **How engaged and helpful will this sponsor (and his/her staff) be in the study?**

> ⚠ **Knowing the sponsor's name and position is not sufficient; get a full understanding of the sponsor.**

Conduct Background Research

- **Considerations associated with understanding the vital elements.**
  - What other studies have been done that relate to the issues I have or the type of study I need to conduct? What do those studies contain?
  - Your study is unique; identify its unique elements.
  - Learn everything possible about the acquisition program, capability area, etc., that your study addresses.
  - Be able to identify all of the factors to consider in the study, and start discerning which factors will have an impact on results.

- **Considerations associated with understanding the study team.**
  - Identify the TRAC study team-members capabilities; solicit their input on the study at hand.
  - Review methods, techniques, and models to determine their potential use in the study.
  - Identify the capabilities of the external-to-TRAC study team members; identify what's on their "support forms."
  - Identify the "friction points" between TRAC and the external study partners and among the partners themselves.

Conduct Background Research

- **Considerations associated with identifying potential study critics (and their agendas).**
  - Consider two types of critics:
    - Those who potentially have something to "lose" as a result of the study.
    - Those who have conflicts with the organizations involved in the effort.
  - Determine who the critics are.
  - Identify the particular aspects of the study that are potential targets for the critics.

> ⚠ Take the time to understand the people and organizations involved in a study; a large portion of the study director's time goes to resolving problems that arise because of the people, not the study issues.

> ⚠ "Background research" is never complete; research throughout to understand the study and its elements, the sponsor, others involved, and to assess how the study is progressing.

Specified, Implied, and Essential Tasks

- **Task: Identify the study's specified, implied, and essential tasks from the study directive and initial research.**

- **Endstate: Identification of the specified, implied, and essential tasks to execute during the conduct of the study.**

- **Considerations:**
  - **Answering the study issues is <u>always</u> one of the essential tasks.**
  - **Most specified tasks will come from the directive or tasking.**
  - **The alternatives may be specified; if they're not, determine what the necessary comparison is as an implied task – you're always comparing.**
  - **Specified tasks may be unachievable or irrelevant to the issues; be prepared to address these tasks with the study sponsor.**
  - **Generally, the more vague the directive, the more you'll need to dig for implied tasks; some of these implied tasks will be essential tasks.**
  - **The background research will lead to many implied tasks, e.g., "So and so is a potential critic so we must produce irrefutable evidence on topic X to defend the expected criticism."**
  - **A thorough review of the directive and good initial background research will greatly assist in identifying implied tasks.**
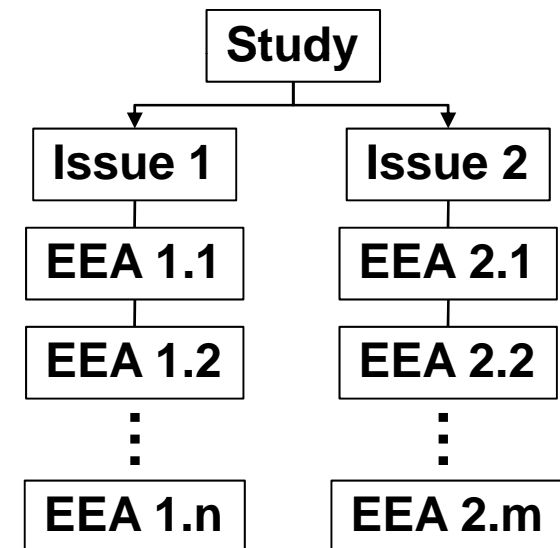
Specified, Implied, and Essential Tasks
A short digression on EEA

> **During the identification of tasks, develop EEA; answering EEA is generally an implied task.**

- **EEA are "specific questions that the <u>analysis</u> must answer to fully address the study issues."**

- **Considerations:**
  - **Don't develop EEA in a vacuum; focus on the issues and use your background research.**
  - **Ensure EEA contribute to answering the study issue (i.e., they're nested).**
  - **Look for a flow in the EEA, i.e., the order in which they might be answered; this flow may drive the methodology.**
  - **Don't confuse EEA with potential process steps; e.g., "What does the IBCT contain" is an information need, not an EEA.**
  - **Don't feel compelled to develop a set number of EEA; develop them only as needed to answer the study issues.**

```
            Study
           /     \
      Issue 1    Issue 2
         |          |
      EEA 1.1    EEA 2.1
         |          |
      EEA 1.2    EEA 2.2
         ⋮          ⋮
      EEA 1.n    EEA 2.m
```

"Nest" the EEA

Review Analysis Assets

- **Task:** Review the analysis assets available for potential use in completing the study.

- **Endstate:** A list of personnel, tools, and methods that have potential for use in satisfying the study's requirements.

- **Considerations:**
  - From the background research, identify the personnel qualifications and tool qualities that may contribute to the study.
  - Assess the expertise of already-designated study team members.
  - Determine what scenarios are available for use.
  - Survey other TRAC study directors to identify how similar studies were accomplished.
  - Survey MMD and SWGD for candidate tools and methods.
  - Survey external study partners for any relevant unique tools and methods.
  - Review the study directive for any personnel, tools, or methods that may have been mandated for, or excluded from, use in the study.

> ⚠ **Do not select tools or methods before addressing constraints, limitations, and assumptions; you'll limit yourself unnecessarily.**

ID Constraints, Limitations, and Assumptions

- **Task: Identify the study constraints, limitations, and assumptions (CLA).**

- **Endstate: An understanding of the bounds for the study.**

  > ⚠️ **Taken with the guidance in the study directive, CLA form the scope of the study.**

- **Definitions:**
  - **Constraint. A restriction imposed by the study sponsor that limits the study team's options in conducting the study.**

  - **Limitation. An inability of the study team to fully meet the study objectives or fully investigate the study issues.**

  - **Assumption. A statement related to the study that is taken as true in the absence of facts, often to accommodate a limitation.**

> **The coverage of CLA in the Study Directors' Course is only an overview. See the TRAC CLA guide for more information.**

ID Constraints, Limitations, and Assumptions

> **The guidance and constraints, limitations, and assumptions form the analytic bounds (scope) for a study.**

Universe of factors bearing on the issue(s).

"What is the appropriate mix of precision munitions…

Guidance …for 2015 BCTs?" } *Sponsor-directed*

Constraints "Deliver results in two months."

Limitations & Assumptions "No 2015 IBCT CONOPS exists."

Analysis space ← *The study's restated issues and resulting methodology are bounded by this space.* } *Study Director-developed*

CLA Tenets

- **Identify the CLA that impact your ability to get at the study issues; if they have no impact on the issues, they're not necessary.**

- **Identify two sets of CLA for a study.**
  - **Full set: The entire set of CLA for the conduct of the study. This set must be understood and agreed to by study participants.**
  - **Key set: A subset of the full set of CLA that is critical to the sponsor for accepting and interpreting the study results.**

- **Ensure that CLA are integrated and consistent across (and throughout) the study effort.**

- **Adhere to the characteristics of good CLA. They must be:**
  - **Necessary, i.e., they must enable the study effort.**
  - **Valid, i.e., they are sound and supportable.**
  - **Accepted, i.e., they are generally agreed upon by study participants.**

> ⚠️ **Be diligent in developing CLA – they're vital to understanding the analysis space and developing an executable study plan.**

Write Restated "Mission"

- **Task: Write the relevant study objectives, issues, and accompanying EEA.**

- **Endstate:**
  - **Refined, written study objective(s).**
  - **Refined, written study issues and EEA.**

- **Considerations:**
  - **Achieving the study objective(s) and answering the study issues is your *mission*; don't stray from it.**
  - **Think of answering the EEA as intermediate objectives you must achieve in achieving the final objective.**
  - **Be sure that you understand everything that you write; don't use words that you haven't defined clearly for yourself.**
  - **Make sure that the objectives and issues satisfy the sponsor's requirements (engagements with the sponsor or his proxies should have cleared things up by now).**
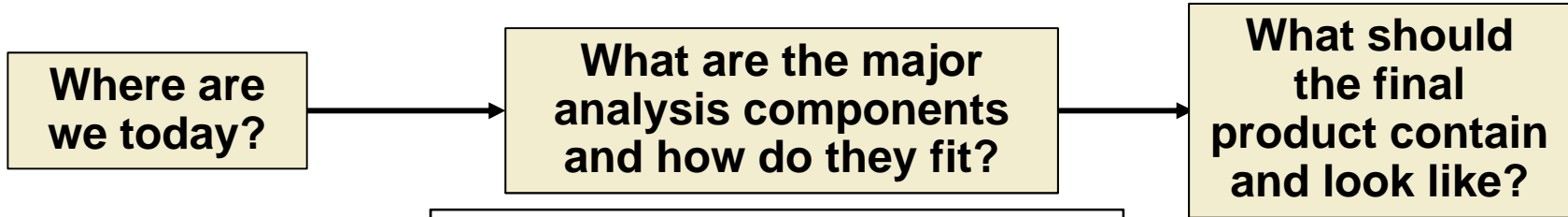
Develop the Study Concept

- **Task: Develop the concept of how to complete the study.**

- **Endstate: An illustration with an accompanying word picture that describes the major analytic steps associated with the study.**

- **Considerations:**

  - **The study concept frames methodology development; bear in mind the issues, EEA, CLA, and specified and implied tasks.**

  - **Developing the study concept is a visualization process; the product that results assists in "describing" the study for the team.**

  - **Throughout concept development, maintain a focus on the desired study endstate, and have in mind what you want the final slides to look like.**

  - **Be sure to capture the major analysis steps and their major inputs and outputs.**

  - **This is an ideal time to include study team members to elicit their input and draw on their experience/expertise.**

  - **Every study director, regardless of experience, should develop a concept for a study; with experience, a study director will integrate more elements of methodology development in this visualization process.**
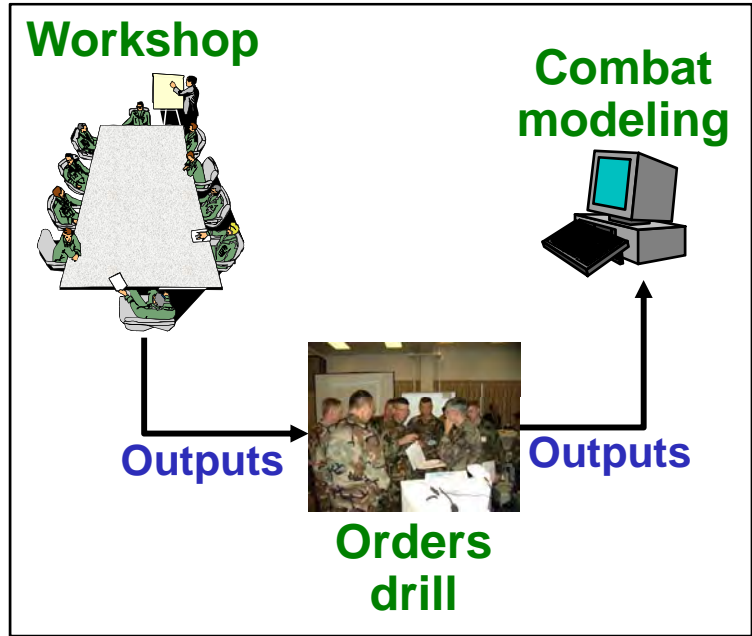
Develop the Study Concept

> **Being able to visualize the conduct of a study requires understanding and some experience.**

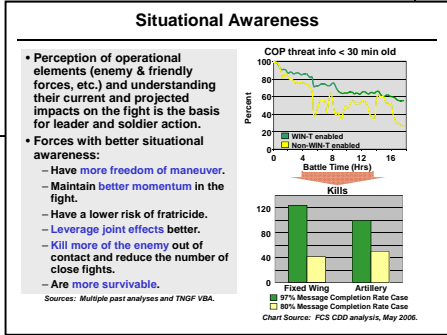## Start from the desired endstate, and generally work backward.

| Where are we today? | → | What are the major analysis components and how do they fit? | → | What should the final product contain and look like? |

Where are we today?

- **Analyze the study directive/tasking.**
- **Conduct background research.**
- **Determine specified, implied, and essential tasks.**
- **Review analysis assets.**
- **ID constraints, limitations, assumptions.**
  - **Determine constraints (including timelines).**
  - **Identify critical facts, info needs, and assumptions.**
- **Write the restated "mission."**
  - **Study objectives.**
  - **Study issues/EEA.**

What are the major analysis components and how do they fit?

Workshop

Combat modeling

Outputs → **Outputs**

Orders drill

What should the final product contain and look like?

Purpose and Outline

- Purpose: To provide results from the Tactical Networks for Ground Forces (TNGF) Operational Team's Analysis.
- Outline:
  - Content Overview and Study Background.
  - Constraints, Limitations, and Assumptions.
  - Overview of the Alternatives.
  - ONA and Past Analyses Overview and Results.
  - Summary.

Situational Awareness

- Perception of operational elements (enemy & friendly forces, etc.) and understanding their current and projected impacts on the fight is the basis for leader and soldier action.
- Forces with better situational awareness:
  - Have more freedom of maneuver.
  - Maintain better momentum in the fight.
  - Have a lower risk of fratricide.
  - Leverage joint effects better.
  - Kill more of the enemy out of contact and reduce the number of close fights.
  - Are more survivable.

Sources: Multiple past analyses and TNGF VBA.

COP threat info < 30 min old

WIN-T enabled
Non-WIN-T enabled

Battle Time (Hrs)

Kills

Fixed Wing   Artillery

97% Message Completion Rate Case
80% Message Completion Rate Case

Chart Source: FCS CDD analysis, May 2006.

This is a framing process; it is not the methodology!!

Develop Methodology

- **Task: Develop a detailed methodology to accomplish the study.**

- **Endstate: An illustration, accompanied by a written statement, that describes a logical sequence of steps for conducting the analysis and that identifies:**
  - **Issues and EEA.**
  - **Measures of merit.**
  - **Analysis steps and their inputs and outputs.**
  - **Tools and techniques to be used.**
  - **Scenario(s) used.**
  - **Any specific assumptions.**
  - **Run/experiment design used.**

> **When the methodology is complete, it should be patently clear that it is logical and will lead to answering the issues and EEA.**
>
> ⚠️ **It's much more difficult for a critic to argue a study's results if he can't discredit the methodology.** ⚠️

Develop Methodology

- **The (pure) process:**
  - **For each EEA, identify the attributes associated with the concept, system, etc., that the EEA addresses.**
  - **As it pertains to each attribute, determine what discriminates one study alternative from the other(s).**
  - **Determine what measures of merit (MOM) will highlight the differences resulting from the discriminators.**
  - **Identify the output data to measure the differences.**
  - **Identify what operational conditions (scenarios) *should* be used, what techniques *could* be used, and what input data is required to obtain the output data.**
  - **Apply the CLA to determine what *can* be done to obtain the required output data.**
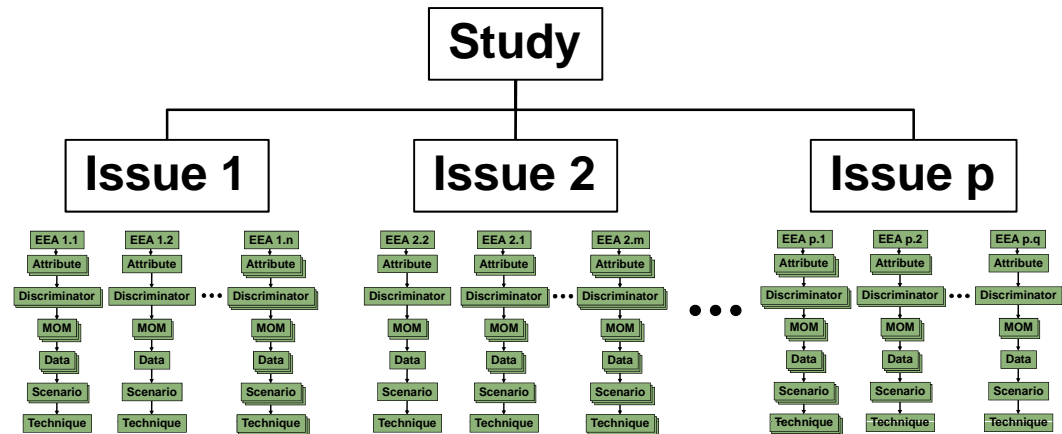 - **Update the study limitations and develop additional assumptions.**

CLA Screen
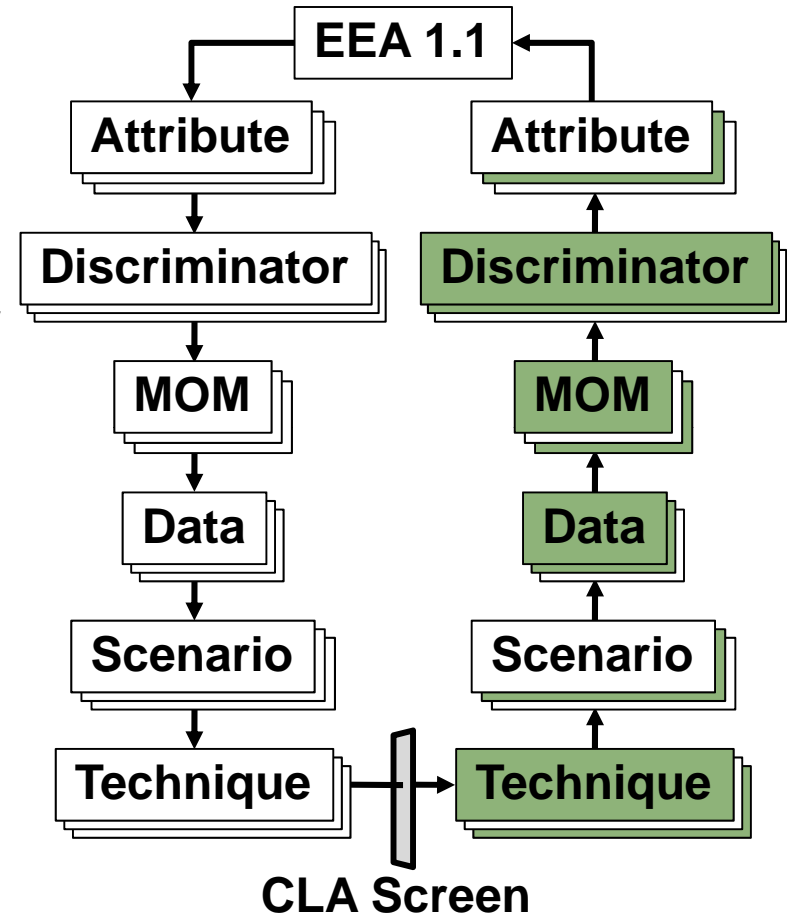
Trace back up to get what the study can address (green boxes). In practice, we screen at each step.

Develop Methodology

When you've completed the steps on the previous slide, you've developed the study *dendritic*.

- **The process (cont'd):**
    - Identify the EEA that have some of the same input data requirements; group them to possibly consider answering them at the same time.
    - Identify the logical order in which the EEA (or portions of them) should be answered (looking at required input and output data).
    - Refine the techniques to use based on the sequence.
    - Update the CLA.
    - Review what you've done and verify that what you've laid out will *answer the EEA and study issues!*

Develop Methodology

- **Considerations:**
  - Developing an executable, defensible methodology takes practice, experience, consideration of many factors, and attention to detail.
  - Some elements (e.g., scenarios, alternatives) required for developing a methodology will be provided in the study guidance.
  - ⚠ If a planned technique requires subject matter experts (SME), identify what qualities and experience they must have – getting the right SMEs is vital for study quality.
  - The "run design," i.e., alternatives or excursions off the alternatives should be a byproduct of working through the methodology process.
  - If in the process of methodology development you identify vital discriminators, consider investigating these as excursions.
  - ⚠ DO NOT cavalierly pull MOMs from your favorite MOM database; make sure you develop MOMs that are appropriate for the EEA.
  - ⚠ DO NOT select a technique before considering the previous steps in the methodology development process; you'll limit yourself unnecessarily.
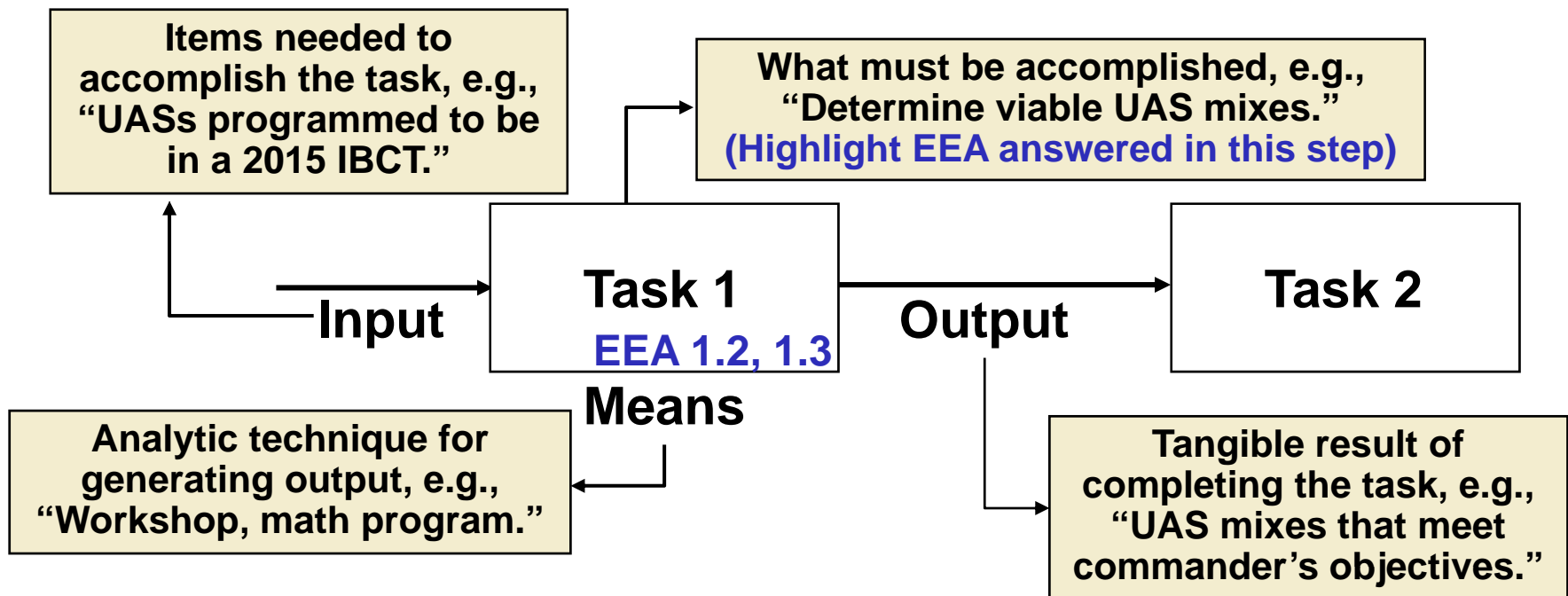 - Continually update CLA, maintaining the "full set" and identifying the "key set."
  - ⚠ VERIFY, VERIFY, VERIFY that the methodology will answer the study issues and EEA – and remain within the study bounds!

Develop Methodology
A digression on conveying the methodology

One approach for a methodology slide is to use building blocks that illustrate, e.g., the task, means, output, and flow.

Items needed to accomplish the task, e.g., "UASs programmed to be in a 2015 IBCT."

What must be accomplished, e.g., "Determine viable UAS mixes."
(Highlight EEA answered in this step)

Input

Task 1
EEA 1.2, 1.3
Means

Output

Task 2

Analytic technique for generating output, e.g., "Workshop, math program."

Tangible result of completing the task, e.g., "UAS mixes that meet commander's objectives."

The form that methodology slide(s) ultimately take will depend on the audience; the study team will need the most-detailed version.
(See TRAC's methodology slide development brief on AKO)

Assign Responsibilities

- **Task: Assign study responsibilities and coordinate for additional resources to conduct the study.**

- **Endstate:**
  - **All study team members know their duties, responsibilities, and key delivery milestone dates.**
  - **Senior TRAC leadership know and understand your additional resource requirements and assist in obtaining them.**

- **Considerations.**
  - **In working to obtain personnel resources, determine the qualities needed in the personnel.**
  - **Assign responsibilities based on the qualifications of the person assuming the responsibility.**
  - **Hold study team members accountable.**
  - **Identify resource "showstoppers" to TRAC leadership as soon as they are identified (even if you're working on a solution).**
  - **Be prepared to conduct the study while simultaneously working to obtain additional resources (personnel, in particular).**
  - **Don't be surprised to be denied additional resources, especially if you can't provide a convincing argument for them.**

Write/Publish Study Plan with Annexes

- **Task: Create and publish the study plan (with annexes) identifying how the study team will satisfy the study directive.**

- **Endstate: A document that contains – in detail sufficient to enable execution – the plan for conducting the study.**

- **Considerations:**
  - **A study plan is a form of communication – make it clear!**
  - **Be sure to convey the message that you know what you're doing; i.e., you understand the problem and the methodology you've laid out will answer the issues.**
  - **Do not necessarily have the outline of the study plan follow the sequence of the planning process – remember; you're communicating now.**
  - **Write the plan well – it serves as a good basis for the final report.**
  - **Don't make the study plan a huge effort in and of itself; volume doesn't matter– quality, clarity of purpose, and clarity of message do.**

Administrative Tasks

- **Complete 'TRAC Project/Study Form.'**

- **Create study folder on network.**

- **Develop cost estimates and any UFRs for conducting the study.**

- **Develop PWS for contract support, as required.**

- **Develop staff notes monthly.**

- **Update 'Key Events List' monthly.**

- **Develop trip reports, as required.**

- **Develop EXSUMs for Director, as required.**

- **Report CCIR to Directors, as required.**

⚠️Cautions & Major Considerations⚠️

- **In the study planning process and in the plan itself, know what you're doing and why you're doing it.**

- **The study directive is only a start to understanding what needs to be done; virtually no directive or tasking will provide all the answers.**

- **Don't discount anything from the study directive, no matter how inane it appears.**

- **Be sure you understand *everything* in the directive/tasking.**

- **Knowing the sponsor's name and position is not sufficient; get a full understanding of the sponsor.**

- **Take the time to understand the people and organizations involved in a study; a large portion of the study director's time goes to resolving problems that arise because of the people, not the study issues.**

- **"Background research" is never complete.**

- **Answering the study issues is <u>always</u> one of the essential tasks.**

⚠️Cautions & Major Considerations⚠️

- The alternatives may be specified; if they're not, determine what the necessary comparison is as an implied task – you're always comparing.

- Do not select tools or methods before addressing constraints, limitations, and assumptions; you'll limit yourself unnecessarily.

- Taken with the guidance in the study directive, CLA form the scope of the study.

- Be diligent in developing CLA – they're vital to understanding the analysis space and developing an executable study plan.

- Achieving the study objective(s) and answering the study issues is your *mission*; don't stray from it.

- When the methodology is complete, it should be patently clear that it is logical and will lead to answering the issues and EEA.

- If a planned technique requires subject matter experts (SME), identify what qualities and experience they must have – getting the right SMEs is vital for study quality.

⚠️Cautions & Major Considerations⚠️

- **DO NOT cavalierly pull MOMs from your favorite MOM database; make sure you develop MOMs that are appropriate for the EEA.**

- **DO NOT select a technique before considering the previous steps in the methodology development process; you'll limit yourself unnecessarily.**

- **VERIFY, VERIFY, VERIFY that the methodology will answer the study issues and EEA – and remain within the study bounds!**

- **A study plan is a form of communication – make it clear!**

- **Be sure to convey the message that you know what you're doing; i.e., you understand the problem and the methodology you've laid out will answer the issues.**

Practical Exercise
Due at Start of Study Directors' Course 18 May Session

Ft Leavenworth is planning on procuring sedans to replace the aging fleet of cars they have like the one TRAC HQ uses to do various errands on post. The post needs 40 – 45 sedans, all of which need to be identical. Be sure you do test drives, but the money and time we have available for the study limits you to test driving only three vehicles. On 18 May, I want you to brief me on the associated issues and EEA.

The post is in the process of re-writing its policy on the use of the vehicles. Limit what you consider to vehicles you can buy in Kansas City. We can order what we need through whatever dealer provides the best option. I want you to figure out which one Ft Leavenworth should buy.

When you do the test drives, don't exceed twenty miles an hour and make sure you have someone riding with you who has a class I commercial driver's license. The post wants a cost-efficient sedan, and the option it selects also has to provide visual advantage. The garrison commander will make the choice, and he likes green. The CG, however, likes blue. When you brief me, let me know what other assumptions you have. Give me the constraints and limitations, too.

Practical Exercise

Due at Start of Study Directors' Course 18 May Session

The garrison commander wants our recommendation by the end of June. I want to showcase TRAC's capabilities to the post so this is a high-priority effort. You'll be doing this by yourself, and the measures you come up with will be really important so I'll want to see those too. In fact, add a methodology chart in the briefing you give me. The sedan has to be American.

I'll be really busy with some high-priority projects I'm working on. If you have any questions, send them to me via email. Limit your 18 May briefing to no more than five slides.

Study Directors' Course
Planning Phase, Part 2

Bill Krondak

Depuy Auditorium

18 May 2009

Agenda

- **Planning phase (Part 2).**
  - **Identify different study types.**
  - **Identify different approaches to get study results.**
  - **Identify scenarios to be used.**
  - **Identify data needs.** *(performance data [thru eDRS], operational data, tasks [from UJTLs, etc.] for CBAs, etc.)*
  - **Identify threat enhancements to study scenarios.**
  - **Identify model/tool development/enhancements.**
  - **Develop queries for modeling output.**
  - **Conduct verification and validation (V&V) of data and models.**
  - **Develop detailed outline of, and begin writing, final report/briefing.** *(determination of final product and writing boiler plate.)*
  - **Conduct runs.** *(wargaming runs, rock drills, SIMEXs)*

Study Types (1 of 4)

- **Analysis of Alternatives.**
  - **AoAs for expensive systems require extensive rigor and multiple supporting analyses (effectiveness, performance, sustainment, etc.).**

- **Capability Based Assessments (CBA).**
  - **Must understand the relevant concepts and doctrine.**
  - **Must identify tasks and functions, examine range of doctrine, organization, training, materiel, leadership, personnel, and facilities (DOTMLPF) to identify gaps and solutions.**

- **Experimentation.**
  - **Must thoroughly understand the issue area, need subject matter experts.**

- **Quick turn-around studies.**
  - **Must frequently rely on completed or ongoing work to support.**
  - **Conduct very rapid survey of TRAC or local subject matter experts to ensure best information is brought to bear.**

- **OPLAN/CONPLAN analysis.**
  - **This is "real world" life and death stuff.**
    - **CFC OPLAN Analysis.**
    - **CENTCOM Branch Plan Analysis.**
    - **PACOM OPLAN Analysis.**
  - **Requires the best that TRAC can provide.**
  - **Determine who is the ultimate customer decision maker (Commander?, C5 Plans?, etc.).**
  - **Make sure you understand:**
    - **The history, geography, and social/cultural issues of the region/nation.**
    - **The issues, and the politics around the issues.**
    - **The ramifications of the potential answers you provide:**
      - **Logistical costs.**
      - **System development.**
      - **Organizational changes.**
      - **Coalition or host nation impacts.**
  - **Establish good relationships with the action officers in the command.**
    - **Make sure you understand their views and their work requirements.**
    - **They can tell you who to talk to and where to get information.**

Study Types (3 of 4)

- ## OPLAN/CONPLAN (continued)

  - Reach out for support to other agencies.
    - Deployment (TRANSCOM's TEA)
    - Sustainment (TRAC-Lee and CASCOM)
    - Joint Service expertise (theater service component commands, theater level units (engineers, signal, logistics, etc.)
    - Other analytical agencies (CAA, AMSAA, MCCDC, Center for Naval Analysis, Air Force Studies and Analysis and Lessons Learned A9,
    - Others: Army Combined Arms Center, CGSC, and SAMS).

  - Prepare the most concise and focused briefs that TRAC is capable of developing.
    - Ensure "bottom line up front (BLUF)" is early in the brief.
    - CLA must be as sparse as possible (don't assume away or constrain away the problem).
    - Ensure two key questions are answered:
      - Can the mission be accomplished?
      - What does mission accomplishment cost (lives, materiel, dollars)

- **Combined Study (with a foreign nation military or a foreign nation analytical agency).**

- **Combined studies can be any of the other types discussed earlier (AoAs, CBAs, etc.), but are unique because of the following combined aspects:**
  - **Everything takes longer because of the levels of review and vetting inherently involved. Plan accordingly.**
  - **Be careful with foreign disclosure and release issues. Even unclassified information (if not previously released to a country) has to go through the G2 Foreign Disclosure Office (FDO).**
  - **If classified information is involved, work hard up front to get the appropriate classes of info to be disclosed into an international Memorandum of Agreement (MOA). Leverage any existing international agreements (ABCA, US/UK 1448, etc.)**
  - **Work in US on Delegation of Disclosure Authority Letter so that appropriate US authorities can release info without further FDO processing. This will have to go through G2 FDO channels.**

Different Study Approaches (1 of 4)

- **How do you get capability results or outcomes?**

- **Time constraints and availability of resources (models, data, scenarios, etc., will help inform your choice of approaches.**

- **Approaches include:**
  - **Analyze historical data.**
    - **Use reliable sources.**
    - **Try to get "both sides" of the story.**
  - **Analyze or compare test results.**
    - **Developmental tests.**
    - **Operational tests.**
    - **Limited User tests.**

Different Study Approaches (2 of 4)

– **Use a subject matter expert (SME) seminar/workshop.**
- Determine scenario(s) or vignette(s) to use to set conditions.
- Ensure doctrinal (or approved concept) application of capability for base case. Can consider other applications for excursions or sensitivity.
- Ensure that threat or opponent capability or response is considered.
- Assess results of application of capability in scenario or vignette.
- Use consensus, voting, survey, or expert judgment.
- Use risk assessment (impact and frequency) to prioritize.

Different Study Approaches (3 of 4)

- Use a map or board-based wargame,
- Use a computer-assisted map exercise (CAMEX, AAMEX)
- Use a computer model or combat simulation.
- Considerations for the above three approaches include:
  - Determine scenario(s) or vignette(s) to use.
  - Get the right experts into the game. **A good "commander" is necessary to keep the players on task.**
    - Scenarists
    - Doctrine/concept writers.
    - Operaters and warfighters for planning operations.
    - Technical experts to assess capabilities relative to plans.
    - Wargamers and modelers to load, run, get output from the model and make necessary model modifications.
    - Analysts to capture discussions, insights, and data.

Different Study Approaches (4 of 4)

- Ensure doctrinal (or approved concept) application of capability for base case. Consider other applications for excursions or sensitivity.
- Set up a system of game turns to enable adequate time for planners, wargamers, modelers, and analysts to do their job.
- Assess results of application of capability in scenario or vignette.
- Get all the experts and players into the discussions of results to help verify inputs and validate outcomes.
- Get the results written down and recorded early so that players can review and comment before "memory dump".

Note: Model or simulation doesn't have to be combat model, could be a spreadsheet or a process model like ARENA.

Study Scenario Identification

- **What is the force year (e.g. 2017)?**
  - Is Red a different force year than Blue?
- **Does study need organizations or equipment that differ from those already defined for this force year (may be study alternatives)?**
- **What are the geographical location of scenario(s)?**
- **Are scenarios Defense Planning Scenario (DPS) and/or Multi-Service Force Deployment (MSFD) compliant and TRADOC approved?**
- **Is an approved TRADOC operational scenario available?**
  - Update force year.
  - Update force structure/equipment.
  - Update concept of operation.
  - Expand existing annexes (logistics, intel, etc).
- **Is dynamically gamed scenario available or planned?**
  - Updates to force structure/equipment/TTP.
  - Additional functionality required (See ARDEP process).
  - Weather considerations.
  - New data/data update from AMSAA.

Scenario Data (1 of 2)

Operational Data

- **Force structure/task organization (All Sides).**
- **Table of organization and equipment - TO&E (All Sides).**
- **Weapons, Munitions, and Sensors List - WMSL (All Sides).**
- **Operational plans down to lowest HQs unit (All Sides).**
- **Supporting plans.**
- **Start time, date, and force year of scenario (All Sides).**
  - **Example: 02 June 2010 0600.**
- **Starting conditions (locations, unit strengths, IPB, etc).**
- **Location of game (Terrain box).**
  - **Lat/Long, lower left/upper right, grid square size.**

Scenario Data (2 of 2)

Operational Data (all sides) con't.

- Unit mission.
- Commander's intent.
- COA Sketch to brigade level.
- Synchronization matrix.
- Decision support template.
- Sensor deployment plan.
- Priority information requirements (PIRs) down to Brigade.
- Direct fire pairings input.
- Flight altitude (RW, FW, Sensors).
- Communications network.
- Message priority.
- Trigger points for plan.
- ROE/TTP.
- Air task order.
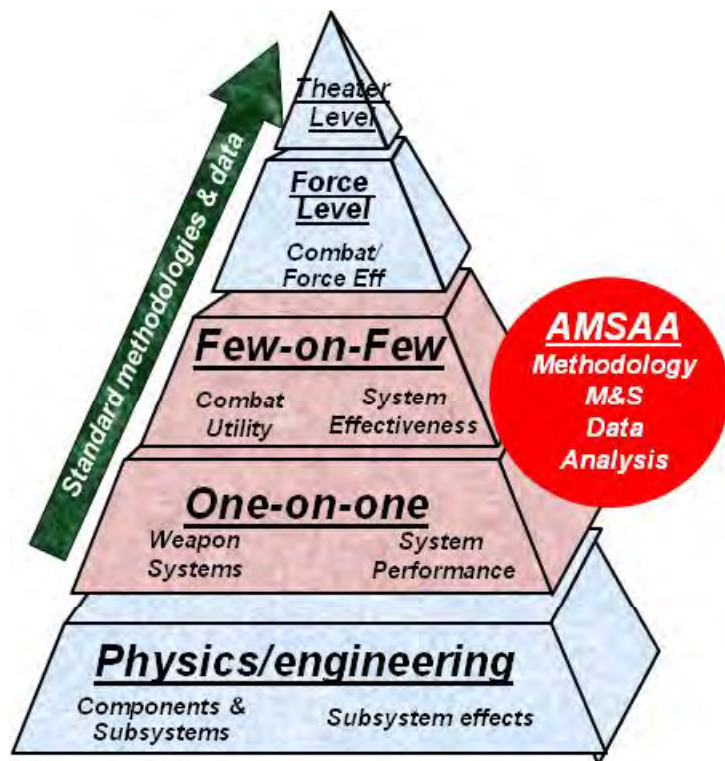- Air Control Measures.
- Obstacle plan.

Identifying Data Needs

- **General.**

- **AMSAA's role.**

- **Data Portal.**
  - **Data request software.**
    - **Standard Nomenclature Database.**
    - **Electronic Data Request System (eDRS).**
  - **Data request review process.**

- **Other data sources**

General Data Needs

- **System Performance Data (all sides)**
  - Firers and Firer-target pairings
  - Sensor performance
  - Vehicle performance
  - Munitions effectiveness

- **Unit Operational Data (all sides)**
  - Tables of organization and equipment
  - Unit or element tasks and standards
  - Unit behaviors
  - Tactics, techniques, and procedures for the warfighting functions

- **Network data (communications and battle command)**

- **Terrain**

- **Weather**

AMSAA's Role in Weapon Systems Analysis

Commodity Areas + **Performance & Effectiveness Areas**

Commodity Areas	Performance & Effectiveness Areas
Air Defense	Delivery Accuracy
APS/CAPS	Combat Identification
Armor	Rate of Fire
Artillery	Terminal Effects
Aviation	Mobility
Command & Control	Target Acquisition
Digitization	Vulnerability
Dismounted Infantry	Signature Management
Mechanized Infantry	Active Protection
Mines	Reliability
Target Acquisition	Delivery Accuracy

AMSAA is Army's Executive Agent for item level performance VV&A

AMSAA Performance Estimate Data System (APEDS)
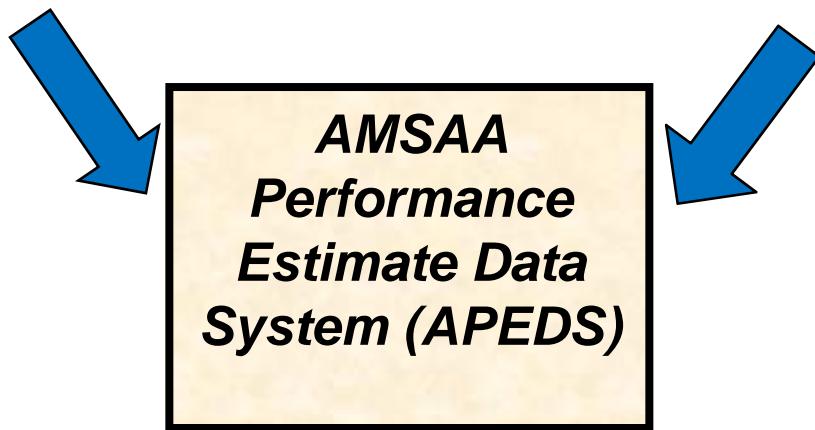
Data Portal

Central hub for Army study process data resources .

AMSAA Data Request Software

Standard Nomenclature Database (SND)
Community standardize names for equipment
  - System
  - Weapons
  - Munitions
  - Abbreviations
Propose new names
Synchronize local databases

Electronic Data Request System (eDRS)
Framework for building data requests.
Imbedded pairing generation algorithms
Direct interface with the SND and APEDS for streamlined processing
Extensible

Note: Both SND and eDRS were initially developed by TRAC and later adapted by AMSAA.

Performance Data
eDRS

- **Performance data is requested from AMSAA using the electronic data request system (eDRS) software.**
  - **Use Weapons / Munitions / Sensors List (WMSL) to create eDRS request (Study rep/SWGD/TRADOC G2).**
  - **Direct fire pairing software generates a platform, weapon, munition versus platform pairings file. Results of this file should be reviewed by the study team to ensure appropriate pairings for the scenario.**

- **Other eDRS data include:**
  - **Platform and system characteristics.**
  - **Munition lethality/accuracy.**
    - **LOS (guns and missiles).**
    - **NLOS (guns, rockets, missiles; area and point).**
    - **Fixed wing/rotary wing munitions.**
    - **Air defense (guns and missiles).**
    - **Mines.**
  - **Intelligence sensor capabilities (ground and air).**
  - **LOS system acquisition.**

- **AMSAA must certify technical data.**

Standard Nomenclature Database (SND)

- **Project Description**
  - **Review and populate US nomenclatures (e.g., platforms, weapons, munitions, etc.) and associated linkages (e.g., platform-weapon-mount).**
  - **Adjudicate differences and submit agreed on updates (additions, deletions, and/or updates) via SND.**
- **Details/Sample**
  - **Baseline Tables: SND_Platform, SND_Weapon, SND_Munition, etc.**
  - **Linkage Tables: SND_OBW (platform-weapon-mount).**
  - **Make-up of SND Platform:**
    - **(a) Side**
    - **(b) Platform Name**
    - **(c) Category**
    - **(d) Origin**
    - **(e) Area**
    - **(f) Classification**
    - **(g) MIDB Code**
    - **(h) Description**

AMSAA Data Request Review Process

Customer

Take the Order

Provide the data

Data Center

Retrieve data

Database

Data Quality

Data review, internal standards

Use the right tools to generate data

Standard Models

Get new input data

Suppliers (ARL, NGIC)
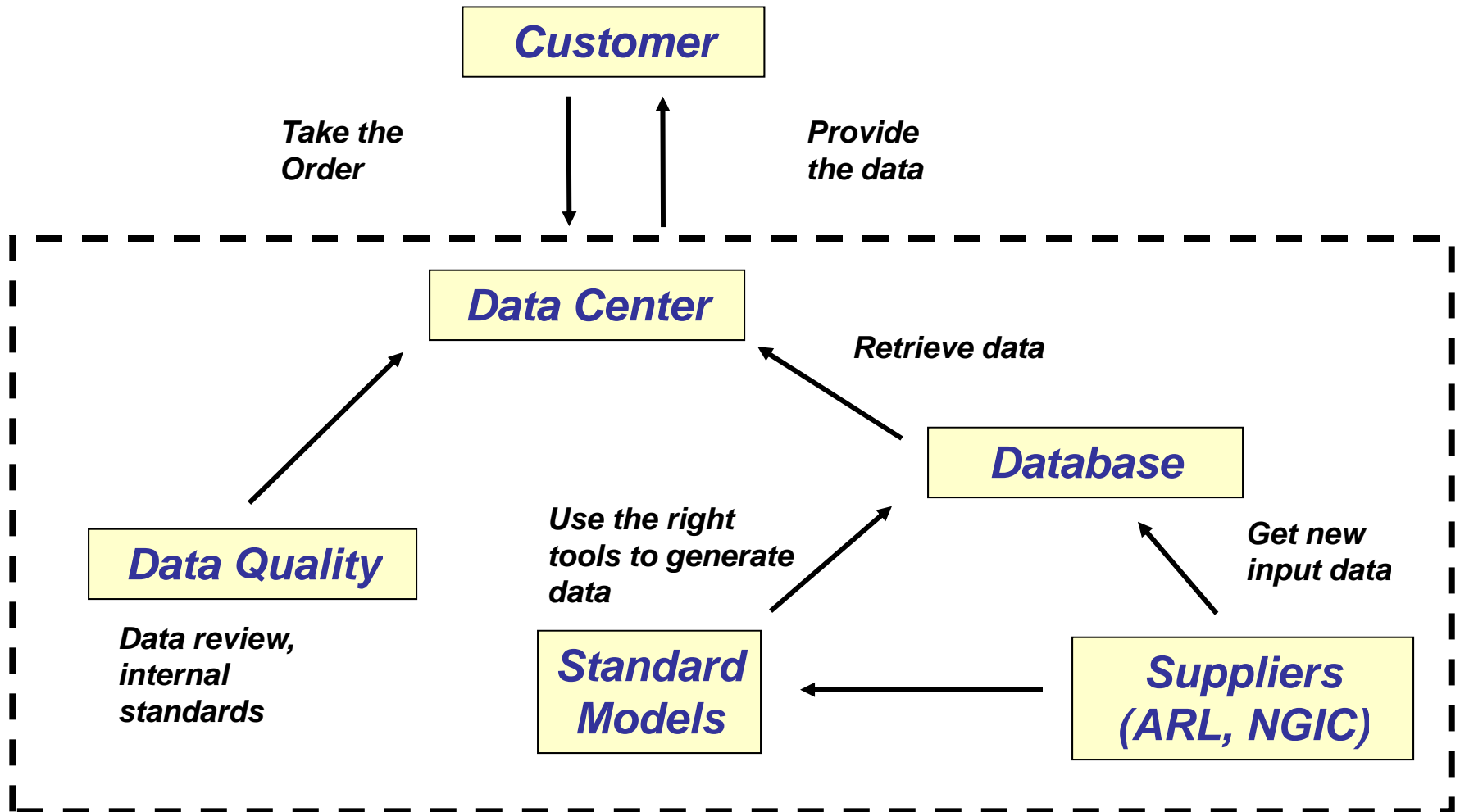
Data Sources

- **AMSAA / Data Division, SWGD** - **Performance data.**

- **TRADOC G2** - **Threat / coalition representation.**

- **Marine Corps Combat Development Center.**
  - **Amphibious operations landing plans.**

- **TRADOC Force Design Directorate** - **Force structure and unit designs (TOEs)**

- **ARCIC, CGSC, CAC, SAMS** - **Future concepts, doctrinal issues.**

- **TRADOC Schools, Centers and Battle Labs, TCMs.**
  - **Operational data, TTPs.**

- **TRAC-LEE/CASCOM** - **Sustainment / maintenance data.**

Identifying Threat Enhancements

- **Review study issues.**
    - Do study issues require modification to the threat to enable assessment or evaluation of a specific capability? Possibilities include:
        - A change in threat force year to determine robustness of the capability against post-fielding threats (organization, quantities, threat systems and capabilities).
        - A change in threat tactics, techniques or procedures that respond to fielding of the capability being studied (reactive threat).
        - A change in threat equipment (through purchase from international sources or other means) to counter the capability being studied.

- **Coordinate with threat experts from TRADOC G2:**
    - Confirm need for threat modification
    - Identify specifics of changes.

- **Coordinate with modelers, war gamers, and data subject matter experts to identify approaches to make needed modifications.**

Identify Model/Tool Development/Enhancements

- **Review study issues.**
  - Do study issues require a tool or model?
    - Can current tools/models be used?
      - Example: ARENA for the Operational Maneuver Analysis.
      - Example: OPNET for Commo studies.
    - If not, can a new tool/model be developed in time to support the study?
  - If study issues require an operational effectiveness evaluation, can AWARS or Combat XXI be used?
  - If model functionality is not sufficient, what needs to be done to add or complete functionality?
  - Is there sufficient time to do model enhancement or functionality development?
  - If so, provide requirements to model requirements development process.

AWARS Requirement Development Process

> **Purpose: Provide a recommended list of prioritized requirements to Dir, TRAC-FLVN for approval.**

- **AWARS Requirement Development Process (ARDEP) Overview:**
  - Develop, deconflict, maintain, and prioritize requirements, including input from external organizations.
  - Ensure the approved requirements are appropriately captured in MMD's detailed implementation plan.
  - Evaluate the implementation through the V&V effort to ensure the requirements are sufficiently met.
  - Identify any delays/problems regarding the implementation effort or potential changes in priorities to Dir, TRAC-FLVN for resolution.
- **The AWARS Requirements Working Group (ARWG) facilitates implementation of the ARDEP process.**

ARWG Responsibilities

The ARWG serves as the single POC for all AWARS requirements and provides oversight of the V&V process.

The overall responsibilities of the ARWG include:

- Review AWARS requirements submitted by individual directorates, study teams, and other organizations for correctness and appropriateness.

- Ensure accepted requirements are well-defined and appropriately documented and their associated acceptability criteria are adequately defined and measurable.

- Identify requirements to further AWARS development.

- Submit requirements for approval and recommend development priorities.

- Maintain configuration control of AWARS requirements.

ARDEP Process

Requirements identified

Long-Term Reqts
Short-Term Reqts

Line Directors approve and prioritize requirements from directorate (Quarterly or as required)

Directorate ARWG Rep. submits requirements as PARs

Rejects

ARWG screens PARs Quarterly to determine if requirement is appropriate for AWARS (Quarterly or as required)

Accepts

ARWG recommends against AWARS to Individual/ Study Leader

Individual/ Study Leader refines requirement

Update database on why rejected

ARWG accepts requirements

Line Directors prioritize requirements for review (Jul/Jan)

Individual/ Study Leader refines criteria

SWGD identifies scenario, data & testing requirements

MMD identifies resource requirements and timelines (short/long term)

Requirement not implemented

ARWG consolidates requirements and recommends priorities

Line Directors refine priorities and resources (Oct/Apr)

Finalize recommendations for Work Program

Director TRAC-FLVN approves requirements and priorities for the Work Program (Oct/Apr)

ARWG develops new timeline

MMD develops implementation plan

Individual/ Study Leader develops testing strategy and V&V Plan

Requirement Development Example

Requirements identified

We need to replicate logistics at the Bde and above.

- Class III & V
- Maintenance
- Convoy Operations
- Battle Command

Directorate ARWG Rep. submits proposed requirements to ARWG

AWARS must replicate Class III and V resupply from the theater assets down to combat Bdes

- Resupply requests must be generated by units.
- Supply request processed by receiving unit.
- Supply convoy dispatched

Individual/ Study Leader refines requirements / testing criteria

SWGD identifies scenario, data & testing requirements

MMD identifies resource requirements and timelines

AWARS must replicate Class III and V resupply from the theater assets down to combat Bdes.

- **Resupply requests must be generated by units.**

-Unit must generate USTM message for required supplies.
-Message must have options for timed resupply, percentage resupply, and emergency resupply.

- **Supply request processed by receiving unit.**

-Receiving unit must compare request to balance on hand and transport capability.

-Unit determines priority of supplies.
-Unit fills request or forwards it to next higher HQ if unable to fill.

- **Supply convoy dispatched.**

-Unit determines method of resupply between ground and air. -Unit allocates transport assets.   -Assets removed from unit pool until convoy returns.
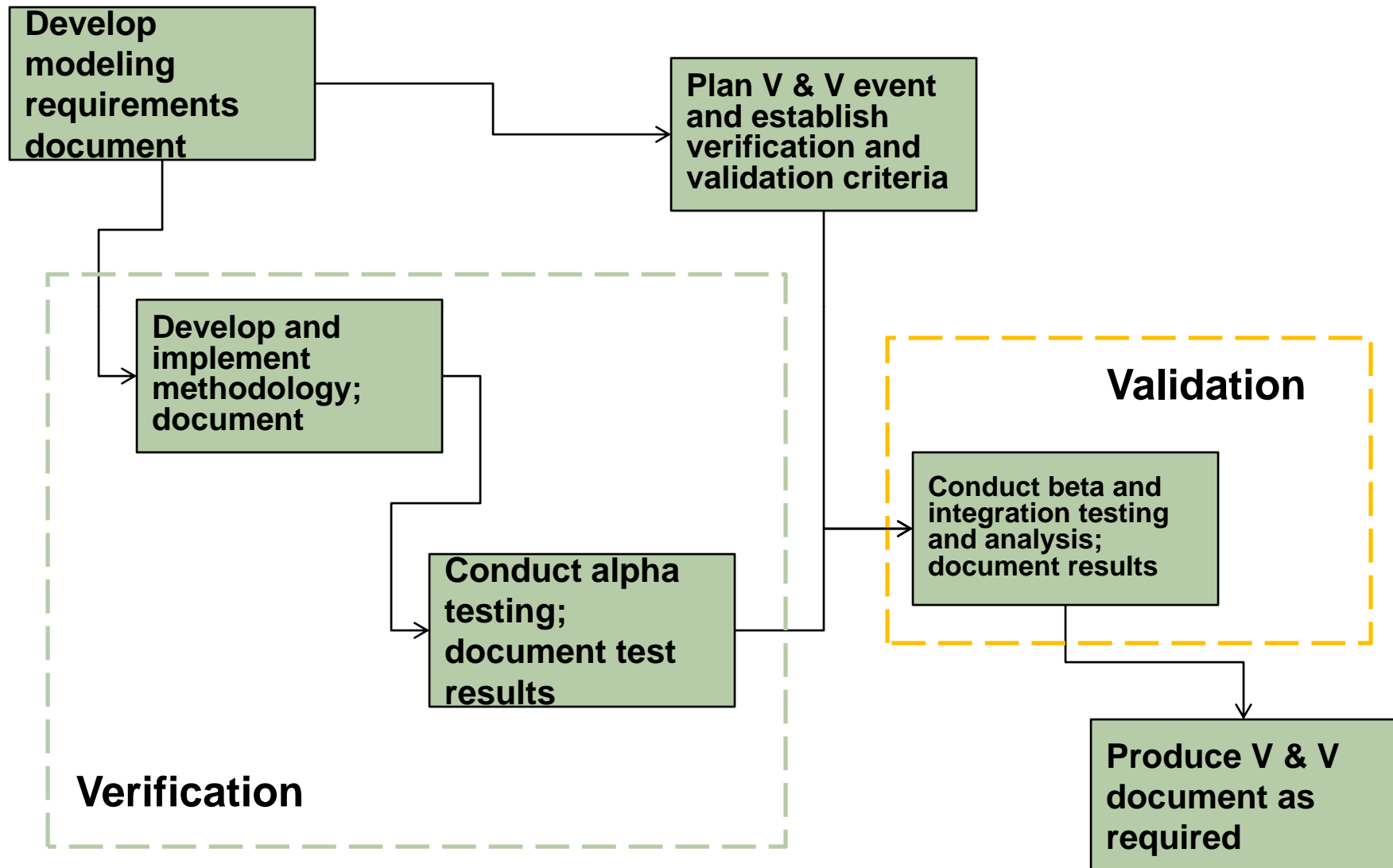
Verification and Validation of Data and Models

- **Verification – The process of determining that a model implementation and its associated data accurately represent the developer's conceptual description and specifications.**

- **Validation – The process of determining the degree to which a model and its data provide an accurate representation for the intended uses of the model.**

- **Accreditation – The official certification that a model, simulation or federation of models and the associated data are fit for use for a specific purpose.**

AWARS Data Verification

- **Performance data from AMSAA.**
    - **First line review by SWGD-DDD.**
    - **Additional verification by APE to ensure data set is complete and matches the scenario data.**
    - **Evaluation of performance data throughout the scenario validation process.**

- **Operational data from various sources.**
    - **Scenario threat data review conducted by TRADOC G2.**
    - **Scenario friendly data review conducted by study team and AWARS wargamers.**

Example V & V Process

Develop modeling requirements document

Plan V & V event and establish verification and validation criteria

Develop and implement methodology; document

Conduct alpha testing; document test results

Verification

Validation

Conduct beta and integration testing and analysis; document results

Produce V & V document as required

V & V Documentation

- **Requirements document.**

- **Methodology design document.**

- **Test plan.**

- **Testing documents.**
  - **Scenario setting information.**
  - **Expected results.**
  - **.Measurement criteria.**
  - **Actual results.**
  - **Validation or assessment of results.**

- **V & V document.**

V & V for AWARS

- **V&V conducted for all three AWARS builds.**
  - **Build I V&V June 2003.**
  - **Build II V&V   March 2007.**
  - **Build III V&V   April 2008.**

- **AWARS accreditation.**
  - **Signed by Mr. Magee July 2008.**

AWARS Run Validation
(Iterative Process)

- **Ensure flow of battle reflects general intent of the operational scenario.**

- **Verify transition triggers.**

- **Conduct functional area verification.**
  - **Systems firing?**
  - **Sensors detecting?**
  - **NAIs/TAIs activating?**
  - **Aircraft flying when expected?**
  - **Units requesting and receiving supplies?**
  - **Obstacles being emplaced or breached?**
  - **Are units communicating?**

- **Assess overall run for "reasonableness".**

- **Apply changes (data, plan, model or operational concept).**

Develop Queries

- **Study issues drive the essential elements of analysis.**

- **Essential elements of analysis lead to measures of effectiveness or measures of performance.**

- **Getting the measures of effectiveness or measures of performance out of a combat simulation or computerized war game requires queries or standardized output.**
  - **Example: AWARS has a number of standard outputs**
    - **Killer-Victim tables**
    - **Unit strength reports**
    - **Etc.**

- **Getting at some of the other measures may require specifically designed queries.**

- **Don't forget to look at measures over time of the scenario. For example, one alternative may have accomplished its mission and defeated the enemy by hour 24 whereas another alternative may have done essentially the same thing by hour 18. If you look at the results only at hour 24, you won't see the difference.**

-

Good Queries Require Scenario Understanding
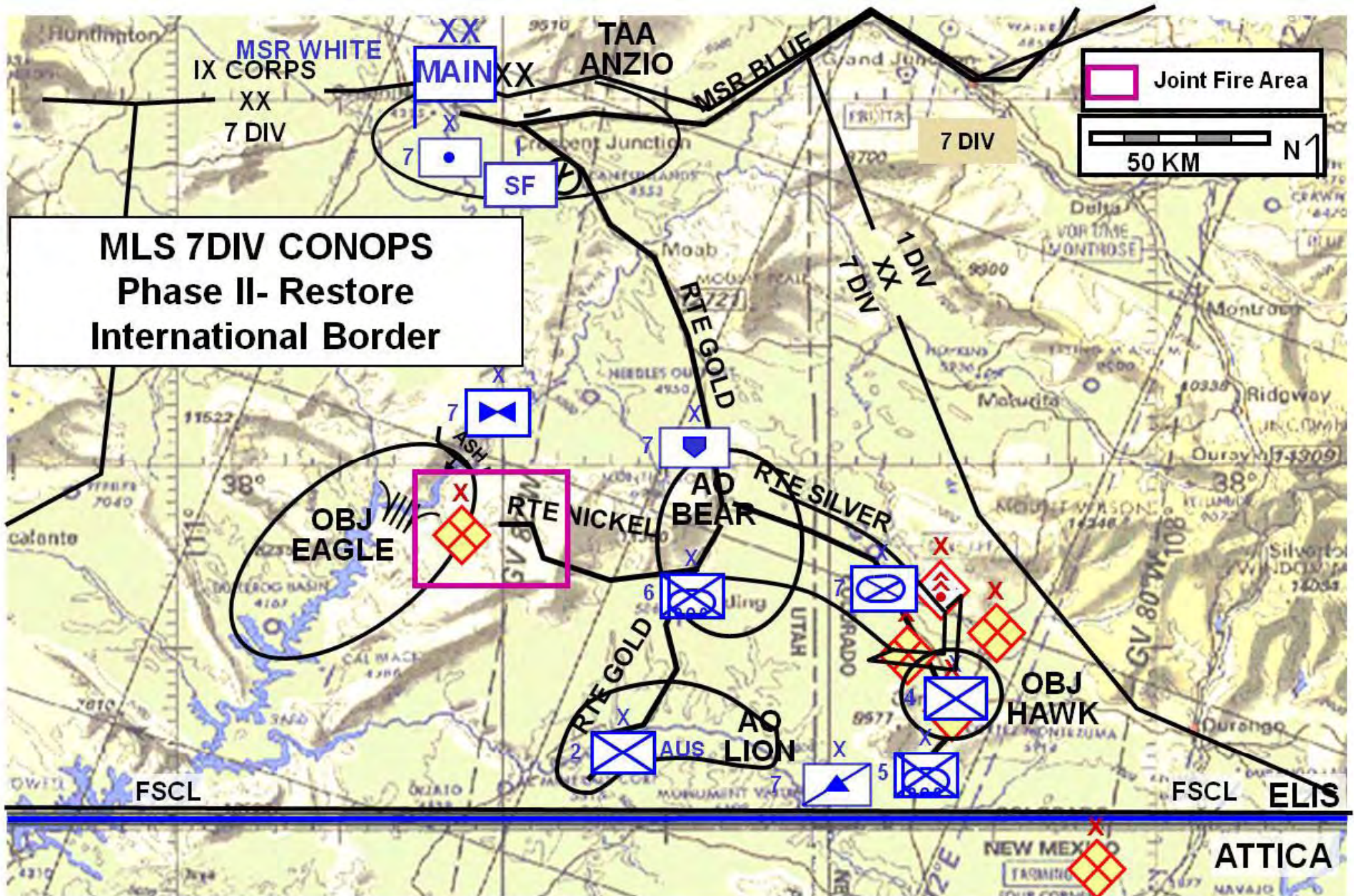
Query Example 1: MLS Helo Kills on Obj Eagle
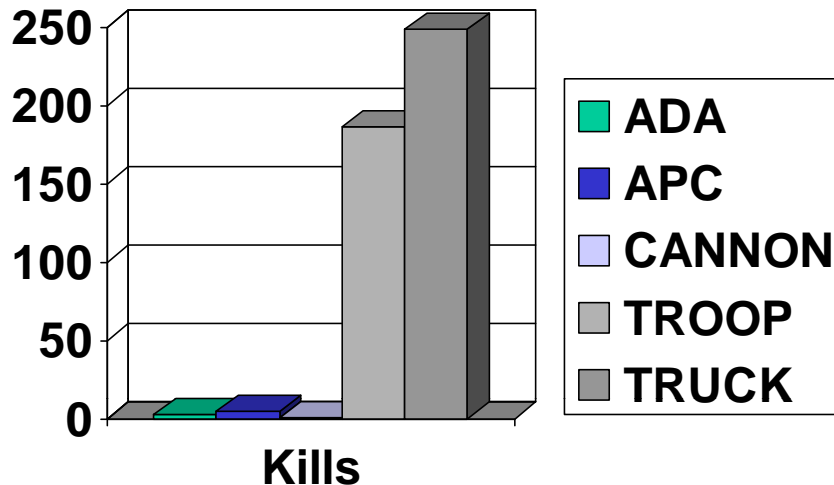
Victim	Kills
ADA	2.3
APC	4.7
CANNON	0.2
TROOP	186.3
TRUCK	248.6

```
-- Blue Helo kills on Obj Eagle

USE mls1_24Nov

SELECT Victim=v.category, Kills=sum(kv.kills)

FROM   kv JOIN kvcat v ON kv.vplatform=v.platform

WHERE  kv.type='HELO' AND kv.kside='Blue' AND
       targetx> 538 AND targetx<588 AND
       targety>4173 AND targety<4213

GROUP BY v.category

HAVING sum(kv.kills)>0.05
```

IFPC Issue

- **Issue 1. How does each intercept alternative contribute to operational effectiveness generated by Indirect Fire Protection Capabilities and what are the operational and tactical attributes that define the alternative's contribution?**

    - **EEA 1.4: What is the overall operational effectiveness benefit of each alternative?**

        - **Rick's MoM: How many missions and kills resulted from counterbattery radar sensings?**

IFPC Artillery Example

```
-- Number of Cbty Missions
SELECT Sensor, Missions=count(*)
  FROM artyhist
 WHERE missionOrigin='CBTY'AND
       FiringUnit like 'B%'
GROUP BY sensor
```

```
-- Kills by Cbty Missions
SELECT kv.kplatform, Victim=v.category,
       Kills=sum(kills)
  FROM (kv RIGHT JOIN artyhist a ON
        a.missionId=kv.missionId) LEFT JOIN
        kvcat v ON kv.vplatform=v.platform
 WHERE kv.type='IDF' AND a.missionOrigin=
       'CBTY' AND a.FiringUnit like 'B%'
GROUP BY kv.kplatform, v.category
```

Sensor	Missions
AN/TPQ-37	19

Killer	Victim	Kills
M109A6	CANNON	2.7
M109A6	MRL	8.7
M109A6	TROOP	94.1
M109A6	TRUCK	21.8

Logistics Example

```
-- Number of fuel only convoys
SELECT Convoys=count(logRequestId)
  FROM log transport Supplies
 WHERE LogisticsPackageName like 'FO%'
```

```
-- Total amount of fuel given to unit
SELECT amtGiven=sum(amountGivenToUnit)
  FROM log_resupplyActions
 WHERE supply='fuel-1'
```
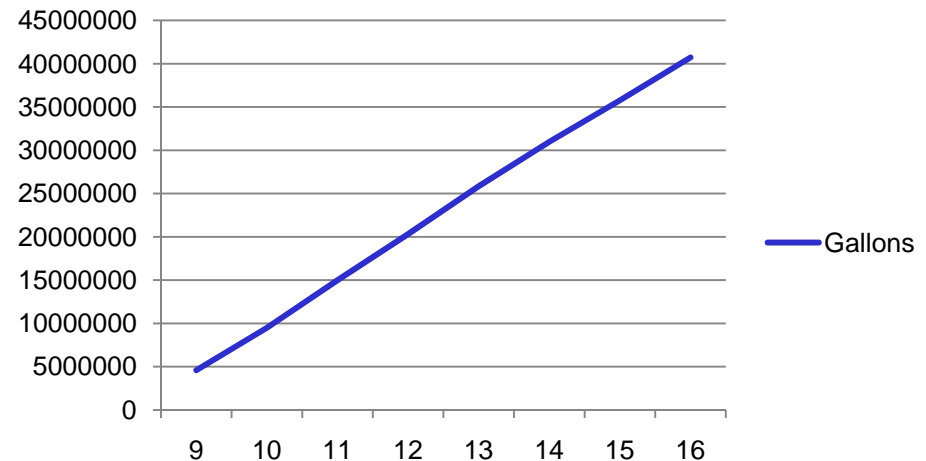
Convoys
544

amtGiven
10997419

Logistics Usage Example
(*measure over time*)

```
-- Cumulative fuel used
SELECT Day=d.dd, Gallons=sum(amountBurned)
  FROM #days d left join log_fuelBurned f on f.dd<=d.dd
 GROUP BY d.dd
```

Day	Gallons
9	4581765
10	9493570
11	14987309
12	20317438
13	25840787
14	30988907
15	35770515
16	40723575

Cumulative Fuel Burned Over Time

Practical Exercises

Log on to the MCN-S.

1) Run the "number of counter-battery missions" query shown on slide 40.

2) Run the "helicopter kills on Objective Eagle" query from slide 38.

3) Modify the helicopter query to find the total helicopter kills (in and out of Objective Eagle).

Using the Query Analyzer

- **If you have the SQL Server Client tools on your machine**
    1) **Start the Query Analyzer**
    2) **Enter the Query in the top window**
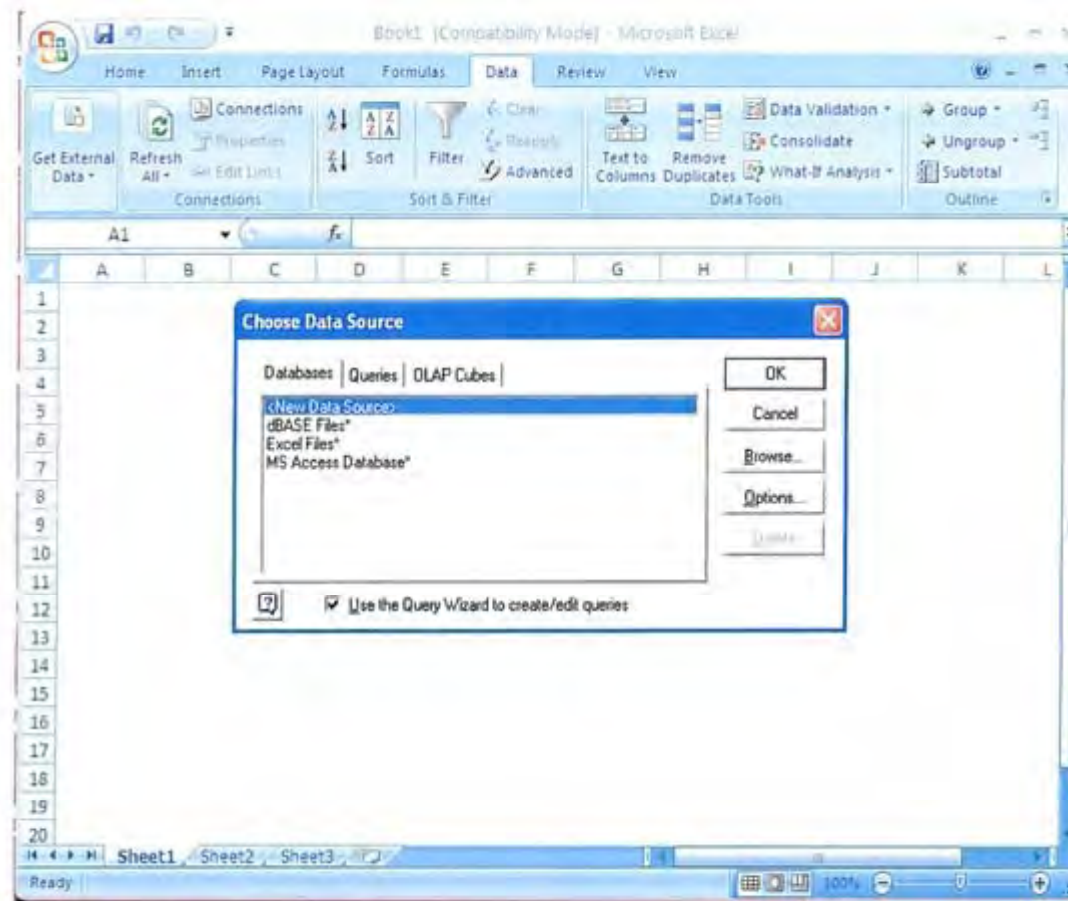   3) **Press F5**
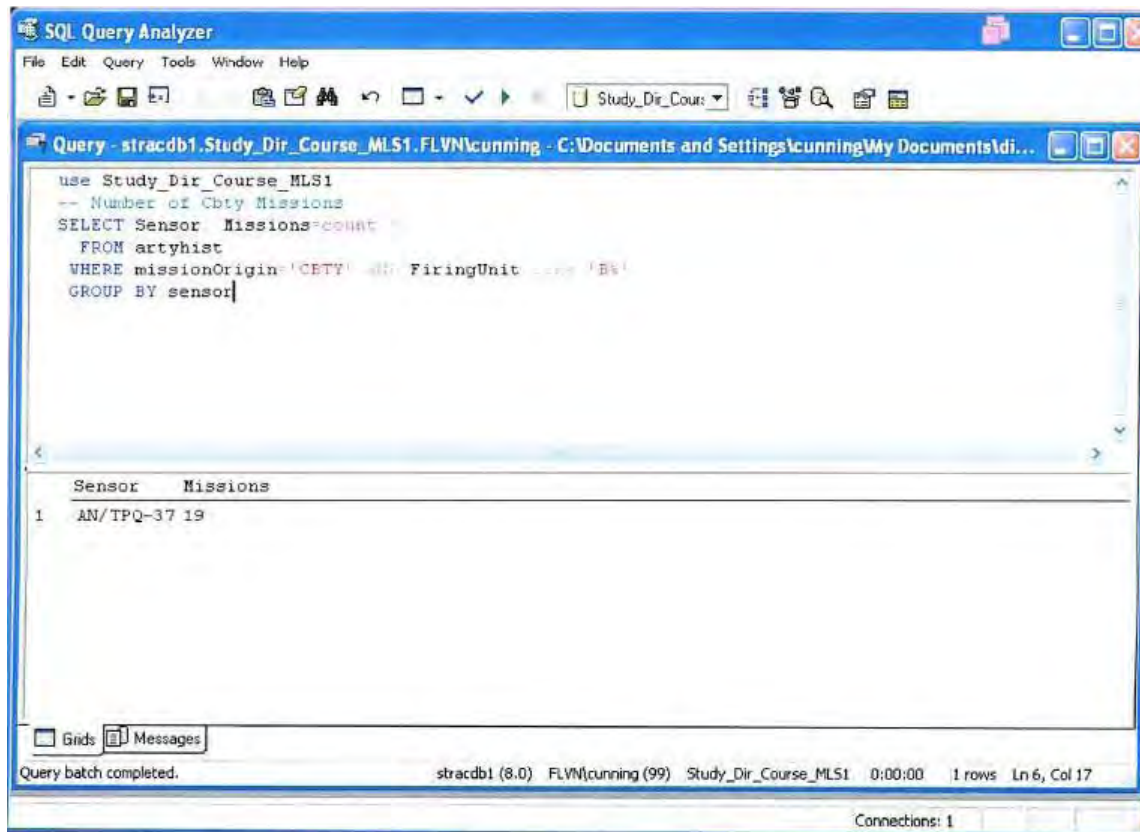
Using Microsoft Query (1/8)

- **If your machine doesn't have the SQL Server client, there is a query tool built into Excel.**

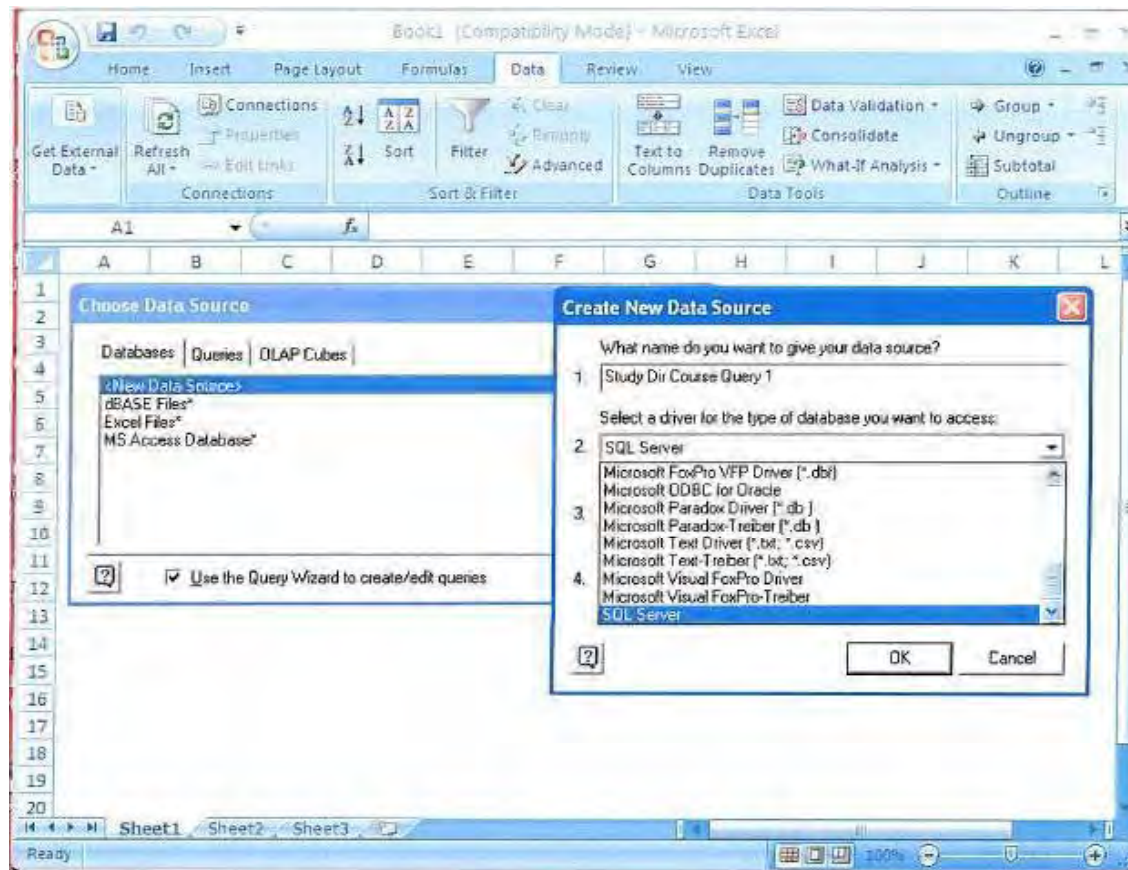- **On the "Data" tab, select "Get External Data" "From Microsoft Query".**
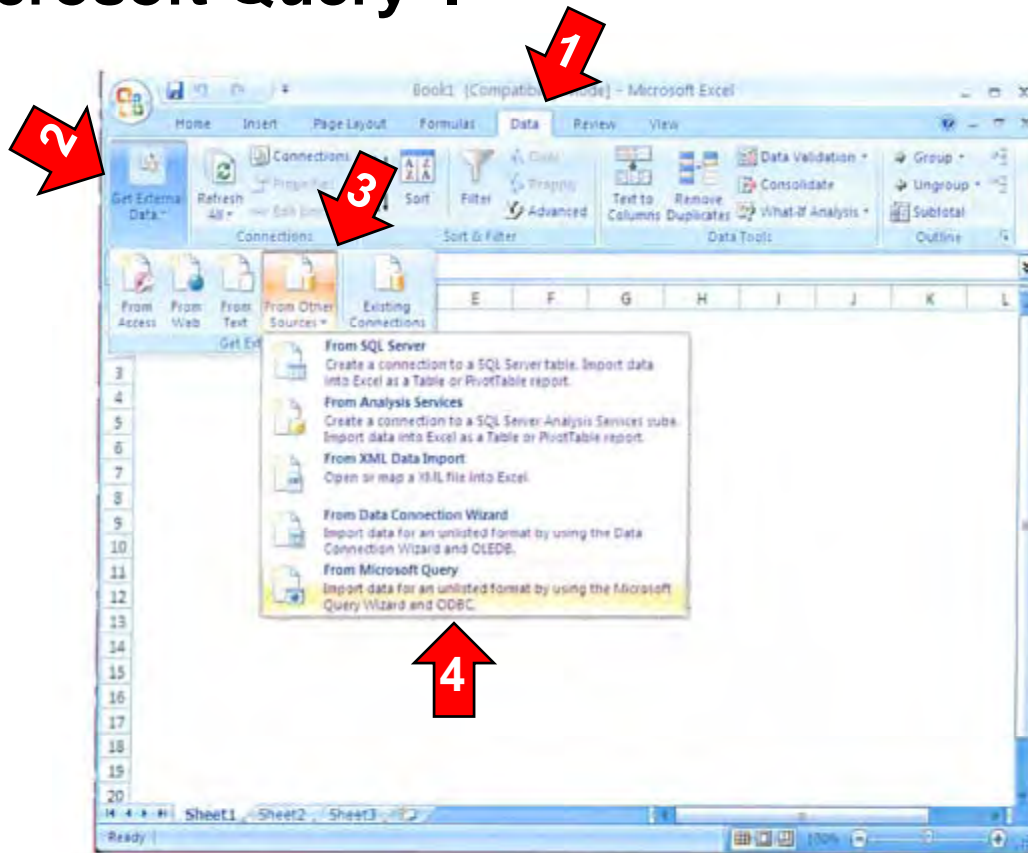
Using Microsoft Query (2/8)
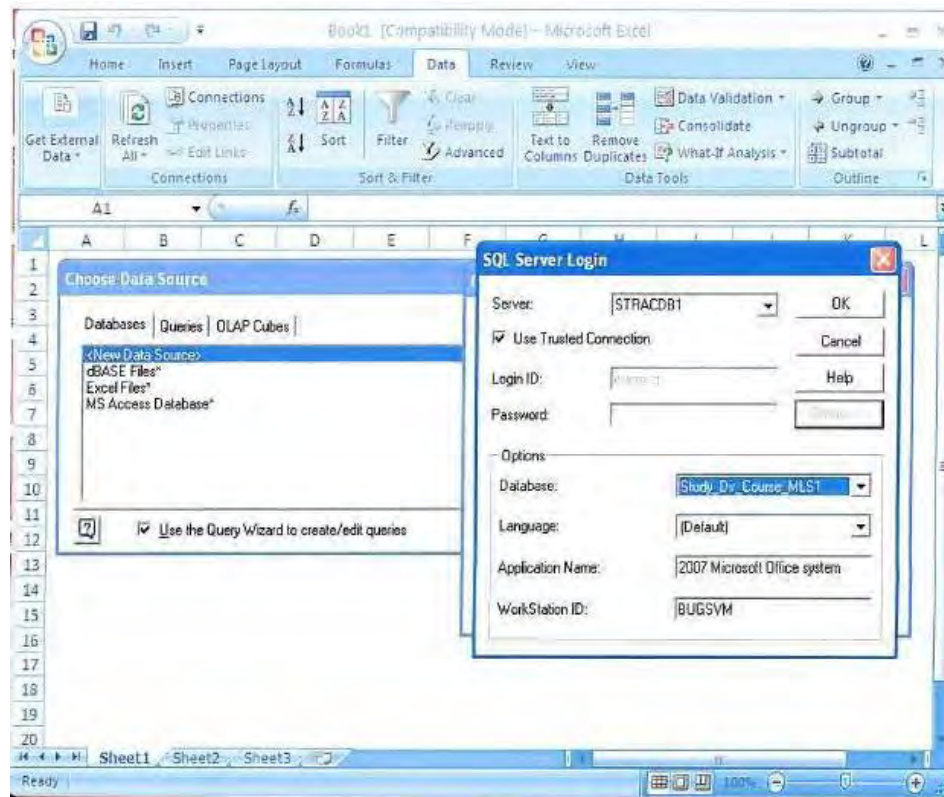
- **Select "New Data Source"**

- **Click the "OK" button**

Using Microsoft Query (3/8)

- **Enter a data source name**

- **Select the SQL Server Driver from the drop-down list**

- **Click the "OK" button**

Using Microsoft Query (4/8)

- **Enter the server name ("STRACDB1")**

- **Select "Use Trusted Connection", click on "Options"**

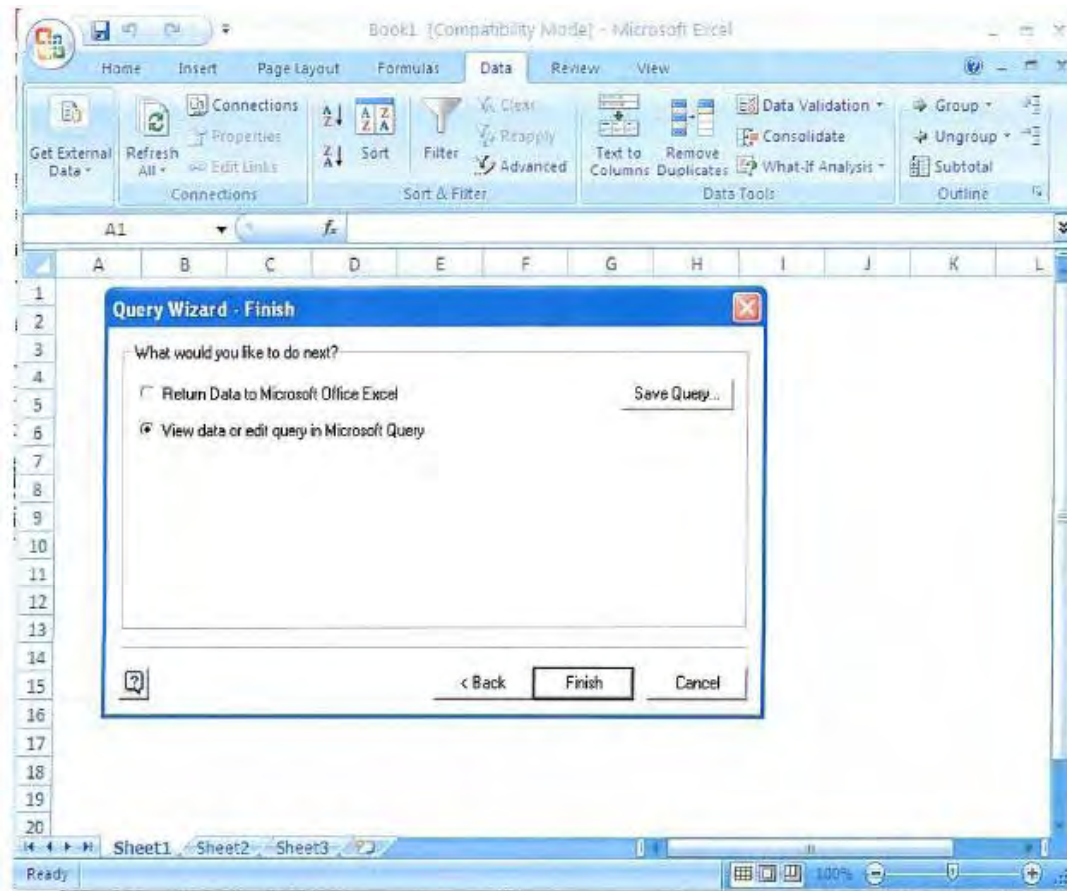- **Select the database name from the drop-down list ("Study_Dir_Course_MLS1")**

Using Microsoft Query (5/8)

- **Select the desired column name (in this case "Sensor") in the left pane and click the "right arrow" button to include the column in the query.**

- **Click "Next".**
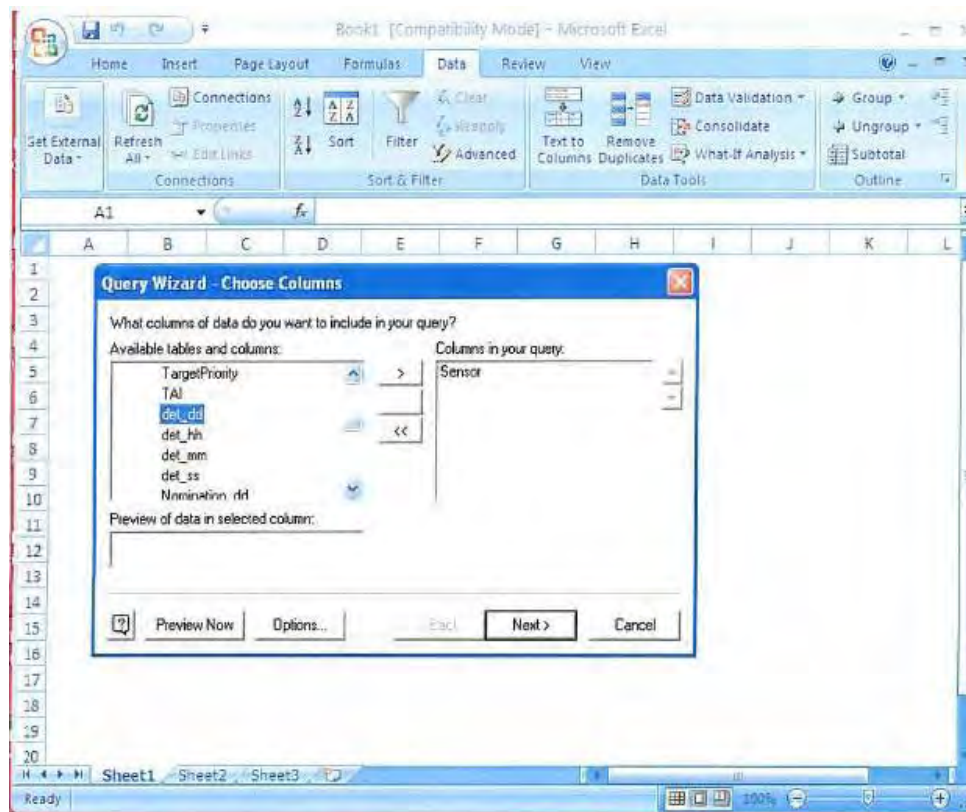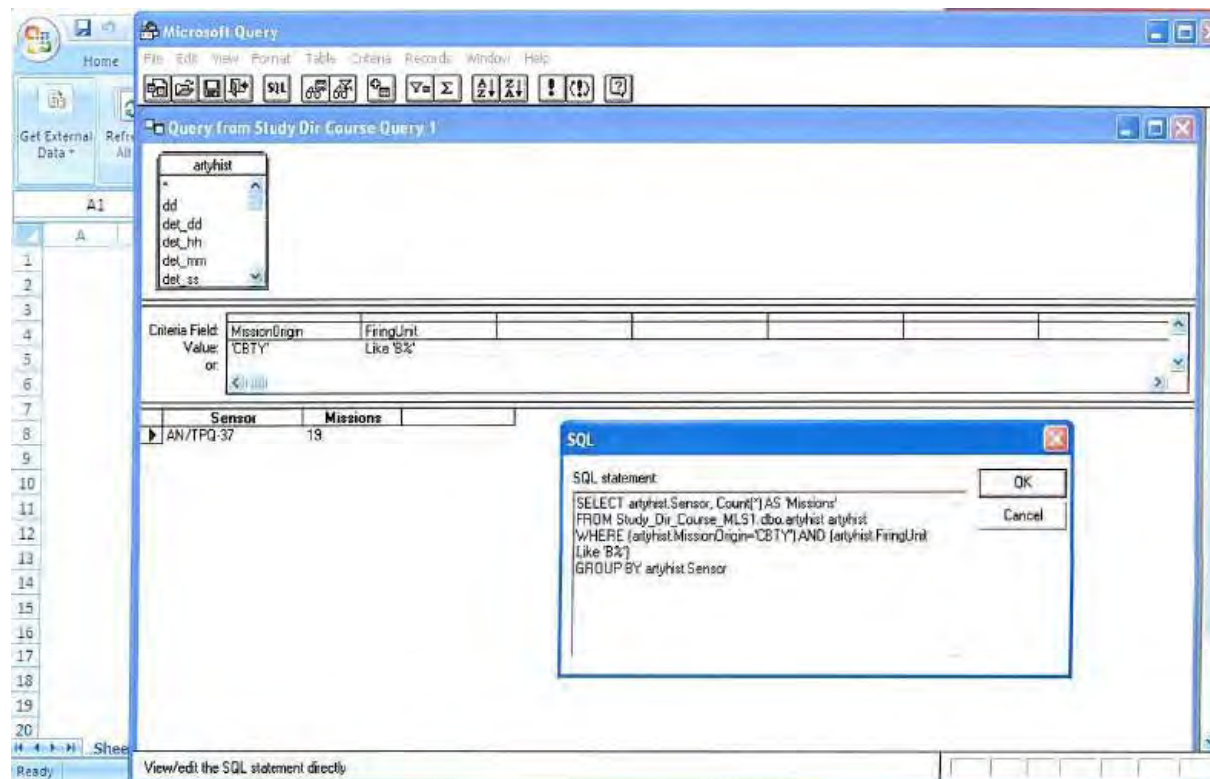
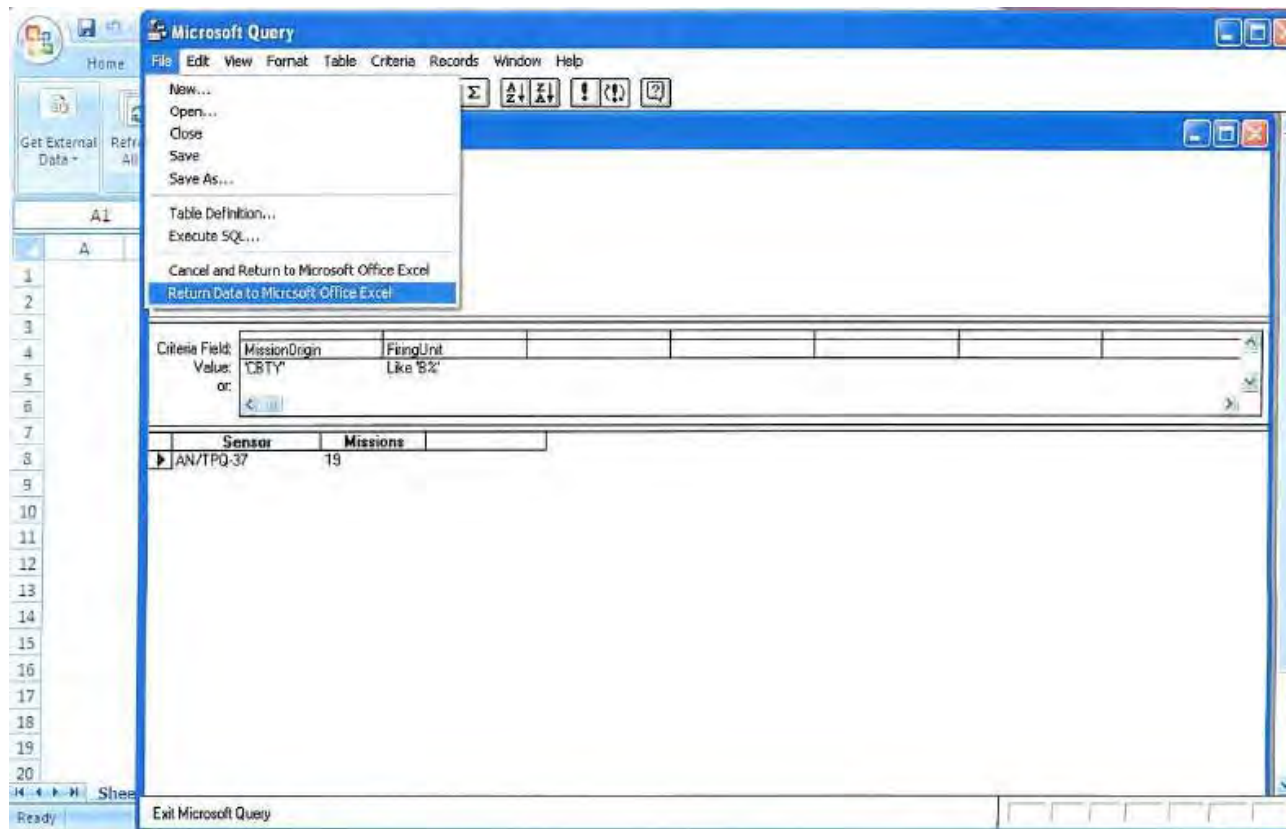- Select "View data or edit query in Microsoft Query"

- Click the "Finish" button

Using Microsoft Query (7/8)

- **Now we're ready to get started.**

- **Add criteria fields and summation, or use the SQL button to edit the query.**

Using Microsoft Query (8/8)

- **Finally select "Return Data to Microsoft Office Excel".**

Develop Outline and Begin Final Report

- **Prepare outline that is a logical description of the work that will be done.**

- **Ensure inclusion of appropriate constraints, limitations, and assumptions.**

- **Carefully describe the relationship between issues, EEA, MOE, MOP, and the wargaming, computer simulation, or other analytical tool work that will be done.**

- **Identify which MOE/MOP are being gathered from each analytical method or tool.**

- **Draft out the appropriate graphs/charts that will communicate the findings.**

- **Carefully label the graphs.**
  - **Descriptive title.**
  - **Appropriately labeled axis or column/rows.**
  - **Proper legend.**
  - **Consider lines and bars may not be printed in color so should be able to distinguish between cases.**

Conduct Runs

- **Study plan (or analysis plan) describes the base case and alternatives to be considered.**

- **If using combat simulation and the number of alternatives are extensive, consider methods of optimizing the run design matrix to reduce the number of model runs while still gaining the appropriate data for MOE and MOP within the comparison points.**

- **If using seminar wargame or human in the loop games, consider the effects of the "learning curve" on the results.**
  - **Use a test game to work out "kinks" and allow necessary learning by gamers/players.**
  - **Wargame one or more of the alternatives first, then come back and game the base case.**

- **Goal is to get most objective comparison possible, not inadvertently favor a later alternative because players were then more knowledgeable and understood how to "game" the results.**

- **Ensure that all the runs are validated, particularly if an alternative required some model changes, data changes, or a change in the scheme of maneuver.**

Questions

What are your questions?

Study Directors' Course
Analysis Phase

Peg Fratzel

Depuy Auditorium

19 May 2009

Introduction

Purpose

Describe the study director's role in the process of analysis.

Outline

- **Leadership lessons.**

- **The role of the study director.**
    - Lead and direct the study.

    - Ensure the quality of the analysis.

    - Understand and integrate the analysis results.

- **Standards for analysis.**

Leadership Lessons

- **Know what you want to do. It's hard to get others to do what you want if you don't know what you want.**

- **Tell people what to do, not how to do it. Recognize that while you may be very smart and very well educated, you are not smarter than everyone on every topic.**

- **Do your homework. Before starting a new challenge, find out how others have succeeded or failed. Learn as much as you can at the beginning. Always learn, always think.**

- **Lead by example. Push your people hard; demand a lot of them. But always work harder than they do.**

- **Demand excellence, not perfection. Expect hard work and commitment. Don't expect everyone to do as much or as well as you, but insist that they do as much and as well as they can.**

- **Take care of your people. Know them as individuals: their strengths, weaknesses, aspirations, fears. Take the criticism from outside the group, but let each of them take the praise for what they contributed.**

- **Be humble.**

- **Have character. Be honest and truthful. Be dependable. Don't waffle on your principles.**

The Best Leader I Ever Knew,
by F. John Reh, About.com

Lead and Direct (1 of 2)

- **Visualize the end state** *(know what you want to do; do your homework)*.
    - What do you think the answer is?
    - What are the most critical tasks to achieve the end state?
    - How will you present the results?
- **Build the team** *(you're not smarter than everyone; be humble)*.
    - Partner with the right agencies and people to get the job done.
    - Showcase their contributions *(take care of your people)*.
- **Clearly communicate guidance, priorities and expectations** *(demand excellence, not perfection)*.

Discussion topic: What are some of the challenges and approaches associated with these tasks?

Lead and Direct (2 of 2)

- **Oversee the study/analysis team(s), internal and external** *(tell people what to do, not how to do it)*.
  - **Establish the study organization and relationships.**
  - **Assign responsibilities.**
  - **Coordinate the schedule; monitor and assess progress.**
  - **Establish "SDCIR".**
- **Maintain the study schedule, modifying plans and communicating changes as necessary and managing risk** *(be dependable)*.
  - **Maintain alignment with study issues.**
  - **Keep study sponsor informed of changes in schedule or direction.**
- **Get involved in the analysis** *(lead by example; be honest and truthful)*.

Ensure Quality of Analysis

- **Data.**

- **Scenarios.**

- **Models.**

- **Milestones.**

Data

Generally:

- **Data types.**
  - Technical. → Consumes long development time.
    - Hardware performance.
    - Physical and environmental interactions.
  - Operational. → Has greater impact on results.
    - Descriptive utilization of systems/units.
  - Subjective. → Ignored.
    - Decision processes.
    - Human interactions.
    - Leadership styles.

- **Study director responsibilities.**
  - Obtain, review , and share data; ensure certification.
  - Determine what information is pertinent and meaningful, and useful in the problem solving process.

Data Challenges (1 of 2)

- **Consistency across all subordinate teams.**
  - **FCS AoA promoted use of FCS Unit of Action Systems Book.**
    - Systems, quantities, key technologies for each UA alternative; dynamic process due to concurrent analysis, O&O and ORD development.
  - **AUMA developed UAS Systems Book; TUFR Study updated it.**

Aircraft Characteristics

AV Endurance (hours)	14-24
Ceiling (ft) (MSL)	25,000
AV Weight (lbs)	1,130
AV Length (ft)	27
AV Height (ft)	6.9
AV Wingspan (ft)	48.7
AV Range (km)	400
System Weight (lbs)	N/A
Auto TO&L	No
Take-Off Method	Runway
Landing Method	Runway
Max Speed (kts)	135
Loiter Speed (kts)	84

Operational Characteristics

Operational Endurance (hours)	24
Max LOS operational range (km)	193
Max operational speed (kts)	105
Loiter speed (kts)	70
Max operational altitude (ft)	23,000
Expected operational altitude (ft)	8-18k
Min operational altitude (ft)	5,000

These tables appeared on two facing pages of the draft UAS Systems Book, v.5, regarding the Predator MQ-1B UAS. What data challenges do you see?

Data Challenges (2 of 2)

- **Collection of qualitative data – most relevant to experiments and exercises.**
  - Select and train unbiased data collectors/observers.
  - Establish team with warfighter focus.
  - Allow dynamic cueing of some data collectors.
  - Establish/control the database format.

- **Create an analytic strategy to guide observer and analysts.**
  - Battle Command example in UQ05: How well did the concepts and capabilities for command enable the Joint and Combined force to effectively perform deterrence and forcible entry operations?
  - Pre-, during, and post-event strategies.

UQ05 Battle Command Pre-Event Analytic Strategy

- **Analytic Conditions:**
  - Pre-conflict crisis development is played.
  - Blue conducts forcible entry operations.

  > *Set the conditions.*

- **Essential elements of analysis (subordinate questions):**
  - What was the impact on Battle Command of the approach to operational art used?
  - How well did the JxI concept contribute to information superiority?
  - How was the Blue command structure affected by multinational, cross-RCC, and global vs. regional coordination requirements?

- **Concepts that may be informed by this issue:**
  - Primary – Command and Control; JC2; EBO; JxI.
  - Secondary – Forcible Entry Operations.

- **Education, Collection and Analysis Tasks before UQ05:**
  - Understand stability operations EEAs.
  - Gain familiarity with the concepts to be informed.

Battle Command Analytic Strategy During UQ05

- Note Blue staff structure.
- Note uses of effects-based language, priority effects list, operational net assessment.
- Note use of MDMP.
- Collect material pertaining to linkage of tactical action to operational goals, and operational to strategic goals.
- Note overlaps or gaps in planning materials produced.
- Record synchronization problems identified as part of ad

Give clear guidance to observer/analysts.

- Record Blue's perception of unanticipated effects of Blue actions.
- Record risks identified by Blue planners and the mitigation strategies adopted.
- Record occurrence of identified risks and effectiveness of mitigation.
- Note utility of Blue planning for branches and sequels, including implementation and adaptation.
- Collect Blue intelligence briefing materials and corresponding ground truth information.
- Record intel requirements from Blue planning cells & responses from Jxl/G2. Collect ground truth.
- Observe synchronization of Intelligence and Information operations.
- Note frictions in direction of RSTA collection & analysis elements across joint/combined force.
- Regularly interview Blue commanders regarding their level of satisfaction with their SU.
- Note Jxl inputs to planning of counter-Red RSTA activities. Record level of success and why.
- Record how the combined force integrated non-US military forces into the command structure.
- Note how C2 responsibilities were divided between the CJFC and the JxG arena.
- Record Blue staff questions put to JIACG.
- Record JIACG inputs to Blue planning.
- Record specific decisions made on the basis of JIACG advice.

UQ05 Battle Command Post-Event Analytic Strategy

- Describe general command structure adopted by Blue.

- Describe planning process used by Blue; include effects-based & traditional approaches (e.g. MDMP).

- Describe how Blue perceived the linkage of tactical actions to strategic goals.

- Identify and describe areas of overlap, or gaps in planning act~~~ ~~~planning positioning of air defenses).

- Identify & describe Blue synchronization problems. Where pos~~~ ~~~rose.

- Describe how effective Blue was in causing intended effects th~~~ ~~~oth the intended effect and any unintended effects arising.

Know what you want to do with the collected data.

- Describe how successful Blue risk identification and mitigation were. Incorporate information on the use of branch and sequel planning in execution.

- Compare Blue intelligence to Ground Truth (including Red intent). Describe areas of success/failure.

- Describe how Blue intelligence and information operations were synchronized.

- Describe how well JxI concept enabled efficient use of RSTA assets across the joint & combined force.

- Describe how satisfied Blue Commanders felt themselves to be with their level of situational understanding. Contrast their understanding of the situation with ground truth.

- Describe how Blue planned to deny Red intelligence on Blue activities. Describe how successful Blue was in denying Red effective intelligence and why.

- Describe allocation of C2 responsibilities across the Joint and combined force, particularly with respect to non-US forces. Note significant frictions and the measures taken to overcome them.

- Describe how C2 responsibilities were divided between the CJFC and JxG community (e.g. for Global strike operations against WMD). Note significant frictions and the measures taken to overcome them.

- Describe the relationship between the Blue planning staffs and the JIACG. Describe how the JIACG influenced (or failed to influence) Blue planning of military operations.

Basic Scenario Considerations

- **Credibility.**
  - Consistent with DPG.
  - Validated threat.
  - Appropriate Joint representation of concepts, forces, and systems.
  - Perishability is sometimes an issue but "grandfathering" is a common practice, within reasonable limits.

- **Adequate range of conditions.**
  - Type of operation.
  - Threat.
  - Terrain, weather.
  - Appropriate force years.

> *A scenario need not be implemented in a combat model to be useful for an analysis.*

- **Measurement space.**
  - Provides sufficient detail and conditions to enable distinction among alternatives.
  - Rarely is a scenario usable for a study directly "off-the-shelf".

Models

- **Model selection.**
  - **Most likely, no existing model is perfectly suited for the job.**
  - **Challenge the model owners:**
    - **Which aspects of an operation are modeled in detail?**
    - **Which are approximated?**
    - **Which are left out?**
    - **Which class of decisions was the model designed to support?**
  - **Choose models that**
    - **Address the issues.**
    - **Assess the defined MOE.**
    - **Are comprehensible.**

- **Model enhancement.**
  - **Focus on critical study-related enhancements.**
    - **Concepts of operation, system capabilities.**
  - **Seek simple solutions (data before code).**

- **In rare cases, a simple model can be built to address niche issues. More likely, the study will identify the need for such a model, which can be developed for the next study.**

Milestones

- **Milestones are concrete statements of measurable events with specific dates.**

- **Interim reviews, with or without SAG oversight, are essential, e.g., see JLTV AoA draft guidance:**
  - **A JSAG will convene NLT 17 May 09 to review and approve the study plan.**
  - **The Study Director will present interim results, in the form of a briefing, to the JSAG for review and approval NLT 1 Feb 11.**
  - **The Study Director must deliver the final report to HQDA 60 days prior to Milestone B or NLT 1 May 2011.**

- **Project slippage can result from almost immeasurable events:**
  - **Sick leave.**
  - **Hardware failure.**
  - **Senior leader calendar conflicts.**
  - **Unscheduled meetings.**

Procrastinators finish last!

Understand and Integrate the Analysis Results

- **Crunch the numbers.**
  - Analysis is not number crunching.   Let the computers carry out any detailed and repetitious mathematical computations.

- **Conduct subjective assessments of the more intangible problem attributes.**

- **Infer causal relationships.**

- **Analysis occurs before the computer starts, and when the computer stops. Once the grinding work of the computer produces results, the analyst must ask:**

  View the results from the perspective of the decision maker.

  - *"Are the results what we expected?"*
  - *"If not, why?"*
  - *"If so, should we believe it?"*
  - *"If we believe it, will the decision maker believe it?"*
  - *"How do we assure the decision maker that the answer is well-founded?"*

Understand and Integrate the Analysis Results

- **Reconcile and integrate supporting analyses. Integrating processes include:**
  - Tradeoffs and parametric processes.
  - SME seminars.
  - In-process reviews (analysts, proponents, management.)
  - Storylines: relate quantitative differences to operational impacts.
  - Scatter diagrams.
  - Optimization; math programming.
- **Test the assumptions.**
- **Conduct risk analysis.**
- **Form final findings, insights, conclusions, or recommendations.**

Following slides provide some examples of integrated analysis results. What questions come to mind as you review these charts?

AUMA Integrated Case Assessment

Integrated performance, cost and personnel analyses.

Each case achieves required mission satisfaction.

Legend:
- ■ = 2 Type UAS Case
- ▲ = 3 Type UAS Case
- ◆ = 4 Type UAS Case
- ● = Personnel

RDT&E/Procurement costs and personnel requirements are closely correlated.

Y-axis (left): Cost per BCT ($ Millions) — 0, 100, 200, 300, 400, 500, 600

Y-axis (right): Personnel per BCT (UAS Operators & Maintainers) — 0, 60, 120, 180, 240, 300, 360

Data points: Case 1, Case 8, Case 6, Case D, Case E, Case 7, Base Case A

Compared to the implied strategy (Case A), several cases avoid significant costs and reduce the requirement for dedicated UAS personnel.

JLTV ABA Balancing of Vehicle Attributes
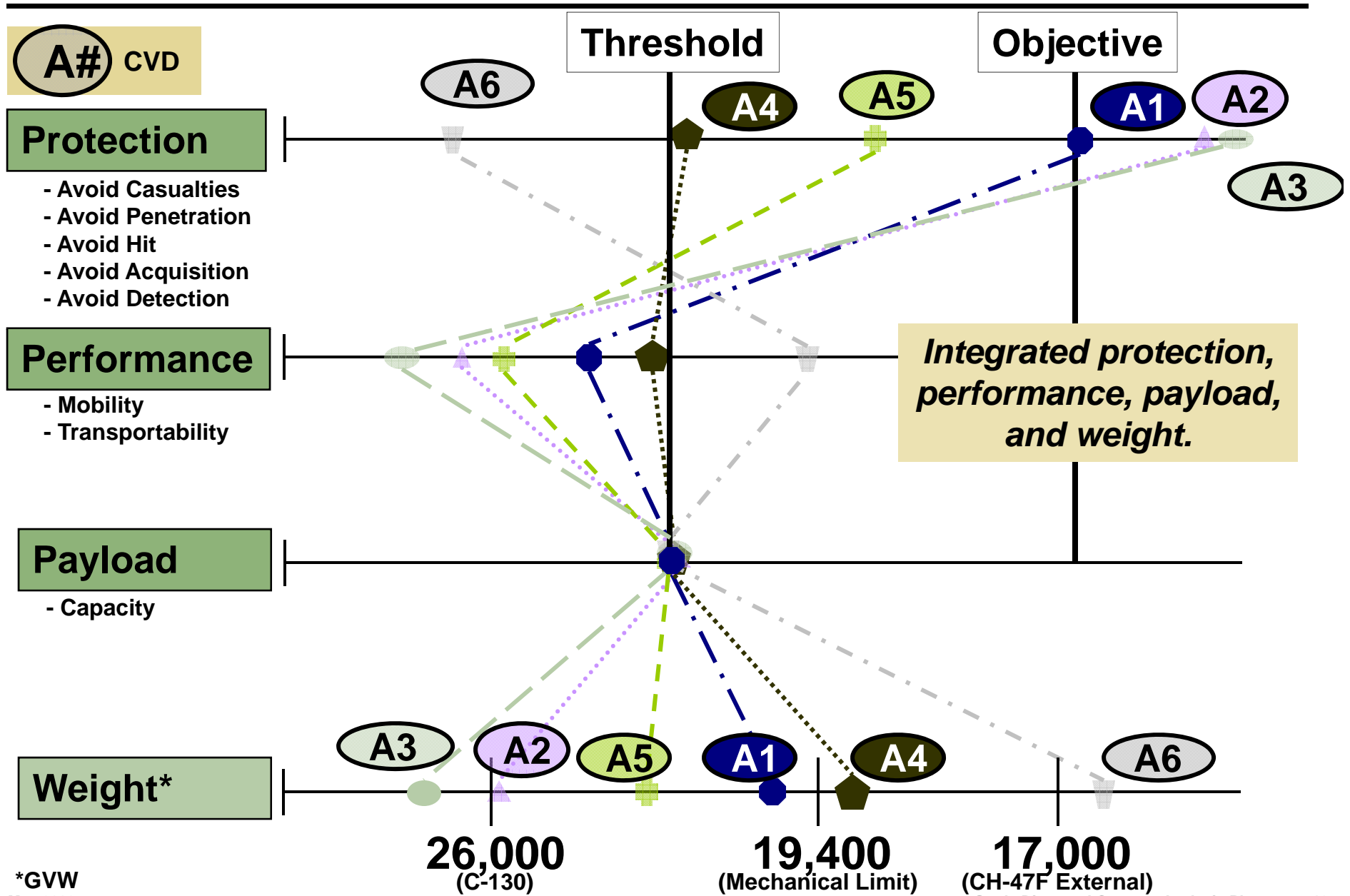
JLTV Overall Assessment

The importance of performance for the GPA variant causes A4 to be preferred to A1.

MRV	GPA		CTV		UV	
Vehicle	A1	A4	B1	B4	C1	C4
Protection	1.00	0.50	0.92	0.58	0.92	0.58
Performance	0.50	0.68	0.56	0.73	0.85	0.85
Payload	0.94	0.94	1.00	1.00	0.96	0.96
Effectiveness Value (unweighted)	0.81	0.71	0.83	0.77	0.91	0.80
Effectiveness Value (weighted)	0.67	0.73	0.83	0.67	0.94	0.85

- **The effectiveness value is a weighted average of the individual requirements' values.**

Cost Effectiveness
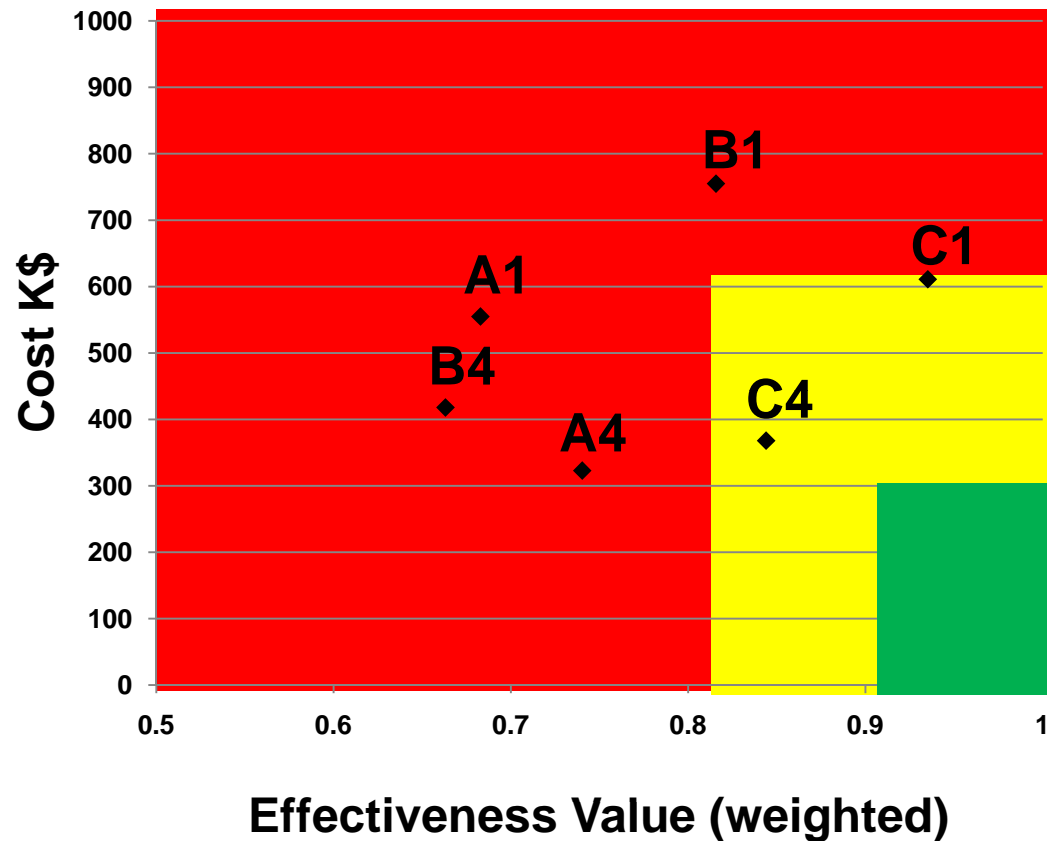
Increases in effectiveness produce significant increases in cost for vehicles B and C.

Standards for Analysis

- **Addresses the right question.**

- **Uses appropriate analytic venue(s).**

- **Accounts for Joint capabilities.**

- **Uses relevant and valid M&S, scenarios and/or data.**

- **Provides a data analysis, not a data presentation.**

- **Supports findings with evidence and without bias.**

- **Appropriately documents & archives the effort.**

Study Directors' Course
Reporting/Documentation Phase

Peg Fratzel

Depuy Auditorium

19 May 2009

Purpose and Outline

- **Purpose: To describe components of the study reporting process and the standards for quality published products.**

- **Outline:**
  - **Guiding principles for TRAC publications.**
  - **Types and components of documents.**
  - **Documentation standards, writing tips and examples.**
  - **A few words about briefings.**
  - **Study director responsibilities.**
  - **Parting thoughts.**

With substantive credit to Dr. Mike Ingram, 20060330 Thoughts on Report Writing, and our many years of collaborative reporting and reviewing.

Guiding Principles for TRAC Publications

- High professional quality in both substance and form.

- Readily identifiable as uniquely TRAC's.

- Prominent acknowledgement of authors.

- Protection from alteration.

- Distribution to those with legitimate need.

- Prevention from loss or inadvertent destruction.

ATRC-TD, Memorandum for TRAC Personnel, Subject: Documentation Standards – TRAC Policy Memorandum #07-01, 29 Sep 06.

Types of Documents

- **Plan.**
  - Describes technical methods and administrative procedures to achieve objectives.
  - Relevant to studies, analyses, research projects, model or simulation development, scenario development, methodology development, data collection management, etc.

- **Technical Report.**
  - Official and formal document that *comprehensively communicates* relevant aspects of study, analysis, research, or other product.
  - *Conveys completed work* to sponsor, other interested parties, and scientific community.
  - Permanent official record of the work.

- **Technical Memorandum.**
  - Official record of work that is independent, largely in-house, narrowly focused, or a supporting component of a larger effort.
  - Examples include literature review, model development, data base development, user's manual, simulation requirements.
  - Permanent official record of work but *typically will remain in-house* or be limited in distribution.

The Study Plan

Execution order for conduct and implementation of study:

– Documents the *study approach* and general analytic methodology.

– Provides a *schedule* which identifies the critical path and risks for completion.

– Links personnel and dollar *resources* required to complete the product.

– Serves as the initial contract between the study director and the study sponsor.

– Becomes the implementing order to supporting organizations, after full coordination with all participating agencies and approval by study sponsor.

The Analysis Plan

- **Describes the context and conduct of an analytic effort.**

- **Breaks down overarching study objectives into a *hierarchy* of the corresponding study issues, essential elements of analysis (EEA), and measures of merit (MOM) to be used to evaluate the results.**

- **Include the scope, *detailed analysis methodology*, the tools to be used for analysis, the input data requirements, critical milestones, and overall schedule.**

A Comparison: Sample Outlines

Study Plan

- **Purpose.**
- **References.**
- **Terms of reference.**
  - Problem statement.
  - Background.
  - Guidance.
  - Analysis objectives.
  - Constraints, limitations, assumptions.
  - Alternatives.
- **Key study issues and responsibilities.**
- **Study approach.**
- **Schedule.**
- **Support and resource requirements.**
- **Key points of contact.**
- **Coordination and distribution.**

Analysis Plan

- **Purpose.**
- **References.**
- **Guidance.**
- **Constraints, limitations, assumptions.**
- **Issue decomposition.**
  - Objectives.
  - Study issues.
  - Essential elements of analysis.
  - Measures of merit.
- **Analytic approach.**
  - Methodology.
  - Scenarios, models and other tools.
  - Data requirements.
  - Analytic end state.
- **Roles and responsibilities.**
- **Schedule and deliverables.**
- **Coordination and distribution.**

Sample Outline, Technical Report or Memorandum

- **Introduction.**
  - **Purpose.**
  - **Organization of the report.**
  - **Overview of guidance, including sponsor, objectives, issues and alternatives.**
  - **Participants.**
  - **Constraints, limitations and assumptions.**

- **Study Approach.**
  - **Methodology.**
  - **Scenarios.**
  - **Data sources.**
  - **Models and simulations.**

Not prescriptive; provides flexibility to study director.

- **Analytic Results.**
  - **Sub-analysis 1.**
  - **Sub-analysis 2…**

- **Integrated Analysis Results.**

- **Summary Findings and Conclusions.**

Document Components

	Plan	Technical Report	Technical Memorandum
Document Number	R	R	O
Cover	R	R	O
Title Page	O	R	O
Report Documentation Page	R	R	O
Acknowledgements	R	R	O
Table of Contents	O^1	O^1	O
List of Tables or Figures	O^2	O^2	O
Executive Summary	N/A	O^3	O
Body	R	R	R
Transmittal Memo	O	R	N/A
Appendices	O	O	O

[1] **Required if main body of document is over 15 pages.**
[2] **Required if more than 5 tables or figures.**
[3] **Required if document is over 100 pages.**

R Required
O Optional
O Optional but … why not required?
N/A Not Applicable

Documentation Standards, Tips, and Examples

- **Will explore both substance and form of documentation through examples of draft and published documents.**

- **Four document components:**
  - **Lead-in section.**
  - **Executive summary.**
  - **Main body.**
  - **Appendices.**

Lead-in Section

Cover	Title (i)	SF298 iii	Thanks v	TOC vii	Fig/Tables viii
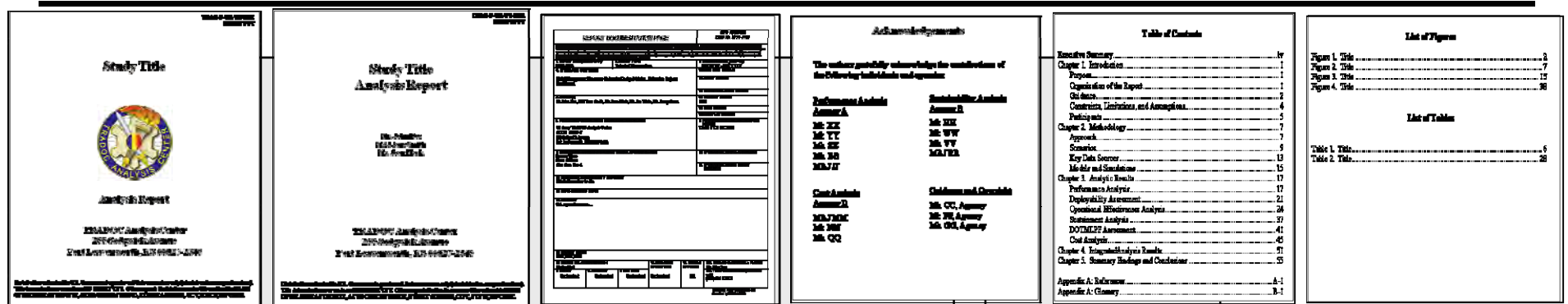
Cover
- Word, not PDF.
- No document number.
- Cumbersome title.
- Incorrect office symbol.

Title (i)
- No document number.
- Title mismatch.
- Subtitle omitted.
- Incorrect office symbol.
- "List of Authors".

SF298 iii
- Mix of three fonts.
- No document number.
- No distribution statement.
- No POC or phone number.
- Two wrong address formats.
- Incorrect (and mismatched) office symbol.

Thanks v
- None provided.

TOC vii
- Misspellings in TOC, and not in corresponding paragraphs.

Fig/Tables viii
- None provided.

A TRAC-FLVN report published in FY09.

Another Example

- From the Title Page, list of authors:

  Mr. James Erin

  MAJ Scott Seidel

  Mrs. Amy Pankau

  LTC Brad Pippin

  Mr. Raphael Toro

- From the Report Documentation Page, authors:

  MAJ Scott Seidel

  LTC Brad Pippin

  Mr. James Erin

  Mr. Rafael Toro

There should never be FEWER authors on the SF298 than on the title page.

Document Number

- **Request from PRD (Susan Matus).**

- **Input:**
  - **Type of document.**
  - **Project code.**
  - **Full title.**
  - **Classification.**
  - **Date of document.**
  - **Project leader name/phone number.**
  - **Reimbursable or not.**

TRAC-F-TM-09-003

| TRAC Center |
| Document Type |
| FY |
| Sequence # |
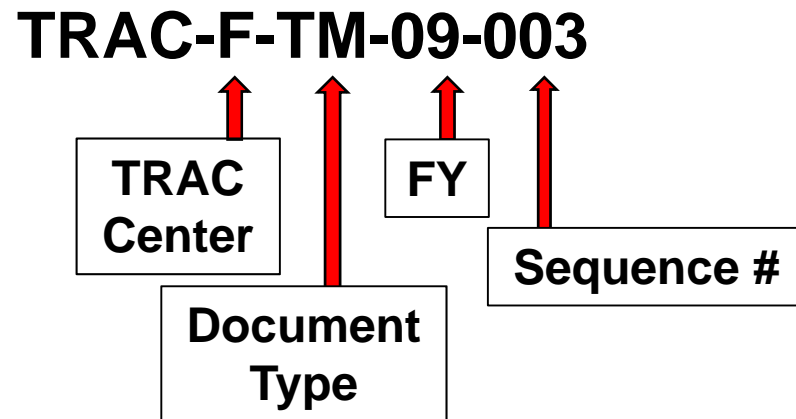
Executive Summary

- This is the *most important part of the report* as most consumers will only read this section.

- *Write the EXSUM after the report* is completed; develop an objective, reflective, high-level summary of the study. *Do not take a cut and paste approach* – think about what is important to an executive-level reader.

- *Target one or two pages.* If there is a requirement for a longer EXSUM that a customer circulates, consider a separate document. A long EXSUM prior to a main body can be distracting and redundant.

- Suggested content includes *tasking summary, primary agencies, approach, salient results, conclusions*, and, if known, any decisions made as a result of the study.

LRGR Executive Summary Example

T A S K E R | This report documents the background, process, and results of the LRGR Study. LTG William Wallace, CG, CAC tasked TRAC in March 2005 to perform this study to inform TAA decisions. The two main study objectives were to establish the organic ground reconnaissance requirements of the division and to assess the capability of alternative ground reconnaissance O&O concepts to meet those requirements.

A P P R O A C H | CADD led the development of four study alternatives. These ranged from a base case LRSD to a composite R&S battalion that included 12 LRS teams and 3 scout platoons. TRAC examined the four alternatives in the context of a range of condition sets based on DPS. TRAC employed several analytic venues in the study, including SME panel, senior mentor review, and combat simulation. Determining the scope and nature of the ground reconnaissance requirements was an essential foundation for the understanding and assessment of the alternatives. The integration of the overall results of the several venues was a critical final component to the study.

Note: All acronyms were defined in the EXSUM but are omitted here for brevity.

LRGR Executive Summary Example

**R
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TRAC determined that none of the study alternatives are clearly optimal without modification. If Army leadership desires the division ground reconnaissance unit to satisfy only a baseline of far, deep requirements, then as a minimum the division must have a 12-team LRS company-type unit. However, TRAC concluded that if Army leadership desires the division organic ground reconnaissance unit to satisfy other potential R&S requirements, including robust mounted reconnaissance, then in addition to the 12 surveillance teams, multiple scout platoons or troops and an additional C2 headquarters are required. Any scout-based ground reconnaissance requires specialized reconnaissance vehicles beyond the capabilities of any HMMWV variant.

**C
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The bottom line study conclusion is that the minimum baseline division organic ground R&S capability must include an enhanced LRS company with at least 12 teams. Refinement of the division R&S operational concept will determine whether an additional mounted capability is required in the Battlefield Surveillance Brigade.

LRGR Executive Summary Example

DECISION TRAC briefed these results to CG, CAC on 4 August 2005. He accepted the main conclusions of the study and directed that CADD work to develop a modified R&S battalion solution which would satisfy the division-level organic ground reconnaissance requirements in total. CADD presented this solution (Appendix I) to CG, CAC 4 October 2005. CG, CAC approved this modified R&S battalion as an organizational requirement, and this intent was forwarded in a Requirements Determination Decision Memorandum from CG, CAC to HQDA.

- This EXSUM filled just a single page, but provided the critical details of the study.

- Even now, an active voice change makes it more concise.

> CG, CAC approved this modified R&S battalion as an organizational requirement, and forwarded this intent in a Requirements Determination Decision Memorandum to HQDA.

Main Body - Introduction

- **Purpose.**

- **Organization of the report.**

- **Overview of guidance.**

- **Participants.**

- **Constraints, limitations and assumptions.**

Purpose

- **There is always a purpose to the report, and a purpose to the work itself. Both should be addressed concisely.**

As published:

Report Purpose. The purpose of this report is to document TRAC-FLVN's Model Management Directorate's (MMD) Federation Design Division's (FDD) work in federating simulations and model components.

- **This TM documented 11 years of work in 11 pages. It begs an explanation as to why the work is now being documented.**

A recommended revision:

Purpose. This report documents the components and status of federation development over the past decade by the US Army Training and Doctrine Command (TRADOC) Analysis Center – Fort Leavenworth (TRAC-FLVN). This effort, conducted by TRAC-FLVN's Model Management Directorate (MMD) sought a more efficient and robust means to provide model and simulation (M&S) support to Army experiments. Despite significant progress, TRADOC's dwindling experimentation budget precludes continued research; thus, this report captures the state of federation development as of March 2009.

Practical Exercise

- **In the next five minutes, write a purpose paragraph for a final report of the study or project to which you are currently assigned.**

- **Paragraph should describe both the report purpose and the purpose of the work.**

Practical Exercise

- **Now exchange paragraphs with someone near you; critique your partner's paragraph. Try to find at least two improvements in substance or form to discuss with your partner. Look for:**
  - **Lack of clarity.**
  - **Missing information.**
  - **Passive voice.**
  - **Grammar, punctuation or spelling errors.**
  - **Use of undefined acronyms.**

A reviewer serves no one if they are not critical and detailed in their review.

Kirin, "9 rules for '99"

Organization of the Report

- **This is a precursor to the chapter or section roadmaps. These serve as transitions throughout the report. The entire breadth of the report should be known after this point.**

- **A roadmap provides the reader a guide to the direction of the report, and provides the author a means to check the consistency of the report contents.**

- **Examples: AUMA, JLTV ABA reports.**

Organization of the AUMA Report

The main report consists of six chapters followed by five appendices. This introduction defines the study problem and explains the strategic study guidance, scope, and implied boundaries of the UAS strategy. The study approach chapter follows with the study issues, context, and methodology. Chapters 3 – 5 explain the three major phases of the analysis: the preparatory effort, case assessments, and affordability assessment. The final chapter of this report provides the study conclusions and recommendations.

Appendices include key reference materials (Appendix A); constraints, limitations and assumptions (CLA) (Appendix B) identified for the entire study; descriptions of significant workshops (Appendix C); detailed explanations of subordinate analyses (Appendix D); and a glossary (Appendix E).

Organization of the JLTV ABA Report

This introductory chapter presents an overview of the study, including discussions of the study tasking and scope of the effort. Chapter 2 provides the study approach, including a general discussion of the study methodology. Chapter 3 then describes the attributes and the alternative vehicle designs that the Tank Automotive Research, Development, and Engineering Center (TARDEC) developed to serve as proxies for a range of attribute sets. The results of the specific methodologies of the cost and effectiveness analyses are then presented in Chapters 4 and 5. Chapter 5 concludes with a discussion of the results of the cost-effectiveness integration. Finally, in Chapter 6, the report addresses the study issues, and presents findings and recommendations based on the overall study effort. Appendices include detailed CVD characteristics, supporting analyses, and other reference material.

Organization – Chapter Roadmaps

- **Roadmaps are also needed at the beginning of each chapter or section, e.g., AC2 Research Paper, Section 2, Current Doctrine:**

This section provides a description of how the Army conducts airspace control as it is currently represented in doctrine. It begins with a general description of A2C2 and then examines the methods of airspace control. A discussion follows on the approaches a leader may utilize to keep separation between airspace users. The section closes with a description of the four A2C2 functions that operators perform and the five activities airspace users conduct.
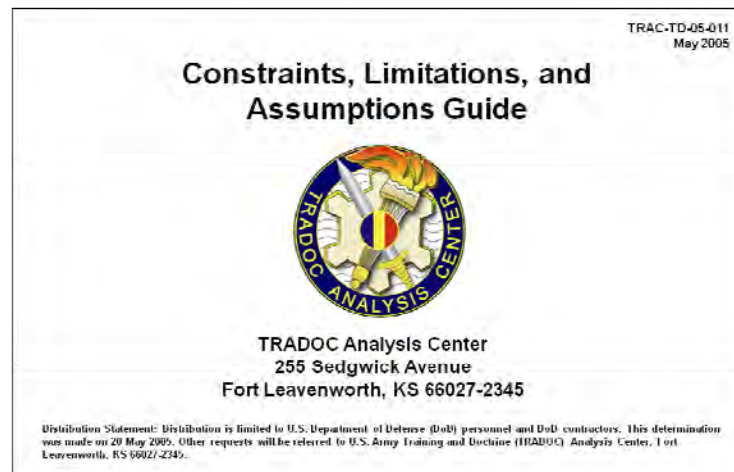
Overview of Guidance

- **Summarize the source and key ideas of the tasker and at a minimum, list the tasker in the references; consider adding as an appendix.**

- **Clearly state the study objectives; these are usually included in the study tasker. Include key study issues too, but if there are many study issues, put the full set in an appendix.**

- **Clearly identify the alternatives. If the alternatives set is fairly complex, summarize in the introduction and include a more detailed explanation in an appendix. The example below may be difficult to understand without additional context in report.**

> **TRAC worked with TARDEC to develop over 27 concept vehicle designs (CVDs) that aided in the evaluation of engineering limits. The designs included 18 different attribute sets for the General Purpose Category A (GPA), Combat Tactical Vehicle (CTV), and the Utility Vehicle (UV). A total of 9 maximum attribute sets were developed to evaluate the extreme values for protection, payload, and performance for the three vehicle categories.**

Remaining Elements of the Introduction

- **Participants.**
  - **Generally focus on agencies, not specific people. However, a specific individual contributed significantly to the credibility of the effort, consider naming that person or their position title.**

- **Constraints, limitations and assumptions.**
  - **Refer to TRAC Code of Best Practices.**
  - **Necessary precursor upon which to base the methodology.**
  - **Vital to properly interpret and use the study results.**
  - **An important contributor to and indicator of quality.**

TRAC-TD-05-011
May 2005

Constraints, Limitations, and Assumptions Guide

TRADOC Analysis Center
255 Sedgwick Avenue
Fort Leavenworth, KS 66027-2345

Distribution Statement: Distribution is limited to U.S. Department of Defense (DoD) personnel and DoD contractors. This determination was made on 20 May 2005. Other requests will be referred to U.S. Army Training and Doctrine (TRADOC) Analysis Center, Fort Leavenworth, KS 66027-2345.

Main Body – Study Approach

- **Methodology.**
  - **Refer to TRAC Code of Best Practices (draft).**
  - **Conveys the logical flow of a process using constituent building block components.**
  - **Identifies pertinent input and output for a component.**
  - **Identifies the tool or means used for a component.**

Methodology Slide Development

27 September 2005

- **Scenarios: Provide tight, clear descriptions must be tight and demonstrate the salient range of conditions. Provide sufficient context without diverting attention from the upcoming analysis section. Highlight major changes from base scenario due to study requirements.**

- **Data sources: Establish the data pedigree but do not sweep away significant data gaps and assumptions.**

- **Models and simulations: Use summary paragraph for each, particularly for widely known and accepted models. However, highlight specific model enhancements that were made to tailor the model to the study problem.**

Main Body – Analytic Results

- Open with a clear framework for the chapter or section.

- Use strong, simple, clear graphics; reference them and provide further amplification in the text.

- Strengthen the analysis with relevant examples from history or current literature.

- Clearly identify what you don't know about the alternatives -- and what the possible impacts are (risk assessment).

- Key challenges:
  - Presenting results from multiple scenarios.
  - Determining the right level of detail and a logical flow.
  - Integrating the work of other agencies.

What are some of the considerations in dealing with these challenges?

Main Body – Integrated Analysis Results

- **Need to directly address the study issues – even if you subsequently need to tell the story of the analysis in a different manner.**

- **Main concern is to characterize the alternatives in terms of the key evaluation factors. Is there a dominant alternative across all factors (not likely).**

- **How well does the analysis plan serve you at this stage? Did you visualize an end-state that makes sense and still fits well?**
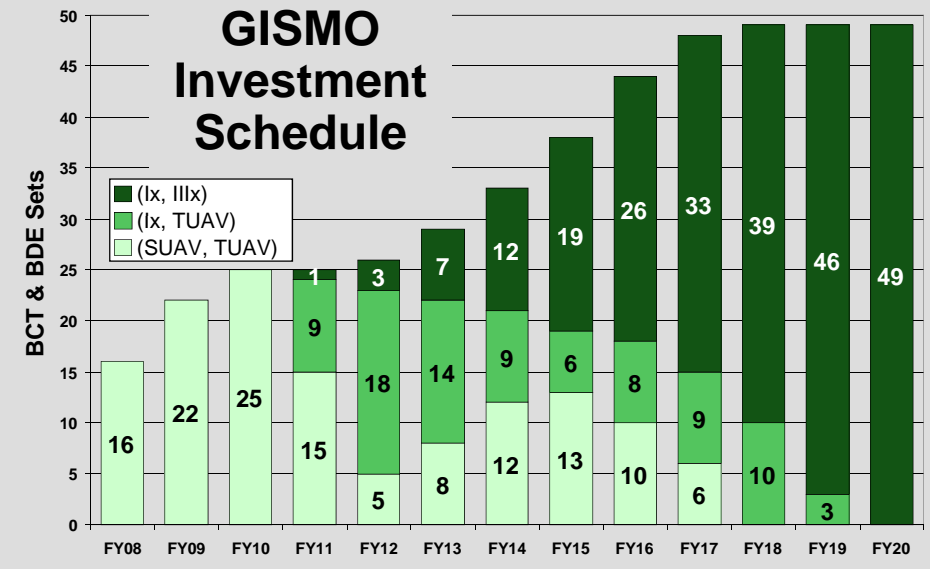
- **AUMA example.**

AUMA Investment Analysis

Cases	ARFORGEN Fielded to Ready & Deployed # BCTs/BDEs.	Personnel Operators & Maint'rs for 76 BCT/BDEs	BOI Quantities Per BCT (BOI Systems) = Tot Air Veh's	Future Concept Implications All Achieve 90% UAS Mission Satisfaction	Transition Simplicity Soldiers Training Maint
Case 1 (Ix, IIIx)	49 by FY20	4,690	(30, 6) = 114	- No H-P-S - No Organic LD	1st
Case 6 (Ix, IIIx IV)	42 by FY29	9,114	(15, 4, 4) = 77	+ 3 Sys Flexibility - No H-P-S - No Organic LD	3rd
Case 8 (I, IIIx)	49 by FY22	6,070	(30, 8) = 92	- No Organic LD	2nd
Case D (I, III, IV)	26 by FY28	11,598	(15, 4, 6) = 70	+ 3 Sys Flexibility - No Organic LD - Increased Log	5th
Case E (II, III, IV)	8 by FY28	16,762	(15, 8, 6) = 71	+ 3 Sys Flexibility - No... - Inc...	6th
Case 7 (II, IV)	13 by FY26	18,266	(30, 10) = 70	- No...	

Integrated investment strategy with DOTMLPF assessment.

Preferred Case (but without H-P-S or organic LD)

Only Case 1 fully equips ARFORGEN Ready and Available pools by FY20.

GISMO Investment Schedule

Legend:
- (Ix, IIIx)
- (Ix, TUAV)
- (SUAV, TUAV)

BCT & BDE Sets

	FY08	FY09	FY10	FY11	FY12	FY13	FY14	FY15	FY16	FY17	FY18	FY19	FY20
(Ix, IIIx)				1	3	7	12	19	26	33	39	46	49
(Ix, TUAV)				9	18	14	9	6	8	9	10	3	
(SUAV, TUAV)	16	22	25	15	5	8	12	13	10	6	10		

H-P-S: Hover, Perch, Stare   *LD: Laser Designation*

Main Body – Summary Findings and Conclusions

- **Findings corroborate evidence across multiple venues or subordinate analyses:**
  - Compared to the base case (4 UAS types), either a 2-type or a 3-type mix can fulfill at least 90& of UAS missions in demanding operations.
  - Case 1 equips ARFORGEN by FY20, is less expensive in procurement and personnel, but lacks H/P/S and organic LD at the tactical level.
  - Case 4 offers H/P/S and potential organic LD, as well as continued development of a Joint program. Continued development of these capabilities may yield a technical solution that is feasible and affordable for the whole future force.

- **Conclusions further consolidate findings into a summary statement:**
  - Rather than five echelons and nine types of UAS within three investment paths, the analysis determined a single investment path with three levels for distinct UAS assignment: platoon/company, battalion/brigade, and division.

Summary Findings and Conclusions

- **Findings and conclusions are derived from the analysis.**

- **No surprises - the reader should already know what you're going to say here.**

- **Re-emphasize key points; avoid emotional appeal.**

- **Use recommendations sparingly; present the evidence and let the decision maker weigh the evidence with other relevant information.**

Appendices

- **At a minimum, references and glossary.**
  - Any other information useful to understanding the study or in providing a reference for potential future study efforts.

- **Be consistent (adhere to an accepted standard) in preparing the list of references.**

- **Glossary can include acronyms as well as explanation of terms.**

- **Quality still matters in the appendices.**

References Example (1 of 2)

A-1. Doctrinal Manuals for AC2.

- **Air Force Doctrine Document (AFDD) 2, *Operations and Organization*, 3 April 2007.**

- **AFDD 2-1.7, *Airspace Control in the Combat Zone*, 13 July 2005.**

- **Air Force Instruction (AFI) 90-901, *Operational Risk Management*, 1 April 2000.**

- **FM 3-09, *Doctrine for Fire Support, DRAFT,* undated.**

- **FM 3-52, *Army Airspace Command and Control in a Combat Zone*, 1 August 2002.**

- **FM 3-90.6, *The Brigade Combat Team*, 4 August 2006.**

- **FM 3-100.2, *Multi-service Tactics, Techniques, and Procedures for Integrated Combat Airspace Command and Control*, 30 June 2000.**

- **FMI 3-01.60, *Counter-Rocket, Artillery, and Mortar (C-RAM) Intercept Operations*, 16 March 2006.**

- **FMI 3-91, *Division Operations, Doctrine Review Approval Group (DRAG) Edition*, 18 April 2007.**

- **JP 1-02, *Department of Defense Dictionary of Military and Associated Terms*, as amended through 17 October 2007.**

- **JP 3-0, *Joint Operations*, 17 September 2006, incorporating change 1, 13 February 2008.**

- **JP 3-09.3, *Joint Tactics, Techniques and Procedures for Close Air Support*, 3 September 2003.**

- **JP 3-52, *Joint Doctrine for Airspace Control in the Combat Zone*, 30 August 2004.**

- **MCWP 3-25, *Control of Aircraft and Missiles,* 26 February 1998.**

- **Training Circular (TC) 1-400, *Brigade Aviation Element Handbook*, 27 April 2006.**

References Example (2 of 2)

A-2. Other Documents.

- *Air & Space Commander's Handbook for the JFACC*, 27 June 2005.

- *AC2 Collective Critical Task List – Training and Evaluation Outlines (T&EOs) Final Draft*, 20 July 2007.

- *AC2 Information Briefing to TRAC*, Battle Command Integration Directorate (BCID), AC2 Proponent Office, 3 July 2007.

- *Army Airspace Command and Control Battle Staff Integration Tasks and Procedures for the Tactical Airspace Integration System,* DRAFT, 6 December 2006.

- Fitch, Steven, *"Employing the Air Defense Airspace Management Cell",* Air Defense Artillery Journal, October – December 2006.

- http://en.wikipedia.org/wiki/Global_Command_and_Control_System.

- http://www.airforce-technology.com/projects/e3awacs.

- *Joint, Interagency, Inter-governmental and Multinational Lessons Learned Report*, CALL, 2007.

- *Leader's Guide to A2C2 at Brigade and Below*, CALL Handbook, June 2005.

- Neal, Curtis. *"JAGC2: A Concept for Future Battlefield Air-Ground Integration",* Field Artillery Journal, November – December 2006.

- *Operation Iraqi Freedom (OIF)/Operation Enduring Freedom (OEF)AC2 CAAT Initial Impressions Report 07-14*, CALL and Air Force Office of Lessons Learned HQ USAF/A9L, November 2006.

Appendix Details

Sky Warrior MQ-1C

Aircraft Characteristics	
Ceiling (ft) (MSL)	29000
Operational Altitude (ft) (AGL)	10000 - 20000
AV Range (km)	2100 mi

Operational Characteristics	
Expected and Loiter speed (kts)	65/70
Max operational altitude (ft)	25000 (day), 15000 (night)

These tables appeared on two facing pages of the draft UAS Systems Book, v.5, regarding the Sky Warrior MQ-1B UAS.

- **Think about potential users of this appendix: wargamers, other study agencies, other services.**

- **Study director is responsible for accuracy and clarity of the report – including the appendices.**

Report Review

- All technical writing must be precise and relevant. Be perfectly correct in operational terms to establish and maintain credibility with the military customer, and correctly convey the customer requirements.

- Great reports rarely come from brilliant first drafts. Good writing takes time and multiple iterations.
  - More a project management problem than rocket science.
  - Begin report development early and work on it continuously.
  - Step back and reflect on the big picture once in a while.
  - Pick it back up and read it as if someone else wrote it.

- Look for:
  - Clear roadmaps.
  - Effective transitions and layouts.
  - Logical arguments.
  - Evidence strongly linked to conclusions.
  - A consistent tone that masks the styles of multiple authors.

A Few Words About Briefings

- **Briefings deliver the analysis. Prepare as a speaker by asking some questions:**
  - **What does this really mean?**
  - **Why is this important?**
  - **What should I really be saying here? What is the point?**
  - **Does this add anything?**
  - **Am I speaking in a language everyone can understand?**
  - **Am I using examples that fit?**
  - **Who really cares?**

- **Don't assume the audience speaks "analysis" as a second language. Use the language of operations with warfighters.**

- **Failure of presentations are most often failures to:**
  - **Develop adequate content.**
  - **Assess what the audience requires.**
  - **Determine purpose for the briefing.**
  - **Determine message to convey.**

Study Director Responsibilities

- **Develop outline.**

- **Assign responsibilities.**

- **Oversee product development.**

- **Use one voice, adhering to TRAC standards –** *keep the writing team small.*

- **Staff the product –** *including transmittal letter.*

- **Deliver to sponsor.**

- **Submit to DTIC –** *get a couple of experts in the directorate.*

- **Develop strategic communications --** *see Modular Force example.*

- **Close out project code.**

Topical Responsibilities

- **Management.**
  - TRAC chain of command ultimately responsible for all TRAC products.
  - Study director/project leader chiefly responsible for proper documentation of work.

- **Editorial review – TRAC subordinate elements will ensure all documents are reviewed and edited for conformance with TRAC guidelines.**
  - At a minimum, FLVN line director and FLVN director will review all technical reports prior to publication.
  - FLVN line director will review all technical memoranda prior to publication.

- **Staffing – TRAC subordinate elements will establish procedures.**
  - At a minimum, TRAC-FLVN products will be staffed with supporting study agencies.

Parting Thoughts – It's About Quality

From Bauman's Inferno

- Quality is the responsibility of each and every individual. If you produce something, anything, **you are responsible for its quality**.

- **Quality is built-in** as you work, not added after-the-fact by someone else.

- Like it or not, **the customer is the ultimate judge** of the quality of your work and products. And it is **based on what you report to them**.

- What constitutes quality is not an intangible or simply a personal opinion; *acceptable quality is defined* **by standards and codes of best practice.**