MTR 04B0000057

MITRE TECHNICAL REPORT

Applying Cognitive Work Analysis to Time Critical Targeting Functionality

October 2004

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Abstract

The ability to destroy fleeing targets in a time critical environment is a key capability for the successful completion of the Joint Forces Commander's operations. The Time Critical Targeting Functionality (TCTF) program combines the functionality of several tools aiding in the prosecution of significant threats of fleeting vulnerability. As with any system, active user involvement and Human Factors guidance are necessary to ensure a usable design. The TCTF program applies these principles through several techniques including Applied Cognitive Work Analysis, GUI Working Groups, Heuristic Evaluations as well as user surveys. The basis for all these analyses is determining the correct information to display to the user at the correct moment. This document illustrates these techniques, provides the results and recommendations from the evaluations as well as providing lessons learned and example surveys.

KEYWORDS: ACWA, Applied Cognitive Work Analysis, ACTA, Applied Cognitive Task Analysis, CTA, Cognitive Task Analysis, Human Factors, GUI, Graphical User Interface, Heuristic Evaluation, Usability Testing, TCT, Time Critical Targeting, AOC, Air Operations Center, User Centered

Acknowledgments

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Section 1

Introduction

1.1 Purpose

This document describes MITRE's Time Critical Targeting Functionality (TCTF) Graphical User Interface (GUI) Team's efforts to use the Applied Cognitive Work Analysis (ACWA) technique in conjunction with other Human Factors Engineering (HFE) practices to assist the contractor in developing a user-centered design for Time Critical Targeting (TCT). The information gathered during this process has been forwarded to the contractor to assist them in designing the TCTF GUI. The contractor has incorporated the information and comments described in this report, as well as feedback received from the users, resulting in display modifications that make the TCTF system more usable.

The primary purpose of this document is not only to share the information gathered during the surveys and analysis, but also to describe the process and benefits of applying these techniques and convey lessons learned.

1.2 Overview of the AOC

The Aerospace Operations Center (AOC) is defined as the weapon system (personnel, capabilities and equipment) through which the Joint Forces Air Component Commander (JFACC) exercises command and control of aerospace forces. It is the senior element of the Theater Air Control System (TACS). The JFACC employs the AOC weapon system to maneuver and mass overwhelming aerospace power through centralized control and decentralized execution to produce desired operational and strategic effects in support of the Joint Force Commander's (JFC) campaign.

The AOC is the aerospace operations planning, execution, and assessment system for the JFACC. The AOC develops the aerospace operations strategy and planning documents to meet JFACC objectives and guidance. The AOC tasks and executes day-to-day aerospace operations and provides rapid reaction, positive control, coordination and deconfliction of weapons systems.

"Kill Chain"

Find
Collection (ISR)
IPB
Defensive reaction
Radar contact
Surveillance

Fix
Locate
Identify
Trap Coordinates
Collateral damage
Ambush
IFF

Track
Prioritize
Follow
Relocate
Retain attack option
Collateral damage
Sort

Target
Final coordinates
Final Identification
Final approval
ROE
Persistent tracking Collateral damage
Final Lock
Landing zone ID

Engage
Clearance to fire
Laser spot
Weapon launch
Humanitarian airdrop

Assess
BDA
Gun camera
Weapon video
CNN
Enemy action

Figure 1-1. F2T2EA

The Find, Fix, Track Target, Engage, Assess (F2T2EA) methodology seen in Figure 1-1 mechanizes the operational level "kill chain" during the execution process. Theater and national assets/resources detect objectives of potential significance (find). These systems identify and determine the location of a target (fix). From this location, tracking systems acquire and monitor the object (track). Dynamic decision-making then directs resources (target), and applies capabilities (engage) in a timely and decisive manner. To assure the desired effect, an assessment (assess) occurs during or after engagement to determine whether the target should be reattacked. These sequential steps describe a critical path that must occur for each dynamic event.

1.2.1 Overview of Time Critical Targeting (AOC ConOps, TCT Checklist)

Time Critical Targets (TCTs) are targets with an extremely limited window of vulnerability or opportunity, and whose destruction is critical to ensure successful completion of the JFC's operations. TCTs require an immediate response because they pose a clear and present danger to friendly forces and are highly lucrative fleeting targets of opportunity. TCTs can be virtually any target set within the theater of operations, as designated by the JFC and they rank high on the Joint Integrated Prioritized Target List (JIPTL). Examples of TCTs are Surface-to-Air Missiles (SAMs), Anti-Aircraft Artillery (AAA), enemy armor elements,

mobile C2 elements and command posts, weapons and storage places for weapons of mass destruction (WMD), and theater missile (TM) threats in prelaunch profiles of operation. TCT engagements fit in virtually all battlespace areas.

Dynamic decision-making is the most challenging process in the AOC. When a dynamic event occurs, the kill chain cycle becomes time-compressed. During the short period of time the system has to prosecute a dynamic target: JFC and JFACC guidance must be weighed; strategic objectives and tasks must be considered; prospective targets must be positively identified and plotted or marked; available assets with the right munitions or sensors must be brought to bear; available support assets must be coordinated to minimize threats; and post-attack information must be properly assessed.

The TCTF enhances the dynamic aerospace C2 of the Joint Forces Air Component Commander (JFACC) in support of the JFC's prosecution of TCTs. The objective of the TCTF acquisition is to develop a planning and execution capability for the Joint Aerospace Operations Center (JAOC) in support of the JFACC's mission to prosecute TCTs. The TCTF will support real/near-real time data access to support decision making and asset tasking for rapid and accurate detection, tracking, nomination, and prosecution of specific TCTs. TCTF products will primarily support, during the Air Tasking Order (ATO), execution phase, operator activity against TCTs. This operator activity consists of eight (8) broad interdependent functions:

- Intelligence Preparation of the Battlespace (IPB);
- Threat mobility and terrain analyses;
- Target development (TD);
- Automated determination of optimum weapon-to-target pairing (WTP) recommendations;
- Joint target execution;
- ISR retasking;
- Combat identification; and
- Battle Damage Assessment (BDA).

1.3 Scope of Document

This document describes three separate but related activities. Section 3 describes the Human Factors Engineering (HFE) process in general: how HFE should be incorporated into the system engineering process, ways in which programs can benefit from sound HFE practices, and introduces several different HFE techniques from Applied Cognitive Work Analysis (ACWA) to heuristic evaluation. Section 4 contains the procedures and results from the ACWA performed for TCT, describing the overall process, a functional decomposition of the TCT process, and the results of the evaluation. Section 5 details the TCTF GUI Working Group (WG) and the findings of a survey that was based on the ACWA results and given to

operators who participated in the first GUI WG. Section 6 contains the results of a Heuristic and Cognitive Evaluation, describing the results of MITRE's GUI team's evaluation of the contractor's design based on information gathered from users through the ACWA and the GUI WG. Section 7 contains a discussion of the ACWA process and conclusions drawn from these HFE activities, as well as lessons learned, and future applications of this information.

The materials used and raw data collected during the execution of these activities are provided in the appendices. Appendix A contains the interview guide used when we first talked to the MITRE Subject Matter Experts (SMEs) in the knowledge acquisition phase of the ACWA. Appendix B contains the survey distributed to the MITRE SMEs later in the process to further refine the ACWA and provide subjective ratings for each of the information elements. Appendix C includes the survey given to the GUI WG participants. Acronyms used within this paper are defined at the end of the document.

Section 2

Applicable Documents

2.1 Government Documents

JEFX 2002 ConOps & TTPs
For TCT during
Millennium Challenge-2002
AFC2TIG TCT Team
15 Jan 02
    Concept of Operations & Tactics Techniques &
Procedures For Time Critical Targeting

MIL-HDBK-46855A
17 May 1999
    Human Engineering Program Processes and Procedures

UI Spec for the DII 4.0
October 1999
    User Interface Specification for the Defense Information
Infrastructure (DII)

USAF CONOPS for AOC
AFC2ISRC
9 March 2001
    Concept of Operations for
Air Operations Center

USAF TCT Team Checklist &
Positional Handbook
AFC2ISRC/C2NT
3 July 2001
    TCT Kill Chain Operations
Tactics, Techniques, and Procedures
Find, Fix, Track, Target, Engage, Assess

2.2 Other Documents

Usability Engineering
By Jacob Nielsen
Academic Press, 1993
ISBN 0-12-518406-9
    Usability Engineering (Practices and Guidelines)

User and Task Analysis By Hackos & Redish John Wiley & Sons, 1998 ISBN 0-471-17831-4	User and Task Analysis for Interface Design
Overview, Comparisons, and Exercises in CTA MITRE CTA Workshop By Elm, Potter, & Roth September 2001	Overview, Comparisons, and Exercises in Cognitive Task Analysis
MITRE Briefing January 2000	Dynamic Battle Management Functional Architecture

Section 3

Human Factors Engineering Process

3.1 Human Factors in System Engineering

The importance of user interaction during the system development process cannot be understated. This paper describes the Human Factors Engineering (HFE) techniques used for the TCTF program to ensure user involvement. Throughout the different phases of spiral development – from requirements generation to testing – HFE involvement will increase the likelihood of a user-preferred system.

> " . . .The time has come to stop concentrating on individual systems and to start focusing on the information they provide. The Air Force needs to automate processing, so that information is displayed intuitively . . . and decision-quality data . . . is delivered directly to decision makers."
> -- General John Jumper, Air Force Chief of Staff,
> C2ISR Summit, April 2002

3.2 Human Factors Engineering Techniques Applied to TCT

The primary tool the GUI Team used in the early stages of TCT development was the Applied Cognitive Work Analysis. It should be noted that there is no clear distinction between Cognitive Work Analysis (CWA) and Cognitive Task Analysis (CTA), therefore this document will refer to these processes interchangeably.

Conducting the ACWA was a detailed process that required extensive document research and numerous interviews with Subject Matter Experts at MITRE. The outcomes of the ACWA enabled the development of a user survey which was given to the MITRE SMEs. This process was refined and a similar survey was given to users and SMEs from the GUI WG from Langley AFB. The results from the ACWA and the GUI WG surveys were used in combination with general HFE standards and principles, to generate the Heuristic and Cognitive Evaluation of the contractor's GUI.

3.2.1 Applied Cognitive Work Analysis

The ACWA consists of a "functional decomposition" of the process, decision and information requirements for each goal in a process, and a "display task description". The "functional decomposition" is a visualization of a task break down. It is organized hierarchically and is not necessarily time dependent. The functional decomposition allows for the examination of each user goal within the process leading to the development of decisions required for each goal. These decision requirements, when carefully analyzed, produce the information elements that are required to make the decisions. In other words,

we can determine the information needed for the user to make a decision at a particular goal. The "display task description" begins to explain the visual display requirements by grouping the goals, with their related decisions and information requirements, into "functional areas." The "functional areas" form the basis for the GUI. The ACWA process guides the GUI development allowing the user to see the right information at the right time to make the appropriate decision.

Following the ACWA process, surveys were developed and given to the MITRE SMEs. The SMEs rated the information requirements for each goal in both "importance" – how critical an information item is for achieving this goal, and "accessibility" – how easy the information should be to retrieve on the display. These surveys not only served as an evaluation technique to ensure the proper information pieces were associated with the proper goals, but also provided a rough order of importance. The problem of there being too much possible information to present to the user is common in many modern systems. The surveys attempted to answer the questions 'What is most important' and 'What is least important' thus guiding the GUI to a truly user-centered design.

A detailed discussion of the ACWA process and the data collected is contained in Section 4.

3.2.2 GUI Working Group Survey

Before the first TCT GUI Working Group (WG), the MITRE TCTF GUI Team distributed surveys to users and SMEs from the AFC2ISR Center at Langley AFB. These surveys resembled the surveys given to the MITRE SMEs with the exception that the information requirements were grouped around the Find → Fix → Track → Target → Engage → Assess (F2T2EA) process instead of by "goals." Each of the ACWA goals and its associated decision and information requirements was associated to the F2T2EA process. This reorganization was based on feedback from the MITRE SMEs due to the length of the initial survey. Although the results were more generalized, the GUI team felt user/SME responsiveness would be increased.

A detailed discussion of the GUI WG survey and the results are contained in Section 5.

3.2.3 Heuristic and Cognitive Evaluation

Following an analysis of the results of the two surveys, a Heuristic and Cognitive Evaluation was performed to examine the contractor's current GUI for consistency with operators' preferences and adherence to basic HFE guidelines and heuristics, e.g., The User Interface Specification for the DII. The MITRE TCTF GUI team generated comments on the layout, organization, look and feel, and functionality for each of the components and applications of the TCTF GUI. The evaluation also included a mapping of the information requirements, sorted both by ACWA goal and F2T2EA category, to the different GUI applications.

A detailed discussion of the Heuristic and Cognitive Evaluation is contained in Section 6.

Section 4

Applied Cognitive Work Analysis

4.1 ACWA Introduction

This section presents a detailed discussion of the ACWA as performed for the TCT process. An ACWA is used to uncover the operator's cognitive activities when performing a task and identify opportunities to provide more effective support for those activities.   This ACWA contains four distinct types of information: The Functional Decomposition, Decision Requirements, Information Required, and a Display Task Description (DTD).

The Functional Decomposition is a hierarchical task breakdown. This 'tree-like structure' identifies the highest-level task, along with all the supporting tasks. The decisions and information describe what information is needed to make what decisions for each goal in the decomposition. The DTD groups several goals, decisions, and information requirements together by related functions (including related decisions and similar information). This is used to describe different displays used to support those functions.

This ACWA depicts the tasks, decisions, information, and displays descriptions for the TCT process. The examination focuses on the processes of Target Development (TD) and Weapon Target Pairing (WTP) and therefore does not address all tasks within the TCT process. This analysis provides the foundation for heuristic evaluations and usability tests by describing what information the operators need to see and when they need to see it. This analysis can also provide insight to the developers as to what information should be presented to the operators, or readily available (this may be useful for pre-populating information panels).

The information contained herein has been gathered from several sources including briefings, documents, and operator/Subject Matter Expert (SME) interviews and surveys. Information elements for each goal were rated by the SMEs, revealing the relative importance of the information to the particular goal. Table 4-1 provides a list of the information elements, noting each goal that requires the information, thus illustrating the importance of certain pieces of information throughout the TCT process.

4.2 Functional Decomposition

The functional decomposition is organized hierarchically, therefore it is not time dependent i.e. the lower level goals contribute to the high level goals. Time does exist within a single goal, whereas an object (called a commodity) moves from left to right changing or being rearranged within the goal. This analysis pursues the tasks and decisions to be performed, and does not differentiate between tasks performed by the human and tasks performed by an

automated computer system. Section 4.2.1 explains how to read the functional decomposition diagram.

Figure 4-2 presents the complete functional decomposition describing the TCT process. Figures 4-3 – 4-5 provide zoomed-in, detailed views of each section of the decomposition in Figure 4-2 for legibility purposes.

4.2.1 How to Read the Functional Decomposition

Figure 4-1 explains how to read the functional decomposition diagram and explains the different components within each goal.
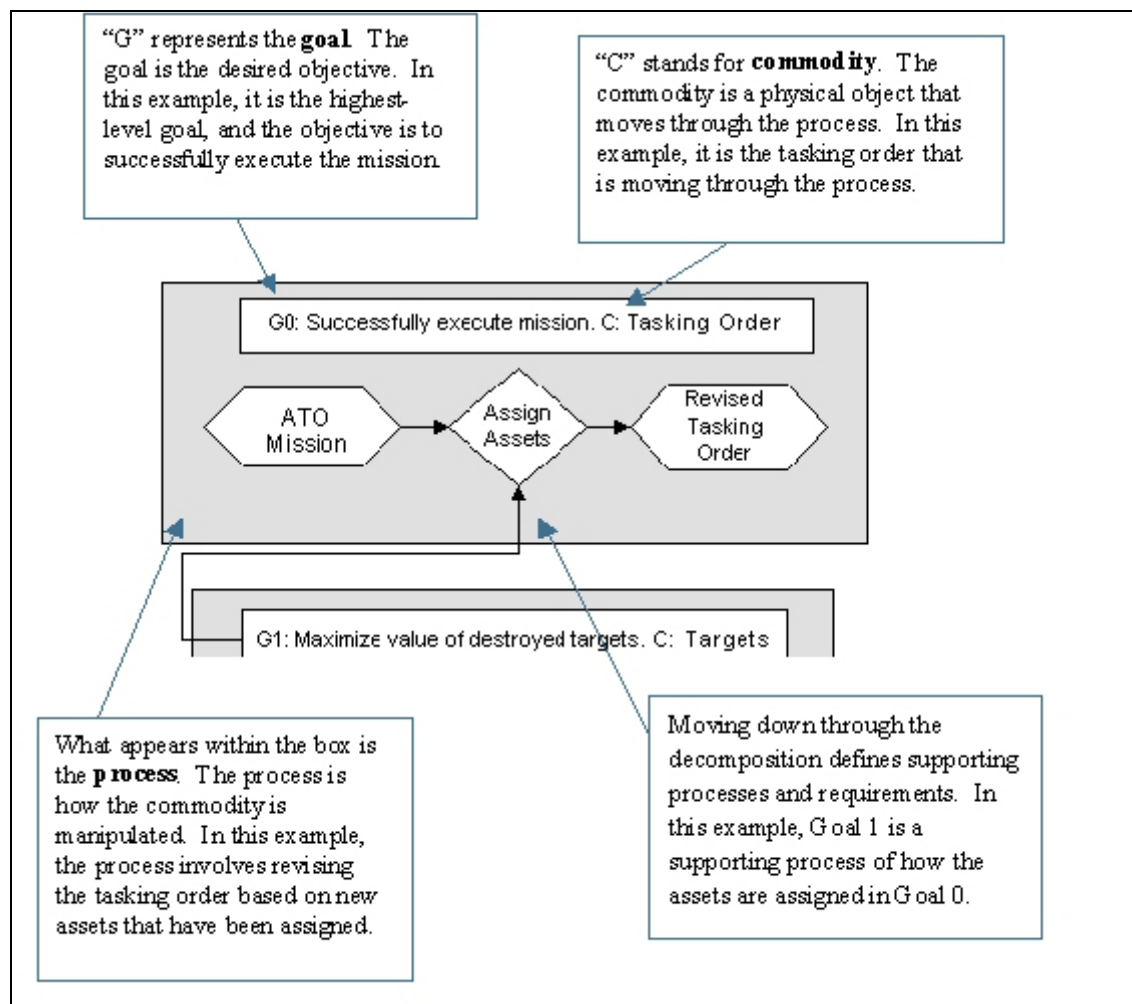
Figure 4-1. How to Read the Functional Decomposition

Figure 4.2 contains the entire Functional Decomposition developed during the ACWA process for TCT. Each goal within the Functional Decomposition is discussed in detail in Section 4.3, associating the decisions and information requirements with each goal.
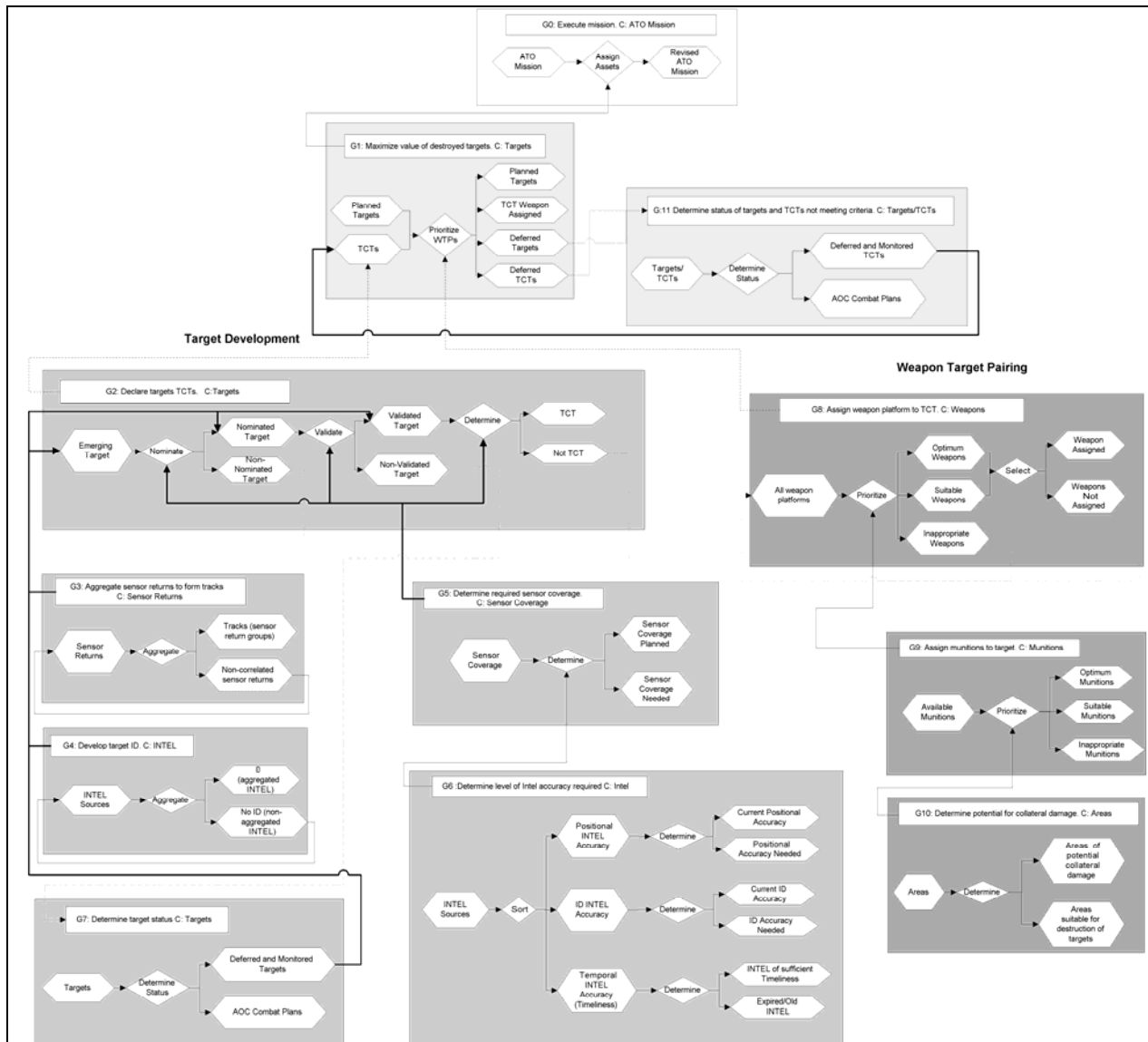
Figure 4-2. TCT Functional Decomposition Overview

Figure 4-3 shows an enlarged picture of the top portion of the Functional Decomposition. Because of its importance in the TCT process, for the purposes of the ACWA, we have named it "TCT Boss".
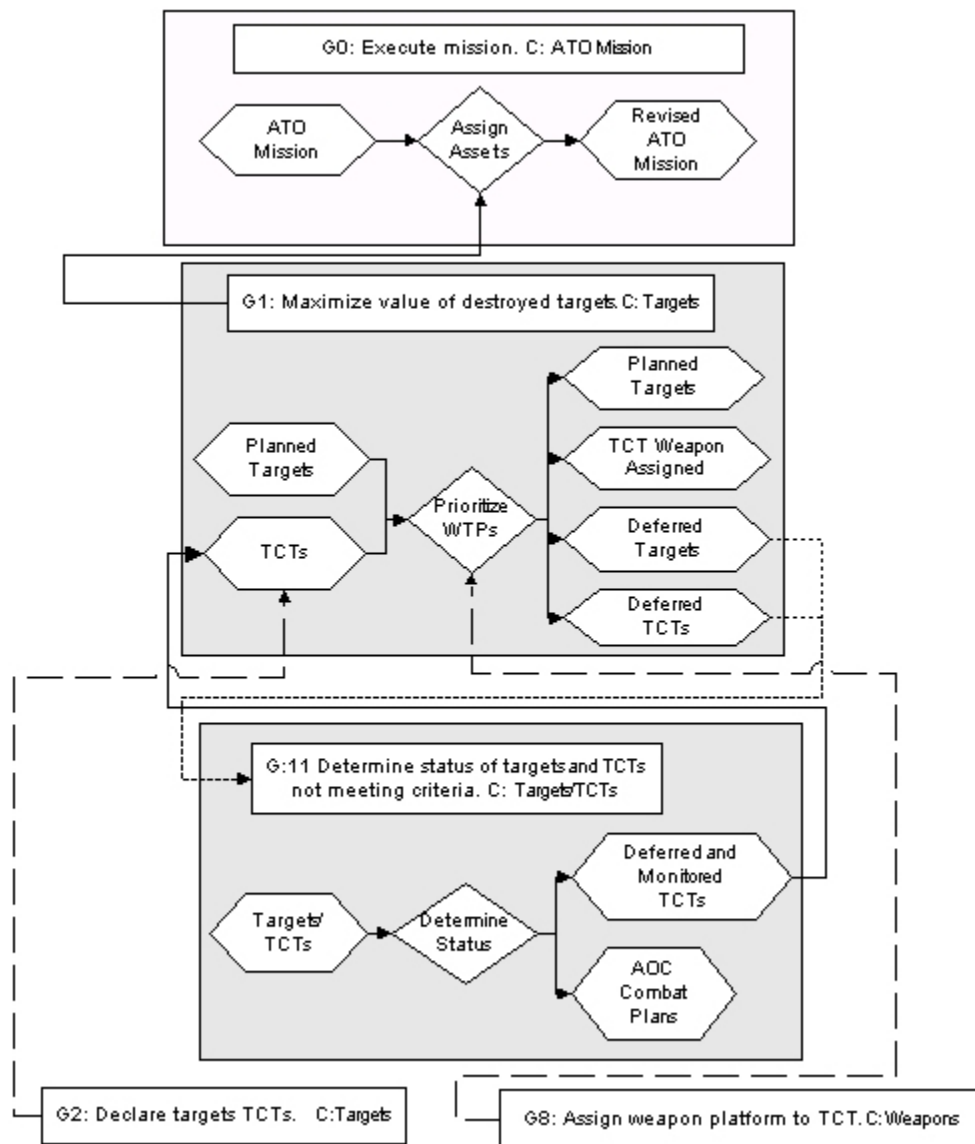
Figure 4-3. TCT Boss

Figure 4-4 shows an enlarged view of the Target Development portion of the Functional Decomposition. The highest goal in this hierarchy, Goal 2: Declare Targets TCTs, feeds into Goal 1: Maximize value of destroyed targets, of the TCT Boss.
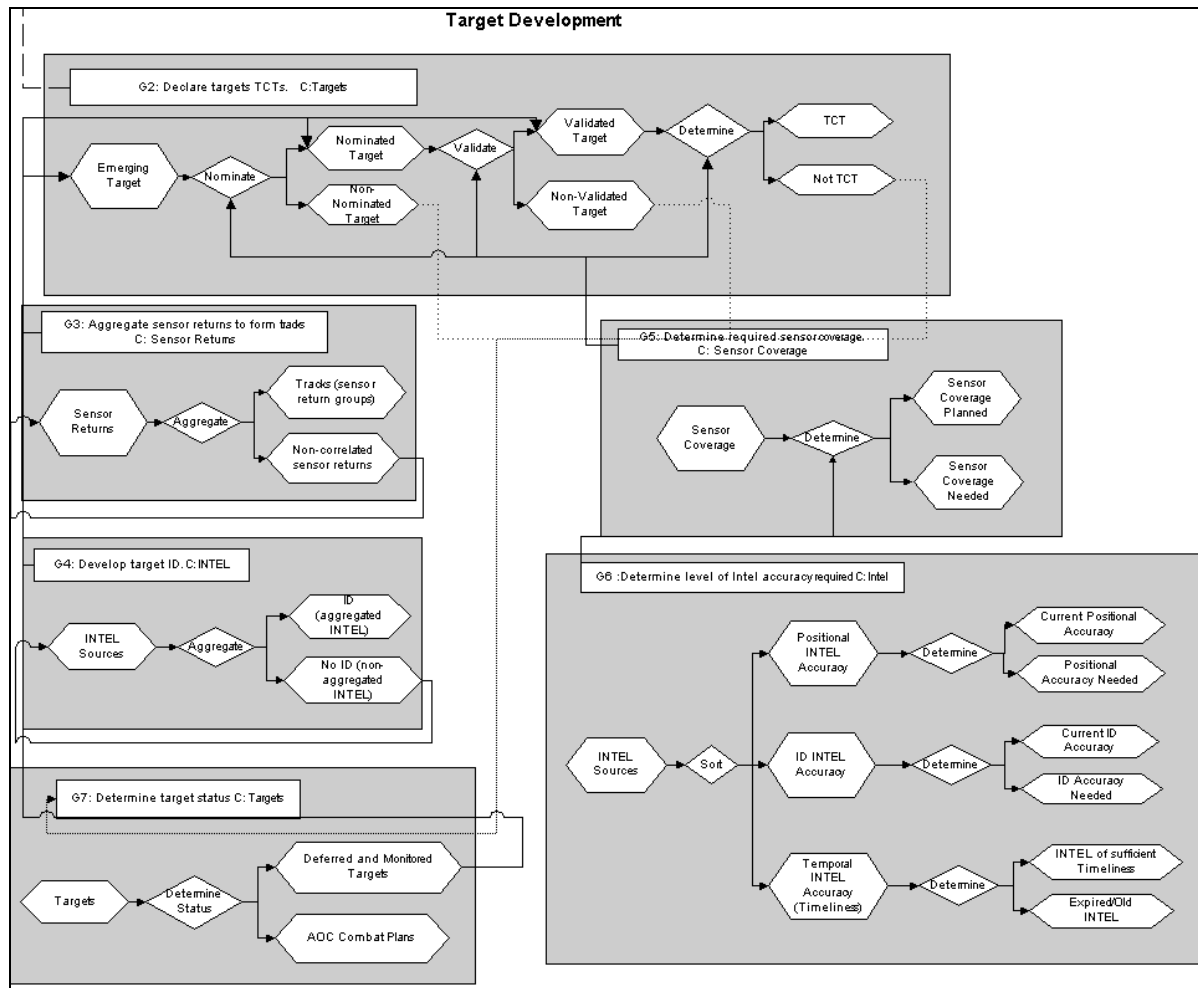
Figure 4-4. Target Development

Figure 4-5 shows an enlarged view of the Weapon Target Pairing portion of the Functional Decomposition. The highest goal in this hierarchy, Goal 8: Assign weapon platform to TCT, also feeds into Goal 1: Maximize value of destroyed targets, of the TCT Boss.
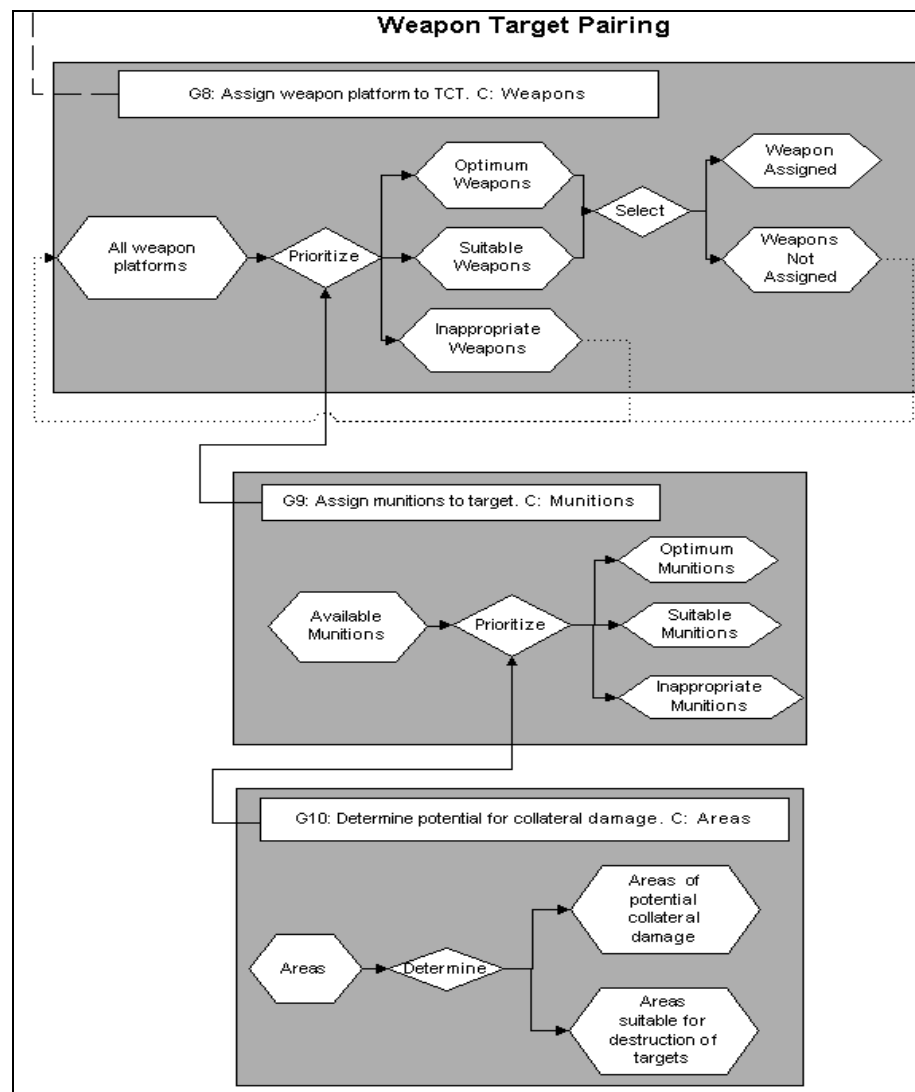
Figure 4-5. Weapon Target Pairing

4.3 Goal Summaries

The following section describes each goal in the functional decomposition including a detailed image, a textual description, and decision and information requirements, and analysis summary. Following the completion of the ACWA, the MITRE TCTF GUI Team distributed surveys to the MITRE SMEs. These surveys required the users to rate the different information elements for importance and how accessible the information needs to be on the display. Two graphs illustrating these ratings are included with each goal.

These ratings show the differences between importance and accessibility. For example, relatively static (speaking in a time-sensitive environment) items such as Rules for Valuation, Laws of Armed Conflict (LOAC), Rules of Engagement (ROEs), and Guidance, are consistently rated as extremely important. Those same items were rated toward the lower end in terms of accessibility on the display. The SMEs rated more dynamic items such as mission value, target value, Air Tasking Order (ATO) information, and Airspace Control Measures (ACMs) at the top of the accessibility list because these items may change more frequently and therefore need to be found more frequently on the display.

4.3.1 Goal 0: Execute Mission

4.3.1.1 Description

Goal 0 is the top-level goal required to successfully execute the TCT mission. It consists of revising the mission of the current ATO to incorporate any TCTs that were not previously included. The decision that needs to be made when achieving this goal is whether or not to task a mission. The information used to make this decision is the ATO itself, the weapons that have been assigned, and the Airspace Control Measures (ACMs).

Determining which assets to assign in Goal 0 is accomplished through Goal 1, which involves maximizing the value of the destroyed targets.

Figure 4-6 shows the task steps involved in achieving Goal 0.
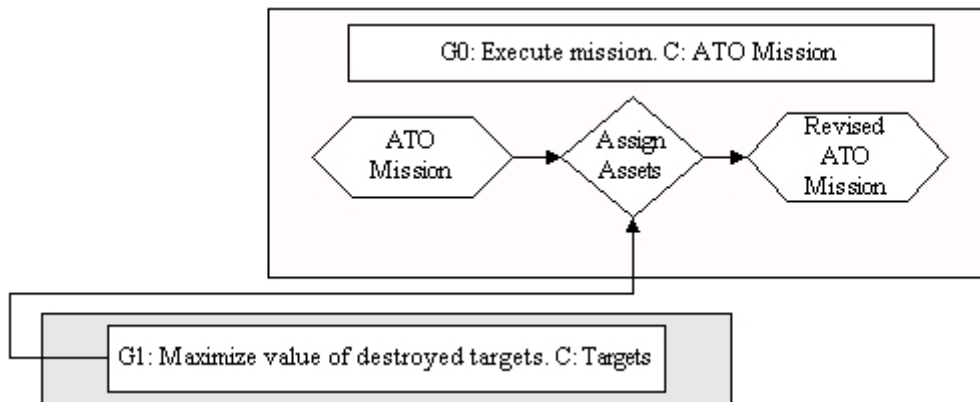
Figure 4-6. Goal 0: Execute Mission

4.3.1.2 Decision Requirements

The major task/decision required to complete this goal is:

- Task Mission Changes

4.3.1.3 Information Requirements

The information requirements are shown in Figures 4-7 and 4-8, and are ordered by the SMEs' ratings. The ratings represent the SMEs' subjective assessment of the information requirements for this goal in terms of importance and accessibility. Items rated as zero were not completed by the SME or hand-written into the survey with no accompanying rating. Because of the emphasis on information importance (and consideration for SMEs' limited time), follow-up interviews focused on the importance ratings and are therefore more complete.

The SMEs rated the "Available Assets" as the most important piece of information for this high level goal along with ACMs and ATO information. This indicates that at this stage in the process, the emphasis is on the asset safely and quickly proceeding to the target.
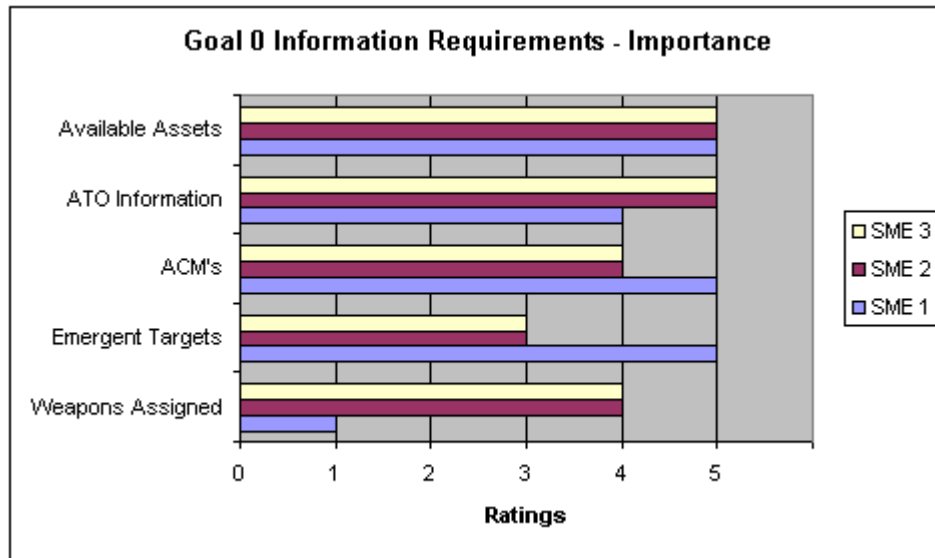
Figure 4-7. Goal 0: Importance
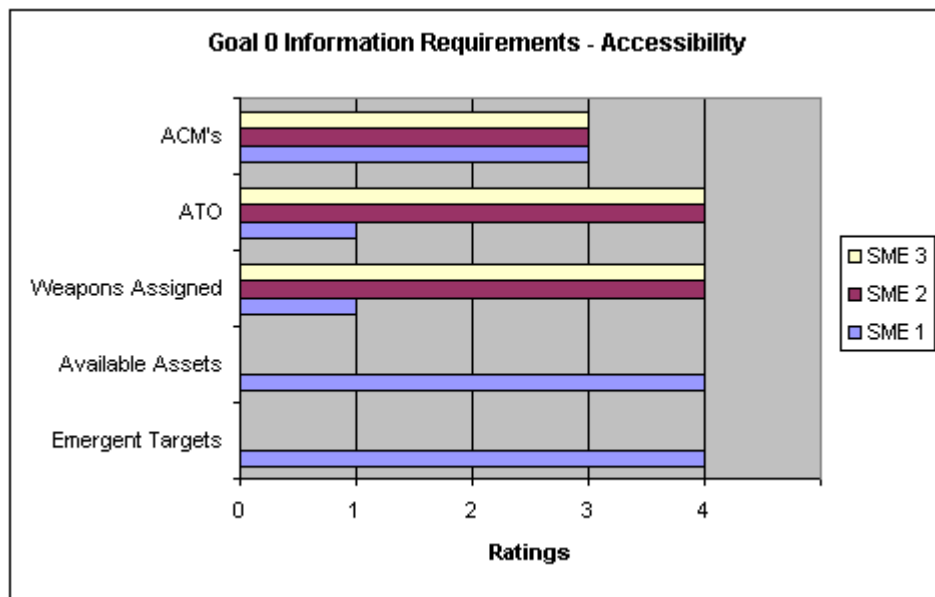
Figure 4-8. Goal 0: Accessibility

4.3.2 Goal 1: Maximize Value of Destroyed Targets

4.3.2.1 Description

Goal 1 involves maximizing the value of destroyed targets. This is accomplished by prioritizing the weapon-target pairings and determining which targets and TCTs to defer and which to pair with weapons and prosecute. There are various pieces of information that aid in this process, such as the ATO, Target Values, Mission Values, and Rules of Engagement (ROEs).

The TCTs that are considered in the prioritization come from successfully nominating targets as TCTs in Goal 2, and from the TCTs that were deferred but are being monitored in Goal 11. The prioritized weapon-target pairings are created through Goal 6, which consists of assigning weapon platforms to TCTs.

Figure 4-9 shows the task steps involved in achieving Goal 1.

Figure 4-9. Goal 1: Maximize Value of Destroyed Targets

4.3.2.2 Decision Requirements

The major tasks/decisions required to complete this goal are:

- Monitor planned targets and their value.

- Monitor weapons assigned and ACMs for TCT.

- Approve best (highest global value) weapon platform/munition for TCT

4.3.2.3 Information Requirements

The information requirements are shown in Figures 4-10 and 4-11, and are ordered by the SMEs' ratings. The ratings represent the SMEs' subjective assessment of the information importance and information accessibility necessary to successfully complete the goal.

The SMEs ratings indicate that this high level goal is dependent upon supporting information successfully developed in lower level goals. The information elements rated the highest concern the overall rules and laws governing the TCT process. Mission and target value also received high importance ratings because these information elements interact with the Guidance to determine whether the mission will benefit from the diversion of an asset. Because many of the rules and laws are fairly static, their respective accessibility ratings are lower than the more dynamic information within the lists.
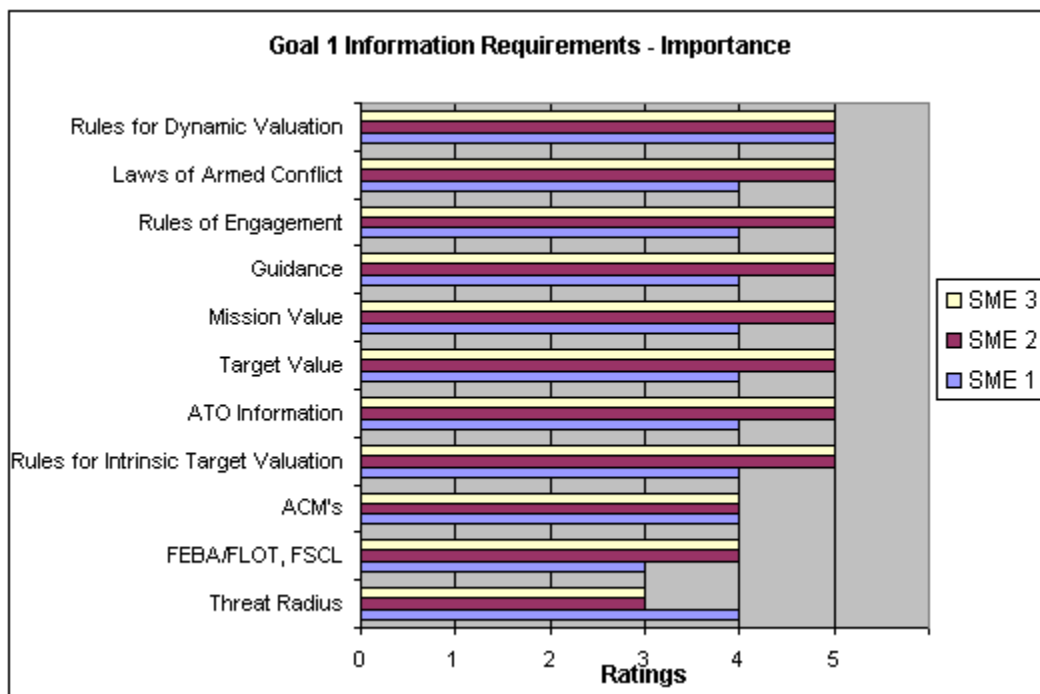
Figure 4-10. Goal 1: Importance
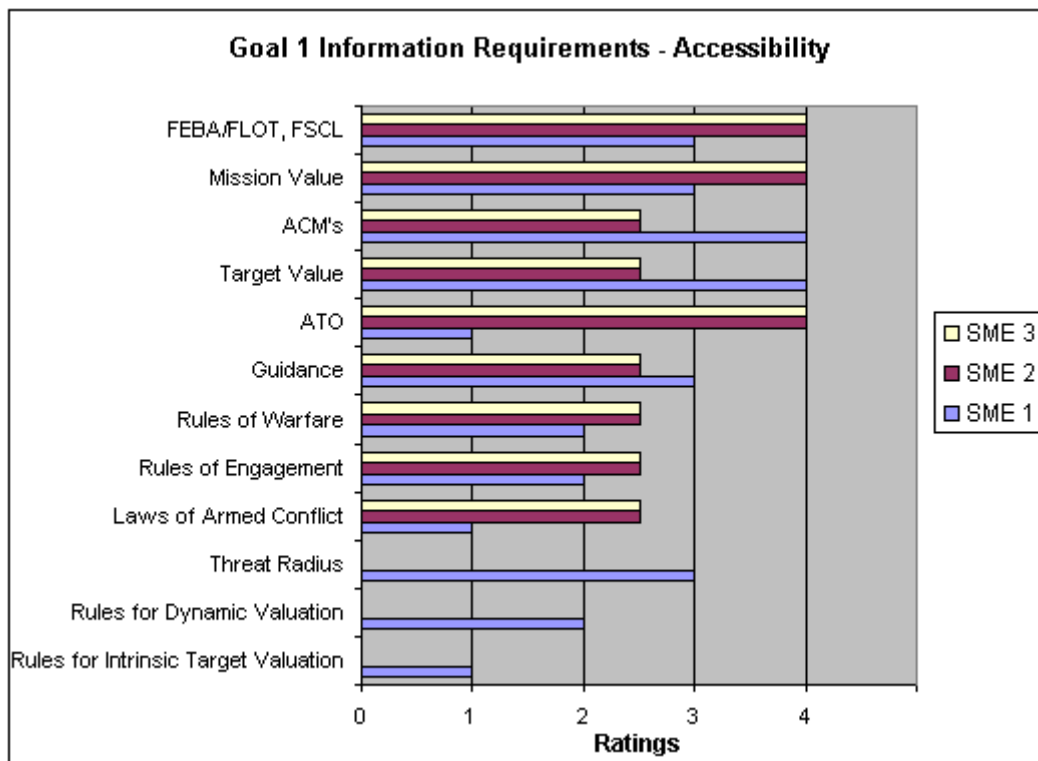
Figure 4-11. Goal 1: Accessibility

4.3.3 Goal 2:Declare Targets TCTs

4.3.3.1 Description

Goal 2 involves declaring targets to be TCTs. The first step in this process is to develop the track and identify the emerging target. This is accomplished through Goal 3 which consists of successfully fusing sensor returns and other information such as IPB together to form tracks and Goal 4 which consists of successfully developing the initial target ID. Once an emerging target has been identified, the steps are to nominate the target, validate the target, and, lastly, declare the target a TCT. In order to complete these steps, Goal 5 is necessary to determine if additional sensor coverage is required.

Figure 4-12 shows the task steps involved in achieving Goal 2.
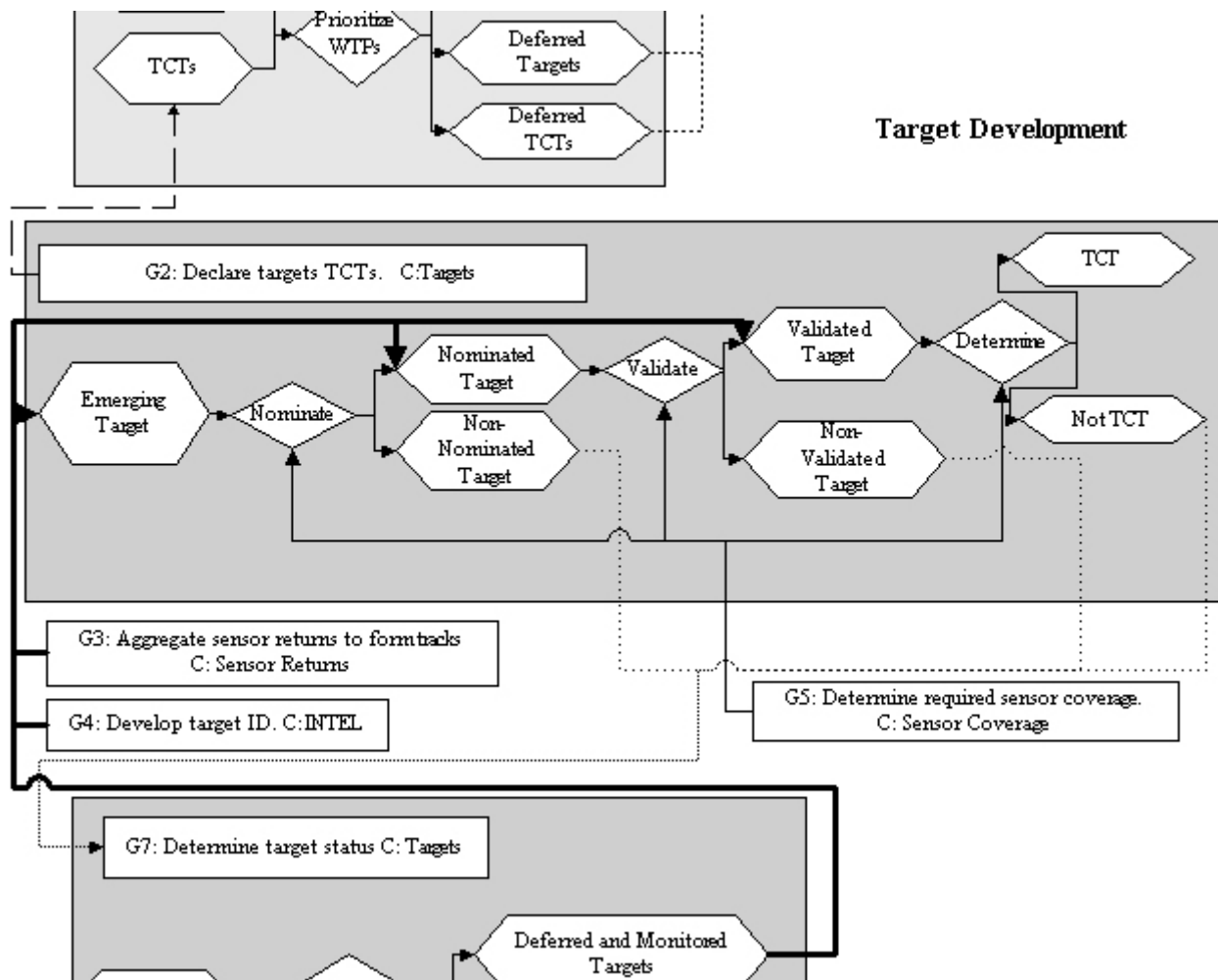
Figure 4-12. Goal 2: Declare Targets TCTs

4.3.3.2 Decision Requirements

The major tasks/decisions required to complete this goal are:

- Monitor targets
- Approve targets as Nominated Targets
- Approve targets as Validated Targets.
- Approve targets as TCTs.

4.3.3.3 Information Requirements

The information requirements are located in Figures 4-13 and 4-14, and are ordered by the SMEs' ratings. The ratings represent the SMEs' subjective assessment of the information importance and information accessibility necessary to successfully complete the goal.

The SME ratings exhibit a preference for a combination of high and low level information elements. Many of the higher rated elements concern the area the target is in, the rules/guidance, and the accuracies and capabilities of the Intel. The order of the SME ratings change from importance to accuracy again, with the static information, e.g., ROEs, LOAC, etc., requiring less visibility than the dynamic target-related information.
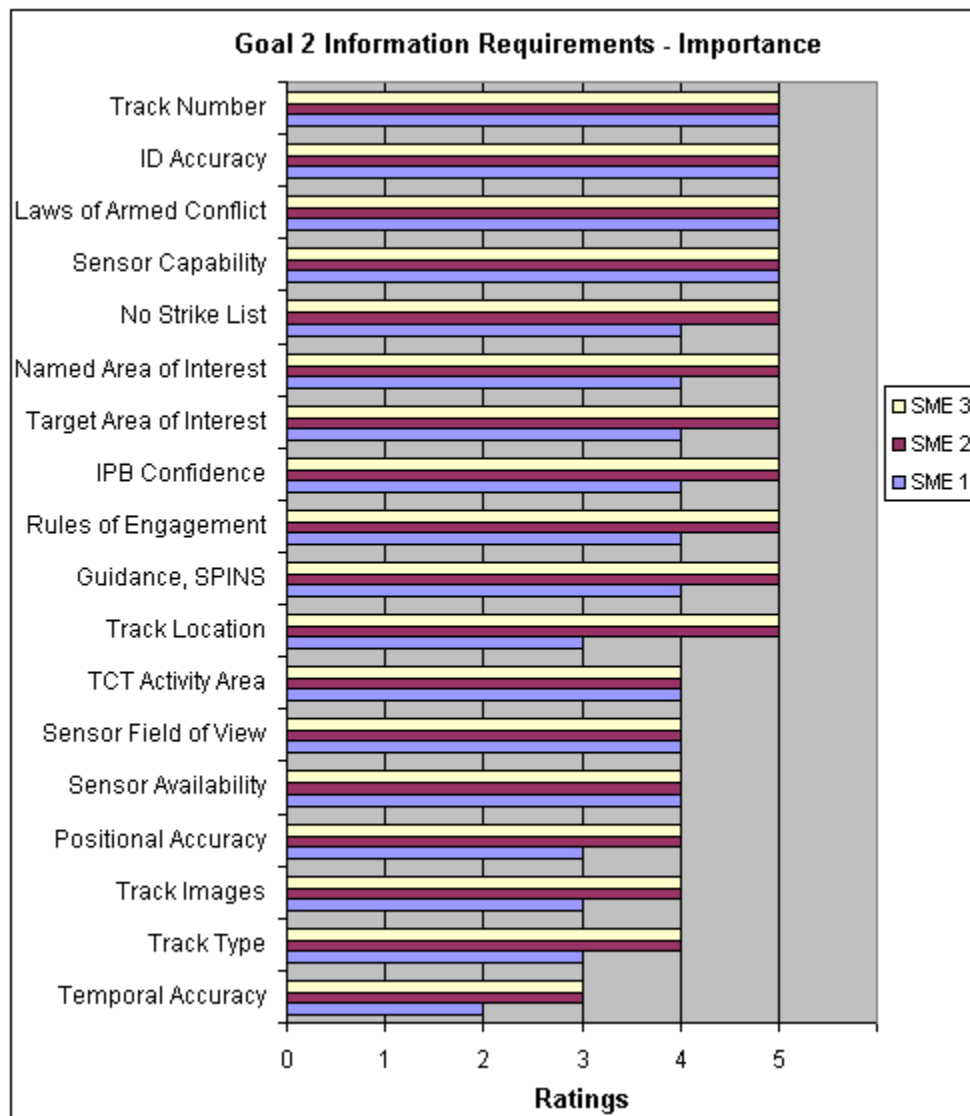
Figure 4-13. Goal 2: Importance
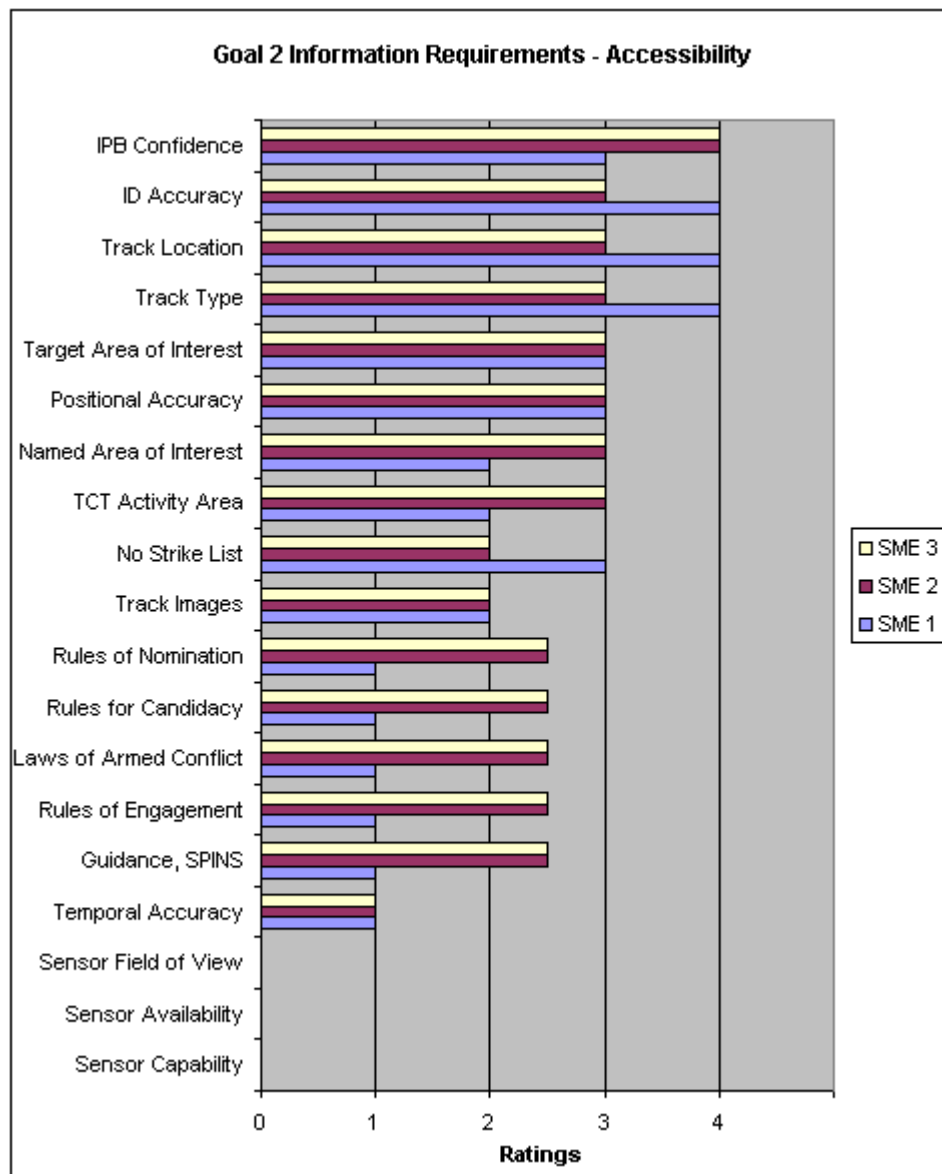
Figure 4-14. Goal 2: Accessibility

4.3.4 Goal 3:Aggregate Sensor Returns to form Tracks

4.3.4.1 Description

Goal 3 consists of aggregating sensor returns to form tracks. This is accomplished by aggregating the sensor returns (including all appropriate sensors) from various ISR sources.

The sensor returns are either associated by relating all available information into a logical object to create tracks or not associated. Tracks that are formed are fed into Goal 2 as emerging targets. Non-aggregated sensor returns remain to be associated with future sensor returns and IPB.

Figure 4-15 shows the task steps involved in achieving Goal 3.
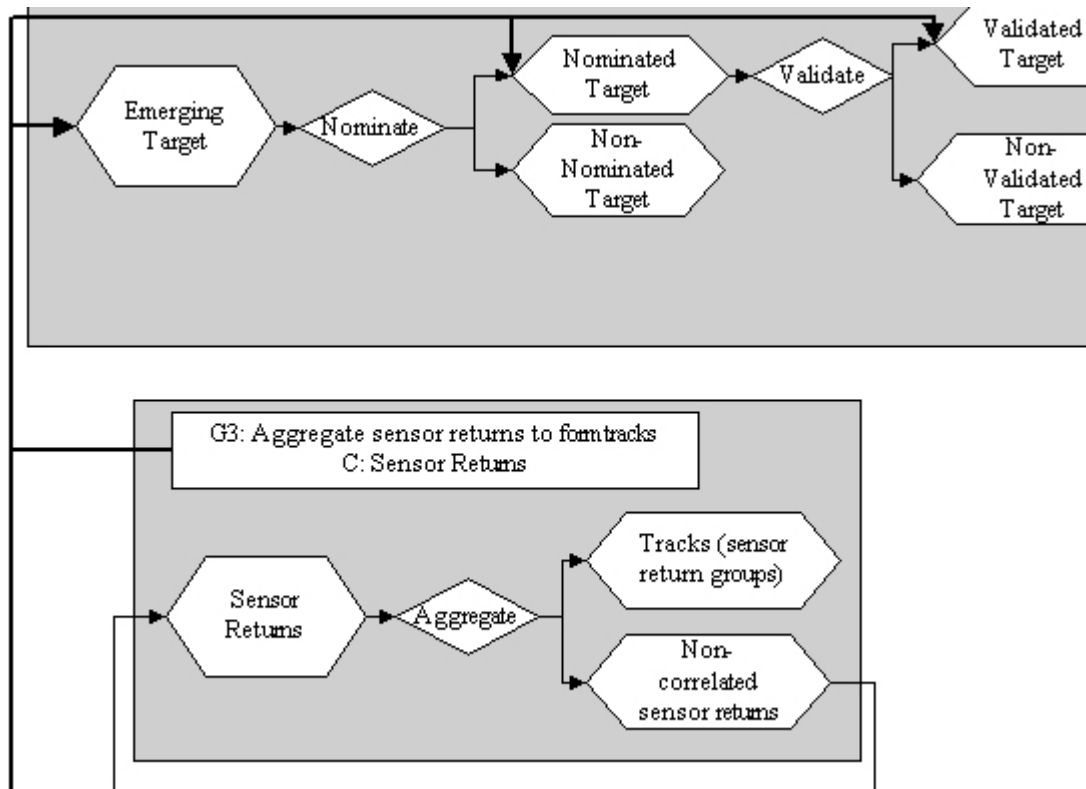
Figure 4-15. Goal 3: Aggregate Sensor Returns to form Tracks

4.3.4.2 Decision Requirements

The major tasks/decisions required to complete this goal are:

- Monitor sensor returns

- Monitor tracked groups of sensor returns

- Correlate/fuse sensor returns to form tracks

4.3.4.3 Information Requirements

The information requirements are shown in Figures 4-16 and 4-17, and are ordered by the SMEs' ratings. The ratings represent the SMEs' subjective assessment of the information importance and information accessibility necessary to successfully complete the goal.

The SMEs rated all of the information elements fairly high for this goal. The ratings do not exhibit much differentiation among the types of information. The SMEs did not rate the accessibility of the information elements here as high as for some other goals.
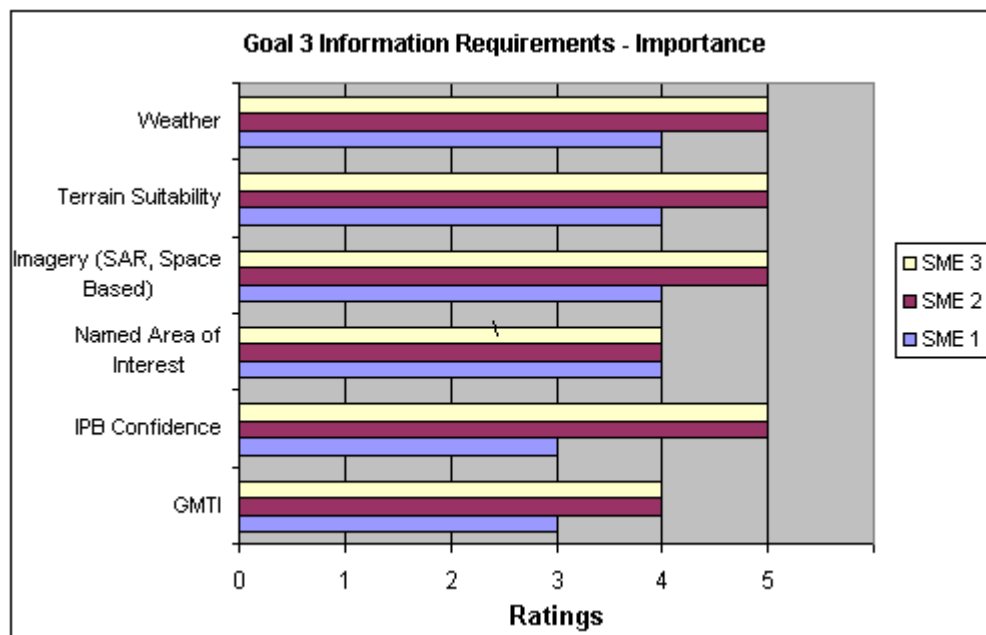
Figure 4-16. Goal 3: Importance
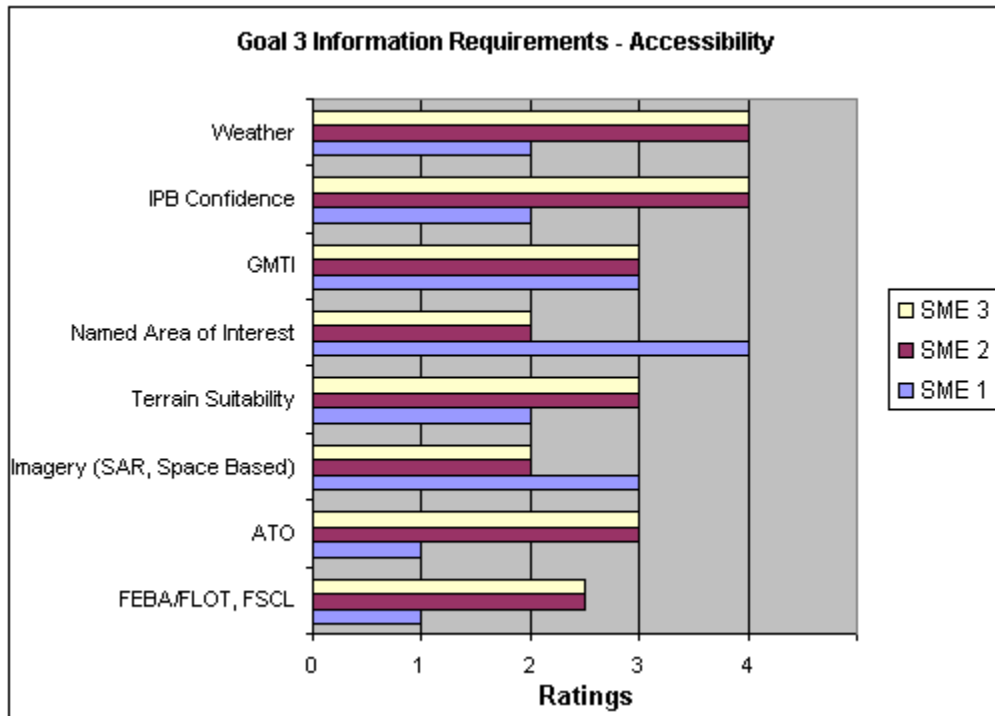
Figure 4-17. Goal 3: Accessibility

4.3.5 Goal 4: Develop Target ID

4.3.5.1 Description

Goal 4 involves developing a target ID. This consists of fusing a vast amount of intelligence information, such as Imagery, Human and Signals INT, and either identifying a target or not finding a correlation in the intelligence information. If a target is identified, then it is forwarded to Goal 2 as an emerging target.

Figure 4-18 shows the task steps involved in achieving Goal 4.
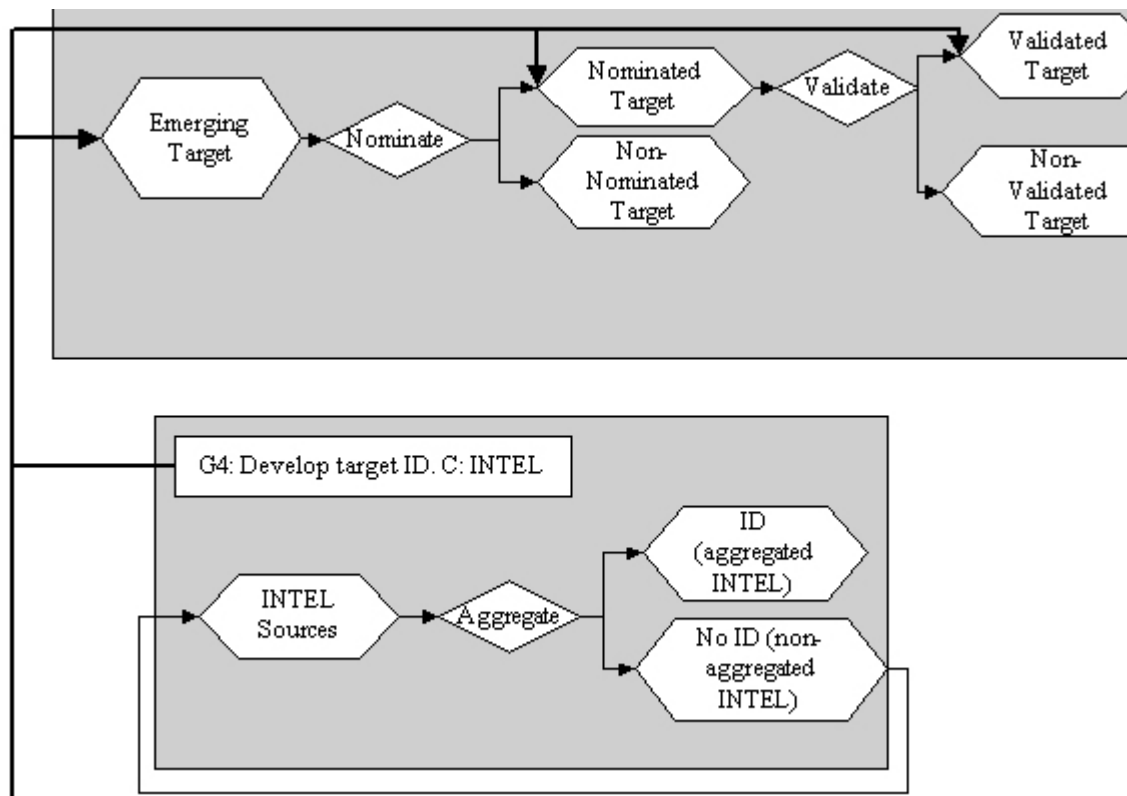
**Figure 4-18. Goal 4: Develop Target ID**

4.3.5.2 Decision Requirements

The major tasks/decisions required to complete this goal are:

- Monitor INTEL sources.

- Correlate INTEL information

### 4.3.5.3 Information Requirements

The information requirements are shown in Figures 4-19 and 4-20, and are ordered by the SMEs' ratings. The ratings represent the SMEs' subjective assessment of the information importance and information accessibility necessary to successfully complete the goal.

The information elements required for the identification of a target are extensive not only because ID can be difficult to obtain, but also because an incorrect ID can have severe consequences. The SMEs rated identification-related information elements (Combat ID, Rules for Identification, and IFF) as most important. The other important information

requirements help further develop the target ID such as IPB info and Intel. Many of the track specific information elements such as location, convoy characteristics, and emissions were rated high for accessibility, perhaps because these elements are important for maintaining situation awareness in this goal.

Goal 4 Information Requirements - Importance
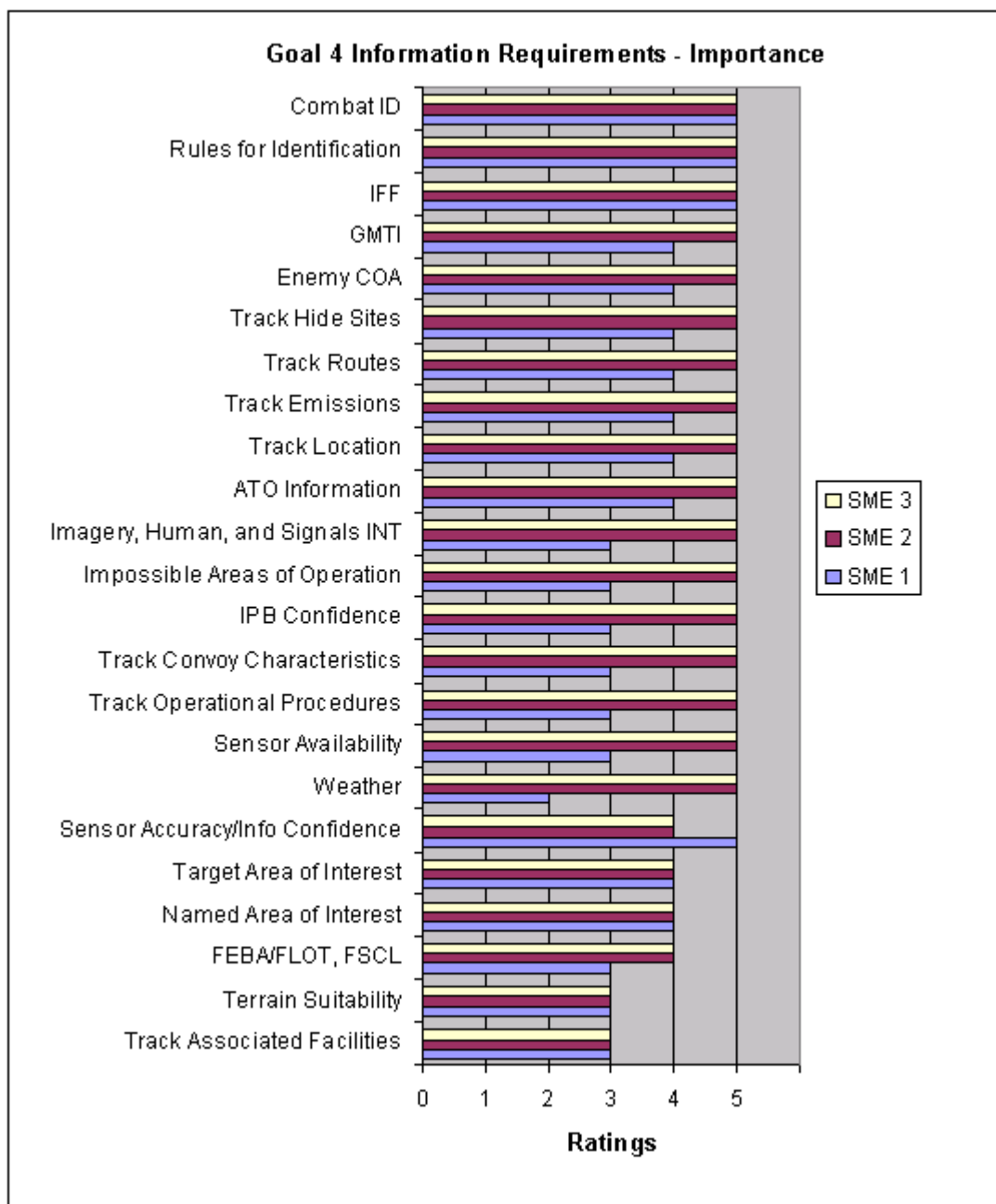
Figure 4-19. Goal 4: Importance
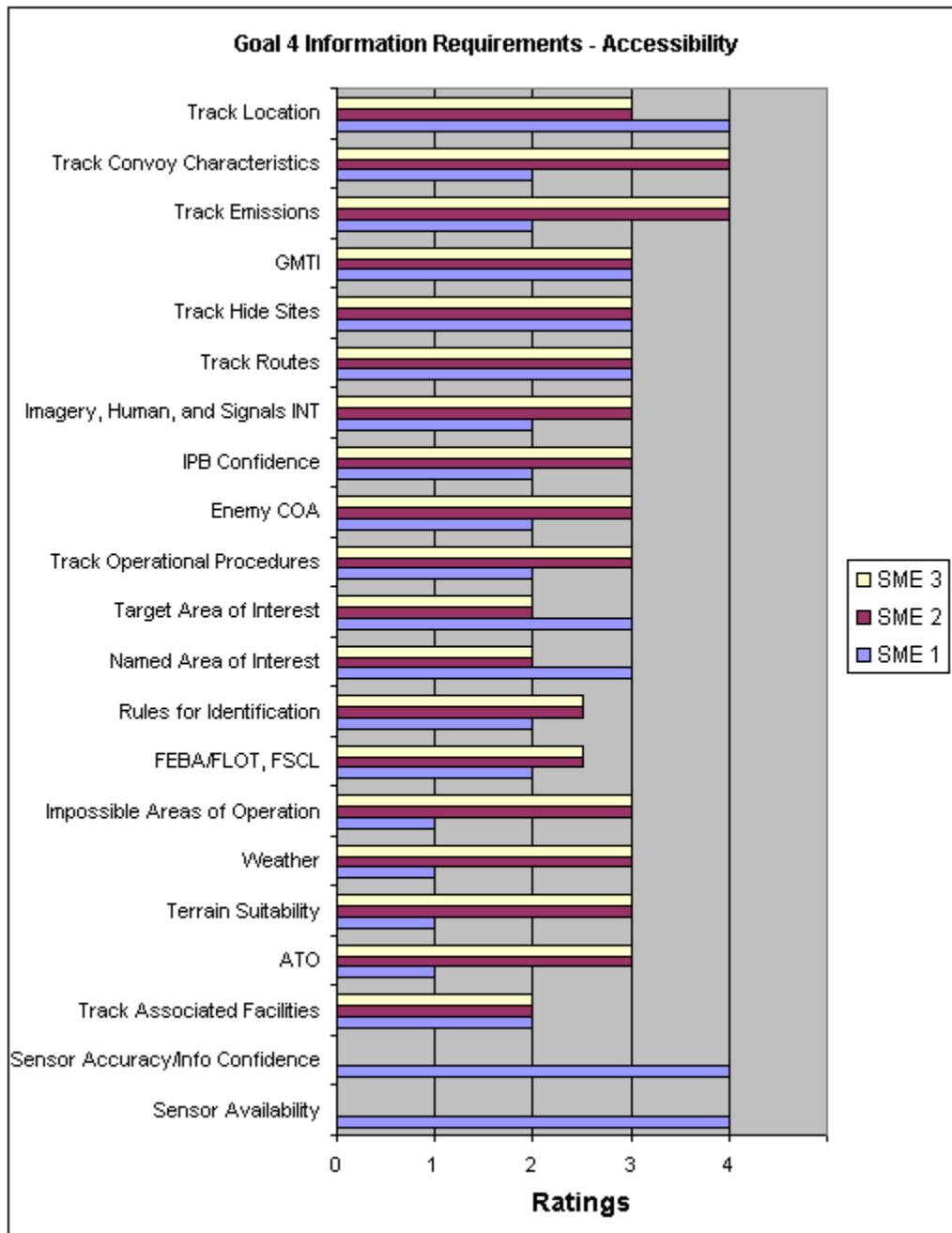
Figure 4-20. Goal 4: Accessibility

4.3.6 Goal 5: Determine Required Sensor Coverage

4.3.6.1 Description

Goal 5 consists of successfully determining required sensor coverage. This involves determining whether sensor coverage has been planned or if sensor coverage is needed for a specific area. This is essential when determining whether or not to nominate a target, validate a target, or decide whether a target is a TCT because each decision requires additional intelligence information, which is obtained through sensor coverage.

Determining whether sensor coverage is needed is accomplished through Goal 6, which consists of successfully evaluating the level of Intel accuracy required. If accuracy is low, then additional sensor coverage is necessary.

Figure 4-21 shows the task steps involved in achieving Goal 5.
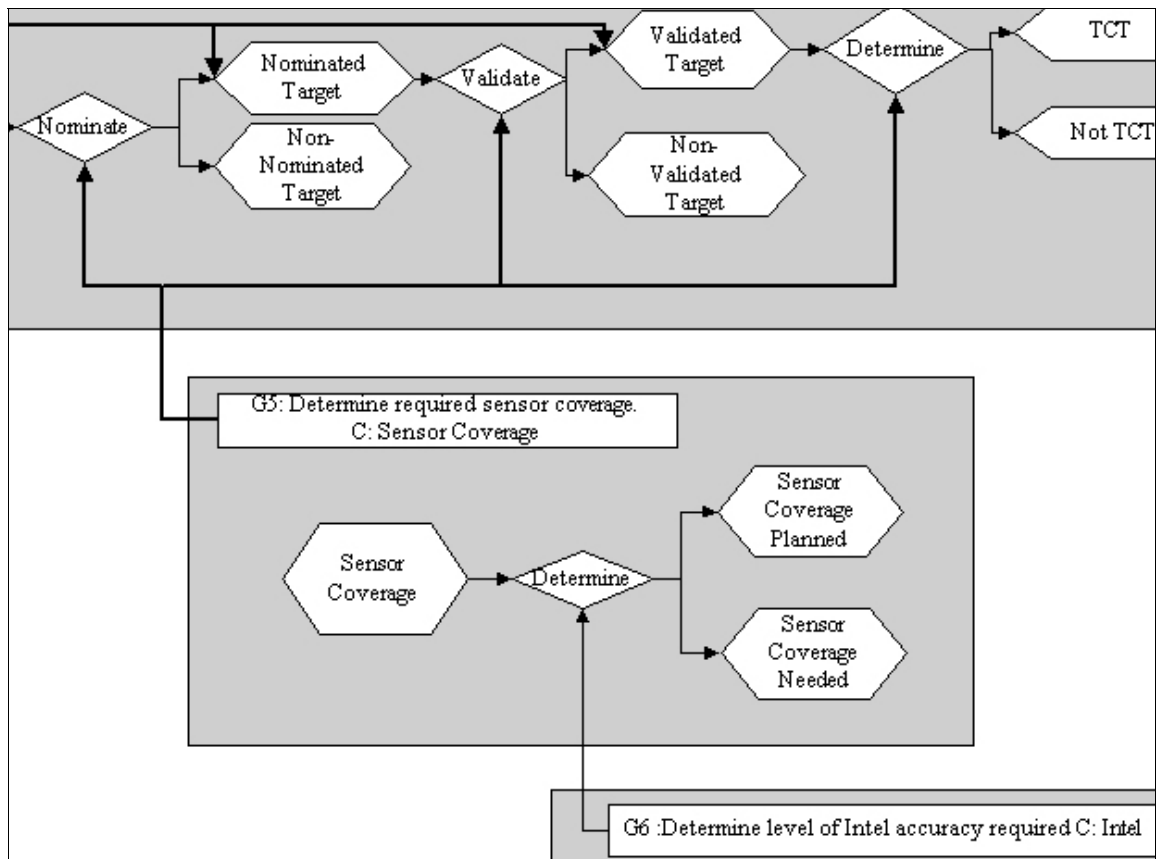
Figure 4-21. Goal 5: Determine Required Sensor Coverage

4.3.6.2 Decision Requirements

The major tasks/decisions required to complete this goal are:

- Determine where additional sensors/INTEL are needed

- Evaluate the likelihood of retasking the sensors

4.3.6.3 Information Requirements

The information requirements are shown in Figures 4-22 and 4-23, and are ordered by the SMEs' ratings. The ratings represent the SMEs' subjective assessment of the information importance and information accessibility necessary to successfully complete the goal.

The SMEs rated "available sensors" as the most important information element for determining the required sensor coverage. What sensors are available, what information they can provide, and their location are all necessary to determine what sensor coverage is desired. Available sensors and sensor information were also rated high in terms of accessibility.

Figure 4-22. Goal 5: Importance
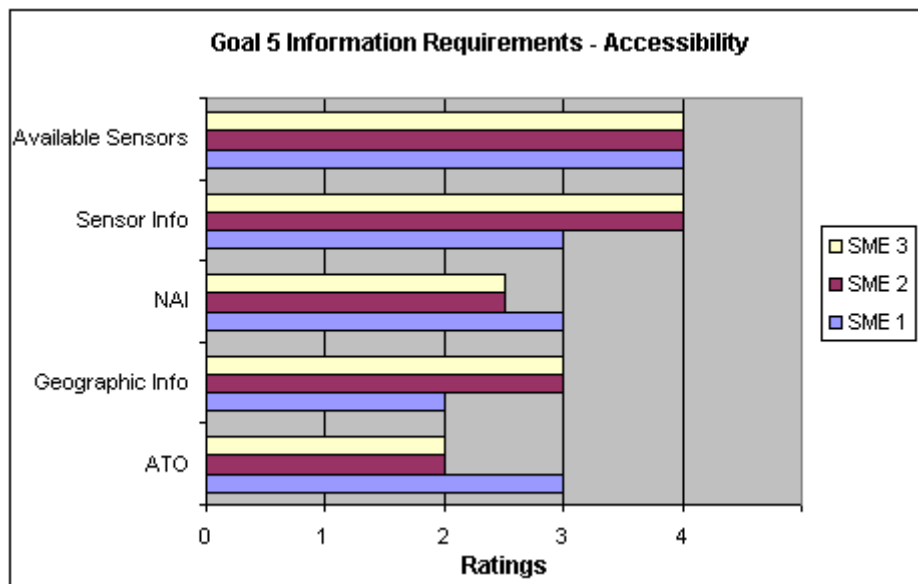
Figure 4-23. Goal 5: Accessibility

4.3.7 Goal 6: Determine Level of INTEL Accuracy Required

4.3.7.1 Description

Goal 6 consists of successfully determining the level of Intel accuracy required. Intel accuracy is divided into three main types: temporal, positional, and ID accuracy. To have complete Intel accuracy, all three types must be achieved. To determine if sensor coverage is required, it is necessary to examine whether all three types of Intel accuracy are sufficiently represented.

Figure 4-24 shows the task steps involved in achieving Goal 6.
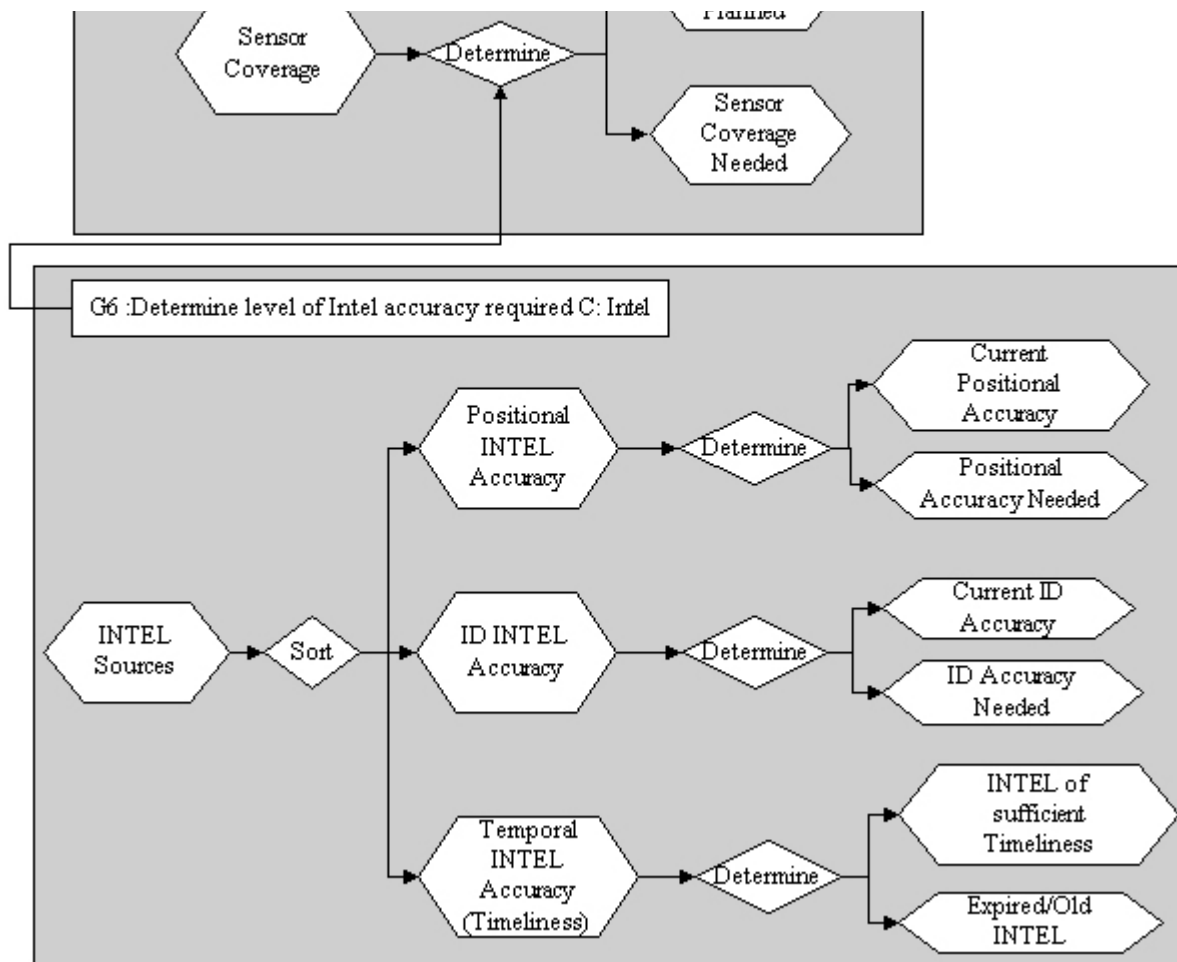
Figure 4-24. Goal 6: Determine Level of INTEL Accuracy Required

4.3.7.2 Decision Requirements

The major task/decision required to complete this goal is:

- Determine the present level of confidence/accuracy for each component: Time, Position, ID

4.3.7.3 Information Requirements

The information requirements are shown in Figures 4-25 and 4-26, and are ordered by the SMEs' ratings. The ratings represent the SMEs' subjective assessment of the information importance and information accessibility necessary to successfully complete the goal.

The SMEs rated the information items here as one would expect. To determine how much additional accuracy is required, the present level of accuracy is very important. In addition, the rules and laws govern how much accuracy is required to continue with the TCT process. The low ratings of 'temporal accuracy' and 'Guidance/SPINS' were surprising. The accessibility ratings followed a similar rating order, with ID and 'positional accuracy' near the top of the list and 'temporal accuracy' and 'Guidance/SPINS' at the bottom.
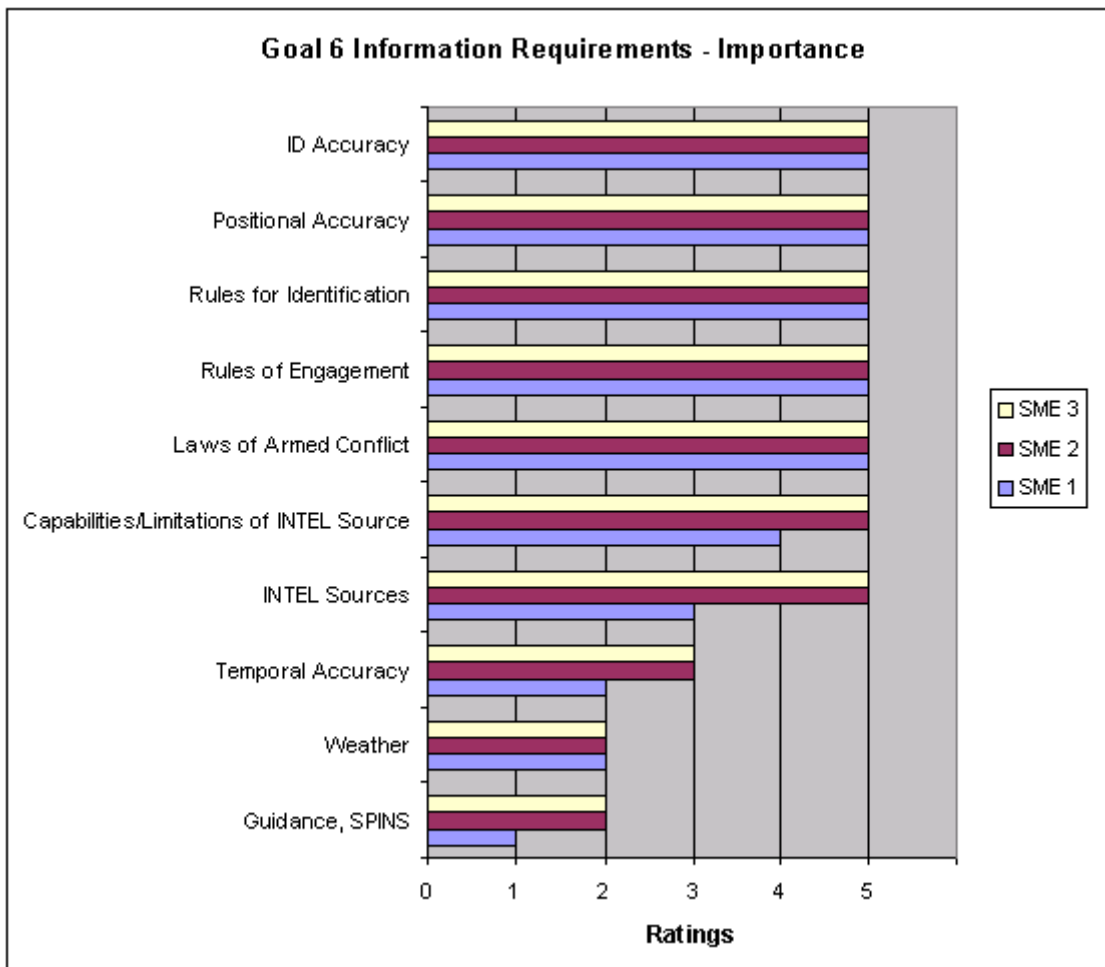
Figure 4-25. Goal 6: Importance
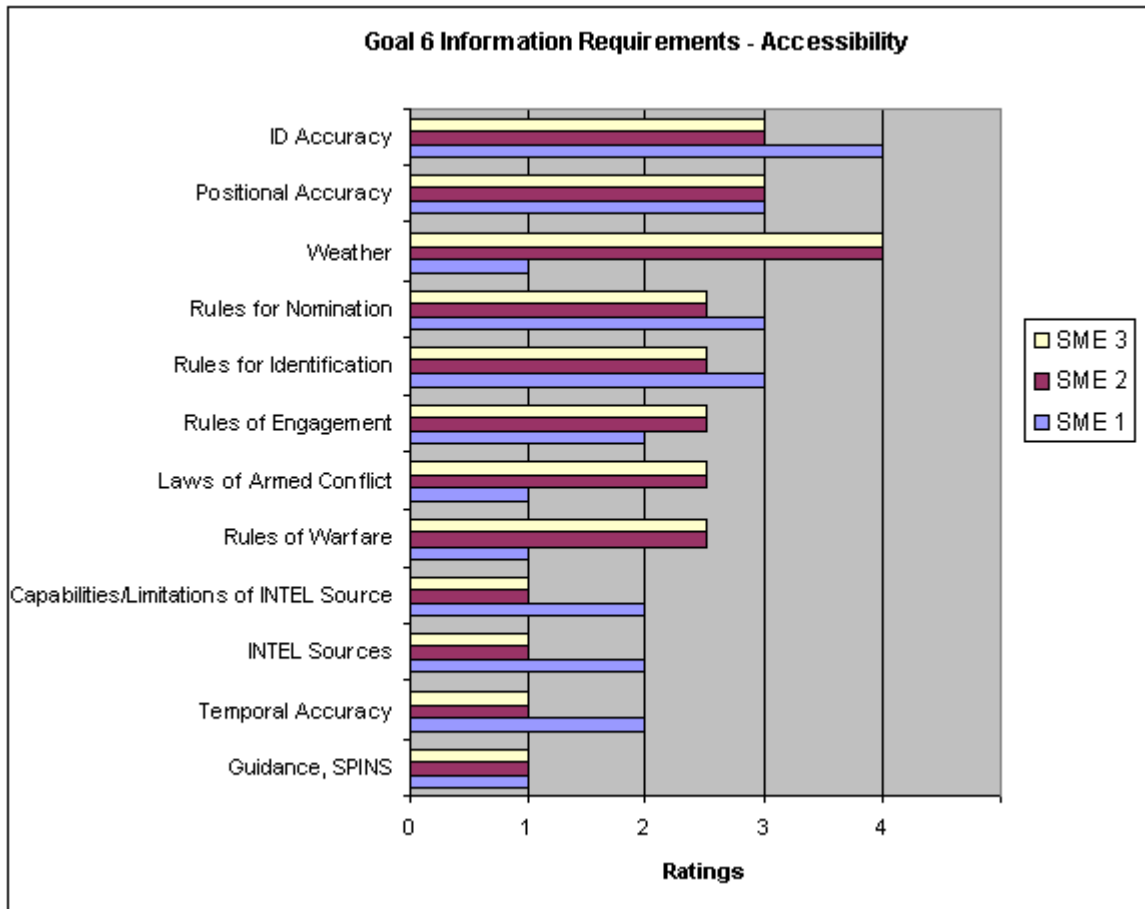
Figure 4-26. Goal 6: Accessibility

4.3.8 Goal 7: Determine Target Status

4.3.8.1 Description

Goal 7 involves determining the status of targets not yet declared TCTs. Because different amounts of INTEL and high level confirmation is required to declare a target a TCT, this process can be time consuming. When a target is not nominated, validated, or declared a TCT, someone must determine whether to continue pursuing the target attempting to obtain more Intel and/or higher level or confirmation, or to forward the target to the plans cell to prosecute during another ATO cycle. When a target is deferred and monitored, it is binned in the appropriate location i.e. remains on the Dynamic Target List/Dynamic Target Queue (DTL/DTQ) in the same place.

Figure 4-27 shows the task steps involved in achieving Goal 7.
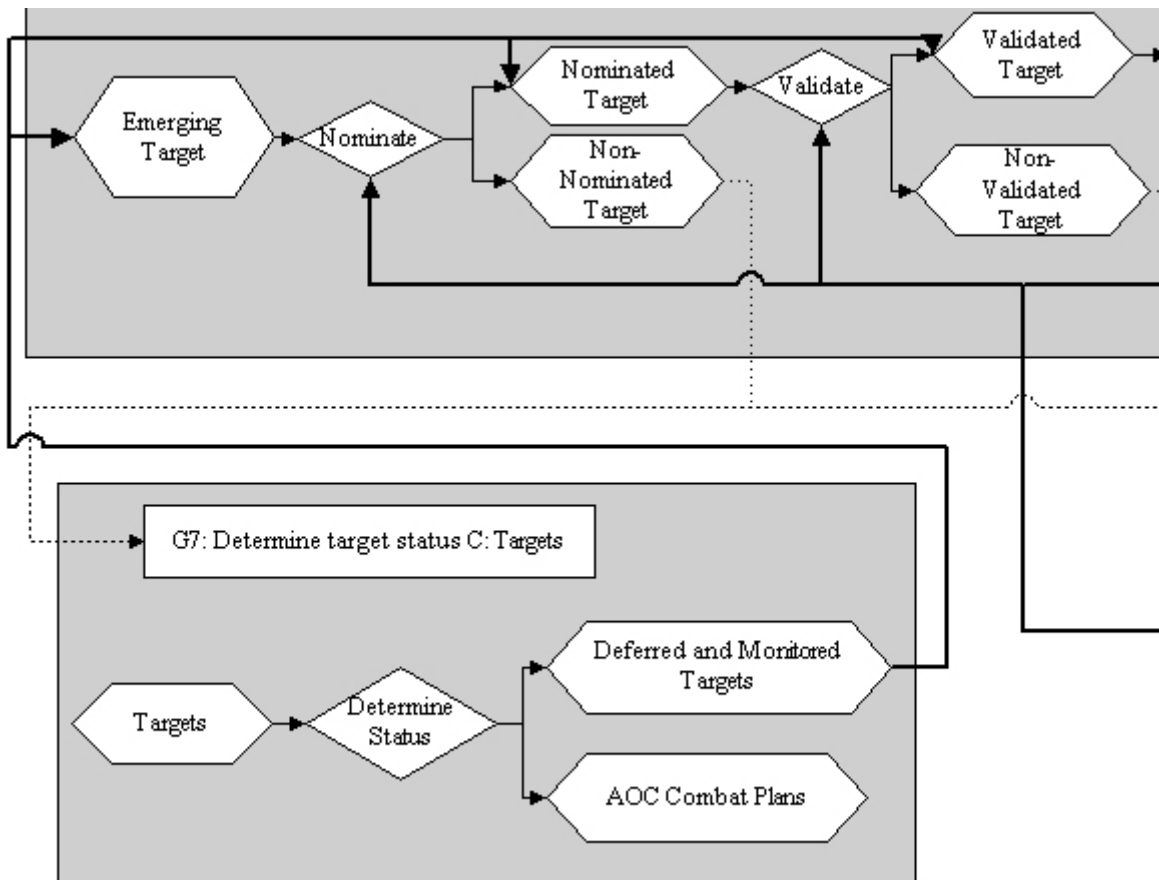
Figure 4-27. Goal 7: Determine Target Status

4.3.8.2 Decision Requirements

The major task/decision required to complete this goal is:

- Determine whether to continue monitoring the target, or forward it to AOC Combat Plans.

4.3.8.3 Information Requirements

The information requirements are shown in Figures 4-28 and 4-29, and are ordered by the SMEs' ratings. The ratings represent the SMEs' subjective assessment of the information importance and information accessibility necessary to successfully complete the goal.

The SMEs rated all of these information elements high in importance without much variation. The accessibility ratings were not very high and did not show much differentiation.

Figure 4-28. Goal 7: Importance
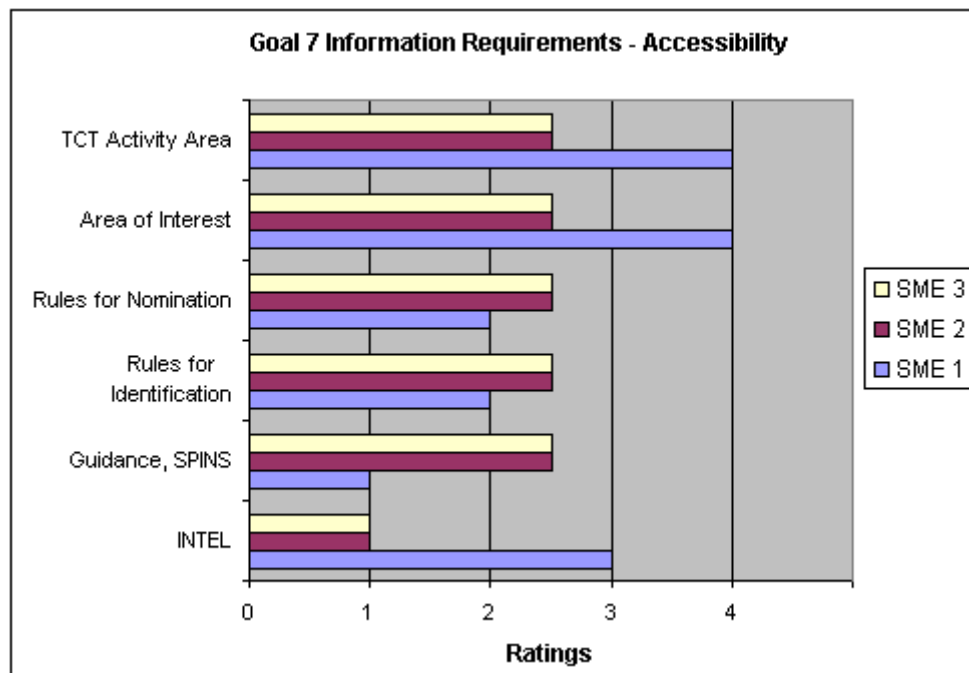
Figure 4-29. Goal 7: Accessibility

4.3.9 Goal 8: Assign Weapon Platform to TCT

4.3.9.1 Description

The first part of this process consists of prioritizing the weapon platforms from the most suited to pair against the TCT to weapons that are inappropriate to pair against the TCT. This is based upon information such as the weapon type, availability, location, and TOT predictions, amongst others. Selecting the best weapon platform for the TCT is the second part of the process. Weapon platforms that are not assigned are returned for prioritization. The weapon that is assigned is incorporated into the prioritized weapon-target pairings in Goal 1.

One important item for consideration while selecting a weapon platform is the munitions currently on-board. Therefore, the prioritization of weapons in this goal is supported by Goal 9, which is assigning the best munitions to a target.

Figure 4-30 shows the task steps involved in achieving Goal 8.
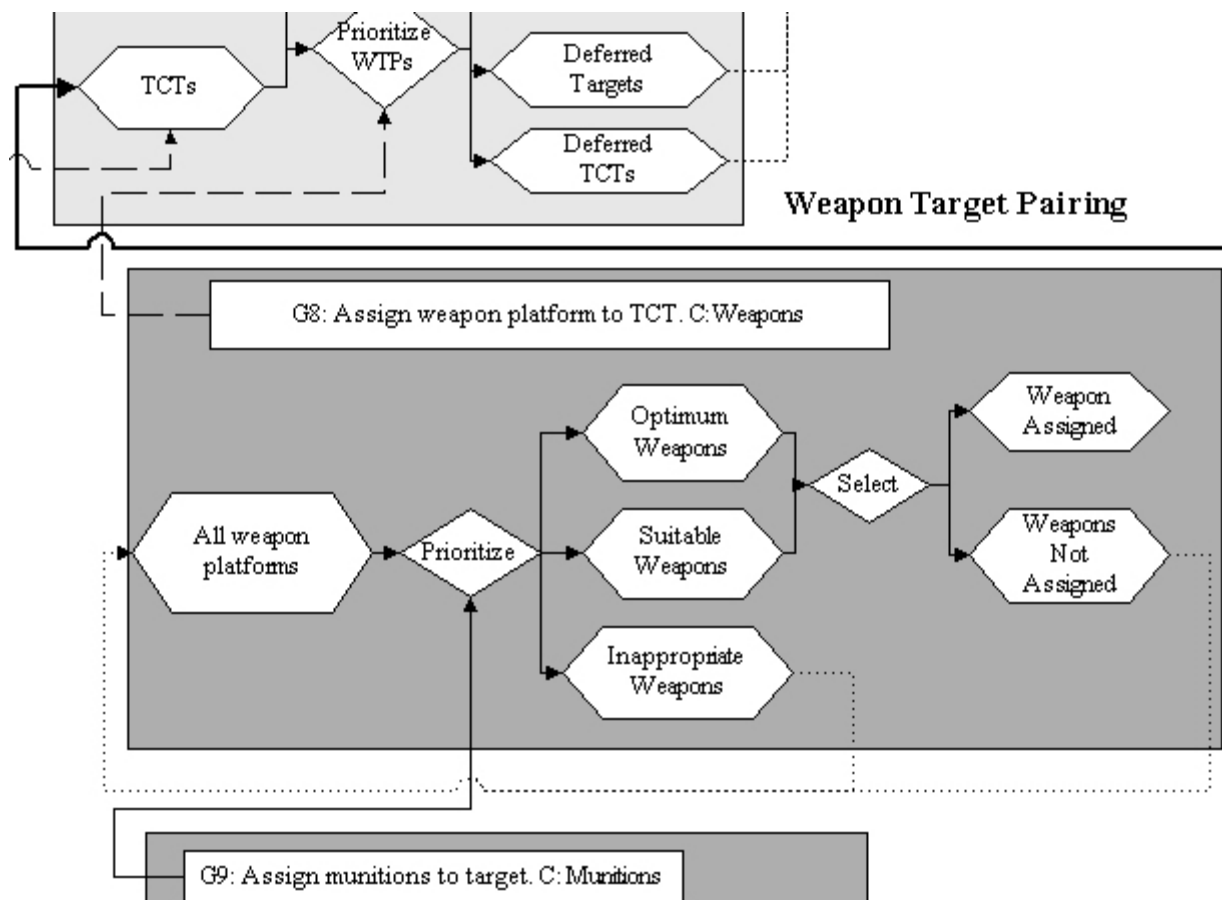
Figure 4-30. Goal 8: Assign Weapon Platform to TCT

4.3.9.2 Decision Requirements

The major tasks/decisions required to complete this goal are:

- Monitor weapon platform assignments.

- Select appropriate weaponeering options for TCT.

- Prioritize appropriate weaponeering options for TCT.

- Coordinate with Duty Officers, if necessary.

- Develop ACMs.

- Assign Weapon Target Pairing (WTP).

4.3.9.3 Information Requirements

The information requirements are shown in Figures 4-31 and 4-32, and are ordered by the SMEs' ratings. The ratings represent the SMEs' subjective assessment of the information importance and information accessibility necessary to successfully complete the goal.

The SMEs rated 'No Strike Zone' and 'target location' as the most important information elements for this goal. Many other information elements were rated highly, including 'weapon platform location', 'TOT predictions', 'areas of potential collateral damage', and others. Interestingly, the 'optimum/suitable munitions' information element was rated at the bottom of the list. The majority of the higher rated information elements involved the ability of the weapon platform to reach the target. The accessibility ratings varied somewhat with the weapon platform information (location, munitions) rated highest.
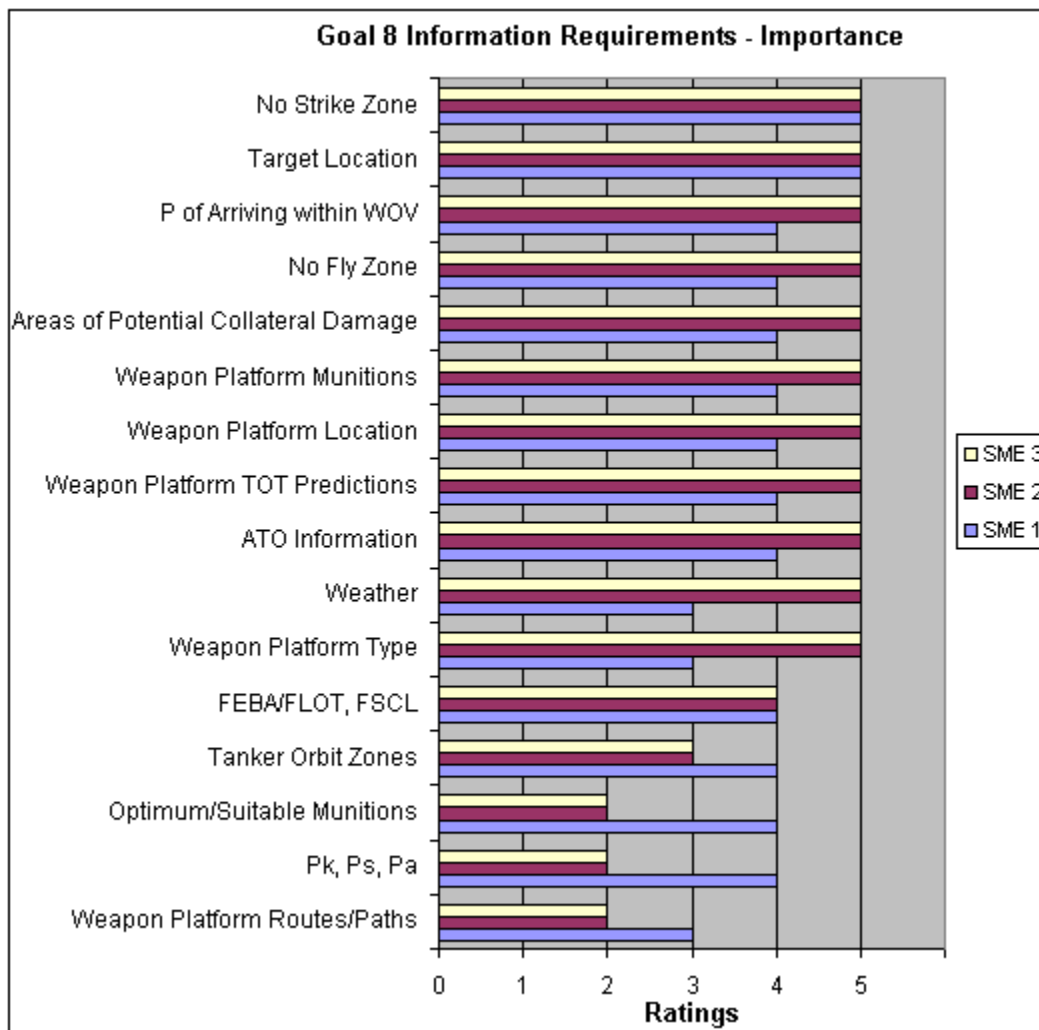
Figure 4-31. Goal 8: Importance
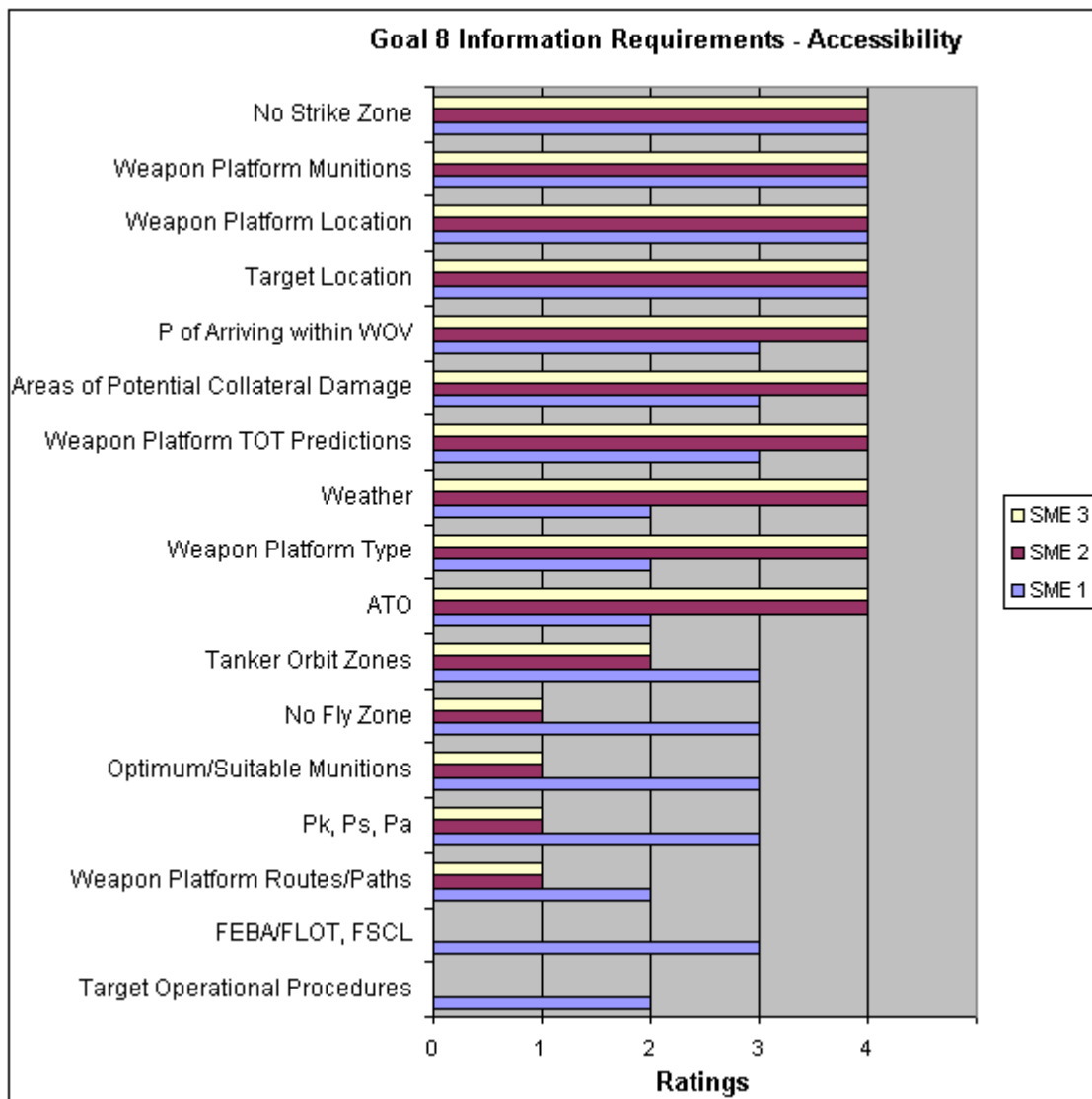
Figure 4-32. Goal 8: Accessibility

4.3.10 Goal 9: Assign Munitions to Target

4.3.10.1 Description

Goal 9 consists of selecting the most appropriate munition for the target situation. This is accomplished by prioritizing the munitions from most suitable for the target to least suitable based upon such information as the target's vulnerabilities, location, and the weather over the target.

One of the main considerations when prioritizing the munitions is the potential for collateral damage around the target. For example, if an armored column were moving down a road in the desert, cluster bombs or the appropriate Precision Guided Munitions (PGMs) would work fine. The same armored column within a busy downtown area may require PGMs instead of cluster bombs depending upon the TCT threat, Commander's Guidance, etc. Therefore, the prioritization in Goal 9 is impacted by Goal10, which is determining the areas of potential collateral damage.

Figure 4-33 shows the task steps involved in achieving Goal 9.
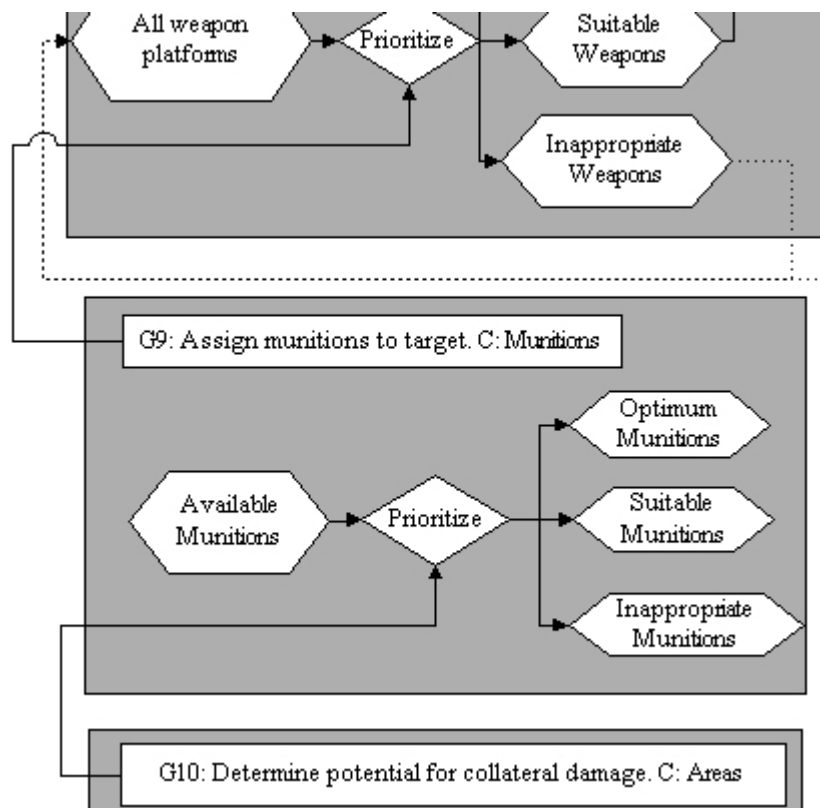
Figure 4-33. Goal 9: Assign Munitions to Target

4.3.10.2 Decision Requirements

The major tasks/decisions required to complete this goal are:

- Monitor available munitions on weapon platforms

- Select all appropriate munitions for TCT.

- Prioritize appropriate munitions for TCT

4.3.10.3 Information Requirements

The information requirements are shown in Figures 4-34 and 4-35, and are ordered by the SMEs' ratings. The ratings represent the SMEs' subjective assessment of the information importance and information accessibility necessary to successfully complete the goal.

As expected, the SMEs rated information about the munitions on the weapon platforms to be most important as this defines the munition choices available for an engagement. Location and environmental characteristics such as 'FEBA/FLOT, FSCL' and 'weather', were also rated as important. Surprisingly, the probabilities of kill and desired destruction were rated on the lower end of the list. For accessibility, the SMEs rated several information elements at the top of the list including 'weather', 'ATO information', 'weapon platform munitions', 'target routes', and 'areas of potential collateral damage'.
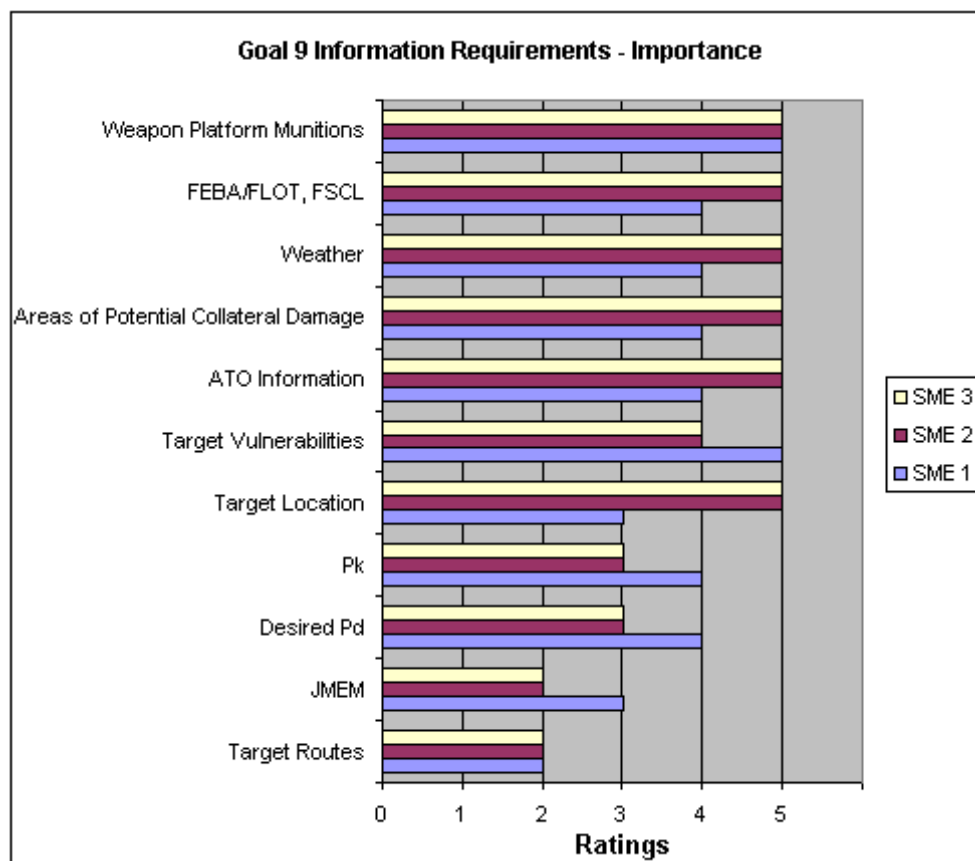
Figure 4-34. Goal 9: Importance
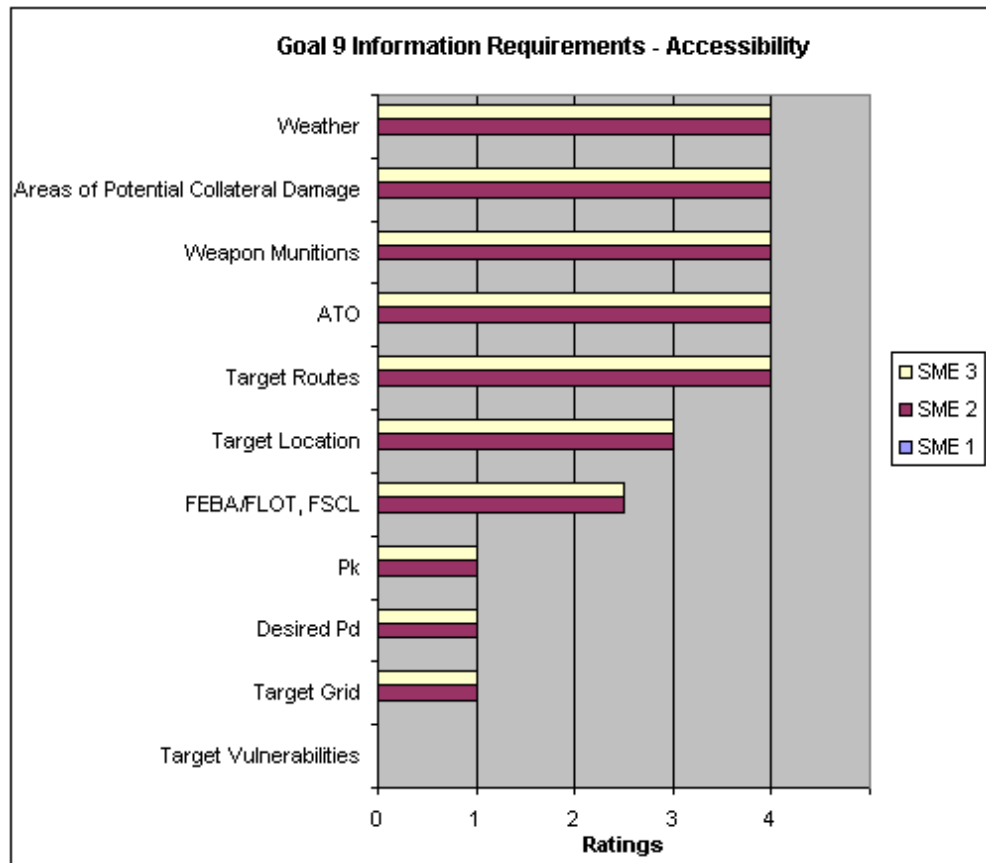
Figure 4-35. Goal 9: Accessibility

4.3.11 Goal 10: Determine Potential for Collateral Damage

4.3.11.1 Description

Goal 10 involves determining areas of potential collateral damage (including fratricide), which is mainly accomplished through applying intelligence gathered and IPB to the current situation. Determining the potential for collateral damage directly impacts the munitions that are selected, which in turn impacts the weapon platform that is selected to be paired with the target.

Figure 4-36 shows the task steps involved in achieving Goal 10.
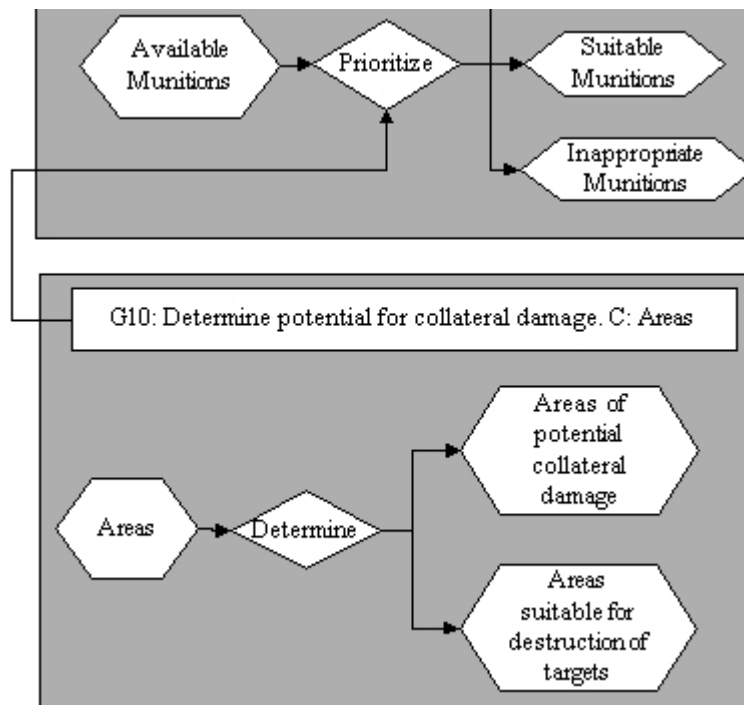
Figure 4-36. Goal 10: Determine Potential for Collateral Damage

4.3.11.2 Decision Requirements

The major tasks/decisions required to complete this goal are:

- Identify non-hostile locations near target.

- Determine possibility of collateral damage.

4.3.11.3 Information Requirements

The information requirements are shown in Figures 4-37 and 4-38, and are ordered by the SMEs' ratings. The ratings represent the SMEs' subjective assessment of the information importance and information accessibility necessary to successfully complete the goal.

The SMEs rated information associated with where the target is and what is around it as most important for determining the potential for collateral damage. These information elements include SOF locations, target location, and target positional accuracy. Intel, including IPB, was also rated high in importance. The SMEs rated the same four information elements highest for accessibility.
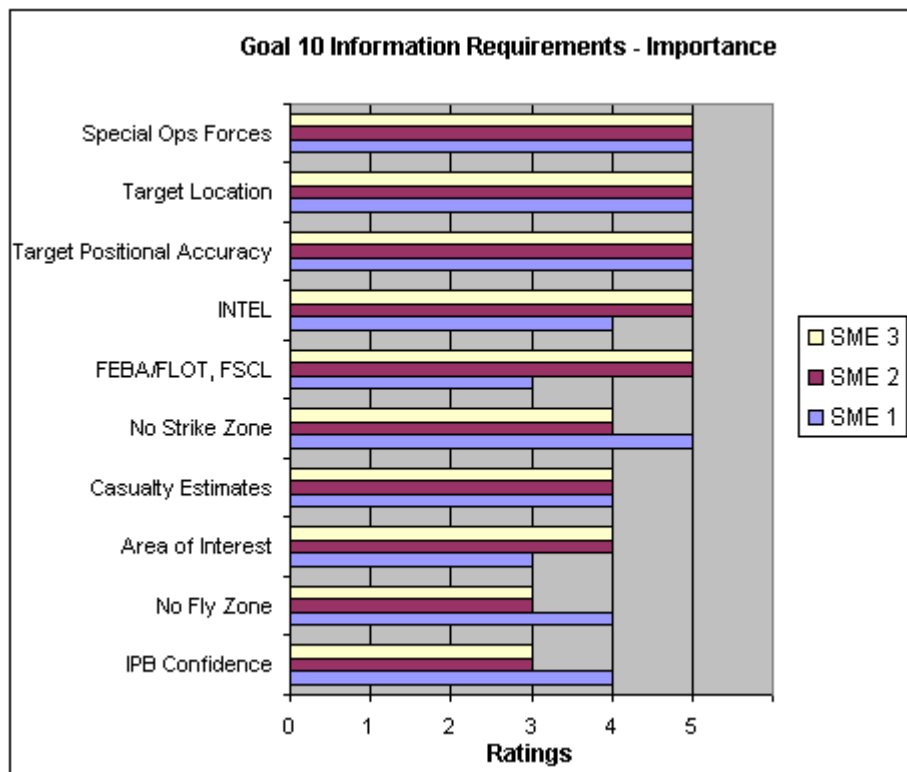
Figure 4-37. Goal 10: Importance
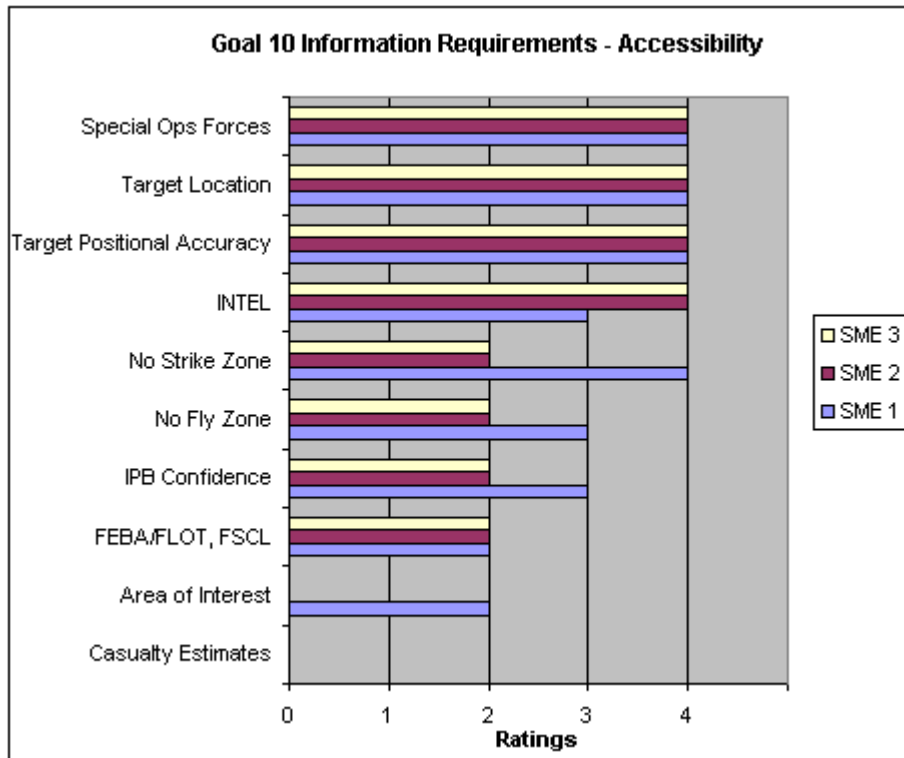
Figure 4-38. Goal 10: Accessibility

4.3.12 Goal 11: Determine Status of Targets and TCTs Not Meeting Criteria

4.3.12.1 Description

Goal 11 consists of determining the status of planned targets and TCTs that have been deferred from the mission during Goal 1, which involves prioritizing the weapon-target pairings. Determining the status depends upon such information as the target value, target location, weapon location, weapon availability, and others. The Guidance will greatly influence whether to continue through the cycle or not. From this, the decision is made to either forward the TCTs back into Goal 1 to be paired with weapons and prioritized, or to forward the deferred targets to AOC Combat Plans.

Figure 4-39 shows the task steps involved in achieving Goal 11.
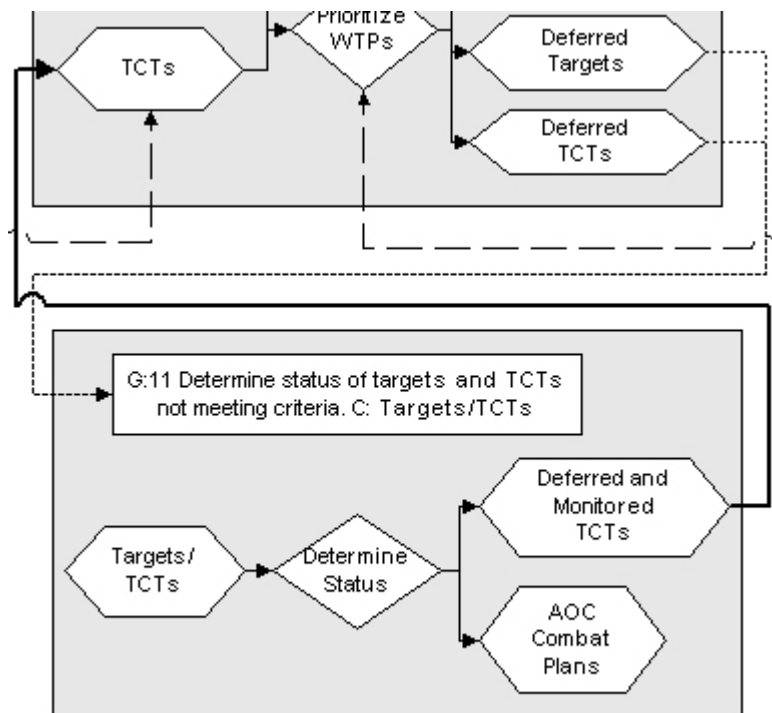
Figure 4-39. Goal 11: Determine Status of Targets and TSTs Not Meeting Criteria

4.3.12.2 Decision Requirements

The major task/decision required to complete this goal is:

- Determine whether to formulate a new WTP or forward to AOC Combat Plans.

4.3.12.3 Information Requirements

The information requirements are shown in Figures 4-41 and 4-42, and are ordered by the SMEs' ratings. The ratings represent the SMEs' subjective assessment of the information importance and information accessibility necessary to successfully complete the goal.

The SMEs rated information regarding the target's predicted location and actions highest along with Guidance/SPINS. These information elements are necessary to determine the feasibility and necessity of prosecuting the target in the near future. Target location and value were rated lower, emphasizing the SMEs focus on where the target was going and what it was doing. Target hide sites, location, and value were rated highest in terms of accessibility.
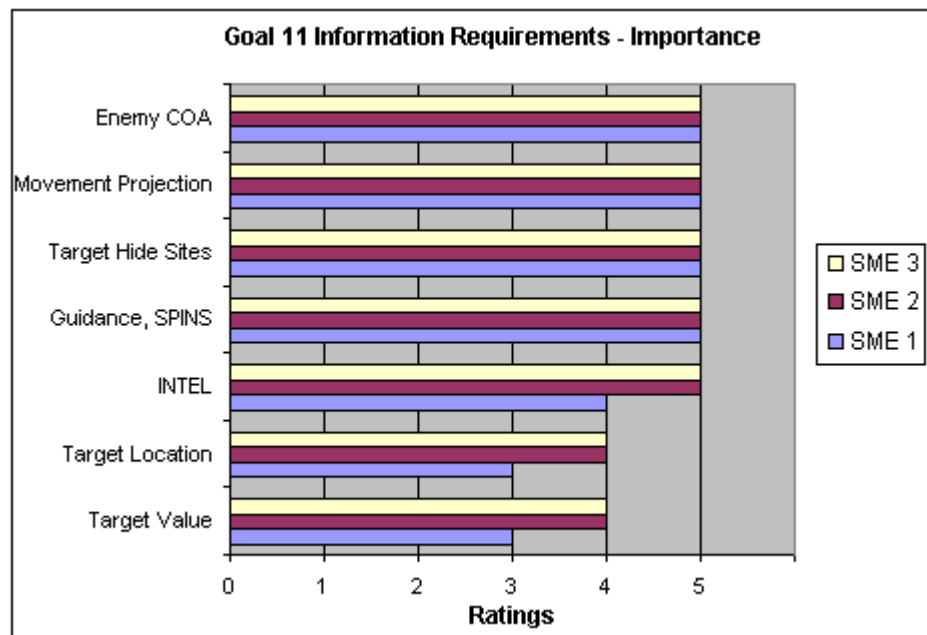
Figure 4-40. Goal 11: Importance
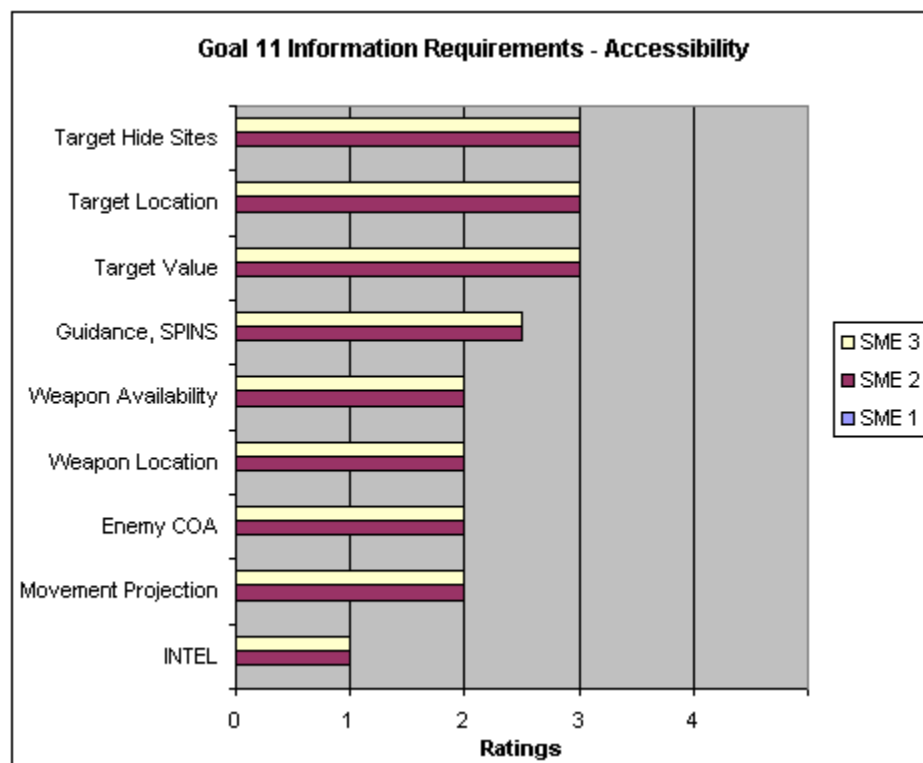
Figure 4-41. Goal 11: Accessibility

4.4 Information Requirements Within Goals

Table 4-1 lists all of the information items in alphabetical order. For each item, the goals that require that information element are listed. This table is useful to uncover which information requirements are needed in multiple goals, and throughout the process.

Table 4-1. Information Requirements vs. Goals

Information Requirements	Goals that Contain this Info Requirement
Airspace Control Measure (ACM)	0
Area of Potential Collateral Damage	8, 9
ATO	0, 1, 8, 9, 3, 4, 5
Available Sensors	5
Enemy COA	11, 4
Fire Support Coordination Line (FSCL)	1, 8, 9, 3
Forward Edge of Battle Area (FEBA)	1, 8, 9, 10, 3, 4
Forward Line of Troops (FLOT)	1, 8, 9, 10, 3, 4
Free Fire Zones	10
GMTI	3, 4
Guidance, SPINS	1, 11, 2, 6, 7
Human INT	4
ID Accuracy	2, 6
Imagery INT	3, 4
Impossible Areas of Operation	4
INTEL	10, 11, 6, 7
IPB Confidence	10, 2, 3, 4
Laws of Armed Conflict (LOAC)	1, 8, 2, 6
Measurement and Signature INT	4
Mission Value	1
Movement Projection	11
Named Area of interest	10, 2, 3, 4, 5, 7
No Fly Zone	8, 5
No Strike Zone	8, 10,
Optimum/Suitable Munitions	8
Positional Accuracy	2, 6
Probability of arriving at target within WOV	8
Probability of Acquisition (Pa)	8
Probability of Kill (Pk)	8, 9
Probability of Survival (Ps)	8
Rules of Candidacy	2
Rules of Dynamic Target Valuation	1
Rules of Engagement	1, 2, 6
Rules of Identification	4, 6, 7
Rules of Intrinsic Target Valuation	1
Rules of Nomination	2, 6, 7
Rules of Warfare	1, 6
Rules to Determine Asset Divertability	1
Sensor Coverage Planned	5
Signals INT	4
Tanker Orbit Zones	8
Target Area of Interest	2, 4
Target Grid (From Targeting Book)	9
Target Hide Sites	11
Target Location (Lat, Long, Heading Elev,	8, 9, 10, 11,

Information Requirements	Goals that Contain this Info Requirement
Speed)	
Target Operational Procedures	8
Target Positional Accuracy	10
Target Routes	9
Target Type	2
Target Value	1, 11
Target Vulnerabilities	9, 7
TCT Activity Area	2, 4, 5
Temporal Accuracy	2, 6
Terrain Suitability	3, 4
Track Associated Facilities	4
Track Convoy Characteristics	4
Track Emissions	4
Track Hide Sites	4
Track Images	2
Track Location (Lat, Long, Heading Elev, Speed)	2, 4
Track Operational Procedures	4
Track Routes	4
Weapon Assigned	0
Weapon Availability	8, 11
Weapon Location	8, 11
Weapon Munitions	8, 9
Weapon Routes/paths	8
Weapon Time On Target (TOT) Predictions	8
Weapon Type	8
Weather	8, 9, 3, 4, 6

4.5 Display Task Description

The organization and groupings of the different goals within the functional decomposition, together with their decisions and information requirements, lead to a Display Task Description (DTD). The DTD indicates what information is required to make the necessary decisions for the different goals involved. The grouping of different goals leads to different functional tasks or areas within the system, not necessarily operator positions. This section describes these different areas including the decisions to be supported as well as the information required.

Because the functional areas are similar, information from different goals within the same functional area is often related. While the different areas within the same section, such as TCT Boss 1 and 2, contain different decisions and information requirements, there are similarities concerning the level of information and the depth of decisions.

4.5.1 TCT Boss

The TCT Boss functional areas consist of Goal 0: Execute mission, Goal 1: Maximize value of destroyed targets, and Goal 11: Determine status of targets and TCTs not meeting criteria. The operator display(s) designed for this area should support the decisions and required information for these three goals. Similar to other goals in the functional decomposition, these high level goals rely on lower level supporting goals.

Table 4-2 lists the goals, decisions, and information requirements for the first section of the TCT Boss.

Table 4-2. TCT Boss 1

Goal	Decision(s)	Information
0. Execute Mission	• Task mission.	• Available assets • ATO information • ACMs • Emergent targets • Weapons assigned
1. Maximize value of destroyed targets	• Monitor paired targets and their value. • Monitor Weapons Assigned and Airspace Control Measures for TCT. • Approve best (highest global value) platform/munition for TCT.	• Rules for dynamic valuation • ATO information • Guidance, SPINS • Laws of Armed Conflict • Mission Value • Rules for intrinsic target valuation • Rules of Engagement • Target value • ACMs • FEBA/FLOT, FSCL • Threat radius

This functional area includes high-level goals, and therefore is highly dependent on the aggregation of information at lower levels (valuations) and high-level strategies/rules. The operator must ensure the mission is progressing according to the higher-level goals of the operation.

To task the mission, the operator must have information from the ATO, know the weapon platform assigned, and the associated ACMs to send out a command message. This function is only performed after collaboration has occurred between the TCT cell and the Duty Officers, the Chief of Combat Ops, and the Judge Advocate General (JAG).

To choose which TCTs to prosecute and which TCTs and planned targets (paired targets that may need to be deferred so the weapon platform can attack the TCT) to defer requires the operator to know the high level information shown in the table above. Some of this information may be readily displayed on the screen and other information should be available if it is needed, such as the ROEs and Guidance.

Table 4-3 lists the goals, decisions, and information requirements for the second section of the TCT Boss.

Table 4-3. TCT Boss 2

Goal	Decision(s)	Information
11. Determine status of targets and TCTs not meeting criteria	• Determine whether to formulate a new WTP or defer to a later time by forwarding to AOC Combat Plans.	• Enemy COA • Guidance, SPINS • Movement Projection • Target hide sites • INTEL • Target location • Target value

For this functional area, to determine whether to re-pair a TCT with a weapon or to defer it to the AOC Combat Plans, the operator must know both high and lower level information. The operator must consider the different aspects of the target (value, location, etc), the available weapons, and the high level goals of the mission.

4.5.2 Target Development

This functional area includes Goals 2 through 7, all dealing with developing a target into an approved TCT. Like the other sections, these goals are both high and low level.

Table 4-4 lists the goals, decisions, and information requirements for the first section of Target Development.

Table 4-4. Target Development 1

Goal(s)	Decision(s)	Information
2. Declare targets TCTs	- Monitor targets. - Approve targets as Nominated Targets. - Approve targets as Validated Targets. - Approve targets as TCTs.	- ID accuracy - Laws of Armed Conflict - Sensor capability - Track Number - Guidance, SPINS - IPB Confidence - Named Area of Interest - No Strike List - Rules of Engagement - Target Area of Interest - Track location (Hdg, Spd, Lat/Long) - Sensor availability - Sensor Field of View - TCT activity area - Positional accuracy - Track images - Track type - Temporal Accuracy (Timeliness)
7. Determine target status	Determine whether to continue monitoring and requesting more INTEL or defer to forward to AOC Combat Plans	- Guidance, SPINS - INTEL - Rules for identification - Area of Interest - TCT activity area

Within this functional area, the operator must make the final decision of whether or not to approve a target as a TCT. This decision consists of several other decisions as well as supporting goals.

These decisions require the operator to consider the different aspects of the target (accuracy, location, etc), along with the high level goals (guidance, rules) of the mission. The operator must compare the current level of information on the track with the rules and guidance to make approvals. The operator must also decide whether to continue monitoring a target and request more information, or whether to take the target out of the TCT process by forwarding it to the Joint Target Board/ Plans.

Operators/Subject Matter Experts (SMEs) described this process as very difficult and very time consuming. Many times a target may not be prosecuted because all the required information could not be gathered in an appropriate amount of time.

Table 4-5 lists the goals, decisions, and information requirements for the second section of Target Development.

Table 4-5. Target Development 2

Goal(s)	Decision(s)	Information
3. Aggregate sensor returns to form tracks	• Monitor sensor returns. • Monitor tracked groups of sensor returns. • Correlate/fuse sensor returns to form tracks.	• Imagery (SAR, Space Based) • Terrain suitability • Weather • IPB confidence • Named Area of Interest • GMTI
4. Develop target ID	• Monitor INTEL sources. • Correlate INTEL information to develop track ID.	• Combat ID • IFF • Rules for identification • ATO information • Enemy COA • GMTI • Track emissions • Track hide sites • Track location (Lat, Long, Heading Elev, Speed) • Track routes • Imagery INT (still, motion, IR, SAR) • Human INT • Signals INT • Measurement and Signature INT • Impossible areas of operation • IPB confidence • Sensor accuracy/Info confidence • Sensor availability • Track convoy characteristics • Track operational procedures • Named Area of Interest • Target Area of Interest • Weather • FEBA/FLOT, FSCL • Terrain suitability • Track associated facilities

The functional area shown in Table 4-5 Target Development 2 describes the process of forming tracks into targets. For the purposes of this analysis, a sensor is conceptualized as any source of INTEL e.g. GMTI platform, space based imagery platform, motion imagery platform, Special Ops Forces with eyes-on-target, etc. As illustrated in the table above, sensor information plays a key role in this area.

The operator must also have thorough Intelligence Preparation of the Battlespace (IPB) information. To infer the movement and identity of a track, the display of the correct information in a timely manner is key.

From operator/SME discussions, operators develop an experimental, if-then, mental process during this functional area. They attempt to figure out the identity of a track by making an initial judgment, and then seeking correlating information to confirm or disprove their judgment.

Table 4-6 lists the goals, decisions, and information requirements for the third section of Target Development.

Table 4-6. Target Development 3

Goal(s)	Decision(s)	Information
5. Determine required sensor coverage.	• Determine where additional sensors/INTEL are needed. • Evaluate the likelihood of retasking the sensors.	• Available sensors • ATO information • Sensor info • Named Area of Interest • Geographic info
6. Determine level of INTEL accuracy required	• Determine how much confidence/accuracy is required to Nominate, Validate, and declare a target a TCT. • Determine how much additional confidence/accuracy is still needed. • Determine the present level of confidence/accuracy for each component: Time, Position, ID.	• ID accuracy • Laws of Armed Conflict • Positional accuracy • Rules for Identification • Rules of Engagement • Capabilities and limitations of INTEL sources • INTEL Sources • Temporal accuracy • Weather • Guidance, SPINS

This functional area illustrates the process of obtaining more information when needed. When additional information is needed, the operators must seek that information from previously prepared sources, or requesting the INTEL Collection Manager (CM) to re-task assets (which can be a lengthy process).

To determine the need for more information, the operator judges the amount of additional INTEL needed based on the temporal accuracy (how timely is the information), positional accuracy (the quality of the information describing the targets' location), and the ID accuracy (how much confidence exists that the target ID is correct). If any of these three components are deficient, the operator may need to seek additional information.

4.5.3 Weapon Target Pairing

This functional includes the following goals: Goal 8: Assign weapon platform to TCT, Goal 9: Assign munitions to target, and Goal 10: Determine potential for collateral damage. These goals consist of a combination of high and low level decisions and information.

Table 4-7 lists the goals, decisions, and information requirements for the first section of Weapon Target Pairing.

Table 4-7. Weapon Target Pairing 1

Goal	Decision(s)	Information
8. Assign weapon platform to TCT	- Monitor platform assignments. - Select appropriate weaponeering options for TCT. - Prioritize appropriate weaponeering platform options for TCT. - Coordinate with Duty Officers if necessary. - Develop ACMs. -Assign WTP.	- No strike zone - Target location (Lat, Long, Heading, Elev, Speed) - Areas of potential collateral damage - ATO information - No fly zone - Probability of weapon arriving at target within WOV - Weapon platform location - Weapon platform munitions - Weapon platform TOT predictions - Weapon platform type - Weather over target - FEBA/FLOT, FSCL - Tanker orbit zones - Optimum/suitable munitions - Pk, Ps, Pa - Weapon platform routes/paths

Within this functional area, the operator must make the final decision of which weapon platform to assign to the TCT. This decision depends upon information gathered from lower level goals.

From our discussions with weaponeering operators, one of the most important stages of this process is the development of options.   There are times when the optimal solution may not be to strike the target, but to impede the target's progress, for example, destroy the bridge a target is moving toward. The operator can weigh the options while considering information provided from the Duty Officers

Table 4-8 lists the goals, decisions, and information requirements for the second section Weapon Target Pairing.

Table 4-8. Weapon Target Pairing 2

Goal(s)	Decision(s)	Information
9. Assign best munition to target	- Monitor munitions available on weapon platforms. - Select all appropriate	- Weapon platform munitions - Areas of potential collateral damage

Goal(s)	Decision(s)	Information
	munitions for TCT. • Prioritize appropriate munitions for TCT.	• ATO information • FEBA/FLOT, FSCL • Weather over target • Target location (Lat, Long, Heading Elev, Speed) • Target vulnerabilities • Desired Pd • Joint Munitions Effectiveness Manual (JMEM) • Pk • Target routes
10. Determine potential for collateral damage	• Identify non-hostile locations near target. • Determine possibility of collateral damage.	• SOF locations (consult SOF liaison) • Target location (Lat, Long, Heading Elev, Speed) • Target positional accuracy • INTEL (video, imagery, HUMINT) • FEBA/FLOT, FSCL • No Strike Zone • Casualty estimates • Area of Interest • IPB confidence • No Fly Zone

Within this functional area, the decision of the best available munitions to defeat the TCT must be made. This will feed into the decision of what weapon platform is assigned to the TCT.

The final decision of what is the optimum munition is usually a quick decision, but also involves generating different options. There are likely several munitions that are effective against the target, either by exploiting the target vulnerabilities, or neutralizing the TCT. The decision of the optimum munitions involves different pieces of information including, but not limited to, the weather over target, the location of friendly forces, Probability of Destruction (Pd), and potential for collateral damage.

The decision of determining the possibility for collateral damage relies heavily on IPB information as well as current INTEL. As always, there will be trade-offs and determining the best course of action will rely on options developed at this low level.

The best munition may not always be the most precise. One operator stated that everybody always wants the most precise weapon for the job, when in some circumstances a cluster munition, Non-Precision Guided Munition (NPGM), or other dumb bomb may be the best choice.

4.6 ACWA Conclusions

The ACWA process not only revealed the underlying goals and functions within the TCT process, but also mapped information requirements to these goals. Great value can be derived from the SME ratings of the information because it is now possible to compare these ratings to the actual TCTF displays and note where they are in alignment and where there are discrepancies. While only three SMEs rated the information, these numbers do provide tremendous insight into the TCT process (statistically speaking, a larger confidence level would be preferred, but access to SMEs is often limited in a military setting).

To gather additional ratings on the information requirements, the ACWA survey was condensed and distributed to users/SMEs from AFC2ISR Center at Langley AFB. These surveys logically followed the MITRE SME surveys in an attempt to obtain more data. The results are discussed in Section 5.

Section 5

TCTF GUI Working Group 1 Survey Results

5.1 GUI WG Introduction

A GUI Working Group is a meeting of users and/or Subject Matter Experts (SMEs) and developers in order to elicit user/SME input on the current and proposed GUI. The focus group nature of these meetings allows for exercises, brainstorming sessions, and detailed discussions that rely on the users'/SMEs' expertise to obtain feedback about specific areas of the GUI, identify issues, or develop and refine new ideas.

Prior to the first TCTF GUI Working Group (WG), a survey was distributed to potential attendees. The survey attempted to determine what information elements were most important from the users' point of view during each part of the Find → Fix → Track → Target → Engage → Assess (F2T2EA) cycle, focusing on Find → Fix → Track → Target. The six users who completed the survey ranged in experience and specialties with averages of 3.8 years prosecuting TCTs in an Ops cell and an average of 1.3 years in an AOC.

The information items were gathered from the results of the Applied Cognitive Work Analysis study. The ACWA goals were sorted into the appropriate phase of the F2T2EA process. The associated decisions and related information requirements for each goal were then grouped with the goals in each phase. While the ideal technique would be to present the decisions and information requirements relative to the ACWA goals or decisions, the survey was shortened based upon feedback from the MITRE SMEs. In addition, we felt this grouping was a more natural representation for the user community who are most familiar with the F2T2EA terminology.

The results of the survey are arranged in several sections. Section 5.2 focuses on all of the users' ratings of the information elements for "importance". Section 5.3 discusses the users ratings for the "accessibility," or visibility, of the same information elements. Section 5.4 contains the differences between expert ratings and all users ratings for the importance of the information. A copy of the survey is provided in Appendix D. These results should be used as guidance, along with other information sources, for the design and evaluation of the TCTF Common GUI.

5.2 Information Importance

The ratings for the importance of information elements during the Find → Fix → Track → Target phases are contained in the following paragraphs. The graphs depict the average rating for each information element (represented by the bars) and the standard deviation (represented by the lines extending from the bars). Standard deviation is a measure of

variation, i.e., how the ratings are spread around the average. The smaller the standard deviation, the more the users agreed on a rating.

The users rated the importance of each information item using the following 5-point scale:

1 – Very Low Priority; not critical for this function
2 – Somewhat Low Priority
3 – Medium Priority
4 – Fairly High Priority
5 – Very High Priority; critical for this function

The graphs are organized with the information elements receiving the highest rating at the top. For information elements with the same average rating, the item with the smaller standard deviation is above the other.

5.2.1 Find – Importance

Figure 5-1 shows the information elements for the Find (Detect Potential Targets) phase organized by average rating and standard deviation. The key tasks and decisions are:

- Monitor sensor data

- Fuse sensor data with IPB/TA and INT info

As seen below, users rated IPB and Order of Battle information as the highest, which is appropriate for the initial task of finding targets. The large standard deviations for FEBA/FLOT, FSCL and the ATO illustrate some disagreement on the importance of these items. As can be seen, no information items received less than a 4 for the average rating, meaning the users rated all of the information as fairly important for the Find phase.
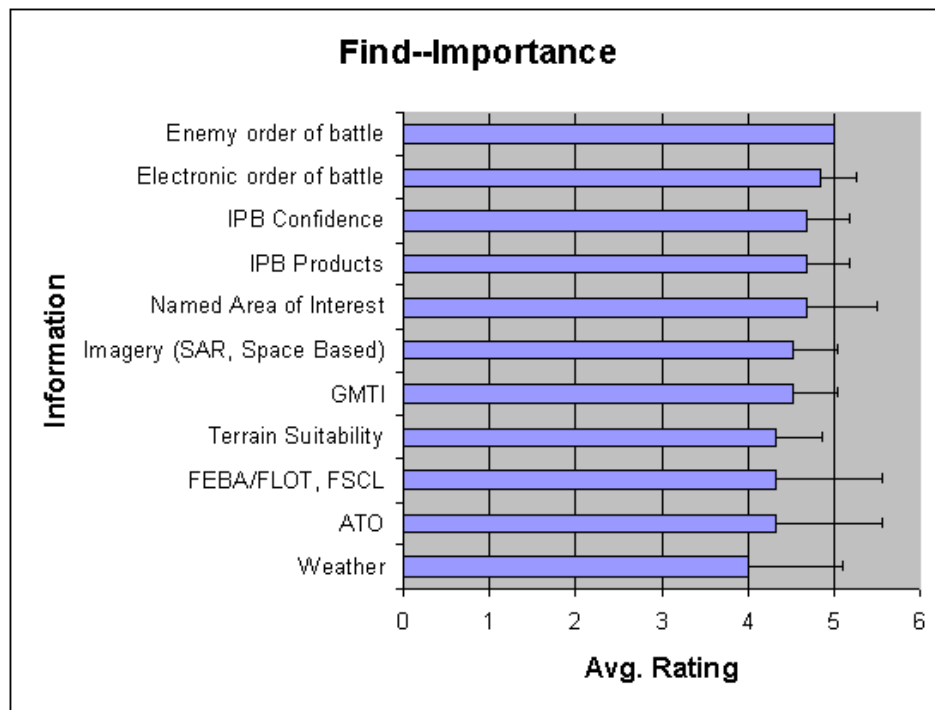
Figure 5-1. Find – Importance

5.2.2 Fix – Importance

Figures 5-2 and 5-3 show the information elements for the Fix (Identify and Locate Targets) phase organized by average rating and standard deviation. The key tasks and decisions are:

- Develop target ID

- Determine location

- Determine information required (ID, location)

- Determine sensor coverage needed

- Recommend ISR tasking

As seen below, users rated the information elements related to the key decisions as highest. Track location, Imagery/Signals/Human INT, INTEL sources, capabilities and limitations of INTEL sources were a few of the items to be rated a 5 (the highest) by all users. As the information item ratings decrease, the variation in the answers increases, shown by the length of the line extending from the bar. Upon examination of the individual results, some users rated almost all the information items as most important, while others did not, thus causing the variation.
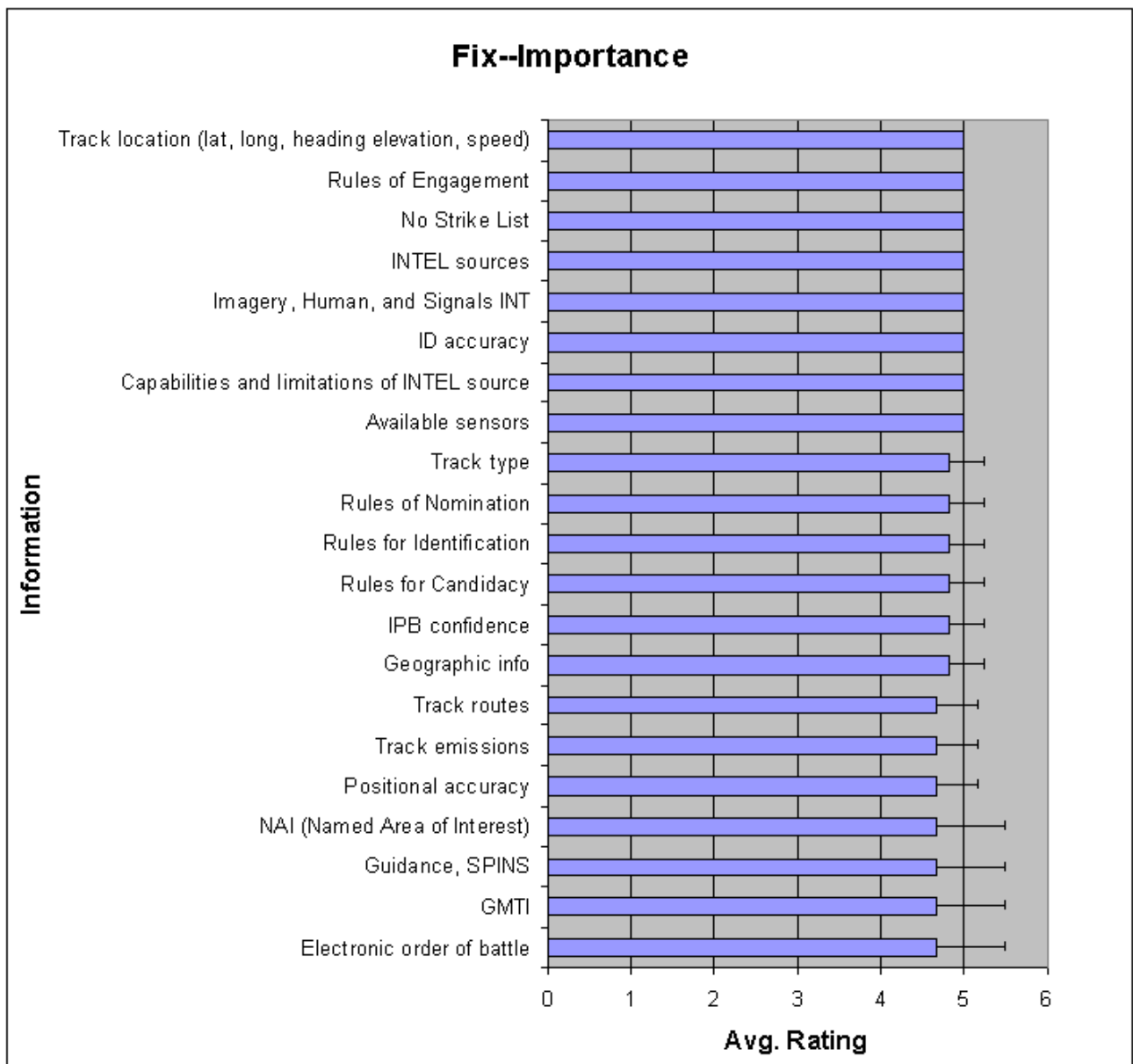
Figure 5-2. Fix – Importance
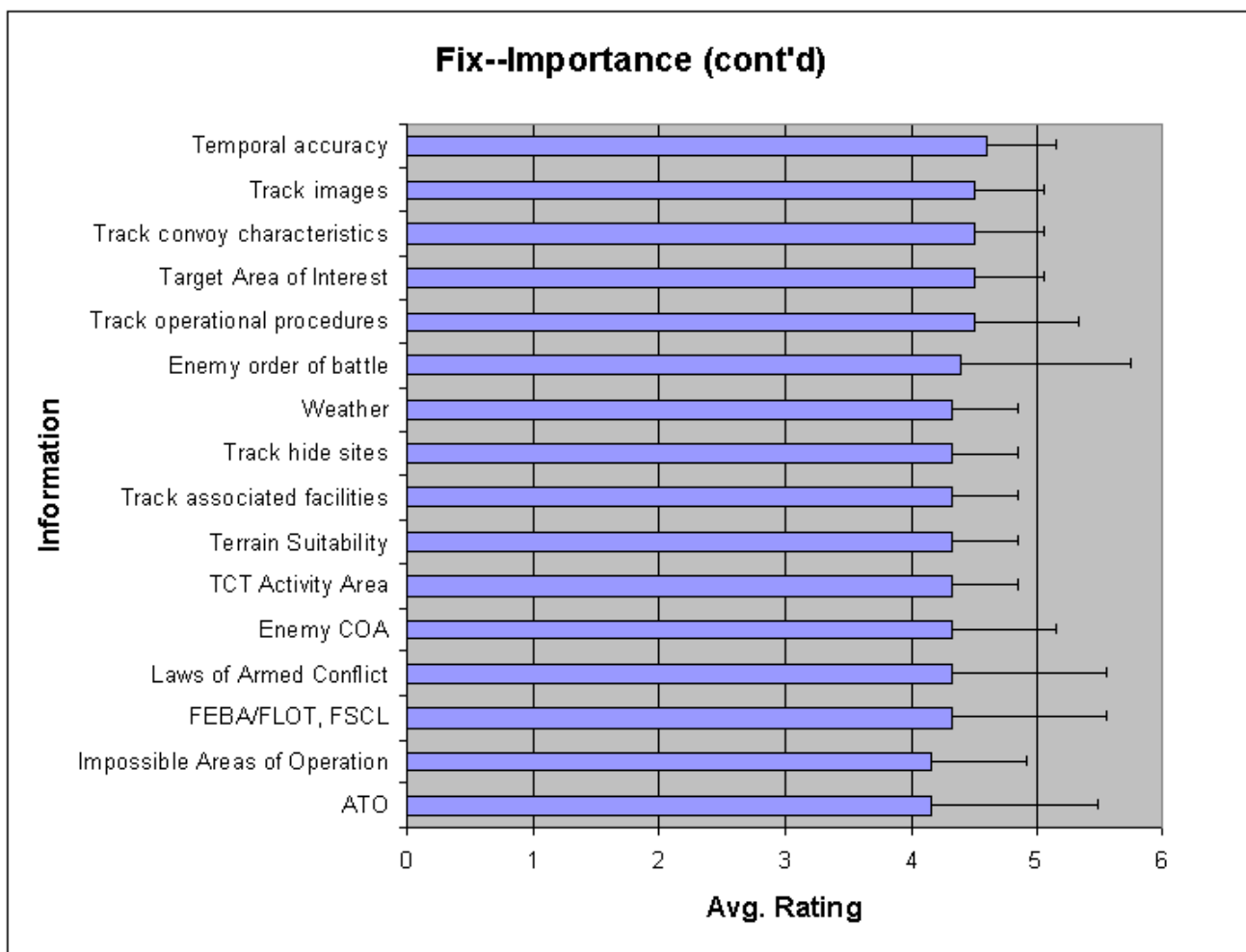
Figure 5-3. Fix – Importance (cont'd)

5.2.3 Track – Importance

Figure 5-4 shows the information elements for the Track (Track and Monitor Targets) phase organized by average rating and standard deviation. The key tasks and decisions are:

- Determine information required (ID, Location)

- Determine sensor coverage needed

- Recommend ISR Tasking

- Update Target Information

As seen in the following graph, users rated the information elements related to the key decisions as highest. Track location and INTEL sources were a few of the items to be rated a 5 (the highest) by all users. In the Track phase, the emphasis is placed on increasing the information about a track including ID and location. ID accuracy, positional accuracy, and temporal accuracy were all at the top of the list. These items will help operators determine what information they have, and what they need.
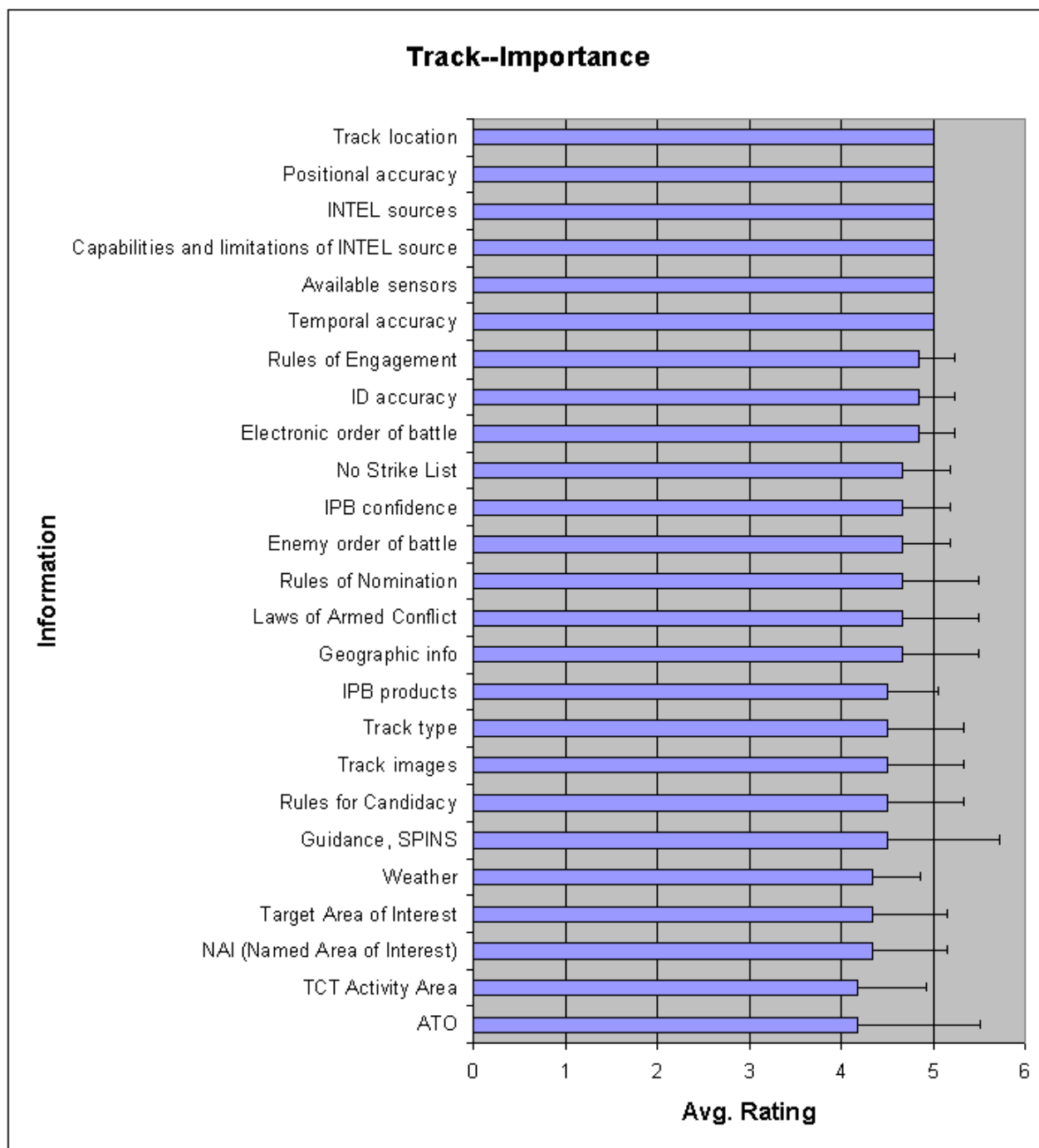
Figure 5-4. Track – Importance

5.2.4 Target – Importance

Figures 5-5 through 5-7 show the information elements for the Target (Direct Resources to Targets) phase organized by average rating and standard deviation. The key tasks and decisions are:

- Compare with TCT criteria

- Formulate attack options

- Determine cost/benefits of collateral damage

- Prioritize attack options

As seen in the following graphs, users rated the information elements related to the weapon platforms, the warfare considerations (ROEs, LOAC, No Strike List, Casualty Estimates, etc.), and target information highest. This phase contains the most information items and the most items with a rating of 5, indicating that a lot of information is required, or needs to be considered, to perform this task. Note the Find, Fix, Track sections could contain a similar amount of information if the INTEL sources and IPB items were expanded. This task also incorporates inputs from other positions including the JAG, the Fighter Duty Officers (FDOs) and many others.
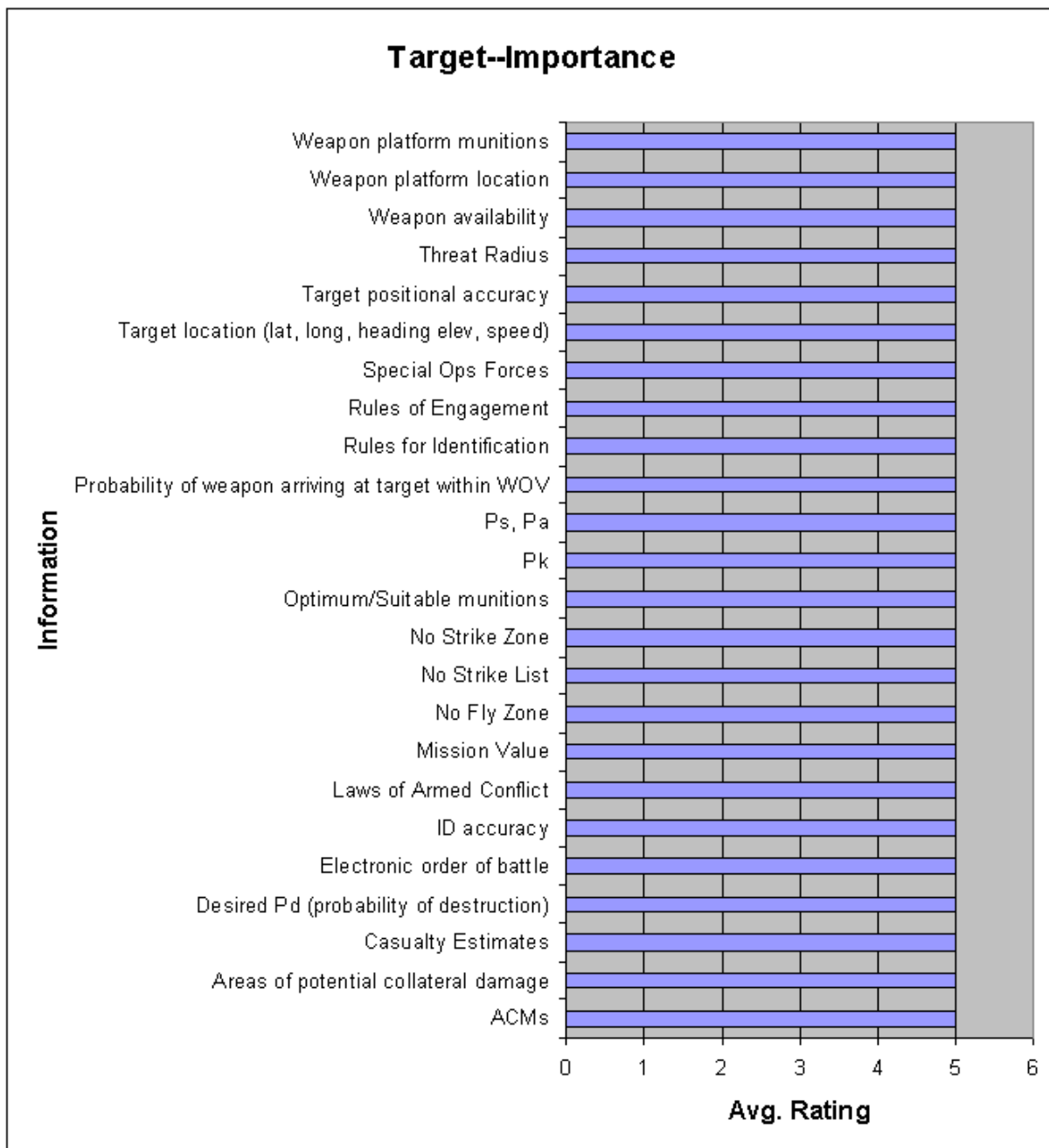
Figure 5-5. Target – Importance
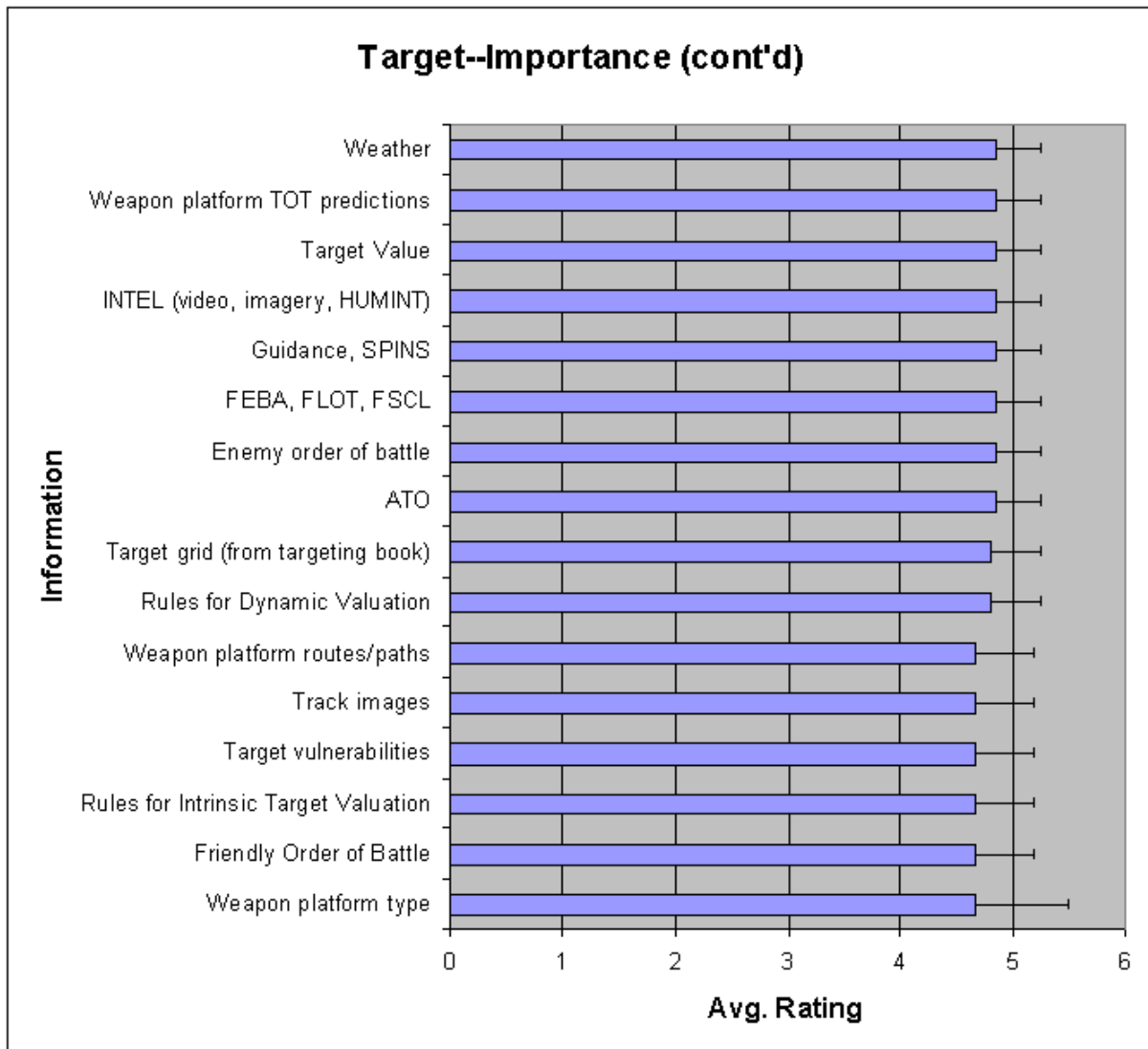
Figure 5-6. Target – Importance (cont'd)
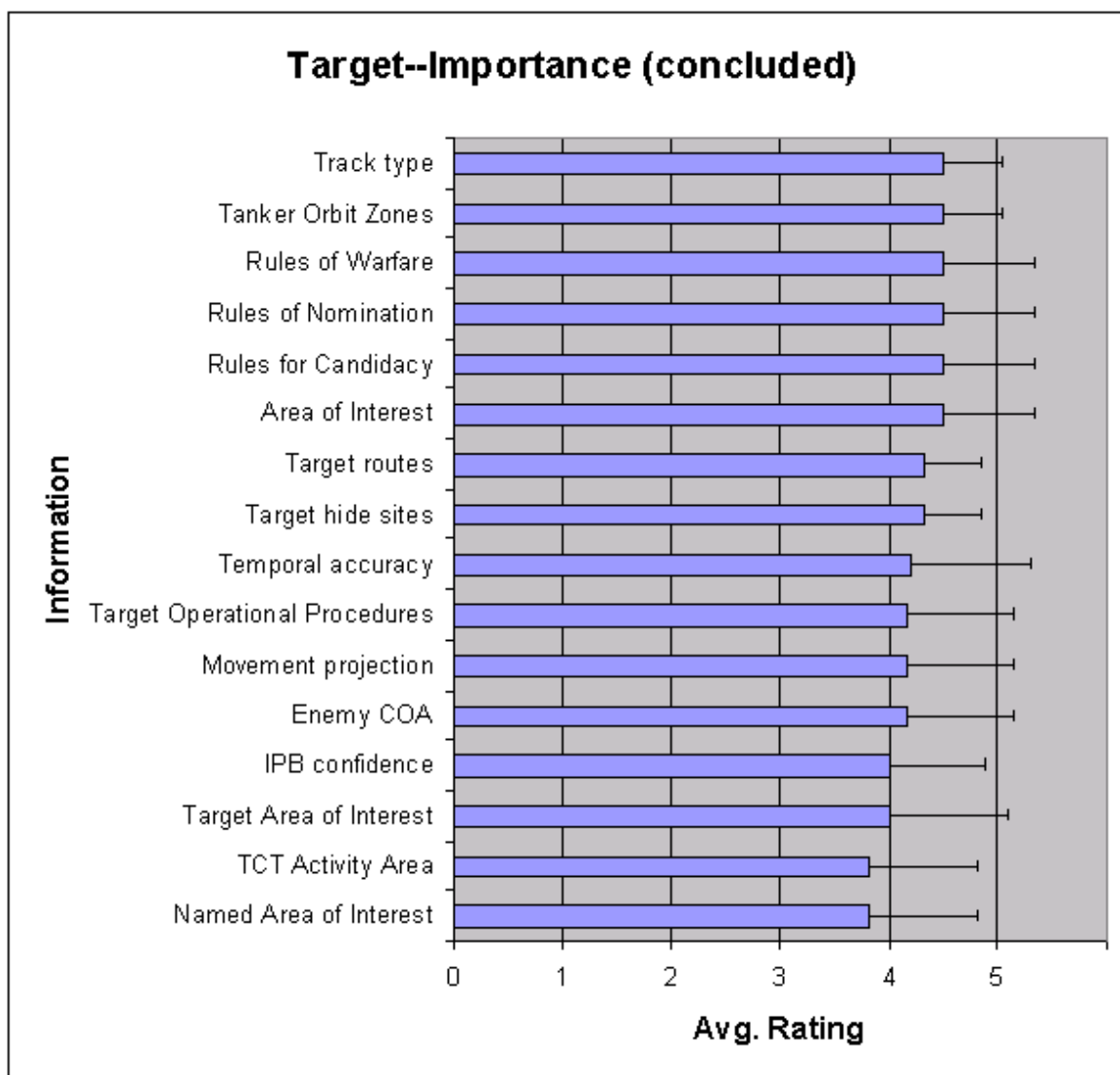
Figure 5-7. Target – Importance (concluded)

5.2.5 Common Information Items

Table 5-1 shows all information items that exist in more than one phase of the F2T2EA cycle. The information elements are arranged in alphabetical order with their mean rating in the appropriate column. The users rated the information items differently according to the key decisions required for the particular phase. A few items received a rating of 5 for all appropriate phases, including available sensors, capabilities and limitations of the sensors, INTEL sources, and track location. These particular information items should be made visible to the operator throughout the applicable stages of the target development and weaponeering process. Because of the variability in the means across the phases, this chart also shows the importance of designing displays to meet a specific task.

Table 5-1. Common Information Elements

Information Element	Find	Fix	Track	Target
ATO	4.33	4.17	4.17	4.83
Available sensors		5.00	5.00	
Capabilities and limitations of INTEL source		5.00	5.00	
Electronic order of battle	4.83	4.67	4.83	5.00
Enemy COA		4.33		4.17
Enemy order of battle	5.00	4.40	4.67	4.83
FEBA/FLOT, FSCL	4.33	4.33		4.83
Geographic info		4.83	4.67	
GMTI	4.50	4.67		
Guidance, SPINS		4.67	4.50	4.83
ID accuracy		5.00	4.83	5.00
IMINT, HUMINT, SIGINT		5.00		4.83
INTEL sources		5.00	5.00	
IPB Confidence	4.67	4.83	4.67	4.00
IPB Products	4.67		4.50	
Laws of Armed Conflict		4.33	4.67	5.00
Named Area of Interest	4.67	4.67	4.33	3.83
No Strike List		5.00	4.67	5.00
Rules for Candidacy		4.83	4.50	4.50
Rules for Identification		4.83		5.00
Rules of Engagement		5.00	4.83	5.00
Rules of Nomination		4.83	4.67	4.50

Information Element	Find	Fix	Track	Target
Sensor info		4.83	4.83	
Target Area of Interest		4.50	4.33	4.00
Target Positional accuracy		4.67	5.00	5.00
TCT Activity Area		4.33	4.17	3.83
Temporal accuracy		4.60	5.00	4.20
Terrain Suitability	4.33	4.33		
Track images		4.50	4.50	4.67
Track location		5.00	5.00	5.00
Track operational procedures		4.50		4.17
Track routes		4.67		4.33
Track type		4.83	4.50	4.50
Weather	4.00	4.33	4.33	4.83

5.3 Information Accessibility

This section contains the ratings for the accessibility of information elements during the Find → Fix → Track → Target phases. The following graphs display the average rating for each information element (represented by the bars) and the standard deviation (represented by the lines extending from the bars). Again, standard deviation is a measure of variation, i.e., how the ratings are spread around the average.

The users rated the desired accessibility of each information item using the following 5-point scale:

> 1 – Rarely or Never Accessed
> 2 – Available somewhere (e.g., more than 3 actions away)
> 3 – Fairly easy to access (e.g., 2 actions away)
> 4 – Very easy to access (e.g., 1 action away)
> 5 – Constant access required; should be visible at all times

The graphs are organized with the information elements receiving the highest rating. For information elements with the same average rating, the item with the smaller standard deviation is shown first.

Overall, the users had difficulty rating these items. One of the reasons is the visibility needed may change depending upon what the user is doing within a certain task. Another reason for the difficulty is once an information item is well known to an operator, they may not need to access it as often. An example of this is the Commander's Guidance. In the beginning of the user's shift, they may refer to this often, but as the day goes on, they may have it memorized. One must also consider whether the information is dynamic or static. The GUI should allow access to dynamic information, such as track location, more easily because the users cannot memorize this. Because of the difficulty the users described in completing this part of the survey, the results should be taken conservatively.

5.3.1 Find – Accessibility

Figure 5-8 shows the information elements for the Find (Detect Potential Targets) phase organized by average rating and standard deviation. The key tasks and decisions are:

- Monitor sensor data

- Fuse sensor data with IMP/TA and INT info

As seen below, users rated IPB and Order of Battle information as needing to be most easily accessible, which is appropriate for the initial task of finding targets. This is similar to the importance ratings for Find. The users rated GMTI higher for accessibility than importance compared to the other information elements. This could be due to the dynamic nature of GMTI.
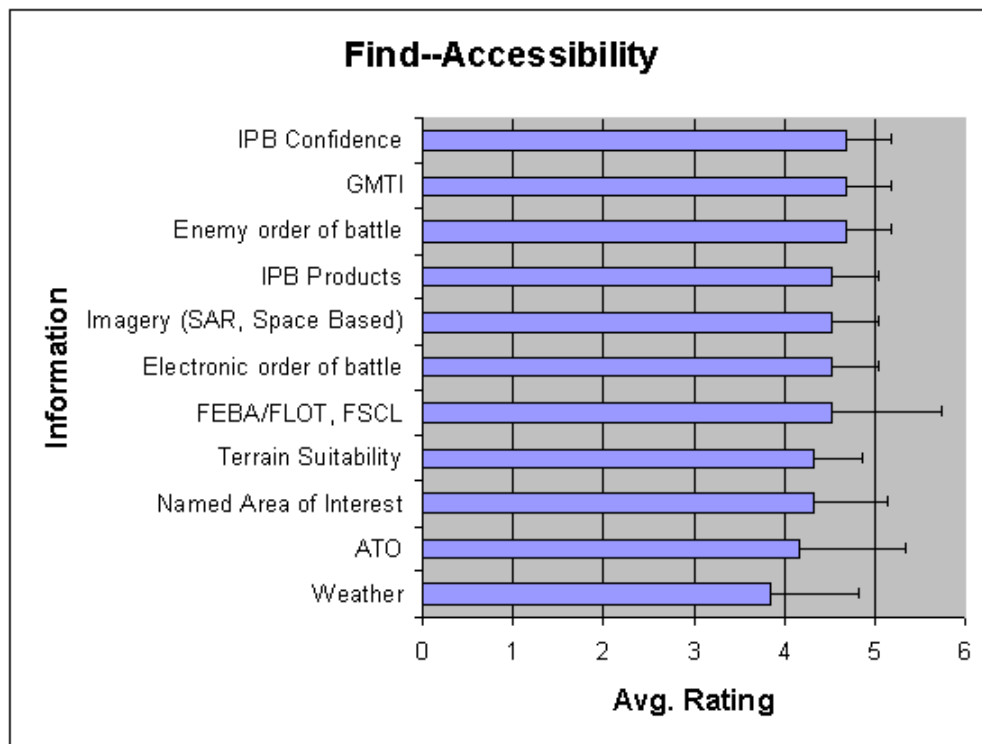
Figure 5-8. Find – Accessibility

5.3.2 Fix – Accessibility

Figures 5-9 and 5-10 show the information elements for the Fix (Identify and Locate Targets) phase organized by average rating and standard deviation. The key tasks and decisions are:

- Develop target ID

- Determine location

- Determine information required (ID, location)

- Determine sensor coverage needed

- Recommend ISR tasking

Many items deemed most important by the users were also rated highest in terms of visibility. Items required for the key tasks and decisions are at the top of the list. One interesting difference is that the warfare considerations (ROEs, LOACs, etc) were ranked lower for accessibility, possibly because of their static nature.
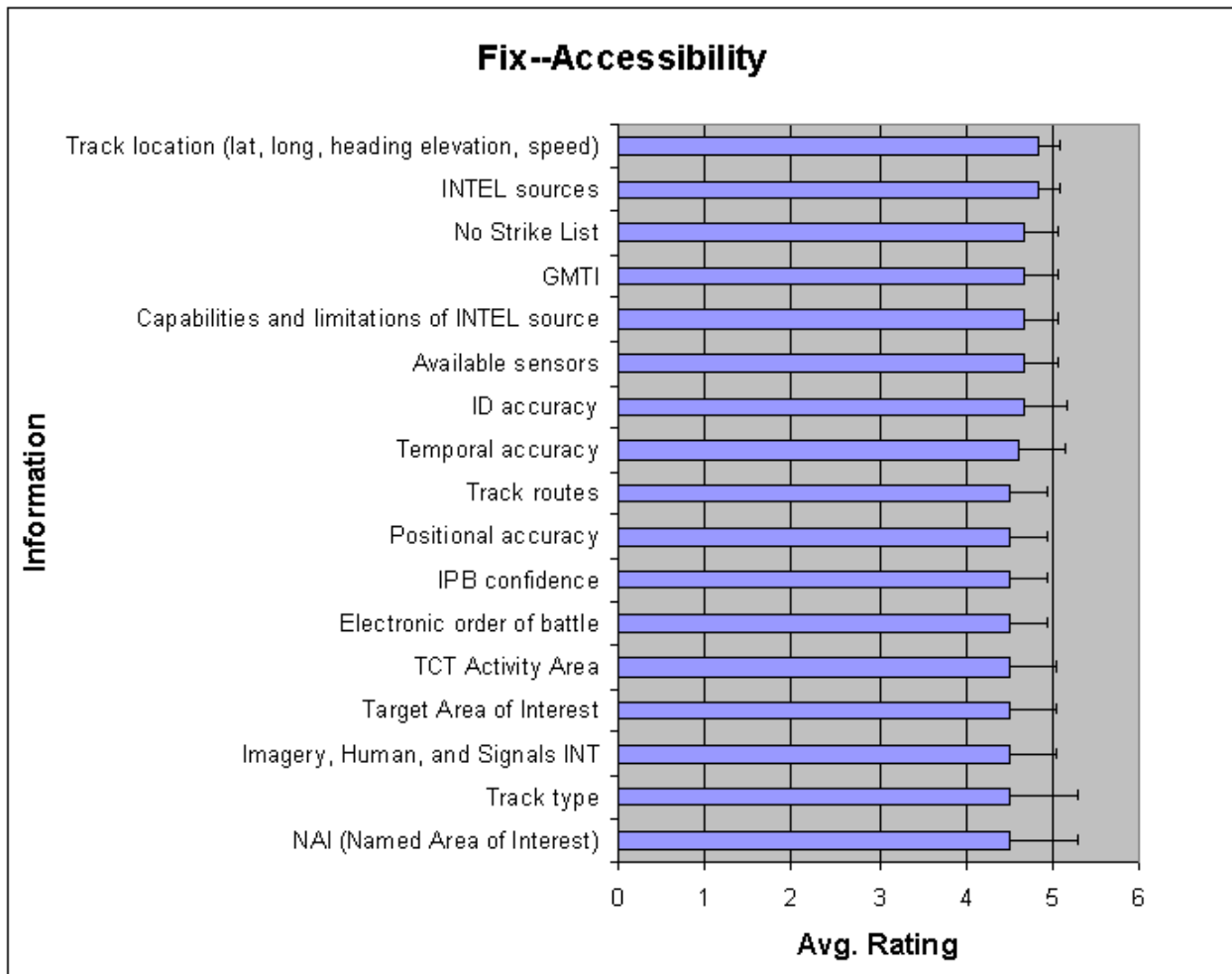
Figure 5-9. Fix – Accessibility
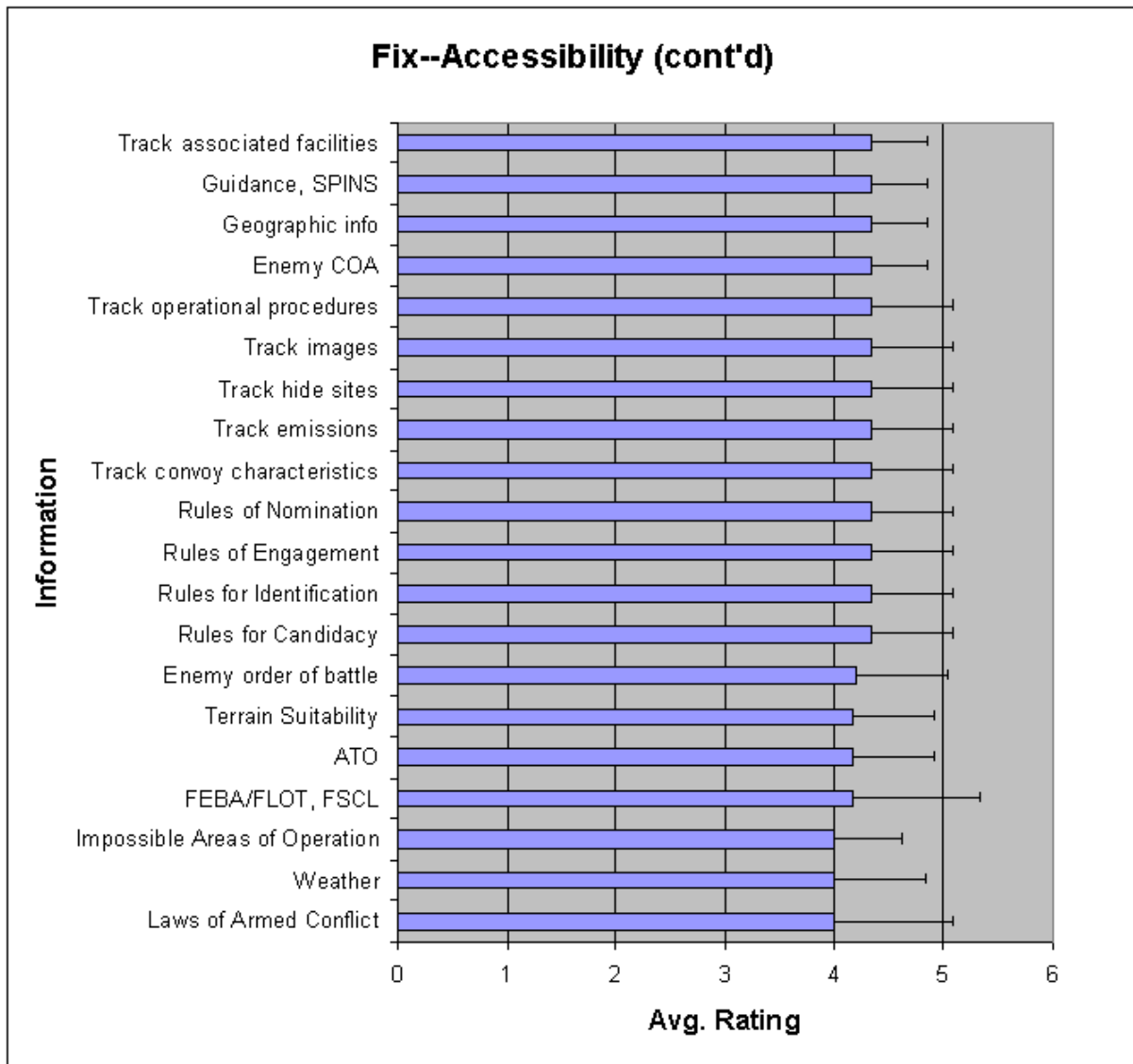
Figure 5-10. Fix – Accessibility (cont'd)

5.3.3 Track – Accessibility

Figure 5-11 shows the information elements for the Track (Track and Monitor Targets) phase organized by average rating and standard deviation. The key tasks and decisions are:

- Determine information required (ID, Location)

- Determine sensor coverage needed

- Recommend ISR Tasking

- Update Target Information

As seen in the following graph, users rated the information elements related to the key decisions as highest. Positional accuracy was the only item to receive a 5. Other items related to the track location and sensors were at the top of the list. The users rated the information deemed most important highest in accessibility also. Note that the information items at the top of the list are mostly dynamic in nature.
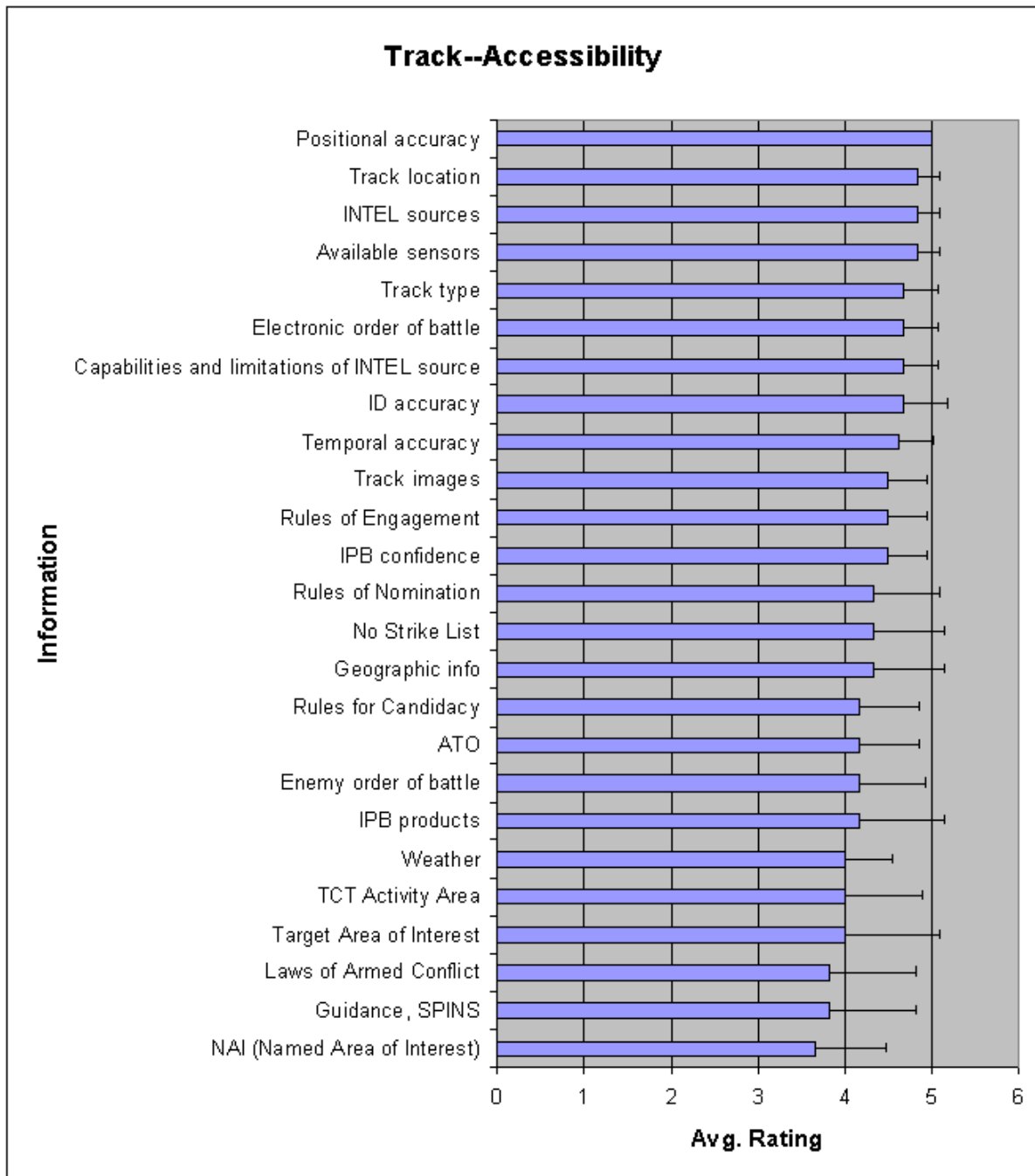
Figure 5-11. Track – Accessibility

5.3.4 Target – Accessibility

Figures 5-12 through 5-14 show the information elements for the Track (Direct Resources to Targets) phase organized by average rating and standard deviation. The key tasks and decisions are:

- Compare with TCT criteria

- Formulate attack options

- Determine cost/benefits of collateral damage

- Prioritize attack options

As seen in the following graphs, users rated the information elements related to locations (target location, no fly zone, no strike zone), weapon platforms, and target information highest. This phase contains the most information items and the most items with a rating of 5. As opposed to the importance ratings for the Target phase, the warfare considerations (ROEs, LOACs, etc) were rated lower on the list for accessibility. Their static nature may account for this.
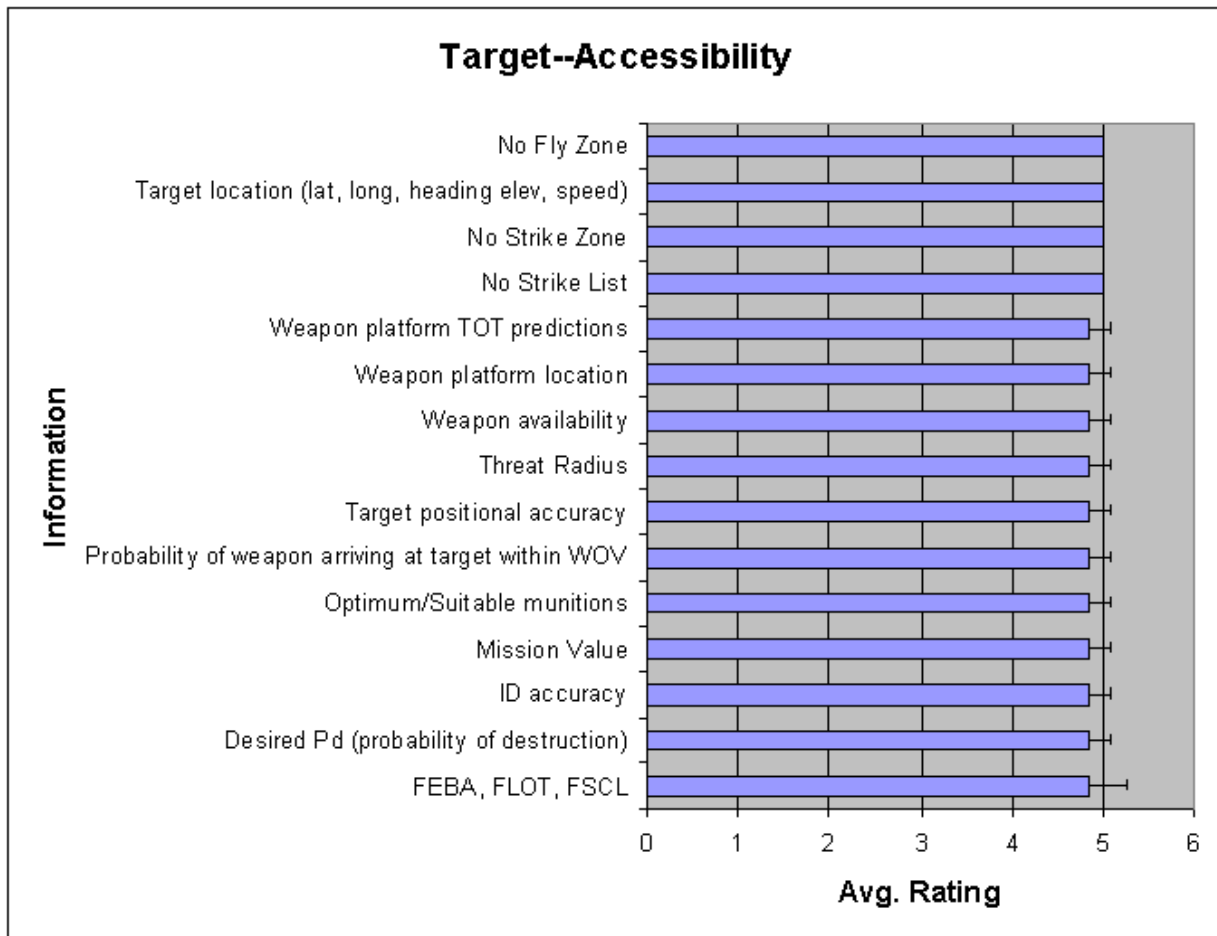
Figure 5-12. Target – Accessibility
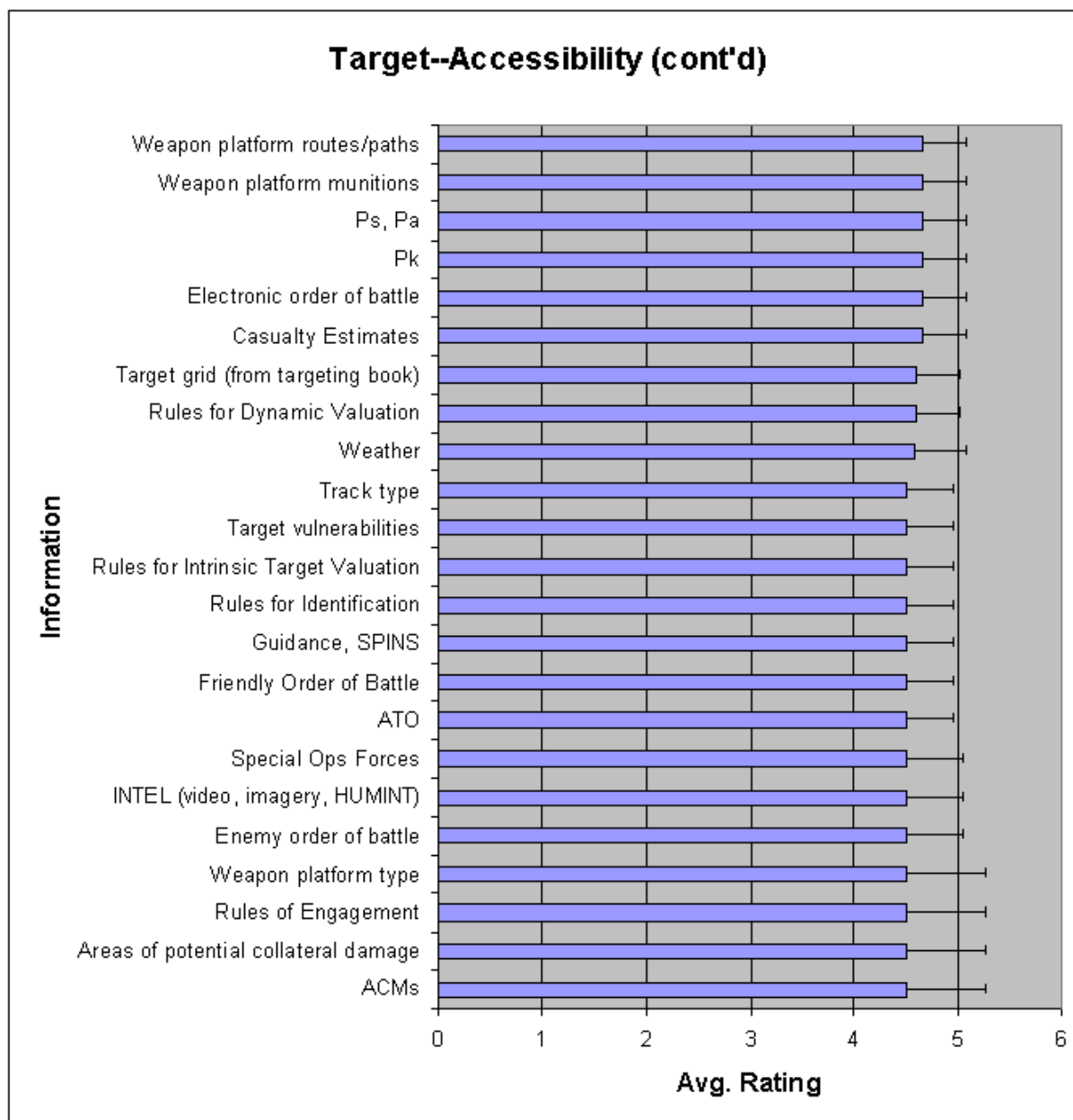
Figure 5-13. Target – Accessibility (cont'd)
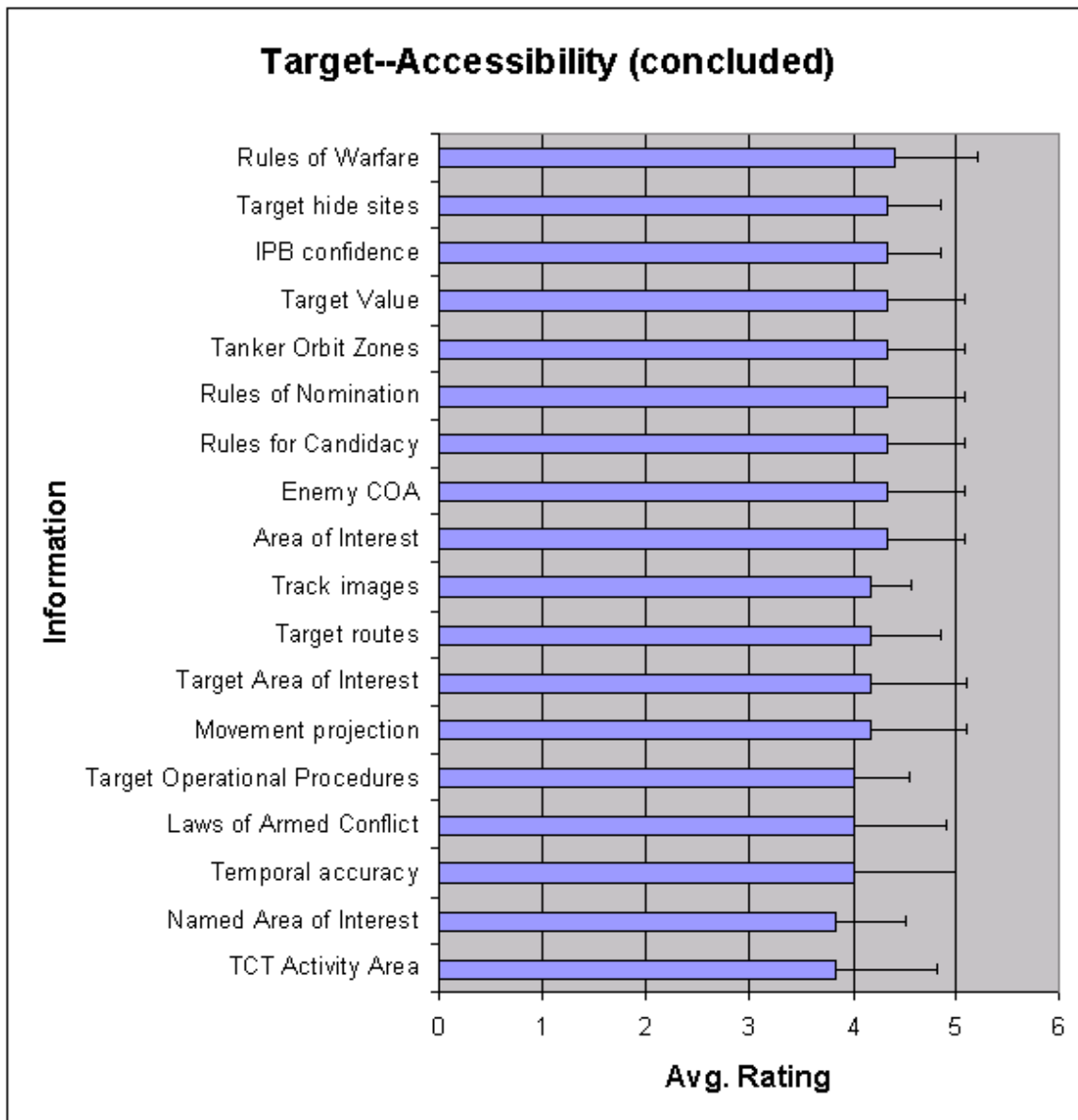
Figure 5-14. Target – Accessibility (concluded)

5.4 Overall vs. Expert Comparisons

Part of the GUI WG user survey included a user profile to determine in what areas the users had experience. A secondary analysis was performed to determine if a difference existed between the experts' ratings and the overall group's ratings for the importance of the information elements. To separate the experts' information, the users' ratings were only included if they indicated they had experience in INTEL analysis, target development, or weaponeering within a ground targeting environment. If they did not have experience in all of these domains, their ratings were eliminated for that particular section.

Some differences did exist between the experts' ratings and the overall ratings. For the most part, the experts' ratings were lower, more conservative, than the group's ratings. The exception for this is the targeting phase. Within the Target phase of the cycle, the experts rated two thirds of the information as 5, critical, whereas the overall ratings were lower. While some differences existed, the order of the information items based on average ratings changed very little.

However, since our total sample size was six users, when only the expert's ratings were analyzed, the sample was lowered to three or four. Because the sample size was small to begin with, when three or four users are eliminated, the sample decreases by 50%. Therefore, we recommend following the initial findings presented in Section 5.2.

5.5 GUI WG Survey Conclusions

Although some information items received the highest possible priority rating (Very High Priority; critical for this function) in several different phases of the targeting cycle, many items received dissimilar average ratings for the different phases. This has a definite impact on design, by demonstrating that operators need to see different information at different times. Table 5-1 illustrates this point very well by showing how the importance rating changes for each item depending on the current tasks.

The first series of graphs represents the importance ratings for the information elements for the Find → Fix → Track → Target segments of the targeting cycle. Because the information elements are arranged by average rating and standard deviation, the items with the highest ratings and highest user agreement are closest to the top of the graphs. These graphs lead into a checklist for the information needed during the particular phase of the targeting cycle that can be used to design or evaluate a set of operator displays.

Because the users' feedback indicated the accessibility sections were more difficult to answer, the results should be used with caution. A few factors impact the required accessibility of an information element, including whether the information is dynamic or static, whether the users can memorize the information, and the immediacy with which the information is needed. The type of information, quantitative or qualitative, also affects the need for accessibility because humans can more readily recall a list of related concepts compared with a list of numbers. The survey ratings, along with these other considerations, can be used as a tool for designing and evaluating the display. Combined with the ACWA results and general HFE guidelines, the information necessary for evaluating the displays exists. Section 6 contains the results of such an evaluation of the TCT GUI.

5.6 CUI Components Relative to Analysis

5.6.1 ACWA to CUI Comparison

The tables below compare the information requirements identified in the ACWA as rated for importance by three SMEs to the information items presented in the TCTF Common UI (CUI).

Table 6-1 maps the Goals from the ACWA into the TCT F2T2EA kill chain and operational role or position responsible for each task.

Table 5-1. Mapping of ACWA Goals to F2T2EA

ACWA Goal	F2T2EA	Operational Role/Position
0	Engage	
1	Target	TCT Chief
2	Fix/Track/Target	TD
3	Find/Fix	TD
4	Fix	TD
5	Fix/Track	ISR Manager/Tech
6	Fix/Track	TD and ISR Manager/Tech
7	Track	TD
8	Target	WTP (with input from SMEs)
9	Target	WTP
10	Target	WTP (inputs from SOF liaison)
11	Target	TCT Chief

Tables 5-2 through 5-12 show the SMEs ratings of importance for each information item to performing that goal on a scale of 1→ 5, with 5 being the highest. The goals in the second column of Tables 5-2 through 5-12 correspond to the goals in the ACWA functional decomposition. These average ratings can be used as design guidance to identify what information is important for a specific goal. Common sense should be used with regard to visibility of the information for some important information may not need to be always visible on the display, such as Commander's Guidance.

The Checklists below were used to determine if the information requirements were displayed on the correct location within the TCTF CUI.

Table 5-2. Goal 0: ACWA to CUI Comparison

ACWA Goals				SMEs' Average Importance Rating (1 → 5)	Visible on Common GUI	Common GUI Component
Goal 0 - Execute Mission	SME 1	SME 2	SME 3	Importance	Visible	CUI
Available Assets	5	5	5	5.00		
ATO Information	4	5	5	4.67		
ACMs	5	4	4	4.33		
Emergent Targets	5	3	3	3.67		
Weapons Assigned	1	4	4	3.00		

Table 5-3. Goal 1: ACWA to CUI Comparison

ACWA Goals				SMEs' Average Importance Rating (1 → 5)	Visible on Common GUI	Common GUI Component
Goal 1 - Maximize Value of Destroyed Targets	SME 1	SME 2	SME 3	Importance	Visible	CUI
Rules for Dynamic Valuation	5	5	5	5.00		
ATO Information	4	5	5	4.67		
Guidance	4	5	5	4.67		
Laws of Armed Conflict	4	5	5	4.67		
Mission Value	4	5	5	4.67		
Rules for Intrinsic Target Valuation	4	5	5	4.67		

ACWA Goals				SMEs' Average Importance Rating (1 → 5)	Visible on Common GUI	Common GUI Component
Goal 1 - Maximize Value of Destroyed Targets	SME 1	SME 2	SME 3	Importance	Visible	CUI
Rules of Engagement	4	5	5	4.67		
Target Value	4	5	5	4.67		
ACMs	4	4	4	4.00		
FEBA/FLOT, FSCL	3	4	4	3.67		
Threat Radius	4	3	3	3.33		

Table 5-4. Goal 2: ACWA to CUI Comparison

ACWA Goals				SMEs' Average Importance Rating (1 → 5)	Visible on Common GUI	Common GUI Component
Goal 2 - Declare Targets TCTs	SME 1	SME 2	SME 3	Importance	Visible	CUI
ID Accuracy	5	5	5	5.00		
Laws of Armed Conflict	5	5	5	5.00		
Sensor Capability	5	5	5	5.00		
Track Number	5	5	5	5.00		
Guidance, SPINS	4	5	5	4.67		
IPB Confidence	4	5	5	4.67		
Named Area of Interest	4	5	5	4.67		
No Strike List	4	5	5	4.67		
Rules of Engagement	4	5	5	4.67		
Target Area of Interest	4	5	5	4.67		
Track Location (Lt/Lng, Elv, Hd, Spd)	3	5	5	4.33		
Sensor Availability	4	4	4	4.00		
Sensor Field of View	4	4	4	4.00		
TCT Activity Area	4	4	4	4.00		
Positional Accuracy	3	4	4	3.67		
Track Images	3	4	4	3.67		

ACWA Goals	SME 1	SME 2	SME 3	SMEs' Average Importance Rating (1 → 5) Importance	Visible on Common GUI Visible	Common GUI Component CUI
Goal 2 - Declare Targets TCTs	**SME 1**	**SME 2**	**SME 3**	**Importance**	**Visible**	**CUI**
Track Type	3	4	4	3.67		
Temporal Accuracy (Timeliness)	2	3	3	2.67		

Table 5-4. Goal 3: ACWA to CUI Comparison

ACWA Goals	SME 1	SME 2	SME 3	SMEs' Average Importance Rating (1 → 5) Importance	Visible on Common GUI Visible	Common GUI Component CUI
Goal 3 - Aggregate Sensor Returns to Form Tracks	**SME 1**	**SME 2**	**SME 3**	**Importance**	**Visible**	**CUI**
Imagery (SAR, Space Based)	4	5	5	4.67		
Terrain Suitability	4	5	5	4.67		
Weather	4	5	5	4.67		
IPB Confidence	3	5	5	4.33		
Named Area of Interest	4	4	4	4.00		
GMTI	3	4	4	3.67		

Table 5-5. Goal 4: ACWA to CUI Comparison

ACWA Goals	SME 1	SME 2	SME 3	SMEs' Average Importance Rating (1 → 5) Importance	Visible on Common GUI Visible	Common GUI Component CUI
Goal 4 - Develop Target ID	**SME 1**	**SME 2**	**SME 3**	**Importance**	**Visible**	**CUI**
Combat ID	5	5	5	5.00		
IFF	5	5	5	5.00		
Rules for Identification	5	5	5	5.00		
ATO Information	4	5	5	4.67		
Enemy COA	4	5	5	4.67		

ACWA Goals	SMEs' Average Importance Rating (1 → 5)				Visible on Common GUI	Common GUI Component
Goal 4 - Develop Target ID	SME 1	SME 2	SME 3	Importance	Visible	CUI
GMTI	4	5	5	4.67		
Track Emissions	4	5	5	4.67		
Track Hide Sites	4	5	5	4.67		
Track Location (Lt/Lng, Elv, Hd, Spd)	4	5	5	4.67		
Track Routes	4	5	5	4.67		
Imagery, Human, and Signals INT	3	5	5	4.33		
Impossible Areas of Operation	3	5	5	4.33		
IPB Confidence	3	5	5	4.33		
Sensor Accuracy/Info Confidence	5	4	4	4.33		
Sensor Availability	3	5	5	4.33		
Track Convoy Characteristics	3	5	5	4.33		
Track Operational Procedures	3	5	5	4.33		
Named Area of Interest	4	4	4	4.00		
Target Area of Interest	4	4	4	4.00		
Weather	2	5	5	4.00		
FEBA/FLOT, FSCL	3	4	4	3.67		
Terrain Suitability	3	3	3	3.00		
Track Associated Facilities	3	3	3	3.00		

Table 5-6. Goal 5: ACWA to CUI Comparison

ACWA Goals	SMEs' Average Importance Rating (1 → 5)				Visible on Common GUI	Common GUI Component
Goal 5 - Determine Required Sensor Coverage	SME 1	SME 2	SME 3	Importance	Visible	CUI
Available Sensors	5	5	5	5.00		
ATO Information	4	5	5	4.67		

ACWA Goals	SMEs' Average Importance Rating (1 → 5)				Visible on Common GUI	Common GUI Component
Goal 5 - Determine Required Sensor Coverage	SME 1	SME 2	SME 3	Importance	Visible	CUI
Sensor Info	4	5	5	4.67		
NAI	4	4	4	4.00		
Geographic Info	3	4	4	3.67		

Table 5-7. Goal 6: ACWA to CUI Comparison

ACWA Goals	SMEs' Average Importance Rating (1 → 5)				Visible on Common GUI	Common GUI Component
Goal 6 - Determine Level of Intel Accuracy Required	SME 1	SME 2	SME 3	Importance	Visible	CUI
ID Accuracy	5	5	5	5.00		
Laws of Armed Conflict	5	5	5	5.00		
Positional Accuracy	5	5	5	5.00		
Rules for Identification	5	5	5	5.00		
Rules of Engagement	5	5	5	5.00		
Capabilities/Limitations of INTEL Source	4	5	5	4.67		
INTEL Sources	3	5	5	4.33		
Temporal Accuracy (Timeliness)	2	3	3	2.67		
Weather	2	2	2	2.00		
Guidance, SPINS	1	2	2	1.67		

Table 5-8. Goal 7: ACWA to CUI Comparison

ACWA Goals	SMEs' Average Importance Rating (1 → 5)				Visible on Common GUI	Common GUI Component
Goal 7 - Determine Target Status	**SME 1**	**SME 2**	**SME 3**	**Importance**	**Visible**	**CUI**
Guidance, SPINS	5	5	5	5.00		
INTEL	5	5	5	5.00		
Rules for Identification	5	5	5	5.00		
Area of Interest	4	5	5	4.67		
TCT Activity Area	4	5	5	4.67		

Table 5-9. Goal 8: ACWA to CUI Comparison

ACWA Goals	SMEs' Average Importance Rating (1 → 5)				Visible on Common GUI	Common GUI Component
Goal 8 - Assign Weapon Platform to TCT	**SME 1**	**SME 2**	**SME 3**	**Importance**	**Visible**	**CUI**
No Strike Zone	5	5	5	5.00		
Target Location (Lt/Lng, Elv, Hd, Spd)	5	5	5	5.00		
Areas of Potential Collateral Damage	4	5	5	4.67		
ATO Information	4	5	5	4.67		
No Fly Zone	4	5	5	4.67		
P of Arriving within WOV	4	5	5	4.67		
Weapon Platform Location	4	5	5	4.67		
Weapon Platform Munitions	4	5	5	4.67		
Weapon Platform TOT Predictions	4	5	5	4.67		
Weapon Platform Type	3	5	5	4.33		
Weather	3	5	5	4.33		
FEBA/FLOT, FSCL	4	4	4	4.00		
Tanker Orbit Zones	4	3	3	3.33		
Optimum/Suitable Munitions	4	2	2	2.67		
Pk, Ps, Pa	4	2	2	2.67		
Weapon Platform Routes/Paths	3	2	2	2.33		

Table 5-10. Goal 9: ACWA to CUI Comparison

ACWA Goals				SMEs' Average Importance Rating (1 → 5)	Visible on Common GUI	Common GUI Component
Goal 9 - Assign Munitions to Target	SME 1	SME 2	SME 3	Importance	Visible	CUI
Weapon Platform Munitions	5	5	5	5.00		
Areas of Potential Collateral Damage	4	5	5	4.67		
ATO Information	4	5	5	4.67		
FEBA/FLOT, FSCL	4	5	5	4.67		
Weather	4	5	5	4.67		
Target Location (Lt/Lng, Elv, Hd, Spd)	3	5	5	4.33		
Target Vulnerabilities	5	4	4	4.33		
Desired Pd	4	3	3	3.33		
JMEM	4	3	3	3.33		
Pk	3	2	2	2.33		
Target Routes	2	2	2	2.00		

Table 5-11. Goal 10: ACWA to CUI Comparison

ACWA Goals				SMEs' Average Importance Rating (1 → 5)	Visible on Common GUI	Common GUI Component
Goal 10 - Determine Potential for Collateral Damage	SME 1	SME 2	SME 3	Importance	Visible	CUI
Special Ops Forces	5	5	5	5.00		
Target Location (Lt/Lng, Elv, Hd, Spd)	5	5	5	5.00		
Target Positional Accuracy	5	5	5	5.00		
INTEL	4	5	5	4.67		

ACWA Goals				SMEs' Average Importance Rating (1 → 5)	Visible on Common GUI	Common GUI Component
Goal 10 - Determine Potential for Collateral Damage	SME 1	SME 2	SME 3	Importance	Visible	CUI
FEBA/FLOT, FSCL	3	5	5	4.33		
No Strike Zone	5	4	4	4.33		
Casualty Estimates	4	4	4	4.00		
Area of Interest	3	4	4	3.67		
IPB Confidence	4	3	3	3.33		
No Fly Zone	4	3	3	3.33		

Table 5-12. Goal 11: ACWA to CUI Comparison

ACWA Goals				SMEs' Average Importance Rating (1 → 5)	Visible on Common GUI	Common GUI Component
Goal 11 - Determine Status of Targets and TCTs Not Meeting Criteria	SME 1	SME 2	SME 3	Importance	Visible	CUI
Enemy COA	5	5	5	5.00		
Guidance, SPINS	5	5	5	5.00		
Movement Projection	5	5	5	5.00		
Target Hide Sites	5	5	5	5.00		
INTEL	4	5	5	4.67		
Target Location (Lt/Lng, Elv, Hd, Spd)	3	4	4	3.67		
Target Value	3	4	4	3.67		

5.7 Heuristic and Cognitive Evaluation Conclusions

Although many of the required information items as identified by the ACWA and GUI WG process are provided somewhere in the TCTF UI, Tables 5-2 through 5-12 disclose several information items that should be added to or moved to a more appropriate section of the CUI

based on the task(s) they support. Some items not currently provided on the CUI and rated very important may only need be accessible when needed (e.g., ROEs, LOAC, etc.).

Section 5 was originally developed to report to the contractor issues and recommendations resulting from the MITRE TCTF GUI Team's work. Since the delivery of the report, the contractor implemented some of the suggestions and is pursuing the implementation of others. These analyses will continue with subsequent heuristic evaluations, GUI WGs, and user reviews of the delivered system.

Section 6

Discussion

6.1 Assessment of GUI Design Process Activities

HFE involvement facilitates user/SME participation in all stages of system acquisition, from requirement development through testing. The information gathered from the ACWA, the GUI WG, and the GUI WG Survey identified many issues and resulted in recommendations for the TCTF CUI. Supplementing the information obtained from the users/SMEs, basic HFE literature and standards provided additional guidance for the heuristic and cognitive evaluation of the CUI. With favorable contractor support, the TCTF CUI continues to evolve into to a more usable system.

6.1.1 Applied Cognitive Work Analysis

The TCT ACWA was the first ACWA that the MITRE TCTF GUI Team had performed. The team felt the ACWA was beneficial for several reasons. The ACWA process resulted in the MITRE TCTF GUI Team gaining a more in-depth understanding of time critical targeting, independent of the planned TCTF UI. The ACWA forced the team to scrutinize every stage of the TCT process and identify the cognitive decisions involved in each stage and the information required to make those decisions. In addition, the primary element of conducting an ACWA is interviewing, and ideally observing, actual users, thus the ACWA process gave us insight into the tasks directly from the users. Although it was not possible for the team to observe TCT operators, we were able to interview SMEs thereby gaining additional insight into the TCT process. A final positive outcome of the ACWA was that the MITRE TCTF GUI Team produced a survey which was distributed to the SMEs to gather ratings of how important various information items are, and how visible those information items should be. The results of this survey were used to assess the TCTF CUI and give constructive feedback to the developers.

Although it is felt that the ACWA was successful using the resources available to us, it is advised that while developing future ACWAs current users are not only interviewed, but also observed performing the tasks within an operational environment. This will result in more robust and well-rounded data.

Ultimately, the ACWA process must result in design or system recommendations, requirements, guidelines, prototypes, or some other tangible deliverable. A task/work analysis many times will sit in a file cabinet waiting for someone to apply it. The goal of the Applied Cognitive Work Analysis technique is to apply the information gathered, instead of hoping someone else will.

6.1.2 GUI Working Group

The first GUI Working Group was a very successful event. It was an opportunity for the people involved in developing the TCTF Common GUI to receive direct feedback from people who had operational knowledge of Time Critical Targeting. To ensure that valuable input is obtained throughout the development of the TCTF CUI, it is recommended that GUI WGs be held regularly.

Prior to the GUI Working Group, surveys were distributed to those who had been invited to attend. As seen in Section 5, these surveys gathered ratings of how important various information items are, and how visible those pieces of information should be, throughout the stages of TCT. The surveys were effective because they could be used as a resource when examining the TCTF CUI to ensure that the information items rated most important, and should be most visible, were very easy to access.

However, it is advised that if similar surveys are distributed in the future, that the participants be asked to focus within the survey on the phase of TCT that they are the most knowledgeable in, and then complete as much of the other sections as they can. It is believed that this will result in a greater number of surveys being completed. Additionally, to elicit more discrimination between importance of information items, the surveys should use a 'rack and stack' approach wherein the users rank order the importance of information elements. On the GUI WG Surveys, several users commented they wanted 'all the information all the time' and rated information as such. This 'rack and stack' approach was used at the first GUI WG to brainstorm the order of columns in the DTL/DTQ Table, a critical component of the TCTF CUI, with successful results, which were incorporated into the new design.

6.2 Lessons Learned

6.2.1 ACWA

- The ACWA process is time consuming. While performing the ACWA, the team was also learning about the ACWA process itself which increased the time required. Several factors can reduce the time required

  o Familiarity with the ACWA process, from a class or documentation and practice, is required.

  o Easy access to the proper documents such as a Concept of Operations (CONOPS), system architectures, and user manuals is very important.

  o Early user/SME involvement proves very useful. Scheduling conflicts must be anticipated when setting up interviews.

  o Users and SMEs generally enjoy talking about what they do or did. Informal discussions focused around structured objectives elicit a great deal of information.

- Determining the level of detail required can be difficult. While the lowest level of detail would be desirable, time considerations often limit this. For specific concepts of interest, a lower level examination of the information can be used. If time permits, mapping the information requirements to each decision within a goal would prove useful.

- Visually presenting the functional decomposition can be difficult when still in progress, requiring the creation of many different images.

6.2.2 Surveys

- While not part of the standard ACWA process, the surveys we developed provided some of the most valuable information.

- Limit the length of the user/SME surveys, trying to obtain all the information needed can result in no information at all, i.e., longer surveys equals lower response rate (or longer response time).

- Using a 'rack and stack' or rank ordering approach will produce data more easy to discriminate. Caution should be used with ranking long lists; this may become frustrating to the user/SME.

- While the surveys attempted to determine how accessible the information should be (always displayed vs. 5 clicks away) this concept was difficult to rate. Part of the problem was sometimes certain information items were needed early in the process and not in the later stages. A measure of accessibility would be very useful.

- The information item checklist (Tables 6-2 and 6-3) organized by operator goal or process is very useful to determine what the operator needs to see and when they need to see it.

6.3 Future Applications

The information gathered in this document will receive continued use by the MITRE TCTF GUI Team for evaluation of future system versions (spirals/increments). Other areas where the results of an ACWA can be used include user documentation and user reviews, discussed below. The same process can also be applied to any other existing or proposed system with the same effectiveness.

6.3.1 User Documentation

The ACWA organizes information around goals and decisions. This organizational structure leads nicely into training manuals and help systems. Users typically use these documents/systems when they have a question about a decision or process, and do not generally read the document straight through. By basing manuals and help systems around

the basic goals and decisions, users can locate the answers to their questions faster than if the documents/systems were organized around the menu structure.

6.3.2 User Reviews

After the delivery of a development spiral, users test the system by performing the necessary tasks in a scenario. The system, meaning the computers and the users controlling the computers, is tested to determine how well it performs the functions required. The review also checks to ensure information items collected and evaluated through the ACWA and the surveys is accessible at the proper times. Errors and problems will almost always be discovered the first time a user uses any system, therefore user involvement is crucial to the early identification of problems or areas for improvement.

6.3.3 Other Programs

The process and techniques applied to the TCTF program should prove useful to other programs. This document described the techniques used as well as provided the results from the HFE procedures. In addition, the appendices contain the various surveys and interview forms used during the gathering of data. This package of information should provide a good starting point for other programs to gather information necessary for a user-centered design.

Appendix A: MITRE SME Interview Questions

During the initial knowledge gathering process of the ACWA, the MITRE TCTF GUI Team interviewed several MITRE SMEs to gain information on the TCT process (both how it existed in the past and ideas for the future). The interviewer used the following questions during the interview to elicit conversation from the SMEs. While having questions prepared before the interview is quite useful, the free flowing conversations with the SMEs enabled answering most of the questions without referring to the list.

User Information

Name: | **Email:**

Organization: | **Phone:**

Please describe your background as it relates to Time Critical Targeting and/or target development and weapon-target-pairing within an AOC:

High-level Operator Questions

1) How would you describe what a typical operator did in your position(s)?

   a) What were the major tasks that needed to be completed?

   b) What were the decisions that were typically made?

   c) What made making those decisions difficult?

   d) How did you ensure that everyone had the same "big picture"?

2) What are the steps involved in identifying a target?

   a) Which characteristics do you look for?

   b) What major elements (information) do you have to know and keep track of?

3) What are the steps involved in developing a target into a nominated TCT?

   a) What major elements (information) do you have to know and keep track of?

   b) What information is readily available and what information needs to be requested for?

4) Is it difficult to gain the necessary level of confidence to develop a TCT?

5) What happens to confirmed TCTs that are not nominated?

6) Do you consider weapons that are available in the decision to nominate?

Weapon-Target Pairing

7) What steps are involved in pairing a weapon to a target?

      a)   What major elements (information) do you have to know and keep track of?

8) How do you choose between appropriate weapons?

      a)   What major elements (information) do you have to know and keep track of?

      b)   How do the types of available sensor collection impact weapon selection?

      c)   What happens to TCTs that don't get paired?

9) Do you ever decide not to prosecute a paired TCT?

Overall Process Questions

10) When a suspected TCT is not prosecuted/destroyed during what stage of the process does the problem typically occur?

11) What parts of the process/tasks are partially or fully automated?

      a)   How do you know the automation is working properly?

12) Do you generate or use any checklists?

13) When you are doing these tasks, are there shortcuts or ways of accomplishing more with less that you found especially useful?

14) Have you had experiences where part of a simulation just 'popped' out at you; where you noticed things going on that other didn't catch? What is an example?

15) Please share any other comments you have on the process.

Appendix B: ACWA User Survey

This appendix contains the survey distributed to the MITRE SMEs. This survey used the functional decomposition and information requirements developed during the ACWA process. The Power Point presentation was printed out and filled out by the SMEs on paper. It should be noted that the functional decomposition, derived from the Applied Cognitive Work Analysis, is different than the one contained in Section 4. Based upon the comments from the SMEs and others, the functional decomposition was updated to better reflect the true system.

MITRE

An Applied Cognitive Work Analysis (ACWA) for TCT
User Survey

28 January, 2002
Janet Blackwell
Erika Darling
Don Means
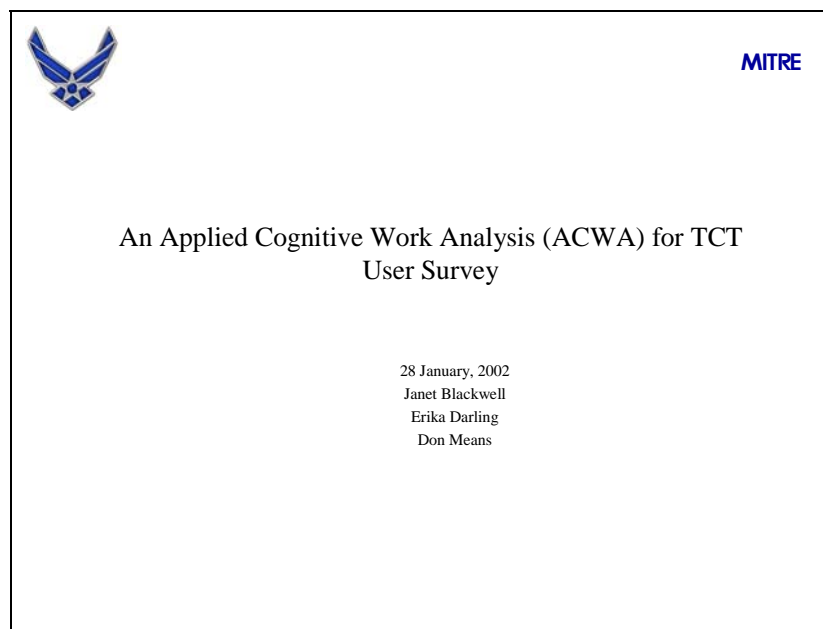
Slide 1

Survey Instructions

- The following slides show a functional decomposition for the TCT process. A functional decomposition breaks down a high level task to a series of goals. The goals are arranged in a top down fashion, with lower level goals contributing to higher level goals.
- The decomposition is not arranged with regard to time.
- Within the TCT process, some of the goals/tasks are performed by the computer.
- For the following slides, each goal has a Comments Box. Please write down any comments on that goal.
- Each goal has associated decision requirements. Please write down any missing decision requirements. A Comments box is also provided.
- Each goal has associated information requirements.
  - For these lists, please rate the importance of the information in regards to the goal (**5** to **1**). 5 is the highest rating, being very important, and 1 is the lowest rating, being not important.
  - Also, rate the information in regards to the visibility needed (**4** to **1**). 4 describes information that should be always visible to the operator. 1 describes information that may only need to be accessed once in a while, and therefore hidden or concealed in the display.
- Thank You very much for your time and assistance.

Slide 2

How to Read the Functional Decomposition

"C" stands for **commodity**. The commodity is a physical object that moves through the process. In this example, it is the tasking order that is moving through the process.

"G" represents the **goal**. The goal is the desired objective. In this example, it is the highest-level goal, and the objective is to successfully execute the mission.

What appears within the box is the **process**. The process is how the commodity is manipulated. In this example, the process involves revising the tasking order based on new assets that have been assigned.

Moving down through the decomposition defines supporting processes and requirements. In this example, Goal 1 is a supporting process of how the assets are assigned in Goal 0.

After each image of the appropriate section in the task decomposition, there is a list of decision and information requirements. A requirement is what is needed for the process to work properly. **Decision requirements** are the cognitive tasks and problem solving necessary for goal achievement. **Information requirements** are required to support the critical decisions.

Slide 3

Slide 4

Slide 5

Goal 0 of 12: Successfully Execute Mission

MITRE

Decision Requirements
* Task Mission

Additional Decisions:
_____
_____
_____

Comments:

Slide 6

Goal 0 of 12: Successfully Execute Mission

MITRE

Information Requirements Please circle the ratings for each information element. If items are missing, use the blank spaces. If more room is needed, write on the back.

Information	Importance 5-1 (5 high, 1 low)	Visibility Needed 4-1 (4 Always Visible, 1 Concealed)
ATO	5 4 3 2 1	4 3 2 1
Weapons Assigned	5 4 3 2 1	4 3 2 1
ACM's	5 4 3 2 1	4 3 2 1
	5 4 3 2 1	4 3 2 1
	5 4 3 2 1	4 3 2 1
	5 4 3 2 1	4 3 2 1
	5 4 3 2 1	4 3 2 1
	5 4 3 2 1	4 3 2 1
	5 4 3 2 1	4 3 2 1

Slide 7
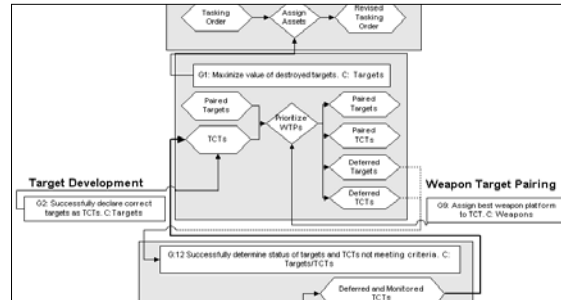
Goal 1 of 12: Maximize Value of Destroyed Targets

Slide 8

Goal 1 of 12: Maximize Value of Destroyed Targets (cont.)

Decision Requirements
* Monitor paired targets and their value.
* Monitor weapons assigned and Airspace Control Measures (ACMs) for TCT.
* Approve best (highest global value) weapon/munition for TCT.

Additional Decisions:

Comments:

Slide 9

Goal 1 of 12: Maximize Value of Destroyed Targets (cont.)

MITRE

Information Requirements Please circle the ratings for each information element. If items are missing, use the blank spaces. If more room is needed, write on the back.

Information	Importance 5-1 (5 high, 1 low)	Visibility Needed 4-1 (4 Always Visible, 1 Concealed)
ATO	5 4 3 2 1	4 3 2 1
Target Value	5 4 3 2 1	4 3 2 1
Mission Value	5 4 3 2 1	4 3 2 1
Guidance	5 4 3 2 1	4 3 2 1
Rules for Dynamic Valuation	5 4 3 2 1	4 3 2 1
Rules for Intrinsic Target Valuation	5 4 3 2 1	4 3 2 1
Rules of Engagement	5 4 3 2 1	4 3 2 1
Rules of Warfare	5 4 3 2 1	4 3 2 1
Laws of Armed Conflict	5 4 3 2 1	4 3 2 1
FEBA/FLOT, FSCL	5 4 3 2 1	4 3 2 1
ACMs	5 4 3 2 1	4 3 2 1
	5 4 3 2 1	4 3 2 1
	5 4 3 2 1	4 3 2 1
	5 4 3 2 1	4 3 2 1
	5 4 3 2 1	4 3 2 1

Slide 10

Goal 2 of 12: Successfully Declare Correct Targets as TCTs

MITRE
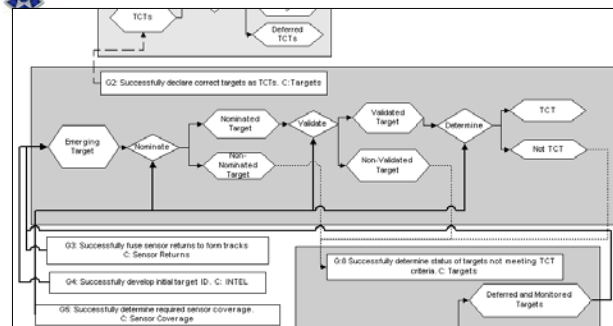
Comments:

Slide 11

Goal 2 of 12: Successfully Declare Correct Targets as TCTs (cont.)

MITRE

Decision Requirements

- Monitor targets.
- Approve targets as Nominated Targets.
- Approve targets as Validated Targets.
- Approve targets as TCTs.

Additional Decisions:

_____
_____
_____

Comments:

Slide 12

Goal 2 of 12: Successfully Declare Correct Targets as TCTs (cont.)

MITRE

Information Requirements Please circle the ratings for each information element. If items are missing, use the blank spaces on the next page. If more room is needed, write on the back.

Information	Importance 5-1 (5 high, 1 low)	Visibility Needed 4-1 (4 Always Visible, 1 Concealed)
Guidance, SPINS	5　4　3　2　1	4　3　2　1
Rules of Engagement	5　4　3　2　1	4　3　2　1
Laws of Armed Conflict	5　4　3　2　1	4　3　2　1
Rules for Candidacy	5　4　3　2　1	4　3　2　1
Rules of Nomination	5　4　3　2　1	4　3　2　1
Track type	5　4　3　2　1	4　3　2　1
Track location	5　4　3　2　1	4　3　2　1
Track images	5　4　3　2　1	4　3　2　1
IPB confidence	5　4　3　2　1	4　3　2　1
ID accuracy	5　4　3　2　1	4　3　2　1
Positional accuracy	5　4　3　2　1	4　3　2　1
Temporal accuracy	5　4　3　2　1	4　3　2　1

Slide 13

Goal 2 of 12: Successfully Declare Correct Targets as TCTs (cont.)

MITRE

Information Requirements (cont.) Please circle the ratings for each information element. If items are missing, use the blank spaces. If more room is needed, write on the back.

Information	Importance 5-1 (5 high, 1 low)	Visibility Needed 4-1 (4 Always Visible, 1 Concealed)
TCT Activity Area	5 4 3 2 1	4 3 2 1
Target Area of Interest	5 4 3 2 1	4 3 2 1
Named Area of Interest	5 4 3 2 1	4 3 2 1
No Strike List	5 4 3 2 1	4 3 2 1
	5 4 3 2 1	4 3 2 1
	5 4 3 2 1	4 3 2 1
	5 4 3 2 1	4 3 2 1
	5 4 3 2 1	4 3 2 1
	5 4 3 2 1	4 3 2 1

Slide 14

Goal 3 of 12: Successfully Fuse Sensor Returns to Form Tracks

MITRE
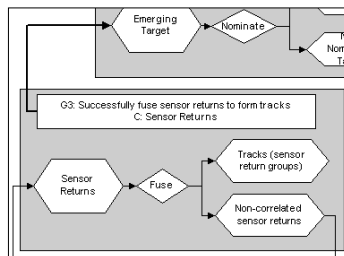
Comments:

Slide 15

Goal 3 of 12: Successfully Fuse Sensor Returns to Form Tracks (cont.)

MITRE

Decision Requirements
- Monitor sensor returns.
- Monitor tracked groups of sensor returns.
- Correlate/fuse sensor returns to form tracks.

Additional Decisions:

_____

_____

_____

Comments:

Slide 16

Goal 3 of 12: Successfully Fuse Sensor Returns to Form Tracks (cont.)

MITRE

Information Requirements Please circle the ratings for each information element. If items are missing, use the blank spaces. If more room is needed, write on the back.

Information	Importance 5-1 (5 high, 1 low)	Visibility Needed 4-1 (4 Always Visible, 1 Concealed)
ATO	5 4 3 2 1	4 3 2 1
GMTI	5 4 3 2 1	4 3 2 1
Imagery (SAR, Space Based)	5 4 3 2 1	4 3 2 1
Terrain Suitability	5 4 3 2 1	4 3 2 1
IPB Confidence	5 4 3 2 1	4 3 2 1
Named Area of Interest	5 4 3 2 1	4 3 2 1
Weather	5 4 3 2 1	4 3 2 1
FEBA/FLOT, FSCL	5 4 3 2 1	4 3 2 1
	5 4 3 2 1	4 3 2 1
	5 4 3 2 1	4 3 2 1
	5 4 3 2 1	4 3 2 1
	5 4 3 2 1	4 3 2 1

Slide 17

Slide 18

Slide 19

Information Requirements Please circle the ratings for each information element. If items are missing, use the blank spaces on the next page. If more room is needed, write on the back.

Information	Importance 5-1 (5 high, 1 low)	Visibility Needed 4-1 (4 Always Visible, 1 Concealed)
Track location (lat, long, heading elev, speed)	5 4 3 2 1	4 3 2 1
Track emissions	5 4 3 2 1	4 3 2 1
Track associated facilities	5 4 3 2 1	4 3 2 1
Track operational procedures	5 4 3 2 1	4 3 2 1
Track convoy characteristics	5 4 3 2 1	4 3 2 1
Track routes	5 4 3 2 1	4 3 2 1
Track hide sites	5 4 3 2 1	4 3 2 1
Enemy COA	5 4 3 2 1	4 3 2 1
ATO	5 4 3 2 1	4 3 2 1
GMTI	5 4 3 2 1	4 3 2 1
Terrain suitability	5 4 3 2 1	4 3 2 1
IPB confidence	5 4 3 2 1	4 3 2 1
Named Area of Interest	5 4 3 2 1	4 3 2 1
Target Area of Interest	5 4 3 2 1	4 3 2 1

Slide 20

Goal 4 of 12: Successfully Develop Initial Target ID (cont.)   MITRE

Information Requirements (cont.) Please circle the ratings for each information element. If items are missing, use the blank spaces. If more room is needed, write on the back.

Information	Importance 5-1 (5 high, 1 low)	Visibility Needed 4-1 (4 Always Visible, 1 Concealed)
Weather	5 4 3 2 1	4 3 2 1
FEBA/FLOT, FSCL	5 4 3 2 1	4 3 2 1
Impossible Areas of Operation	5 4 3 2 1	4 3 2 1
Imagery, Human, and Signals INT	5 4 3 2 1	4 3 2 1
Rules for Identification	5 4 3 2 1	4 3 2 1
	5 4 3 2 1	4 3 2 1
	5 4 3 2 1	4 3 2 1
	5 4 3 2 1	4 3 2 1
	5 4 3 2 1	4 3 2 1
	5 4 3 2 1	4 3 2 1
	5 4 3 2 1	4 3 2 1
	5 4 3 2 1	4 3 2 1

Slide 21

Goal 5 of 12: Successfully Determine Required Sensor Coverage

Slide 22

Goal 5 of 12: Successfully Determine Required Sensor Coverage (cont.)

Decision Requirements
* Determine where additional sensors/INTEL are needed.
* Evaluate the likelihood of retasking the sensors.

Additional Decisions:
_____
_____
_____

Comments:

Slide 23

Goal 5 of 12: Successfully Determine Required Sensor Coverage (cont.) MITRE

<u>Information Requirements</u> Please circle the ratings for each information element. If items are missing, use the blank spaces. If more room is needed, write on the back.

Information	Importance 5-1 (5 high, 1 low)	Visibility Needed 4-1 (4 Always Visible, 1 Concealed)
Available sensors	5 4 3 2 1	4 3 2 1
Sensor info	5 4 3 2 1	4 3 2 1
NAI (Named Area of Interest)	5 4 3 2 1	4 3 2 1
Geographic info	5 4 3 2 1	4 3 2 1
ATO	5 4 3 2 1	4 3 2 1
	5 4 3 2 1	4 3 2 1
	5 4 3 2 1	4 3 2 1
	5 4 3 2 1	4 3 2 1
	5 4 3 2 1	4 3 2 1
	5 4 3 2 1	4 3 2 1

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Goal 6 of 12: Successfully Evaluate Level of Existing Accuracy MITRE

Comments:

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MITRE

Decision Requirements
- Determine how much confidence/accuracy is required.
- Determine how much additional confidence/ accuracy is still needed.

Additional Decisions:
_____
_____
_____

Comments:

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MITRE

Information Requirements Please circle the ratings for each information element. If items are missing, use the blank spaces. If more room is needed, write on the back.

Information	Importance 5-1 (5 high, 1 low)					Visibility Needed 4-1 (4 Always Visible, 1 Concealed)			
Guidance, SPINS	5	4	3	2	1	4	3	2	1
Rules of Engagement	5	4	3	2	1	4	3	2	1
Rules of Warfare	5	4	3	2	1	4	3	2	1
Rules for Identification	5	4	3	2	1	4	3	2	1
Rules for Nomination	5	4	3	2	1	4	3	2	1
Laws of Armed Conflict	5	4	3	2	1	4	3	2	1
	5	4	3	2	1	4	3	2	1
	5	4	3	2	1	4	3	2	1
	5	4	3	2	1	4	3	2	1
	5	4	3	2	1	4	3	2	1

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Information Requirements Please circle the ratings for each information element. If items are missing, use the blank spaces. If more room is needed, write on the back.

| Information	Importance 5-1 (5 high, 1 low)	Visibility Needed 4-1 (4 Always Visible, 1 Concealed)
Positional accuracy	5 4 3 2 1	4 3 2 1
ID accuracy	5 4 3 2 1	4 3 2 1
Temporal accuracy	5 4 3 2 1	4 3 2 1
INTEL sources	5 4 3 2 1	4 3 2 1
Capabilities and limitations of INTEL source	5 4 3 2 1	4 3 2 1
Weather	5 4 3 2 1	4 3 2 1
	5 4 3 2 1	4 3 2 1
	5 4 3 2 1	4 3 2 1
	5 4 3 2 1	4 3 2 1
	5 4 3 2 1	4 3 2 1

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Comments:

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Goal 8 of 12: Successfully Determine Status of Targets Not Meeting TCT Criteria (cont.)

MITRE

Decision Requirements

- Determine whether to continue monitoring and requesting more INTEL or to forward to AOC Combat Plans/Joint Targeting Board.

Additional Decisions:

_____

_____

_____

Comments:

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Goal 8 of 12: Successfully Determine Status of Targets Not Meeting TCT Criteria (cont.)

MITRE

Information Requirements Please circle the ratings for each information element. If items are missing, use the blank spaces. If more room is needed, write on the back.
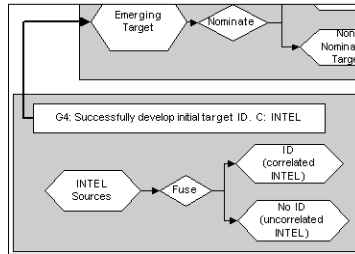
Information	Importance 5-1 (5 high, 1 low)	Visibility Needed 4-1 (4 Always Visible, 1 Concealed)
Guidance, SPINS	5 4 3 2 1	4 3 2 1
INTEL	5 4 3 2 1	4 3 2 1
Rules for Identification	5 4 3 2 1	4 3 2 1
Rules for Nomination	5 4 3 2 1	4 3 2 1
Area of Interest	5 4 3 2 1	4 3 2 1
TCT Activity Area	5 4 3 2 1	4 3 2 1
	5 4 3 2 1	4 3 2 1
	5 4 3 2 1	4 3 2 1
	5 4 3 2 1	4 3 2 1
	5 4 3 2 1	4 3 2 1

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Information Requirements Please circle the ratings for each information element. If items are missing, use the blank spaces on the next page. If more room is needed, write on the back.

Information	Importance 5-1 (5 high, 1 low)					Visibility Needed 4-1 (4 Always Visible, 1 Concealed)			
Target location (lat, long, heading elev, speed)	5	4	3	2	1	4	3	2	1
Target Operational Procedures	5	4	3	2	1	4	3	2	1
ATO	5	4	3	2	1	4	3	2	1
Pk, Ps, Pa	5	4	3	2	1	4	3	2	1
Weapon platform type	5	4	3	2	1	4	3	2	1
Weapon platform TOT predictions	5	4	3	2	1	4	3	2	1
Weapon platform routes/paths	5	4	3	2	1	4	3	2	1
Weapon platform location	5	4	3	2	1	4	3	2	1
Weapon platform munitions	5	4	3	2	1	4	3	2	1
Optimum/Suitable munitions	5	4	3	2	1	4	3	2	1
Areas of potential collateral damage	5	4	3	2	1	4	3	2	1
Weather	5	4	3	2	1	4	3	2	1

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Information Requirements (cont.) Please circle the ratings for each information element. If items are missing, use the blank spaces. If more room is needed, write on the back.
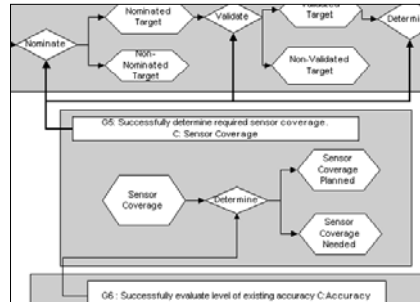
Information	Importance 5-1 (5 high, 1 low)					Visibility Needed 4-1 (4 Always Visible, 1 Concealed)			
Tanker Orbit Zones	5	4	3	2	1	4	3	2	1
FEBA, FLOT, FSCL	5	4	3	2	1	4	3	2	1
No Fly Zone	5	4	3	2	1	4	3	2	1
No Strike Zone	5	4	3	2	1	4	3	2	1
Probability of weapon arriving at target within WOV	5	4	3	2	1	4	3	2	1
	5	4	3	2	1	4	3	2	1
	5	4	3	2	1	4	3	2	1
	5	4	3	2	1	4	3	2	1
	5	4	3	2	1	4	3	2	1
	5	4	3	2	1	4	3	2	1
	5	4	3	2	1	4	3	2	1
	5	4	3	2	1	4	3	2	1

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Goal 10 of 12: Determine Best Munitions for Target   **MITRE**
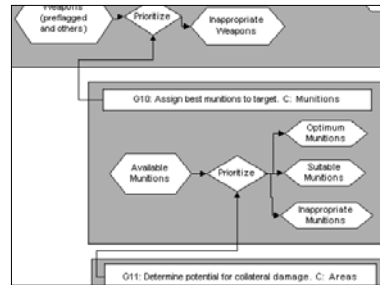
Comments:

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Goal 10 of 12: Determine Best Munitions for Target (cont.)   **MITRE**

Decision Requirements
- Analyze target elements
- Monitor available munitions.
- Select all appropriate munitions for TCT.
- Prioritize appropriate munitions for TCT.

Additional Decisions:
_____
_____
_____

Comments:

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Goal 10 of 12: Determine Best Munitions for Target (cont.)

MITRE

<u>Information Requirements</u> Please circle the ratings for each information element. If items are missing, use the blank spaces. If more room is needed, write on the back.
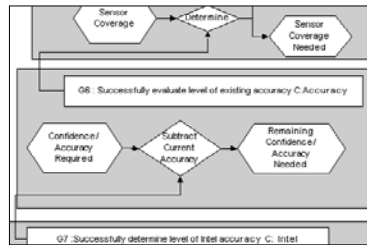
Information	Importance 5-1 (5 high, 1 low)					Visibility Needed 4-1 (4 Always Visible, 1 Concealed)			
Target vulnerabilities	5	4	3	2	1	4	3	2	1
Target location (lat, long, heading elev, speed)	5	4	3	2	1	4	3	2	1
Target routes	5	4	3	2	1	4	3	2	1
Target grid (from targeting book)	5	4	3	2	1	4	3	2	1
Desired Pd (probability of destruction)	5	4	3	2	1	4	3	2	1
Pk	5	4	3	2	1	4	3	2	1
ATO	5	4	3	2	1	4	3	2	1
Weapon munitions	5	4	3	2	1	4	3	2	1
Areas of potential collateral damage	5	4	3	2	1	4	3	2	1
Weather	5	4	3	2	1	4	3	2	1
FEBA/FLOT, FSCL	5	4	3	2	1	4	3	2	1
	5	4	3	2	1	4	3	2	1
	5	4	3	2	1	4	3	2	1
	5	4	3	2	1	4	3	2	1

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Goal 11 of 12: Determine Potential for Collateral Damage

MITRE
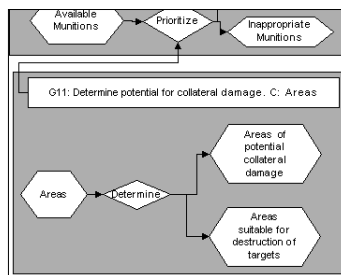
Comments:

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Goal 11 of 12: Determine Potential for Collateral Damage (cont.)

MITRE

Decision Requirements
* Identify non-hostile locations near target.
* Determine possibility of collateral damage.

Additional Decisions:

_____
_____
_____

Comments:

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Goal 11 of 12: Determine Potential for Collateral Damage (cont.)

MITRE

Information Requirements Please circle the ratings for each information element. If items are missing, use the blank spaces. If more room is needed, write on the back.
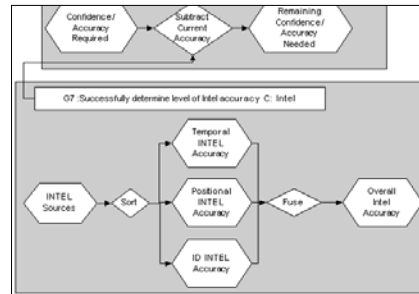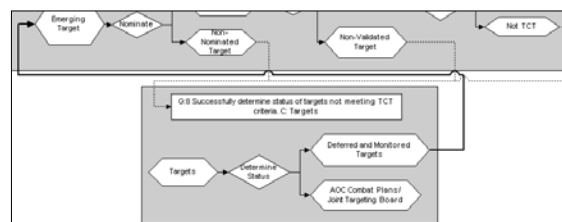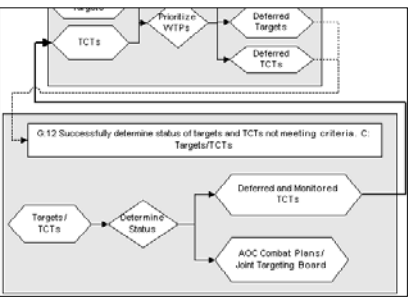
Information	Importance 5-1 (5 high, 1 low)	Visibility Needed 4-1 (4 Always Visible, 1 Concealed)
IPB confidence	5 4 3 2 1	4 3 2 1
Target positional accuracy	5 4 3 2 1	4 3 2 1
Target location	5 4 3 2 1	4 3 2 1
INTEL (video, imagery, HUMINT)	5 4 3 2 1	4 3 2 1
No Strike Zone	5 4 3 2 1	4 3 2 1
No Fly Zone	5 4 3 2 1	4 3 2 1
FEBA/FLOT, FSCL	5 4 3 2 1	4 3 2 1
Area of Interest	5 4 3 2 1	4 3 2 1
Special Ops Forces	5 4 3 2 1	4 3 2 1
	5 4 3 2 1	4 3 2 1
	5 4 3 2 1	4 3 2 1
	5 4 3 2 1	4 3 2 1
	5 4 3 2 1	4 3 2 1

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Goal 12 of 12: Successfully Determine Status of Targets and TCTs Not Meeting Criteria

Comments:

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Goal 12 of 12: Successfully Determine Status of Targets and TCTs Not Meeting Criteria (cont.)

Decision Requirements
* Determine whether to formulate a new WTP or forward to AOC Combat Plans/Joint Targeting Board.

Additional Decisions:

Comments:

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Goal 12 of 12: Successfully Determine Status of Targets and TCTs Not Meeting Criteria (cont.)

MITRE

<u>Information Requirements</u> Please circle the ratings for each information element. If items are missing, use the blank spaces. If more room is needed, write on the back.
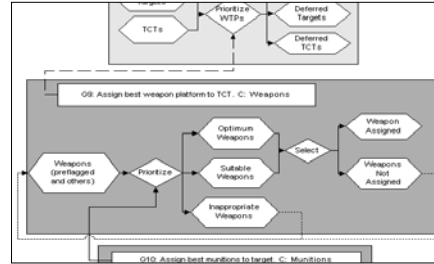
Information	Importance 5-1 (5 high, 1 low)					Visibility Needed 4-1 (4 Always Visible, 1 Concealed)			
Guidance, SPINS	5	4	3	2	1	4	3	2	1
INTEL	5	4	3	2	1	4	3	2	1
Target value	5	4	3	2	1	4	3	2	1
Target location	5	4	3	2	1	4	3	2	1
Target hide sites	5	4	3	2	1	4	3	2	1
Movement projection	5	4	3	2	1	4	3	2	1
Enemy COA	5	4	3	2	1	4	3	2	1
Weapon location	5	4	3	2	1	4	3	2	1
Weapon availability	5	4	3	2	1	4	3	2	1
	5	4	3	2	1	4	3	2	1
	5	4	3	2	1	4	3	2	1
	5	4	3	2	1	4	3	2	1
	5	4	3	2	1	4	3	2	1

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Acronym List

MITRE

ACM	Airspace Control Measure	Pa	Probability of Acquisition
AOC	Aerospace Operations Center	Pk	Probability of Kill
ATO	Air Tasking Order	Ps	Probability of Survival
COA	Course of Action	SAR	Synthetic Aperture Radar
FEBA	Front Edge of Battle Area	TCT	Time Critical Targeting
FLOT	Forward Line of Troops	TOT	Time on Target
FSCL	Fire Support Coordination Line	WOV	Window of Vulnerability
GMTI	Ground Moving Target Indicator	WTP	Weapon-Target Pairing
IPB	Intelligence Preparation of the Battlespace		
NAI	Named Area of Interest		

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Appendix C: GUI Working Group 1 – User Survey

This appendix contains the survey the MITRE TCTF GUI Team developed and distributed to the users from AFC2ISRC. The results of the survey are found in Section 5.

User Information

Name:		**Email:**	
Organization:		**Phone:**	

Your answers are confidential and will not be associated with your name. We will assign numbers to each survey received, and only refer to these if we have questions about your responses.

Please type an "X" into the box above your answer or type directly in the text fields provided.

Do you have operational experience prosecuting Time Critical Targets within an Ops cell?

☐   ☐
Yes   No

If **Yes**:

         a.   **How long did you perform this function?**

         b.   **Where did you perform this function?**

         c.   **What were your primary job(s) (e.g., Intel analyst, IPB, Target development, Weaponeering) and rank?**

2.   **Do you have operational experience in an AOC?**

☐   ☐
Yes   No

If **Yes**:

a. **How long were you there?**

┌──┐
│   │
└──┘

b. **Where were you?**

┌──┐
│   │
└──┘

c. **What cell were you in (e.g., Intel, plans, ops, etc)?**

┌──┐
│   │
└──┘

d. **What was your specific job(s) and rank?**

┌──┐
│   │
└──┘

3. Are you familiar with the current suite of TCT tools (e.g., WTP, JSWS, A2IPB)?

☐   ☐
Yes   No

a. **If so, which ones?**

┌──┐
│   │
└──┘

4. Have you had any experience using any of the TCT tools (e.g., WTP, JSWS, A2IPB)?

☐   ☐
Yes   No

a. **If so, which ones?**

┌──┐
│   │
└──┘

Information Requirements and Data Accessibility

Time-Critical-Targeting Process
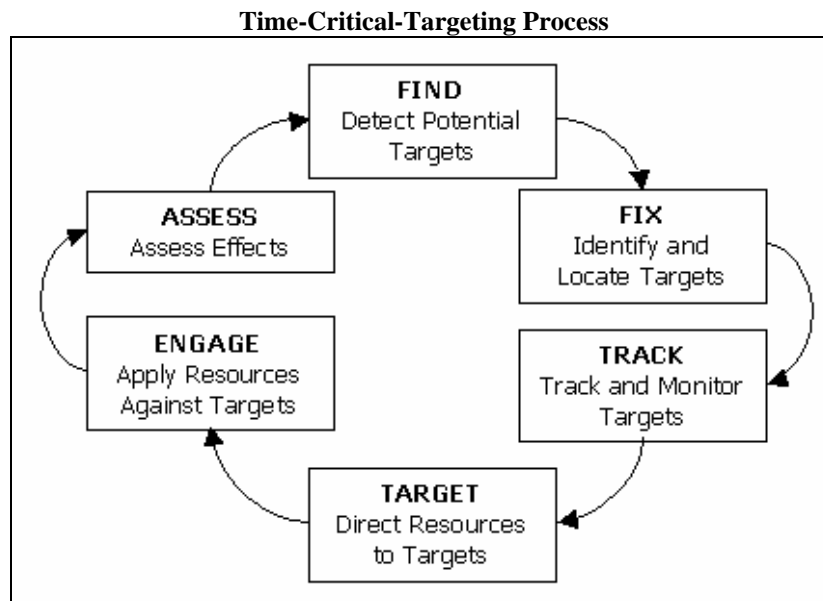
The following questions deal with critical information elements and the accessibility of data for the Find → Fix → Track → Target functions.

In the tables below, please indicate <u>the importance of each information item</u> for this function using the following 5-point scale:

1 – Very Low Priority; not critical for this function
2 – Somewhat Low Priority
3 – Medium Priority
4 – Fairly High Priority
5 – Very High Priority; critical for this function

Also indicate how <u>easily accessible each information item needs to be</u> using the following 5-point scale:

1 – Rarely or Never Accessed
2 – Available somewhere (e.g., more than 3 actions away)
3 – Fairly easy to access (e.g., 2 actions away)
4 – Very easy to access (e.g., 1 action away)
5 – Constant access required; should be visible at all times

FIND: Detect Potential Targets

Key Tasks and Decisions:

- Fuse sensor data
- Monitor sensor data

Please add any additional decisions related to this function:

```

```

Please type an "X" into the box above your selection.

Key Information Items:

	Importance (1 = Low → 5 = High)					Accessibility 1 – Rarely/Never Accessed → 5 – Constant Access				
	1	2	3	4	5	1	2	3	4	5
ATO	1	2	3	4	5	1	2	3	4	5
Electronic order of battle	1	2	3	4	5	1	2	3	4	5
Enemy order of battle	1	2	3	4	5	1	2	3	4	5
FEBA/FLOT, FSCL	1	2	3	4	5	1	2	3	4	5
GMTI	1	2	3	4	5	1	2	3	4	5
Imagery (SAR, Space Based)	1	2	3	4	5	1	2	3	4	5
IPB Products	1	2	3	4	5	1	2	3	4	5
IPB Confidence	1	2	3	4	5	1	2	3	4	5
Named Area of Interest	1	2	3	4	5	1	2	3	4	5
Terrain Suitability	1	2	3	4	5	1	2	3	4	5
Weather	1	2	3	4	5	1	2	3	4	5
Other: _____	1	2	3	4	5	1	2	3	4	5
Other: _____	1	2	3	4	5	1	2	3	4	5
Other: _____	1	2	3	4	5	1	2	3	4	5
Other: _____	1	2	3	4	5	1	2	3	4	5
Other: _____	1	2	3	4	5	1	2	3	4	5

FIX – Identify and Locate Targets

Key Tasks and Decisions:

- Develop target ID
- Determine location
- Determine information required (ID, location)
- Determine sensor coverage needed
- Recommend ISR tasking

Please add any additional decisions related to this function:

In the table below, please indicate <u>the importance of each information item</u> to this function and how easily accessible that information item needs to be using the following scale:

Key Information Items:

	Importance (1 = Low → 5 = High)					Accessibility 1 – Rarely/Never Accessed → 5 – Constant Access				
ATO	1	2	3	4	5	1	2	3	4	5
Available sensors	1	2	3	4	5	1	2	3	4	5
Capabilities and limitations of INTEL source	1	2	3	4	5	1	2	3	4	5
Electronic order of battle	1	2	3	4	5	1	2	3	4	5
Enemy COA	1	2	3	4	5	1	2	3	4	5
Enemy order of battle	1	2	3	4	5	1	2	3	4	5
FEBA/FLOT, FSCL	1	2	3	4	5	1	2	3	4	5
Geographic info	1	2	3	4	5	1	2	3	4	5
GMTI	1	2	3	4	5	1	2	3	4	5
Guidance, SPINS	1	2	3	4	5	1	2	3	4	5
ID accuracy	1	2	3	4	5	1	2	3	4	5
Imagery (SAR, Space Based)	1	2	3	4	5	1	2	3	4	5
Imagery, Human, and Signals INT	1	2	3	4	5	1	2	3	4	5

	Importance (1 = Low → 5 = High)					Accessibility 1 – Rarely/Never Accessed → 5 – Constant Access				
Impossible Areas of Operation	1	2	3	4	5	1	2	3	4	5
INTEL sources	1	2	3	4	5	1	2	3	4	5
IPB confidence	1	2	3	4	5	1	2	3	4	5
Laws of Armed Conflict	1	2	3	4	5	1	2	3	4	5
NAI (Named Area of Interest)	1	2	3	4	5	1	2	3	4	5
Named Area of Interest	1	2	3	4	5	1	2	3	4	5
No Strike List	1	2	3	4	5	1	2	3	4	5
Positional accuracy	1	2	3	4	5	1	2	3	4	5
Rules for Candidacy	1	2	3	4	5	1	2	3	4	5
Rules for Identification	1	2	3	4	5	1	2	3	4	5
Rules of Engagement	1	2	3	4	5	1	2	3	4	5
Rules of Nomination	1	2	3	4	5	1	2	3	4	5
Sensor info	1	2	3	4	5	1	2	3	4	5
Target Area of Interest	1	2	3	4	5	1	2	3	4	5
TCT Activity Area	1	2	3	4	5	1	2	3	4	5
Temporal accuracy	1	2	3	4	5	1	2	3	4	5
Terrain Suitability	1	2	3	4	5	1	2	3	4	5
Track associated facilities	1	2	3	4	5	1	2	3	4	5
Track convoy characteristics	1	2	3	4	5	1	2	3	4	5
Track emissions	1	2	3	4	5	1	2	3	4	5
Track hide sites	1	2	3	4	5	1	2	3	4	5
Track images	1	2	3	4	5	1	2	3	4	5
Track location (lat, long, heading elevation, speed)	1	2	3	4	5	1	2	3	4	5
Track operational procedures	1	2	3	4	5	1	2	3	4	5
Track routes	1	2	3	4	5	1	2	3	4	5
Track type	1	2	3	4	5	1	2	3	4	5

	Importance (1 = Low → 5 = High)					Accessibility 1 – Rarely/Never Accessed → 5 – Constant Access				
Weather	1	2	3	4	5	1	2	3	4	5
Other: _____	1	2	3	4	5	1	2	3	4	5
Other: _____	1	2	3	4	5	1	2	3	4	5
Other: _____	1	2	3	4	5	1	2	3	4	5
Other: _____	1	2	3	4	5	1	2	3	4	5
Other: _____	1	2	3	4	5	1	2	3	4	5

TRACK – Track and Monitor Targets

Key Tasks and Decisions:

- Determine information required (ID, Location)
- Determine sensor coverage needed
- Recommend ISR Tasking
- Update Target information

Please add any additional decisions related to this function:

In the table below, please indicate <u>the importance of each information item</u> to this function and how easily accessible that information item needs to be using the following scale:

Key Information Items:

	Importance (1 = Low → 5 = High)					Accessibility 1 – Rarely/Never Accessed → 5 – Constant Access				
ATO	1	2	3	4	5	1	2	3	4	5
Available sensors	1	2	3	4	5	1	2	3	4	5
Capabilities and limitations of INTEL source	1	2	3	4	5	1	2	3	4	5
Electronic order of battle	1	2	3	4	5	1	2	3	4	5
Enemy order of battle	1	2	3	4	5	1	2	3	4	5
Geographic info	1	2	3	4	5	1	2	3	4	5
Guidance, SPINS	1	2	3	4	5	1	2	3	4	5
ID accuracy	1	2	3	4	5	1	2	3	4	5
INTEL sources	1	2	3	4	5	1	2	3	4	5
IPB confidence	1	2	3	4	5	1	2	3	4	5
IPB products	1	2	3	4	5	1	2	3	4	5
Laws of Armed Conflict	1	2	3	4	5	1	2	3	4	5
NAI (Named Area of Interest)	1	2	3	4	5	1	2	3	4	5

	Importance (1 = Low → 5 = High)					Accessibility 1 – Rarely/Never Accessed → 5 – Constant Access				
Named Area of Interest	1	2	3	4	5	1	2	3	4	5
No Strike List	1	2	3	4	5	1	2	3	4	5
Positional accuracy	1	2	3	4	5	1	2	3	4	5
Rules for Candidacy	1	2	3	4	5	1	2	3	4	5
Rules of Engagement	1	2	3	4	5	1	2	3	4	5
Rules of Nomination	1	2	3	4	5	1	2	3	4	5
Sensor info	1	2	3	4	5	1	2	3	4	5
Target Area of Interest	1	2	3	4	5	1	2	3	4	5
TCT Activity Area	1	2	3	4	5	1	2	3	4	5
Temporal accuracy	1	2	3	4	5	1	2	3	4	5
Track images	1	2	3	4	5	1	2	3	4	5
Track location	1	2	3	4	5	1	2	3	4	5
Track type	1	2	3	4	5	1	2	3	4	5
Weather	1	2	3	4	5	1	2	3	4	5
Other: _____	1	2	3	4	5	1	2	3	4	5
Other: _____	1	2	3	4	5	1	2	3	4	5
Other: _____	1	2	3	4	5	1	2	3	4	5
Other: _____	1	2	3	4	5	1	2	3	4	5
Other: _____	1	2	3	4	5	1	2	3	4	5

TARGET – Direct Resources to Targets

Key Tasks and Decisions:

- Compare with TCT criteria
- Formulate attack options
- Determine Cost/Benefits of Collateral Damage
- Prioritize attack options

Please add any additional decisions related to this function:

In the table below, please indicate <u>the importance of each information item</u> to this function and how easily accessible that information item needs to be using the following scale:

Key Information Items

	Importance (1 = Low → 5 = High)					Accessibility 1 – Rarely/Never Accessed → 5 – Constant Access				
ACMs	1	2	3	4	5	1	2	3	4	5
Area of Interest	1	2	3	4	5	1	2	3	4	5
Areas of potential collateral damage	1	2	3	4	5	1	2	3	4	5
ATO	1	2	3	4	5	1	2	3	4	5
Casualty Estimates	1	2	3	4	5	1	2	3	4	5
Desired Pd (probability of destruction)	1	2	3	4	5	1	2	3	4	5
Electronic order of battle	1	2	3	4	5	1	2	3	4	5
Enemy COA	1	2	3	4	5	1	2	3	4	5
Enemy order of battle	1	2	3	4	5	1	2	3	4	5
FEBA, FLOT, FSCL	1	2	3	4	5	1	2	3	4	5
Friendly Order of Battle	1	2	3	4	5	1	2	3	4	5
Guidance	1	2	3	4	5	1	2	3	4	5
SPINS	1	2	3	4	5	1	2	3	4	5
ID accuracy	1	2	3	4	5	1	2	3	4	5

	Importance (1 = Low → 5 = High)					Accessibility 1 – Rarely/Never Accessed → 5 – Constant Access				
INTEL (video, imagery, HUMINT)	1	2	3	4	5	1	2	3	4	5
IPB confidence	1	2	3	4	5	1	2	3	4	5
Laws of Armed Conflict	1	2	3	4	5	1	2	3	4	5
Mission Value	1	2	3	4	5	1	2	3	4	5
Movement projection	1	2	3	4	5	1	2	3	4	5
Named Area of Interest	1	2	3	4	5	1	2	3	4	5
No Fly Zone	1	2	3	4	5	1	2	3	4	5
No Strike List	1	2	3	4	5	1	2	3	4	5
No Strike Zone	1	2	3	4	5	1	2	3	4	5
No Strike Zone	1	2	3	4	5	1	2	3	4	5
Optimum/Suitable munitions	1	2	3	4	5	1	2	3	4	5
Pk	1	2	3	4	5	1	2	3	4	5
Ps, Pa	1	2	3	4	5	1	2	3	4	5
Positional accuracy	1	2	3	4	5	1	2	3	4	5
Probability of weapon arriving at target within WOV	1	2	3	4	5	1	2	3	4	5
Rules for Candidacy	1	2	3	4	5	1	2	3	4	5
Rules for Dynamic Valuation	1	2	3	4	5	1	2	3	4	5
Rules for Identification	1	2	3	4	5	1	2	3	4	5
Rules for Intrinsic Target Valuation	1	2	3	4	5	1	2	3	4	5
Rules of Engagement	1	2	3	4	5	1	2	3	4	5
Rules of Nomination	1	2	3	4	5	1	2	3	4	5
Rules of Warfare	1	2	3	4	5	1	2	3	4	5
Special Ops Forces	1	2	3	4	5	1	2	3	4	5
Tanker Orbit Zones	1	2	3	4	5	1	2	3	4	5
Target Area of Interest	1	2	3	4	5	1	2	3	4	5
Target grid (from targeting book)	1	2	3	4	5	1	2	3	4	5

	Importance (1 = Low → 5 = High)					Accessibility 1 – Rarely/Never Accessed → 5 – Constant Access				
Target hide sites	1	2	3	4	5	1	2	3	4	5
Target location (lat, long, heading elev, speed)	1	2	3	4	5	1	2	3	4	5
Target location (lat, long, heading elev, speed)	1	2	3	4	5	1	2	3	4	5
Target Operational Procedures	1	2	3	4	5	1	2	3	4	5
Target positional accuracy	1	2	3	4	5	1	2	3	4	5
Target routes	1	2	3	4	5	1	2	3	4	5
Target Value	1	2	3	4	5	1	2	3	4	5
Target vulnerabilities	1	2	3	4	5	1	2	3	4	5
TCT Activity Area	1	2	3	4	5	1	2	3	4	5
Temporal accuracy	1	2	3	4	5	1	2	3	4	5
Threat Radius	1	2	3	4	5	1	2	3	4	5
Track images	1	2	3	4	5	1	2	3	4	5
Track location	1	2	3	4	5	1	2	3	4	5
Track type	1	2	3	4	5	1	2	3	4	5
Weapon availability	1	2	3	4	5	1	2	3	4	5
Weapon location	1	2	3	4	5	1	2	3	4	5
Weapon munitions	1	2	3	4	5	1	2	3	4	5
Weapon platform location	1	2	3	4	5	1	2	3	4	5
Weapon platform munitions	1	2	3	4	5	1	2	3	4	5
Weapon platform routes/paths	1	2	3	4	5	1	2	3	4	5
Weapon platform TOT predictions	1	2	3	4	5	1	2	3	4	5
Weapon platform type	1	2	3	4	5	1	2	3	4	5
Weather	1	2	3	4	5	1	2	3	4	5
Other: _____	1	2	3	4	5	1	2	3	4	5
Other: _____	1	2	3	4	5	1	2	3	4	5

	Importance (1 = Low → 5 = High)					Accessibility 1 – Rarely/Never Accessed → 5 – Constant Access				
Other: _____	1	2	3	4	5	1	2	3	4	5
Other: _____	1	2	3	4	5	1	2	3	4	5
Other: _____	1	2	3	4	5	1	2	3	4	5

Acronyms

AAA	Anti-Aircraft Artillery
AFC2ISRC	Air Force Command and Control Intelligence Surveillance and Reconnaissance Center
ACM	Airspace Control Measures
ACWA	Applied Cognitive Work Analysis
AOC	Air Operations Center
ATO	Air Tasking Order
CM	Collection Manager
COAs	Courses of Action
CTA	Cognitive Task Analysis
CUI	Common User Interface
CWA	Cognitive Work Analysis
DTD	Display Task Description
DTL/DTQ	Dynamic Target List/Dynamic Target Queue
FDO	Fighter Duty Officer
FEBA	Forward Edge of Battle Area
FLOT	Forward Line of Troops
FOV	Field of View
FSCL	Fire Support Coordination Line
GMTI	Ground Moving Target Indicator
GUI	Graphical User Interface
HF	Human Factors
HUMINT	Human Intelligence
INT	Intelligence
IPB	Intelligence Preparation of the Battlespace
JAG	Judge Advocate General
JMEM	Joint Munitions Effectiveness Manual
LOAC	Laws of Armed Conflict
LTOV	Last Time of Value
NAI	Named Area of Interest
NPGM	Non-Precision Guided Munition
Pa	Probability of Acquisition
PGM	Precision Guided Munition
Pk	Probability of Kill
Ps	Probability of Survival
RFI	Request For Information
RSR	Radar Service Request

SAM	Surface to Air Missile
SAR	Synthetic Aperture Radar
SME	Subject Matter Expert
SOF	Special Operations Force
SPINS	Special Instructions
TAI	Target Area of Interest
TCT	Time Critical Targeting
TOT	Time on Target
TST	Time Sensitive Targets
UI	User Interface
WG	Working Group
WOV	Window of Vulnerability
WTP	Weapon Target Pairing

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