Advanced Multimodal Watchstation

QUICK LOOK
Critical Decisions in the AMMWS Air Dominance Scenario

Manning Technology For Affordability
Thrust 2

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October 15, 1997

1. BACKGROUND AND PURPOSE

On September 3-4, 1997, a team met at the Control Systems Advanced Concepts & Technology (CSACT) Laboratory in Dahlgren, Virginia to discuss plans for future demonstrations of the Advanced Multimodal Watchstation (AMMWS). The AMMWS project seeks to utilize and expand advanced human-computer interface technology in order to support the surface warrior of the 21st century. The project focuses on developing, testing, and demonstrating a prototype watchstation for shipboard combat information or command centers (CICs). A major goal of the project is to draw on advanced technology and automation to make human-computer interactions in the CIC more efficient, allowing the CIC warfighter to function effectively in a reduced manning ship.

The purpose of the September meeting at Dahlgren was to involve the Decision Spectrum Group (DSG) in planning future demonstrations of the AMMWS through the use of demanding real-time operational scenarios. DSG was asked to conduct a Cognitive Task Analysis (CTA) to identify and explore the most important decisions being made in the CIC. A function analysis is already underway to identify all of the functions, both human and machine, being performed in the CIC of the future (Heasly, 1997). This function analysis is broad in scope and inclusive, but it does not provide detail about where and how the *most critical decisions* are being made in the CIC. The goal of the CTA is to provide information about these critical decisions.

Cognitive Task Analysis is an evolving methodology that has been developed to capture the knowledge and processes that experts use to perform their jobs (Gordon & Gill, 1997). CTA typically uses interviews with real-world experts, based on realistic scenarios and situation descriptions, to identify critical decisions, understand how decisions are actually made in the field, (which may not be how they are described in doctrine or taught during training), identify the information used in decisions, and understand the ways that expert decision makers differ from novices in the same situation .

CTA has been applied in a variety of domains over the past decade to learn more about how decisions are actually made in complex, uncertain real-world environments (see Zsambok & Klein, 1997). Insights gained from CTA have been used to design displays that provide critical information at just the right time, to develop decision support that is integrated with the way that real decision makers function, and to develop training that prepares people for the decision-making demands they will encounter in the real world.

Cognitive Task Analysis can contribute in several ways to the AMMWS design, test, and demonstration process. First, CTA can identify the most difficult and complex decisions faced by the warfighter in the CIC, and the information used to make those decisions. Based on the CTA, the AMMWS can be designed to support critical decisions by providing the information needed by decision makers in the form that is most useful. Second, the CTA can provide insight for developing test and demonstration scenarios that highlight AMMWS capabilities. AMMWS test scenarios should create circumstances in which warfighters must make a variety of critical decisions in order to demonstrate the effectiveness of the AMMWS technology in supporting those decisions. Third, the CTA can suggest appropriate measures for evaluating the success of the AMMWS in supporting critical decisions.

A effort is underway at CSACT to develop an Air Dominance Scenario to be used in testing and demonstrating the AMMWS (LaChance, 1997). This scenario takes place in an environment similar to the Persian Gulf, and involves tensions between a country friendly to the U.S. (Country X) and a country not friendly to the U.S. (Country Y). Over the course of the scenario, several harassing air and surface events take place, culminating in an air attack on ownship and a theater ballistic missile (TBM) launch from Country Y against Country X.

In the September meeting at Dahlgren, DSG agreed, as a first step in the AMMWS CTA, to review the Air Dominance Scenario and to identify the critical decisions that occur within the functions included in that scenario. This initial "Quick Look" review was to be based on the DSG team's previous experience in performing CTA for a variety of situations and functions in the CIC. Much, but not all, of this prior CTA was performed under the Navy's TADMUS program. The major output of this initial Quick Look was to be feedback on the scenario—where might the scenario be strengthened or enhanced to ensure that tests and demonstrations include the most important decisions made by the warfighter in the CIC?

This report documents the results of this Quick Look—a review of the Air Dominance Scenario, based on the results of previous CTA efforts for CIC functions. It identifies critical decisions, describes relevant findings from prior CTA work, and offers suggestions for enhancing the scenario to emphasize the most difficult decisions that are encountered in the CIC.

2. CRITICAL DECISIONS IN THE AIR DOMINANCE SCENARIO

The Air Dominance Scenario includes both air and surface threats, as well as TBM launches, and it takes place in a littoral or "brown water" environment of escalating tensions rather than in the midst of an all-out unambiguous attack. Figure 1 diagrams the major activities that take place in the scenario from the point of view of the human decision makers in the CIC.

Previous analysis of decisions in the CIC has identified certain types of decisions, in certain circumstances, as "critical." Critical decisions are defined as:

- Decisions that are cognitively complex,
- Decisions that require substantial expertise,
- Decisions that have important consequences.

Figure 1 highlights the areas in the Air Dominance scenario within which prior CTA has identified critical decisions. These include identification of unknown tracks and assessment of their threat capability as part of creating a "picture" of the tactical situation, and evaluation of intent as it relates to possible responses.

Note that because TBM launches were not studied as part of previous CIC CTA, the critical decisions involved in assessing and responding to a TBM launch are not well understood. TBM launches have not, historically, been an element in CIC decision making. Future CTA for the AMMWS should examine TBM decisions in more depth, but this must be based on plans and future concepts of operation rather than on actual experience because there is currently no TBM experience base for the CIC.

Figure 1 shows a sequential process, starting with searching and detecting contacts, and progressing through identification, assessing threat capability for possible hostile aircraft, creating a tactical picture, evaluating intent, responding, and assessing the results of that response. This sequential overview greatly oversimplifies CIC processes from the human decision-making viewpoint. The diagram does not capture the dynamics of decision making in the CIC. All of the activities in the diagram can take place continuously and simultaneously, not in a well-ordered sequence. The CIC is working continuously to identify tracks, assess threat capability, and assess intent as new information comes in. The tactical picture is constantly changing, and response selection, rather than being a one-time decision, is a constantly changing series of actions, many of which may involve seeking information or preparing for action, rather than actual engagement.

The diagram also does not show team processes and communication in the CIC. Information flows in several direction in the diagram, not just from left to right. For example, as the TAO and CO assess the situation, they may feed assessment information back to the watchstations that are

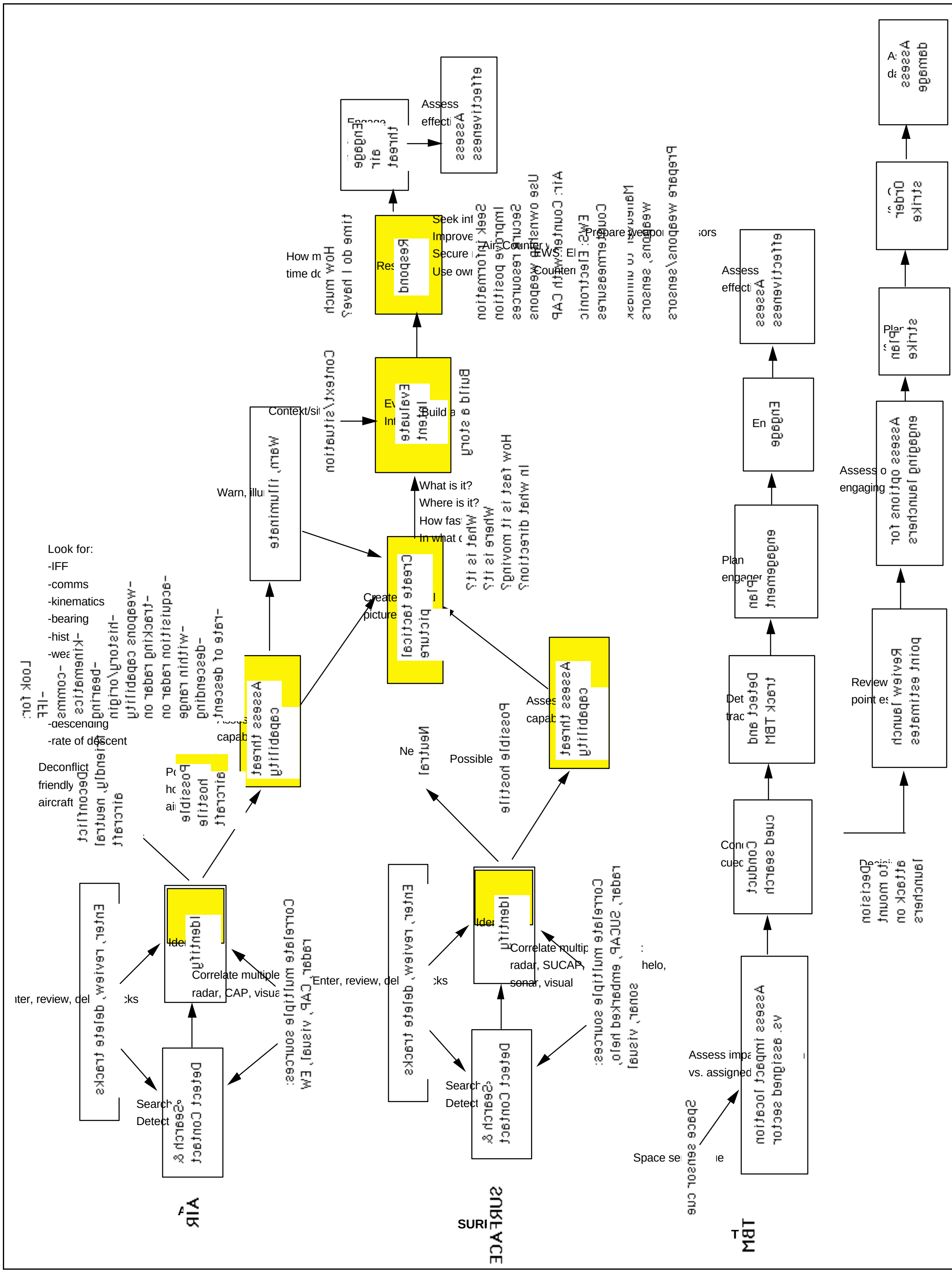

Figure 1. Major Decision in the Air Dominance Scenario (Critical Area Highlighted)

seeking to identify unknown tracks, identifying some types of information or some behaviors that are especially critical given the overall situation.

Findings from CIC Cognitive Task Analysis

Prior CTA for the CIC generates the following insights about the decision areas highlighted in Figure 1 (references documenting these findings are provided at the end of the report):

- The most important combat decisions are often those involved in situation assessment, rather than those involved in action selection.

A CTA of AAW operators estimated that 95 percent of the courses of action described by the experts interviewed were generated through recognition of the situation and matching to a COA, rather than by selection among multiple options (Kaempf, Klein, Thordsen, & Wolf, 1996).

Once they have assessed the tactical situation, decision makers often rely on standard operating procedures and rules of engagement to tell them what action to take. The most difficult aspect of combat decision making is judging the nature of the situation given the many uncertainties, not selecting among alternative courses of action.

- Comparison to prior patterns is a critical part of threat assessment. Decision makers rely predominantly on feature matching to develop an assessment of the situation.

Human decision makers depend heavily on whether events match prior patterns, and history is a critical element in their decision making. In evaluating the extent to which a particular hostile track represents a threat, for example, decision makers will consider previous behavior of aircraft from that country. How do they typically train? How are they known to attack?

Decision makers may lack the subtle vigilance required to detect small deviations from a pattern, and can be lulled into a false sense of security if they have seen a similar pattern many times. The Stark incident was a good example of this, when a potentially hostile but routine and previously harmless set of actions turned out to be an actual attack.

- When feature matching does not produce an adequate picture of the situation, decision makers may build “stories” to explain what they are seeing. Story building may include generating assumptions to fill gaps in the available information, then questioning the reliability of those assumptions in a larger context, i.e., does the story “make sense”?

Decision makers are likely to consider an uncertain situation from the enemy’s viewpoint: Why is he behaving in this way? What is he trying to accomplish?

In assessing the situation, decision makers evaluate how much time remains before they must commit to various alternative actions and they weigh the consequences of errors. In a situation that seems highly atypical, where actions have grave consequences, and there is time available, the decision makers may go through several cycles of building and critiquing stories. If there is little time available, the decision makers will take action quickly based on the applicable ROEs.

The warfighter typically builds "worst case" stories based on own resources, possible threats, and assessment of intent.

- Identification of unknown tracks can involve critical decisions when multiple conflicting sources of data must be reconciled.

Multiple data sources can generate double tracks, and EWS data must be correctly integrated with radar data. These decisions can be critical if they involve potential threats at close range.

- Relatively few of the actions taken by decision makers are designed to end the incident (e.g., engaging a vehicle with a weapon system). Most actions serve other purposes such as gathering information, positioning for a possible use of weapons, and ensuring the availability of the resources needed if further action is required.
- Decision makers typically consider the potential for escalation carefully when applying ROEs, and they may seek to de-escalate a situation.
- Actions to *prepare* are a critical aspect of response and a key way that decision makers respond to uncertainty in the situation.

Preparation, e.g., putting missiles up on rails, cuts the reaction time if an unknown track turns out to be a threat. Preparatory actions may involve opportunity costs or consume scarce resources, however. They may also be seen as escalating hostility levels.

- The most difficult decisions for the human decision maker occur when there has been no overt hostile action, but it appears that such an action is possible.

Once there is an overt action (e.g., an attack on ownship in the scenario) then ROEs typically allow relatively unconstrained responses, and the automatic capabilities of the AEGIS system to track and engage targets can be called into play. The major concern at this point will be the accuracy with which the system is differentiating friendly and neutral tracks from hostile tracks.

- In a typical scenario where multiple events are happening simultaneously, decisions must be made to prioritize threats.

For example, in the Air Dominance scenario, there are threats against ownship, threats against the battle group, and threats against Country X. The CIC must decide how to allocate resources against those threats. In the Air Dominance scenario, the decision maker might consider whether going against the TBM launch sites in Country Y is the best use of resources. Self protection will have the highest priority.

The decision maker must consider the bigger picture, not just ownship. There may be a division of responsibilities within the Battle Group, for example, between defending the Battle Group and attacking the TBM launchers.

- Decision makers take into account the personalities of the individuals involved in a situation and their prior histories.

For example, the CO might react differently in the Air Dominance scenario if an AAM fired at a CAP aircraft involves a pilot who provoked an incident while flying CAP a week earlier.

- Effective CIC *teams* typically use less active periods to “buy time” through preparation. They discuss the situation, identify uncertainties, and plan possible actions.
- Feedback from the CO or TAO about the situation can improve the accuracy of the team in identifying and assessing threats. If team members know how the TAO or CO is assessing the situation, they can focus their attention on the data that is most relevant to that assessment.

Implications for Critical Decisions in Demonstration Scenario

Previous CTA work on critical decisions in the CIC suggests that the following types of decisions will be frequent and/or difficult for a decision maker, and should be included in a demonstration scenario:

- Decisions regarding the hostile intent of a platform in situations where it is important not to escalate hostilities.
- Response decisions where the decision maker will want to consider a history of prior enemy behavior and use pattern matching in selecting a response.
- Response decisions in which pattern matching fails, there is a need to resolve contradictory evidence, and there is enough time available to construct a “story” about possible enemy actions.
- Response decisions where sensor and weapon preparation and information gathering, rather than the immediate use of weapons, are the most appropriate responses.
- Decisions that require setting priorities for the use of resources to address multiple simultaneous threats of different types.
- Identification decisions for tracks with multiple conflicting sources of information
- Planning activities conducted during less active periods in order to prepare for anticipated action.

Based on previous CTA for the CIC, we suggest the following general changes in the Air Dominance scenario to expand the range of critical decisions that are included. Specific

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situations that can present a serious challenge for CIC decision making.

- Provide more difficult decision making before the scenario escalates with the air attack on ownship. This should include the opportunity to mistake an "innocent" for an attacker. After the attack on ownship, decision making in the CIC becomes much more straightforward and most of the ambiguity and uncertainty have been eliminated.
- Provide for possible de-escalation. The current scenario escalates until it ends. A more challenging situation for the decision maker is to de-escalate the conflict.
- Provide for more simultaneous air/surface action. Timing for scenario events is not yet fully developed, but the presence of simultaneous rather than sequential air and surface events will require setting priorities, be more challenging for decision makers, and stress the concept of reduced manning in the CIC.
- Make enemy actions part of a (possible) intelligent story about enemy intent. Given enough time, CIC decision makers will construct a story about what the enemy is trying to accomplish. It should be possible to develop one or more stories about enemy intent, based on observable actions.
- Place more emphasis on prior enemy behavior in interpreting events. Decision makers depend on known, previously observed patterns of enemy behavior in interpreting events. The scenario should make this information available.
- Require the integration of track information from diverse sources. For example, the scenario should require the fusion of SLQ-32 and NTDS data, and should contain double tracks generated from multiple sensors.

Selected Cognitive and Team Processes in the CIC

We recommend that the demonstration scenario for the AMMWS be designed to illustrate ways in which the AMMWS technology helps officers to execute cognitive and team interaction processes that are often both crucial to mission success and error-prone.

The cognitive and team processes listed below have been found to be important components of CIC decision making. They are both important to mission success and sometimes prone to errors. Each of them played a role in almost every incident described in TADMUS critical incident interviews. Each of them is exercised in at least one of the scenario events discussed below in Table 1.

Selected cognitive processes

- Detect failure of pattern recognition (identify problems)
- Detect and resolve conflicting evidence
- Identify and resolve conflicting goals
- Identify and resolve unreliable assumptions
- Integrate information
- Estimate time available before action must be taken

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Selected team processes

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_ Monitor staff performance (e.g., to level workload among team members)

_ Provide situation updates (to keep staff informed of current priorities and problems)

Table 1 describes scenario events that require the critical cognitive and team processes listed above. Some of the scenario events are taken from full-blown critical incidents used in prior

overview of the original critical incident from which the scenario events were taken is provided in the Appendix.

the processes and, thus, the overall performance of the CIC. (Since we are not aware of the detailed AMMWS design, these are only illustrations of the kind of AMMWS features that might

Of course, the final demonstration scenario cannot include all of the aspects listed in the table. Moreover, the AMMWS probably cannot support all the listed cognitive and team processes.

support, and utilizing scenario aspects that call forth those processes. (Also, of course, AMMWS designers might consider adding support for some of these processes.) These scenario events can

original critical incident.

Table 1. Scenario Events that Draw on Cognitive and Team Processes

Scenario **(Details in Appendix)**	**Event**	**Process that event exercises**	**Potentially relevant features of an advanced workstation**
Lost helo	Air track travels slower than fixed wing aircraft	Detect and resolve conflicting evidence (slow speed vs. expectations of fixed wing aircraft)	Display of current and historical speed data, possibly correlated with database of platform characteristics
Lost helo	Track is too far from Iran to be Iranian	Detect and resolve conflicting evidence (distance from Iran vs. direction of track from Iran)	Display of track history; possible range rings indicating platform range capability round trip; display of platforms capable of supporting a track in a given mission, such as launch sites for a helo (or tankers for a long-range attack aircraft, or third-party localization platforms for coordinated attacks)
Lost helo	Track is circling (not performing a triangular return-to-force profile)	Detect failure of pattern recognition	Display of track history including altitude history.
Libyan gunboat	Track is outside its sensor range when it turns inbound. It cannot know where we are from its sensors.	Identify and resolve unreliable assumption (that track could detect us)	Display of range rings indicating platform localization capability; display (with track history) of emissions history and reliable range of emissions; display of platforms capable of supporting track in localization.
Libyan gunboat	Area has many U.S. assets in the water. The vessel may be coincidentally vectored towards ownship.	Identify and resolve unreliable assumption (that track turned toward us intentionally)	Filtered display of, for example, suspect tracks and all friendlies and/or neutrals.

Libyan gunboat	Track bypassed more lucrative US ship	Detect and resolve conflicting evidence (track seems hostile vs. passed a good target without engaging)	Filtered display of, for example, suspect tracks and all friendlies and/or neutrals; range rings for localization and weapons to support inferences concerning whether a suspect track had the opportunity to engage a target it bypassed.
Libyan gunboat	Contact with specified weapons closes on own ship from outside its weapons range. Visibility, weather, localization technology or other conditions may require the track to approach closer than technical weapons range to localize before launching.	Estimate available time before action must be taken (track may not shoot at nominal weapons range due to specific conditions, such as weather)	Range rings for localization and engagement ranges; range rings might be multi-colored or multi-patterned to indicate both technical and customary ranges (of localization, engagement, round-trip travel); customary range rings might display context-specific codes, indicating customary range in bad weather, at night, etc.
Circling F-4s	Circling maneuver violates prior patrol pattern	Detect failure of pattern recognition	Display of historical patterns for a given flight type (similar to displays of commercial air corridors, but designed to show patterns of recent patrols, anticipated training exercises, return-to-force maneuvers, etc.)
Circling F-4s	Circling F4s are locking on and getting closer to own ship, but doing without stealth (at high altitude, in plain sight)	Detect and resolve conflicting evidence (between apparent hostile intent and lack of covertness)	Display of altitude and emissions history
Vectoring CAP to a fix	Conflicting coordinates from E2 and picket. Must decide which coordinates to use to intercept contact in time.	Detect and resolve conflicting evidence (between conflicting coordinates)	Track symbology coded to display reliability of data source or database display of list of data sources with reliability indices (context-sensitive indices may be desirable).

Ambiguous attacker	Inbound missile emerges from cluster of tracks whose identity is unclear	Integrate information (determine who fired missile)	Tight integration of geoplot display of tracks with database of track characteristics (such as weapons capability); filtered display of history of selected tracks (e.g., two potential launch platforms and a missile)
Context affects assessment	Air tracks perform a threatening maneuver, followed by an attack on ownship by other platforms of the same nationality, followed again by other air tracks repeating the original threatening maneuver. ROE prohibits engagement of tracks not traveling in concert, except for self defense.	Detect and resolve conflicting goals (ROE vs. self-defense) Detect failure of pattern recognition (change in context due to intervening attack)	Display of track history.
Prioritization problem	Several potential threats are active simultaneously. The uncertainty surrounding the identity and/or intent of these tracks varies. Which are immediate priorities? Which require time-consuming critical thinking and information gathering? Which can be ignored for now?	Prioritize tasks Provide situation updates (to keep rest of team on same page)	Help the CO and TAO communicate their priorities and concerns to staff: display of tracks by priority in useful categories (e.g., immediate threat, prospective threat, no threat); support for detecting and communicating problematic issues regarding prospective threats.
Loss of track continuity	Two or more distinctively different air tracks (e.g., one from a threatening nation, one from a neutral country) drop below radar horizon, then one pops up with a new NTDS number. CIC officers must correlate the pop-up to older tracks to determine the threat level.	Integrate information	Filters that display history of lost tracks and pop-ups; database that supports linking pop-ups to data concerning lost tracks.

Variance in scenario tempo	Some periods of the scenario are characterized by engagement conditions, some by a slower pace in which officers may gather information to resolve uncertainty about problem tracks, formulate contingency plans, or rehearse expected procedures.	Capitalize on slow periods (in anticipation of higher workload periods)	Display of time available until an irreversible action is to be executed according to ROE tripwires or manually set tripwires (Such a display would sensitize staff to the availability of time for working problems); display of tracks by priority in useful categories (e.g., immediate threat, prospective threat, no threat); support for detecting and communicating problematic issues regarding prospective threats
Military a/c mimics commair	A military aircraft mimics commair but originates from a military base or performs a maneuver that is subtly characteristic of military a/c.	Detect and resolve conflicting evidence (between cues suggesting commercial airliner and military aircraft)	Display of track history closely linked to database of platform capabilities; automated recognition and highlighting of patterns (e.g., maneuvers, origin, emissions) that discriminate between important classes of air or surface platforms (e.g., helicopters, light aircraft, commercial aircraft, military aircraft)
Variance in workload	One position becomes overloaded with data or tasks at some point in the scenario. The supervisor should notice this and help to offload the affected officer.	Monitor staff performance	Supervisor’s display of subordinates’ workload or response latency.

Performance Measures

require critical cognitive and team processes, in the scenario is that they form a natural basis for developing

AMMWS is supporting CIC decision makers. If we deliberately introduce uncertainty at various points in the

makers to that uncertainty. For example, performance measures could include the accuracy of the tactical

assessment, and the actions taken to prepare in the face of uncertainty. The success of the AMMWS in supporting

accurate assessments of the tactical situation, and by the presence of preparatory actions that are judged appropriate

4. NEXT STEPS

The next step will be to conduct CTA interviews to expand the Quick Look critical decision

scenario. We suggest that DSG undertake the following tasks, in a six-month effort:

- Examine previous interviews and research results in depth to identify critical decisions in the CIC. This expands the Quick Look results.

  Identify key design features of the AMMWS through interviews with AMMWS

  support critical decisions.
- Identify scenario incidents that incorporate critical decisions and draw on key design features.

  Validate and flesh out selected scenario incidents through interviews with

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  relevant display features, and key cognitive skills.

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APPENDIX

SUMMARIES OF SCENARIOS REFERENCED IN TABLE 1

An AEGIS cruiser serving as part of a large Allied battle force was stationed off the Iranian coast. The US had just bombed two Iranian oil wells in the southern part of the Gulf, so tensions

the cruiser detected a small aircraft flying from Iran, 90 miles off the coast, in a zigzag pattern at 80-100 knots, and at low altitude. The craft then took a direct course for the cruiser. It did not

closing in at 20 miles. The cruiser identified the aircraft as a hostile plane and requested "Red and Free" weapons status from the Battle Force Commander (BFC). The BFC did not grant the

plane; it was too distant from Iran to complete a round-trip attack on the cruiser, and thus that it was unlikely to be Iranian; allies in the area might well have lost a helicopter but not have

comms for many plausible reasons, including broken communications gear or that the pilot was attending to other (e.g., Allied) frequencies. As the BFC put it, "This thing did in fact meet a

at low level at low speed. It was wandering all over the place. But that is also the profile of a lost helicopter..." The BFC vectored a CAP to the area and gave the cruiser control over the CAP,

this scenario that we developed, the helicopter pops up, then circles. The circle can be interpreted as an attacker's maneuver to delay while he awaits another track with whom to conduct a

or an attempt to get a visual fix on a target. However, the circle can also be interpreted as a poorly flown return-to-force triangular maneuver.

U.S. ships were conducting freedom of navigation demonstrations in Libyan-claimed waters, amidst threats from the Libyan leader, when a gunboat emerged from a Libyan port in the Gulf

cruiser was convinced the gunboat intended to attack. Several factors supported this assessment. The track was inbound and appeared to be a combat vessel from a hostile nation. It was moving

the Libyans, since it was 20 miles within the "Line of Death" (in Libyan claimed waters). Furthermore, the cruiser (but not other members of the battle group) had detected apparent

actively engaging surface vessels. However, other factors complicated this assessment. The Libyans had far better air assault assets than this small gunboat, and had in fact used them earlier

TAO considered that perhaps Libya was willing to use every available asset to strike the U.S.

This gunboat probably did not have the capability to detect the cruiser at the range at which it had turned inbound, and the dark of night only complicated localization. The TAO and captain reasoned that third party targeting or unusual technology might explain the choice of vectors. Furthermore, own ship was not the only AEGIS cruiser below the "Line of Death." Virtually any maneuver by the track would have put it on a vector to a friendly ship. Was the vector to ownship merely a coincidence? There was also another U.S. cruiser farther into Libyan waters and closer to the gunboat. If the gunboat planned to attack, why wasn't the other cruiser the target? Perhaps, the cruiser personnel thought, the gunboat captain was simply not informed of the presence of the closer target. The TAO recommended that cruiser engage the gunboat preemptively at the gunboat's technical weapons range of 50 nm, then again at 35 nm and at 25 nm. The captain held him back each time, arguing that the vessel was not liable to shoot until it was within 20 nm. (Alpha Sierra also ordered the cruiser to wait, but the wisdom of this order was suspect given that Alpha Sierra had previously kicked the cruiser out of the datalink for reporting missile launches that appeared, to the cruiser, to be real.) The captain planned to destroy the gunboat at 20 nm. SuCAP arrived by surprise and made two passes over the vessel, failing to identify it both times. In its third pass, SuCAP confirmed that the vessel was a La Combattante gunboat and launched against it. On the cruiser's radar, the track slowed. A delayed SuCAP report of damage to the vessel indicated that the gunboat was on fire in the bow. The TAO and captain were concerned that the gunboat would unload its volatile midship weapons at the nearest and most suspect target, the cruiser. It did not. The gunboat turned toward port and sank en route. The cruiser staff never learned whether the gunboat was an innocent, had planned to attack the cruiser, or was engaged in a blind, opportunistic attack on whatever it found in its path. (Details concerning track range, timing and speeds are available).

CIRCLING F-4S

An AEGIS cruiser was escorting a flagship near Iran. Recently, there had been an increase in flights by Iranian jet fighters, apparently on patrols along the country's coast. The cruiser noticed the launch of a pair of jet fighters. The fighters emitted a signature F-4 search radar, then fire control radar as they turned inbound (towards ownship) on a circular path. The fighters gradually widened their circle, bringing them closer to ownship and within the aircrafts' weapons release range. They continued to target the cruiser with fire control radar on the inbound leg of each turn. Two issues troubled the cruiser command staff. The aircraft were not taking the standard patrol route up the coast, but was making its conspicuous and arguably threatening maneuver at high altitude in plain sight of the cruiser. Second, the F-4s were emitting repeatedly. Iran had difficulty maintaining the fragile radar systems in its jets. Pilots typically tested their radar once at the beginning of each flight, then shut it off. There are numerous possible explanations of this behavior that were consistent with an attack, including that the F-4s were tanking, awaiting other assets or trying to validate a fix on the cruiser using faulty equipment. However, the flight could also be interpreted as harassment, training, an equipment calibration run, or a probe of American ROE. The CO was within the ROE to engage the aircraft. However, he decided to do so only if the F-4s broke orbit and approached the cruiser directly. The CO elected to break the lock of the fire control radar with EW, though he was well aware that this action might provoke the aircraft to fire. The aircraft made two more circles, then flew away. The incident lasted five minutes.

VECTORING CAP TO A FIX

A battle group was operating in the Sea of Japan (a small theater) when one of its pickets reported to an AEGIS cruiser (ownship) that Soviet Badgers were inbound at mach speed towards the battle group. The pickets did not send coordinates over the datalink. The cruiser transferred two CAP to an E-2 to intercept, identify, and escort the Badgers. The E-2 vectored the CAP using its own data. The picket then sent coordinates for the Badgers, which conflicted with those used by the E-2. The cruiser's air control supervisor noted this and took control of the CAP, vectoring them towards the location specified by the picket. Shortly thereafter, the cruiser independently detected the Badgers at a third location, different from that specified by both the picket and the E-2. An erroneous choice of coordinates would have required the CAP to fly on afterburners in a desperate chase after the intruders. The captain considered several factors in choosing between vector coordinates: the cruiser's data correlated best with the picket's data, the ship's ACS had performed reliably while the E-2 had not, and the cruiser's data, unlike the E-2 data, did not require American fighters to fly over sovereign territory. Thus, the cruiser did not change the CAP vector until the CAP detected the Badgers themselves, intercepted them, and escorted them past the battle group.