U.S. Army Research Institute
for the Behavioral and Social Sciences

Research Report 1943

Developing Performance Measures for Army Aviation Collective Training

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May 2011

U.S. Army Research Institute
for the Behavioral and Social Sciences

Department of the Army
Deputy Chief of Staff, G1

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NOTICES

REPORT DOCUMENTATION PAGE

1. REPORT DATE (dd-mm-yy)	2. REPORT TYPE	3. DATES COVERED (from. . . to)
May 2011	Final	April 2010 - March 2011

4. TITLE AND SUBTITLE Developing Performance Measures for Army Aviation Collective Training	5a. CONTRACT OR GRANT NUMBER W91WAW-10-C-0038
	5b. PROGRAM ELEMENT NUMBER 622785
6. AUTHOR(S) Melinda K. Seibert and Frederick J. Diedrich (Aptima, Inc.); John E. Stewart and Martin L. Bink (U.S. Army Research Institute); Troy Zeidman (Imprimis, Inc.)	5c. PROJECT NUMBER A790
	5d. TASK NUMBER 310
	5e. WORK UNIT NUMBER
7. PERFORMING ORGANIZATION NAME(S) AND ADDRESS(ES) Aptima, Inc. 12 Gill Street, Suite 1400 Woburn, MA 01801 U.S. Army Research Institute for the Behavioral and Social Sciences ATTN: DAPE-ARI-IJ P. O. Box 52086 Fort Benning, GA 31995-2086	8. PERFORMING ORGANIZATION REPORT NUMBER
9. SPONSORING/MONITORING AGENCY NAME(S) AND ADDRESS(ES) U. S. Army Research Institute for the Behavioral & Social Sciences ATTN: DAPE-ARI-IJ 2511 Jefferson Davis Highway Arlington, VA 22202-3926	10. MONITOR ACRONYM ARI
	11. MONITOR REPORT NUMBER Research Report 1943

12. DISTRIBUTION AVAILABILITY STATEMENT

Approved for public release; distribution is unlimited.

13. SUPPLEMENTARY NOTES

Contracting Officer's Representative and Subject Matter POC: John E. Stewart

14. ABSTRACT *(Maximum 200 words)*: Army Aviation tactical training exercises usually involve an entire Battalion or Combat Aviation Brigade (CAB). Due to cost and logistical considerations, the Army's aviation tactical exercise (ATX) takes place in a shared virtual environment employing networked simulators and training devices. ATX employs state of the art technology; however, objective measurement of team performance has not kept abreast of aviation simulation technology. It is unclear how observational ratings and electronic system data (from simulators) can be used to assess team performance and provide actionable feedback to unit commanders and trainees. To address these challenges, we: (1) determined the dimensions that differentiate high-performing aviation teams from low-performing aviation teams in scout- attack missions at the Battalion and Company levels; (2) determined collective-task dimensions that can be captured using simulator data during ATX, and (3) constructed behaviorally-based prototype measures to assess unit-level performance for those collective task dimensions not represented by simulator data. Future implementation of system-based and observer-based measures of collective task performance should lead to improved assessment of training strategies at ATX where CABs prepare for deployment. Refinement of these measures should likewise provide specific, diagnostic feedback to commanders on their unit's progress during virtual and live training.

15. SUBJECT TERMS:

collective training, Army aviation, collective performance measurement, aviation tactical exercise

SECURITY CLASSIFICATION OF			19. LIMITATION OF ABSTRACT	20. NUMBER OF PAGES	21. RESPONSIBLE PERSON
16. REPORT	17. ABSTRACT	18. THIS PAGE			
Unclassified	Unclassified	Unclassified	Unlimited	133	Ellen Kinzer Publications Technician Specialist 703-545-4225

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May 2011

Army Project Number	**Personnel, Performance**
622785A790	**and Training Technology**

ACKNOWLEDGEMENT

We would like to thank COL Anthony Krogh and COL Christopher Sullivan, previous and current Directors of Simulation, for their sponsorship and support of this research effort. We would also like to thank LTC Gregory Williams, Mr. Paul Hinote, and many others in the Directorate of Simulation who, through their expertise and dedicated support, made this effort possible. We also thank the Army aviators, simulation experts, and engineers, who served as workshop participants for their hard work and commitment to improving Army training. Their input was of exceptional quality and was key to the success of this effort. We thank COL Morgan Lamb and other members of the 21st Cavalry Brigade (Air Combat), Fort Hood, TX, for the evaluative input they provided on the training usability of these performance measures. Last but certainly not least, we would like to thank the other members of our technical team, Courtney Dean and Jeanine Ayers, for their dedication to high quality technical work. Without the time and assistance of each of these individuals we could not have succeeded in producing these potentially useful prototype training aids.

DEVELOPING PERFORMANCE MEASURES FOR ARMY AVIATION COLLECTIVE TRAINING

EXECUTIVE SUMMARY

Research Requirement:

Assessment systems are an essential element of effective training solutions. As a result, it is of critical importance to develop performance criteria for aviation collective tasks in order to provide feedback to aircrews and to enable leaders to monitor the progress of the unit, diagnose and remedy training deficiencies. This research was intended to provide prototype measures of Army aviation collective task performance in attack-reconnaissance missions as currently conducted in theater.

Procedure:

The aviation training exercise (ATX) is conducted in a networked virtual environment at the U. S. Army Aviation Warfighting Simulation Center at Fort Rucker, AL. Limiting our efforts to the reconnaissance-attack mission, we examined the utility of observer-based and automated simulator (i.e., system-based) data as measures of collective performance at all possible points during the simulation. First a set of critical tasks was defined. Next, indicators of high, average and low performance on these tasks and underlying skills were developed. Finally, measures were developed to quantify task performance and to provide systematic feedback. These steps were accomplished in an iterative series of three workshops in which subject matter experts collaboratively worked with behavioral scientists. The measures were based on tasks commonly performed in Attack Weapons Team or Scout Weapons Team missions.

Findings:

Performance indicators for five mission phases and further broken down into 12 mission events. A set of 44 performance indicators and 101 supporting performance indicators (observable behaviors) were identified that captured collective performance during critical events. Based on these observable behaviors, a total of 115 observer-based measures that could discriminate high-performing from low-performing teams and that provided behaviorally-based feedback were developed for each of these performance indicators. In addition to the 115 observer-based measures developed in this effort, 33 additional system-based measures were defined using simulator data available during ATX. Further development and validation is required before the prototype measures can be incorporated into a set of usable training tools.

Utilization and Dissemination of Findings:

Prototype paper versions of observer-based measures were disseminated to several Combat Aviation Brigades upon request to assist in home-station training. Findings were briefed to the Director of Simulation at the U. S. Army Aviation Center of Excellence, 20 January 2011.

DEVELOPING PERFORMANCE MEASURES FOR ARMY AVIATION COLLECTIVE TRAINING

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Introduction

Background

Previously, collective (i.e., unit level) aviation training was accomplished through live field exercises. However, for many reasons (e.g., limited resources, and lack of access to suitable practice areas), live training is less feasible than in the past. A response to these limitations was the development of the U. S. Army Aviation Warfighting Simulation Center (AWSC), a networked training system located at Fort Rucker, Alabama. The AWSC consists of a total of 24 networked cockpit simulators that can be reconfigured to represent the Army's four currently operational combat helicopters (AH-64D Apache, CH-47D/F Chinook, OH-58D Kiowa Warrior, and UH-60 A/L Blackhawk). The AWSC executes tactical missions in a shared virtual environment consisting of a highly accurate geospecific terrain database with constantly updated cultural features (e.g., buildings and streets). From various vantage points within this virtual environment (e.g., battle master's station; stealth platform), data on the position, location, and movement of entities, including the aircraft represented by the training devices, can be electronically captured.

Using the AWSC, a Combat Aviation Brigade (CAB) can participate in a collective Aviation Tactical Exercise (ATX) that places CAB aircrews and battlestaff in a common virtual environment. ATX is the most important virtual aviation exercise for Army aviation CAB-level training, and it consists of a week-long mission readiness exercise prior to deployment to theater. As a result, the Army has a heavy investment in and reliance on networked training devices that operate in shared virtual environments in order to prepare units for battle. While the primary purpose of ATX is to assess the readiness of battlestaff, it also provides an opportunity for feedback on the readiness of aircrews. Currently, ATX Observer Controllers (OC) not only provided feedback to battlestaff throughout the exercise, but also to aircrews on collective task performance.

Even though individual aviation tasks are generally well defined, aviation collective tasks are poorly defined as broad mission segments that Army Aviation teams must accomplish (Cross, Dohme, & Howse, 1998). Army aviation collective tasks for reconnaissance and attack operations are outlined in Army Training and Evaluation Program (ARTEP) manual 1-126 (Department of the Army, 2006) and refer to those aviation tasks that require coordination between one aircraft and another, coordination between an aircraft (or flight of two or more aircraft) and a tactical command element (e.g., Brigade Aviation Element), and coordination between an aircraft and a Ground Commander. For example, coordinating and adhering to flight formation and flight duties, deconflicting airspace, fulfilling communication requirements, and applying rules of engagement (ROE) are all types of aviation collective tasks. However, the requisite underlying knowledge and skills that support aviation collective tasks cannot be inferred from such broad functions within those tasks, and nor from task descriptions that lack objective performance criteria. Rather, behaviorally-anchored indicators of aviation team performance, which link observable behaviors to discrete benchmarks, should be used to evaluate performance on aviation collective tasks. That evaluation can illuminate the underlying knowledge and skills necessary for aviation collective tasks.

Training research (e.g., Salas, Bowers, & Rhodenizer, 1998; Stewart, Dohme, & Nullmeyer, 2002; Stewart, Johnson & Howse, 2007) has demonstrated that the lack of clear performance assessment criteria fails to fully exploit the effectiveness of simulation-training events. Moreover, the military value of simulation-based training, such as ATX, is determined by performance improvement of participants within the virtual-training environment (Bell & Waag, 1998). In the case of ATX, there is a need to develop performance criteria on aviation collective tasks in order to assist OCs in providing feedback to aircrews and Leaders. It is not enough simply to identify what collective tasks aircrews can perform at the end of ATX. Instead, simulation-based training like ATX must provide opportunities for feedback on specific skills and for correction of performance in order to improve learning (e.g., Bransford, Brown, & Cocking, 2000; Ericsson, Krampe, & Tesch-Romer, 1993). Thus, in order to increase the training effectiveness of ATX, there is a need (a) to identify observable indicators that define levels of performance on aviation collective tasks, and (b) to create measures that assess aviation collective task performance during ATX.

The sophistication of the virtual-training technology supporting ATX stands in contrast to the way in which collective performance is measured. Currently, there are limited systematic means by which collective performance is quantified during ATX. Instead, OCs attempt to capture critical incidents that illustrate representative performance for a given unit. While these critical incidents are recorded in the simulation data and can be "replayed" as feedback, defining critical incidents and utilizing available simulator data to illustrate a critical incident depends solely on the unaided ability of an OC to notice and note the event. By contrast, designing and implementing effective performance measures usually relies on a variety of techniques (e.g., system-based, observer-based, and self-report) to fully capture performance (e.g., Campbell & Fiske, 1959; Jackson, et al., 2008). In addition, measures of collective performance should capture both outcomes and processes of the collective behavior (Bell & Waag, 1998). In ATX, system-based (i.e., simulator) data can be used to extract measures such as timing of events or success of an attack while observer-based data can provide insights that are not easily obtained from system-based data (e.g., communication patterns or team interactions), and self-report data can provide information on cognitive factors that are not easily externally observable (e.g., workload, situation awareness). Instead of relying on OC observations alone to capture collective performance, the integrated use of multiple types of measures guided by training objectives and mission scenarios can provide a comprehensive representation of aviation collective performance.

Technical Objectives and Scope of Research

The primary objective of this research effort was to develop a tool that could assist ATX OCs to assess performance on aviation collective tasks. This tool would allow OCs to provide behaviorally-based feedback to aircrews and would help to distinguish high-performing teams from low-performing teams. Performance results from across training units could then be aggregated to provide unit leadership with a "snapshot" of proficiency on aviation collective tasks, resulting ultimately in better-performing teams. To achieve this objective, a set of critical aviation collective tasks was first defined. Next, indicators of high performance and low performance on the identified collective tasks were developed. Finally, measures were developed to quantify task performance and to develop a systematic structure for assessing feedback. Another important consideration was to utilize automated simulator data to measure collective performance whenever possible. Automating the measurement process could augment observation-based measures or, in some cases, could obviate the necessity of observational measurement. In this research effort, the objective was to identify and define both observational and automated measures that could eventually be implemented in data collection tools.

It is important to note that for the purposes of this research the type of aviation collective tasks was intentionally constrained. The Army's four operational helicopter types represent four different types of missions: attack, lift (i.e., cargo), scout-reconnaissance, and utility. From a tactical standpoint, attack and scout-reconnaissance appear to be the most demanding missions because these missions involve interaction with hostile forces on the battlefield, constant coordination with battlestaff at tactical operations centers (TOCs) and Ground Commanders, and the identification, detection and engagement of targets. In short, attack and scout-reconnaissance teams are the most likely to be exposed to the risks inherent in combat. For these reasons, the current research effort was limited to collective tasks critical to performing typical missions that Attack Weapons Teams (AWT) and Scout Weapons Teams (SWT) train and experience in combat.

Method

The methodology for measure development combined the experiential knowledge base of subject matter experts with established psychometric practices. The process ensures that subject matter experts (SME) work collaboratively with scientists to reveal insights and drive the creation of measures (e.g., Seibert, Diedrich, MacMillan, & Riccio, 2010). This methodology is referred to as COmpetency-based Measures for Performance ASsessment Systems (COMPASS^{SM}). The COMPASS process was initially developed to assess performance of a team of F-16 pilots in training for air-to-air combat in a high-fidelity simulation environment. (MacMillan, Entin, Morley, & Bennett, in press). More recently, the method has been extended to develop observer- and system-based measures for a wide range of applications including the Air and Space Operations Center's Dynamic Targeting Cell, U.S. Marine Corps Motorized Patrols, U.S. Navy submarine Fire Control Technicians, and U.S. Army Outcomes-Based Training and Education, as well as other domains (e.g., Jackson et al., 2008; Riccio, Diedrich, & Cortes, 2010).

The COMPASS methodology employs an iterative series of three workshops with subject-matter experts to develop and initially validate performance measures. The COMPASS process starts with identifying key training objectives, competencies, and/or selected missions for focus. Using these items, performance measurement requirements are elicited from SMEs in the first workshop in the form of Performance Indicator (PIs). PIs refer to observable behaviors that allow an individual to rate the quality of individual or team performance. In the second workshop, more detailed information is gathered for each PI in order to identify a range of likely and desired behaviors. This information is then used to create behaviorally-anchored performance measures and/or to define system-based indications of performance. The goal of the third workshop is to conduct a detailed review and to modify a set of draft performance measures. As part of this detailed review, SMEs confirm the relevance of each measure and ensure that each performance measure appropriately represents the behaviors described in the PIs derived during the first workshop.

Participants

For the current research effort, the COMPASS methodology was applied over the course of three small-group sessions (i.e., workshops) with SMEs from diverse professional, civilian, and military backgrounds. The heterogeneous backgrounds of the SMEs ranged from military aviators to simulation training experts and software engineers. SMEs represented two main organizations of the U.S. Army Aviation Center of Excellence: the Directorate of Simulation (DOS); and the Training and Doctrine Command Capability Manager (TCM) for Reconnaissance-Attack (RA). In addition, SMEs were recruited from the Aviation Captain's Career Course. Across the workshops, some SMEs participated in all three workshops, whereas others participated in only one workshop. This mix of participants ensured consideration of a variety of viewpoints.

COMPASS Workshop One took place on 22-23 June 2010 at Fort Rucker, AL, with a group of participants from DOS and TCM-RA. The 11 SME participants included three experienced active duty Kiowa Warrior (OH-58D) pilots, two active duty Officers who were knowledgeable on ATX operations and simulations, three retired Army aviators with current expertise and knowledge of Aviation Combined Arms Tactical Trainer, Unmanned Aircraft System (UAS) simulation, simulation and training operations, and three additional DOS personnel with experience in virtual systems, simulations, and Army aviation training.

COMPASS Workshop Two took place 15-16 July 2010 at Fort Rucker, with additional follow-up interviews for several individuals in order to complete data collection over the subsequent month. Altogether during this workshop period, nine SMEs from Workshop One as well as six new SMEs participated in the process. Of the new SMEs, four were current students in the Aviation Captain's Career Course, one was a retired Army aviator who now works for DOS along with several of our other workshop participants, and one was an active duty Army aviator currently assigned to DOS.

COMPASS Workshop Three took place on 26-27 October 2010, also at Fort Rucker. Similar to Workshops One and Two, the SME participants included ten of varying backgrounds and expertise. Five SMEs had participated in both of the prior workshops; there were five new workshop participants. Of those who participated in Workshops One and Two, one was an experienced active duty Kiowa Warrior pilot, two were retired Army aviators with current expertise and knowledge in simulation and training, and two were DOS personnel with experience in virtual systems, simulations, and training Army aviation collective tasks. Of the new participants, three were active duty Kiowa Warrior pilots, one was an active duty Apache Longbow (AH-64D) pilot, and one was a recently retired Kiowa Warrior pilot.

In addition to individuals participating in COMPASS workshops at Fort Rucker, three Company Commanders within a CAB were interviewed at their home station to verify collective training needs and priorities. All three Company Commanders had operational experience in Iraq and/or Afghanistan, and each was preparing for deployment under a different task force. Two were Kiowa Warrior pilots and one was a Chinook (CH-47) pilot.

Procedure

COMPASS Workshop One. The goals of the first COMPASS workshop was to identify the workflow (i.e., flow of tasks and events over time) for collective tasks and interactions performed by Army aviation aircrews and flights in attack/reconnaissance missions and to derive a set of PIs relevant to the crews, tasks, and mission being analyzed. A PI is an observable behavior that allows an expert (i.e., one familiar with the mission objectives and task requirements) to recognize whether an individual or team is performing well or poorly. During this step of the COMPASS process, it was critical to identify *observable* rather than *inferred* behaviors. The resulting PIs and relevant missions/tasks provided a solid basis on which to develop benchmarked measures that were less sensitive to subjective biases and more reliable over repeated sessions. In addition, the PIs provided a framework on which to develop measures based on critical decisions and events.

Participants focused the development of PIs for collective tasks within a flight, within an aircrew, between aircrews, between aircrews and TOCs, and between aircrews and ground forces in an attack/reconnaissance scenario. To facilitate the development of relevant PIs during the first workshop, a hypothetical mission scenario (see Appendix A) was developed and briefed. Several factors were considered in the development of this scenario in order to provide a complex, realistic mission description. First, it had to be a common mission for an AWT, SWT, or a combination of the two. Second, it had to be challenging with multiple elements involved during the mission. Finally, it had to be relevant to experiences likely to occur in combat for which pilots need to train. Based on pilot experiences in Iraq and Afghanistan and using terminology from appropriate ARTEP manuals, the mission scenario was developed with combined elements of Reconnaissance and Close Combat Attack (CCA) tasks typical of current combat missions. Once developed, the scenario was presented to the Director of Simulation and his staff, and all agreed that CCA was an appropriate collective mission to use for this effort. The scenario mimicked those currently used at ATX, and the mission provided a framework on which to identify the critical events and decisions that needed to be measured.

COMPASS Workshop Two. While some PIs identified in Workshop One were readily translated into performance measures, more detailed information was generally required in order to create behaviorally-anchored performance measures. That is, for a given PI, the *specific* behaviors related to performing poorly or performing well needed to be determined in order to create performance measures with appropriate rating scales. COMPASS Workshop Two, therefore, focused mostly on one-on-one interviews (one to three hours each) to discuss the PIs and identify explicit behaviors that were representative of good, average, and poor performance for each of the PIs. Using individual interviews was thought to be a more thorough and efficient method, compared to group sessions, for obtaining detailed information required for the development of behaviorally-anchored measures and scales.

During the interviews, a variety of questions were asked to obtain information describing personnel most responsible for each PI, to elicit behavioral anchors relevant to each of the PIs, and to determine—from the perspective of the SMEs—the appropriate type of measures to develop for each PI (i.e., systems-based or observer-based). A number of specific questions were also posed targeting performance parameters for the development of system-based measures. The following is a small set of the types of questions asked during COMPASS Workshop Two:

- What might a member of the flight say or do to indicate good/average/poor performance for this PI?
- What would cause a person to do well or poorly at this PI?
- Does this person interact with other crewmembers, the ground, or their TOC for this PI?
- In what situations during this step of the mission could a person be observed performing well or poorly for this PI?
- What specific tools/systems do help accomplish this PI?
- What simulator data may be published that can be used to assess this PI?

Also during the interviews, two to three individuals from the research team took detailed notes and logged direct quotes as often as possible. Just as it is essential for multiple note takers in a single interview, it is essential to obtain multiple perspectives on each PI. A single SME may only be able to provide a partial description of the situation, or may provide a perspective not shared by others. By recording notes from several researchers on perspectives and descriptions provided by a number of SMEs on each PI, it was more likely that the resulting performance measures reflected reality.

The information gathered during the Workshop Two interviews was used in post-workshop analysis to develop tentative sets of behaviorally-anchored performance measures and system-based measure definitions. This process involved taking each PI and the associated notes obtained in Workshop Two and creating measures using behavioral anchors and/or simulator data that define good and poor performance for that PI. Thus, one PI could have one or more measures associated with it, and these measures could describe observable behaviors for either individual roles or the entire flight team. Ultimately, this process provided analysts with a set of measures that could be used together or in separate elements depending on the specific evaluation criteria.

Verification of critical collective tasks. To ensure that training needs and priorities expressed during Workshop One and Workshop Two were consistent with current needs and priorities of CABs in theater and CABs preparing for deployment to theater, three CAB Company Commanders were interviewed at their home station. During these interviews, a semi-structured interview format was employed where question prompts and follow-up questions were proposed and open discussion of topics of interest was encouraged. A sample of these questions can be viewed in Appendix B. In addition to tracking operational collective training priorities, supplemental information on elements of *good*, *average*, and *poor* performance for collective task performance at the Company and aircrew levels for topics identified during the interviews was obtained.

COMPASS Workshop Three. As previously mentioned, the COMPASS process is driven by SMEs to ensure that PIs and performance measures are operationally relevant, as thorough as possible given the mission scenario, and appropriately worded using the experts' language and terminology. Therefore, after development of the performance measures, the complete set of measures was presented to SMEs for review during COMPASS Workshop Three. This workshop used the same group format as Workshop One, which ensured that the final set of performance measures was understood and accepted by a wide range of users. During this workshop, each performance measure was reviewed with respect to the following criteria:

- Relevance
- Observability
- Measure type (e.g., scale, yes/no, checkboxes; system-based vs. observer)
- Measure wording
- Scale type
- Scale wording

In real time, each of the observer-based and system-based performance measures was addressed to incorporate the inputs of SME participants with respect to the mentioned criteria. In addition, SMEs were asked if there were additional measures that needed to be developed (in real time) to fill any gaps in the measurement framework or if there were measures that needed to be removed completely. The result of this process was a set of measures that were developed, reviewed, and refined by a wide range of SMEs.

Results

Using the sample mission scenario as a starting point, the three COMPASS workshops leveraged SME knowledge and experience to identify critical skills required for effective collective performance in the form of behaviorally-anchored measures. Behaviorally-based measures are systematic descriptions of what constitutes good, average, or poor performance in a particular job or task and the knowledge and skills needed for that job (MacMillan, Garrity, & Wiese, 2005). The results of this process yielded Army aviation collective task performance measures that were:

- **Behaviorally anchored**. Behavioral anchors provide raters with observable features of performance that observers (or a measurement software system) can link to ratings on a scale.
- **Designed to be taken at critical points in the training program.** Measures taken at specific intervals address performance at critical phases in the exercise, rather than as an average across the entire exercise, allowing the ratings to be tied to specific phases in the mission.
- **Developed to evaluate system-based and observer-based behaviors**. Together, system-based measures, which facilitate automated performance feedback, and observer-based measures, which facilitate evaluative feedback that systems are unable to capture, support a comprehensive evaluation of collective task performance.
- **Focused on aspects of performance not currently standardized across OCs**. Measures guide and standardize OC observation, facilitating specific behaviorally-based

feedback to each unit that can be used to more easily identify and document trends throughout a brigade and between brigades.

- **Useful for assessment of knowledge and skills that are exercised in the training environment.** Collectively, the items are designed to reflect critical objectives from the perspective of the OCs running an ATX.

Taken as a whole, the COMPASS effort yielded three products: (1) a set of PIs representing 12 critical mission events during five phases of the exemplar mission; (2) a set of observer-based behavioral measures that can be completed manually by an OC; and (3) a set of system-based behavioral definitions of measures that can guide implementation into measurement software which can collect data electronically from the simulator log. The PI list and two sets of measures reflect the anticipated collective tasks performed during either preplanned or dynamically re-tasked aviation missions. The PI list, observer-based performance measures, and system-based performance measures can be viewed in Appendices C, D, and E respectively. In the sections that follow, the specific outcomes of each step throughout this effort are described in more detail.

Outcomes of COMPASS Workshop One

One goal of Workshop One was to identify PIs that represented the essential elements of an example mission. In general, PIs represent critical tasks and interactions occurring during a mission that require proper execution for successful mission completion. PIs also represent specific opportunities to observe measureable behavior during the course of a mission or an operation within a larger mission. Moreover, PIs represent both task outcomes and the *processes* used to achieve a given outcome. The assessment of process is particularly important in consideration of collective tasks because the efficiency of team interaction is a hallmark of team performance (e.g., Ilgen, 1999).

The general format of a PI is a phrase or sentence that begins with an action verb that focuses on an observable behavior. For example, one PI reads: “Confirm target with appropriate technique for Ground Commander using Standard Operating Procedures (SOP).” The full list of PIs was formatted in a spreadsheet to organize the PIs and to show the hierarchical dependencies among PIs. Accordingly, the PI spreadsheet numbered each PI and identified the personnel most likely to exhibit the PI. The entire PI list is provided in Appendix C and an excerpt appears in Table 1. This list was also used to organize the development of the measures.

The PI list is organized according to an operational timeline with mission phases serving as major segments, from ‘Mission Planning’ to ‘Post Flight Tasks and After Action Review (AAR)’. Each PI is also mapped to the positions (e.g., Fire Support Officer, Battle Captain), or personnel (e.g., aircrew, aircrew commander) within the participating unit that have relevant actions associated with the PI. Altogether, PIs were developed for five mission phases and further broken down into 12 mission events. A total of 44 major PIs were developed, and 101 additional details supporting the major PIs were also developed. As an example, in the sample exert from the PI list in Table 1, items 7.1.1 and 7.1.1.1 are additional supporting PIs to the major PI 7.1. Similarly, 7.1, 7.2, and 7.3 are major PIs in mission event 7 ‘Apply ROE’.

In addition to representing specific observed behaviors and interactions, PIs served as the context from which performance measures were developed. As an example, PI 6.5 is located in section 6 ‘Target Acquisition’ and is the last step before section 7 ‘Apply ROE’ (see Table 1). This PI represents actions the flight is performing during a mission but prior to the engagement of a target. It is an essential step in the target acquisition process in order to ensure that subsequent actions (e.g., firing on the target) are executed properly and on the right subject (e.g., the desired target). In the next step of the COMPASS process, each PI was evaluated individually to obtain acceptable and unacceptable ranges of performance on associated tasks.

Table 1
Sample Excerpt from Performance Indicators List.

Mission Event	PI Number	PI Title	Position
		Mission Execution Phase	
6 Target Acquisition (In parallel with on station tasks)			
	6.1	Communicate Last Known Position and Description of Target	Ground Commander
	6.1.1	Request this information if not given freely	Air Mission Commander
	6.2	Begin Search for Target	Flight Team
	6.2.1	Incorporate the ISR Plan	Flight Team
	6.2.2	Visual	Flight Team
	6.2.3	Sensor	Flight Team
	6.2.3.1	Choose proper sensor given ambient conditions	Flight Team
	6.2.3.2	Share sensor feeds if required	Flight Team
	6.2.4	Recognize threats	Flight Team
	6.2.4.1	Utilize Appropriate Standoff Distance	Flight Team
	6.3	Announce target in sight	Flight Team
	6.3.1	Wingman confirm target	Flight Team
	6.4	Communicate Target Acquisition to ground forces	Aircrew and Ground Commander
	6.5	Confirm target with appropriate marking technique for ground commander using SOP	Aircrew and Ground Commander
7 Apply ROE			
	7.1	Confirm ground commanders intent	Ground and Air Commander
	7.1.1	If apply lethal, determine hostile intent	Ground and Air Commander
	7.1.1.1	Ground commander or AMC must confirm hostile intent	Ground and Air Commander
	7.2	Discuss lethal nonlethal COAs	Ground and Air Commander
	7.3	Discuss proportionality	Ground and Air Commander
	7.3.1	Desired effect accomplished with minimal collateral damage	Ground and Air Commander

Outcomes of COMPASS Workshop Two

In Workshop Two, each PI (i.e. major PI) and supporting PI (i.e. additional details supporting a major PI) was discussed with SMEs and the goal was to gather as much information as possible about the PIs and supporting PIs. At the conclusion of Workshop Two, notes from all interviews were compiled and organized to facilitate meaningful interpretation. Once the full set of Workshop Two notes was organized, each PI and in some cases supporting PI, was characterized by a question that represented a behavior amenable to an observer-based or a system-based measure. Questions, scale types, and scale anchors for each PI were developed. Scale types were determined based on the nature of the question and the available information to assess it. If a task or procedure was so simple or so regimented that there was no behavior between right and wrong, a yes/no scale was applied. Other tasks reflected a set of regimented procedures or a checklist of communications or procedures that must be followed the same way every time. For these situations, a checklist was the most appropriate means of assessing performance. While yes/no and checklist questions did occur on occasion, the majority of items were developed into Likert-type-scale items where a '1' indicated poor behavior and a '5' indicated the best possible behavior.

To demonstrate the procedure applied in the development of performance measures, PI 6.5, 'Confirm target with appropriate technique for Ground Commander using SOP,' can serve as an example (see Figure 1). A review of sample notes compiled during Workshop Two interviews revealed several behaviors that reflected poor, average, and good performance on PI 6.5. In this example, the notes referred to understanding how to discuss the target and confirm its identity within the flight crew as well as with the ground forces using proper communications procedures (e.g., follow SOP). These notes provided some general descriptions of the procedures as well as examples of good, average and poor behavior. During measure development, researchers identified key words or phrases that illustrated these three levels of behavior. These notes allowed us to develop appropriate measures with behavioral anchors to compose a Likert scale item. In Figure 1, the key words and phrases identified for each performance level are noted by thick (good), thin (average), and dotted (poor) boxes. Following the identification of poor, average, and good behavior, the identified key words and phrases were extracted from the notes and formatted into a draft observer-based performance measure (see Figure 2). In Figure 2, N/A equals not applicable; NO equals not observed.

For many PIs, notes indicated or suggested that additional measures composed of system-based data could be developed. System-based measures were defined based on data understood to be on the simulator's events database. System-based measures can provide insight into aspects of performance that are difficult for humans to observe or to reliably report, such as coordinated control actions and aircraft state. In contrast, observer-based measures are specific measures rated by OCs about aspects of performance that are more difficult to assess from available system data, such as adherence to communications standards. However, many of the actions and tasks performed by the aircrews and flights involved interaction with targeting systems, sensors, and mission control software. These types of interactions provided opportunities to develop system-based measures using data already being published in simulator log files. These system-based measures can serve as either alternatives or complements to the observer-based measures. In the case of PI 6.5, a draft system-based measure definition was also composed from notes gathered in Workshop Two. As Table 2 shows, the draft system-based measure for PI 6.5 reflects key actions required for target confirmation that involve interaction with the rotorcraft's electronic systems. In this example, the system-based measure does not look exactly like its corresponding observer-based measure. However, it does measure complementary actions indicated by SMEs as required for successfully accomplishing PI 6.5.

As part of the system-based measure definition, each identified measure was assigned a status indicating the likelihood of implementing the measure definitions in current system operations. Determinations of *Likely, Potential* and *Future* were made for each system-based measure definition based on an assessment of current simulator operations. Specifically,

6.5 Confirm target with appropriate technique for ground commander using SOP

Interview Notes 1
Knowing SOP and be able to discuss target in accordance with SOPs and in ways that ground forces know and understand (which following SOP will ensure)
Average: using SOP with errors
Poor: disregard for established procedures, hesitation, failing to confirm target

Interview Notes 2
poor - doesn't use appropriate technique for marking conditions or marks wrong, doesn't give ground guy options
avg - marks target with appropriate technique and asks ground for confirmation
good - gets ground to mark as well

Interview Notes 3
Marking target; laser, fire, smoke, ground and air can do it. The gig is up at this point.
Great: Selects marking approach; Marks and acknowledges; Use of brevity codes; Makes a call to wing; All units are in agreement
Average: Marks and acknowledges; Not all comms between groups happen; Average guy marks with appropriate and asks for confirmation
Poor: Doesn't use appropriate marker; Doesn't give ground guy options; Marks wrong target

POOR AVERAGE GOOD

Figure 1. Example notes taken from Workshop Two for Performance Indicator (PI) 6.5.

6.5 Confirm target with appropriate marking technique for Ground Commander using SOP

80. Does the flight mark the target to confirm its location?

1	2	3	4	5	
Flight does not mark correct target or uses the incorrect maker		Flight marks target		Flight discusses marking strategy with ground; marks target appropriately	☐ N/A ☐ N/O

POOR AVERAGE GOOD

Figure 2. Draft observer-based performance measure from Performance Indicator (PI) 6.5.

distributed interactive simulation (DIS) data log files from previous ATX exercises at AWSC were reviewed and analyzed. The purpose of this assessment was to determine the likely data generated by the simulation infrastructure and to provide a first pass analysis of the types and quantity of data that is available over this infrastructure.

Table 2

Draft System-based Measure Definition for Performance Indicator (PI) 6.5: Confirm Target with Appropriate Marking Technique for Ground Commander using SOP.

Category of Data	Data Required for System-based Measurement
Mission Phase	Mission execution
Mission Event	6 Target Acquisition (in parallel with on-station tasks)
PI	6.5 Confirm target with appropriate marking techniques using SOP
Status	Likely
Reason for Classification	Will not be able to determine if they used the appropriate marking, but only if they correctly used the chosen marking.
Performance Measure	Does the flight mark the correct target? Does the flight use the appropriate technique to mark the target?
Required Data System	Distributed Interactive Simulation Network
Required Simulation Data	Electromagnetic Emission Protocol Data Unit (PDU); Laser designator; Position of target; Position of laser designator. (could also be gunfire or rocket fire to mark target)
Assessment	Correct or incorrect within specified acceptable performance ranges
Unit of Measure	Feet; Seconds
Acceptable Range of Performance	Exactly on target for Laser; 15 feet for rocket or gunfire
Frequency of Occurrence	Once when target is marked
Triggering Event	Engaging the designator
Additional Notes	If there are any questions regarding target, pilot will ask ground to use smoke or gunfire to identify target. If ground is already engaging target, clearance of fires is already complete. Will use laser at night unless IR laser is used. IR laser requires goggle use at night. If a second type of laser is emitted for aircraft or UAS, that laser can be used to designate target. Can use coded laser to guide weapon. PDUs tell hit or miss and why. How much own sensor is used vs. other sensor will depend on units and type of aircraft. Smoke during the day is good. Gunfire is good because clearance of fires is complete.

The process that was used to review and analyze the DIS data log files was as follows. First, documentation from the Institute of Electrical and Electronics Engineers Standards for DIS Application Protocols (Institute of Electrical and Electronics Engineers, 1996) and the Simulation Interoperability Standards Organization Enumeration and Bit Encoded Values for use with Protocols for DIS Applications (Simulation Interoperability Standards Organization, 2006) were reviewed to obtain the information-technology protocols required for DIS and the specific numerical values and associated definitions for DIS applications. The definitions for protocol data units (PDU) were also obtained. PDUs are data messages that are exchanged on a network between simulation applications. The next step was to replay data from an ATX event and analyze the content and type of data being communicated within the simulation network. The PDU types sent over the simulation environment were recorded and analyzed at a field and data level, as well as with respect to the key PDU packets identified as critical to the system-based measures. The results of the data log review and analysis suggest that there is enough data available on the simulation network to inform a variety of system-based measures. Possible system-based measures include skills beyond the reconnaissance-attack mission that was the subject of the present investigation. Together, the results of this PDU type and field analysis should facilitate the implementation of system-based measure definitions at AWSC.

The analysis of DIS log files and the PDUs indicated that a number of collective performance measures could be measured with system data. A system-based measure was assigned a Likely status if review of system operations suggested the required simulator data and information appears to be available in current simulator log files. An example of a Likely measure is provided in PI 6.5 defined in Table 2. A system-based measure was assigned a Potential status if the review of system operations suggested the required simulator data may be available but it was not clear how easily the data could be obtained. System-based measures requiring observer-based measure(s) as triggering events were also given Potential status because their ability to assess performance hinges on implementation of observer-based measures. For an example of a Potential system-based measure, see ‘PI 3.3 Launch Order’ in Appendix E. This item was given a Potential status because it requires a comparison of the reported launch order (to be obtained through observer-based methods) with time of take-off (to be obtained through system-based methods). Finally, a system-based measure was assigned a Future status if, based on current simulator operations, it does not appear that the measure can be implemented (i.e., additional simulator functionality is needed). For an example of a Future system-based measure, see ‘PI 1.1 Coordination for Brief Preparation’ in Appendix E.

During the post-Workshop Two measure development effort, draft performance measures (observer-based measures and/or system-based measures as appropriate) like those shown in Figure 2 and Table 2 were developed for each PI. In some instances, one measure was developed for each PI. In other cases there were multiple measures for one PI or multiple PIs covered in one measure. Where information was missing or confusing in notes, comments were made to prompt discussion for clarification during Workshop Three. No assumptions were made regarding the intent of a SME’s description without documentation and subsequent verification of these assumptions. At the end of the measure development effort between Workshops Two and Three, there were 130 draft observer-based and 41 draft system-based measures.

Outcomes of Verification of Critical Collective Tasks

During this step, three current Army aviation company commanders preparing for deployment were interviewed to ensure the training needs and priorities expressed during Workshops One and Two were consistent with current needs and priorities of deploying CABs. While the company commanders had slightly different backgrounds and experiences, similar insights were shared regarding training needs and priorities. Specifically, training needs and priorities similar to those covered in the PI list, and identified in Cross , et al. (1998) surfaced. Tables 3 and 4 summarize key training needs that surfaced during these interviews. For each key training need, relevant PIs and specific comments from the aviators interviewed are noted.

Table 3
Example Performance Indicators (PI) and SME Comments Related to Understating the Information Needs of Friendly Forces.

Relevant PIs	SME Commentary
5.3.1 Establish task and purpose for aviation assets	"Ability to meet the intent of ground forces is key. Knowing how to help ground forces – coaching ground forces about your capabilities to help."
7.1 Confirm Ground Commanders intent	"In Afghanistan, ground forces may say 'we are getting this report, can you engage' so AMC will have to decide if should do that. Communication between ground forces and air crew is critical – MUST seek specific clarification from ground forces as to WHY to shoot if you don't see why you should"
7.1.1.1 If apply lethal, determine hostile intent - Ground Commander or AMC must confirm hostile intent	"Ground forces may clear aircraft hot to fire, but still falls to aircraft if there are any questions or concerns over why they shot…"

In order to verify further that the critical aspects of collective tasks were captured, the developed PI list was compared against Army doctrine, namely ARTEP 1-126, Mission Plan for the Attack Reconnaissance Helicopter Battalion/Squadron (Department of Army, 2006). A subset of tasks in the ARTEP was selected and PIs were mapped to them as a demonstration of the relevance of PIs and resulting performance measures to current Army doctrine. As CCA was the primary focus mission for performance measure development, the ARTEP and Mission Training Plans (MTP) were used as guidelines in developing the scenario and guiding the workshops. As workshop participants began to explore the scenario, elements for a Quick Reaction Force and talk of tactical movement began to develop in relation to the PIs created. As a result, it was anticipated that the resulting measures would provide direct links to a number of tasks within the ARTEP and MTP manuals. Using ARTEP 1-126, this expectation was confirmed by mapping PIs to collective tasks within the Training and Evaluation Outlines (T&EO). The resulting comparison is presented in Appendix F. The goal in that evaluation was not to provide another training guideline but to enhance the current processes by providing a toolset that can be implemented with current Army training documents (e.g., ARTEP, MTPs, and Units Status Reports). PIs and resulting performance measures show a level of abstraction one

Table 4
Example Performance Indicators (PI) and SME Comments Related to Communicating Effectively within an Aircrew, between Aircrews, with Ground Forces, and with the Battalion TOC.

Relevant PIs	SME Commentary
1.3 Flight team and aircrew mission preparation	“Good team (AMC) will disseminate individual tasks or crew tasks within the SWT. The key is to have as detailed a plan as possible before you take off.”
4.3 Monitor and acknowledge updates	“Good team knows how to skin the cat before you get out there. Knows the objective, what looking for, and how to conduct. Checks in with each of the ground units before proceeding. If see something suspicious, lead aircraft communicates this to trail aircraft. Left seat trail clarifies any gaps because he does the reporting. Depending on what you are seeing, may have the AMC call the ground forces.”
5.3.4 Discuss plan among crew	“Informal conversation between lead and trail aircrafts”
5.5 Develop the situation	“Crews talking between cockpits to find the required information or develop the situation.”
5.6 Communicate differences in pattern of life as appropriate	“Speaking in language everyone understands (pro-words, lighting signals, lingo) – communications.”
7.5 Make shoot/don’t shoot decision	“If anyone in an aircrew (flight team) has questions about if should engage target, may be best to not engage… or to discuss more.”

down from the T&EO collective task list from the ARTEP. By nesting performance measures in the ARTEP tasks where appropriate, Commanders have a resource that provides detailed information as to “where” a unit must focus to successfully accomplish the ARTEP task. This level of detail will allow Commanders to focus on specific collective aviation skills and provides a more concrete evaluation tool in relation to the readiness level of the unit to perform specific missions such as CCA.

Outcomes of COMPASS Workshop Three

During Workshop Three, draft performance measures were reviewed, edited and finalized. Conversations in the workshop were focused on measure and scale observability, clarity, relevance, importance, and wording. All required revisions were made to measures in real time during the workshop. While many measures were modified during Workshop Three, a number of the measures were deemed appropriate as written in draft form and thus no changes were made. SMEs reviewed all measures with the same level of critique but determined that some appropriately reflected the actions of the PI and levels of performance without modifications. The observer-based performance measure for PI 6.2.4.1, "Utilize Appropriate Standoff Distance," (question number 74 in Appendix D), for example, was one such measure that was not modified during Workshop Three.

The observer-based measures for PI 4.4.1, "Loiter or Holding Area" (question numbers 35 and 36 in Appendix D) is an example of a measure that was slightly modified during Workshop Three. Specifically, workshop participants modified the language in the scale anchors, the checklist items, and decided it made more doctrinal sense to split the question into two separate questions, one for loiter area and one for holding area (the original item was one item for both loiter and holding areas). In accordance with Army doctrine, a loiter area is in the air whereas a holding area is on the ground or hovering over a specific spot on the ground. While the requirements for loitering and holding areas are practically the same, additional security considerations are required if an aircraft is to land in a holding area. Thus, SMEs felt it was more appropriate to split holding and loiter areas into two separate measures.

Summary of Products

A total of 115 observer-based measures and 33 system-based measure definitions were generated reflecting PIs from every mission phase. Of the system-based measure definitions, there were 12 measures that were deemed likely to be implemented given current system operations, 14 measures that may potentially be able to be implemented given current system operations, and 7 measures that could be implemented if system operations were enhanced. When considering the full PI list, most items are depicted using behaviorally anchored rating scales that describe measurable collective task behavior at the novice, average, and expert (coordinated with poor, average and good) levels. Appendix G summarizes each type of measure developed for each PI in this effort for each phase of the mission. In this summary table, measures are grouped by PI for each mission phase, with corresponding observer-based measures categorized according to number and system-based measures according to developmental status. The Likely, Potential, and Future distinctions in the system-based column indicate the implementation status for the measure definition corresponding to each applicable PI. The final list of 115 observer-based performance measures can be found in Appendix D. A summary of the status of system-based measures can be viewed in Appendix H, and the final list of all 33 system-based measures can be found in Appendix E.

Together, these measures operationalize the desired behaviors and skills of a set of Army aviation collective tasks in terms of a formative assessment, that is, an assessment that is actionable in the continual improvement of training and education. These and similarly derived sets of performance measures can be implemented during ATX as well as at other deployment readiness exercises. Disciplined use of these measures provides the opportunity for users to become increasingly oriented to the values and best practices within Army aviation collective task performance.

Discussion and Recommendations

The intention of this effort was to provide definitions of observer-based and system-based measures of Army aviation collective task performance in attack-reconnaissance missions as currently conducted in theater. Once developed, tested, and implemented into user-friendly technologies, the resulting performance measurement tools could be used to enhance the training experience of aircrews during ATX. This research effort produced (1) a set of PIs representing critical events occurring during an exemplar mission, (2) a set of observer-based behavioral measures that can be manually collected by an OC, and (3) a set of system-based behavioral measure definitions that can guide implementation into measurement software to electronically collect data directly from the simulator log. These prototype tools indicate the types of aviation collective skills that should be evaluated and can be used to provide constructive feedback on collective outcomes and processes. However, additional development, testing, and implementation are required before the measures can be effectively applied at ATX.

This research effort was successful in identifying over 100 performance indicators of Army aviation collective skill. All of these performance indicators had at least one observer-based measure associated with it. However, only 33 possible system-based measures were identified. As currently defined, system-based measures require much more development to be usable in ATX than do observer-based measures because of limitations of information in the simulator data streams and of challenges associated with processing available data.

In order to use the developed measures during ATX, OCs or other trainers would rate performance in real-time during regularly scheduled mission events using observer-based performance measures. In addition to the collection of observable measures, system-based data for a subset of measures would be saved for later processing using a measurement tool that meets the specifications previously provided. Following completion of missions, Companies would receive hotwashes and debriefs as usual using the feedback provided by the measures. The measures can also be used to determine the extent to which the teams (or Companies) performed well on the key training objectives the Brigade Commander and Company Commanders indicated as high priority. For example, if the Brigade Commander wanted a special focus on ROE, the extent to which the teams appropriately handled ROE could be assessed.

To facilitate use in ATX, observer-based measures can be used in paper-based format or be implemented into a hand-held electronic tool (e.g., tablet with touch-screen display) and used by OCs or unit Leaders who observe the training. Implementation of the observer-based measures into a hand-held electronic tool would provide observers the ability to quickly and easily select only those measures that apply to a given training event. In addition, implementation into an electronic tool would enable recording and storage of the measures in an electronic format. Likewise, system-based measures can be implemented in a software application that connects directly to the distributed simulation network and collects data required to calculate a pre-defined set of performance measures. Having all of the performance-measurement data in electronic format will make it easier to provide feedback during AARs and to store data for assessment of trends over time. What is more, performance data collected through both sources (i.e., observer-based and system-based) will likely be needed to provide a clear picture of performance and to provide feedback to both participants and the greater training community.

Further development of the measures would require an evaluation of validity and utility during an actual training event (e.g., ATX). Previously, such testing has enabled substantial refinement of similar types of measures (e.g., Jackson et al., 2008). Testing the measures in ATX would enable refinement of wording, identification of measurement gaps, facilitation of workflow for ease of rating, testing of inter-rater reliability, evaluation of response variance, and correlation with mission outcomes. However, the most significant measure-development process would involve refining the system-based measures in order to fit them into a usable tool.

There are a number of requirements a system-measurement tool should employ. A system measurement tool should have two major components: The first component is a data adapter or data collection program. The second component is a measurement calculation engine that uses the data collected by the data adapter program. The data adapter program should be capable of collecting data generated by the training and simulation center's distributed-simulation network. The data adapter should then be capable of storing this data in a format that can be used to calculate performance measures. The data adapter will need to collect data from simulation network that publishes PDUs. It should be made clear that such a tool need not be DIS specific but could apply to other simulation systems based on High Level Architecture (HLA) standard in case wider dissemination is required. The measurement calculation engine must take a set of measurement definitions, interpret the definitions, and perform the required calculations on data being collected in the simulator system. The calculation engine should also contain the workflow, or the business logic, of the assessment calculations. Hence, producing these two major components for the data available at ATX requires further resources and development, but the results of the current research (i.e., PIs and measure definitions) provide a framework for doing so.

Even though the measures were developed for training conducted at an ATX, trainers or unit leaders could apply the observer-based measures to any home-station training exercise the same way that OCs would use the measures at ATX. In fact, the current set of observer-based measures was disseminated upon request to CABs who participated in the development process. CAB leaders voiced interest in incorporating the measures in their training programs. Additionally, the increasing prevalence of home-station simulation-based trainers such as Aviation Combined Arms Tactical Trainer (AVCATT) and the Longbow Crew Trainer (LCT) will soon make system-based measures available to commanders who want to take full advantage of such training resources.

One should also consider the "big picture" in which the horizon for ATX extends far beyond the physical confines of the local area network (LAN) at AWSC. The *raison d'être* for DIS, HLA, and other networking standards is that participants can take part in virtual exercises from various remote locations over a wide-area network (WAN). For example, a Battalion Commander at home station should be able to link AVCATT and LCT to AWSC to share the same virtual environment. An Air Force Research Laboratory research effort (Portrey, Keck, & Schreiber, 2006) summarizes the development, evaluation, and architecture of system-based performance measures for military aviation training in both LAN and WAN environments.

Portrey, et al. (2006) discuss the challenges faced in developing and validating , and demonstrating system-based performance measurement architectures appropriate to complex, distributed virtual environments which involve disparate simulator systems, characteristic of joint/coalition virtual exercises. Because it is likely that Army Aviation will increasingly participate in joint virtual training exercises in the future, collaboration across services is necessary if the systems and entities on the WAN are to interact and function according to the same criteria.

In summary, the results of this research provided both an initial understanding of the team processes required for successful Army aviation collective-task performance as well as a first step toward the measurement of aviation collective-task performance. Collectively, the developed measures show promise as tools to provide formative feedback to guide learning during training. As constructed, the measures provide descriptions of observed and expert performance and, as such, the measures can be used to illustrate desired performance across various elements of collective tasks. Moreover, in addition to providing individual and team feedback during training, the measures could also facilitate the analysis of performance trends over time and within and across units. Analysis of performance trends could identify more global performance improvements and persistent training challenges at aircrew, flight, Company, and Battalion levels. Once incorporated into appropriate data collection tools, system-based and observer-based measures of collective task performance have the potential to improve the Army's ability to maximize effectiveness of training time for mission critical tasks, to assess the effectiveness of ATX in preparing CABs for deployment, and to improve unit performance by providing specific, constructive feedback to CABs.

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Acronyms

ARTEP	Army Training and Evaluation Program
ATX	Aviation Tactical Exercise
AWSC	Aviation Warfighting Simulation Center
AWT	Attack Weapons Team
CAB	Combat Aviation Brigade
CCA	Close Combat Attack
COMPASS	COmpetency-based Measures for Performance ASsessment Systems
DIS	Distributed Interactive Simulation
DOS	Directorate of Simulation
HLA	High Level Architecture
LAN	Local Area Network
MTP	Mission Training Plan
OC	Observer Controller
PI	Performance Indicator
PDU	Protocol Data Unit
RA	Reconnaissance Attack
ROE	Rules of Engagement
SME	Subject Matter Expert
SOP	Standard Operating Procedure
SWT	Scout Weapons Team
T&EO	Training and Evaluation Outlines
TCM	Training and Doctrine Command Capability Manager
TOC	Tactical Operations Center
UAS	Unmanned Aircraft System
WAN	Wide Area Network

APPENDIX A

MISSION SCENARIO

Collective Tasks under Mission – Conduct attack reconnaissance operations:

Bn Msn	01-1-5127	Conduct Aerial Close Combat Attack Operations	p5-61(147)
S3 Section	01-1-5140	Plan Aerial Close Combat Attack Operations	p5-68(154)
Co Msn	01-2-5199	Perform Aerial Close Combat Attack Operations	p5-179(265)

References – FM 3-04.126, FM-100, FM 3-04.111, FM 3-90, FM 3-100.12, FM 7-0, FM 7-1, TC 1-210, TC 1-248, TC 1-251

1. B/4-31 is an infantry company that is conducting presence patrols in the southern part of Humdalia valley. They are using a Raven UAS to screen near a village to provide the company with early warning as they search for weapons caches in the valley. There are infantry companies on patrol in the vicinity but none directly in the village. The Raven feed shows a possible technical vehicle that the infantry battalion has been looking for based on intel from a HUMINT source. The truck is headed in an east to west direction through the winding village streets.

2. 4-31IN battalion battle captain requests aviation attack assets to come 'on station' to help track and identify the possible gun truck. 5-5 ARB battle captain receives the infantry company's call sign and freq as well as a description of the target, its location, and enemy activity in the area. The battle captain then calls the TOC together to perform a quick mission analysis. The S2 provides the enemy situation from both the air and ground perspectives. The battle captain provides analysis on the amount of station time required to track and find the target, type of munitions needed to destroy the target, and crew experience. Weighing the importance of the mission, risk analysis, and time to accomplish, the battle captain reviews available apache teams (not assigned a specific mission) and assigns the mission to an apache team. The aviation battle captain approves the request and notifies the 4-31IN battle captain the call sign, freq, and ETA for the apache team. The 5-5 ARB battle captain also de-conflicts the airspace asking that the Raven UAS stay to the north above grid line 55 and stay at or below 500' AGL.

01-1-5410 Plan Aerial Close Combat Attack Operations Task 1-6

3. A team of AH-64s is sent to the B/4-3 IN AO. The team receives a call sign, grid, freq, description of the vehicle, and a direction of travel from the 5-5 ARB TOC. The team also is given the location and altitude of the Raven. Finally, the aviation battle captain provides the team with an enemy situation from both the air threat and ground threat perspectives. The AH-64 team, call sign Killer 11, acknowledges the brief and departs for the B/4-3 IN AO.

01-1-5410 Plan Aerial Close Combat Attack Operations Task 1-6
01-1-5199 Perform Aerial Close Combat Attack Operations Task 1-3

4. Killer 11 approaches the B/4-31 IN AO and checks in with the infantry battalion providing call sign, team composition, estimated time enroute, weapons configuration, and time on station. They receive a quick update on the target, location of the Raven, and enemy situation.

01-1-5199	Perform Aerial Close Combat Attack Operations Task 3-4

5. The infantry battle captain then pushes Killer 11 to the infantry company's net. The team contacts the infantry company and calls the 5-5 ARB battle captain to acknowledge he is in the area and has made contact with the infantry battalion.

01-1-5199	Perform Aerial Close Combat Attack Operations Task 5

6. Killer 11 begins reconnaissance along the route from the last known location. They maintain radio comms with the infantry battalion and company to receive updates until they find the target. Killer 11 positively identifies the vehicle as a white gun truck with a darker color door on the right side. The vehicle is stopped in an open area within the city limits. A heavy machine gun is identified in the bed of the truck with no gunner present. The vehicle is stationary and parked near a wall that separates the open area from a section of houses along a main thoroughfare. The vehicle is running and the driver is inside the vehicle.

01-2-5189	Perform Aerial Area Reconnaissance Operations

7. Killer 11 runs through the clearance of fires talking to the infantry company and aviation battle captain to ensure there are no friendlies in the area, they have the correct target (not an IP vehicle), collateral damage is at a minimum, and the ROE is appropriately used to destroy the gun truck. The aviation battle captain and infantry company confirm the identification of the correct vehicle and that there are no coalition forces in the vicinity.

01-1-5199	Perform Aerial Close Combat Attack Operations Task 6

8. Killer 11 selects the 30mm cannon and destroys the vehicle. It reports BDA to the infantry company (who relays to the infantry battalion battle captain) and the aviation battalion battle captain.

01-1-5199	Perform Aerial Close Combat Attack Operations Task 8-9

APPENDIX B

SAMPLE HOME STATION INTERVIEW QUESTIONS

INTERVIEWEE NAME & RANK:
INTERVIEWER NAME:
DATE AND TIME:

BACKGROUND INFORMATION

1. Purpose of this project
    a. This work is funded by the Army Research Institute.
    b. Our primary focus is on ATX at the U. S. Army Aviation Warfighting Simulation Center at Fort Rucker, but we expect our measures to generalize to collective tasks outside of ATX as well.
    c. The primary goal of this project is to develop measures of collective tasks performance for tasks between aircrews of the same flight, among aircrews in the same mission, between aircrews and ground forces, and between aircrews and their controlling HQs (TOCs).
2. Introductions
    a. Troy
    b. Melinda
    c. Interviewee

GENERAL EXPERIENCE WITH COLLECTIVE TASKS

3. In your experience and opinion, what characteristics describe a good performing air team? A good performing aviation company? A good performing Battalion? A good performing Combat Aviation Brigade? What about a bad one (Air team, Company, Battalion, Brigade)?
4. How do you prepare for collective missions as an Air team? As a Company? As a Battalion? As a Combat Aviation Brigade?
5. What kinds of experiences are helpful for developing as an air team? (in aircraft or not, in theater or exercise)
6. What kinds of missions might you encounter that require high levels of coordination between air teams?
    a. What about between your air team another aircraft part of the same mission?
    b. What about between the Battalion TOC and aviation teams?
    c. What about between air teams and ground forces?
    d. What about between air teams and brigade level folks?
7. Besides ATX at AWSC, what does your Company, Battalion, and Brigade do to train collective tasks? Are there other TADSS you are using?
8. For your upcoming deployment, what kinds of collective tasks does the 10th CAB anticipate they will need to perform on a regular basis?
    a. At the Air Team level?
    b. At the Company level?
    c. At the Battalion level?
    d. At the Brigade level?
9. Of these, which collective tasks do you consider most challenging?
    a. Is it the same at each level (air team, company, battalion, etc) or do the most challenging collective tasks vary?

10. Again, of those you listed, which collective tasks do you consider easiest to perform?
    a. Is it the same at each level (air team, company, battalion, etc) or do the most challenging collective tasks vary?
11. Again, are there any that are more critical to performing well as a CAB than others?
    a. Is it the same at each level (air team, company, battalion, etc) or do the most challenging collective tasks vary?

COLLECTIVE TASKS REQUIRED IN YOUR LAST DEPLOYMENT

12. When was your last deployment as part of an aviation brigade? What was your primarily role during your deployment?
13. If recently deployed:
    a. Based on your most recent deployment, how did your unit perform on the specific areas you targeted in ATX?
    b. Were there areas you knew would be challenging (esp. collective tasks)?
    c. Were there collective task performance issues that came up that you were not expecting?
    d. If you could re-do your ATX / AWSC exercise, would you focus on any additional collective tasks?

EXPERIENCE WITH ATX

14. How much experience have you had attending or leading ATX? Can you describe your involvement? What role(s) did you fill? (i.e. flight lead, AMC, battle captain, etc.)
15. Have you been to the AWSC for ATX? What was your experience like?
    a. How useful did you find the training personally as an aviator?
    b. How useful did you find the training for your company?
    c. How useful did you find it for training at the battalion and/or brigade levels?
16. What areas of collective task performance did these exercises help you to perform better? (i.e. communication, identifying what you know and do not know, etc.)
    a. What about your company? Battalion? Aviation brigade?
17. For your upcoming exercise, do you have some target areas for collective task training?
    a. What are areas do you hope to work on individually at ATX? What about as Company? Battalion? Aviation brigade?
    b. How has your unit been preparing for ATX, or how will you prepare?
18. What type of feedback is helpful for training collective tasks at the Air Team, Company, Battalion, and Brigade levels?
    a. If you were in an exercise and you were doing something wrong (as an individual), how and when would you want feedback on your performance?
    b. As a team, how and when would you want feedback on our performance?
    c. What format would you prefer feedback to be in (verbal, written, etc.)?
    d. Have you ever had a hot wash that you will never forget? Can you tell me about it? Why was it so memorable – what did you learn?
    e. What about an AAR?
    f. At an event like the ATX, how do you know when your team, company, battalion, and brigade is performing well? How do you know when you are not?

19. We are developing measures to assess collective task performance primarily for use during ATX at AWSC. What do you believe would be the best place (hot wash, AAR?) for collective performance results to be presented? To whom should they be presented? In what format (report card, computer printout, etc.)?
    a. Would you want to just know how you did or would it be helpful to also know how you could improve (even if you did okay)?
    b. What level (individual, air team, company, battalion) would be appropriate to assess collective task performance for it to actually change future performance?
    c. In general, once you get feedback either at the individual or more so at the collective level, how do you implement feedback to ensure improvement the next time?

ADDITIONAL QUESTIONS OR COMMENTS

20. Do you have any additional comments for us about your experience with Collective Task performance, either in exercises or in theater?
21. May we contact you with brief (15 min) additional questions after your unit goes through ATX? If there is time while we are on site (we will not interfere in any with your ATX!), would you be willing to meet with us again for 15 minutes or so?
    a. If yes, can you provide us with your email and phone contact information?

APPENDIX C

PERFORMANCE INDICATOR LIST

Mission Event	PI Number	PI Title	Position
		Mission Planning Phase	
1 Pre-Mission Planning			
	1.1	Coordination for Brief Preparation	Battalion Staff
	1.1.1	Coordinate with Adjacent, Higher, and Lower Units	Staff Counterparts, LNO
	1.1.2	Adherence to SOP Battle Rhythm	Battalion Staff, Brigade Staff
	1.2	Operation Summary (Past, Current, Future)	S3 Section
	1.3	Flight Team and Aircrew Mission Preparation	Air Mission Commander
	1.3.1	Flight Team Briefs	Air Mission Commander
	1.3.2	Establish weapons release authority	Air Mission Commander
	1.3.3	Aircrew Briefs	Air Mission Commander
2 Mission Analysis			
	2.1	Flight Team Receipt of WARNO and Parallel Mission Planning	Flight Team (Air Mission Commander)
	2.2	Mission Coordination	Battalion Staff and Flight Crews
	2.2.1	Airspace	Battalion Staff and Flight Crews
	2.2.2	Coalition Forces	Battalion Staff and Flight Crews
	2.2.3	Obtain UAS Feeds (if possible)	Battalion Staff and Flight Crews
	2.2.4	Update Friendly Situation	Battalion Staff and Flight Crews
	2.2.5	Verify Communication Frequencies	Battalion Staff and Flight Crews
	2.2.6	Verify Call Signs	Battalion Staff and Flight Crews
	2.2.7	Verify Grid Locations	Battalion Staff and Flight Crews
	2.2.8	Threat Update	Battalion Staff and Flight Crews
	2.2.9	React to threat update/change COA	Battalion Staff and Flight Crews

(continued)

Mission Event	PI Number	PI Title	Position
3 Task Quick Reaction Force (QRF)			
	3.1	Attend Final Mission Brief as required	Air Mission Commander
	3.1.1	Final Adjustments to Plan	Flight Team
	3.1.2	Report changes to aircrew	Flight Team
	3.2	Request SITREP on Net (prior to launch)	Air Mission Commander
	3.3	Launch Order	Battle Captain
		Enroute Phase	
4 Enroute			
	4.1	Call Off to Battalion TOC	Air Mission Commander
	4.1.1	Battalion Staff log the flight off and acknowledge	Brigade Battalion Battle Captain
	4.1.2	Report to higher Flight Team Departure	Brigade Battalion Battle Captain
	4.1.3	Report to ground forces that Flight Team is Enroute	Brigade Battalion Battle Captain
	4.2	Aircrew to deconflict airspace as required (air traffic services)	Flight Lead
	4.3	Monitor and Acknowledge Updates	As assigned according to SOP
	4.4	Coordinate Team Tactics with wingman	Flight Lead et al.
	4.4.1	Loiter or Holding Area	Flight Lead et al.
	4.4.2	Deconfliction Measures	Flight Lead et al.
	4.4.3	Delegation of coordination and flight related duties (e.g. Communications)	Air Mission Commander
	4.5	Adherence to the SOP	Air Mission Commander
	4.5.1	Formation	Air Mission Commander
	4.5.2	Flight Duties	Air Mission Commander
	4.5.3	Communication Protocol	Air Mission Commander
	4.5.4	SOP Driven Communication (FARM etc.)	Air Mission Commander
	4.5.5	Tactics	Air Mission Commander

(continued)

Mission Event	PI Number	PI Title	Position
	4.6	Execute Air Ground Integration Checklist	Aircrew to Ground Commander
	4.6.1	Check-in with Ground	Battalion and Company Nets
	4.6.1.1	Number of Aircraft	Battalion and Company Nets
	4.6.1.2	Number and Type of Weapons System Available	Battalion and Company Nets
	4.6.1.3	Station Time	Battalion and Company Nets
	4.6.1.4	Request SITREP	Battalion and Company Nets
	4.6.2	Receive SITREP from Ground	Ground Commander to Aircrew
	4.6.2.1	Frontline Trace and unit composition	Ground Commander to Aircrew
	4.6.2.2	Markings	Ground Commander to Aircrew
	4.6.2.3	Updates to the situation	Ground Commander to Aircrew
	4.6.2.4	Obtain UAS feed (if/when possible)	Ground Commander to Aircrew
	4.6.2.4.1	Goal is to obtain as soon as possible in mission thread	Ground Commander to Aircrew
	4.6.2.5	Immediate Airspace Deconfliction and/or Avoidance Measures	Ground Commander to Aircrew
		Mission Execution Phase	
5 Arrive on Station - Update Situational Awareness			
	5.1	Communicate Arrival On Station	Air Mission Commander to Battle Captain and Ground Commander
	5.1.1	Update Situation as needed	Between Aircrew and TOC and Aircrew and Ground Commander
	5.2	Visually ID location of Friendlies	Aircrew to Ground Commander
	5.2.1	Verbally Confirm location	Aircrew to Ground Commander
	5.2.2	Visual/Digital (Blue Force Tracker) if equipped or possible	Aircrew to Ground Commander

(continued)

Mission Event	PI Number	PI Title	Position
	5.3	Develop Plan/Scheme of Maneuver	Aircrew to Ground Commander
	5.3.1	Establish Task and Purpose for Aviation Assets	Ground Commander
	5.3.2	Establish clearance of fires authority	Between Aircrew and Ground Commander
	5.3.3	Coordinate Designation and Shooter Duties	Between Aircrew and appropriate assets
	5.3.4	Discuss plan among aircrews	Aircrew
	5.3.5	Recommend course of action to Ground Commander	Aircrew and Ground Commander
	5.4	Provide security in accordance to unit SOP (this can be a part of all the sections)	Wingman
	5.5	Develop the situation	Aircrew
	5.5.1	Use UAS data to develop the situation	Aircrew and Ground Commander
	5.5.2	Establish UAS command Relationship (Direct Support, OPCON, etc)	Aircrew and Ground Commander
	5.6	Communicate Differences in Pattern of Life as appropriate	Aircrew
6 Target Acquisition (In parallel with on station tasks)			
	6.1	Communicate Last Known Position and Description of Target	Ground Commander
	6.1.1	Request this information if not given freely	Air Mission Commander
	6.2	Begin Search for Target	Flight Team
	6.2.1	Incorporate the ISR Plan	Flight Team
	6.2.2	Visual	Flight Team
	6.2.3	Sensor	Flight Team
	6.2.3.1	Choose proper sensor given ambient conditions	Flight Team

Mission Event	PI Number	PI Title	Position
	6.2.3.2	Share sensor feeds if required	Flight Team
	6.2.4	Recognize threats	Flight Team
	6.2.4.1	Utilize Appropriate Standoff Distance	Flight Team
	6.3	Announce target in sight	Flight Team
	6.3.1	Wingman confirm target	Flight Team
	6.4	Communicate Target Acquisition to ground forces	Aircrew and Ground Commander
	6.5	Confirm target with appropriate marking technique for Ground Commander using SOP	Aircrew and Ground Commander
7 Apply ROE			
	7.1	Confirm Ground Commanders intent	Ground and Air Commander
	7.1.1	If apply lethal, determine hostile intent	Ground and Air Commander
	7.1.1.1	Ground Commander or AMC must confirm hostile intent	Ground and Air Commander
	7.2	Discuss lethal nonlethal COAs	Ground and Air Commander
	7.3	Discuss proportionality	Ground and Air Commander
	7.3.1	Desired effect accomplished with minimal collateral damage	Ground and Air Commander
	7.3.2	Weapon choice made and fires coordinated	Ground and Air Commander
	7.3.3	Engagement Scheme of Maneuver	Ground and Air Commander
	7.4	Discuss collateral damage	Ground and Air Commander
	7.4.1	Minimum safe distance for weapon effect	Ground and Air Commander
	7.5	Make Shoot/Don't Shoot Decision	Appropriate Command Element
	7.5.1	Communicate Decision to ground	Air Mission Commander
	7.5.1.1	If Don’t Shoot, continue to observe	Flight Team
8 Clearance of Fires			
	8.1	Request Clearance of Fires from Ground Commander	Air Mission Commander

(continued)

Mission Event	PI Number	PI Title	Position
	8.1.1	Clearance Received and Acknowledged by appropriate authority	Ground Commander
	8.1.1.1	Cleared Hot	Ground Commander
	8.2	Verbally Communicate Weapons release clearance within flight	Air Mission Commander
9 Employ Weapon System			
	9.1	Fire weapon based on SOP and previous plan	Aircrew
	9.1.1	Flight lead sets inbound and formation	Aircrew
	9.1.2	Wingman provides overwatch and cover	Aircrew
	9.1.3	Applies appropriate weapons engagement technique based on SOP	Aircrew
	9.1.3.1	Employ appropriate combined arms technique.	Aircrew
	9.1.4	Flight lead calls engaging	Aircrew
	9.1.4.1	Wingman acknowledges	Aircrew
	9.1.5	Flight lead calls break	Aircrew
	9.1.5.1	Wingman acknowledges	Aircrew
	9.1.6	Wingman calls engaging (if required)	Aircrew
	9.1.6.1	Flight lead acknowledges	Aircrew
	9.2	Determine Effects of Weapons and Objective Met	Aircrew
	9.2.1	Communicate to Ground Commander	Air Mission Commander
	9.3	Determine Health State of Aircraft (if applicable)	Flight Team
	9.3.1	If damage, Go/No-go	Aircrew
	9.3.2	If no-go choose course of action	Flight Team
	9.3.2.1	Coordinate with ground forces and higher	Air Mission Commander, Ground Commander

(continued)

Mission Event	PI Number	PI Title	Position
		End of Mission Phase	
10 Battle Damage Assessment			
	10.1	Give BDA to Ground Commander as per unit SOP	Air Mission Commander
	10.1.1	Weapon Effect	Air Mission Commander
	10.1.2	Collateral Effects	Air Mission Commander
	10.2	Give BDA to TOC as per unit SOP	Aircrew Member
	10.2.1	Weapon Effect	Aircrew Member
	10.2.2	Collateral Effects	Aircrew Member
11 Obtain Revised Task and Purpose			
	11.1	Aircrew Determine FARM (Fuel Ammo Rockets Missiles)	Air Mission Commander Directed
	11.1.1	AMC Reports Status to higher and ground	Air Mission Commander
	11.1.2	Determine Go/No-go Status	Flight Team
	11.2	Obtain Next Mission	Flight Team
	11.2.1	If current mission incomplete coordinate with Ground Commander	Air Mission Commander to Ground Commander
	11.2.2	If current mission complete coordinate with TOC	Air Mission Commander to Battle Captain
	11.3	Egress Per Unit SOP and APG (Area Procedures Guide)	Air Mission Commander to Battle Captain
	11.3.1	Address METTTC	Air Mission Commander to Battle Captain
	11.4	Ingress to next mission if appropriate	Air Mission Commander to Battle Captain

(continued)

Mission Event	PI Number	PI Title	Position
		Post Flight Tasks and AAR Phase	
12 Post Mission			
	12.1	Post Flight Mission Tasks per SOP	Flight Team, Battalion
	12.1.1	Aircrew conducts post flight on aircraft	Flight Team, Battalion
	12.1.2	Battalion closes AMR	Flight Team, Battalion
	12.2	Conduct Debrief in accordance with unit SOP	Air Mission Commander and Battalion S2 Section at a minimum
	12.2.1	Notes	Air Mission Commander and Battalion S2 Section at a minimum
	12.2.2	Video	Air Mission Commander and Battalion S2 Section at a minimum
	12.2.3	Provide INPUT to the Story Board	Aircrew to Battalion Staff
	12.2.4	Create Story Board (if trigger pulled)	Battalion Staff
	12.3	Conduct AAR in accordance with unit SOP	Aircrew
	12.3.1	Notes	Aircrew
	12.3.2	Video	Aircrew
	12.3.3	Clear Concise and Complete	Aircrew
	12.3.4	Participatory	Aircrew

APPENDIX D

PROTOTYPE OBSERVER-BASED PERFORMANCE MEASURES

Army Aviation Collective Tasks (AACT)
Flight Team Performance Measures

1 Pre-Mission Planning

1.1 Coordination for Brief Preparation
1.1.1 Coordinate with Adjacent, Higher, and Lower Units
1.1.2 Adherence to SOP Battle Rhythm

1. Does the S3 Section brief the required elements of the Operation Summary (past, current, future) during the pre-mission brief?

1	2	3	4	5	
Staff does not brief all required elements		Staff briefs all required elements, but not all accurate or timely		Staff briefs all required elements in an accurate and timely manner	☐ N/A ☐ N/O

a. If applicable, which required elements were missed?

- ☐ Fires
- ☐ Airspace
- ☐ Signal (Call signs, grids, frequency)
- ☐ Weather
- ☐ Air/Ground scheme of maneuver
- ☐ Timelines
- ☐ ISR platforms
- ☐ Other (specify):

b. Does the Battle Captain provide updates and verify required information?

1	2	3	4	5	
Battle Captain does not check for updates		Battle Captain briefs information; some is current but not all		Battle Captain talks to all relevant units to get updates; verifies plan prior to the air crew brief	☐ N/A ☐ N/O

2. Does the Battalion staff brief the required Intelligence elements during the pre-mission brief?

1	2	3	4	5
Staff does not brief all required elements		Staff briefs all required elements, but not all accurate or timely		Staff briefs all required elements in an accurate and timely manner

☐ N/A
☐ N/O

a. If applicable, which required elements were missed?
- ☐ Last 12-24hrs
- ☐ Last 24-74 hrs
- ☐ Most Likely/Most Dangerous Enemy Course of Action
- ☐ Refine and Update PIR (BOLO)
- ☐ Terrain Analysis
- ☐ Other (specify):

1.2 Operation Summary (Past, Current, Future)

3. Does the flight incorporate the elements of the Operation Summary in their pre-mission planning?

1	2	3	4	5
Flight does not incorporate all information from the brief		Flight incorporates some information from the brief; plan is not fully developed		Flight incorporates all information from the brief; plan is fully developed

☐ N/A
☐ N/O

a. If applicable, which required elements were missed?
- ☐ Fires
- ☐ Airspace
- ☐ Signal (Call signs, grids, frequency)
- ☐ Weather
- ☐ Air/Ground scheme of maneuver
- ☐ Timelines
- ☐ ISR platforms
- ☐ Last 12-24 hrs
- ☐ Last 24-72 hrs
- ☐ Intel analysis of Enemy Course of Action in area of operation (e.g. most likely, most dangerous)
- ☐ Refine and Update PIR (BOLO)
- ☐ Terrain Analysis
- ☐ Other (specify):

1. 3 Flight Team and Aircrew mission preparation

4. Is the flight performing the appropriate tasks prior to take off?

1	2	3	4	5
Flight does not complete all tasks in time allotted		Flight completes all tasks in time allotted		Flight completes all tasks in time to perform rehearsals; prepares for contingencies

☐ N/A
☐ N/O

1.3.1 Flight Team Brief

5. Does the flight brief the mission in accordance with unit SOP?

1	2	3	4	5
Flight does not brief all required information		Flight briefs all required information, but not all accurate or timely		Flight briefs and discusses all required information in an accurate and timely manner

☐ N/A
☐ N/O

a. If applicable, which required elements were missed?

- ☐ Fires
- ☐ Airspace
- ☐ Signal (Call signs, grids, frequency)
- ☐ Weather
- ☐ Air/Ground scheme of maneuver
- ☐ Timelines
- ☐ ISR platforms
- ☐ Last 12-24 hrs
- ☐ Last 24-72 hrs
- ☐ Intel analysis of Enemy Course of Action in area of operation (e.g. most likely, most dangerous)
- ☐ Refine and Update PIR (BOLO)
- ☐ Terrain Analysis
- ☐ Other (specify):

6. Does the flight discuss and designate roles for the mission?

1	2	3	4	5	
AMC does not assign roles		AMC assigns roles per SOP		AMC assigns and flight discusses roles per SOP	☐ N/A ☐ N/O

1.3.2 Establish weapons release authority

7. Do the aircrews establish weapons release authority within the flight?

☐ Yes ☐ N/A
☐ No ☐ N/O

1.3.3 Aircrew Brief in accordance with SOP and checklist

8. Does the aircrew follow the aircrew brief checklist in accordance with SOP?

☐ Yes ☐ N/A
☐ No ☐ N/O

a. If no, what was missed?

☐ Mission Overview and Flight Plan

☐ Crew actions, duties, and responsibilities

☐ Emergency Actions and Downed Aircraft Procedures

☐ Downed Aircraft Procedures

☐ Analysis of the Aircraft (logbook, maintenance, PPC)

☐ SPINS

☐ Fighter Management and Risk Mitigation

☐ Other (specify)

2 Mission Analysis

2.1 Flight Team Receipt of WARNO and Parallel Mission Planning

9. Does the flight develop and/or adjust their mission plan according to information provided in the pre-mission brief and WARNO?

1	2	3	4	5	
Flight does not incorporate all information from the brief		Flight incorporates some information from the brief; plan is not fully developed		Flight incorporates all information from the brief; plan is fully developed	☐ N/A ☐ N/O

a. If applicable, which required elements were missed?

- ☐ Fires
- ☐ Airspace
- ☐ Signal (Call signs, grids, frequency)
- ☐ Weather
- ☐ Air/Ground scheme of maneuver
- ☐ Timelines
- ☐ ISR platforms
- ☐ Last 12-24 hrs
- ☐ Last 24-48 hrs
- ☐ Intel analysis of Enemy Course of Action in area of operation (e.g. most likely, most dangerous)
- ☐ Refine and Update PIR (BOLO)
- ☐ Terrain Analysis
- ☐ Other (specify):

2.2 Mission Coordination

2.2.1 Airspace

10. Does the flight coordinate airspace deconfliction measures with all entities prior to launch (e.g. ROZs, ground units, ATC, UAS, TOC, etc.)?

1	2	3	4	5	
Flight does not coordinate with other entities during airspace deconfliction		Flight coordinates with other entities; recommends adjustments to maximize their flight		Flight coordinates with other entities; recommends adjustments to maximize all assets	☐ N/A ☐ N/O

2.2.2 Coalition Forces

11. Does the flight ensure proper coordination (airspace, cross boundary request, transition request, other information required when operating in or through coalition area of operation) with coalition forces?

1	2	3	4	5	
Flight does not coordinate with coalition forces or seek updates		Flight coordinates with coalition forces to get updated information		Flight coordinates with coalition forces to get updated information and adjusts as needed	☐ N/A ☐ N/O

2.2.3 Obtain UAS Feeds (if possible)

12. Does the flight request and use UAS feeds, if available and needed?

1	2	3	4	5	☐ N/A ☐ N/O
Flight is unaware that UAS feeds are available		Flight requests UAS data and has UAS feeds available for use		Flight requests and uses (e.g. coordinates, discusses, controls, etc.) UAS to develop the situation	

2.2.4 Update Friendly Situation

13. Does the flight ensure it is aware of changes to the friendly situation?

1	2	3	4	5	☐ N/A ☐ N/O
Flight does not receive or ask for update		Flight receives update on friendly situation		Flight receives updated friendly situation and adapts as needed	

2.2.5 Verify Communication Frequencies

14. Is the flight utilizing communication in accordance with the Signal Operations Instructions (SOI) and SOP?

1	2	3	4	5	☐ N/A ☐ N/O
Flight does not utilize communications in accordance with SOI and SOP		Flight communicates via non-secure means when secure is appropriate		Flight utilizes communications in accordance with SOI and SOP	

   a. Does the flight use the correct communication frequencies?

      ☐ Yes ☐ N/A
      ☐ No ☐ N/O

2.2.6 Verify Callsigns

15. Does the flight ensure accurate call signs for units?

1	2	3	4	5	☐ N/A ☐ N/O
Flight does not obtain correct call signs prior to mission launch; requests from TOC during mission		Flight verifies call signs are accurate; requests from TOC before mission launch if incorrect		Flight establishes correct call signs and frequencies from parallel mission planning	

2.2.7 Verify Grid Locations

16. Does the flight ensure accurate grid location for friendlies?

1	2	3	4	5	☐ N/A ☐ N/O
Flight does not obtain accurate grid locations		Flight obtains grid location information; enters into system		Flight performs crosscheck of grid location information; verifies with supported commander	

2.2.8 Threat Update

17. Does the flight request a threat update?

☐ Yes ☐ N/A
☐ No ☐ N/O

18. If required, does the flight request additional information based on content of threat update?

1	2	3	4	5	☐ N/A ☐ N/O
Flight does not request additional information		Flight requests some additional information		Flight requests action to obtain all information required to fill SA	

2.2.9 React to threat update/change COA

19. Does the flight react appropriately to the threat update?

1	2	3	4	5	☐ N/A ☐ N/O
Flight executes pre-planned mission regardless of threat update		Flight recognizes adjustment required; creates hasty plan		Flight adjusts tactics to fit threat update	

3 Task Quick Reaction Force (QRF)

20. Was a QRF required?

- ☐ Yes ☐ N/A
- ☐ No ☐ N/O

3.1 Attend Final Mission Brief as required
3.1.1 Final Adjustments to Plan

21. Does the Flight adjust their plan according to differences between WARNO and Final Mission Brief

1	2	3	4	5	
Flight does not review current plan for changes		Flight acknowledges changes		Flight acknowledges changes and discusses impact on their plan	☐ N/A ☐ N/O

a. Is the flight performing the appropriate tasks prior to take off?

1	2	3	4	5	
Flight does not complete all tasks in time allotted		Flight completes all tasks in time allotted		Flight completes all tasks in time to perform rehearsals; prepares for contingencies	☐ N/A ☐ N/O

b. If time is limited, is the flight performing the appropriate tasks prior to QRF?

1	2	3	4	5	
AMC and aircrew are either all attending final brief or all preparing the aircraft		Pilots split duties between final air brief and final aircraft preparation		AMC and PCs attend final air brief while rest of aircrews ready the aircraft	☐ N/A ☐ N/O

3.1.2 Report changes to aircrew.

22. Does the AMC request mission updates from TOC prior to launch?

1	2	3	4	5	
AMC does not request changes		AMC requests update		AMC request update; verifies update with wingman	☐ N/A ☐ N/O

3.2 Request SITREP on Net

23. Does the AMC request SITREP from all appropriate resources prior to launch?

1	2	3	4	5
AMC does not check in with resources		AMC checks in with some resources (e.g. UAS, ground, BAE)		AMC checks in with all resources (e.g. UAS, ground, BAE)

☐ N/A
☐ N/O

24. Does the AMC confirm receipt of SITREP information to the flight?

1	2	3	4	5
AMC does not verify receipt of SITREP information by wingman		AMC queries wingman for confirmation		AMC verifies wingman receives; confirms understanding

☐ N/A
☐ N/O

25. Does the AMC adjust the COA in response to changes to the situation?

1	2	3	4	5
AMC does not adjust COA to address changes in the situation		AMC makes ad hoc adjustments to the COA to address changes in the situation		AMC applies contingency COAs to address changes in the situation

☐ N/A
☐ N/O

3.3 Launch Order

26. Was the final launch order communicated?

☐ Yes ☐ N/A
☐ No ☐ N/O

a. Does the flight launch as soon as they are authorized?

☐ Yes ☐ N/A
☐ No ☐ N/O

b. If no, was the delay communicated to the TOC?

1	2	3	4	5
No communication of delay to the TOC		Communicates delay to TOC; no indicates of new launch time		Immediately alerts the TOC will not make launch time; explains reason for delay; recommends new launch time; provides updates as necessary

☐ N/A
☐ N/O

4 Enroute

4.1 Call Off to Battalion TOC

27. Does the aircrew commander successfully call off to Battalion TOC?

☐ Yes ☐ N/A
☐ No ☐ N/O

4.1.1 Battalion Staff log the flight off and acknowledge

28. Does the Battalion Staff log the flight off and acknowledge?

1	2	3	4	5	
Staff does not acknowledge without repeated prompts; does not verify information		Staff acknowledges call off but does not verify information		Staff acknowledges call off; verifies information is correct	☐ N/A ☐ N/O

4.1.2 Report to higher Flight Team Departure

29. Does the Battalion Staff communicate aircrew takeoff time to Brigade TOC?

1	2	3	4	5	
Staff does not communicate aircrew takeoff time		Staff communicates aircrew takeoff time but it is not timely; some incorrect information is passed		Staff immediately passes aircrew takeoff time; information is accurate	☐ N/A ☐ N/O

4.1.3 Report to ground forces that Flight Team is Enroute

30. Does the Battalion Staff communicate aircrew takeoff time to Ground Unit TOC as required?

1	2	3	4	5	
Staff does not communicate aircrew takeoff time or ETA; no communication with ground unit TOC		Staff communicates aircrew takeoff time and ETA		Staff immediately passes aircrew takeoff time and ETA; provides additional situation awareness information (e.g. call sign, number of aircraft, weapons available, etc.)	☐ N/A ☐ N/O

4.2 Aircrew to deconflict airspace as required (air traffic services)

31. Does the flight deconflict the airspace?

1	2	3	4	5	
Flight does not use information sources to anticipate events; does not make radio calls		Flight uses information sources to anticipate events but does not push information to rest of team		Flight uses information sources to anticipate events and proactively pushes information to rest of team)	☐ N/A ☐ N/O

4.3 Monitor and Acknowledge Updates

32. Does the flight monitor air to air radio communication?

1	2	3	4	5	
Flight does not monitor or acknowledge air to air communications		Flight monitors and disseminates air to air communications		Flight monitors air to air communications; discusses and addresses impacts to mission	☐ N/A ☐ N/O

33. Does the flight monitor ground channels?

1	2	3	4	5	
Flight does not monitor updates		Flight monitors and disseminates updates		Flight monitors updates; discusses and addresses impacts to mission	☐ N/A ☐ N/O

4.4 Coordinate Team Tactics with wingman

34. Does the flight coordinate team tactics internally?

1	2	3	4	5	
No collaboration; AMC dictates decision on COA.		Collaborative discussion, but not timely; overanalyzes decision.		Collaborative discussion is short and concise; considers all variables (e.g., loiter, orbit, approaches, threats); timely decision on COA	☐ N/A ☐ N/O

4.4.1 Loiter or Holding Area

35. Does the flight select holding area?

1	2	3	4	5	
Flight selects area without considering tactical implications (e.g., too small, indefensible, cannot communicate)		Flight selects an area; area is suitable but not optimal		Flight selects an area; considers size, comms, defensibility, etc. to identify optimal location	☐ N/A ☐ N/O

a. If applicable, what tactical implications were missed?

- ☐ Concealment
- ☐ Obstacles
- ☐ Key terrain
- ☐ Approach and departure directions
- ☐ 360° Security
- ☐ Other (specify):

36. Does the flight select loiter area?

1	2	3	4	5	
Flight selects area without considering tactical implications (e.g., too small, indefensible, cannot communicate)		Flight selects an area; area is suitable but not optimal		Flight selects an area; considers size, comms, defensibility, etc. to identify optimal location	☐ N/A ☐ N/O

a. If applicable, what tactical implications were missed?

- ☐ Size
- ☐ Suitable location
- ☐ Communication availability
- ☐ Altitude for loiter
- ☐ Pattern of loiter
- ☐ Time to target
- ☐ Other (specify):

4.4.2 Deconfliction Measures

37. Does the flight develop the appropriate flight deconfliction measures?

☐ Yes ☐ N/A
☐ No ☐ N/O

4.4.3 Delegation of coordination and flight related duties (e.g. Communications)

38. Does the flight delegate and coordinate flight related duties (e.g., communication) in response to a change in the mission?

1	2	3	4	5	☐ N/A ☐ N/O
Flight does not have a plan; confusion over assigned tasks		Flight continues with assigned flight duties; adapts to current situation		Flight reassigns duties to suit situation	

4.5 Adherence to the SOP

39. Does the flight adhere to the SOP?

1	2	3	4	5	☐ N/A ☐ N/O
Flight does not follow SOP; does not communicate deviation from SOP		Flight follows SOP and adapts within its constraints		Flight understands SOP and deviates when necessary; communicates deviation for flight internal SA	

40. If a deviation was required, did the flight appropriately deviate from the SOP?

1	2	3	4	5	☐ N/A ☐ N/O
Flight did not recognize need for deviation; did not deviate from the SOP		Flight recognized need for deviation; did not appropriately deviate from the SOP		Flight recognized need for deviation; deviated appropriately from the SOP	

4.5.1 Formation

41. Does the flight discuss vertical and lateral displacement, tactics, and protection of flight?

1	2	3	4	5	☐ N/A ☐ N/O
No detailed plan or discussion		Defines all measures but does not discuss adjustments		Defines all measures and discusses required adjustments	

42. Does the flight adhere to the flight formation as briefed?

1	2	3	4	5	
Flight maintains loose formation; no discussion on the formation or changes to the formation		Flight sets formation based on briefed tactics		Flight sets formation based on briefed tactics; constantly updates formation based on current situation	☐ N/A ☐ N/O

4.5.2 Flight Duties

43. Does the flight adhere to the flight duties required for the mission?

1	2	3	4	5	
Flight does not adhere to flight duties		Flight adheres to flight duties; no further coordination or backup		Flight adheres to flight duties; adjusts to mitigate task overload and based on current situation	☐ N/A ☐ N/O

4.5.3 Communication Protocol

44. Does the flight follow appropriate communication protocol?

1	2	3	4	5	
Flight uses some available communication tools (e.g., data, voice); does not use pro-words or brevity codes as required; stepovers occur		Flight uses some available communication tools (e.g., data, voice); uses pro-words and brevity codes		Flight uses appropriate communication tools (e.g., data, voice); uses pro-words and brevity codes; messages contain appropriate level of detail	☐ N/A ☐ N/O

4.5.4 SOP Driven Communication (FARM etc.)

45. Does the flight use the SOP to dictate the right communication flow?

1	2	3	4	5	
Flight does not follow the proper SOP report order		Flight follows the proper SOP report order		Flight follows the proper SOP report order; weighs the information against the plan and uses it to adjust the plan	☐ N/A ☐ N/O

4.5.5 Tactics

46. Does the flight develop appropriate tactics if there is misalignment between SOP and situation?

1	2	3	4	5	
Flight does not recognize the misalignment; makes no changes to SOP or tactics		Flight recognizes misalignment; tries to fit the SOP to the situation		Flight recognizes misalignment; appropriately modifies the tactics based on the environment	☐ N/A ☐ N/O

4.6 Execute Air Ground Integration Checklist
4.6.1 Check-in with Ground
4.6.1.1 Number of Aircraft
4.6.1.2 Number and Type of Weapons System Available
4.6.1.3 Station Time
4.6.1.4 Request SITREP

47. When does the flight make the check-in call to Ground?

1	2	3	4	5	
On arrival		Before they arrive in the AO		Immediately upon radio communication range	☐ N/A ☐ N/O

48. Does the flight check in with ground?

1	2	3	4	5	
Flight does not know proper format; misses multiple items		Flight checks in with all appropriate items; check-in not done in correct order		Flight checks in with all appropriate items; check-in done in correct order	☐ N/A ☐ N/O

a. Which items were missed?

☐ Call sign

☐ Type and Number of Aircraft

☐ Type and Number of Weapons System Available

☐ Station Time

☐ Request SITREP

b. Did the ground acknowledge aircraft?

☐ Yes ☐ N/A
☐ No ☐ N/O

c. Did the ground send SITREP to flight?

- ☐ Yes ☐ N/A
- ☐ No ☐ N/O

4.6.2 Receive SITREP from Ground
4.6.2.1 Frontline Trace and unit composition
4.6.2.2 Markings
4.6.2.3 Updates to the situation

49. Does the flight receive the SITREP from Ground?

1	2	3	4	5
Flight does not receive SITREP; does not follow up with request		Flight receives SITREP		Flight receives SITREP; verifies completeness and requests information pertinent to mission

☐ N/A ☐ N/O

4.6.2.4 Obtain UAS feed (if/when possible)
4.6.2.4.1 Goal is to obtain as soon as possible in mission thread

50. If UAS feed was available, when does the flight request it?

1	2	3	4	5
Flight does not request		Flight requests, but not as soon as possible		Flight requests as soon as possible in mission thread

☐ N/A ☐ N/O

4.6.2.5 Immediate Airspace Deconfliction and/or Avoidance Measures

51. Does the flight verify the airspace is clear or free from obstacles (e.g. helicopters, fixed wing, UAS, artillery)?

1	2	3	4	5
Flight does not verify airspace deconfliction		Flight reviews ROZ information		Flight reviews ROZ information; makes final call to verify prior to entering airspace

☐ N/A ☐ N/O

5 Arrive on Station - Update Situational Awareness

5.1 Communicate Arrival on Station
5.1.1 Update Situation as needed

52. Does the flight communicate on-station arrival?

- ☐ Yes ☐ N/A
- ☐ No ☐ N/O

5.2 Visually ID location of Friendlies

53. Does the flight communicate location of the friendlies to the ground TOC?

☐ N/A
☐ N/O

1	2	3	4	5
Flight does not pass correct information to TOC		Flight passes correct information to TOC		Flight passes correct information to TOC; communicates implications of friendly position on mission execution

5.2.1 Verbally Confirm location

54. Does the flight confirm location of friendlies verbally?

☐ N/A
☐ N/O

1	2	3	4	5
Flight does not verbally confirm location of friendlies		Flight verbally confirms location of friendlies		Flight verbally confirms location of friendlies; confirms among aircrews as well

5.2.2 Visual/Digital (Blue Force Tracker) if equipped or possible

55. Does the flight identify the location of friendlies using all sources available?

☐ N/A
☐ N/O

1	2	3	4	5
Flight does not use available resources		Flight uses some of the available resources		Flight maximizes use of all available resources

5.3 Develop Plan/Scheme of Maneuver

5.3.1 Establish Task and Purpose for Aviation Assets

56. Does the flight work with the ground to establish task and purpose for their mission?

1	2	3	4	5
Flight does not communicate with ground to establish task and purpose		Flight communicates with ground to establish task and purpose		Flight collaborates with ground to meet commander's intent

☐ N/A
☐ N/O

5.3.2 Establish clearance of fires authority.

57. Does the flight establish who has clearance of fires authority?

☐ Yes ☐ N/A
☐ No ☐ N/O

5.3.3 Coordinate Designation and Shooter Duties

58. Do the aircrews coordinate and designate shooter duties within the flight?

1	2	3	4	5
Aircrews do not have an established plan for designating shooter; still discussing roles.		Aircrews have a plan; assigns duties according to plan		Aircrews have a plan; continuously updates plan and assigns or reassigns duties based on updates to the situation

☐ N/A
☐ N/O

5.3.4 Discuss plan among aircrews

59. Does the flight discuss applicable changes to the tactical mission?

1	2	3	4	5
Flight does not discuss		Flight discusses; considers changes if required but tries to force initial plan		Flight discusses; makes changes if required

☐ N/A
☐ N/O

5.3.5 Recommend course of action to Ground Commander

60. Does the flight recommend course of action to Ground Commander?

1	2	3	4	5	☐ N/A ☐ N/O
Flight does not recommend course of action; moves forward with own plan		Flight recommends course of action before discussing with ground		Flight establishes course of action based on discussion with ground over execution of task and purpose	

5.4 Provide security in accordance to unit SOP (this can be a part of all the sections)

61. Does the flight establish security within the flight?

1	2	3	4	5	☐ N/A ☐ N/O
Flight does not establish or follow security plan		Flight maintains security using assigned duties		Flight maintains security using assigned duties; constant communication between aircraft to maintain a high level of security	

5.5 Develop the situation

62. Does the flight continue to develop the situation with ground?

1	2	3	4	5	☐ N/A ☐ N/O
Flight continues the mission using only the information provided in check-in with ground and their recommended COA		Flight continues to observes situation and passes information to ground		Flight continues to observe the situation; constant dialog with ground to develop situation	

5.5.1 Use of UAS data to develop the situation

63. If dedicated UAS data is available, does the flight communicate information to ground forces?

1	2	3	4	5	☐ N/A ☐ N/O
Flight does not offer information to ground		Flight shares some information with ground when asked		Flight pushes all relevant and available information to ground	

64. If UAS data (beyond dedicated mission support UAS) is available, does the flight communicate information to ground forces?

1	2	3	4	5	
Flight does not offer information to ground		Flight shares some information with ground when asked		Flight pushes all relevant and available information to ground	☐ N/A ☐ N/O

65. If additional ISR data is available, does the flight share information with ground forces?

1	2	3	4	5	
Flight does not offer information to ground		Flight shares some information with ground when asked		Flight pushes all relevant and available information to ground	☐ N/A ☐ N/O

5.5.2 Establish UAS command relationship (Direct Support, OPCON, etc)

66. Does the flight coordinate with UAS control authority?

1	2	3	4	5	
Flight does not establish relationship		Flight establishes relationship		Flight establishes relationship; works to develop the situation	☐ N/A ☐ N/O

5.6 Communicate Differences in Pattern of Life as appropriate

67. Does the flight communicate observed differences in pattern of life?

1	2	3	4	5	
Flight doesn’t recognize or communicate differences		Flight recognizes and communicates differences		Flight recognizes and communicates change; discusses courses of action based on differences	☐ N/A ☐ N/O

6 Target Acquisition (In parallel with on station tasks)

6.1 Communicate Last Known Position and Description of Target
6.1.1 Request this information if not given freely

68. Does the flight communicate with ground to locate the target?

1	2	3	4	5	
Flight uses last SITREP and begins search; does not coordinate further with ground		Flight asks ground for target location		Flight maintains dialogue with ground to identify targets	☐ N/A ☐ N/O

6.2 Begin Search for Target
6.2.1 Incorporate the ISR plan (areas of observation)
6.2.2 Visual
6.2.3 Sensor

69. Does the flight incorporate the ISR plan?

1	2	3	4	5	
Flight does not use all assets available; does not distribute areas of observation		Flight coordinates use of sensors and available assets; distributes areas of observation		Flight coordinates use of sensors and available assets; distributes areas of observation; factors in METT-TC	☐ N/A ☐ N/O

70. Does the flight actively search for the target?

1	2	3	4	5	
Flight does not have a plan in place for search; does not distribute areas of observation		Flight executes an ISR plan; does not effectively distribute areas of observation		Flight executes an ISR plan that is adapted to search environment	☐ N/A ☐ N/O

6.2.3.1 Choose proper sensor given ambient conditions

71. Does the flight use the appropriate sensors to search for targets?

1	2	3	4	5	
Flight does not use available sensors		Flight uses some of the available sensors		Flight maximizes use of all available sensors	☐ N/A ☐ N/O

6.2.3.2 Share sensor feeds if required

72. Does the flight share sensor feeds among aircrews?

1	2	3	4	5	☐ N/A ☐ N/O
Flight does not share sensor feeds; no cross-talk among aircraft		Flight shares sensor feeds; no cross-talk among aircraft		Flight shares sensor feeds; cross-talk focuses on what observations are being made	

6.2.4 Recognize threats

73. Does the flight effectively recognize threats?

1	2	3	4	5	☐ N/A ☐ N/O
Flight does not recognize threats		Flight recognizes possible threats		Flight recognize threats; evaluates potential impact on mission; reports as necessary	

6.2.4.1 Utilize Appropriate Standoff Distance

74. Does the flight utilize an appropriate standoff distance?

1	2	3	4	5	☐ N/A ☐ N/O
Flight does not apply appropriate standoff distance to search based on perceived threat; gross violations of minimum standoff		Flight considers appropriate standoff distance; small, unintended violations of minimum standoff		Flight applies appropriate standoff distance; no violations occur	

6.3 Announce target in sight

75. Does the aircrew announce that the target is in sight?

1	2	3	4	5	☐ N/A ☐ N/O
Aircrew does not communicate detection of target to other aircraft		Aircrew announces detection		Aircrew announces detection; pushes target information	

76. Does the flight use correct terms to announce target in sight?

1 2 3 4 5 ☐ N/A ☐ N/O

1	3	5
Flight does not use correct terms; not concise	Flight uses correct terms with a few errors; not concise	Flight uses correct terms; concise

6.3.1 Wingman confirm target

77. Does the wingman confirm target detection?

1 2 3 4 5 ☐ N/A ☐ N/O

1	3	5
Wingman does not acknowledge detection of the target	Wingman acknowledges detection of the target	Wingman establishes PID

78. Does the wingman use correct terms to confirm target?

1 2 3 4 5 ☐ N/A ☐ N/O

1	3	5
Wingman does not use correct terms; not concise	Wingman uses correct terms with a few errors; not concise	Wingman uses correct terms; concise

6.4 Communicate Target Acquisition to ground forces

79. Does the flight confirm target acquisition to ground?

1 2 3 4 5 ☐ N/A ☐ N/O

1	3	5
Flight does not communicate target acquisition to ground	Flight communicates target acquisition to ground while maintaining PID	Flight communicates target acquisition and transfers PID to ground

6.5 Confirm target with appropriate marking technique for Ground Commander using SOP

80. Does the flight mark the target to confirm its location?

1	2	3	4	5	
Flight does not mark correct target or uses the incorrect maker		Flight marks target		Flight discusses marking strategy with ground; marks target appropriately	☐ N/A ☐ N/O

7 Apply ROE

7.1 Confirm Ground Commander's intent

81. Does the flight consider Ground Commander's intent?

1	2	3	4	5	
Flight does not consider Ground Commander's intent		Flight considers Ground Commander's intent		Flight considers and confirms Ground Commander's intent	☐ N/A ☐ N/O

7.1.1 If apply lethal, determine hostile intent
7.1.1.1 Ground Commander or AMC must confirm hostile intent

82. Does the flight confirm hostile intent prior to applying lethal force?

☐ Yes ☐ N/A
☐ No ☐ N/O

a. If no, why not?

1	2	3	4	5	
Flight does not discuss hostile intent		Flight assumes hostile intent; relies on other reports		Flight determines possible hostile intent; talks themselves into it	☐ N/A ☐ N/O

7.2 Discuss lethal nonlethal COAs

83. Does the flight discuss lethal and nonlethal COAs with Ground Commander?

☐ N/A
☐ N/O

1	2	3	4	5
Flight does not know commander's intent; acts without considering commander's intent		Flight applies commander's intent		Flight applies commander's intent; communicates alternative COAs based on aerial perspective

7.3 Discuss proportionality
7.3.1 Desired effect accomplished with minimal collateral damage

84. Does the flight discuss proportionality?

☐ N/A
☐ N/O

1	2	3	4	5
Flight does not discuss proportionality		Flight discusses proportionality		Flight uses proportionality considerations to select the most appropriate weapon

7.3.2 Weapon choice made and fires coordinated

85. Does the flight choose the right weapon and coordinate fires?

☐ N/A
☐ N/O

1	2	3	4	5
Flight misappropriates weapons; does not coordinate fires within the flight		Flight selects appropriate weapons system; coordinate fires within the flight		Flight selects appropriate weapons system; coordinates fires within flight and with ground

7.3.3 Engagement Scheme of Maneuver

86. Does the flight coordinate an engagement scheme of maneuver?

☐ N/A
☐ N/O

1	2	3	4	5
Flight does not coordinate a scheme of maneuver		Flight coordinates a scheme of maneuver applicable for the situation		Flight coordinates a scheme of maneuver optimized for the situation

7.4 Discuss collateral damage
7.4.1 Minimum safe distance for weapon effect

87. Does the flight consider collateral damage?

1 2 3 4 5

☐ N/A
☐ N/O

1	3	5
Flight does not consider collateral damage	Flight discusses collateral damage	Flight uses collateral damage considerations to select method of engagement and weapon system

7.5 Make Shoot/Don't Shoot Decision

88. Does the flight make an appropriate shoot/don’t shoot decision (e.g. considers commander’s intent; hostile intent; collateral damage)?

1 2 3 4 5

☐ N/A
☐ N/O

1	3	5
Flight does not consider critical variables before making shoot/don’t shoot decision	Flight considers critical variables before making shoot/don’t shoot decision	Flight considers critical variables before making shoot/don’t shoot decision; develops alterative COAs if don’t shoot is determined

7.5.1 Communicate Decision to ground

89. Does the flight communicate shoot/don’t shoot decision to ground?

1 2 3 4 5

☐ N/A
☐ N/O

1	3	5
Flight does not communicate decision to ground	Flight communicates decision to ground; does not provide alternative COAs	Flight communicates decision to ground; provides alternative COAs

7.5.1.1 If Don’t Shoot, continue to observe.

90. Does the flight continue to observe the target after don’t shoot decision is made?

1 2 3 4 5

☐ N/A
☐ N/O

1	3	5
Flight goes off station after don’t shoot decision is made	Flight remains on station and continues to observe target	Flight remains on station and continues to develop the situation

8	Clearance of Fires

8.1 Request Clearance of Fires from Ground Commander

91. Does the flight request clearance of fires from Ground Commander?

1	2	3	4	5
Flight does not request clearance of fires		Flight considers ROE; establishes friendly/enemy positions; requests clearance of fires; not ready to effect the target while going through this process		Flight considers ROE; establishes friendly/enemy positions; requests clearance of fires; anticipates clearance and sets up shot during this process

- N/A
- N/O

8.1.1 Clearance Received and Acknowledged by appropriate authority

8.1.1.1 Cleared Hot

92. Does the flight receive acknowledgement of clearance of fires from ground prior to engagement?

- Yes
- No
- N/A
- N/O

8.2 Verbally Communicate Weapons release clearance within flight

93. Does the AMC communicate weapons release clearance within the flight?

1	2	3	4	5
AMC does not communicate weapons release clearance to the rest of the flight		AMC communicates cleared hot, but does not confirm acknowledgement from rest of the flight		AMC communicates and confirms cleared hot from rest of the flight

- N/A
- N/O

9	Employ Weapon System

9.1 Fire weapon based on SOP and previous plan.
9.1.1 Flight lead sets inbound and formation

94. Does the flight establish inbound heading and formation in accordance with briefed tactics?

1	2	3	4	5	
Flight does not communicate, does not follow briefed inbound heading and formation		Flight communicates follows briefed inbound heading and formation		Flight communicates and follows briefed inbound heading and formation; trail effectively covers lead	☐ N/A ☐ N/O

9.1.2 Wingman provides overwatch and cover

95. Does the wingman provide overwatch and cover?

1	2	3	4	5	
Wingman does not provide overwatch and cover; fixates on target		Wingman provides overwatch and cover; uses appropriate resources to aid in overwatch		Wingman provides overwatch and cover; uses appropriate resources to aid in overwatch; communicates developing situation with lead aircraft	☐ N/A ☐ N/O

9.1.3 Applies appropriate weapons engagement technique based on SOP
9.1.3.1 Employ appropriate combined arms technique.

96. Does the flight apply appropriate weapons engagement technique based on threat environment (METT-TC)?

1	2	3	4	5	
Flight does not apply appropriate technique; target not prosecuted		Flight does not apply appropriate technique; target still prosecuted		Flight applies appropriate technique; target prosecuted	☐ N/A ☐ N/O

9.1.4 Flight lead calls engaging
9.1.4.1 Wingman acknowledges
9.1.5 Flight lead calls break
9.1.5.1 Wingman acknowledges
9.1.6 Wingman calls engaging (if required)
9.1.6.1 Flight lead acknowledges

97. Does the flight communicate appropriately throughout the engagement ?

1	2	3	4	5	
Aircrews employ inappropriate radio chatter		Aircrews employ clear, concise, and timely radio calls		Aircrews employ clear, concise, and timely radio calls; acknowledgements made in a timely manner	☐ N/A ☐ N/O

a. Position boxes

- ☐ Lead Aircraft
- ☐ Trail Aircraft
- ☐ Other lead (specify):
- ☐ Other trail (specify):

9.2 Determine Effects of Weapons and Objective Met

98. Does the flight determine effects of weapons and meeting of engagement objectives?

1	2	3	4	5	
Flight does not determine weapons effects; does not communicate effects		Flight determines effects of weapons; communicates within flight		Flight determines effects of weapons; communicates within flight; determines next COA	☐ N/A ☐ N/O

9.2.1 Communicate to Ground Commander

99. Does the flight communicate weapons effect to ground?

1	2	3	4	5	
Flight does not communicate weapons effect		Flight communicates weapons effect; not clear and descriptive		Flight communicates weapons effect; clear, concise, and descriptive	☐ N/A ☐ N/O

9.3 Determine Health State of Aircraft (if applicable)
9.3.1 If damage, Go/No-go
9.3.2 If no-go choose course of action
9.3.2.1 Coordinate with ground forces and higher

100. Do the aircrews determine the health states of their aircrafts?

1	2	3	4	5	
Aircrews do not consider health status of aircraft		Aircrews check warning and caution lights; determine go/no-go		Aircrews check warning and caution lights; perform visual inspections of others' aircrafts; discuss observed damage locations; determine go/no-go	☐ N/A ☐ N/O

a. Which aircrews did not determine health status?

	Present	Checked health
Lead aircraft	☐	☐
Trail aircraft	☐	☐
Other (text box)	☐	☐
Other (text box)	☐	☐

b. If no-go, do the aircrews choose an appropriate course of action?

1	2	3	4	5	
Aircrews react to no-go decision without consideration for threat, other aircrews, etc.; do not coordinate with others		Aircrews determine proper course of action in response to no-go decision; coordinate with ground and higher aviation		Aircrews follow predetermined contingency plan; coordinate with ground and higher aviation	☐ N/A ☐ N/O

10	Battle Damage Assessment

10.1 Give BDA to Ground Commander as per unit SOP
10.1.1 Weapon Effect
10.1.2 Collateral Effects
10.2 Give BDA to TOC as per unit SOP
10.2.1 Weapon Effect

101. Does the flight conduct a battle damage assessment?

1	2	3	4	5	
Flight does not conduct BDA; assumes target is destroyed without verification		Flight evaluates target; reports BDA to ground and command elements		Flight evaluates target; proactively reports complete BDA in proper protocol pushes/reports BDA to ground and appropriate command elements	☐ N/A ☐ N/O

a. Which required elements were missed?
- ☐ Supported unit (ground)
- ☐ Air Element TOC
- ☐ Other (specify):

b. What BDA items were missed?
- ☐ Sending to right place
- ☐ Alpha, Call sign of observing source
- ☐ Bravo, location of target
- ☐ Charlie, time strike started and ended
- ☐ Delta, percentage of target coverage
- ☐ Echo: itemized destruction

11	Obtain Revised Task and Purpose

11.1 Air Crew Determine FARM (Fuel Ammo Rockets Missiles)

102. Do the aircrews discuss FARM (Fuel, Ammo, Rockets, Missiles)?

1	2	3	4	5	
Aircrews do not determine FARM; assume appropriate stores		Aircrews make accurate assessment of FARM		Aircrews make accurate assessment of FARM; discuss capabilities based on FARM	☐ N/A ☐ N/O

11.1.1 AMC Reports Status to higher and ground
11.1.2 Determine Go/No-go Status for revised task and purpose

103. Does the flight advise ground on go/no-go status for the revised task and purpose?

1 — 2 — 3 — 4 — 5 ☐ N/A ☐ N/O

1	3	5
Flight makes decision based on one aircrafts' status and not as a flight	Flight makes decision based on status of all aircraft	Flight makes decision based on status of all aircraft; Develops FARP rotation for revised task and purpose

11.2 Obtain Next Mission
11.2.1 If current mission incomplete coordinate with Ground Commander

104. Does the flight coordinate with ground to complete original mission?

1 — 2 — 3 — 4 — 5 ☐ N/A ☐ N/O

1	3	5
Flight does not recognize original mission is incomplete; does not coordinate with ground	Flight recognizes original mission is incomplete; waits for task and purpose tasking from ground	Flight recognizes original mission is incomplete; proactively coordinates with ground to obtain task and purpose

11.2.2 If current mission complete coordinate with TOC

105. Does the flight coordinate with aviation TOC after being released from ground?

1 — 2 — 3 — 4 — 5 ☐ N/A ☐ N/O

1	3	5
Flight does not coordinate with aviation TOC	Flight coordinates with aviation TOC after departing the AO	Flight coordinates with aviation TOC prior to leaving the AO; proactively requests follow-on mission based on FARM

11.3 Egress Per Unit SOP and APG (Area Procedures Guide)
11.3.1 Address METTTC
11.4 Ingress to next mission if appropriate

106. Does the flight tactically egress from the AO?

1	2	3	4	5	
Flight chooses straightest line to next mission or home		Flight plans proper route to egress/next mission based on METT-TC		Flight varies egress route to avoid predictive behaviors; adjusts plan based on METT-TC	☐ N/A ☐ N/O

12 Post Mission

12.1 Post Flight Mission Tasks per SOP

107. Does the flight log down with aviation TOC?

☐ Yes ☐ N/A
☐ No ☐ N/O

108. Does the flight conduct post flight mission tasks per SOP?

1	2	3	4	5	
Flight does not conduct post flight mission tasks		Flight follows tasks according to SOP as a group		Flight divides tasking among team members; follows tasks according to SOP	☐ N/A ☐ N/O

12.1.1 Aircrew conducts post flight on aircraft

109. Do the aircrews conduct post flight maintenance and tie down?

1	2	3	4	5	
Aircrews skip multiple steps; skips maintenance and tie down altogether		Aircrews conduct post flight maintenance and tie down		Aircrews conduct a thorough post flight maintenance and tie down; reports to maintenance personnel	☐ N/A ☐ N/O

12.1.2 Battalion closes AMR (Air Movement Request)

110. Does the Battalion close the AMR?

1	2	3	4	5
Battalion does not close out the AMR; no log down occurs		Battalion communicates closure to brigade		Battalion communicates closure to brigade quickly and without errors

☐ N/A
☐ N/O

12.2 Conduct Debrief in accordance with unit SOP
12.2.1 Notes
12.2.2 Video

111. Does the flight conduct debrief in accordance with unit SOP?

1	2	3	4	5
Flight provides a limited debrief; numerous errors and omissions		Flight provides review of the mission and minimally debriefs		Flight provides clear, concise, and complete review; reports additional observations not related to the mission

☐ N/A
☐ N/O

12.2.3 Provide INPUT to the Story Board

112. Does the flight provide input to the storyboard?

☐ Yes ☐ N/A
☐ No ☐ N/O

12.2.4 Create Story Board (if trigger pulled)

113. Does the Battle Captain create the storyboard?

1	2	3	4	5
Battle Captain does not create storyboard or creates storyboard with multiple errors; submits it late		Battle Captain focuses on timeliness rather than quality and detail; does not consult all sources of information		Battle Captain creates a thorough storyboard based on information gathered during the mission; consults all sources of information

☐ N/A
☐ N/O

12.3 Conduct AAR in accordance with unit SOP
12.3.1 Notes
12.3.2 Video
12.3.3 Clear Concise and Complete

114. Does the flight conduct an AAR?

1	2	3	4	5
Flight does not conduct an AAR		Flight conducts a quick AAR; touches on key points		Flight conducts a thorough review; records lessons learned

☐ N/A
☐ N/O

12.3.4 Participatory

115. Do all crew members participate in the AAR?

1	2	3	4	5
Aircrew members are absent during the AAR		All flight members are present during the AAR		All flight members are present and actively participate in the AAR

☐ N/A
☐ N/O

APPENDIX E

DETAILED DEFINITIONS OF PROTOTYPE SYSTEM-BASED PERFORMANCE MEASURES

Category of Data	Data Required for System-Based Measurement
Mission Phase	Mission Planning
Mission Event	1 Pre-Mission Planning
PI	1.1 Coordination for Brief Preparation
Status	Future
Reason for Classification	Communication in the TOC (a meeting). If electronic messages are used to communicate operation summary data, there is a possibility of measuring whether it happened or not. Can not assess quality of the communication via system.
Performance Measure	Did the area of responsibility communicate the data for the intelligence update? (a) Previous 24 (b) Most likely/Most dangerous enemy course of action (c) Refine and update PIR (BOLO) (d) Terrain analysis
Required Systems for Data	Email, mIRC, or CPOF messages
Required Sim Data	Not Applicable
Assessment	Message is sent (communicated).
Unit of Measurement	Not Applicable
Acceptable Performance Ranges or Values	Message is sent (communicated).
Frequency of Occurrence	Not Applicable
Triggering Event(s)	Not Applicable
Additional Notes	Cannot assess quality of messages. Measure requires that inputs are passed electronically.

Category of Data	Data Required for System-Based Measurement
Mission Phase	Mission Planning
Mission Event	1 Pre-Mission Planning
PI	1.2 Operation Summary (Past, Current, Future)
Status	Future
Reason for Classification	Communication in the TOC (a meeting). If electronic messages are used to communicate operation summary data, there is a possibility of measuring whether it happened or not. Can not assess quality of the communication via system.
Performance Measure	Did the area of responsibility communicate the data about: (a) Fires and measures of effects? (b) Airspace? (c) Signal? (d) Weather?
Required Systems for Data	Email, mIRC, or CPOF messages (a) AFATDDS as source of info (b) TAIS as source of info (c) Compare SOI and SOP vs AMPS -- Can check to see if data were entered correctly -- does it match? Looking for errors. If can't exchange verbally, what has been done otherwise? Parts can be sent digitally.
Required Sim Data	Not Applicable
Assessment	Message is sent (communicated).
Unit of Measurement	Not Applicable
Acceptable Performance Ranges or Values	Not Applicable
Frequency of Occurrence	Not Applicable
Triggering Event(s)	Not Applicable
Additional Notes	Cannot assess quality of messages. Measure requires that inputs are passed electronically.

Category of Data	Data Required for System-Based Measurement
Mission Phase	Mission Planning
Mission Event	1 Pre-Mission Planning
PI	1.3 Flight Team and Aircrew Mission Preparation
Status	Future
Reason for Classification	Did the flight complete all appropriate flight preparation data on electronic kneeboard?
Performance Measure	Not Applicable
Required Systems for Data	Electronic kneeboard data.
Required Sim Data	All required values filled in.
Assessment	Not Applicable
Unit of Measurement	Not Applicable
Acceptable Performance Ranges or Values	Before take-off
Frequency of Occurrence	Not Applicable
Triggering Event(s)	Assessing quality of knee board data would require a standard value for each field.
Additional Notes	Not Applicable

Category of Data	Data Required for System-Based Measurement
Mission Phase	Mission Planning
Mission Event	1 Pre-Mission Planning
PI	1.3 Flight Team and Aircrew Mission Preparation 1.3.3 Aircrew Briefs
Status	Potential
Reason for Classification	If there are settings in the aircraft that are captured in the simulator, can assess whether or not the aircrews are setting up aircraft here like they are instructed.
Performance Measure	Did they initialize X system(s)? a. Did each position in the air crew set up required radio frequencies?
Required Systems for Data	DIS Network Airspace Weapons Electronics (AWE) File from AMPS in AH-64D Cockpit HUD Interactions
Required Sim Data	Transmitter PDU (Radio ID, Radio Entity Type, Transmit State, Input Source, Frequency, other fields may be required); The Transmitter PDU provides detailed information about a radio transmitter.
Assessment	Not Applicable
Unit of Measurement	Not Applicable
Acceptable Performance Ranges or Values	Not Applicable
Frequency of Occurrence	Once at start of mission.
Triggering Event(s)	Start of mission.
Additional Notes	The critical question is what pages were opened by the crew once they loaded their AWE/AMPS files in the cockpit. The pages should be tagged by seat (not sent over DIS but on a separate subsystem).

Category of Data	Data Required for System-Based Measurement
Mission Phase	Mission Planning
Mission Event	3 Task Quick Reaction Force (QRF)
PI	3.2 Request SITREP on Net (prior to launch)
Status	Future
Reason for Classification	Communication in TOC. May be via radio or mIRC (or other C2 system). If electronic messages, might be able to do temporal measures.
Performance Measure	a. Does the TOC request SITREP? b. Does the TOC request a SITREP in X amount of time?
Required Systems for Data	Email, mIRC, or CPOF messages (SITREP); analysis on content of SITREP
Required Sim Data	Not Applicable
Assessment	a. Yes/No b. X amount of time.
Unit of Measurement	a. boolean b. time (in hours?)
Acceptable Performance Ranges or Values	b. Between X and X amount of time.
Frequency of Occurrence	Once at start of mission.
Triggering Event(s)	Start of mission.
Additional Notes	What is the triggering event? How do we know a SITREP is requested?

Category of Data	Data Required for System-Based Measurement
Mission Phase	Mission Planning
Mission Event	3 Task Quick Reaction Force (QRF)
PI	3.3 Launch Order
Status	Potential
Reason for Classification	We can measure when the aircrafts take off. This system measure could also be used in conjunction with an observer-measure that looks at launch order (most likely situation). The flight needs to take off on-time to arrive on-station at the appropriate time.
Performance Measure	Does the flight launch in time to arrive on-station in the agreed upon time on target? At what time does the flight launch?
Required Systems for Data	DIS Network; Estimated Time On Target (TOT)
Required Sim Data	Entity PDU (Entity Identification, Force Identification, Entity Type, Entity World Location). Entity PDU (Entity Linear Velocity). The Entity Linear Velocity is represented by a vector. The Linear Velocity vector is composed of three components in either world coordinate or entity coordinate system depending on the field in the Dead Reckoning Algorithm field. The three components represent the x, y and z axis of the entity. Each vector component is in meters per second squared.
Assessment	Compound Measure: Compare reported launch order (observer-based) with time of take-off (system-based) and did they arrive on-station at agreed upon TOT?
Unit of Measurement	Time in seconds; meters per second squared.
Acceptable Performance Ranges or Values	Arrive on-station at agreed upon TOT. Good performance + or - 3 minutes. 4-6 minutes is moderate performance. 10 minutes late is a fail.
Frequency of Occurrence	Once
Triggering Event(s)	Not Applicable
Additional Notes	The critical issue is whether you take off with enough time to be on station when you need to be there–this is really a time on target measure. "here is your mission–be on station by X…" Battle Captain gives time, then crew needs to backward plan. It is the responsibility of the AMC to make sure you take off in time.

Category of Data	Data Required for System-Based Measurement
Mission Phase	Enroute
Mission Event	4 Enroute
PI	4.1 Call Off to Battalion TOC
Status	Future
Reason for Classification	Communication between aircraft and TOC. May be via radio or mIRC (or other C2 system). If electronic messages, might be able to do temporal measures or assess if they are at a specific phase of flight. Might be a trigger measure for some other system-based measures.
Performance Measure	Not Applicable
Required Systems for Data	DIS Network
Required Sim Data	Not Applicable
Assessment	Not Applicable
Unit of Measurement	Not Applicable
Acceptable Performance Ranges or Values	Not Applicable
Frequency of Occurrence	Not Applicable
Triggering Event(s)	Not Applicable
Additional Notes	Not Applicable

Category of Data	Data Required for System-Based Measurement
Mission Phase	Enroute
Mission Event	4 Enroute
PI	4.2 Aircrew to deconflict airspace as required (air traffic services)
Status	Likely
Reason for Classification	We can check to ensure they do not break restricted air space. We would need to know beforehand if there were pre-determined airspace restrictions. You can talk your way through most airspace. Need to know whether or not broke the airspace, then need to look at observer notes to see whether or not they called it.
Performance Measure	a. Does the aircrew adhere to airspace restrictions? b. Does the aircrew adhere to special use airspace?
Required Systems for Data	TAIS (for airspace restriction data); DIS Network (for aircraft position data)
Required Sim Data	Entity Position data; Restricted airspace parameters from TAIS. Entity PDU (Entity Identification, Force Identification, Entity Type, Entity World Location). The Entity Linear Velocity is represented by a vector of x,y,z axis data.
Assessment	Compound Measure: If airspace restrictions were broken, it will be important to assess whether or not a radio call was made (assess via observer-based measures).
Unit of Measurement	Meters
Acceptable Performance Ranges or Values	Acceptable performance is not breaking restricted airspace. Any break is unacceptable.
Frequency of Occurrence	Constant
Triggering Event(s)	Within .1 mile of restricted airspace parameters
Additional Notes	We will not be able to assess this fully unless the observer records that a radio call was made to break airspace. Can get predetermined restrictions from TAIS. AMPS is also capable of doing it, but may not be used. Requests for airspace all go through TAIS. Cannot enter area within 3K of ROZ -- it is represented by point on ground. Can be varying diameter often plotted as a circle, but can be other shapes. At borders there may be a buffer. In ATX there are sometime cross boarder situations deliberately put in scenario. Note that there is also special use airspace (in addition to restricted).

Category of Data	Data Required for System-Based Measurement
Mission Phase	Enroute
Mission Event	4 Enroute
PI	4.3 Monitor and Acknowledge Updates
Status	Likely
Reason for Classification	If radio calls are written into the scenario, will have a specific number/frequency. Then we need to see if aircraft returns a message on that same frequency, and how long it takes to do that. But, the way in which a transmission ends is important: If OVER, a response is required; if OUT, no response is required. Therefore, this measure may be more appropriate once a basic level of voice recognition is available. There is a flight internal frequency (designated frequency for that mission for the number of aircraft in that flight). This will be one of the 5 frequency switches. Length of comm should not be a factor, and may be tracking 5 frequencies, but everyone tracking the same 5 frequencies. SMEs think this measure is more likely assessed by observer.
Performance Measure	Did the flight properly divide and maintain responsibility for communication channels?
Required Systems for Data	DIS Network
Required Sim Data	Knowledge of the internal flight frequency (Each device has a seat position with an assigned frequency); Knowledge of the external locations frequency (Ground and TOC); Signal PDU (Entity ID, Radio ID, Encoding Scheme, TDL Type, Sample Rate, Data Length)
Assessment	Each seat position should be responding to a proportionate number of transmissions. For example, front 2 are responsible for Ground, backseat 2 are responsible for TOC, etc.)
Unit of Measurement	Counts; Percentages
Acceptable Performance Ranges or Values	Situation dependent.
Frequency of Occurrence	Continuous, computed at the end of the mission.
Triggering Event(s)	Continuous.

(continued)

Category of Data	Data Required for System-Based Measurement
Additional Notes	Digital messages are acknowledged automatically. On verbal, should respond if "over" and not necessary if "out" (this helps with preventing stepping on each other). Crew brief will include division of communication responsibilities. They should divide up who is listening to what (front 2, backseat 2, and wingman 2). Point is to divide up load. Measure would be whether divided up appropriately. Simulator should be able to tell you who has what channel set up. Some may also be delegated to electronic tools, chat, etc.

Category of Data	Data Required for System-Based Measurement
Mission Phase	Enroute
Mission Event	4 Enroute
PI	4.4 Coordinate Team Tactics with wingman
Status	Future
Reason for Classification	Cannot get at quality of conversation or to ensure certain things covered. If noticed an exchange (not just one person dictating) may be indicative of good performance per PI notes. Talking on the right frequencies, amount of time spent in conversation. It will be hard to isolate team tactics discussion from other discussion. A lot depends on how well plan before take off, and how much of situation has changed.
Performance Measure	Not Applicable
Required Systems for Data	DIS Network
Required Sim Data	Not Applicable
Assessment	Not Applicable
Unit of Measurement	Not Applicable
Acceptable Performance Ranges or Values	Not Applicable
Frequency of Occurrence	Not Applicable
Triggering Event(s)	Not Applicable
Additional Notes	This is low priority because so high in difficulty.

Category of Data	Data Required for System-Based Measurement
Mission Phase	Enroute
Mission Event	4 Enroute
PI	4.4 Coordinate Team Tactics with wingman 4.4.1 Loiter or Holding Area
Status	Potential
Reason for Classification	The context and environment of the mission plays a large part in the selection of the loiter/holding area (and whether it happens at all). Size of loiter and holding area is measurable. Defensible? Geometric characteristics we can calculate (i.e. distance from enemy SAMS site, enemy forces in that area, etc.). If loiter area has certain physical characteristics that can be measured, we can possibly develop this system-based measures. We may not be able to tell if it is a good area based on things like ingress/egress patterns though... Also, depending on mission (e.g. scout) may not use loiter/holding area at all.
Performance Measure	Is the loiter or holding area outside of weapons engagement zones? Are they using a terrain feature?
Required Systems for Data	DIS Network; MSEL
Required Sim Data	Location in relation to enemy; Type of enemy's weapon system. Entity PDU for Friendly (Entity Identification, Force Identification, Entity Type, Entity World Location, Entity Capabilities, Articulation Parameters) and Entity PDU for Hostile (Entity Identification, Force Identification, Entity Type, Entity World Location, Entity Capabilities, Articulation Parameters). Location in relation to building/mountain/etc.
Assessment	The area selected should be as close as possible, without breaking the enemy engagement zone. Having a building/mountain (something that will obstruct the shot) between you and the enemy.
Unit of Measurement	Meters.
Acceptable Performance Ranges or Values	Situation dependent.
Frequency of Occurrence	Whenever approaching on-station and/or approaching the enemy (whenever loitering prior to mission execution).

(continued)

Category of Data	Data Required for System-Based Measurement
Triggering Event(s)	How to know if loitering: Stay in one area for more than a minute. Size of loiter area varies -- may be a race track pattern, may just be hovering.
Additional Notes	Will be context dependent, and decided by AMC. Issue will be whether on station during critical time (arrive late, leave early due to fuel, etc…). If larger air assault mission will have preplanned loiter area -- but for attack, will rarely preplan loiter area. Air assaults are set up ahead of time. Should not loiter too close to target area -- need to stand off to not tip off enemy.... but should still be able to see target from long way off. Should loiter within sensor range. If you know where aircraft is, and where FARP is, and fuel, can calculate when they need to leave -- this may or may not match mission requirements, which may be hard to automatically calculate... fuel check should be done shortly after take off... (observer). Breaking off will be done verbally... Could cue observer that time is running short --- but, they can already see some of this. 700 pounds (AH-60) is lowest they should go... "bingo"

Category of Data	Data Required for System-Based Measurement
Mission Phase	Enroute
Mission Event	4 Enroute
PI	4.5 Adherence to SOP 4.5.1 Formation
Status	Potential
Reason for Classification	If an average distance or altitude from wingman is required, we can measure that. For each aircraft the Acceptable distance is different; The distance for a wing should be an appropriate distance to see and still effect the other aircraft.
Performance Measure	a. Does the flight (lead and wing) remain in line of sight? b. How much time does a wing remain out of line of sight?
Required Systems for Data	DIS Network; Mission specifications (aircraft, objective)
Required Sim Data	Position of lead (Entity PDU: Entity Identification, Force Identification, Entity Type, Entity World Location); Position of wing (Entity PDU: Entity Identification, Force Identification, Entity Type, Entity World Location); Acceptable distance to see and still effect other aircraft (< quarter mile); Entity PDU (Entity Linear Velocity).
Assessment	Acceptable distance to see and still effect other aircraft (< quarter mile)
Unit of Measurement	Meters
Acceptable Performance Ranges or Values	Good data would be average distance from wingman. Combine SOP and what was briefed during mission to assess performance. But, this part of brief can be changed on the fly. Unit SOP will determine Acceptable distances. Brief different formations and based on weather, enemy, etc., will determine how far to separate aircraft. Could be different every flight, and for phase of flight too. Try not to write too much on knee board card esp. when in theater. When flying for awhile, remember those numbers. Talk about it in brief—may spread out by time instead of 3-5 rotar wings for Apache, it varies greatly. May change during flight depending on situation.
Frequency of Occurrence	Continuous; might be best to measure any deviations.
Triggering Event(s)	Take-off

(continued)

Category of Data	Data Required for System-Based Measurement
Additional Notes	Formation flying is extremely mission dependent. The following data is rough estimates that may be used initially to develop a measure. But, ultimately parameters must be flexible. A set formation for utility aircraft (Blackhawk, Chinook) may be 3 to 5 rotor disks apart (this is a rough estimate they use, rotor disk is diameter of the helicopter blades); attack aircraft does not use this standard. A common rule of thumb is to stay within a distance where you can see and effect the other guy. However, there is no set standard. During ingress, should be whatever is required to support. But, they should not be in a straight line. Also, should not be a kilometer.... should be close enough to coordinate. So, lots of latitude, but will be determined by AMC. Could provide OC info on average distance, but assessment depends on what is determined by AMC. Could also report altitude differences -- criterion is whether they can support each other. So, best may be just to give stats to help OCs... Unit SOP will specify distances desired. Note that this is about ingress.. will be based on threat analysis. bottom line -- good to provide distances and altitudes, but assessment TBD.

Category of Data	Data Required for System-Based Measurement
Mission Phase	Enroute
Mission Event	4 Enroute
PI	4.5 Adherence to the SOP 4.5.3 Communication Protocol
Status	Potential
Reason for Classification	If target locations and geospatial information is passed through electronic means, we may be able to capture. Are the right targets being sent? (target locations, geospatial information)
Performance Measure	Does the flight enter in the updates to target and friendly locations? Does the flight enter the updates to ground unit frequencies?
Required Systems for Data	DIS Network; Blue Force Tracker Device(s) (FBCB2); FBCB2 to DIS gateway
Required Sim Data	Target and friendly actual positions (from scenario); target and friendly coordinates entered in the cockpit via targeting system; frequency of ground unit;
Assessment	The exact position of the friendlies is Acceptable; anything else is unacceptable.
Unit of Measurement	Not Applicable
Acceptable Performance Ranges or Values	Accurate data entry is performed. It is either yes or no.
Frequency of Occurrence	On entry of data into system.
Triggering Event(s)	On entry of data into system.
Additional Notes	Pilots fat finger in the position in the cockpit; BFT link (targeting system); Blue Force Tracker information is generally available in DIS when an FBCB2 to DIS gateway is available. The exact form of the DIS packet is unknown; if preplanned mission, might put target in AMPs. More likely on kneeboard packet -- will type in when get into cockpit. When close, verify with sensors that image and visual match. If mismatch, may call ground to verify coordinate. Note that FCR (Fire Control Radar) can give a lot of information on targets (e.g., Korea), but unlikely to be used much in current situation. Will use TSD page to get plot of target -- then look at sensors -- verify match. Note -- Army uses MGRS to index location (may or may not use lat/long).

Category of Data	Data Required for System-Based Measurement
Mission Phase	Enroute
Mission Event	4 Enroute
PI	4.6 Execute Air Ground Integration Checklist
Status	Potential
Reason for Classification	Should be able to measure whether or not they send messages to ground (or talk to them). But we cannot assess the quality of that communication via system-measures.
Performance Measure	Not Applicable
Required Systems for Data	DIS Network
Required Sim Data	Signal PDU (Entity ID, Radio ID, Encoding Scheme, TDL Type, Sample Rate, Data Length)
Assessment	Not Applicable
Unit of Measurement	Not Applicable
Acceptable Performance Ranges or Values	Not Applicable
Frequency of Occurrence	Not Applicable
Triggering Event(s)	Not Applicable
Additional Notes	Not Applicable

Category of Data	Data Required for System-Based Measurement
Mission Phase	Enroute
Mission Event	4 Enroute
PI	4.6 Execute Air Ground Integration Checklist 4.6.1 Check-in with Ground
Status	Likely
Reason for Classification	Not Applicable
Performance Measure	Does the flight initiate the air ground integration checklist prior to arrival on-station?
Required Systems for Data	DIS Network
Required Sim Data	Prior to arrival on-station (as soon as radio contact); Position of on-station; Entity PDU (Entity Linear Velocity); Signal PDU (Entity ID, Radio ID, Encoding Scheme, TDL Type, Sample Rate, Data Length)
Assessment	Need to assess the pattern and length of communication; should be frequent back and forth and of substantial length
Unit of Measurement	Counts; Percentages.
Acceptable Performance Ranges or Values	Situation dependent.
Frequency of Occurrence	Once when arrive on-station; need to determine what the end-point is (might just be a length of time)
Triggering Event(s)	Arrival on-station
Additional Notes	It is going to be hard to recognize the end of the air ground check-in; perhaps use observer-based question; See notes above -- by 5 km should have contact with ground -- but the earlier the check-in the better. Should be done before arriving on station -- if wait to fully on station, not passing.

Category of Data	Data Required for System-Based Measurement
Mission Phase	Enroute
Mission Event	4 Enroute
PI	4.6 Execute Air Ground Integration Checklist 4.6.2 Receive SITREP from Ground 4.6.2.3 Updates to the situation
Status	Likely
Reason for Classification	Not Applicable
Performance Measure	a. Are flight team members communicating to the appropriate channels? b. Are flight team members communicating to their assigned channels?
Required Systems for Data	DIS Network; AsTi System Setup Information
Required Sim Data	Signal PDU (Entity ID, Radio ID, Encoding Scheme, TDL Type, Sample Rate, Data Length)
Assessment	The flight seats are communicating with assigned frequencies (talking with fewer and most appropriate frequencies are better).
Unit of Measurement	Counts; percentage.
Acceptable Performance Ranges or Values	Fewer and distributed frequencies among the flight team.
Frequency of Occurrence	Continuing
Triggering Event(s)	Not Applicable
Additional Notes	Total time will be impossible to interpret, will depend on mission and individuals. More/less is not necessarily better/worse. Could pick up that some communication occurred. Better performance may be characterized by directly talking to ground (vs TOC) because will be better, more current information. This will depend on situation, could get a log of who talked to (first, last, etc.) but interpretation will be context dependent. Talking to fewer, more direct, correct folks is better. List of who talked to who could be provided to OC, OC will have to do interpretation. Essentially this is an OC aide rather than an assessment per se. Should also see that talking to ground is better to the extent that it can be done prior to getting on station (i.e. when was first contact to ground made), this will help OC assess. Important to log who talked to and when, when you make your initial contacts is important (before on station).

Category of Data	Data Required for System-Based Measurement
Mission Phase	Enroute
Mission Event	4 Enroute
PI	4.6 Execute Air Ground Integration Checklist 4.6.2 Receive SITREP from Ground Obtain UAS feed (if/when possible)
Status	Future
Reason for Classification	If UAS Feed available, can we tell if it is being sent/viewed in cockpit? Is there a way to know if UAS feed is available? UAS feed is always available, but it is up to unit commander to decide whether or not to use it.... also helpful when have UAS operators to role play what they would be doing (they use casual officers (who are not trained UAS operators) to fly them. They are officers training to be pilots, but not UAS operators. When Aviation goes to full spectrum CAB, will have UAS operators that come with them to ATX. Second quarter FY12 is when uas feed may be available to pilots during ATX. Sim center upon request does have an electronic knee board that some units still have. If unit has knee boards and bring with them, will plug up to knee board and can get UAS feeds. Only can remember 3 or 4 units that have done that. Just in TOC that this is being published. Observer Controllers may be able to view this as well. Only by request though.
Performance Measure	Does the aircraft set up UAS feeds? a. If yes, does the aircraft interact with the UAS feed? b. Does the flight establish communication with UAS operator?
Required Systems for Data	DIS Network
Required Sim Data	Question for sim people if signal is going to sim or have a plan; if signal available, would we have any data to measure over the network?
Assessment	COMPOUND Measure: Will depend on ATX setup/configuration (if UAS feeds are available to flight) a. Whether or not set up UAS feeds b. Communicating on frequency of UAS operator
Unit of Measurement	Boolean

(continued)

Category of Data	Data Required for System-Based Measurement
Acceptable Performance Ranges or Values	Not Applicable
Frequency of Occurrence	Not Applicable
Triggering Event(s)	Not Applicable
Additional Notes	How often should they be communicating with UAS operators? How often do they need to set up UAS feeds (i.e. once upon take off, once upon entering area of operation, etc.) 5 levels of control for UASs (future system capability); level 1 UAS apache relays to toc; level 2 apache can see; (future even in combat); level 3 apache moves sensor only; level 4 apache controls UAS in flight (sensor and fly); level 5 apache does everything (takeoff, land). The level 2 and 3 is sometimes available in the simulator environment. Level 4 and 5 still in development but may be available in the test world sooner than in the operational world.

Category of Data	Data Required for System-Based Measurement
Mission Phase	Mission Execution
Mission Event	5 Arrive On Station – Update Situational Awareness
PI	5.1 Communicate Arrival On Station
Status	Potential
Reason for Classification	System-based measures is to assess we are on station. We can tell if are 5 miles out from on station. Then need observer-based measures to assess that they made the calls. The SMEs define on-station as in weapon's effects range -- or, in other words, are you able to effect the outcome of the current fight from the perspective of the ground troops?
Performance Measure	Does the flight initiate the radio call when they arrive on station?
Required Systems for Data	DIS Network
Required Sim Data	Arrival on-station; Position of on-station (ground entities); Position of flight (Entity PDU :Entity Identification, Force Identification, Entity Type, Entity World Location); Signal PDU
Assessment	Single call on-station
Unit of Measurement	Count
Acceptable Performance Ranges or Values	It happens
Frequency of Occurrence	Once
Triggering Event(s)	Geographic location to station
Additional Notes	On station is within weapons status -- can support ground unit. Note - will depend on weather, haze, weapons load, etc. -- all environmental factors.

Category of Data	Data Required for System-Based Measurement
Mission Phase	Mission Execution
Mission Event	5 Arrive On Station – Update Situational Awareness
PI	5.2 Visually ID location of Friendlies
Status	Potential
Reason for Classification	Does BFT communicate to DIS or another system we need to hook into (can we get that information?). The answer is YES, BFT does communicate over DIS via a gateway. Need to confirm if a gateway exists at ATX. Verbal, visual, and digital = good behavior.. But what does digital really mean?
Performance Measure	Does the flight update the position of the friendlies in the cockpit?
Required Systems for Data	DIS Network
Required Sim Data	Position of the friendly; compare it to the truth location provided by white force;
Assessment	Exact lat-lon
Unit of Measurement	Lat-lon comparison.
Acceptable Performance Ranges or Values	Exact location of friendlies is required; anything else is a fail.
Frequency of Occurrence	Continuous
Triggering Event(s)	Not Applicable
Additional Notes	The flight should be visually identifying. Verify with eyes and visual sensors. Sight, sensor, and eyes. BFT will tell you that unit should be at location X, but need to do this visually. May mark with laser -- to help wingman find target, or may just be verbally for confirmation. Both wing and lead should confirm that they have correct and same target. Avoid fratricide.

Category of Data	Data Required for System-Based Measurement
Mission Phase	Mission Execution
Mission Event	5 Arrive On Station – Update Situational Awareness
PI	5.3 Develop Plan/Scheme of Maneuver
Status	Likely
Reason for Classification	Verbal communication between flight an ground. Can measure length of comms and channels used. Based on system data you can figure out axis of friendly to enemy -- flight should come in on different axis... never fire over or toward friendlies.
Performance Measure	Does the flight verify and update the planned scheme of maneuver?
Required Systems for Data	DIS Network
Required Sim Data	Once on-station (as soon as radio contact); Position of on-station; Position of flight (Entity PDU); Signal PDU; Frequency of cockpit; Frequency of ground
Assessment	Need to assess the pattern and length of communication; should be frequent back and forth and of substantial length between cockpits
Unit of Measurement	Count; percentages.
Acceptable Performance Ranges or Values	Situation dependent
Frequency of Occurrence	Continuous
Triggering Event(s)	On- station arrival
Additional Notes	Just really talking to ground -- Most of info will be verbal. But, may be able to pick up some info regarding plan of attack (i.e., avoid fly over or at own forces…) Based on system data you can figure out axis of friendly to enemy -- flight should come in on different axis... never fire over or toward friendlies.. .

Category of Data	Data Required for System-Based Measurement
Mission Phase	Mission Execution
Mission Event	6 Target Acquisition (In parallel with on station tasks)
PI	6.2 Begin Search for Target
Status	Likely
Reason for Classification	Are they scanning the entire area? (not using radar) What % of area have they scanned? (looking through the optical sensors) Are they duplicating scan areas or dividing them up? (yes, but probably not measurable) Type of aircraft determines ability/capability of sensors. Are they using the right sensors for ambient conditions? Do they use appropriate standoff distances? Crew search, or observation, is the act of carefully viewing or watching the area of operation using search and scanning techniques and sectors of observation to acquire targets. Sectors of observation are areas assigned to each crew member for search and target acquisition. Crew members must know their assigned sectors of observation to thoroughly cover the battlefield.
Performance Measure	a. Is the flight using the appropriate sensors for target acquisition? b. Is the flight searching the assigned sectors of observation?
Required Systems for Data	DIS Network
Required Sim Data	IR sensor; DAYTV camera; Laser spot; laser designator (updates all target information for the launch of missile/weapon system); Electromagnetic Emission PDU contains information about active electronic warfare emissions. Would need to connect video feed with lat-lon and observer recorded plan of search;
Assessment	No way for the system to determine this; have to match what was discussed as far as method used to search;
Unit of Measurement	Counts; geographic locations.
Acceptable Performance Ranges or Values	Not Applicable
Frequency of Occurrence	Continuous
Triggering Event(s)	Arrival on-station
Additional Notes	Fire control radar does not have the capability; right now radar is being used for terrain avoidance; Scanning technique will be in gunnery manual and SOP. It does define a pattern. Might coordinate with wingman -- e.g., wagon wheel -- inner and outer rings -- hunt target -- so you have coverage of

Category of Data	Data Required for System-Based Measurement
Mission Phase	Mission Execution
Mission Event	6 Target Acquisition (In parallel with on station tasks)
PI	6.2 Begin Search for Target 6.2.4.1 Utilize appropriate standoff distance
Status	Likely
Reason for Classification	Type of aircraft determines ability/capability of sensors. Do they use appropriate standoff distances?
Performance Measure	Is the crew using appropriate standoff distances?
Required Systems for Data	DIS Network
Required Sim Data	Position of on-station; Position of flight (Entity PDU); Signal PDU; Position of enemy (Entity PDU); Capabilities of enemy weapons.
Assessment	Yes or No, depending on whether flight mainained appropriate distance.
Unit of Measurement	Counts; geographic locations.
Acceptable Performance Ranges or Values	Depends on weapons systems.
Frequency of Occurrence	Continuous
Triggering Event(s)	Arrival on-station
Additional Notes	Will also need data on ranges of weapons systems.

Category of Data	Data Required for System-Based Measurement
Mission Phase	Mission Execution
Mission Event	6 Target Acquisition (In parallel with on station tasks)
PI	6.3 Announce target in sight
Status	Potential
Reason for Classification	Measure if people were talking on the radio using right channels… can only assess this if can know footprints on radio network. Observer needs to record that this is the target in sight comm; no way for a system to capture this.
Performance Measure	Does the flight announce target in sight?
Required Systems for Data	DIS Network
Required Sim Data	Signal PDU; Frequency of cockpit positions; flight positions
Assessment	Yes it happens, No it does not
Unit of Measurement	Count
Acceptable Performance Ranges or Values	Not Applicable
Frequency of Occurrence	Once
Triggering Event(s)	Target acquired.
Additional Notes	When announce target in sight -- will announce to wingman. Triggering event is after confirmation -- will tell ground that they have it.

Category of Data	Data Required for System-Based Measurement
Mission Phase	Mission Execution
Mission Event	6 Target Acquisition (In parallel with on station tasks)
PI	6.4 Communicate Target Acquisition to Ground Forces
Status	Potential
Reason for Classification	Measure if people were talking on the radio using right channels… can only assess this if can know footprints on radio network. More back and forth = better performance.
Performance Measure	Does the flight announce target in sight to ground forces?
Required Systems for Data	DIS Network
Required Sim Data	Signal PDU; Frequency of cockpit positions; ground frequency
Assessment	Yes it happens; No it does not
Unit of Measurement	Count
Acceptable Performance Ranges or Values	Not Applicable
Frequency of Occurrence	Once
Triggering Event(s)	Target acquired
Additional Notes	Will announce target in sight to ground -- verify target -- then coordinate with wing. Need to verify with ground prior to release. If weapons fire, there should have been comms to ground proceeding -- and wingman.

Category of Data	Data Required for System-Based Measurement
Mission Phase	Mission Execution
Mission Event	6 Target Acquisition (In parallel with on station tasks)
PI	6.5 Confirm target with appropriate marking technique for Ground Commander using SOP
Status	Likely
Reason for Classification	Will not be able to determine if they used the appropriate marking, only that if they used a certain type we can tell if they did that correctly. The appropriate type may need to be an observer measure.
Performance Measure	Does the flight mark the correct target? Does the flight use the appropriate technique to mark the target?
Required Systems for Data	DIS Network
Required Sim Data	Electromagnetic Emission PDU; laser designator; Position of target; Position of laser designator; could also be gunfire or rocket fire to mark a target
Assessment	Correct or inccorect given values specified acceptable performance ranges.
Unit of Measurement	Feet; seconds
Acceptable Performance Ranges or Values	Need to be right on the target with a laser; with a rocket or tracer fire maybe within 15 feet (not as accurate as a laser)
Frequency of Occurrence	Once when they mark target.
Triggering Event(s)	Engaging of the designator.
Additional Notes	If any question regarding target—will ask to use smoke or ask ground to shoot at target. Note that if ground are shooting at it, they have already gone through clearance of fires. Will use laser at night, unless IR laser. IR laser requires goggle, use at night. Second type of laser is emitted from aircraft or UAS—can use this to laser designate—laser if meant for weapon system. You can't see this laser beam—it is coded—can use to guide weapon if have appropriate code. This can be cooperation between air asset or ground if they have it—enter code, and then find laser to drop on target.... PDUs tell you hit or miss and why. How much you use own sensor vs. others will depend on units and type of aircraft. Smoke during the day is good, because enemy did not have it. Shooting at target is good because have clearances of fires, just need final authorization.

Category of Data	Data Required for System-Based Measurement
Mission Phase	Mission Execution
Mission Event	9 Employ Weapon System
PI	9.1 Fire weapon based on SOP and previous plan 9.1.2 Wingman provides over watch and cover
Status	Likely
Reason for Classification	How close should wingman be and in what position? Should be able to measure distance and position from lead here. Can measure how far wingman was on average from lead. How far was he when took the shot. What general angle or direction was the wingman? Sensor directions?
Performance Measure	Did the wing maintain an appropriate distance to provide over watch and cover? Does the wingman stay outside weapons engagement zone but still maintain ability to affect target or surrounding area with own weapon system?
Required Systems for Data	DIS Network
Required Sim Data	Position of lead (Entity PDU); Position of wing (Entity PDU); Position of target; to side or above; should rarely be below (but it can happen); know affective range of ownship weapons system; Detonation PDU is the trigger.
Assessment	3-5 rotor lengths from lead (Utility only); outside weapons engagement zone of target
Unit of Measurement	Meters
Acceptable Performance Ranges or Values	Situation dependent
Frequency of Occurrence	At every weapons fire; when both are at a hover
Triggering Event(s)	Weapons fire (Detonation PDU).
Additional Notes	3-5 rotor disks (Utility Helicopter) is during ingress; during weapons release 3-5 is not a useful number here; wing staying outside of the target data line (safety fan --stay out of the fire pattern between aircraft and target); weapons fans would be useful when doing bounding over watch; no friendly forces or wing in the safety fan when they pull the trigger; weapons fan should not intersect with the friendly force; missile is related to the range fan.

Category of Data	Data Required for System-Based Measurement
Mission Phase	Mission Execution
Mission Event	9 Employ Weapon System
PI	9.1 Fire weapon based on SOP and previous plan 9.1.3 Applies appropriate weapons engagement technique based on SOP
Status	Likely
Reason for Classification	Angle at which weapon was fired. Distance away from target. Airspeed. Altitude. May be other weapons engagement techniques applicable here. Do air crews stay at designated altitudes? Does air crew maintain standoff distances during flight? (average standoff during mission?) May be other phases where formation type measures are appropriate/valid and should be collected. Controls in correct modes for firing selected weapons. Did they look at certain aircraft controls/sensors/etc. before employing weapon.
Performance Measure	Did the team use proper laser designator techniques? Did they maintain the appropriate altitude for weapons release? Did they maintain the proper airspeed at weapons release? Did they maintain the proper angle of attack at weapons release?
Required Systems for Data	DIS Network
Required Sim Data	Position of target (Entity PDU); target status (Damage State : No damage, Damaged, Destroyed); Position of all entities; Position of target; weapons systems on helos; weapons systems on target; aircraft parameters (speed, altitude, angles)
Assessment	Maybe look at average time within WEZ
Unit of Measurement	Seconds
Acceptable Performance Ranges or Values	We need apache engagement performance criteria to determine acceptable range
Frequency of Occurrence	At every weapons fire
Triggering Event(s)	Weapons fire
Additional Notes	Apache pilot required for correct assessment criteria and to review target engagement zone measures; restrictions for firing missiles and weapons systems are in gunnery manual; running or diving fire in current env. (hovering fire is not recent but is a technique); all in gunnery manual.

Category of Data	Data Required for System-Based Measurement
Mission Phase	Mission Execution
Mission Event	9 Employ Weapon System
PI	9.2 Determine Effects of Weapons and Objective Met
Status	Potential
Reason for Classification	Did they fire the right weapon? This might be too subjective for system) Was the target destroyed? Was anything else destroyed? (Was desired effect achieved would be observer based).
Performance Measure	Did they destroy the target?
Required Systems for Data	DIS Network
Required Sim Data	Position of target; Target Entity Damage State (no damage, damaged, destroyed);
Assessment	Target is destroyed
Unit of Measurement	Not Applicable
Acceptable Performance Ranges or Values	Might be combined with observer; (disabled but not destroyed still meets objective, e.g.)
Frequency of Occurrence	At every weapons fire
Triggering Event(s)	Weapons fire
Additional Notes	OC will be able to tell if the right weapon was used; overall thing is to kill the target; hard (building/tank) target fire a missile; soft target (car/bus/people) fire rocket or gun (traditional); rockets aren't precision; missile is only precision target; what kind of rocket is chosen (different types of rockets); flushette lots of shrapnel and takes out people/car tires, etc.

Category of Data	Data Required for System-Based Measurement
Mission Phase	Mission Execution
Mission Event	9 Employ Weapon System
PI	9.3 Determine Health State of Aircraft (if applicable)
Status	Potential
Reason for Classification	Visually looking at most of these items. However, we may be able to measures status of different measure indicators. If we know entity descriptions (healthy, partly damaged, destroyed, etc.). We can tell if aircraft is damaged, but need observer to rate what they did as a result....did they talk about it?
Performance Measure	Was there any damage to the flight?
Required Systems for Data	DIS Network
Required Sim Data	Entity PDU status of aircraft (no damage, damaged, destroyed)
Assessment	No damage to aircraft
Unit of Measurement	Not Applicable
Acceptable Performance Ranges or Values	No damage to aircraft
Frequency of Occurrence	At every weapons fire
Triggering Event(s)	Weapons fire (Detonation PDU)
Additional Notes	Red screen of death is bad; could lose portion of weapons system; aircraft PDUs will tell you state of the aircraft entity.

Category of Data	Data Required for System-Based Measurement
Mission Phase	End of Mission
Mission Event	10 Battle Damage Assessment
PI	10.1 Give BDA to Ground Commander as per unit SOP
Status	Likely
Reason for Classification	Is target destroyed? What % of targets are destroyed? Was desired weapon effect achieved? Were things besides the target destroyed (what %?)?
Performance Measure	Did they communicate the status of the target?
Required Systems for Data	DIS Network
Required Sim Data	Position of target; Target Entity Damage State :No damage, Damaged, Destroyed)
Assessment	Target is destroyed
Unit of Measurement	Boolean
Acceptable Performance Ranges or Values	Might be combined with observer (e.g., disabled but not destroyed still meets objective).
Frequency of Occurrence	Once
Triggering Event(s)	Weapons fire
Additional Notes	We can pull out which targets were destroyed -- Most targets are SAF entities -- can also pull up damaged buildings, etc., for collateral damage -- targets also give fire power kills, mobility kill, and catastrophic kill for vehicles. For personnel, it is kill or not. Note - Collateral damage is subject to sim capabilities -- i.e., buildings, etc.. things like craters are only partially represented (deforming terrain). Note that sim drivers can add civilians, etc.

Category of Data	Data Required for System-Based Measurement
Mission Phase	End of Mission
Mission Event	11 Obtain Revised Task and Purpose
PI	11.1 Aircrew Determine FARM (Fuel Ammo Rockets Missiles)
Status	Likely
Reason for Classification	Report out fuel, ammo, rockets, missiles counts. Compare to standard amounts? (i.e. if fuel is at X level and they still decide to go, that could be poor performance depending…)
Performance Measure	Does the flight report the correct FARM?
Required Systems for Data	DIS Network
Required Sim Data	Grouped Entity Description Record (Enhanced Rotor Wing Aircraft): Supplemental Fuel Status, Air Maintenance Status, Primary Ammunition Status, Secondary Ammunition Status
Assessment	Would need to compare to observer data as far as whether what was reported was actual state of aircraft.
Unit of Measurement	Not Applicable
Acceptable Performance Ranges or Values	Acceptable is correct radio call that matches actual state of aircraft
Frequency of Occurrence	Once
Triggering Event(s)	Call to TOC for mission complete
Additional Notes	Too hard to identify the call to TOC (can't interpret speech) therefore; triggering event may not exist; This is never really wrong -- they report out what AVCATT says… For FARM report, system will take what you have and aircraft will send that info back to TOC -- note that 58s have to do this verbally. Probably going to get correct. Unlikely to be that useful for assessment.

Category of Data	Data Required for System-Based Measurement
Mission Phase	End of Mission
Mission Event	11 Obtain Revised Task and Purpose
PI	11.3 Egress Per Unit SOP and APG (Area Procedures Guide)
Status	Potential
Reason for Classification	If we have egress path (i.e. SW of target) we can tell if they have done that. If we don't know path, we can't measure this…. May be that we want to just read out the path they went and provide that information to them, then in the hotwash they can interpret and discuss because they know the path they were supposed to take...This may apply to other measures, too... where we provide read outs and a SME interprets them in light of the mission.
Performance Measure	What was the egress route?
Required Systems for Data	DIS Network
Required Sim Data	Position of aircraft during egress; outside of airspace restrictions or enemy wez
Assessment	Too many factors to measure what was appropriate.
Unit of Measurement	Flight path
Acceptable Performance Ranges or Values	Too hard to tell Acceptable; just the information may be valuable
Frequency of Occurrence	Continuous
Triggering Event(s)	Possible observer measure trigger; Leave on-station
Additional Notes	A radio call could be used but too hard to assess what was said in call to tell it is right before egress; in terms of planned routes, Afghanistan will have some limited routes based on geography. For Iraq, not as many distinctions. But, regardless, there should be some varying of patterns -- but geography will limit this. Planned ingress and egress should be apparent in brief if different. Could plot ingress and egress to let OC see difference and then discuss, based on what they heard in brief? Note that they might change route depending on fuel needs, etc... It would help OCs to see traces -- use to promote discussion... would be good to track over different flights... see if unit is creating a pattern...

Category of Data	Data Required for System-Based Measurement
Mission Phase	End of Mission
Mission Event	11 Obtain Revised Task and Purpose
PI	11.4 Ingress to next mission if appropriate
Status	Potential
Reason for Classification	If we have ingress path (i.e. SW of target) we can tell if they have done that. If we don't know path, we can't measure this.
Performance Measure	What was the ingress route?
Required Systems for Data	DIS Network
Required Sim Data	Position of aircraft during ingress
Assessment	Too many factors to measure what was appropriate
Unit of Measurement	Flight path
Acceptable Performance Ranges or Values	Too hard to tell acceptable; just the information may be valuable
Frequency of Occurrence	Not Applicable
Triggering Event(s)	Possible observer measure trigger
Additional Notes	A radio call could be used but too hard to assess what was said in call to tell it is right before egress; See above -- looking to see if folks are developing detectable patterns.

APPENDIX F

EXAMPLE PERFORMANCE INDICATOR TO ARTEP MAPPING

ARTEP Task and Step	Performance Indicator
01-1-5125 Conduct QRF Planning Operations	
Task 1: Commanders, operations, plans, and training staff officer (S3) section, leaders, and staff gain and/or maintain situational understanding using information that is gathered from Force XXI Battle Command Brigade and Below (FBCB2) (if applicable), frequency modulated (FM) communications, maps, intelligence summaries, situation reports (SITREPs), and/or other available information sources.	1.1 Coordination for Brief Preparation
Task 2: Commander receives an OPORD or FRAGO and issues warning order (WARNO) to the staff and subordinate companies/troops using FBCB2, FM, or other tactical means.	2.1 Flight Team Receipt of WARNO and Parallel Mission Planning
Task 3: Commander and staff plan QRF operations using troop-leading procedures.	2.1 Flight Team Receipt of WARNO and Parallel Mission Planning 2.2 Mission Coordination
Task 7: S3 issues a FRAGO, as necessary, to address changes to the plan identified during the rehearsal.	3.1.1 Attend Final Mission brief as required--Final Adjustments to Plan
Task 10: Commander directs the XO and S3 to commit the QRF at the decisive place and time to:	3.3 Launch Order
01-2-5183 Perform Tactical Air Movement Operations	
Task 2: The unit conducts a tactical air movement.	4.2 Aircrew to deconflict airspace as required (air traffic services)
01-2-5198 Conduct Aviation Mission Planning	
Task 4: Unit conducts planning mission according to unit standards and applicable field manuals (FM).	1.2 Operation Summary (Past, Current, Future)
Task 5: Unit conducts air mission brief (AMB) according to unit tactical standing operating procedures (TACSOP).	1.3.1 Flight Team and Aircrew Mission Preparation--Flight Team Briefs
01-2-5199 Perform CCA Operations	
Task 1: The aviation team completes QRF planning/preparation prior to receiving mission.	1.3.2 Flight Team and Aircrew Mission Preparation--Establish weapons release authority 1.3.3 Flight Team and Aircrew Mission Preparation--Aircrew Briefs
Task 2: The aviation team leader receives and disseminates all mission information available prior to launching mission.	1.3.2 Flight Team and Aircrew Mission Preparation--Establish weapons release authority 1.3.3 Flight Team and Aircrew Mission Preparation--Aircrew Briefs
Task 3: The aviation team conducts tactical air movement.	4 Enroute
Task 4: The aviation team contacts the supported battalion/squadron element on its command net at the earliest opportunity and conducts mission coordination.	4.6 Execute Air Ground Integration Checklist
Task 5: Aviation team conducts check-in with unit in contact on company/troop command net.	4.6.1 Execute Air Ground Integration Checklist--Check-in with Ground 5.1.1 Communicate Arrival On Station--Update Situation as needed
Task 6: Aviation team conducts close combat engagements.	5.2 Visually ID location of Friendlies 5.3 Develop Plan/Scheme of Maneuver 9.2 Determine Effects of Weapons and Objective Met 10.1 Give BDA to Ground Commander as per unit SOP 10.2 Give BDA to TOC as per unit SOP
Task 8: With unit in contact, once the CCA support is complete, aviation team leader recontacts supported battalion/squadron element for further required CCAs.	11.2.2 Obtain Next Mission--If current mission complete coordinate with TOC

APPENDIX G

SUMMARY OF PERFORMANCE MEASURES

Mission Event	PI Number	PI Title	Observer-based Measure Number	System-based Measure Status
		Mission Planning Phase		
1 Pre-Mission Planning				
	1.1	Coordination for Brief Preparation	1, 2	Future
	1.1.1	Coordinate with Adjacent, Higher, and Lower Units	—[a]	—[b]
	1.1.2	Adherence to SOP Battle Rhythm	—[a]	—[b]
	1.2	Operation Summary (Past, Current, Future)	3	Future
	1.3	Flight Team and Aircrew Mission Preparation	4	Future
	1.3.1	Flight Team Briefs	5, 6	—[b]
	1.3.2	Establish weapons release authority	7	—[b]
	1.3.3	Aircrew Briefs	8	Potential
2 Mission Analysis				
	2.1	Flight Team Receipt of WARNO and Parallel Mission Planning	9	—[b]
	2.2	Mission Coordination	—[a]	—[b]
	2.2.1	Airspace	10	—[b]
	2.2.2	Coalition Forces	11	—[b]
	2.2.3	Obtain UAS Feeds (if possible)	12	—[b]
	2.2.4	Update Friendly Situation	13	—[b]
	2.2.5	Verify Communication Frequencies	14	—[b]
	2.2.6	Verify Call Signs	15	—[b]
	2.2.7	Verify Grid Locations	16	—[b]
	2.2.8	Threat Update	17, 18	—[b]
	2.2.9	React to threat update/change COA	19	—[b]

(continued)

Mission Event	PI Number	PI Title	Observer-based Measure Number	System-based Measure Status
		Mission Planning Phase		
3 Task Quick Reaction Force (QRF)				
	3.1	Attend Final Mission Brief as required	20	—[b]
	3.1.1	Final Adjustments to Plan	21	—[b]
	3.1.2	Report changes to aircrew	22	—[b]
	3.2	Request SITREP on Net (prior to launch)	23, 24, 25	Future
	3.3	Launch Order	26	Potential
		Enroute Phase		
4 Enroute				
	4.1	Call Off to Battalion TOC	27	Future
	4.1.1	Battalion Staff log the flight off and acknowledge	28	—[b]
	4.1.2	Report to higher Flight Team Departure	29	—[b]
	4.1.3	Report to ground forces that Flight Team is Enroute	30	—[b]
	4.2	Aircrew to deconflict airspace as required (air traffic services)	31	Likely
	4.3	Monitor and Acknowledge Updates	32, 33	Likely
	4.4	Coordinate Team Tactics with wingman	34	Future
	4.4.1	Loiter or Holding Area	35, 36	Potential
	4.4.2	Deconfliction Measures	37	—[b]
	4.4.3	Delegation of coordination and flight related duties (e.g. Communications)	38	—[b]
	4.5	Adherence to the SOP	39, 40	—[b]
	4.5.1	Formation	41, 42	Potential
	4.5.2	Flight Duties	43	—[b]
	4.5.3	Communication Protocol	44	Potential

(continued)

Mission Event	PI Number	PI Title	Observer-based Measure Number	System-based Measure Status
	4.5.4	SOP Driven Communication (FARM etc.)	45	—[b]
	4.5.5	Tactics	46	—[b]
	4.6	Execute Air Ground Integration Checklist	47, 48	Potential
	4.6.1	Check-in with Ground	—[a]	Likely
	4.6.1.1	Number of Aircraft	—[a]	—[b]
	4.6.1.2	Number and Type of Weapons System Available	—[a]	—[b]
	4.6.1.3	Station Time	—[a]	—[b]
	4.6.1.4	Request SITREP	—[a]	—[b]
	4.6.2	Receive SITREP from Ground	49	—[b]
	4.6.2.1	Frontline Trace and unit composition	—[a]	—[b]
	4.6.2.2	Markings	—[a]	—[b]
	4.6.2.3	Updates to the situation	—[a]	Likely
	4.6.2.4	Obtain UAS feed (if/when possible)	50	Future
	4.6.2.4.1	Goal is to obtain as soon as possible in mission thread	—[a]	—[b]
	4.6.2.5	Immediate Airspace Deconfliction and/or Avoidance Measures	51	—[b]
		Mission Execution Phase		
5 Arrive on Station - Update Situational Awareness				
	5.1	Communicate Arrival On Station	52	Potential
	5.1.1	Update Situation as needed	—[a]	—[b]
	5.2	Visually ID location of Friendlies	53	Potential
	5.2.1	Verbally Confirm location	54	—[b]
	5.2.2	Visual/Digital (Blue Force Tracker) if equipped or possible	55	—[b]
	5.3	Develop Plan/Scheme of Maneuver	56	Likely

(continued)

Mission Event	PI Number	PI Title	Observer-based Measure Number	System-based Measure Status
	5.3.1	Establish Task and Purpose for Aviation Assets	—[a]	—[b]
	5.3.2	Establish clearance of fires authority	57	—[b]
	5.3.3	Coordinate Designation and Shooter Duties	58	—[b]
	5.3.4	Discuss plan among aircrews	59	—[b]
	5.3.5	Recommend course of action to ground commander	60	—[b]
	5.4	Provide security in accordance to unit SOP (this can be a part of all the sections)	61	—[b]
	5.5	Develop the situation	62	—[b]
	5.5.1	Use UAS data to develop the situation	63, 64, 65	—[b]
	5.5.2	Establish UAS command Relationship (Direct Support, OPCON, etc)	66	—[b]
	5.6	Communicate Differences in Pattern of Life as appropriate	67	—[b]
6 Target Acquisition (In parallel with on station tasks)				
	6.1	Communicate Last Known Position and Description of Target	68	—[b]
	6.1.1	Request this information if not given freely	—[a]	—[b]
	6.2	Begin Search for Target	69, 70	Likely
	6.2.1	Incorporate the ISR Plan	—[a]	—[b]
	6.2.2	Visual	—[a]	—[b]
	6.2.3	Sensor	—[a]	—[b]
	6.2.3.1	Choose proper sensor given ambient conditions	71	—[b]
	6.2.3.2	Share sensor feeds if required	72	—[b]
	6.2.4	Recognize threats	73	—[b]
	6.2.4.1	Utilize Appropriate Standoff Distance	74	Likely

(continued)

Mission Event	PI Number	PI Title	Observer-based Measure Number	System-based Measure Status
	6.3	Announce target in sight	75, 76	Potential
	6.3.1	Wingman confirm target	77, 78	—[b]
	6.4	Communicate Target Acquisition to ground forces	79	Potential
	6.5	Confirm target with appropriate marking technique for ground commander using SOP	80	Likely
7 Apply ROE				
	7.1	Confirm ground commanders intent	81	—[b]
	7.1.1	If apply lethal, determine hostile intent	82	—[b]
	7.1.1.1	Ground commander or AMC must confirm hostile intent	—[a]	—[b]
	7.2	Discuss lethal nonlethal COAs	83	—[b]
	7.3	Discuss proportionality	84	—[b]
	7.3.1	Desired effect accomplished with minimal collateral damage	—[a]	—[b]
	7.3.2	Weapon choice made and fires coordinated	85	—[b]
	7.3.3	Engagement Scheme of Maneuver	86	—[b]
	7.4	Discuss collateral damage	87	—[b]
	7.4.1	Minimum safe distance for weapon effect	—[a]	—[b]
	7.5	Make Shoot/Don't Shoot Decision	88	—[b]
	7.5.1	Communicate Decision to ground	89	—[b]
	7.5.1.1	If Don’t Shoot, continue to observe	90	—[b]
8 Clearance of Fires				—[b]
	8.1	Request Clearance of Fires from Ground commander	91	—[b]
	8.1.1	Clearance Received and Acknowledged by appropriate authority	92	—[b]
	8.1.1.1	Cleared Hot	—[a]	—[b]

(continued)

Mission Event	PI Number	PI Title	Observer-based Measure Number	System-based Measure Status
	8.2	Verbally Communicate Weapons release clearance within flight	93	—[b]
9 Employ Weapon System				
	9.1	Fire weapon based on SOP and previous plan	94	—[b]
	9.1.1	Flight lead sets inbound and formation	—[a]	—[b]
	9.1.2	Wingman provides overwatch and cover	95	Likely
	9.1.3	Applies appropriate weapons engagement technique based on SOP	96	Likely
	9.1.3.1	Employ appropriate combined arms technique.	—[a]	—[b]
	9.1.4	Flight lead calls engaging	97	—[b]
	9.1.4.1	Wingman acknowledges	—[a]	—[b]
	9.1.5	Flight lead calls break	—[a]	—[b]
	9.1.5.1	Wingman acknowledges	—[a]	—[b]
	9.1.6	Wingman calls engaging (if required)	—[a]	—[b]
	9.1.6.1	Flight lead acknowledges	—[a]	—[b]
	9.2	Determine Effects of Weapons and Objective Met	98	Potential
	9.2.1	Communicate to Ground Commander	99	—[b]
	9.3	Determine Health State of Aircraft (if applicable)	100	Potential
	9.3.1	If damage, Go/No-go	—[a]	—[b]
	9.3.2	If no-go choose course of action	—[a]	—[b]
	9.3.2.1	Coordinate with ground forces and higher	—[a]	—[b]
		End of Mission Phase		
10 Battle Damage Assessment				
	10.1	Give BDA to Ground Commander as per unit SOP	101	Likely

(continued)

Mission Event	PI Number	PI Title	Observer-based Measure Number	System-based Measure Status
	10.1.1	Weapon Effect	—[a]	—[b]
	10.1.2	Collateral Effects	—[a]	—[b]
	10.2	Give BDA to TOC as per unit SOP	—[a]	—[b]
	10.2.1	Weapon Effect	—[a]	—[b]
	10.2.2	Collateral Effects	—[a]	—[b]
11 Obtain Revised Task and Purpose				
	11.1	Aircrew Determine FARM (Fuel Ammo Rockets Missiles)	102	Likely
	11.1.1	AMC Reports Status to higher and ground	103	—[b]
	11.1.2	Determine Go/No-go Status	—[a]	—[b]
	11.2	Obtain Next Mission	104	—[b]
	11.2.1	If current mission incomplete coordinate with ground commander	—[a]	—[b]
	11.2.2	If current mission complete coordinate with TOC	105	—[b]
	11.3	Egress Per Unit SOP and APG (Area Procedures Guide)	106	Potential
	11.3.1	Address METTTC	—[a]	—[b]
	11.4	Ingress to next mission if appropriate	—[a]	Potential
		Post Flight Tasks and AAR Phase		
12 Post Mission				
	12.1	Post Flight Mission Tasks per SOP	107, 108	—[b]
	12.1.1	Aircrew conducts post flight on aircraft	109	—[b]
	12.1.2	Battalion closes AMR	110	—[b]
	12.2	Conduct Debrief in accordance with unit SOP	111	—[b]
	12.2.1	Notes	—[a]	—[b]
	12.2.2	Video	—[a]	—[b]

(continued)

Mission Event	PI Number	PI Title	Observer-based Measure Number	System-based Measure Status
	12.2.3	Provide INPUT to the Story Board	112	—[b]
	12.2.4	Create Story Board (if trigger pulled)	113	—[b]
	12.3	Conduct AAR in accordance with unit SOP	114	—[b]
	12.3.1	Notes	—[a]	—[b]
	12.3.2	Video	—[a]	—[b]
	12.3.3	Clear Concise and Complete	—[a]	—[b]
	12.3.4	Participatory	115	—[b]

[a]No individual measure for this PI because it is adequately covered in another PI.
[b]No system-based measure was defined for this PI.

APPENDIX H

SUMMARY OF PROTOTYPE SYSTEM-BASED PERFORMANCE MEASURES

Mission Event	PI Number	PI Title	Status
		Mission Planning Phase	
1 Pre-Mission Planning			
	1.1	Coordination for Brief Preparation	Future
	1.2	Operation Summary (Past, Current, Future)	Future
	1.3	Flight Team and Aircrew Mission Preparation	Future
	1.3.3	Aircrew Briefs	Potential
3 Task Quick Reaction Force (QRF)			
	3.2	Request SITREP on Net (prior to launch)	Future
	3.3	Launch Order	Potential
		Enroute	
4 Enroute			
	4.1	Call Off to Battalion TOC	Future
	4.2	Aircrew to deconflict airspace as required (air traffic services)	Likely
	4.3	Monitor and Acknowledge Updates	Likely
	4.4	Coordinate Team Tactics with wingman	Future
	4.4.1	Loiter or Holding Area	Potential
	4.5.1	Adherence to the SOP - Formation	Potential
	4.5.3	Communication Protocol	Potential
	4.6	Execute Air Ground Integration Checklist	Potential
	4.6.1	Check-in with Ground	Likely
	4.6.2.3	Receive SITREP from Ground - Updates to the situation	Likely
	4.6.2.4	Obtain UAS feed (if/when possible)	Future

(continued)

Mission Event	PI Number	PI Title	Status
		Mission Execution	
5 Arrive on Station - Update Situational Awareness			
	5.1	Communicate Arrival On Station	Potential
	5.2	Visually ID location of Friendlies	Potential
	5.3	Develop Plan/Scheme of Maneuver	Likely
6 Target Acquisition (In parallel with on station tasks)			
	6.2	Begin Search for Target	Likely
	6.2.4.1	Recognize threats - Utilize Appropriate Standoff Distance	Likely
	6.3	Announce target in sight	Potential
	6.4	Communicate Target Acquisition to ground forces	Potential
	6.5	Confirm target with appropriate marking technique for Ground Commander using SOP	Likely
9 Employ Weapon System			
	9.1	Fire weapon based on SOP and previous plan	
	9.1.2	Wingman provides overwatch and cover	Likely
	9.1.3	Applies appropriate weapons engagement technique based on SOP	Likely
	9.2.1	Determine Effects of Weapons and Objective Met - Communicate to Ground Commander	Potential
	9.3	Determine Health State of Aircraft (if applicable)	Potential

(continued)

Mission Event	PI Number	PI Title	Status
		End of Mission	
10 Battle Damage Assessment			
	10.1	Give BDA to Ground Commander as per unit SOP	Likely
11 Obtain Revised Task and Purpose			
	11.1	Aircrew Determine FARM (Fuel Ammo Rockets Missiles)	Likely
	11.3	Egress Per Unit SOP and APG (Area Procedures Guide)	Potential
	11.4	Ingress to next mission if appropriate	Potential