

Performance Measurement for Diagnosing and Debriefing Distributed Command and Control Teams

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ICCRT 2003

Navy Requirements

TRANSITION SPONSORS

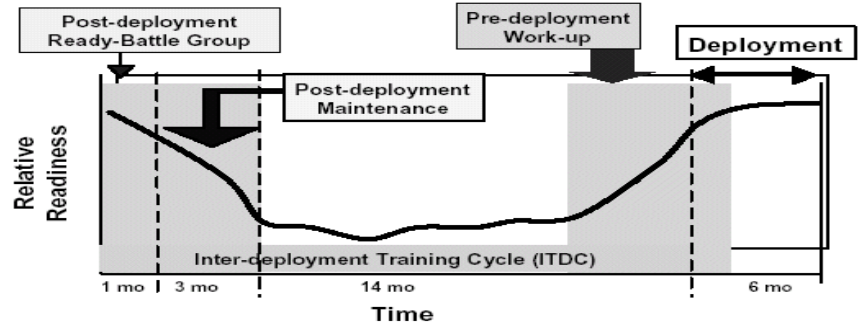
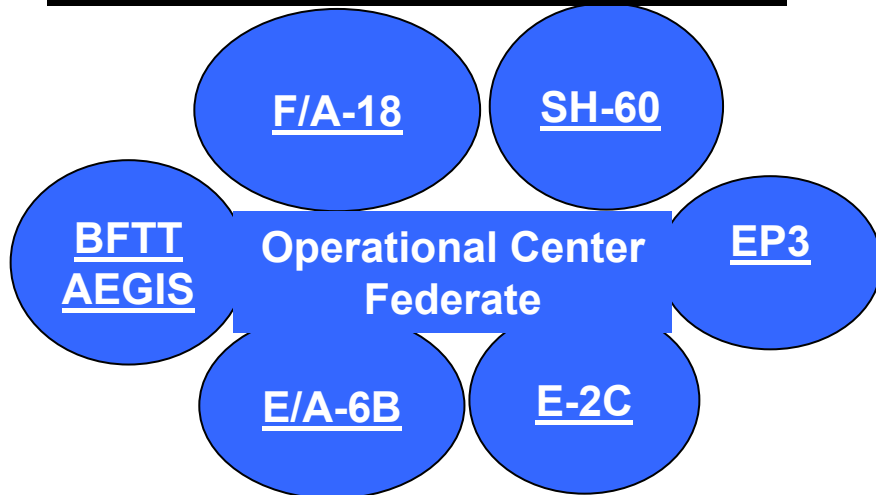
NAVAIR Navy Aviation Simulation Master Plan

NAVAIR Advanced Warfare Training Development 6.4 Program

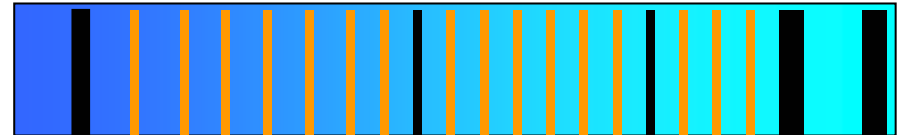
NAVSEA IWS 1E -BFTT



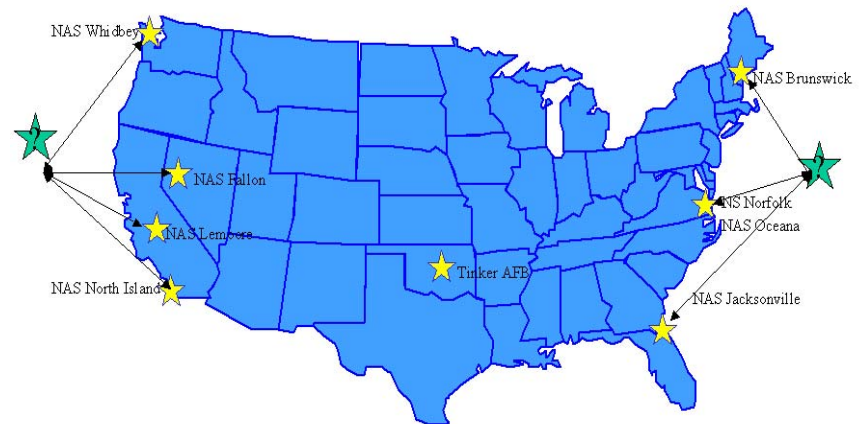
NASMP PLAN FY03-FY08 +→



Deficiency: Just 5 Post Fleet Replacement Squadron Distributed Training Events



Distributed Training CONOPS



AAR System Example for Aviation Teams



AAR System Example for Battle Group

Shipboard Training: BFTT Debrief

Replay
File Set View Tools Maps Help
1995:02:02 17:34:31 (1 00:11:54)
Constellation SETS NEW TRACK

Range & Bearing
Click mouse to hook initial track.
Initial point: 12358.26E, 3501.19N
Terminal point: 12227.54E, 3519.72N
Range: 76.44 nm Bearing: 284 deg

Select Track
Refresh
Enter filter
STN : 7041
CTSL :
Mode2 :
Mode3 :
CCD 41

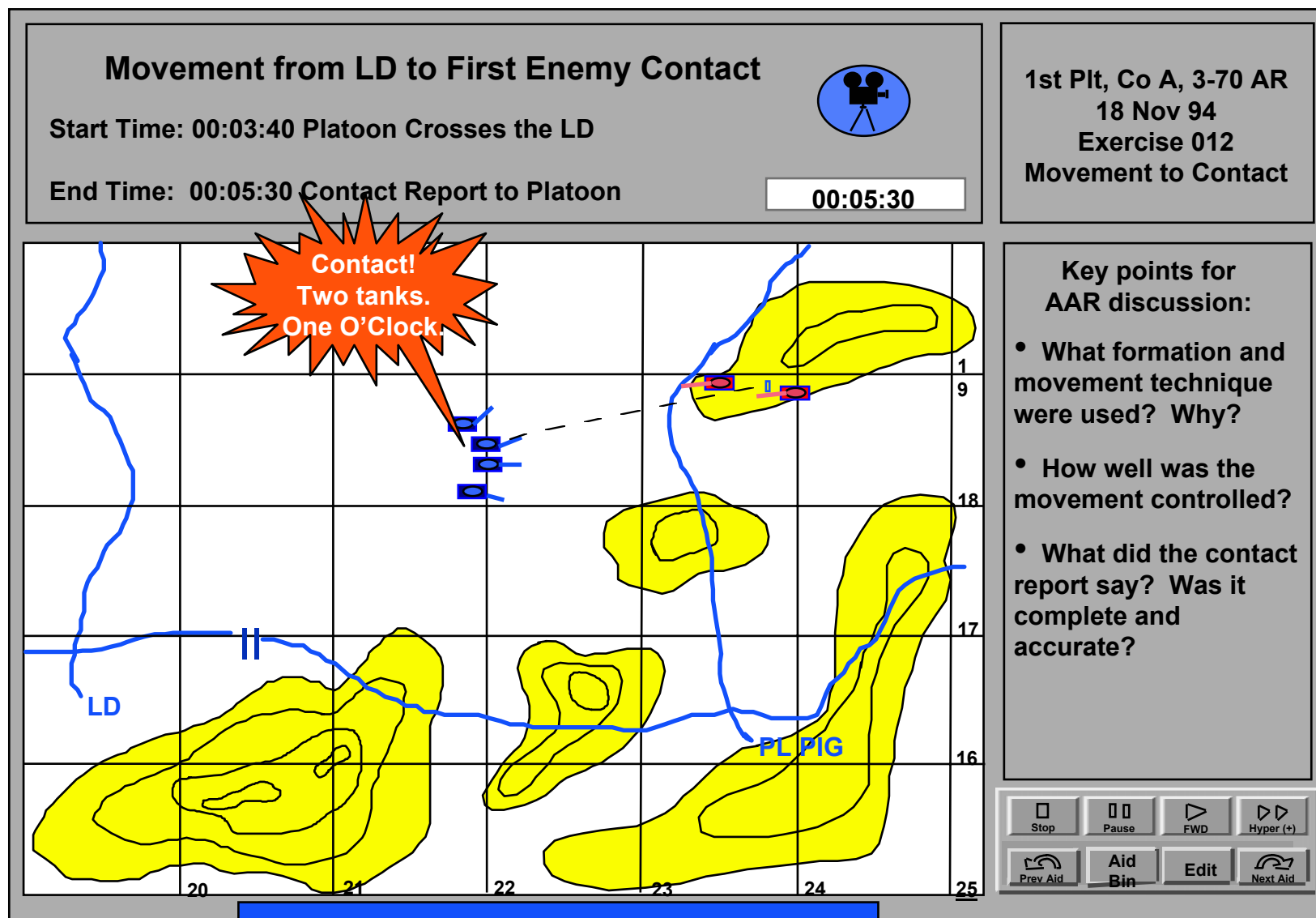
Control Panel
Play Speed
Prv Action Nxt
Restart Time
In Center Out
< > 3D v ^
v Altitude ^
- Symbols +
Reset View
Interpolation:
Truth Non Tru
Source Filter: CCD TRU
Find Track
History Future
Rng Brg Platfrm
Print

DEBRIEF 2.4 -- 02.14.96
File Help
Module Selection:
Main Data Replay
Tracks Charts Summaries
Screen Selection:
◆ Primary
◇ Alternative
◇ Network
Network Screen Name:
unix:0.0
CCD 41
File
1995:02:02 17:34:31
Src:
Exp: Cor:
12231.55 E, 3518.80 N
Alt: 16000 ft
Hdg: 155 deg T
Spd: 364 knts
Cat: A Comp: ONE
Id: F
L/R: L LTQ: 7 RTQ: 1
STN: 7041 CTSL: 141
M1-M4: / / /

AAR System Example for Army/USMC: PowerSTRIPES

The screenshot displays the PowerSTRIPES PVD (PowerSTRIPES Visual Display) software interface. The main window shows a tactical map with a grid overlay. The map features several units, including a cluster of red units at the top and a cluster of blue units at the bottom. A red line connects the red units to the blue units, indicating a communication or command link. The map also shows terrain features, including a river and a road. A blue box highlights a specific area on the map, and a red box highlights another area. The interface includes a menu bar at the top with options like File, Edit, View, Insert, Format, Tools, Slide Show, Window, and Help. A toolbar below the menu bar contains various icons for file operations, navigation, and editing. A 'PowerSTRIPES Command Toolbar' is visible on the left side of the map, with a dropdown menu showing 'AAR', 'Edit', 'View', and 'Insert'. An 'Exercise Monitor' dialog box is open in the center-right of the map, with buttons for 'Load', 'Monitor', 'Pause', and 'Event'. A tooltip 'Load the exercise for Monitoring' is visible near the 'Load' button. The bottom of the screen shows the Windows taskbar with the Start button and several open applications: PowerSTRIPES PVD, PowerSTRIPES - [Prototyp..., Microsoft Excel, and PowerSTRIPES User's Gui... The system clock shows 5:14 AM.

Army Research Institute: Automated Training Analysis and Feedback System



Plan View Animation Aid

Distributed Training Challenges

- Nature of Effective Teams: Ability to Adapt Behaviors
 - Self-Correct, Compensate, Re-Allocate Functions
- Adaptation Forces Changes to Scenario Events
- Increased Workload for Instructors/Assessors
 - Distributed Teams Multiply Measurement Requirements
 - Increased Reliance on VTC/Phone Conferences and Fewer Face-to-Face Debriefs/AARs
- Need Rapid Tailoring and Debrief Based on Distributed Team Training Requirements
- Training Technology Gap: Theory- and Empirically-Based Measurement Strategies to Optimize Partitioning Debrief/AAR for Distributed Simulation-Based Exercises

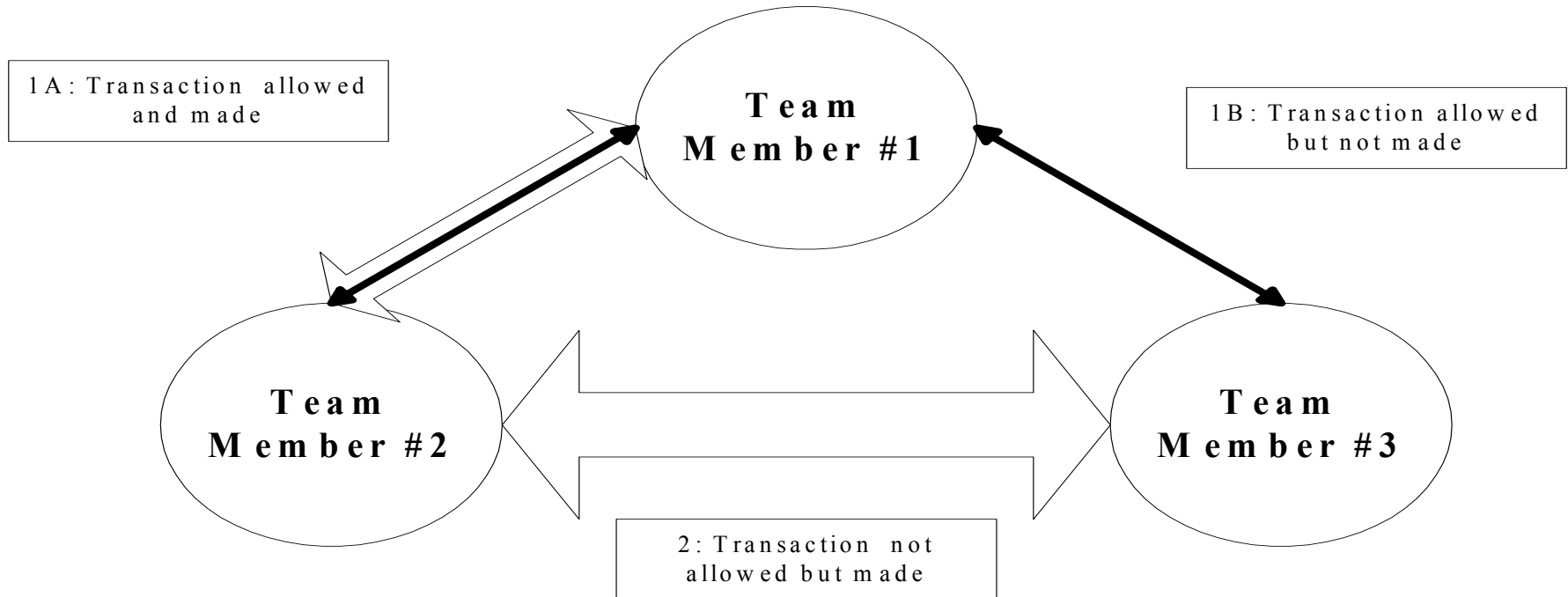
Partitioning the Debrief/AAR

- NOT TRIVIAL! Additional challenges:
 - Partitions may not correspond to existing boundaries between teams or functions--They may be quite novel
 - There may be more interacting groups than there are venues (e.g., VTC facilities) and time to debrief them
- A practical balance must be struck VERSUS
 - Debriefing every interacting sub-team about every failure OR
 - The common solution: debrief everyone in intact groups (e.g., each flight element) about everything
- Partitioning Decisions
 - Identify individuals within the organization whose interactions influenced team performance
 - Set priorities
 - Bring those individuals together to critique the interactions and recommend improvements in them

Model of Organizational Behavior

- Adaptive Architectures for C2 and Team Training R&D (MacMillan et al.)
- Model of Organizational Behavior for Command and Control
- Organizational Structure
 - Static--Decision Hierarchy and Task Responsibilities
 - Who Is Subordinate to Whom Through Command Authority
 - Who Has Control of Specific Assets
 - Who Has Access to Specific Information Resources
 - Communication Rules for Passing Information
 - Distributed Expertise
 - Dynamic—Adaptive Behaviors of Team Members
 - Team Members Command, Communicate, Control Assets, Access Information, and Exercise Expertise
 - Content and Timing of Communications

Model of Organizational Behavior



Thin black lines = (official) communications transactions

Wide white lines = (actual) dynamic communication transactions

Partitioning for Feedback May Be Determined by Assessing the Transactions Made Among Team Members in Response to the Organizational Structure

Partitioning for Feedback

- Volume and criticality of behaviors (indicated by the breadth of lines in Figure 1) can guide instructors to prioritize feedback so that they give the most weight to most frequent or critical errors – whether of commission (1B) or omission (2).
- (1A)--Conforming to architectural constraints may warrant feedback that reinforces the behavior, particularly if that behavior is spotty
- (1B)--Behaviors that fail to exploit the allowances of the architecture may warrant instruction that reminds team members of this aspect of the architecture (e.g., the available communication channel or control over some asset)
- (2)--Violating architectural designs may warrant corrective instruction or organizational redesign

Partitioning the Debrief/AAR: Measurement Strategy

- Combine Team Measures to Identify Performance Patterns
 - Team Decision Making Processes
 - Team Adaptation and Coordination
- Team Decision Making Dimensions
 - (Paris et al. (1998) & Marshall (1995))
 - Identification
 - Recognizing the Problem
 - Effective use of Pattern Recognition Strategies using Track Profile Information
 - Elaboration
 - Interpreting the Situation
 - Recognizing Constraints
 - Prioritizing Threats
 - Planning
 - Knowing what to do and when to do it
 - Execution
 - Effective and Timely Implementation of Plans
 - Knowing Who Should Perform the Required Actions

Air Warfare Team Performance

Detect-to-Engage Sequence

IDENTIFICATION

- Detect
- Entity Type ID

ELABORATION

- Threat ID

PLANNING

- Query
- Final Warning
- Illuminate
- Cover With Weapons
- Engage

EXECUTION

- Query
- Final Warning
- Illuminate
- Cover With Weapons
- Engage

IDENTIFICATION				ELABORATION	EXECUTION									
Acq. Time Detec. Lost Brg/Rge	Track No. Craft Type	Detect	Entity Type ID	Threat ID /Threat Prioritization		Query			Final Warning	Illuminate		Cover w/ Weapons	Engage	
1:06 - 030/77	7024 Comair	0 ⇐ (2:30) >	0 X ⇐ (3:00) >	0 X ⇐ (3:00) >	0 1 2			0 X(E)	0 X(E)	0 X(E)	0 X(E)	X(E)		
					⇐ (7:00 E) >								⇐ (6:00 P) >	
1:06 - 255/36	7023 Helo	0 ⇐ (2:30) >	0 X ⇐ (4:30) >	0 X ⇐ (15:00) >	0 1 2			0 1 2 ⇐ (19:30 E) >	0 1 2 ⇐ (19:30 E) >	0 1 2 ⇐ (19:30 E) >	0 1 2 ⇐ (10:30 E) >	X(E)		
					⇐ (6:00 E) >								⇐ (5:00 P) >	
2:06 - 030/76	7017 P-3	0 ⇐ (3:30) >	0 X ⇐ (16:30) >	0 X ⇐ (16:30) >	0 1 2			0 1 2 ⇐ (26:30 E) >	0 1 2 ⇐ (26:30 E) >	0 1 2 ⇐ (26:30 E) >	0 1 2 ⇐ (17:00 E) >	X(E)		
					⇐ (15:30 E) >								⇐ (14:30 P) >	
6:06 - 029/76	7027 F-4 (1)	0 ⇐ (7:30) >	0 X ⇐ (9:30) >	0 X ⇐ (11:30) >	0 1 2			0 1 2 ⇐ (26:30 E) >	0 1 2 ⇐ (26:30 E) >	0 1 2 ⇐ (26:30 E) >	0 1 2 ⇐ (17:30 E) >	X(E)		
					⇐ (17:00 E) >								⇐ (16:00 P) >	
6:06 - 029/76	7030 F-4 (2)	0 ⇐ (7:30) >	0 X ⇐ (9:30) >	0 X ⇐ (11:30) >	0 1 2			0 1 2 ⇐ (26:30 E) >	0 1 2 ⇐ (26:30 E) >	0 1 2 ⇐ (26:30 E) >	0 1 2 ⇐ (23:00 E) >	X(E)		
					⇐ (23:00 E) >								⇐ (22:00 P) >	
12:06 - 031/78	7034 Comair	0 ⇐ (13:30) >	0 X ⇐ (14:00) >	0 X ⇐ (14:00) >	0 1 2			0 X(E)	0 X(E)	0 X(E)	0 X(E)	X(E)		
					⇐ (18:00 E) >								⇐ (17:00 P) >	

ATPI Critical Event Clusters- Emphasis on Resource Allocation

Event 1: Begins 1 minute after scenario start and ends at 5 minutes Team Actions in Min:Sec	Made Detection	Made Platform Identification	Made Platform Threat ID And Priority
Commercial Aircraft #1 Wanders Off of COMAIR Route	1:30	2:30	3:00
Potentially Hostile Aircraft #1	2:30	4:30	5:00
Potentially Hostile Aircraft #2	3:30	4:30	5:00

Event 2: Begins 5 min after scenario start and ends at 15 minutes	Plan/Execute Query	Plan/Execute Final Warning	Plan/Execute Illuminate	Plan/Execute Cover With Weapons
COMAIR #1	6:00/7:00	N/A	N/A	N/A
Potentially Hostile A/C #1	5:30/5:30	7:30/7:30	8:00/8:30	8:00/8:30
Potentially Hostile A/C #2	6:00/7:00	7:30/8:30	8:30/8:30	14:30/15:00

% Team Actions Performed on Each Dimension for Each Event Cluster

Team A

Scenario	Identification	Elaboration	Planning	Execution
Event 1	90	90	40	40
Event 2	80	80	20	20
Event 3	80	80	0	0

Team B

Scenario	Identification	Elaboration	Planning	Execution
Event 1	60	40	99	99
Event 2	60	40	99	99
Event 3	50	30	99	99

Partitioning the Debrief/AAR: Measurement Strategy (Cont.)

- Team Adaptation and Coordination (Serfaty et al., 1998)
- Anticipation Ratio Enables Diagnosis of the Dynamic Communication Exchanges Among Team Members
- Categories
 - Type of Communication (E.G., Information Exchange, Situation Updates, Supporting Behavior, Error Correction, and Feedback)
 - Direction of the Communication in the Hierarchy (e.g., Team Member to Team Member and Team Member to Higher Authority)
- Example of A Good Anticipation Ratio
 - # of Team Member Communications to Higher Authority Greater Than # of Communications From Higher Authority to Team Members

Partitioning Debrief for Teams A & B: Using ATPI With Anticipation Ratios

Team A: Was Higher Authority Asking
For Information?

Scenario	Identification	Elaboration	Planning	Execution
Event 1	90	90	40	40
Event 2	80	80	20	20
Event 3	80	80	0	0

Team B: Were There Improper Team
Member to Team Member
Communications?

Scenario	Identification	Elaboration	Planning	Execution
Event 1	60	40	99	99
Event 2	60	40	99	99
Event 3	50	30	99	99

Sponsored Research Initiatives

- **Semi-Automated Assessment Synchronized With Automated Performance Recording**
- **Automated Diagnosis and AAR/Debrief Tools**

