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REDEFINING E-3 CORE COMPETENCIES FOR DOMINANT BATTLESPACE KNOWLEDGE IN FUTURE COMBAT OPERATIONS

by

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September 2005

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This thesis explores how E-3 Air Battle Managers train for and perform their duties on board the Airborne Warning and Control System. The study focuses on how E-3 training is driven by the maintenance of a set of battle management core competencies rooted in the basics of aircraft tactical fluid control, force accountability and aerial refueling. The advent of a revolution in Information Management technology in the form of the 40/45 weapons system upgrade for the E-3 will drive the Air Force to rethink how training is accomplished with new capabilities and emerging missions in the battlespace. The current approach to block will not allow the Air Force to exploit the capabilities of the 40/45 airframe. Lessons from emerging areas such as knowledge management and sensemaking need to be assimilated into the way the Air Force trains E-3 Air Battle Managers to ensure future combat capability of aircrews in the increasingly technical and complex battlespace of future military operations. Existing core competencies need to be considered individual skill sets, and knowledge management and sensemaking introduced to better prepare battle managers to effectively and efficiently interpret inputs in the battlespace and place information where it needs to be.

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REDEFINING E-3 CORE COMPETENCIES FOR DOMINANT BATTLESPACE KNOWLEDGE IN FUTURE COMBAT EMPLOYMENT

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ABSTRACT

This thesis explores how E-3 Air Battle Managers train for and perform their duties on board the Airborne Warning and Control System. The study focuses on how E-3 training is driven by the maintenance of a set of battle management core competencies rooted in the basics of aircraft tactical fluid control, force accountability and aerial refueling. The advent of a revolution in Information Management technology in the form of the 40/45 weapons system upgrade for the E-3 will drive the Air Force to rethink how training is accomplished with new capabilities and emerging missions in the battlespace. The current approach to block will not allow the Air Force to exploit the capabilities of the 40/45 airframe. Lessons from emerging areas such as knowledge management and sensemaking need to be assimilated into the way the Air Force trains E-3 Air Battle Managers to ensure future combat capability of aircrews in the increasingly technical and complex battlespace of future military operations. Existing core competencies need to be considered individual skill sets, and knowledge management and sensemaking introduced to better prepare battle managers to effectively and efficiently interpret inputs in the battlespace and place information where it needs to be.

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This thesis is dedicated to battle management professionals who have persevered through challenging times in all the corners of the globe. Combatant Commanders don't go to war without you, and even in these challenging times of budget constraints and limited resources, the community still continues to perform at an impressive level. The E-3 continues to prove its value as an essential asset, and it will continue to be so in the future of combat employment. We, as a community, will continue to perform no matter what the odds and overcome all the obstacles in our way to the best command and control in the world.

I also would like to thank Dr. Erik Jansen and Dr. Bob O'Connell for allowing me to explore this topic. Without their steadfast guidance and trust, this project would not have been possible.

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I. INTRODUCTION

A. A BRIEF HISTORY OF E-3 OPERATIONS 1979-2005

The E-3 community has been deployed in support of operations worldwide since the original delivery of the weapons system to the Air Force in 1979. From the Yemen conflict that same year to the most recent conflict in Iraq; aircrews have supported a myriad of air battle management missions ranging from surveillance to tactical fluid control, and finally dynamic targeting operations in Afghanistan and Iraq. Over the years since Yemen and throughout these conflicts, technology improvements in weapons systems and tactics for employment have changed significantly. Air battle management operations during the 1980's were primarily surveillance, identification and data link management, primarily in the Middle East surrounding the ELF ONE operation where crews were tasked with monitoring the ongoing Iran-Iraq war. Although E-3 crews were deployed to other areas of the world in support of North American Aerospace Defense (NORAD) operations and special surveillance mission in the Pacific Theater covering the downing of KAL flight 200, the primary mission of E-3 crews went primarily unchanged.

E-3 crews redeployed back to the United States, ending an eleven year continuous deployment in support of ELF ONE in 1990. Soon after the crews returned home, the call for the buildup back in Saudi Arabia came in for support of Operation DESERT SHIELD following the Iraqi invasion of Kuwait. E-3 crews were called on for their same basic functions; combat identification of air traffic, surveillance of the airspace surrounding the Arabian Peninsula, and information flow to the command authority which was primarily in the form of data link communications. Although there were 39 of 41 air to air kills credited with air battle management assistance, the basic core competencies of E-3 aircrews were tested, and the results supported the training that E-3 crews had been doing.[1]

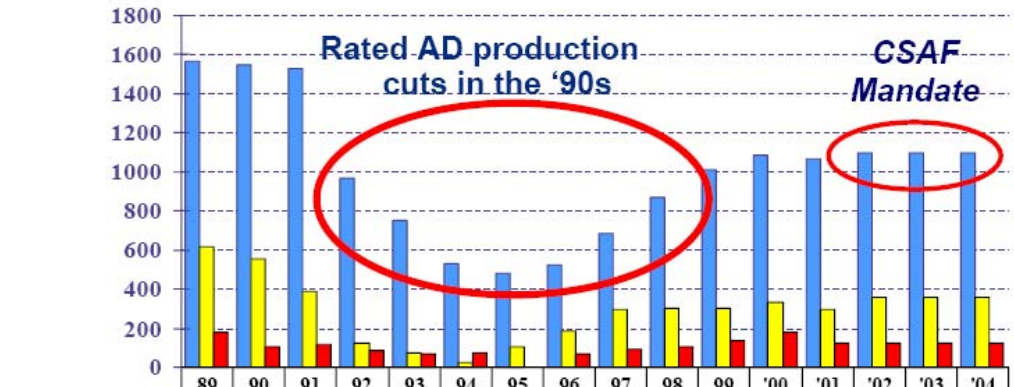
[1] 552 Air Control Wing Lessons Learned (1992). *Operation Desert Storm Lessons Learned.* Verified by telephone interview with Major Justin Hickman, 552 OSS/OSK DSN: 884-4466

In 1993, the air battle management community took a big hit during the Department of Defense wide Reduction in Forces as our military drawdown began. One hundred eighty-nine air battle management professionals were relieved from duty that year, dealing a significant blow to the career field's experience base just having returned from war in the Gulf.[2] The effect of this experience drain coupled with a two year draw down and eventual zero accession in 1995 of officers into the career field further exacerbated the lack of experience in the air battle management community.[3] There were only 209 Air Battle Manager (ABM) accessions between 1993 and 1996, which works out to a net gain of only 20 battle managers over the four year period. This timeframe is referred to as the ABM "bathtub" where lack of aircrew manning prevailed at Tinker Air Force Base, Oklahoma from the late 1990's until early 2001. The results of these cuts and redesignations were corrected in 1996 and are not projected to be normalized until 2009.[4] The prolonged presence of aircrews in the Middle East supporting the Northern and Southern no fly zones over Iraq, coupled with less than challenging missions as far as battle management core competencies are concerned, such as counter-drug missions in the southern hemisphere, eroded E-3 crews battle management competencies.

[2] Telephone interview with Major George Wilson, Headquarters Air Force Personnel Center, Randolph Air Force Base, Texas. Interview conducted 15 July 2005.

[3] Cathey, M. (2005) *ABM Career Field Update.* PowerPoint presentations delivered at the USAF Combat Air Forces Weapons and Tactics Conference.

[4] Ibid.



	89	90	91	92	93	94	95	96	97	98	99	'00	'01	'02	'03	'04
Pilot Production	1565	1548	1528	967	749	533	481	525	682	869	1011	1085	1068	1100	1100	1100
Nav Production	618	554	391	125	73	23	102	188	293	303	304	330	298	360	360	360
ABM Production	181	103	119	87	67	71	0	66	90	106	136	178	126	126	126	126

Table 1. Rated aircrew production 1989-2004

B. AIR BATTLE MANAGER TRAINING SYNOPSIS 1979-2005

Undergraduate controller training at Tyndall AFB, FL underwent major changes during the mid-1990s to better prepare ABMs for their unique requirement to become proficient in a number of core competencies. The E-3 community has tremendous challenges to deal with concerning training and maintaining combat readiness for the spectrum of operations they are tasked to support. The E-3 community does the best it can with current training guidance to maintain combat mission readiness with concentrating on core competencies of assigned missions. These core competencies include directing aircraft in offensive and defensive tactical missions, coordinating aircraft control and warning activities, force accountability of assigned assets, and aerial refueling.[5] As an ABM progresses, responsibilities and core competencies may broaden and become more complex to include: knowledge of electronic attack and protect fundamentals, interaction with other C2 agencies, and familiarization with air defense organizations, air defense capabilities, and operating procedures between air and naval forces.[6]

[5] Air Battle Manager Career Path Guide. Extracted from http://www.afpc.randolph.af.mil/ofcr-cpguide/New_Folder/Ch2-21.htm 2 December, 2004.

[6] Ibid.

These battle management core competencies are based largely on mission, doctrine and lessons learned. The result is that many of the training requirements for E-3 aircrews are based upon reward looking requirements. Although a logical place to start, this leads the E-3 community many times to train for the "last mission" instead of looking forward to base training on expected future operations. Although a challenge, and recognizing that no one can accurately predict the future, the advent of new weaponry and Information Management technology warrants a retooling of the way we do business as ABMs.

Core competencies such as aerial refueling and force accountability are not trained to adequately; these are two of the most important, challenging and least successful missions performed by E-3 aircrews in large force operations. Battle management skills such as the unique challenges of Dynamic Targeting and support for ground forces have emerged from Operations ENDURING FREEDOM and IRAQI FREEDOM as the newest requirements for Combatant Commanders, but E-3 training does not adequately prepare crews for these missions and requirements.[7]

E-3 crews leading up to OEF and OIF were forced to bridge the gap between current core competencies and mission requirements for those conflicts. The result in both instances was a "just in time" conflict spin up methodology where short notice academics and simulation scenarios were developed on the fly and incorporated just prior to crews deploying. Although relatively effective, the E-3 community must develop a new training philosophy supported by existing and future training simulations to better prepare crews for future operations.

C. BLOCK 40/45 UPGRADE FOR THE E-3

The USAF has chosen to prolong the AWACS program as a cornerstone of the JFACC's ability to execute the ATO in support of a myriad of graduated combat operations. Block 40/45 will bring a huge leap forward in technological capability concerning air battle management. The baseline increase in capability will come from a revolutionary change in computing capability transitioning from

[7] Air Battle Manager Career Path Guide. Extracted from http://www.afpc.randolph.af.mil/ofcr-cpguide/New_Folder/Ch2-21.htm 2 December, 2004

1960s legacy architecture to an open systems architecture utilizing and ETHERNET LAN.[8] Along with the computer upgrade, Man-machine interface will be much better than in the previous 30/35 configuration introducing "rollover information" options, operator selected tabular displays of information and tactical bearing and range as well as topography and ATO data available at the operator's fingertips.[9]

40/45 production is scheduled for Fiscal years 2008-2015, with initial delivery to Tinker AFB in October of 2009.[10] Initial operational capability (IOC) will be declared with five aircraft delivered and is estimated to be in fiscal year 2010.[11] It is clear that the Air Force is committed to upgrading the primary weapons system dedicated to tactical command and control, and it has invested significant resources to that end. The potential pitfall, however, lies in falling back into the old core competencies of the block 30/35 aircraft. The true combat capability of the new weapons system on board the E-3 will not be realized without significant and far reaching changes to the philosophy of training employed from Initial Qualification Training all the way to Continuation Training of E-3 aircrews. The new philosophy of training needs to be centered on knowledge management and sensemaking, transitioning current core competencies to necessary skill sets. By rethinking current core competencies in this way, they will not drive E-3 aircrew training, but will be necessary skills required to execute new concepts of core competencies centered on effective decision making, information flow and assurance, and dynamic battle management in extremely congested and fast paced environments.

D. DOMINANT BATTLESPACE KNOWLEDGE AND SENSEMAKING

In 1995, VADM William Owens argued that the advances in technology and weapons systems was increasing the U.S. military's capacity to process and

[8] Talking Paper on Block 40/45. Mr. Don Gricol, 552 ACW/XPR. July 2004.

[9] Ibid.

[10] Ibid.

[11] Ibid.

make sense of incredibly large volumes of data.[12] Dominant Battlespace Knowledge (DBK) encompasses a wide range of information from target recognition and identification to knowledge of our opponent's operational scheme of maneuver.[13] If we can significantly increase DBK ahead of our opponent, we can increase the gap that exists between our capability to wage operations within a specific battlespace more quickly, efficiently and lethally than our adversaries. Our ability to transfer DBK among players committed to a specific campaign will increase our capability to apply force with speed, accuracy and persistence required to be successful. DBK will aid in ensuring correct force allocation for a specific mission.[14]

DBK at the tactical level as it applies to E-3 ABM crews is not practiced nor trained to under the current E-3 training plan detailed in Air Force Instruction 11-2E3 volume 1.[15] Operations no longer take place on the linear battlefield, and they encompass a much wider spectrum of operations to include asymmetric threats and dynamic targeting scenarios. Today's battlespace is populated by multiple coalition military and non-governmental organizations on the ground and in the air, often prosecuting non-Air Tasking Order assigned missions on very short timelines. Also, E-3 crews are being asked to execute new employment concepts not trained adequately to before, such as Close Air Support, Dynamic Targeting and multiple anchor and aircraft aerial refueling. Existing core competencies do not effectively prepare ABMs to perform these missions to the level required in major theater warfare. Further, as the U.S. military adopts network centric operations as the standard, a fundamental shift from "platform-centric" warfare will go by the wayside as DBK emerges as the requirement for success.[16]

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[12] Labicki, M. & Johnson, S. (1995) *Dominant Battlespace Knowledge.* National Defense University Press.

[13] Ibid.

[14] Ibid.

[15] US Air Force Instruction 11-2E3 Volume 1. (2005) *E-3 Aircrew Training.* Retrieved 9 August 2005 from http://www.e-publishing.af.mil/pubfiles/af/11/afi11-2e-3v1/afi11-2e-3v1.pdf

[16] Labicki, M. & Johnson, S. (1995)

Sensemaking as it applies to E-3 ABMs addresses issues such as placing information into frameworks or a schema, comprehending what is happening around the individual, constructing the meaning of a situation and interacting in pursuit of shared mutual understanding.[17] This is the crux of the ABM's job as it applies to tactical command and control, battle management and information flow in the battlespace among integrated forces. Core competencies such as Tactical Fluid Control of aircraft, Aerial Refueling mechanics and Communications discipline are not core competencies, but skill sets required to accomplish the greater goal of sensemaking and DBK.

E. THE FOCUS AND METHODOLOGY OF THIS PAPER

This paper will not have all the answers, nor is it designed to replace the current E-3 training plan for ABMs. The purpose of this paper is to explore how E-3 crews train today and identify more effective ways to prepare aircrews for future military operations. The way to do that lies in utilizing a more comprehensive approach to training, realizing that technology available to E-3 crews will undergo a major renovation in the next 5 years. I introduce in more detail the art of sensemaking and DBK and how marrying this new training philosophy with IT positional training on the new weapons system will be essential to fully realize the combat capability of 40/45. The USAF should not miss this opportunity to rethink how we do business during an already monumental upgrade in capability, because another opportunity of this magnitude might not appear again in the life of the weapons system.

[17] Leedom, D. (2001). *Workshop on Sensemaking.* Powerpoint Presentation.

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II. E-3 TRAINING: HOW THEY DO IT NOW

A. THE CURRENT TRAINING PLAN FOR E-3 AIR BATTLE MANAGERS

The governing document for E-3 aircrew members conducting Initial Qualification, Mission Qualification and Continuation Training is Air Force Instruction 11-2E3 Volume 1. This instruction is designed to ensure ABMs have all required prerequisites and minimum training requirements necessary to prepare aircrew members to perform basic aircrew duties in the E-3 aircraft.[18] Upon graduation from Undergraduate Controller Training at Tyndall Air Force Base, an ABM is expected to have the basic skill sets required to perform basic battle management functions, some exposure to mission scenarios, and basic training in datalink and communications as well as electronic attack and protect procedures.[19] When ABMs are assigned to Tinker Air Force Base, Oklahoma and enter training, the focus in Initial Qualification Training is on positional proficiency in a crewmembers specific job area. Although training scenarios test and build on previously acquired skills, ABM scenarios are at a basic level, emphasizing proficiency and efficiency in specific skill sets such as communications discipline, computer interface, and standards of weapons control and battle management.

Upon completion of Initial Qualification Training (IQT), E-3 aircrews are sent to Mission Qualification Training (MQT), which is designed to qualify personnel to perform aircrew duties during E-3 operational and training missions. MQT builds on acquired skill sets, with emphasis on crew integration and mission scenarios.[20] Aircrews learn more about the various missions of the E-3 and practice integrating into an effective and efficient combat team on board the E-3. Mission Qualification Training introduces missions such as Dynamic Targeting, Close Air Support and advanced datalink operations, however, the focus on

[18] United States Air Force Headquarters Air Education and Training Command. (2004) *Undergraduate Air Battlem Manager Training Syllabus (Validation).* Randolph Air Force Base, TX.

[19] Ibid.

[20] US Air Force Instruction 11-2E3 Volume 1. (2005) *E-3 Aircrew Training.* Retrieved 9 August 2005 from http://www.e-publishing.af.mil/pubfiles/af/11/afi11-2e-3v1/afi11-2e-3v1.pdf

these scenarios is at an exposure level only. Crews can not be expected to be proficient at these missions upon completion of mission qualifying training. Continuation Training is designed to maintain E-3 qualification and currency, maintain the ABMs basic skill sets, and increase proficiency at more complex mission scenarios.[21] Air Force Instruction11-2E-3 volume 1 defines currency as "flying and Aircrew Training Device (ATD) training designed to maintain proficiency and improve crewmember capabilities".[22] Along with localized simulator training and flight training, the USAF has many venues in which aircrews on the E-3 practice combat mission employment. Live fly exercises include RED FLAG at Nellis Air Force Base, Nevada, and MAPLE FLAG at Cold Lake, Ontario, Canada and Joint Expeditionary Force Exercise with major flying operations at Nellis.

The biggest challenge to developing the necessary skills to perform more complex missions such as Dynamic Targeting and Close Air Support is that these scenarios are not properly prioritized in continuation training for E-3 ABMs. Much of E-3 training is driven by other asset availability as the E-3 aircrews are essentially "end users" when it comes to battle management and aircraft control. Current simulation systems available at Tinker Air Force Base, Oklahoma, Kadena Air Base, Japan, and Elmendorf Air Force Base, Alaska do not provide adequate training scenarios for these complex missions. This is due largely to the fact that legacy AWACS mission simulators lack the technology and simulator operator personnel capability to adequately reproduce scenarios of enough complexity to effectively train. Distributive mission trainers[23] are also available, however, due to the number of DMT sites available to the Air Force; training scenarios with enough complexity to emulate real missions are not yet possible.

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[21] US Air Force Instruction 11-2E3 Volume 1. (2005) *E-3 Aircrew Training.* Retrieved 9 August 2005 from http://www.e-publishing.af.mil/pubfiles/af/11/afi11-2e-3v1/afi11-2e-3v1.pdf

[22] Ibid.

[23] Distributive Mission Trainers are the backbone of virtual combat in the Distributed Mission Operations which emerged in 1998 as an avenue to provide aerial war fighters with cyberspace training from remote locations while interacting with each other real time in a synthetic battlespace. The USAFs training requirements are relying more on DMO as the fidelity of the overall system increases.

As the number of DMTs increase, this capability will continue to improve. Mission Simulator Live Intercept Training Environment (MSLITE) is a system that allows AWACS Air Battle Managers to control live fighters from Tinker Air Force Base using Air Defense Sector's remote RADAR, Identification friend or foe, and communications feeds from coastal sensor sites.[24]

B. CURRENCY VERSUS PROFICIENCY

1. Currency

Air Force Instruction 11-2E3 volume 1 specifies flying requirements for maintaining *currency* in the aircraft. Currency, although not defined in the instruction, is "the state of being current; up to datedness"[25] The use of the word currency as it pertains to the training volume indicates the period in which an individual must fly to maintain the legal capability to perform duties as an aircrew member without instructor or evaluator supervision. Currency requirements for E-3 ABMs are listed below in table 2:

TRAINING	CREW POSITION	FREQUENCY
Event Operation	MCC, SD, ASO,ECO, SST,AST,BDT	1/60 Days
Controlled Mission	AWO, WD	1/60 Days
System Check	ART,CDMT	1/60 Days
Radio Ops	CSO, CT	1/60 Days

Table 2. E-3 Mission Crew Currency Requirements

Table 2 details how often specific crew positions need to fly to maintain this currency—that is the ability to fly without an instructor or evaluator present. An event operation for a Senior Director (the leader of the weapons section) is where the SD conducts mission planning for and then supervises Air Weapons Officers or enlisted Weapons Directors while controlling live aircraft.[26] A controlled mission required to maintain currency for an AWO / WD occurs when

[24] US Air Force Instruction 11-2E3 Volume 1. (2005) *E-3 Aircrew Training.* Retrieved 9 August 2005 from http://www.e-publishing.af.mil/pubfiles/af/11/afi11-2e-3v1/afi11-2e-3v1.pdf

[25] Online Dictionary (n.d.) Retrieved 18 August 2005 from: http://dictionary.reference.com/search?q=currency

[26] US Air Force Instruction 11-2E3 Volume 1. (2005) *E-3 Aircrew Training.* Retrieved 9 August 2005 from http://www.e-publishing.af.mil/pubfiles/af/11/afi11-2e-3v1/afi11-2e-3v1.pdf

at least one mission is controlled by an AWO / WD from check-in of the aircraft with the controller to handoff of the aircraft back to another agency.[27] This currency requirement can be fulfilled from a myriad of control missions to include Composite Force Training, Aerial Refueling, Time Sensitive Targeting, Close Air Support, Combat Search and Rescue, and Check-in / Force Accountability.[28]

2. Proficiency

Proficiency is defined as "the quality of having great facility and competence; skillfulness in the command of fundamentals deriving from practice and familiarities".[29] The maintenance of proficiencies in certain tasks on board the E-3 also are governed by 11-2E-3 volume 1. Training requirements for proficiency are listed in three categories: (1) Ground training requirements; (2) Aircrew training device requirements; and (3) Flying training requirements. Ground training comprises events that contribute to safety in the operation of duties in the airborne environment. Ground training requirements also include skills such as the wear of protective chemical equipment, physiological training and periodic intelligence training.[30] Combat Mission Ready (CMR) status indicates a crewmember who is current on all three categories of training and does not require an instructor or evaluator to be present when performing duties as an Air Battle Manager. CMR flying and ATD training requirements are reevaluated every 20 months to coincide with the Air Expeditionary Force rotation cycle. The current RAP Tasking message covers the period from 1 September 2004 to 31 May 2006.[31] There is a provision written into the message that allows for mid-cycle updates to the message to allow units to tailor their training for

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[27] US Air Force Instruction 11-2E3 Volume 1. (2005) *E-3 Aircrew Training.* Retrieved 9 August 2005 from http://www.e-publishing.af.mil/pubfiles/af/11/afi11-2e-3v1/afi11-2e-3v1.pdf

[28] Ibid.

[29] Online Dictionary (n.d.) Retrieved 18 August 2005 from: http://dictionary.reference.com/search?q=proficiency

[30] US Air Force Instruction 11-2E3 Volume 1. (2005) *E-3 Aircrew Training.* Retrieved 9 August 2005 from http://www.e-publishing.af.mil/pubfiles/af/11/afi11-2e-3v1/afi11-2e-3v1.pdf

[31] Headquarters Air Force Ready Aircrew Program Tasking Message. (2004). Headquarters Air Combat Command: Langley Air Force Base, Virginia.

specific requirements and to allow for new training requirements should E-3 tasking be modified based upon new mission requirements.[32]

The RAP tasking message states that the total sorties and events specified in it are minimums that ensure training to continually meet all tasked requirements for AWACS squadrons; they may only be reduced with the submission of a waiver request.[33] The following tables detail Air Battle Manager 20 month Aircrew Training Device (ATD), Distributed Mission Trainers (DMT) and live flight requirements for proficiency, current as of August 2005:

TRAINING EVENT	NOTES	CMR/E	CMR/I
Mission Scenario	2	13	13
Air to Air	1, 5, 6	3	7
Air Refueling	1, 6	2	3
Time Sensitive Targeting	1, 3	2	3
Combat Search And Rescue	1, 3	2	3
Close Air Support	1, 4	2	3
E=Experienced/I=Inexperienced.			
NOTES: 1. SDs may use excess live Controlled Missions to credit the applicable type of ATD mission on a 1 for 1 basis. 2. Mission scenarios can consist of AOR, NORAD, FLAG, etc and will be conducted with a weapons team, a surveillance team, and when possible an ECO 3. Will be conducted with an MCC and an ECO 4. Will be conducted with an MCC 5. At least 50% of air to air events must be at least 4 v X 6. Requires only weapons crew positions			

Table 3. SD 20 Month ATD Training Requirements, August 2005.

Table 3 details the requirements for both an experienced and inexperienced Senior Director—the lead Air Battle Manager of the weapons team

[32] Headquarters Air Force Ready Aircrew Program Tasking Message. (2004). Headquarters Air Combat Command: Langley Air Force Base, Virginia.

[33] Headquarters Air Force Ready Aircrew Program Tasking Message. (2004). Headquarters Air Combat Command: Langley Air Force Base, Virginia.

on board the E-3. As table 3 shows, to maintain CMR status, an SD must perform at least 13 mission training scenarios and two or three each of the specified missions based on experience. These mission scenarios help to simulate battle management and command and control operations and maintain proficiency in the essential skills required of an E-3 crewmember.

TRAINING EVENT	NOTES	CMR/E	CMR/I
DMT Mission	1, 2	5	10
E=Experienced/I=Inexperienced			
NOTES: 1. DMT Events include any 2 v X, 4 v X, or CFT mission briefed, executed, and debriefed in the DMT environment. 3. For units where DMT is not available, live Event Operations (SD) and Controlled Missions (AWO/WD) may be substituted for DMT Missions on a 1 to 1 basis.			

Table 4. Weapons (SD/AWO/WD) 20 Month DMT Requirements, Adapted from AFI 11-2E-3 Volume 1, August 2005

Table 4 lists Distributive Mission Training events required within the same cycle for all ABMs on the jet; both SDs and AWOs. DMT provides a more realistic simulation environment linking AWACS DMT simulators together with F-15 and F-16 simulators with live pilots at other bases.[34] Note three in figure 4 details that live missions may be substituted for DMT missions on a one for one basis in the event that DMT missions are not available. The DMT requirement introduces ten more events for an inexperienced ABM; however, the available missions are usually smaller and less complex than ATD missions and concentrate more on core skills rather than mission simulation.

[34] Brower, M. (n.d.) *Distributed Mission Training.* Retrieved 17 August 2005 from: http://www.military-training-technology.com/print_article.cfm?DocID=272

TRAINING EVENT	NOTES	CMR/E	CMR/I
Event Operation		20	40
Controlled Mission	All	6	6
E=Experienced/I=Inexperienced.			
NOTES: 1. CMR SDs will control any live mission at least once a quarter and meet 20 month live controlling requirements. Controlling consists of OCA/DCA, SEAD, CSAR, A/R, 2 v X, or 4 v X mission 3. Individuals may log up to 25% of their 20 month flying SD control requirements by controlling events on ground based radar equipment (MSLITE, TDF, Air Defense Sector, or other ground based radar).			

Table 5. SD, ECO 20 Month Flying Requirements, August 2005. ADAPTED

Table 5 details Senior Director flying training requirements for the 20 month training cycle encompassed by the RAP tasking message. For an inexperienced SD, usual flight planning at the squadron level would have inexperienced SDs flying at least 2 times per month and experienced SDs flying at least once a month. The total training requirement for an SD combines all live flying, DMT and ATD requirements and totals 63 events for an inexperienced SD, and 38 events for an experienced SD. These numbers work out to roughly three events per month for inexperienced and almost two per month for experienced senior directors.

TRAINING EVENT	NOTES	CMR/E	CMR/I
Controlled Mission	1,2	26	52
E=Experienced/I=Inexperienced.			
NOTES: 1. Consists of any mission with control of the following types: Air-to-Air Employment, CFT, PACAF LFE event, TST, CAS, CSAR, Air Refueling, Check-In, or Assist. Assist control will only qualify when conducted at any Flag exercise, Weapons School Integration phase, or Weapons School Mission Employment phase. Check-In control will only qualify if conducted at any Flag exercise 2. Individuals may log up to 25% of their 20 Month controlled mission requirements by controlling events on ground based radar equipment (MSLITE, TDF, Air Defense Sector, or other ground based radar).			

Table 6. AWO/WD 20 Month Flying Requirements, August 2005.

Table 6 details Air Weapons Officer flying requirements for the 20 month training cycle. An inexperienced AWO is required to fly 52 times, whereas an

experienced AWO requires 26 flights to maintain proficiency. The total training requirement for AWOs combined which is comparable to the SD totals in table 5, is 94 training events for an inexperienced AWO and 55 events for an experienced AWO. Over the span of a 20 month training cycle, based on experience level, and AWO will fly for proficiency 4.7 times per month and 2.75 respectively. The number of required events specified in the message support currency and proficiency as they are written in 11-2E3 volume 1; however, the actual training events that comprise the majority of the training requirements are not of sufficient size and complexity to adequately prepare E-3 Air battle managers for the tasks they perform in current AWACS real world missions and future combat operations.

TRAINING EVENT	NOTES	CMR/E	CMR/I
Mission Scenario	2	13	13
Air to Air	1, 5, 6	3	7
Air Refueling	1, 6	2	3
Time Sensitive Targeting	1, 3	2	3
Combat Search And Rescue	1, 3	2	3
Close Air Support	1, 4	2	3
E=Experienced/I=Inexperienced.			
NOTES: 1. SDs may use excess live Controlled Missions to credit the applicable type of ATD mission on a 1 for 1 basis. 2. Mission scenarios can consist of AOR, NORAD, FLAG, etc and will be conducted with a weapons team, a surveillance team, and when possible an ECO 3. Will be conducted with an MCC and an ECO 4. Will be conducted with an MCC 5. At least 50% of air to air events must be at least 4 v X 6. Requires only weapons crew positions			

Table 7. AWO/WD 20 Month ATD Training Requirements

3. Making up for Missed Time—The Spin up for OIF

Prior to November 2004, 11-2E-3 volume contained static aircrew training requirements that underwent revision approximately every two years to ensure that training was consistent with USAF requirements concerning AWACS employment. Shortly after the 11 September attacks in 2001, E-3 aircraft and crews were called on to participate in operation ENDURING FREEDOM (OEF) flying combat operations over Afghanistan in support of air strikes against

terrorist and Taliban targets as well as supporting coalition teams on the ground. E-3 ABMs faced many challenges in supporting these missions. The Operation ANACONDA after action report cited some of the challenges faced by all the aircrews in the battlespace as detailed by Major General Corley, USAF:

> The battle space was extremely constrained… B-52s at higher altitudes dropping JDAMs; B-1s at lower altitudes; unmanned vehicles such as Predator flying through there; P-3s, aircraft contributing to the ISR assets; helicopters down at the ground; fast-moving aircraft, F-14s, F/A-18s, F-16s, F-15Es; tanker aircraft that are flying through there. So you begin to see and sense the degree of difficulty of deconfliction,[35]

There were further challenges faced by E-3 ABMs as well concerning orientation of the battlespace. General Mosely commented that "in any given space – ground space – out there, you had regular and unconventional forces, humanitarian assistance guys, maybe regular guys and not one of us in the command authority knew where all of those guys were".[36] The battlespace was extremely complex in Afghanistan. E-3 crews were exposed to situations and scenarios they not trained adequately for based on core competencies and training at the time. General Mosely went on to say that:

> "you had to either have a JSOA [Joint Special Operations Area] stood up, or a killbox [engagement zone] stood up, or targets outside of that had to be blessed through an elaborate process" reaching "back to Tampa and in some cases back to Washington."[37]

The control of the airspace and weapons releases was so tight that only pieces of the Afghanistan battlespace were "open" for strikes at any one time.[38] At times, the restrictions caused aircrew in the battlespace to miss opportunities to hit emerging targets. Over time, the Combined Air Operations Center (CAOC) grew accustomed to the new style of warfare and became adept at handling the

[35] Headquarters United States Air Force. (2005). *Operation ANACONDA: An Airpower Perspective.* Retrieved 21 April 2005 from: http://www.af.mil/library/posture/Anaconda_Unclassified.pdf

[36] Ibid.

[37] Ibid.

[38] Ibid

intricacies of the coordination process.[39] These intricacies of a non-linear battlespace were difficult for E-3 ABMs to conceptualize, but the crews did get better over time as they gained experience in the Area of Responsibility (AOR). Looking back to the E-3 training plan, a question emerges: Why have these principles of command and control in a non-linear environment coupled with the advent of more dynamic battle management missions such as Time Sensitive Targeting (TST), not been written into E- 3 training?

4. Bringing the Lessons Forward—Spin up for OIF

As action slowed down after Operation ANACONDA, a new emerging operation loomed in the future of the United States and E-3 crews. With almost 16 months in between OEF and OIF, very little had been done to E-3 ABM training to account for TST and congested airspace control of aircraft. TST and CAS requirements were not written into 11-2E-3 volume 1 until after OIF in 2004. Due to operational security of the impending operation in Iraq, very little advanced warning was given to the 552 Air Control Wing (ACW) at Tinker AFB, Oklahoma prior to the deployment order in January 2005. The 552 ACW was tasked with controlling two thirds of the airspace along the Saudi / Iraq border, accounting for all strike, defensive counter air, offensive counter air, CAS and aerial refueling of assets supporting air operations for OIF.

Due to the lack of training for TST and CAS, the 552 ACW underwent an abrupt and on the fly spin-up prior to deployment to adequately prepare crews for action in Iraq.[40] During the preparation for OIF, leadership at the 552 ACW determined that the wing had not completed adequate training in the mission areas of TST and CAS to perform adequately during operations in Iraq. To answer this shortfall, 552 ACW Wing tactics was empowered to assemble a team of experts from the USAF and Boeing to rapidly assemble two mission

[39] Headquarters United States Air Force. (2005). *Operation ANACONDA: An Airpower Perspective.* Retrieved 21 April 2005 from: http://www.af.mil/library/posture/Anaconda_Unclassified.pdf

[40] The usual timeline for simulation scenario development with Boeing Aerospace contractors at Tinker AFB is approximately 6 months. This timeline includes conceptualizing what the scenario is to entail, building the simulation on computer drives to run in the simulator, and completing a review process until the mission scenario is deemed to meet standards for crew training.

scenarios—a CAS scenario and TST scenario—to prepare all the mission crews deploying to participate in OIF. The 552 ACW tactics office also was tasked with developing academics to present to the crews prior to executing the newly developed simulation scenarios.

In the course of less than one week, in a Herculean effort, two simulation scenarios had been developed and refined, as well as CAS and TST academic briefs both approved by the Operations Group and Wing Commanders. The 552 ACW now had adequate training to at least expose ABM crews to these two essential missions. Each crew received academics on both missions and then worked through each simulation at least once; some crews had the opportunity to complete the exercise scenarios twice prior to deployment. Along with the introduction of these new missions, seating and communications plans were developed to account for the flexibility needed in executing these missions within the weapons section on board the E-3 that would be required to successfully execute these dynamic and demanding missions.

The experience that many of the crews gained in OEF exposed them to the concept of a non-linear battlespace and an extremely fluid environment where more than battle management core competencies were put to the test. The flow of information was the biggest challenge to the E-3 crews: how to process inputs from multiple sources, match it to their understanding of assigned tasking, and then ensure the information got to where it needed to go. Coupled with extremely congested airspaces, with total sortie counts exceeding 1,500 aircraft in a 24 hour period, which many controllers had not experienced before, it was difficult initially for many ABMs to maintain good situational awareness during the operation.[41] Once controllers had the experience of flying those operations, mental frameworks developed in which they could process the information coming into them and know where it need to be passed, whether to the mission commander, the CAOC, or internally to another controller on the E-3.

[41] Cordesman, A. (2003). *The Iraq War: A Working Chronology.* Washington: Center for Strategic and international studies.

To see how the crews really performed, the next chapter examines lessons learned from OEF and OIF to determine how prepared the crews really were to perform their duties.

III. LESSONS LEARNED FROM OEF AND OIF

A. REFOCUSING EFFORTS AFTER OEF AND ANACONDA

Operation ENDURING FREEDOM ushered in a version of aerial warfare unlike any the Air Force or joint operations had seen before. Eighty percent of the time over Afghanistan, pilots received their targets after taking off for their missions. [42] The war in Afghanistan had a very different face than previous U.S. operations as well. From October 2001 through January 2002, save for a handful of special operations teams on the ground, the fight in Afghanistan was mostly air and space power.[43] Rebecca Grant stated that "the mechanics of airpower for OEF were different from those seen in other recent conflicts. Distance was a major challenge. Navy fighters flew more than 700 miles one way from their carriers to their combat stations…bombers coming from the British-owned atoll of Diego Garcia faced a 2,500 mile one way trip".[44] The remoteness of the Area of Responsibility (AOR) wasn't the only difference in this air war. Vice Admiral John B. Nathman, then commander of all naval flying assets in the Pacific fleet stated that "After the first week, the pilots didn't know what targets they'd be striking when they launched".[45]

This environment created many challenges for ABMs on board the E-3 in Afghanistan. The dynamics and fluidity of operations as it pertained to the increased occurrence of Time Sensitive Targets (now referred to as Dynamic Targets) required standard skills of CMR controllers to be used in new ways for which they had never previously trained. Although the numbers of aircraft over Afghanistan at any given time were not many, the tight constraint of the airspace provided significant challenges to ABMs. As emerging targets became the norm for combat aircrews, persistent availability of on call airpower was required. This necessity evolved into B-1s and B-52s as the desired platforms in the AOR for

[42] Grant, R. (2002). *An Air War like no other.* Air Force Magazine. November, Volume 85, number 11.

[43] Ibid.

[44] Ibid.

[45] Ibid.

support of TST. The result for E-3 crews was more proactive management of aerial refueling to provide this persistent availability of firepower. "Tanker consolidation" was a new concept introduced in the skies over Afghanistan. Turn times of aircraft between missions and loiter times in the AOR were watched closely to ensure asset availability and to not impact the next day's Air Tasking Order (ATO).

The dynamic nature of air operations during OEF and ANACONDA saw multiple types of aircraft ranging from KC-135 tankers, RQ-1 Predators, AC-130 Gunships, B-52 and B-1 bombers as well as a myriad of USAF and U.S. Navy (USN) fighter and strike aircraft. E-3 ABMs were not used to controlling all of these types of aircraft during the same operation, and issues of airspace deconfliction, especially altitude deconfliction, target information passing, and ground troop deconfliction became prevalent in the operation. Problems would arise when multiple assets in the AOR would go to prosecute targets within the same vicinity. B-52s could provide persistent and lethal cover from above 40,000 feet, but their weapons delivery profile might have them dropping ordnance through the altitude block of the AC-130, which might be operating significantly below them in the same geographic area. Deconfliction, coupled with new concepts of employment of air to ground dynamic targeting and direct support of special operations and conventional army teams was something that many ABMs had not trained for and literally had to learn on the fly.

These concepts of dynamic targeting and persistent asset management for refueling and maximum station time worked well during the OEF campaign. Many of the lessons learned from these operations were carried home to the units that executed those missions as "the future" of aerial combat operations. The E-3 community, primarily the 552 ACW, recognized the significance of what ABMs did during OEF, and, at least in concept, attempted to incorporate these new ideas into training. There were no majors changes made to AFI 11-2E-3 volume 1 at that time. In the 16 months between OEF and OIF, the 552 ACW went back to business as usual adhering to RAP training requirements that were contained within 11-2E-3 volume 1.

B. LESSONS RELEARNED IN OIF

The 363 Expeditionary Airborne Air Control Squadron (EAACS) amassed an impressive record in OIF from the start of combat operations 19 March 2003 to the cessation of AWACS participation 28 May 2003. The E-3 unit garnered a 100% combat effectiveness rating, totaling 2,198.7 combat and combat support on station hours, controlling over 24, 000 aircraft sorties.[46] During this period of AWACS operations, E-3 ABMs controlled over 700 strike packages and 13,000 individual aerial refuelings which aided in the prosecution of over 150 TSTs.[47] The operation was dynamic almost from the start as described by Anthony Cordesman:

> The air campaign was adjusted in stride, as it was underway. Some planes hit they targets with which they were tasked upon departure, others had their targets shifted en route. Gen. Moseley, head of the air campaign, was described as "the quarterback of the operation, calling audibles in response to changing circumstances.[48]

Dynamic targeting was not new to E-3 crews—especially to ABMs having endured a week of intensive spin up applying lessons learned in OEF to future operations such as TST and CAS in Iraq. Crews in OIF experienced more dynamic inputs, however this time, the strike packages were much bigger, and the airspace was even more congested than in OEF. This was due in large part to the sheer size of the operation in Iraq as opposed to Afghanistan, as well as the fact that there were three E-3s on station simultaneously in Iraq, where there was only one in Afghanistan. Multiple E-3 operations present unique challenges to crew employment in an already congested airspace... Although the lessons concerning TST and CAS had been carried forward from OEF to OIF, the lessons learned report generated in October of 2003 detailed that the same issues concerning lack of training in certain mission areas still existed.

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[46] Unclassified Accomplishments of the 363d Expeditionary Airborne Air Control Squadron: Operations Southern Watch and Iraqi Freedom. (2003). 552 Air Control Wing: Tinker AFB, OK.

[47] Ibid.

[48] Cordesman, A. (2003). *The Iraq War: A Working Chronology.* Washington: Center for Strategic and international studies.

The report generated by the 552 ACW detailed many shortfalls in training and preparation that were highlighted during the initial spin up prior to deployment for OIF. The report also highlighted more experiences the crews had during combat operations that were recommended to be included as future training requirements. The table below details these findings and their frequency within the lessons learned report.

	Spin-up	Execution	Training	Total
TST/CAS	4	1	4	9
AAR	1	2	1	4
Crew Employment	1	2	5	8

Table 8. Instances of events mentioned in 552 ACW OIF Lessons Learned[49]

Table 8 shows from the raw lessons learned data that after OIF, TST and CAS operations were still a high priority for ABMs, as well as aerial refueling operations. ABMs experienced volumes of aircraft never seen by E-3 ABMs prior to OIF. Comments in the report also identified that continued refinement and practice of these skills was need to maintain proficiency for what one entry stated "…prepared the crews to apply a new skill set that will most likely be needed in future conflicts".[50] Although these inputs were obtained from the "raw" lessons learned document that was compiled from inputs from all the E-3 units that participated in OIF, the final Lessons Learned presented to Headquarters Air Combat Command (ACC) echoed the same requirements for more emphasis and training in CAS and TST as well as more complex scenario training for refueling operations that would better prepare crews for the complexity and sheer numbers experienced in major theater warfare.

The final 552 ACW lessons learned identified CAS and TST training as a shortfall and recommended the following actions:

[49] 552 Operations Group. (2003). *552 Operations Group OIF Lessons Learned.* Tinker AFB, Oklahoma.

[50] Ibid.

- Scenarios (live, DMO, and simulation)
- Task training
- Computer Based Training
- Training should start in AFSC awarding school and continue through IQT, MQT, and CT[51]

The recommendations for CAS added the following recommendation:

- Training should be based on 'doctrinal' execution of CAS and apply some lessons learned from recent conflicts[52]

Further lessons learned also identified that aerial refueling training was not adequate to prepare crews for refueling operations of the size or complexity experienced in OIF. The following recommendations were made:

- Close and tactical air refueling training needs to continue
- Build complexity with number of receivers and tankers/tanker tracks
- Provide training on managing several anchors (wx, loss of tankers, prioritization of information)
- Tanker fuel management and MDS differences
- Training should start in AFSC awarding school and continue through IQT, MQT, and CT[53]

The report also identifies the fact that current mission crew simulation training does not adequately support complex battle management scenarios that would adequately train them for scenarios such as OIF.[54] The recommendation identified that the current Boeing simulation teams in legacy ATD are unable to support full crew scenarios, and that these scenarios include few, if any dynamic inputs. The lack of dynamic inputs in ATD scenarios presents a significant challenge to E-3 ABMs concerning the validity and completeness of training as discussed in chapter one with the definitions of proficiency and currency. The report also recommended that AFI 11-2E-3 volume 1 be reviewed and include these training requirements:

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[51] 552 Operations Group. (2003). *552 Operations Group OIF Lessons Learned.* Tinker AFB, Oklahoma.

[52] Ibid.

[53] Ibid.

[54] Ibid.

- Dynamic targeting
- CAS
- Data links
- Interoperability
- Air-to-air vs Air-to-surface
- Integration of DMO

The summary of the lessons learned report identified two essential items that current E-3 training does not adequately address. The "common threads" as described in the report centered around training for complex battle management scenarios, with emphasis on 1) Decision making processes, and 2) Management of information.[55] These are the two pillars of battle management; understanding what the information is when it is received, otherwise known as sensemaking, and knowing where the information needs to go. These processes have two sides: 1) information management (IM) through technology, and 2) knowledge management (KM) that can be improved and developed through more effective training. The next chapter discusses the new block 40/45 AWACS modification and the technological changes in IM that it will bring to the E-3 ABM.

[55] 552 Operations Group. (2003). *552 Operations Group OIF Lessons Learned.* Tinker AFB, Oklahoma.

IV. BLOCK 40/45: THE NEW INFORMATION MANAGEMENT TECHNOLOGY

> The imperatives of this era demand that we modify our legacy systems, as well as the systems currently under development, and ensure that, when employed, we use them in ways that are suitable to the strategies we must support and the missions we must perform.—*Dr. James Roche, Secretary of the Air Force*[56]

A. AN OVERVIEW OF BLOCK 40/45

The E-3 has continually proven over the years through many operations and conflicts that it is truly a "Go / No-go" asset for combatant commanders.[57] The 40/45 upgrade scheduled for Initial Operational Capability (IOC) and delivery of five aircraft to the USAF in 2010 will usher in an unprecedented technological leap forward in battle management capability. This leap forward not only enhances the capability of the ABMs on board, but also serves to solidify the E-3's place as a hub in the future command and control constellation.[58]

The major advances in technology in 40/45 encompass 8 major areas. They are: (1) Multi-source integration of on and off board sensors; (2) battle management tools to include automatic Air Tasking Order and Airspace Control Order; (3) electronic support measure upgrades; 94) digital communications system upgrade; (5) improved data link infrastructure; (6) Single Integrated Air Picture (SIAP) fusion and tracking; (7) radar upgrades; and (8) mission recording and playback capability.[59] Battle management upgrades will most directly affect operators on board the E-3. They will offer technological solutions to improve processes currently performed with the more laborious man-machine interface (MMI) presently on block 30/35 situation display console (SDC). Block 40/45 is expected to reduce operator workload and improve situational awareness (SA)

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[56] Quote by Secretary of the Air Force Dr. Roche in February, 2004 issue of Air Force Magazine.

[57] Waechter, B. (2004). *Creating the Future AWACS Airborne Battle Management and Surveillance Capability.* Powerpoint Briefing

[58] Talking Paper on Block 40/45. Mr. Don Gricol, 552 ACW/XPR. July 2004.

[59] Waechter, B. (2004). *Creating the Future AWACS Airborne Battle Management and Surveillance Capability.* Powerpoint Briefing

with the advent of more intuitive operator displays of information and flexible communications selectable at the operator's console.[60]

B. NEW APPLICATIONS AVAILABLE TO THE ABM

This revolutionary change to the legacy computer system currently on the E-3 will offer many new applications that, in the 30/35 configuration, are done by hand or involve multi-step processes. The new system will use commercial off-the-shelf (COTS) hardware and Windows/NT software, both of which are more familiar to operators than the legacy system currently employed on the E-3. For example, feature select and category select switches, which are currently physical toggle switches, will be replaced with software driven displays that require less physical manipulation by the ABM and are more easily customized to an individual's preferences for information display.[61]

Other battle management applications such as bearing and range between points, aircraft altitude, passive detection system displays and data link information will be available as "rollover" options. The rollover option only requires the display cursor to be placed over the displayed track and information once available after 2-3 switch actions are now displayed instantaneously. This allows the ABM to keep their field of view and attention on the developing air picture in front of them rather than focusing on the machine interface to get information. The 40/45 system will have the ability to perform ATO parsing and ACO updates on the fly with no operator input.[62] These are processes that are extremely operator intensive and cumbersome to accomplish in flight. The 30/35 AWACS requires that any updates are sent to the crews while airborne via High Frequency Messenger (HFM)—a system that uses HF radio waves and a standard email program such as Outlook to transmit data in the form of emails, word documents or excel documents for updates to ATO or ACO information.[63]

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[60] Waechter, B. (2004). *Creating the Future AWACS Airborne Battle Management and Surveillance Capability.* Powerpoint Briefing

[61] Ibid.

[62] Talking Paper on Block 40/45. Mr. Don Gricol, 552 ACW/XPR. July 2004.

[63] 552 Operations Group. (2003). *552 Operations Group OIF Lessons Learned.* Tinker AFB, Oklahoma

Block 40/45 will provide automatic ATO reception and parsing as well as automatic ACO reception and display to ensure that the most up-to-date information is available to ABMs making critical decisions in the airspace.[64]

Multi Source Integration (MSI) will combine all inputs from both on and off board the E-3 to include radar, Identification Friend or Foe (IFF), electronic support measures, and data link information into a single, fused track on the display console.[65] MSI will present the operator with higher fidelity track information to better facilitate continuous tracking and combat identification, significantly reducing operator workload required on 30/35 to maintain accurate reporting of track data.[66] The physical console itself will also provide a better visual display for the ABM; the current plan calls for a 21 inch flat panel display with the option to expand to a 24 inch display when available.

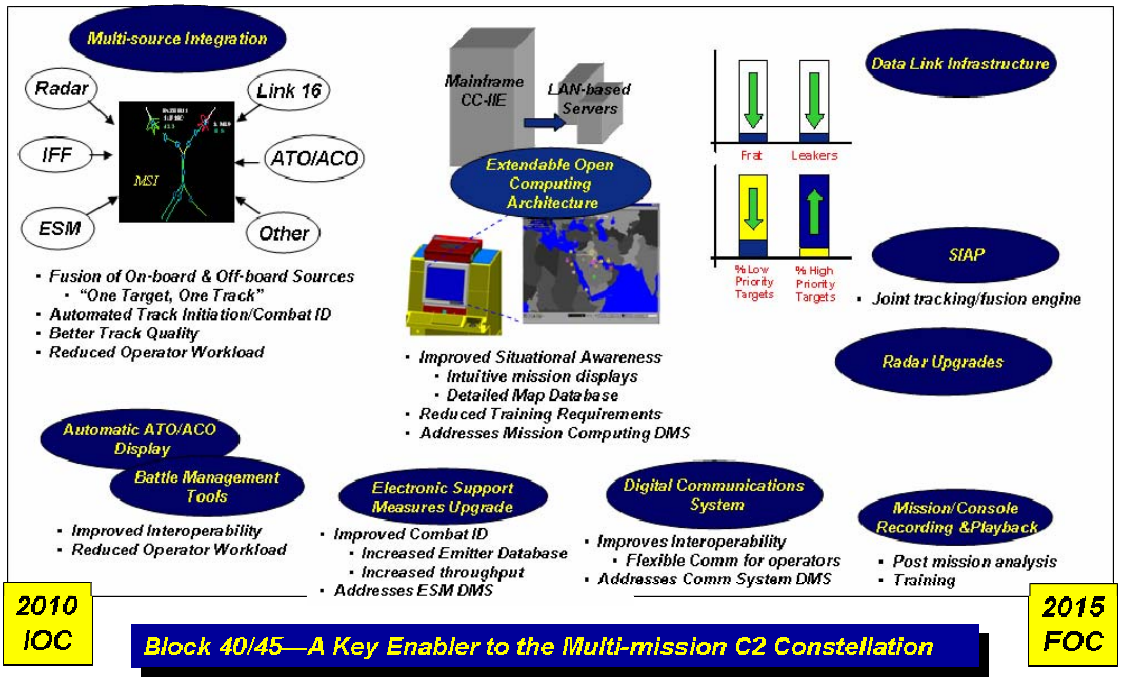

Figure 1. What's in block 40/45[67]

64 64 552 Operations Group. (2003). *552 Operations Group OIF Lessons Learned.* Tinker AFB, Oklahoma.

65 Ibid.

66 Ibid.

67Waechter, B. (2004). *Creating the Future AWACS Airborne Battle Management and Surveillance Capability.* PowerPoint Briefing

Although information management can be greatly aided and facilitated by technology, there is a slippery slope of what 40/45 itself will do to improve battle management on board the E-3. There is a false and dangerous assumption that major advances in technology inevitably generate major advances in capability. This assumption is problematic; new technology certainly will help operator situational awareness and capabilities; however, technology alone will not be the catch all fix to improve SA among ABMs and E-3 performance overall. The complete overhaul of capability for the E-3 will be in two parts. First will be the immense leap forward in technology detailed in this chapter. The second and more crucial portion is training. If the E-3 community continues to train to current core competencies and skill sets, the full potential of the 40/45 system upgrade will not be realized. To be completely effective, the major system overhaul scheduled for the E-3 needs to be completed by a major overhaul of the way ABMs use the system, and how they train to prepare for the full capability of the system, keeping pace with the rapidly advancing technology available from other weapons systems in the battlespace. The answer will come in a complete retooling of the way we think about E-3 battle management training—that answer will come with the advent and embracing of knowledge management and sensemaking into how the E-3 community does business.

V. SITUATIONAL AWARENESS, SENSEMAKING AND KNOWLEDGE MANAGEMENT: TRAINING FOR THE FUTURE

A. SITUATIONAL AWARENESS—THE KEY TO EFFECTIVE EMPLOYMENT

Situational Awareness (SA) is being aware of what is happening around you and understanding what the information means to you in the present, as well as what it will mean to you in the future.[68] SA is an essential element of operational effectiveness to ABMs. During operations, the concept of SA usually is applied to situations where individuals or groups of individuals are required to have a certain level of understanding of the environment and events as they are happening within that environment. The formal definition of SA is:

> "The perception of the elements in the environment within a volume of time and space, the comprehension of their meaning, and the projection of their status in the near future" [69]

SA derives itself from the annals of military aviation history and the classic OODA (Observe, Orient, Decide, Act) Loop made famous by Colonel John Boyd in 1976.[70]

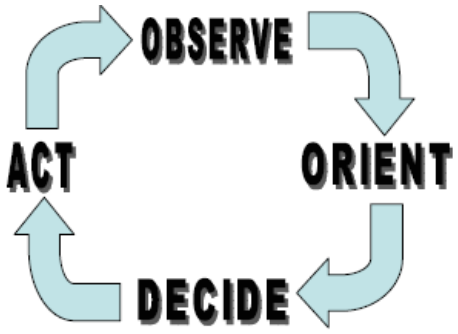

Figure 2. Boyd's OODA Loop[71]

[68] Endsley, M., Bolte. B. &Jones, D. (2003). *Designing for Situation Awareness: An approach to user-centered design.* New York: Taylor and Francis.

[69] Endsley, M. (1988). Designing and evaluation for situation awareness enhancement. *Proceedings of the Human Factors Society 32d Annual meeting* (pp.97-101). Santa Monica: Human Factors Society

[70] Boyd, J. (1976). *Destruction and Creation.* This was the only written text on the subject, and he further developed his ideas in a series of *Patterns of Conflict* briefings from 1986 to 1992.

[71] Angerman, W. (2004). *Coming Full Circle With Boyd's Ooda Loop Ideas: An Analysis Of Innovation Diffusion And Evolution.* Wright Patterson Air Force Base, Ohio: Air Force Institute of Technology.

Individual elements that comprise SA for a particular event or operation differ greatly based on a situation; however, the fact that SA is crucial to decision making and performance is universal regardless of the endeavor.[72] SA breaks down into three levels:

- Level 1—perception of the elements in the environment
- Level 2—comprehension of the current situation
- Level 3—projection of future status

1. Level 1 SA—Perception

Level 1 SA is the first step to achieving SA where an individual perceives the status, attributes and dynamics of relevant elements in the environment.[73] For the ABM, this level of SA would translate into seeing and understanding alerts and alarms from the operator console, knowing the E-3s relative position in space to other aircraft, the status of communications and identification systems used for battle management, and the developing enemy situation. Level 1 SA, or perception, can be visual, auditory, tactile, olfactory and taste, or possibly a combination of two or more of these senses.[74] An ABMs confidence in information also contributes to the perception of information coming into the individual. In military situations, it is difficult to assess all the required bits of information required to make effective decisions given the many factors involved. Obscured vision, aircraft noise, disorientation due to flight attitudes, confusion, and the dynamics of rapidly changing situations all contribute to distracting the ABMs attention and may lead to missing information critical to SA.[75]

A study found that 76% of errors in the aviation realm occurred at Level 1, when pilots did not perceive necessary information to enhance their SA.[76] This same study identified more key factors to Level 1 SA:

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[72] Endsley, M., Bolte. B. &Jones, D. (2003). *Designing for Situation Awareness: An approach to user-centered design.* New York: Taylor and Francis.

[73] Ibid.

[74] Ibid.

[75] Ibid.

[76] Jones, D. & Endsley, M. (1996). Sources of situation awareness errors in aviation. *Aviation, Space and Environmental Medicine, 67(6), 507-512.*

- In roughly two-fifths of cases, errors occurred due to missing information not provided due to operator or system limitations
- In roughly one-fifth of the cases, errors occurred when the input was taken in but later forgotten, as new information was taken in and prioritized ahead of previous inputs
- In approximately one-third of cases, all the information required was present, but not understood due to outside factors (distractions from something else)[77]

All of these examples can happen to ABMs on board the E-3 in the current 30/35 configuration and in the future 40/45 configuration. No matter how good the technology of the system, information overload, rapidity of information onset, and multi-tasking requirements of the ABMs job can lead to missed information crucial to building SA.

2. Level 2 SA—Comprehension

Comprehension is the second step in achieving SA. Level 2 SA is about understanding what the information means that is being taken in relation to the operator's environment and situation. This second step to SA involves integrating many pieces of data to construct information, and then prioritizing the importance of that information as it relates to achieving present goals.[78] Level 2 SA applied to the ABM includes: (1) seeing an air-to air-engagement develop visually on the situation display console, and (2) being able to understand communications calls from the pilots involved in that intercept so as to judge the call that needs to be made next to assist in the targeting of an enemy aircraft. In this same situation, Level 1 SA would be simply hearing the words; in Level 2, the ABM would comprehend what is unfolding before them and is able to use the information to take some tactical action.

Approximately 19% of aircraft errors occur at Level 2 SA.[79] In cases of Level 2 errors, people are able to see or hear the necessary inputs; however, they are not able to correctly understand the meaning of that information. An

[77] Jones, D. & Endsley, M. (1996). Sources of situation awareness errors in aviation. *Aviation, Space and Environmental Medicine, 67(6), 507-512.*

[78] Endsley, M., Bolte. B. &Jones, D. (2003). *Designing for Situation Awareness: An approach to user-centered design.* New York: Taylor and Francis.

[79] Ibid.

example of this type of error would be an ABM recognizing that an aircraft under their control is at 10,000 feet altitude, but not realizing that this was 5,000 feet below the airspace minimum safe altitude. An ABMs experience level will determine how adept they are at distinguishing between the two levels of SA. An ABM with less experience or less training may lack the knowledge or experience base required to understand the inputs occurring to them, and will be at a disadvantage compared to an ABM with greater experience in developing Level 2 SA.

3. Level 3 SA—Projection of Future Status

Level 3 SA is marked by the ability of an operator to know what elements of information are present, what they mean in relation to one another, and then to predict what those elements will do in the future.[80] The use of Level 3 SA to accurately predict future action requires a solid understanding of the domain in which they are operating—a process that requires significant mental demands on the part of the operator or ABM.[81] An example of Level 3 SA for the ABM is the ability to see and comprehend inputs in an air-to-air scenario and to determine what actions the pilots executing the intercept will most likely take based on understanding the current situation. This experience allows the ABM to develop frames of reference in which to process the current information.

Roadblocks to Level 3 SA can result from overloads of information—the inability to process all the information available—or due to insufficient knowledge of the domain—a lack of experience.[82] Only six percent of aviation errors were found to occur at Level 3 SA, which most likely were caused by deficiencies at Levels 1 and 2, which contributed to an inability to achieve Level 3 SA. A lack of experience and expertise, coupled with the lack of well designed information systems can lead many ABMs to fail in achieving the earlier stages of SA. If an operator fails to achieve the first two levels of SA, they are not afforded the

[80] Endsley, M., Bolte. B. &Jones, D. (2003). *Designing for Situation Awareness: An approach to user-centered design.* New York: Taylor and Francis

[81] Ibid.

[82] Ibid.

chance to achieve Level 3 SA.[83] It is this level of SA that ABMs need to strive for in order to be effective when dealing with complex battle management situations. The advent of the 40/45 weapons system upgrade will help alleviate mistakes at level 1 with more intuitive displays and interfaces, however, action needs to be taken not only technologically at the lower levels of SA, but also through training to better prepare crews to process information at Levels two and three. Although training can not instantly provide experience, the proper methodology and content of training can develop effective frames of reference in which operators can process information, ultimately achieving Level 3 SA. The process of understanding information within frames of reference—or sensemaking—is crucial to an ABM's ability to efficiently and effectively deal with dynamic situations encountered while performing battle management functions on board the E-3.

4. Mental Models, Schema and Scripts

a. Mental Models

Long-term memory structures known as mental models play a critical role in the development and improvement of an individual's SA in a given situation. Mental models are complex structures individuals use to model the behavior of specific systems regardless of system purpose.[84] Mental models also provide a systemic understanding of how a process works. An example of a common mental model for an ABM may be understanding how to get information from the E-3's computer. Once the ABM receives the information, they also need to know where it needs to be passed to achieve a specific purpose, whether it is threat warning, information on an aircraft, or passing direction to a strike package. Mental models may be formed for physical processes of interactions, such as computer system interfaces, as well organizational systems of passing and receiving information.

ABMs form mental models of how their systems work; the E-3 weapons system, the systems of aircraft under control, and the system of other

[83] Endsley, M., Bolte. B. &Jones, D. (2003). *Designing for Situation Awareness: An approach to user-centered design.* New York: Taylor and Francis

[84] Ibid.

ABMs who comprise the weapons team on the E-3. These mental models detail formal rules as well as the detailed expectations of their own behavior and the behaviors of others within these systems.[85]

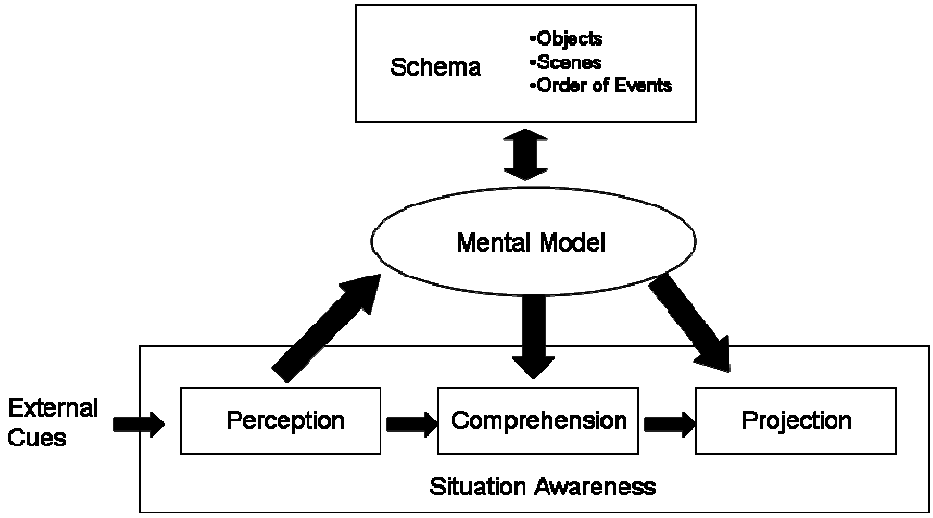

Figure 3. Schema, mental models and situation awareness, adapted from Endsley, M., Bolte. B. &Jones, D. (2003). Designing for Situation Awareness: An approach to user-centered design. New York: Taylor and Francis

Mental models are made up of two types of knowledge: semantic and system knowledge.[86] Semantic knowledge usually is related to knowing the "what" side of information, whereas system knowledge answers the "how" aspect. Semantic knowledge as it applies to the E-3 ABM includes the capabilities of the aircraft under their control or what a specific indicator on the situation display console means when illuminated. System knowledge, which is the "how" portion of information, is crucial to developing mental models and begins by constructing how things work together for the observer to understand functions of systems.[87]

Mental models help an operator determine what information is important to address and in what sequence, and to enable the higher two levels

[85]Endsley, M., Bolte. B. &Jones, D. (2003). *Designing for Situation Awareness: An approach to user-centered design.* New York: Taylor and Francis

[86] Ibid.

[87] Ibid.

of SA (2&3) to develop without a big strain on working memory.[88] In short, mental models allow ABMs to package information from internal and external sources based on experience and capability of the individual. The absence of a mental model would make it impossible for an individual to understand what is happening around them, regardless of the amount or fidelity of the information being received.[89]

b. Schemata

Schemata are prototypical states of mental models that enable an individual to efficiently and effectively process information.[90] An example of two schemata for an ABM would be: (1) how a certain aircraft would perform based upon type (fighter, bomber, tanker) and (2) how missions dealing with ground troops will look, sound and flow. Schemata for ABMs allow them to quickly classify and understand information and to fit it together with other cues perceived by the operator. What schemata really break down to is, "I've seen this before"; they really function as mental shortcuts where ABMs can see a situation they have been exposed to previously and rapidly place information into context where it needs to be.[91] Schemata are built by experience; both live and training in the case of the ABM, as well as through the passing of experience from more experienced ABMs to those with less experience in the form of "war stories" and lessons learned.[92]

c. Scripts

Scripts are associated with schema and dictate sequences of actions of what to do in each case that a schema represents. ABMs have scripts of what actions to take in certain situations. For example, when providing tactical threat warning, the actions of determining bearing and range from the friendly aircraft to the threat would be a script. Scripts are developed over time with

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[88] Endsley, M., Bolte. B. &Jones, D. (2003). *Designing for Situation Awareness: An approach to user-centered design.* New York: Taylor and Francis

[89] Ibid.

[90] Ibid.

[91] Ibid.

[92] Ibid.

experience, and in the case of the ABM, may come from live experience or be developed over time in training. Although scripts reduce the mental workload on an individual, the ABM still must understand the circumstances they are in completely enough to know which scripts to employ.[93]

Models, Schema and scripts are all developed and reinforced over time with experience in particular situations. Individuals with more experience require much less time processing and sorting out information to develop SA, whereas ABMs with less experience have a harder time, as they lack these cognitive frameworks. The lack of frameworks to process information can lead to work overloads for less experienced individuals, which in turn result in gaps of SA.[94] One way to aid ABMs in establishing these SA building tools is to design systems and train effectively to develop these mental models. Individuals with well developed mental models have access to three main cognitive resources:

- Dynamic direction of attention to critical environmental cues
- Expectations of the future of the environment based on projection from Level 3 SA
- An established a link between recognized cue classification and associated actions, allowing rapid decisions to be made in a give situation[95]

These frameworks allow ABMs to effectively deal with the dynamic and complex environments presented in command and control and battle management scenarios. A large portion of what the ABM does is making sense of the situations they are in, understanding that many of the scenarios they encounter are being experienced for the first time. Although effective training can't identify every possible event scenario, training to enhance the SA building process and employing the art of sensemaking to E-3 ABM training will better prepare ABMs for their mission tasking.

B. SENSEMAKING—MAKING SENSE OF THE SITUATION

[93]Endsley, M., Bolte. B. &Jones, D. (2003). *Designing for Situation Awareness: An approach to user-centered design.* New York: Taylor and Francis

[94] Ibid.

[95] Ibid.

ABMs are being exposed to new methods and scenarios of warfare such as Effects Based Operations (EBO), where forces synchronize both lethal and non-lethal means of warfare to defeat their adversaries. Fusing lethal and non-lethal means of warfare as was evidenced in OEF and OIF, require ABMs to be able to make sense of their changing situations in the battlespace across multiple functional areas and technical disciplines.[96] Network centric warfare, one of the major selling points of the 40/45 AWACS upgrade, represents a departure from traditional platform-centric warfare to a concept of operations emphasizing information superiority.[97] Alberts, Garstka and Stein (1999) define network-centric warfare as:

> An information superiority-enabled concept of operations that generates increased combat power by network sensors, decision makers, and shooters to achieve shared awareness, increased speed of command, higher tempo of operations, greater lethality, increased survivability, and a degree of self-synchronization.[98]

Sensemaking is a concept that builds on traditional concepts of SA at the individual, organizational and cultural level. It has broad reaching applicability to E-3 ABMs as sensemaking helps an individual or group of individuals to have a "deep understanding" of a situation.[99] Sensemaking address key cognitive issues such as:

- Placement of items into frameworks
- Comprehending
- Constructing Meaning
- Interacting in pursuit of mutual understanding
- Patterning
- Redressing surprise[100]

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[96] Leedom, D. (2001). *Final Report: Sensemaking Symposium.* Command and Control Research Program: Office of the Assistant Secretary of Defense.

[97] Ibid.

[98] Ibid.

[99] Report of the Workshop on Sensemaking, 6-8 March 2001. Command and Control Research Project

[100] Ibid.

Sensemaking can be summed up in the German Expression *Fingerspitzengeguhl*—"the ability to feel the situation in one's fingertips".[101] This is what we need to strive for in E-3 ABM training to address the dynamic and complex environments in which they do their jobs, as well as the fact that it takes valuable time to gain experience to the point that ABMs can exceed Level 1 and 2 SA and enter into the realm of sensemaking and Level 3 SA.

Training can be used to close the gap of experience by exposing ABMs to scenarios and situations that allow them to develop scripts, schemata and mental models. This development through proper training will help ABMs achieve higher levels of SA and sensemaking when faced with situations never seen before or more taxing and complex than usually experienced. Enhanced sensemaking can provide the ABM with the ability to deal with:

- Rapidly emerging threats
- Unfamiliar situations
- Dynamic situations
- Evaluate new information appropriately into existing frameworks
- Collaborative network-centric operations[102]

All the elements of sensemaking listed were identified as shortfalls in one form or another in the lessons learned following OEF and OIF. They were termed differently as identified in chapter three as "congested airspace", "dynamic targeting situations", and "volumes of aerial refueling never seen before". The problem we are left with now is how and when to implement training changes that will be broad reaching enough to address the shortfalls identified in recent combat operations, and in what venue the changes will take place. There will be an associated risk with making these changes; however, if the E-3 as a weapons system is to keep pace in the rapidly changing, effects-based operations push of the current Air Force, changes will need to be addressed.

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[101] Report of the Workshop on Sensemaking, 6-8 March 2001. Command and Control Research Project

[102] Ibid.

VI. REVAMPING TRAINING—THE ART OF EXECUTION

A. PUTTING THE PIECES TOGETHER: THE INTEGRATED TRAINING MODEL

E-3 ABM training needs to reflect a steady progression from skills to core competencies to the ability to assimilate these lower order skills into effective scenario execution. The ability to effectively manage scenario execution is represented by the term *Mission Essential Competency* (MEC). Mission Essential Competencies, such as the ABM experiences on the E-3 during operations, whether that is combat, peacetime or military operations other than war (MOOTW), are the pinnacle of training for crew environments. MECs will not only affect group training and crew combat employment, but also will have effects on how individual training is completed from IQT, where positional training is accomplished, to MQT where initial aspects of crew integration are introduced. MECs serve to answer the major problem that plagues E-3 training today: as mission complexity increases in training, available opportunities to accomplish this training diminish due to availability of assets, capability of current simulation equipment and DoD budgetary constraints.[103] MECs essentially tie all underlying training—essential skill development and core competencies—together to ensure E-3 aircrews are best prepared for all situations they might encounter operationally.

As training complexity increases from individual proficiency to crew employment proficiency, training also supports the building of scripts, schemata and mental frameworks to enhance the operator's ability to build SA from level 1 to level 3. The ultimate goal of this training hierarchy is to produce individuals and crews who are Combat Mission Ready (CMR): prepared to deploy at a moment's notice and handle any operational mission they are tasked to execute. The CMR designation of an individual and E-3 crew denotes that they have

[103] Colegrove, C. & Bennet, W. (2005). *Mission Essential Competencies.* PowerPoint presentation prepared for Headquarters Air Combat Command. Express permission granted for use of information contained within the briefing from Mr. Chuck Colegrove, HQ ACC/DOTO, (757) 764-7785, 9 September 2005 via telephone.

successfully completed all subordinate training and have passed a standardized aircrew positional evaluation stating that they are in fact capable of perform their assigned duties. As discussed in chapter two, there are two levels of experience for crew members based on numbers of hours flown executing operational missions as well as capabilities reviews; however, the frequency of training events is not the major issue with designing the most effective training for E-3 ABMs. The key to training effectiveness lies in its ability to emulate situations and circumstances experienced by ABMs. It is through the process of training as realistically as possible that ABMs will develop the essential individual skills and competencies to improve their chances of higher SA and better integrate for effective combat crew employment at the highest level of SA and competency.

1. The Integrated Training Model

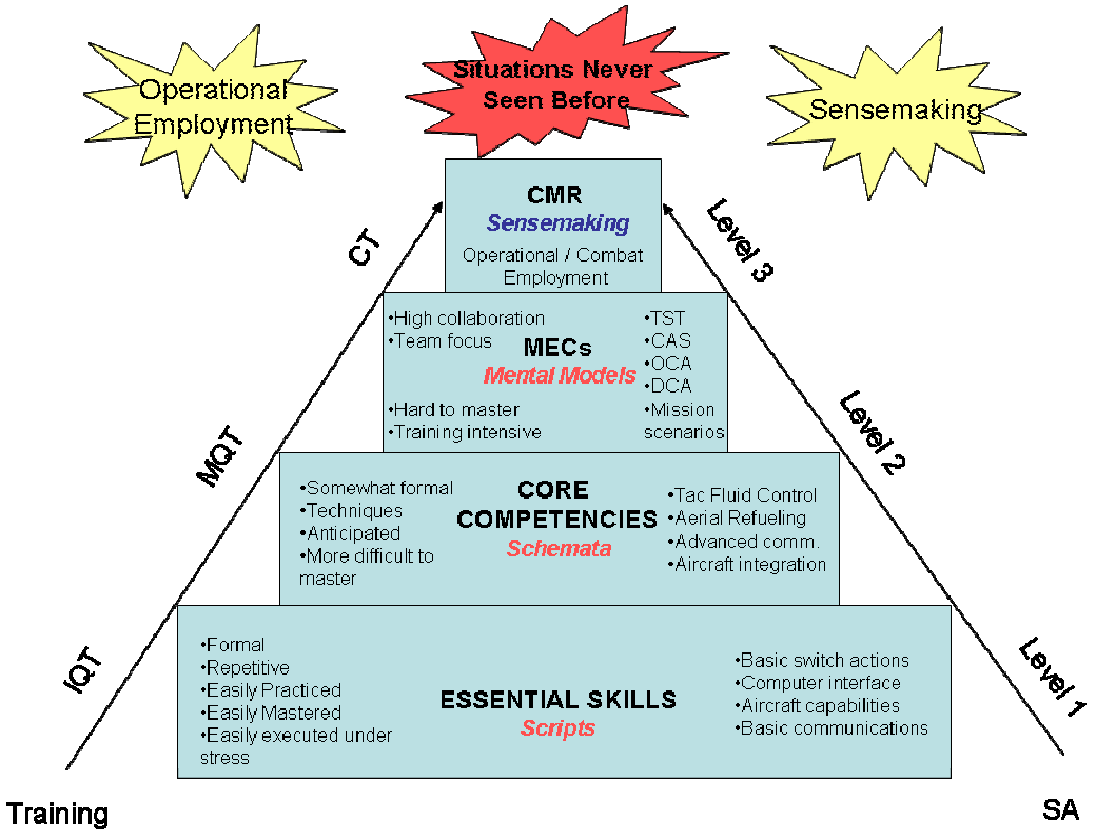

Figure 4. The Integrated Training Model

The top of the Integrated Training Model is Combat Mission Ready status where an ABM should be able to achieve level 3 SA relying upon the scripts,

schemata and mental models developed over time through both live and training experiences. ABMs will be presented in both simulated and live training with situations that they have never seen; however, with the proper training in place, coupled with the technological advances that the 40/45 weapons system promises, ABMs should be able to make sense of their situations, adapt appropriately, and make effective decisions. The left side—training—of the model shows the continuum of training as it begins at Initial Qualifying Training (IQT) with positional proficiency and progresses upward with increasing complexity to Continuation Training (CT). CT is designed to emulate as best as possible through DMO, ATD, Live flying exercises (such as RED FLAG) and training missions, the conditions that will be experienced by ABMs in the field. As detailed earlier, however, many of these venues do not train to the workload and complexity required to effectively develop mental models that will help prepare E-3 crews and ABMs to deal with situations they have never seen before. The mental models developed will provide frameworks where even though the exact experience is new to the ABM, they will be able to interpret and place information where it needs to be. In fact, as discussed concerning the 552 ACW spin up for OEF and OIF, critical shortfalls that were identified and rapidly accounted for have not remained in the E-3 ABM training regiment to a level that will ensure that they are prepared to execute them when necessary. The right side—the progression of SA—shows how each of the blocks of graduated capabilities coupled with the cognitive tools associated increase as they approach Combat Mission Ready status.

2. AWACS Mission Essential Competencies: The Heart of the Matter

There are seven identified MECs for AWACS overall:

1. Plan and prepare for missions
2. Organize and manage forces and combat systems to enable employment
3. Detect entities in Area of Interest
4. Identify entities in Area of Interest
5. Fix, track and report entities in Area of interest

6. Direct and manage tactical action in Area of interest
7. Employ the E-3 and crew to enhance battle management[104]

The advent of the 40/45 weapons system will no doubt make many of these tasks easier for operators on the E-3 to accomplish. The tasks and skills associated with detecting, identifying, tracking and reporting entities will be more automated with MSI and improved displays of information discussed earlier with the 40/45 upgrade. These functions exist in the lower levels of training and SA—they are effectively the bottom half of the Integrated Training Model—and therefore will feel the biggest impact due to better technology and man-machine interface. The other issues detailed in the MECs—organizing and managing forces, directing action and employing the E-3 weapons system—all exist at the top of the Integrated Training Model. This is the realm that requires higher SA (Level 3 and sensemaking) to ensure that ABMs will be effective in future combat operations. This realm also requires more intensive and complex training not yet widely available to all E-3 ABMs. The question is: How and when should a plan be executed to revamp E-3 training to most effectively utilize the technology leaps in 40/45 and enhance overall combat effectiveness of the E-3 weapons system?

B. CHOOSING THE RIGHT TIME TO CHANGE AND EXECUTING THE PLAN

1. When is the Right Time?

A major overhaul of any existing "way of doing things" is a daunting task. There is a large capacity for the "if it's not broken, don't fix it" mindset to take over, especially when success has been proven over the years, as it has in the USAFs E-3 impressive combat record. The fact that E-3 training has to evolve is not up for debate if the USAF wants to keep E-3 ABMs viable and capable of completing the evolving AWACS mission into the future. Returning into "reconstitution" for two years following OIF, the task of the 552 ACW and 18th Wing at Kadena AB, Japan and 3d WG at Elmendorf AFB, Alaska was clear: (1)

[104] Colgorve, C. & Bennet, W. (2005). *Mission Essential Competencies.* PowerPoint presentation prepared for Headquarters Air Combat Command. Express permission granted for use of information contained within the briefing from Mr. Chuck Colegrove, HQ ACC/DOTO, (757) 764-7785, 9 September 2005 via telephone

train existing E-3 aircrews back to CMR status for requirements they weren't able to accomplish while deployed, and (2) train to clear up the backlog of ABMs awaiting IQT and MQT at Tinker Air Force Base, Oklahoma as a result of flying training slowing way down due to the heavy deployment load for OIF.

As stated earlier, current E-3 DMO and ATD can not effectively emulate scenarios to adequately train crews to the level this paper is advocating: creating scenarios to reinforce lower supporting competencies and provide ABMs with the capability to get to higher levels of SA and sensemaking. That only will happen with experience—which is hard to come by—or filling that existing experience gap with effective training. The 552 ACW will have to determine the best course of action for training crews on the new 40/45 technology once delivered. They have many options available as the aircraft will be delivered over a 5 year period with Initial Operational Capability slated for Fiscal Year 2010 and Full Operational Capability in 2015.[105] Regardless of what route the 552 ACW and the USAF decide to take with transition training to block 40/45, a revamping of training to enhance the E-3s overall combat capability should compliment the advance in technology. Without revamping training to provide E-3 ABMs with the capability to achieve higher levels of SA through building on skill sets and core competencies with more advanced and complex training scenarios in the form of training for Mission Essential Capabilities, the leaps of capability afforded by 40/45 never will be realized. No change in training to realize the full potential of the 40/45 weapons system would be like buying a Ferrari, only to drive it 35 miles per hour and never take it to the race track.

Fiscal year 2010 will bring about great changes for the 552 ACW and Air Force with the arrival of the new E-3 system. Although the final plan for the acceptance and crew transition from 30/35 to 40/45 has not been drafted, one thing should be clear: the arrival of the new weapons system marks the most logical time to revamp ABM training. However the 552 ACW, along with inputs from Headquarters Air Combat Command, Headquarters Air Force and Boeing,

[105] Waechter, B. (2004). *Creating the Future AWACS Airborne Battle Management and Surveillance Capability.* PowerPoint Briefing

decides to implement the transition, there will be some loss of combat capability during the transition. Regardless of what implementation plan the Air Force chooses, a major weapons system overhaul will require positional familiarization training and time for the operators to be comfortable with the new system. Regardless of how much "better" or "easier" the new technology will make the ABMs job on the E-3, anything new requires training and time to learn how to use it effectively.

2. Implementing the New Idea—the Art of Execution

> Execution is a systematic process of rigorously discussing hows and whats, questioning, tenaciously following through, and ensuring accountability. It includes making assumptions about the environment, assessing the organization's capabilities, linking strategy to operations and the people who are going to implement the strategy, synchronizing those people and their various disciplines…it also includes mechanisms for changing assumptions as the environment changes and upgrading the organization's capabilities to meet the challenges of an ambitious strategy. *Bossidy & Charan on Execution, The Discipline of Getting Things Done.*[106]

The discipline of execution derives from the idea that, to get things done, the organization, from the highest level to the lowest, must embody the transition that is underway. There are three main points to execution:

- Execution is a discipline, and integral to strategy
- Execution is the major job of the organization's leader
- Execution must be a core element of an organization's culture[107]

The Air Force and 552 ACW will be taking on a major challenge when upgrading to the 40/45 weapons system on board the E-3. Due to the critical capabilities that the E-3 provides for the Department of Defense and regional combatant commanders, the transition to 40/45 must occur with a minimal loss of combat capability in the overall E-3 force. It is difficult for strategy implementation to be successful without taking into account an organization's ability to execute the

[106] Bossidy, L. & Charan, M. (2002). *Execution: The Discipline of Getting Things Done.* New York: Crown Business.

[107] Ibid.

plan.[108] The Air Force has nominally five years to develop a strategy of implementation for 40/45 accession. Although there is no clear cut plan at this point, there are many factors that need to be considered. Some of these points that will have an effect on combat capability of the 552 ACW are:

- Which squadron will be the first to upgrade?
- When will the Replacement Training Unit (966 AACS) transition from training 30/35 to 40/45?
- How many crews will be entered into transition training at a time?
- How long will it take to declare and entire E-3 crew CMR following upgrade?
- Will an ABM have to maintain currency on both 30/35 and 40/45 weapons system?
- How will a "split fleet" at the 552 ACW impact employment options for combatant commanders?

Although this is not an exhaustive list, the point to take away is that any major evolution that an organization encounters will have broad reaching impacts on how that organization will function. The idea is that once the new way of doing things is introduced, the organization will not be the same as it once was. Although this seems intuitive and obvious, a lack of strategy for change and the means to execute the plan are where many transitional organizations fall short of their goals.[109]

The heart of execution lies in three core processes:

1. The people process
2. The strategy process
3. The operations process[110]

Every organization has these three processes in one form or another, and the 552 ACW is no different. Often, these processes are not well integrated within an organization and are treated separately rather than integrated into one unified strategy for change. The people within the organization will look at the change

[108] Ibid.

[109] Bossidy, L. & Charan, M. (2002). *Execution: The Discipline of Getting Things Done.* New York: Crown Business

[110] Ibid.

and do what is required of them; however, old patterns of behavior and thought processes may remain in place even after the change has occurred. This lingering clutch on the old organizational ideas is the major inhibitor to progress and change within an organization. This stagnation of thought can inhibit the strategy process; it is often marked by putting working groups together that sit in conference rooms looking at PowerPoint presentations on what should happen and gain reassurance from the fact that the change processes have been identified.[111] A solid plan of execution, where the ideas make it out of the computer into action, is necessary for the future capability of the organization to be realized. The operations process is the 'how' of doing things in the future. It is hard for a person to conceptualize how things will be after the change in an organization. This is especially true if the organization as a whole does not embrace the change from top to bottom and execute it in a manner that forces the people, strategy and operations to work together and break down the fractionalized nature of these processes operating independent of one another.

Another inhibitor to sweeping changes within an organization is the expectation of performance associated with a new idea or process for doing things. Changes bring high expectations on the part of an organization's leadership. One primary expectation is that assumption of risk that comes with implementation of new processes will have immediate payoffs. That is not always the case, however, as the positive impact of major organizational change—such as revamping the overall training philosophy for the E-3 ABM—may not be realized instantaneously. The desired effect may take months or years to be fully realized, but without this acceptance of risk to change, major moves forward in capability will scarcely be realized.

[111] Bossidy, L. & Charan, M. (2002). *Execution: The Discipline of Getting Things Done.* New York: Crown Business

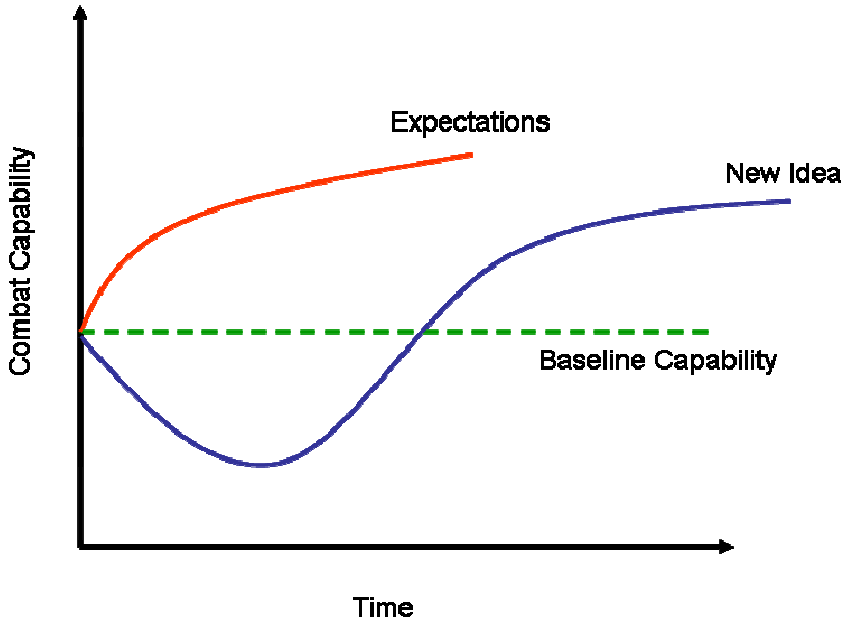

Figure 5. Expectations versus reality with the introduction of a new idea and its effects on combat capability.[112]

Figure 13 shows how the introduction of a new idea into an organization will spark the individual's expectations to lead them to believe that instantaneous improvements will be realized above the baseline capability. The reality of the situation is better depicted in the new idea curve. Any transformational idea or process once executed in an organization will have an effect on capabilities; in the case of the 552 ACW, this effect will be manifested in combat readiness. The major point to take from this chart is that although there will be an initial dip in combat capability; the payoff is that the overall capability of the squadron *in the long term* will be greater than the initial baseline capability. The mitigation of this risk has the potential to be the biggest roadblock to implementing a new idea on how to train E-3 ABMs. No one individual wants to be the one to suggest a loss of capability based on a theory that things will get better if we do them differently. The decision to retool the training game for the E-3 to get increased complexity in training and to better realize the full potential of the new weapons system needs to be initiated and supported by the Air Force as whole. The 552 ACW needs the support of the Air Force to effectively transition to 40/45 and implement the new

[112] Adapted from the US Navy Chief Information Officer briefing delivered 19 July 2005 to the US Naval Post Graduate School, Monterey, California.

training concepts detailed in this thesis. If that support is not in place, the chance of a 100% effective transition to 40/45, with all the enhanced capabilities it promises, might never be realized.

VII. CONCLUSION

Training for E-3 ABMs is not adequate to prepare them for all of the missions they may be tasked to perform in the battle space of the future. Gaps in required experience were well documented following OEF and OIF, and the changes to training reflected in AFI 11-2E-3 volume 1 although an attempt to rectify the problem, do not provide the frequency and complexity of training required for ABMs to become proficient in complex battle management scenarios. Developing training scenarios that will allow ABMs to develop the capacity to operate at the highest levels of situational awareness and sensemaking will bridge the gap of experience in the E-3 ABM career field. The 40/45 weapons system upgrade on the E-3 will help ABMs and other aircrew in performing duties in the lower realms of SA (levels one and two) but achieving level three requires mental models that are only developed through practical experience in conjunction with realistic simulation and training.

As an end user of flying training, the E-3 must rely on many other weapons systems and organizations to fly to get adequate training in battle management scenarios. Continuing budget constraints and difficulty in meshing training requirements between the E-3 and the aircraft they control for training will continue into the future. The implementation of training in the form of Mission Essential Competencies will help ABMs to gain experience in complex battle management scenarios that will allow them to form the mental models required to make difficult decisions during live operations, often in situations they have never experienced previously. The most effect method to accomplish this training is in the emerging Distributed Mission Trainers (DMT) at Tinker Air Force Base, Kadena Air Base and Elmendorf Air Force base. Although the DMT lay down for other weapons systems required for training is not robust enough to support the complexity of training scenarios required today, that capability will continue to increase over time as more weapons systems receive their DMTs and are linked into the overall DMO architecture.

It is absolutely critical that the Air Force continue to fund and develop the connectivity required among all the DMT users to join the network and train together to simulate the complexity of operational missions experienced by E-3 crews in OEF and OIF. The 40/45 upgrade is half the equation concerning E-3 sustainability. There is a critical piece that needs to be addressed in training, or the Air Force will not evolve its command and control and battle management capabilities to keep pace with the vision of Dominant Battlespace Knowledge introduced in chapter two. If the United States military is to not only keep pace with our adversaries, but to stay in front of them in technological and personnel capability, we can not miss this opportunity to revamp how the E-3 trains for combat proficiency.

The time to accomplish this revolution in training is simultaneously with the 40/45 upgrade beginning in fiscal year 2010. The 552 ACW already will have accepted some loss in combat capability no matter what manner of upgrade to 40/45 they choose. By consolidating the retooling of training with the technology upgrade, ABMs and other E-3 crew members will be able to more effectively change their mental models of how to employ with the new weapons system rather than using old cognitive methods associated with the 30/35 weapons system. The Air Force leadership and 552 ACW leadership will need to accept the fact that there will be some loss of combat capability to implement this plan; however, with proper execution, the ultimate payoff will provide combatant commanders with a much more capable command and control platform.

To make this transition possible, the Air Force will need to continue funding and implementing the Distributed Mission Operations concept of operations. Also, the Air Force will need to support training to accomplish the technology upgrade in 40/45. Much of the ABMs transition training will be accomplished positionally in a simulated environment; however, to ensure that the weapons system can be employed to the best of its capability will only be tested in realistic training scenarios. To accomplish this will require the support of other organizations whether in live flying or DMO operations.

The path is clear for the Air Force. Ensuring the E-3 is a viable platform both technologically and capability-wise, changes need to happen. The 40/45 upgrade will answer the technological viability of the platform for the future. The point to take away here is that we also need to change training, and 2010 is the target date for execution.

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