Combat Air Force Distributed Mission Operations: Immersion Into Daily Training

Walter Johnson, Santa Barbara Applied Research
Headquarters Air Combat Command
Langley AFB, VA
Walter.Johnson.ctr@Langley.af.mil

ABSTRACT

The sustainment of high readiness training across Combat Air Force (CAF) platforms remains a challenge, especially in today's environment of increased deployments, reduced flying hours, range limitations, and geographically separated units. One method used to maintain the readiness level and increase the "train like we fight" experience is through Distributed Mission Operations (DMO). Several DMO training-focused events were accomplished in 2006 and 2007 in an effort to enhance team training, highlight new platforms on the DMO Network (DMON), and stabilize combat capability.

As the CAF 2007 annual flying hour program drew to a close, the Air Combat Command Director of Air and Space Operations championed an increase in distributed team-training events in conjunction with the decrease in live-fly training. The unique aspect of this effort was that it was not a centrally controlled exercise but a series of warfighter initiated training opportunities scheduled and conducted on a persistent "hub-less" network without the need of a simulation center. Over 90 distributed events took place logging more than 300 hours of accredited training. This type of training requires a thoughtful design and disciplined development of scenarios to meet individual and team training objectives. If properly accomplished, it improves sensor-shooter composite training, immerses the operators into a realistic DMO scenario, and improves integration efforts for sustainment of future daily training.

This paper will discuss the issues associated with designing, planning, and executing numerous inter-team training events over short intervals involving multiple missions, scenarios, and databases associated with all CAF platforms around the world. It will also examine the challenges and strategies used to foster better training and improved combat capability.

ABOUT THE AUTHOR

Walt Johnson is employed by Santa Barbara Applied Research in Ventura CA as an Air-to-Ground Fighter Analyst to the Air Combat Command (ACC) DMO program. His primary responsibility is working DMO training and training integration issues to improve the overall training capabilities of CAF warfighters. He previously served over 20 years as an A/OA-10 Instructor/Evaluator Pilot in the Air Force.

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INTRODUCTION

The sustainment of high readiness training for units in the Combat Air Forces (CAF) remains a challenge, especially in today's atmosphere of increased deployments, reduced flying hours, range limitations, and geographically separated units. The challenge for commanders at all levels is the proper balance between training methods, time, and effectiveness, against the units' capability to conduct combat operations. One method used to maintain the readiness level and increase the "train like we fight" experience is through Distributed Mission Operations (DMO).

CAF DMO, formally known as Distributed Mission Training (DMT), is designed to provide warfighters with team training and mission rehearsal capabilities using advanced simulators, simulations, and real-world systems networked together to form a distributed synthetic battlespace (See Figure 1). DMO team training is designed to enable operational units to practice their high-end individual, team and inter-team combat skills on a daily basis (DMT CONOPS, 1998)

Figure 1: DMO Training in a Synthetic Battlespace

As the CAF 2007 annual flying hour program drew to a close, the Air Combat Command (ACC) Director of Air and Space Operations championed an increase in distributed team-training events in conjunction with the end-of-year decrease in live-fly training. The unique aspect of this effort as with most CAF DMO training, centered on the fact that it was not a centrally controlled exercise but a series of warfighter initiated training opportunities scheduled and conducted on a persistent "hub-less" network without the need of a simulation center. Over 90 distributed events took place during 18 training days, logging more than 300 hours of accredited training. This type of training required warfighters to carefully develop scenarios to meet individual and team training objectives. If properly accomplished, it would improve sensor-shooter composite training, immerse the operators into a realistic DMO scenario, and improve integration efforts for sustainment of future daily training.

Purpose

The thought processes and procedures for running numerous small-team training events are similar to those required for large force exercises. However the complexity of connecting a large number of locations around the world in varying team combinations, from two sites to multi-site composite training, over long periods of time, necessitates unique requirements beyond short duration large force exercises to reduce technical, integration, scheduling, and scenario issues.

The purpose of this paper is to explore the method used by Air Combat Command to enable daily persistent team training in an immersive distributed environment. The intent of this training environment is to provide a suitable desired training atmosphere to complement live-fly training and encourage mission events which are difficult to obtain in other training realms.

This paper addresses specific issues associated with designing, planning, and executing numerous inter-team training events over short intervals, involving

multiple missions, scenarios, and databases associated with the various combat and training locations around the world. It will also examine the challenges and strategies used to foster better training and improve combat capability.

DMO PROGRAM

The CAF DMO program started in 1997 and has grown to over 30 locations. CAF DMO is used to focus at both the operational and strategic training levels of the warfighter. However, the primary focus is on unit level, daily mission proficiency training, utilizing local, short-haul connectivity followed by combat mission training involving shooter-sensor small team training using long-haul connectivity (e.g. F-15C/ AWACS, A-10/JTAC, B-1/JSTARS). Figure 2 illustrates the current and future locations of DMO capable systems within the CAF (Chapman, 2006).

It should be noted that as the intensity and complexity of the training increases, the frequency of events usually decreases. Thus, individual and small-team training occur daily, but larger-force events and exercises occur on a monthly or quarterly basis.

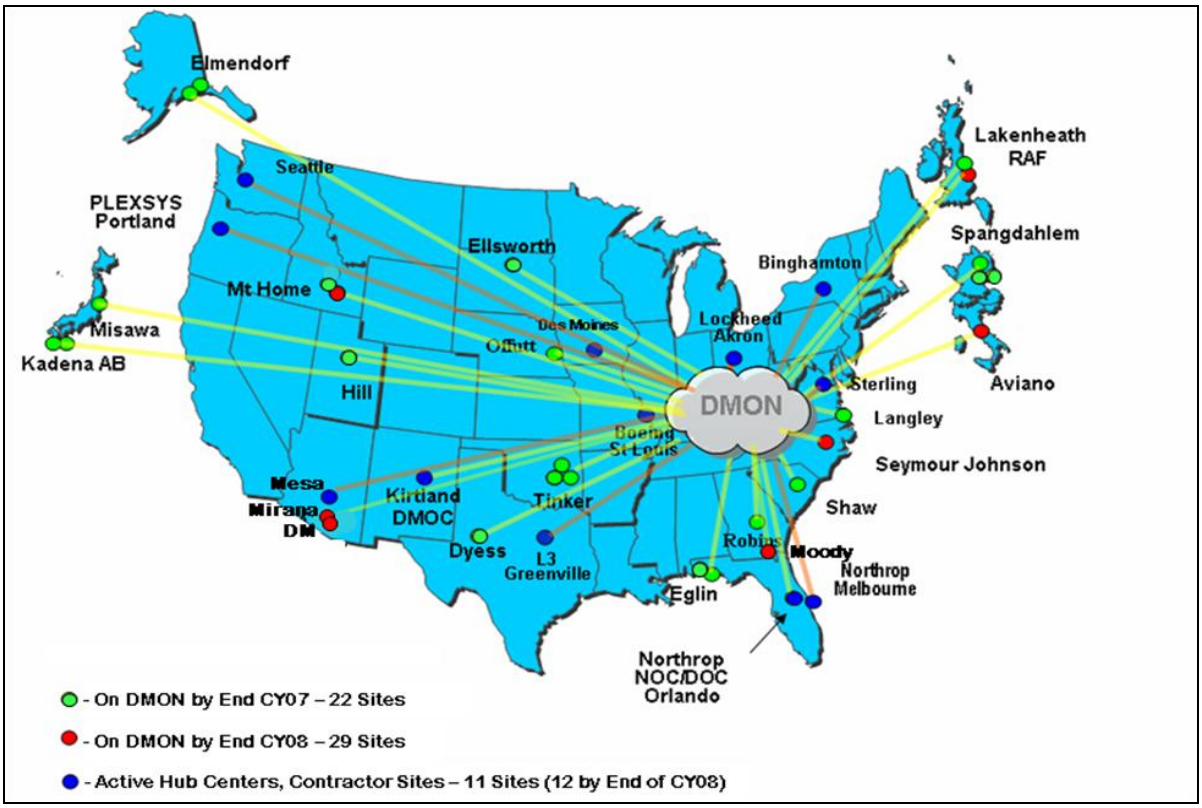

Figure 2 – CAF DMO Sites

CAF DMO Efforts

In an effort to increase the amount of distributed training within CAF DMO, ACC sponsored several venues. In December 2006, an event called DMO Network (DMON) Realistic Airpower Virtual Event (RAVE) was accomplished. DMON RAVE was designed to maximize unit to unit distributed training over a short period, with minimal integration testing and minimal outside technical support, and showcase the DMO Network by assigning various bases to execute distributed events with each other in Air Combat Command, Pacific Air Forces (PACAF), US Air Forces in Europe (USAFE) and the Air National Guard and Air Force Reserves. Overall, 22 events (total training network time of 87 hours) were accomplished in 48 hours. The event highlighted several areas for improvement for future multi-mission events to include providing off the shelf canned scenarios, pre-developed mission execution materials, and white force support. In May 2007, the Air Combat Command Director of Air and Space Operations directed a follow-on effort to increase DMO training, but this time for an entire month in September 2007 as the annual flying hour program wound down. Figure 3 shows the total hours DMON

was used for training from 2003 through 2007. While the increase in the number of sites during this period accounts for the increase in training hours, the number of DMO events per month per site was also increasing as the operators realized the training benefits of DMO missions (DMON RAVE Report, 2007).

Successful Features of CAF DMO

There were several factors necessary to make distributed training a viable option for accomplishing combat training in simulators to augment live-fly training on a daily basis. First and foremost were high fidelity simulators with a distributive debriefing capability to capture lessons-learned. Second, was the use of a persistent, hub-less network and standards process that eliminated the need to accomplish integration testing for each new team training combination. CAF DMO was designed to provide a transparent environment desired by operators for distributed training.

DMO training: Warfighter oriented training on a "hub-less" network

The key to the DMO Network was the creation of a persistent, hubless network that provided an on-demand training capability. Current squadron operations tempos are high due to deployments, extended TDYs, exercises, and inspection schedules, as well as the daily routine of training for various combat environments. The network had to be highly reliable with high bandwidth and low latency. It needed to be available at varying times throughout the day to account for changing flying windows and long training windows, and be capable of linking units around the globe in ACC, PACAF, and USAFE.

A hub and spoke network is an acceptable alternative when conducting a single integrated exercise but is not conducive to conducting multiple small-team events simultaneously. At one interval in September 2007, the DMO network was running four separate simultaneous events, briefs, or debriefs, involving 14 different sites. A single hub and spoke network would have greatly limited this training due to the inability to conduct numerous simultaneous events. Additionally, a hub and spoke network operated from a single facility would have required an extensive technical staff to accommodate 24 hour manning to provide training to units across the globe. The hub-less network enabled numerous events to be accomplished without impacting operator training.

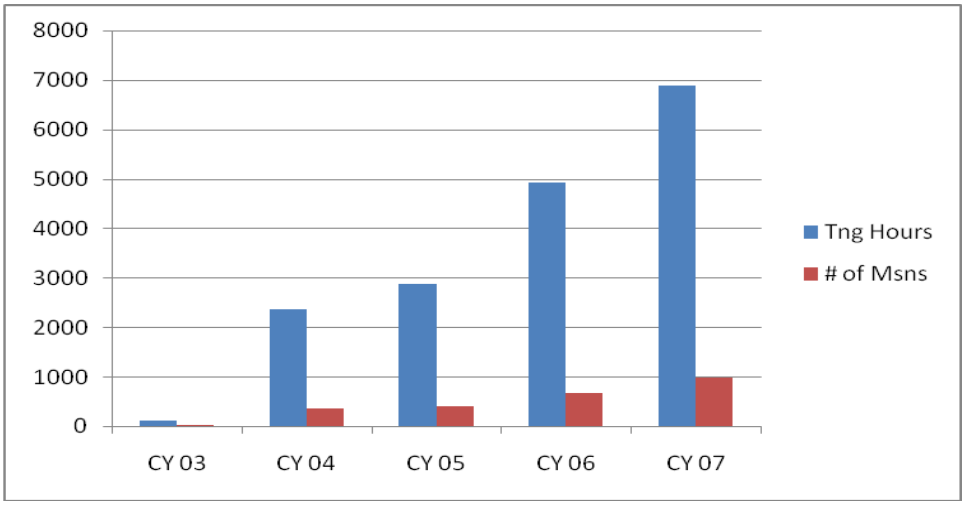

Figure 3 – DMON Training Hours and Missions

Standards Process

The CAF DMO Operational Requirements Document states that "DMT will provide a realistic, full spectrum combat training system for combat-coded aircraft and aircrews. DoD/industry standards for interoperability are the key concept to implementing DMT as envisioned by senior AF leadership to allow the space and air team to train and exercise together--as they will fight." (Operational Requirements Document (ORD) CAF (USAF) 009-93-I-A for Distributed Mission Training 8 Oct 97).

Simulator platforms involved in CAF DMO training are a combination of new and legacy systems developed over several decades and are designed by numerous different contractors. These two specifics result in disparate systems that are difficult to connect on a network to provide an operational team training capability. The task of ensuring connectivity between sites is a difficult and extensive process.

The objective of a strict standards process is to facilitate daily training between varying sites without necessitating repeated integration testing. The interoperability standards apply to all systems participating in CAF DMO events on the DMON, to include systems outside the DMO Network that link routinely to the DMON (e.g. an ANG or Reserve A-10 Full Mission Trainer (FMT) connecting to other CAF DMO platforms via the ARCNet to the DMON) (Aldinger & Keen, 2007).

Currently there are 12 interoperability standards. Each standard in this set addresses one or more aspects of the CAF DMO environment and is categorized under one of three categories: Interface, Integration Process, and Federate System Performance. Interface Standards address the network connectivity, software and hardware interfaces, and the protocols necessary for federate systems to exchange information. Integration Process Standards document common processes and procedures that facilitate coordinated operation of individual simulator systems as a harmonized CAF DMO System. Federate System Performance Standards address consistency, fidelity and performance factors ensuring a fair fight among training participants. As a whole, the set of standards is intended to ensure a routine, interoperable, distributed, simulated battle-training environment. (CAF DMO Standards Website). Figure 4 displays the common CAF DMO standards.

Standards Category	Interoperability Standard
Interface Standards	Network (incl Portal) DMT Tailored DIS Reference Federation Objective Model (FOM)
Integration Process Standards	Event Control Security Conformance Testing Data Sharing
Federate System Performance Standards	Technical Performance Synthetic Natural Environment (SNE) Threat Representation and Computer Generated Forces Common Models Visualization

Figure 4: CAF DMO Standards

An important aspect of standards implemented into CAF DMO is they are vetted through the Institute of Electrical and Electronics Engineers (IEEE) and Simulation International Standards Organization (SISO) standards if applicable. While the DMO Network is a closed network, the CAF DMO program does not operate in an isolated environment from the rest of the simulator community. The CAF DMO program and the stakeholders are active participants in SISO activities and provide inputs to standards implementation. For new standards, CAF DMO first looks to IEEE/SISO to determine if the standard exists and is appropriate for use. If it doesn't exist or is not sufficient for CAF DMO use, they take the lead to develop the standard and present the new standard to IEEE/SISO for possible incorporation. A good example is the implementation of SISO-STD-002—2006. This standard for Link 16 simulation was developed with major contributions in leadership and technical expertise from the CAF DMO community.

DMO USER CONFERENCE

DMON RAVE highlighted a concern that even with a persistent network, the tasks associated with

coordinating, planning, and executing repeatable events is burdensome. Operator involvement is required to ensure proper mission planning and coordination. During DMON RAVE, the Chief of the Flight Operations Division at ACC drove most of the scheduling process and expected units to use and share existing scenarios and modify them to meet unit training requirements for all players. However, due to high operations tempo, scenario development and mission planning was lacking and impacted the training of some events (DMON RAVE Report, 2007). Unit ownership of the schedule was non-existent since it was developed at the Headquarters and provided to each unit.

To resolve these issues, the Chief of the Flight Operations Division held a DMO User Conference in July 2007. All CAF Operations Group Commanders were asked to send their military simulator representative as well as the Group Weapons and Tactics Officer. The main goals of this conference were:

- To develop scenarios with complete mission planning materials that meet units' training objectives
- Build a firm and detailed schedule with scenario locations, lead agents, and mission commanders identified
- Provide a venue wherein aircrew would be "looking forward" to training and be challenged to improve and increase scenario complexity
- Create ownership for unit DMO training – vital to unit desired vs. MAJCOM pushed training

The conference resulted in a fairly robust DMO schedule for September 2007 with over 100 events planned. Also, nine scenarios were developed in the following mission sets:

- Offensive Counter Air (OCA) / Defensive Counter Air (DCA) / Suppression of Enemy Air Defenses (SEAD)
- Close Air Support (CAS) / Time Sensitive Targeting (TST) / Dynamic Targeting (DT)
- Strike Escort/TST/DT

Additional C2ISR scenarios were developed after the conference as well as four existing C2ISR scenarios which were also used in the September events.

Scenarios

The operators were grouped in teams to develop scenarios to meet the training needs of all participants in an event. In addition to the scenarios, attendees built mass briefing slides and mission planning and execution materials to adequately conduct training during September's events and beyond. This process reduced the amount of time operators needed to spend for coordination, scenario development, and mission planning.

Conference attendees were directed to build the scenarios to meet the units training objectives and fill shortfalls in current training. ACC did extensive analysis to identify training gaps for each platform through the Mission Essential Competency (MECs) process. MECs are the higher-order individual, team, and inter-team competencies that a fully prepared pilot, operator, crew, flight, or team requires for successful mission completion under adverse conditions and in a non-permissive environment. MECs are not abstract knowledge or general skills. They are demonstrated in the context of an actual mission or high-fidelity simulated mission under wartime conditions. (MEC Final Report, 2007)

Involvement of Wing Weapons and Tactics Officers was crucial to ensuring scenarios met all unit wartime tasking, focused on training gaps identified during the Mission Essential Competency (MEC) process, and provided challenging but adaptive scenarios that could flex to the varying experience levels of the different operators. (Colegrove & Alliger, 2002, Colegrove, 2006).

In addition to these scenarios, the Distributed Missions Operation Center (DMOC) accomplished Warfighter Focused Events (WFEs) utilizing pre-existing scenarios. The DMOC conducts WFEs periodically to provide units with some mission planning and execution support for small team training events. The Distributed Training Operations Center (DTOC) supported training with scenarios developed to meet unit specific AEF preparation training. The DTOC is an Air National Guard unit that provides mission preparation, scenario development, and white force support for guard and reserve units as well as active duty units requiring their services. While the DMOC mainly focuses on periodic large force events, the DTOC focuses on daily unit training requirements and AEF spin-up.

A shortfall to this conference process was the amount of time spent on scenario development and mission planning materials. The 2008 CAF DMO User Conference started out with pre-developed scenarios and materials that were modified to meet specific unit requirements, thereby allowing more conference time to be dedicated to other important tasks.

Schedule

During DMON RAVE, the training division at ACC developed the schedule and requested unit input and changes. The schedule was developed in this manner due to the inability to conduct a consolidated scheduling meeting of the worldwide users. Since all CAF units were represented at the User Conference, the unit POCs developed the September 2007 schedule.

Most hub and spoke operations or single events, even those with a large number of players, usually have a predetermined, finite schedule and may involve units in a limited number of time zones. However, CAF DMO events span units in eight different time zones and operations are conducted up to 24 hours each day. Flexible scheduling required units to account for local operating windows of the simulator facility, differences in time zones, deconfliction in work days (e.g. holidays and weekends), and live fly operations (e.g. night flying).

Having a unit-developed schedule created ownership of that schedule, a desire to interact with more units, and required units to alibi changes to the schedule. The downside to unit scheduling is the hesitancy to sign on for too many missions which results in a lighter than expected schedule. A typical day's schedule during the event is shown in Fig 5 (DMON Month of DMO Report, 2007).

VTC/Brief/Debrief

A major hindrance to the learning process of combat training in a distributed environment is the difficulties to adequately debrief missions. Video Tele-Conferencing (VTC) capability exists at most sites and is adequate for the initial mass briefs and coordination. However, synchronized replay among different platforms is desirable but not yet attainable. The most successful replay debriefs were conducted by each site recording the event locally and the mission commander directing start, stop, and fast forward commands verbally. While not ideal, this method provided a learning environment more beneficial than a simple verbal VTC debrief.

ACC is working hard with the all CAF platforms to resolve debrief and synchronized replay issues at the earliest opportunity.

Tuesday 25 September 2007		
Time (Zulu)	**Mission**	**Units**
1400 – 1600	CAS – SWA	DTOC Ft. Hood
1400 – 2200	Homeland Defense	HLD Peterson HLD 1st AF DTOC
1645 – 2100	CATO Glory	Robins JSTARS Eglin CRC Offutt RJ Elmendorf AWACS DTOC
1800 – 1930	DCA –Pacific region	Shaw F-16CJ Tinker AWACS Elmendorf F-15C
2300 – 0100	CAS – Korea	DTOC Osan A-10
2130 - 0200	Phased OCA	Elmendorf F-15C Elmendorf AWACS Kadena F-15C Misawa F-16CJ

Figure 5: Typical Schedule During September 2007 Month of DMO

RESULTS

Twenty-seven different units or organizations participated in September's month of DMO training including Homeland Defense (HLD) units of the Air National Guard and Air Force Reserves. Overall, 90 events for a total training network time of 303 hours were accomplished during the month of September.

Of these missions, only three of the missions were completely non-effective, and three missions were non-effective for at least one unit. Figure 6 shows site participation during DMON RAVE and September's month of training.

Results from the initial week's missions were less effective than missions accomplished from the second through fourth weeks. Operators identified minor flaws in the scenario and mission planning process that had a minor impact to training but were fixed and resulted in more productive missions later in the month. Good examples of improvements included changes to the Data Link and communications plan, reallocating red threats to provide better presentations for training, and addressing white force shortfalls. Technical improvements from repeatedly running missions with similar training teams resulted in smoother operations and less technical issues which greatly improved operator training and their desire to conduct distributed training. Initial non-effective missions were caused by duplication of CGF entities or overloading system capabilities. These issues were quickly resolved through real-time assessment and changes to scenarios.

Participants in DMON RAVE and September's DMO Training				
Platform	**Base**	**Number of Systems**	**In RAVE**	**In Sept**
F-15C	Langley	4-ship	X	X
	Eglin	4-ship	X	X
	Lakenheath	2-ship	X	X
	Kadena	4-ship	X	X
	Elmendorf	4-ship	X	X
F-16CJ	Shaw	4-ship	X	X
	Mt Home	2-ship	X	
	Spangdahlem	4-ship	X	X
	Misawa	4-ship	X	X
JSTARS	Robins	1 system	X	X
AWACS	Tinker	2 MTCs	X	X
	Elmendorf	1 MTC	X	X
	Kadena	1 MTC	X	X
RJ	Offutt	1 system	X	X
B-1	Ellsworth	1 system	X	X
	Dyess	1 system	X	X
B-52	Minot	1 system	X	X
A-10	Pope	1 FMT	X	
	Battle Creek	1 FMT	X	
A-10	Davis Monthan	2 FMTs		X
	Whiteman	1 FMT	X	X
	Barksdale	2-ship	X	X
	Osan AB	1 FMT		X
CRC	Spangdahlem	1 system		X
	Eglin	1 system		X
JTAC	Ft Hood	1 system		X
DTOC	Des Moines, IA	White Force	X	X
DMOC	Kirtland	White Force	X	X
USAF HLD	Peterson AFB, 1st AF			X
US Army				X

Figure 6: CAF DMO Event Participation

Since the main focus on Septembers Month of DMO was to increase team training, formal mission effectiveness for each event was not conducted. Additionally, individual assessment of events or operator performance was not tracked since most operators only conducted one event during the month. However, informal feedback from the operators indicated that events accomplished during the last two weeks of the month were more conducive to and provided a higher level of training. Scenarios were fine tuned to better meet objectives and in some cases the scenarios were intensified to provide a better training forum.

LESSONS LEARNED

Mission Planning

Operator involvement is crucial to the success in conducting a large number of events involving multiple geographically separated units. However, there are several steps an organizer can take to reduce the workload of planning numerous events and provide a better opportunity for execution success.

- Start with prebuilt scenarios, preferably based on current intelligence.
- Provide scenarios on map overlays with friendly and enemy situations so they can be easily modified by the operators to meet training needs.
- Provide basic mission planning materials to include ATO, SPINS, and communication information, as well as a skeleton set of briefing slides.
- Have two operators for each platform (more if required for large crew platforms) to conduct mission planning. Keep the planning teams small enough to provide a working environment so that the planners don't get sidetracked with non-pertinent issues.
- Provide one person not part of the planning team to provide oversight of the group to ensure they stay on task and to be able to track down information for the team.

Scheduling

Again, operator participation is key to building a successful schedule involving numerous events over a month or longer period. Main areas to consider are:

- Units need to account accurately for their local flying schedule and the hours when the simulator facility will be operational.
- A worldwide Zulu to local timetable should be provided so units can accurately schedule events and ensure time are consistent across the differing time zones.
- Units need to commit to the schedule after development. Changes to the schedule need to be coordinated with all units in the event and should be made only when necessary as the changes affect other unit training.

Execution

As the events are being conducted, close monitoring at several levels is required.

- An overall event manager should monitor the progress and status of each event. Events rated non-effective should be identified quickly to determine the causal factors and the provide solutions to ensure success of follow-on events.
- Technicians should be monitoring events real time to quickly resolve issues that impact operator training.
- Instructors should also monitor events real time and provide changes to the scenario that will enhance overall training and ensure the event runs smoothly and properly challenging.

SUMMARY

The Air Combat Command Director of Air and Space Operations made a push to increase DMO training with the intent of increasing operator awareness and DMO activity throughout the year. There are many factors that influence the amount and level of distributed training a unit accomplishes. Among these are deployments, spin-up training, and manning the flying hour program status.

Stand-alone unit training will always be the easiest to schedule, plan, coordinate and execute. However, one measure of success to September's training is the relative increase in distributed activity before September 07 compared to post September 07 periods. While training hours may not be the best measure of DMO event training or training credibility, the overall increase is an indication that distributed training is becoming a mainstay in CAF training programs.

Overall, the month of DMO training was very productive. Units developed their own training program, objectives, and schedule, and utilized existing scenarios to meet those requirements. The main difference between September's DMO training events and DMON RAVE was increased unit ownership.

The utilization of off-the-shelf scenarios and mission planning materials kept all players on the same track and drastically reduced the amount of effort required to develop and execute a mission. Future DMO User Conferences should account for this success and build on the lessons learned to provide more capability to the warfighters.

Focusing DMO training for the entire month instead of a few days enabled operators to improve on the mission materials and fine tune the scenarios to better meet training objectives. The month of training also allowed simulator instructors and technicians of new platforms to address and fix minor detractors to DMO training and feel more comfortable with DMO capabilities. The result were changeable, but reusable scenarios and materials that provided high quality team training with reduced operator workload to execute these missions and a high success rate for mission effectiveness.

September's training also highlighted the success and requirement for strict CAF DMO standards. The standards process enabled numerous units around the world to participate in varying multi-site training events without routine integration testing. And a hub-less network allowed numerous events to be conducted simultaneously.

Future endeavors will focus less on sporadic events and more on enhancing unit-to-unit commitments for persistent frequent events throughout the year for all operators and to raise DMO training awareness. CAF DMO is rapidly becoming a part of the daily training programs. And a periodic conference, with all users in attendance, strengthens inter-team commitments for persistent training in an immersive DMO environment.

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