

Cross-Divisional Analysis of Competency-Based Training Requirements for the Air and Space Operations Center (AOC)

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ABSTRACT

As a result of standardization and fiscal inefficiencies, the US Air Force designated the AOC as a weapon system four years ago to improve its condition. Since then, this classification has sparked multiple efforts to advance AOC training. One such effort that has caught the interest of many in the Air Force, including the current Chief of Staff of the Air Force, is competency-based research conducted by the Air Force Research Laboratory Warfighter Training Research Division, Aptima Incorporated, and the Group for Organizational Effectiveness (gOE). Detailed competency-based knowledge, skill, and experience requirements have been identified for individuals working throughout the AOC, from the Joint Force Air Component Commander (JFACC) down through each position within four of the five major divisions of the AOC.

While the AOC training research efforts have been focused at the division and JFACC levels, this paper will leverage both approaches to begin to identify overall implications for AOC operator training. More specifically, the competencies, knowledge, skills, and experiences will be compared and contrasted across the four divisions. Special emphasis will be given to how these coincide with or differ from the JFACC analysis effort. In addition, a comprehensive inventory of AOC training requirements will be developed from this analysis along with recommendations for competency-based training for AOC operators at all levels of responsibility. Finally, as progress is made towards automated and enhanced training performance measurement, this analysis will help drive several efforts in targeted training tool development for AOC operators and teams.

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INTRODUCTION

The AOC is the senior element of the Theater Air Control System (TACS). It provides operational level command and control of air and space forces as the focal point for planning, directing, and assessing air and space operations. Although the Air Force provides the core manpower capability for the AOC, other service component commands contributing air and space forces provide personnel in accordance with the magnitude of their force contribution. An AOC is typically organized into five divisions and multiple specialty teams. The divisions include Strategy; Combat Plans; Combat Operations; Intelligence, Surveillance, and Reconnaissance; and Mobility. Specialty Teams include Communications, Information Warfare, Space Operations, Special Operations, and Judge Advocate. Core manning is the responsibility of a Numbered Air Force with an Air Operations Group (AOG) assigned. Based on the requirements of the particular contingency, the Numbered Air Force commander will direct the formation of an AOC using the organic AOG augmented to meet the needs of the contingency. The AOC is made up of an officer contingent currently made up of pilots, navigators, air battle managers, space operators, airfield operators, intelligence officers, weather officers, operations support officers, logisticians, communications/computer officers, psychological operations officers, lawyers, operations assessors, electrical engineers, and special investigators. The enlisted contingent is made up of journeymen and craftsmen from a variety of career fields including air traffic control, command post, aircraft control and warning, intelligence, ground radio and electronic communications, munitions, information management, communications-computer systems, audio/visual, and security forces. None of

these personnel are trained in AOC operations in their basic career field training.

AOC operators need to be mission ready in their specialty areas and are expected to use their knowledge and experience to provide subject matter expertise to the planning and operations functions. Additionally, since the AOC is the interface between the operational art of war and tactical execution, operators are expected to be versed in professional knowledge gained from professional military education and reading. Joint and aerospace doctrines are also required knowledge areas for AOC operators. Finally, the AN/USQ-163-1 Falconer system, the formal designation of the AOC weapon system, consists of over 40 systems and applications which are used by the various operators. Training on these systems, and some of the required knowledge, is currently provided by the Command and Control Warrior School (C2WS) Formal Training Unit at Hurlburt Field in Florida. The Formal Training Unit (FTU) courses are the standard preliminary requirement for all personnel assigned to an AOC position. The FTU is designed to certify AOC operators for initial qualification status and represents the first step in developing a robust AOC operational training pipeline. Conceptually, every operator assigned to an AOG will receive FTU training either prior to reporting for their assignment or soon after arrival.

The weapon system designation presents the Air Force with the responsibility of developing a training system that adequately prepares AOC warfighters with the knowledge and skills necessary to perform their mission. Such a training system includes Initial Qualification Training (IQT), Mission Qualification Training (MQT), and Continuation Training (CT). While the FTU provides the basis for IQT, it remains the responsibility of the AOGs to conduct MQT and

CT. Currently, MQT is based on theater specific training, AOC knowledge training, and participation in exercises. While ACC has provided general guidelines, each AOG is responsible for developing and administering MQT and CT instruction.

ACC, with the support of the AFRL Warfighter Training Research Division, is currently applying the highly successful Mission Essential CompetencySM (MECSM) process to address both AOC MQT and CT. The MECSM process provides a level of detail and analysis necessary to address the complexity of AOC operations, and a training program based on the MECSM construct will help alleviate the problem of personnel influx and outflow by reducing the learning curve associated with initial exposure to a real-world AOC. MECSM constructs have been developed for four of the five AOC divisions and the Joint Force Air Component Commander (JFACC). This paper compares MECsSM from four AOC divisions (Strategy, Combat Plans, Combat Operations, and ISR) and derives training requirements which can be applied consistently across all AOG MQT and CT programs.

AOC Division-Level MECSM Construct

MECsSM are a collection of statements written at different levels of abstraction (Colegrove & Alliger, 2001, 2002). These statements are divided according to their level of granularity. From a higher-level of abstraction down to the lowest, MECsSM include MECsSM (proper), Supporting Competencies (SCs), Knowledge, Skills, and Experiences.

At the highest level are the MECsSM – such as the statement from the Combat Operations Division of the AOC:

Monitor Battle Plan Execution: Confirm taskings are carried out and that the JFACC objectives, in support of JFC's intent, are achieved. Ensure that tasked aircraft are packaged appropriately for maximum mission effectiveness and force protection.

Clearly, this statement is more concise than the Air Force Level Task: “Centralized Command/Decentralized Execution”, but still overarching the more specific training tasks such as “use TBMCS for reachback communication”.

At the next level down are Supporting Competencies. Though the titles are more general than the MECsSM

proper, they reflect areas of competence needed in carrying out the MECsSM. For example, SCs identified as important for the Combat Operations Division include:

- **Decisiveness:** Ability and willingness to make timely decisions based on available information.
- **Adaptability:** Identify and adjust to changes in the environment.
- **Multi-tasking:** Ability to effectively perform multiple responsibilities simultaneously.
- **Situational Awareness:** Ability to assimilate information to develop and maintain a perception of current operations scaled to individual responsibilities.

At the lowest level of granularity are the knowledge and skills. Knowledge is defined as *information or facts that can be accessed quickly under stress*. A skill is defined as *a compiled sequence of actions that can be carried out free of error under stress*. Examples of specific knowledge and skills needed for operators within the Combat Operation Division include:

- Understands ATO change processes and procedures
- Knows AOC battle rhythm
- Able to maintain daily activity log

The last, and possibly the most relevant components of the MECSM construct to training development, are the developmental experiences. An experience is defined as *a developmental event during training and/or career necessary to learn a knowledge or skill, or practice a MECSM or SC under operational conditions*. Examples of experiences for the Combat Operations Division include:

- Late completion of data inputs
- Change of target priorities

Due to the complexity and size of the AOC, the MECSM analysis was conducted at the division level. Thus, instead of having general AOC MECsSM that would be applied to each of the five divisions, our efforts have focused on developing Division-specific MECsSM. In addition, the MECsSM developed for each division have been further mapped to teams and individual positions within those divisions.

AOC Cross-Divisional Analysis of MECsSM

To fully understand and provide for the training needs of the AOC community, it is imperative to not only look at each division in isolation, but to look across teams and divisions for how training may impact readiness. For example, if it is important for a TST Analyst within integrated ISR and a TST Chief within Offensive Operations to understand ROE, training those positions/teams together may make sense. In addition, if it is important for the Chief of Combat Operations and the Chief of the Strategy Plans Team to understand how the JFACC guidance is derived, it may also make sense to train those positions together. To date, researchers have worked with subject matter experts for the Combat Operations, Combat Plans, ISR (Intelligence, Surveillance, and Reconnaissance), and Strategy division of the AOC as well as the Senior Mentors representing the JFACC community to develop MECs. with each effort being at a different stage of development. As such, any of the findings herein are preliminary in nature and likely to change based on further refinement. Table 1 indicates the current status of each effort.

Table 1. AOC MECSM Status

Specific Effort	Current Status	Next Steps
JFACC	Follow-up workshop has been conducted resulting in refined MEC SM products	Make decision regarding specific surveys and use to validate the initial products from the workshops
Combat Operations Division	Initial data analysis has been conducted	Collect additional data to ensure each position is represented within the sample
Combat Plans Division	Initial data analysis has been conducted	Collect additional data to ensure each position is represented within the sample
Intelligence, Surveillance, & Reconnaissance Division	Initial survey development	Review surveys and collect data from the operational community
Strategy Division	Initial survey development	Review surveys and collect data from the operational

		community
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For the remainder of the paper, a high-level comparison of MECSM products from the divisions of the AOC and from the JFACC will be made. In addition, recommendations for future comparisons will be outlined.

Cross Divisional Analysis: MECsSM

One way to look for similarities across efforts is to identify similar, or analogous, kinds of processes within the MECsSM. Proposed here are three such processes: Information Processing, Production/ Distribution, and Understanding of Red Forces, (Figure 1).

Of course, these identifications are just preliminary and meant to suggest a method of analysis rather than any final result of such an analysis. Thus, any analysis of similarities or trends or linking by MECsSM across domains (such as divisions, platforms, etc.) must at this stage be preliminary and suggestive, awaiting a more formal analysis. Such analyses are planned. It should be noted too, that survey data remain to be collected from all divisions and JFACC – these must inevitably influence our understanding of connections across these.

That the degree of identification would vary by team or division seems reasonable, in that a) the MECsSM are high-level functions, b) for some divisions, teams may in fact be rather distinct in function, in which case c) MECsSM will tend to identify with teams. This may occur particularly if the teams operate on a product somewhat in sequence (e.g., Plans).

Of further interest is the fact that there are two MECsSM (“Interpret Commander’s Guidance and Intent,” and “Gather, Process, and Analyze Information”) that overarch the teams of the AOC Combat Plans division. The other four MECsSM map onto particular teams (“Identify and Nominate Targets” – GAT, “Develop Air Attack Plan” – MAAP, “Establish and Maintain Command and Control” – C2, “Produce and Distribute Products” – ATO Production) while the competencies they discuss are not limited to any one team.

It should be noted that additional analyses across AOC divisions (and potentially including the JFACC) are possible. These may include: Input/Output links (e.g., the plan from Plans to Operations), feedback loops, managerial connections, and the like.

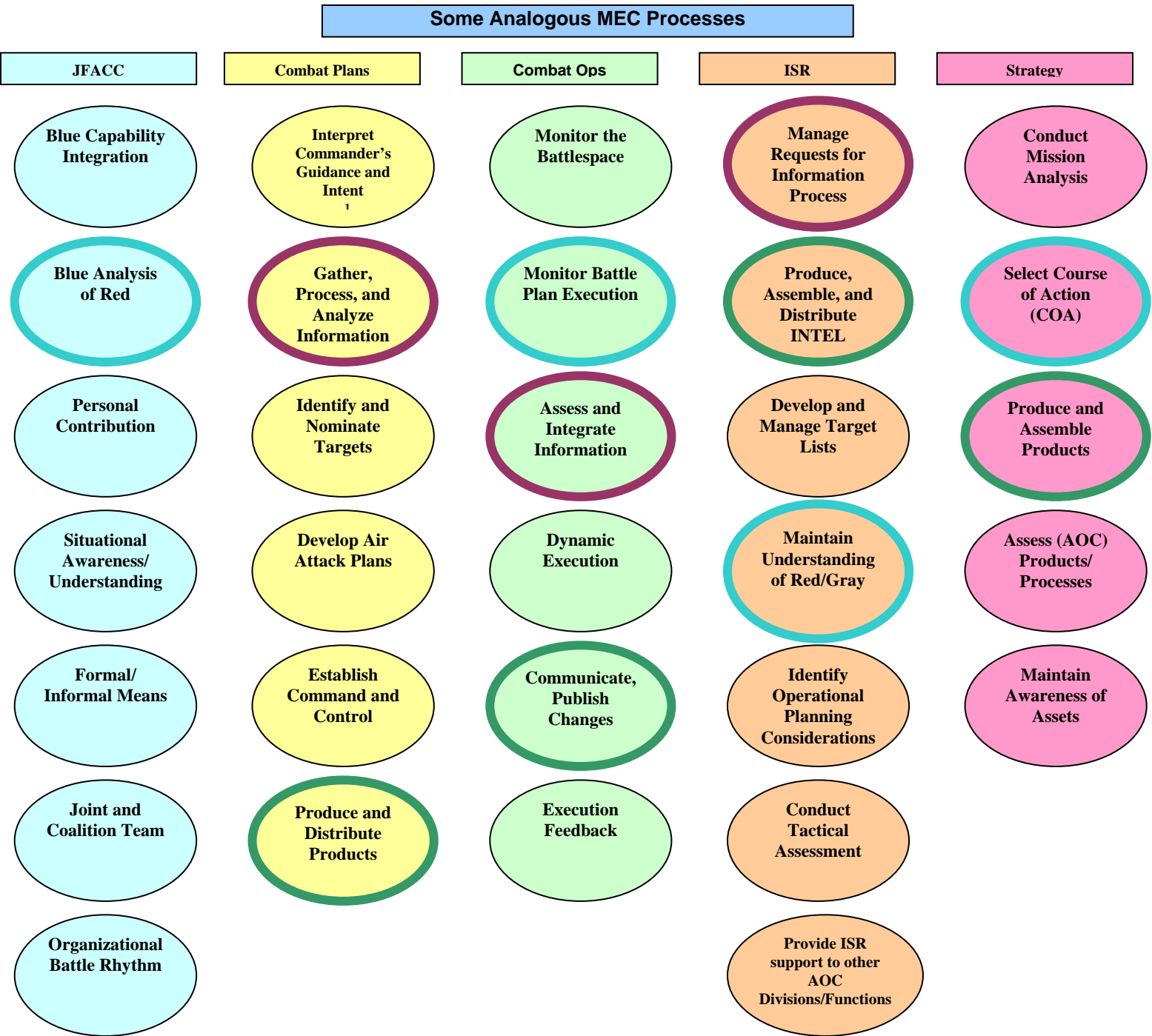
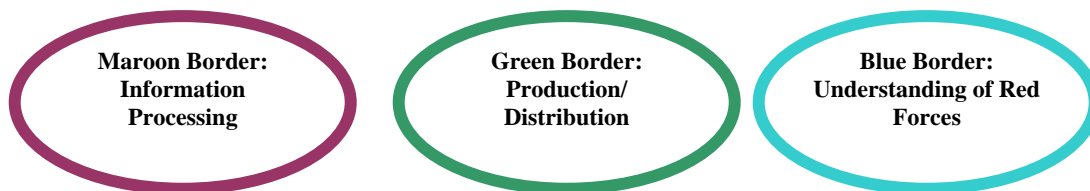


Figure 1 High-Level MEC Comparison Across AOC Divisions



Supporting Competencies

Supporting competencies are general abilities that may be needed across several jobs. As such, it is perhaps not surprising that several of the supporting competencies for these efforts generalize to at least one other effort. The supporting competencies provided below were identified by SMEs for at least two of the five efforts of interest for this paper. Please note that the supporting competencies are presented in no particular order.

- Decisiveness
- Adaptability
- Interpersonal Communication
- Leadership
- Negotiation
- Situational Awareness
- Multi-tasking
- Perseverance
- Projection

In addition to this comparison, it will be important that researchers identify those competencies that may be a subset of one another. For example, some may argue that “Negotiation” is a subcomponent of “leadership” It will also be important to ensure that supporting competency labels, across efforts, are operationalized in the same fashion.

Knowledge and Skills

A major challenge facing the team in these efforts has been the identification of meaningful differences between positions, within and between divisions, in regard to knowledge and skill requirements. Because of the relatively high number of knowledge and skill requirements within a division, it is perhaps not surprising that several knowledge and skill requirements are common at a surface level. For example each of the knowledge and skill requirements below, flow across each division and across several positions within divisions.

- Understands rules of engagement
- Understands AOC processes
- Knows AOC battle rhythm
- Understands the law of Armed Conflict
- Able to maintain daily activity logs
- Able to train others

As such, part of the MECSM process for the AOC effort has included identifying the level of a particular knowledge and/or skill required at the position level (Basic, Intermediate, or Advanced). When this comparison occurs, particular knowledge and skill requirements may become more affiliated with a team (Offensive Operations vs Defensive Operations) or with the level of responsibility within the organization (Chief of Combat Operations vs SADO).

Developmental Experiences

Perhaps the most critical products from the MECSM framework are the developmental experiences. Indeed, developmental experiences allow for personnel to “learn a Knowledge or Skill requirement, or practice a MECSM or Supporting Competency under operational conditions”. When looking across the divisions of the AOC, several developmental experiences are common. For example:

- Joint/Coalition environments
- Late arrival of products or inputs
- Manual input of requirements
- Security issues: classification
- Increased OPSTEMPO
- Intense time constraints

Three Approaches to MECsSM and Competency-based Training Needs Analyses

In the research literature, “competency-based training” has a number of definitions (Smith & Keating, 1997). Central to these is the use of determining individual training success or completion on the basis of performance indicating competence, rather than on either time (e.g., pilot “hours”), relative ranking (e.g., comparison to normed peer performance), or simple completion of a series of courses (unless those courses themselves require competency demonstration).

The MECSM model provides a set of competencies (both MECsSM and Supporting Competencies) and other related elements (such as Knowledge and Skill statements) that can be used in various ways to build a competency-based training program, for example, for the AOC. Consider the following linking model:

Figure 2 is meant to illustrate a potential relationship among elements of the MECSM model. Experiences

lead to the development of Knowledge and or Skills and, in turn, these support the performance of Supporting Competencies and/or MECsSM. Actual linkages would have different weights and, perhaps, determined via ratings specifically designed for the purpose. France & Symons (2003) have in fact

developed just such a MECSM element relevance rating scale). They have found that (as hinted at in Figure 2) some Skills may be linked directly to MECsSM, rather than just mediated through Supporting Competencies

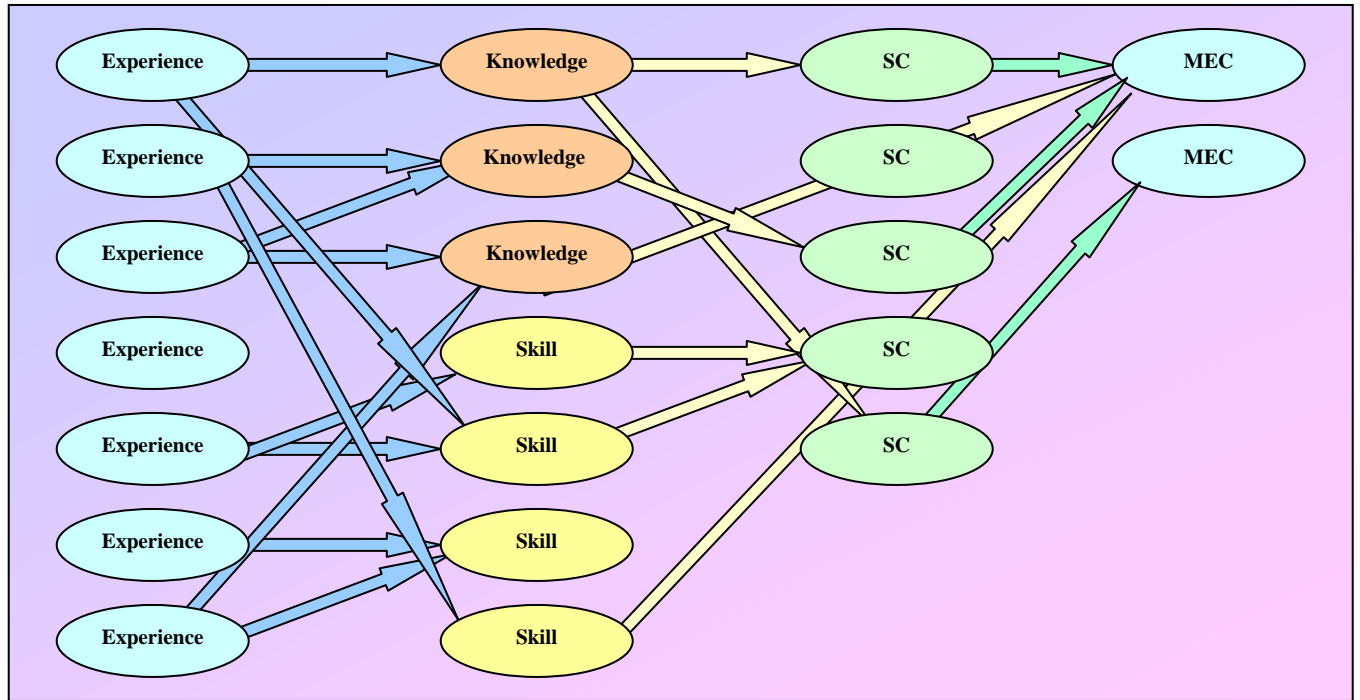


Figure 2. A schematic showing “links” between some of the elements of the MEC model.

A. MECSM -based training needs analysis, approach 1: Using MECSM proficiencies. Given such the conceptual linking of Figure 2, one implication for competency-based training needs assessment becomes apparent: it would be possible to use a deductive approach, working backwards from the highest level, MECsSM, to determine training needs. Specifically, an Assessment and Analysis approach could be used, as outlined below:

Assessment: First, assessment can determine which competencies require training. The MECSM survey process typically gathers self-report information about the proficiency of individuals on each MECSM.

For example, initial data on the Combat Operations Division in the AOC indicated that the MECSM ranked lowest in proficiency was Execution

Feedback. This MECSM could be targeted for training, based on that data (although in actuality more data will need be collected to determine training need).

Analysis: Assuming a complete linking among MECSM elements, the Experiences can be provided in a targeted way; that is, a “backward walk” from the appropriate MECSM, to the associated Knowledge and Skill(s), and from there to the associated Experience(s).

This kind of reverse analysis, working from MECSM proficiency data, would of course require that the entire linking schema as illustrated in Figure 1 would need to have been completed. This undertaking has been clearly specified elsewhere (France & Symons, 2003).

B. MECSM -based training needs analysis, approach 2: Using the COMMAND results. Yet another approach for identifying training needs is via

the COMMAND (Comprehensive MECSM Analysis and Needs Determination) process. Here, Experiences are reviewed in sequence, following the following format: Within an AOC division, for each Experience, three questions are asked of SMEs, with survey data being presented for each:

Table 2. The COMMAND questions and data provided for each

Question	Data
How important is the experience in developing the MECs SM ?	By team, averages of expert ratings for each MEC SM , indicating importance.
How useful would it be to provide this experience in this environment?	By team, averages of expert ratings for AOC learning environments (e.g., Flag, Other Exercises, FTU/IQT), indicating usefulness.
How often have you had this experience in this environment over the last 2 years?	By team, averages of frequencies for operators within AOC learning environments.

Experts on the AOC interpret the data and answer the questions listed in Table 1 during a facilitated session. Conclusions for each question are captured, as well as overall conclusions for each experience. The result is that certain experiences are identified as requiring training – that is, training gaps are identified. The SME conclusions (but not the data on which they based them) from a preliminary (Offensive Operations and Defensive Operations teams for Combat Operations Division) COMMAND session for a single experience is shown below.

Table 3. The COMMAND questions conclusions provided for the Experience “Late Completion of Data Inputs”

Experience: Late Completion of Data Inputs	
Question	Conclusion
How important is the experience in developing the MECs SM ?	For Offensive Operations and Defensive Operations, the importance ratings make sense
How useful would it be to provide this experience in this environment?	For Offensive Operations and Defensive Operations, the importance ratings make sense; the importance ratings could be increased for Offensive Operations if the Part Task Trainer were considered; in Offensive Operations opportunities limited for delivering this experience in MQT and CT, although these opportunities could perhaps be increased with understanding of capability of these environments
How often have you had this experience in this environment over the last 2 years?	Defensive Operations: these frequencies make sense; for example, you can't make injections into exercise without causing havoc for exercise
Overall Conclusion?	Part Task Trainer should allow for increased opportunities for this experience in Defensive Operations, particularly in CT. There is a training gap for this experience

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How often have you had this experience in this environment over the last 2 years?	Defensive Operations: these frequencies make sense; for example, you can't make injections into exercise without causing havoc for exercise
Overall Conclusion?	Part Task Trainer should allow for increased opportunities for this experience in Defensive Operations, particularly in CT. There is a training gap for this experience

C. MECSM -based training needs analysis, approach 3: Knowledge and Skill Inventory. Yet a third approach to training needs analysis using the MECsSM is via the AOC Knowledge and Skills surveys for each major position within a team within division (e.g., within GAT within Combat Plans),

SMEs stipulated during the development of the MECsSM the minimum level of Knowledge or Skill (Basic, Intermediate, or Advanced) required for proficient performance at that position. Then, during surveys, each individual completes a Knowledge and Skill inventory in which he or she indicates current level (Basic, Intermediate, or Advanced). These results can then be analyzed to suggest where training needs to occur (e.g., if most operators at a given position for a particular Knowledge or Skill

report a Basic level when an Intermediate level is required).

Below is an example of such an analysis conducted on initial data for the Offensive Operations team within the Combat Plans division. This analysis (though on too small a sample as yet to draw conclusions for most of the positions) shows green where at least 75% of individuals reported having the minimum required level of Knowledge or Skill (indicated in each cell as B, I, or A for Basic, Intermediate, and Advanced); a hatched cell indicates at least 75% reported exceeding the minimum level;

yellow indicates a smaller majority than 75% reported meeting the minimum level; red indicates that less

than half the sample indicated meeting the minimum level. The uses of such an analysis seem intuitively obvious, in that training needs are identified by the red and perhaps yellow cells, while potential areas for training savings may be indicated by the hatched cells.

Refresh		Knowledge and Skills					
Return to Table of Contents		Key: Percent at Level or Above					
1 = Basic (B): you have the basic minimum knowledge or skill expected by an augmentee or less experienced personnel.						>75	Level *
2 = Intermediate (I): you are currently applying the knowledge or skill but still need to seek direction and guidance regularly.						50-74	
3 = Advanced (A): you serve as a model and source of information for the particular knowledge or skill.						<50	
N/A: the knowledge or skill is obviously not applicable for your position.						N/A or no data	
	Knowledge or Skill	Offensive Operations					CCO
		SODO (n=2)	SODO Tech (n=5)	QDO(s) (n=7)	TST Chief (n=3)	ATO Change Tech (n=11)	CCO (n=4)
7	Understands how defensive operations puts assets on the target in a timely, effective, and efficient manner	A	B	B	B	B	A
8	Understands how to coordinate with TACS units	A	B	I	A	N/A	A
9	Understands the data link architecture	I	N/A	N/A	I	N/A	I
10	Understands how Defensive Operations provides information for SA	I	B	B	A	N/A	I
11	Understands how Defensive Operations coordinates for alert status	I	I	I	B	B	I
12	Knows AOC battle rhythm	A	A	A	A	B	A
13	Knows function of other AOC teams and divisions	I	B	I	I	B	I
14	Understands the offensive and defensive capabilities, limitations, and effects of weapons systems	A	I	I	A	N/A	I
15	Knows criteria for alerts and warnings	I	B	I	B	N/A	I

Figure 3. Example of Knowledge and Skill Gap Analysis

Training to Meet Identified Needs

Once the training needs for the AOC teams and positions have been defined, training can target those needs. If the needs have been identified by the “backwards walk” approach from MECSM proficiencies, appropriate Experiences and/or Knowledge and Skills can be targeted. The COMMAND analysis provides Experiences that can usefully be provided to meet deficiencies. The Knowledge and Skill inventory approach obviously provides information on Knowledge and Skills that need training attention.

Actual training may occur in any number of ways, either in classroom, exercises, simulation or some combination. Actual specification on training methods will be determined by instructional designers. It should be noted that training in areas

other than the AOC are using the MECSM approach, particularly via simulation.

This is true in part because the most advanced MECSM work is in the area of aircraft, where

simulation, including distributed simulation, is perhaps easier than with the complex team environment of the AOC. Nonetheless, distributed exercises may provide a good environment for providing many of the Experiences which have been identified as useful for the AOC.

Limits of the MECsSM in Identifying Training Needs

The MECSM model has proved useful in identifying training needs in a variety of warfighter environments. The survey results show good agreement among respondents (i.e., reliability), while

validity is built in by the careful design (i.e., a content validity approach is followed). What are the limits of the MECsSM in identifying training needs?

One problem for the AOC MECSM process is sample size – sometimes, especially when examining at the position level, it has not yet been possible to get a sample size which meets traditional standards for stable effect sizes. In some cases, it is simply the fact that the actual population of operators in a given position is itself small. In others, it has just been difficult so far to locate and survey a sufficient sample of operators. Plans for further surveying continue to go forward.

A second limiting factor for the AOC MECSM process is the linking suggested in Figure 1. This linking has not yet been done, and while it has been shown to be completely feasible (France & Symons, 2003), it will require a substantial amount of effort and time.

CONCLUSION

The impact of the above on developing continuation training and mission qualification training for AOC operators has already been positive. Examples of this include the use of MECs (1) as the definition of AOC training requirements (AFI 13-1AOC Vol 1.), (2) to assess the training effectiveness of scenarios that are being created for the primary mission trainer for AOC units worldwide, (3) to spark the AFRL C2 performance measurement effort, and (4) to provide a competency-based framework for C2 training technology development.

The Command and Control Warrior School Part Task Trainer (C2WSPTT) is a system of integrated computers and applications that enable multiple operators to train simultaneously on a particular operational scenario. These systems were fielded at all of the AOC units by ACC, and work has begun to develop the scenarios to populate the system databases. The aforementioned knowledge and skills analysis for AOC positions will be linked to critical decision points in a scenario ensuring the appropriate competencies are targeted. Thus, building a relevant scenario for a particular position is a matter of building scenarios that incorporate these “rich” events that target specific knowledge, skills and competencies. Variation, as well as quick syllabus development, is possible through a library of known scenarios that target specific competencies.

AOC MECsSM will also be the starting point to training tool development. The AFRL Warfighter

Training Research Division is currently developing training tools that target specific training need areas within the AOC. By understanding the key knowledge and skills requirements, the appropriate tools can be developed to target the gaps identified in the COMMAND process. Areas where we are helping include Time Sensitive Targeting (TST), Joint Force Air Component Commander Cognitive Readiness, Master Air Attack Plan Team Training, and Strategy Development. Most importantly, the MEC constructs will provide the framework for integrating the AOC into Distributed Mission Operations (DMO) training in accordance with the ACC DMO Vision.

As technology and processes change frequently, the value of creating training that is competency-based, and not just tool-specific, is key. As one operator explained of his real-world AOC experience, “I know how to use the secure phones, but knowing the right people to call and when... that’s what gets the mission accomplished and that’s a different kind of training than being ‘checked off’ on being able to use the phones.”

Clearly, the need for a competency-based training approach is understood by operators working in AOCs. Since the relatively recent designation of the AOC as a weapon system, those conducting AOC training research are in a unique position. Training researchers are finding themselves at the front-end of training development, with their work potentially having an immediate impact on today’s AOC community. Often, researchers are forced to find training gaps after training is fully developed and therefore must devise means to address those training gaps, but also work around the technologies and methods already in place. This analysis, like others we suspect, are purposed in ensuring the training being developed during the infancy of the AOC as a weapons system is both relevant to knowledge and skill development and comprehensive at all levels.

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