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# Integrating ACE and MCA Requirements into the Civil Engineer Officer Occupational Competency Framework

Stone D. Williford

# INTEGRATING ACE AND MCA REQUIREMENTS INTO THE CIVIL ENGINEER OFFICER OCCUPATIONAL COMPETENCY FRAMEWORK

THESIS

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## Abstract

The Air Force Civil Engineer officer career field has made dedicated efforts to the professional development of its company grade officers. In response to the 2015 Air Force Strategic Master plan, the Civil Engineer officer career field adopted a competency-based education approach. In 2020, the Civil Engineer Officer Career Field Education and Training Plan was published, officially integrating the career field's operational requirements into a competency framework. However, since 2020, the Air Force has adopted an updated force generation strategy, and with it, changes to the way the Air Force assets are employed in contingency environments. This scheme of maneuver was titled Agile Combat Employment and was enabled by the new Multi-Capable Airmen model. With the adoption of these new strategies and models; the roles, responsibilities, and duties Air Force Civil Engineer officers fulfill when deployed may change in response to changing environmental and operational conditions.

This research investigated Agile Combat Employment and Multi-Capable Airmen process implications for Air Force Civil Engineer Officer occupational competencies. A textual analysis of the latest, relevant official publications on Air Force Civil Engineer Company Grade Officer competencies created a context for eliciting expert opinion regarding new knowledge, skill and ability requirements for Air Force Civil Engineer Company Grade Officers. The panel of experts, consisting of senior USAF Civil Engineer leaders, achieved consensus on a proposed model and framework for integrating research-based requirements and changes to current Air Force Civil Engineer Company Grade Officer competencies.

This analysis identified 14 knowledge, skills, and abilities recommended for Civil Engineer Company grade officers when operating within the Agile Combat Employment and Multi-Capable Airmen Models, 10 of which were not captured within the existing competency framework. Several of these skillsets were then combined to create a recommended new competency and several new subcompetencies to be added to the core competency framework.

*This thesis is dedicated to my Civil Engineer brothers and sisters.*

*Engineers Lead The Way*

**Acknowledgments**

*I would like to thank Dr. Tay Johannes and Col Laurie Richter for their support and guidance throughout this journey. I would also like to thank my friends and classmates for their advice and encouragement to press on.*

Stone D. Williford

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# I. Introduction

## 1.1 Statement of Problem & Research Questions

With recent major shifts in the USAF force generation strategy and the global operational environment, as well as the implementation of the Multi-Capable Airmen, MCA, model, notable changes are expected to arise in the roles, responsibilities and duties of Civil Engineer officers deployed to support of contingency operations. The most current version of the USAF Civil Engineer Officer occupational competency framework was revised in summer of 2020 with the publishing of the updated Civil Engineer Officer Career Field Education and Training Plan, also referred to as the 32E CFETP, which was during the development of, but prior to the adoption of the Agile Combat Employment, ACE, and MCA concepts by the USAF. This raises the question as to whether the current Civil Engineer occupational competency framework sufficiently encompasses the complex requirements of ACE and MCA.

This research investigated the application of MCA constructs and ACE processes to force management and development of Air Force Civil Engineer Company Grade Officers. These initiatives have yet to be operationally implemented in a modern context and working groups from across the Air Force have adopted numerous schools of thought as to how various career fields and functions will contribute. This research investigated the various ACE and MCA strategies, definitions and implementations used throughout the Air Force and ultimately seeks to answer the question:

*"How do Agile Combat Employment and the Multi-Capable Airmen Concept apply to Civil Engineer Company Grade Officers in the context of the existing occupational competency framework?"*

The intent of this study was two-fold. First, to identify potential additions or changes to the existing Air Force Civil Engineer Company Grade Officer occupational competencies brought about by the adoption of ACE and MCA. Second, this research investigated several available learning opportunities and requirements to identify those courses already in place which build proficiency in any newly identified ACE or MCA competencies.

## 1.2 Background of Study

In the 2018 National Defense Strategy, Secretary of Defense James Mattis called for the development of a more lethal, agile, and resilient force through Dynamic Force Employment. This strategy was in response to challenges to the U.S. military advantage and the changing character of war (Mattis, 2018). This call to build warfighter readiness and to structurally change the way that the joint force was postured was answered by the USAF with the development of the Agile Combat Employment, ACE, model. Since the publishing of this strategy, subsequent strategies, initiatives, and publications at both the DoD and Air Force levels have echoed the need for innovation in the way that missions are generated and how manpower is employed as seen in the 2022 National Defense Strategy, in Secretary of the Air Force Kendall's Seven Operational Imperatives, and in Air Force Chief of Staff General Brown's "Accelerate Change of Lose" strategy (Austin, 2022; Kendall, 2022; Brown, 2020). The 2022 National Defense Strategy's defense priorities, security environments and force planning priorities all echo those of the 2018 National defense strategy; calling for greater resilience and agility for the DoD's forces in complex defensive environments and further driving the requirement for the USAF to continue ACE and MCA development and operations.

ACE is a component of a larger force generation model that fundamentally changes the way that the USAF deploys its assets and personnel. Decades of conflict in the Middle-East in an extremely permissive environment with dominant air superiority (Deptula & Penney, 2019) has molded the Air Force's rotational deployment model to sustain large, permanent air bases in the Middle-East. However, adversarial technological advances have shifted national focus to the rise of long-term strategic competition and changed how, when and where the USAF deploys its forces. This change in force generation strategy, along with the significantly different environment that Airmen will operate in also necessitates a change in the training and education they receive.

In addition to the new operational requirements of ACE, the development of the Multi-Capable Airmen, MCA, concept has broadened the scope of responsibility for some airmen by empowering them to perform jobs outside their normal duties. The introduction of MCA, as an enabler of ACE, also brings with it the question of how the various career field fits into this concept and how they are educated and trained to fulfill their duties in an increasingly complex environment. While some Air Force Major Commands, MAJCOMs, have developed their own working definitions of MCA, no widely distributed Headquarters Air Force, HAF, level publication exists linking specific career fields with associated MCA functions

## 1.3 USAF Civil Engineer Officer Competency Background

In 2015, the USAF officially released the Strategic Master Plan; a strategic document for Air Force Planners to align efforts with a common set of goals. Along with this core document, the Human Capital Annex was released, providing specific guidance on the recruiting, retaining and developing of Airmen to achieve collective innovative potential (Secretary of the Air Force Public Affairs [SECAF PA], 2015). In response, the Air Force conducted numerous analyses to develop recommendation on how to leverage leaning theory and educational technology and improve learning for Airmen (Roberson & Stafford, 2017).

Two years later at CORONA South, a meeting of key Air Force leaders, such as the Air Force Chief of Staff and the Chief Master Sgt. of the Air Force, to discuss strategy, priorities and initiatives, The Air Force Education and Training Command proposed a new force development paradigm. This proposal consisted of five, initiatives to create agile, resilient, and competent airmen: modularized learning, blended learning, on-command and on-demand learning, competency-based learning, and the Airman's Learning Record (Roberson & Stafford, 2017). These five innovations merge together to create the Air Force Continuum of Learning to fundamentally change how Airmen and developed. From these five lines of effort, Competency-Based Education, CBE, has been widely studied and implemented into a variety of applications. Competencies were not a new concept for the Air Force, having published Air Force Manual 36-2647 on developing institutional competencies. However, following this initiative, the Air Force further progressed CBE by publishing Air Force Handbook 36-2647, which providing guidance on planning and modeling of both institutional and occupational competencies and assigning the Commander of the Air Education and Training Command as the office of primary responsibility for developing competency-modeling policies (Department of the Air Force [DAF], 2022). The Civil Engineer Officer Career field soon took action to develop its own CBE model to enhance force development of the Civil Engineer Officer Corps. The Civil Engineer School, TCES, Staff developed a Civil Engineer Competency Model using data from the 2018 Education Working Group and a Career Field Survey. Independently, Capt Scott Guerin, an Air Force Institute of Technology student studying at the Graduate School of Engineering & Management, developed his CBE model separate from TCES's venture. These two Civil Engineer CGO competency-based learning models were then compared and reconciled in 2020 to create a proposed, combined model comprised of 19 core occupational competencies (Guerin, 2020b).

This undertaking to integrate competency-based learning into Civil Engineer Officer force development and education culminated in the 2020 Civil Engineer Officer Career Field Education and Training Plan, CFETP. This framework outlines identifies seven core occupational competencies for civil engineer officers and illustrates the rank at which varying levels of proficiency should be achieved (DAF, 2020). These seven core competencies are broken down into 20 sub-competencies which are each defined by several descriptors. These descriptors provide context on the knowledge, skills, abilities, and other characteristics, KSAOs, required to achieve proficiency in a given competency. With this adoption of competency-based learning by the Air Force Civil Engineer, or 32E, career field, further efforts have begun to develop a methodology to evaluate course curriculums and to assess how well they develops competencies. Prior research has utilized competency descriptors to relate course work to the competency framework (Lowe, 2022). Through this research, a tool to assess course curriculum was developed but has yet to be applied to the full catalog of TCES's offerings.

## 1.4 Significance of Research

With the dynamic nature of warfare and the global political environment, Air Force and Department of Defense doctrine undergoes continual review and reform to maintain a U.S. military advantage. Doctrinal evolution and change naturally motivate changes in force development. In 2018, the Air Force Civil Engineer officer career field first adopted its competency-based education framework and identified the competencies required of Civil Engineer CGOs (Guerrin, 2020a). While minor changes to verbiage and structure have been made, no major changes are found in the 2020 CE CFETP to the list of core competencies; even though Air Force strategy continues to change, especially with respect to contingency operations. This research incorporated the roles, responsibilities and duties placed upon Civil Engineer CGOs deployed in support of ACE operations. With this information, the knowledge, skills, abilities, and other characteristics, KSAOs, required to operate in an ACE environment were translated into the competency framework as seen in the 32E CFETP and serve as a list of recommended adjustments and additions to the Civil Engineer officer occupational competency model. Additionally, this research identified shortfalls in existing training and education opportunities, which will allow the career field to tailor the development of the CGO corps to meet the requirements of combatant commanders

Additionally, this research presented a methodology for other Air Force career fields to identify new competency requirements during this and future doctrinal shifts in Air Force force generation strategy. The technique used in this research incorporated a wide variety of sources, both military and civilian, and data from informed representatives with multiple Air Force Civil Engineer backgrounds to identify the true competency requirements deriving from a deployment model in which none have yet participated in and for which a clear-cut expert does not exist. The research included a systematic literature review to generate a list of potential ACE and MCA competency requirements for Civil Engineer CGOs. Feedback from a panel of experts was then elicited to refine and validated this list of competency requirements before translating these requirements into a competency framework.

## 1.5 Limitations

There were three primary limitations to this research endeavor. The first being a scope limitation and the final two being data limitations. Details on these limitations are as follows:

1. The scope of this research endeavor was limited to Air Force Civil Engineer Company Grade Officers. While the methodology used in this investigation may be applied to integrate ACE and MCA requirements to other career fields, the findings of this research identify only those requirements specific to Civil Engineer Company Grade Officers. The decision to limit the scope of this research to only CGOs was made due the wide variety of roles and responsibilities CE CGOs are expected to fulfill in support of ACE operations, and the career field's emphasis on the development of junior officers.

2. Both ACE and MCA are relatively new concepts for the Air Force. As these techniques have yet to be employed in an operational environment, there are no Air Force members with operational experience with these concepts. Though installations have conducted exercises and called together working groups for ACE and MCA, each MAJCOM has developed their own strategies and there is no common, widely agreed upon definition of an expert in the field. Consequently, the feedback collected from the Delphi study may not be consistent across all participants as they may have varying levels of experience with the concepts.

3. The results produced by this study's Delphi study have several data limitations deriving from panel member participation. Of the 15 individuals invited to participate in this study, only 11 completed Round 1 of the elicitation. While 10 of these 11 participants also completed the second round of study, only 6 of 10 completed Round 3, exhibiting a sharp increase in participant drop-out. Additionally, two participants in Round 2 submitted only partially completed questionnaires, impacting the amount of panel member data for several prompts. Finally, the panel of experts was unable to achieve consensus on several of the prompts presented to them in Rounds 1 and 2. While this may be due to differing interpretations of the prompt's intended meaning, it may also be due to opposing opinions of the panel members.

## 1.6 Assumptions

Four overarching assumptions were made during data collection and analysis:

1. The panel of experts participating in the Delphi study panel are representative of the career field and fully understand the capabilities and responsibilities of Civil Engineer CGOs.

2. Delphi study participants have a sufficiently strong understanding of ACE and MCA operations and environmental factors to provide accurate data.
3. All Delphi Study participant responses have equal weight in the analysis of the data. Consequently, all experts will have equal say in which skillsets are recommended to be integrated to the Civil Engineer Officer occupational competencies list, regardless of the population of Civil Engineer Officers within the organization they represent. Additionally, this assumption presumes that each expert on the panel has a prevailing opinion on each topic and that the methodology used is capable of capturing.

## 1.7 Organization

In this thesis, 5 chapters are presented, outlining the separate components of this research endeavor. This first chapter introduces the importance of competency-based education in the USAF Civil Engineer officer career field, presents the purpose of this study to integrate emerging requirements into the existing competency framework, explains the significance of this research endeavor, and finally acknowledges several of the critical underlying limitations and assumptions of this research.

In chapter two, a thorough literature review of several topics pertaining to this research will be provided. This literature will first provide context on USAF Civil Engineer Company Grade Officers and their career field's education model. Following, this chapter will define and provide background information on ACE and MCA, establishing vocabulary and concepts used throughout this thesis. In the third and fourth sections, literature on competency-based education and on developing competency frameworks will be explored. Next, this chapter will review several research methods before identifying the method to be used to address the research question. Finally, this chapter will review literature on several organizations external to the air force to serve as references for potential applicable competencies.

In the third chapter, methodologies for the three distinct phases of this research will be discussed. First, details on the comprehensive literature review are presented which identifies knowledge, skills, abilities, and other characteristics applicable to Civil Engineer CGOs in an ACE and MCA environment. Next, this chapter presents the methodology used during the expert elicitation phase to include informed representative selection, information on the data collection instrument, and details on the analysis of the participants' feedback. This chapter then addresses potential sources of bias in the panel member feedback and details the methodology used to measure familiarity bias. The final section of this chapter details the methodology used to compare the competency requirement findings from the expert elicitation to the learning objectives from several training opportunities for Civil Engineer officers to determine if current education and training opportunities can satisfy new ACE and MCA proficiency requirements.

The fourth chapter of this thesis presents the results of the various analyses completed in this research and will detail how the data come together to answer the research question. First, the results of the comprehensive literature review to create a preliminary list of KSAOs will be presented. Next, this chapter will present the consolidated feedback of the Delphi study as well as the validated list of Civil Engineer CGO competencies required for ACE and MCA. In the following section, the results of the expert elicitation comparison with the official Civil Engineer Officer competency framework will be presented. Additionally, within this chapter the Air Force Manpower Analysis Agency's library of Civil Engineer Squadron Manpower Determinants and Standard Work Documents will be briefly investigated to see if they capture any ACE and MCA specific operational requirements. Finally, the closing section of this chapter will deliver the outcome of a thematic analysis comparing the occupational competencies identified in this research and several available Civil Engineer training and education opportunities.

In the final chapter, this thesis will summarize the findings from the expert elicitation, the occupational competency list comparison and the investigation of available education and training opportunities. This chapter will then address the overall research question while acknowledging several additional limitations encountered during the execution of this research. Finally, this thesis will conclude with the presentation of several recommended areas for further research with respect to the Civil Engineer Competency Based Education Model and the ACE and MCA concepts.

# II. Literature Review

## 2.1 Introduction

This chapter serves to review and summarize existing literature relevant to the topics researched in this academic thesis. This chapter will provide an overview of the current knowledge on the topic and identify methodologies to aid an answering the research question while also pointing out any gaps in the research. The first section of this chapter will provide context on the USAF Civil Engineer CGO career field, outline their traditional roles and responsibilities in a contingency environment, and detail the current state of their education and training structure. In section two, the ACE and MCA concepts will be defined and the development of these concepts presented. Section three will define competency-based education and outline the drivers for adopting a competency-based education model, while the fourth section discusses how competency frameworks are developed. The information presented in this section serves as the broad methodology used to address the overall research question. The fifth section discusses several research methods considered for this thesis and provides a further background on the Delphi study technique. Section sixth section will identify and detail several additional career fields which served as external references used to identify performance attributes relevant to CE officers supporting ACE and MCA operations. Finally, the seventh section will discuss two training and education opportunities/requirements for Civil Engineer CGOs relating to ACE and MCA operations.

## 2.2 USAF Civil Engineer Company Grade Officer Context and Education

The core mission for Air Force Civil Engineers is to "build, operate, sustain, modernize and recover enduring and expeditionary installations for the Air Force" (Laviolette, 2020). These installations serve as the power projection platforms for the USAF and her sister services (Burleson, L., 2021). The responsibilities of Air Force Civil Engineers have expanded since their origin as Army Engineers supporting flying operations through the construction of airfields and aviation related facilities in the 1910s (Hartzer & Walker, 2015). Since then, their mission set has expanded to include establishing temporary and permanent air bases to support peace and war-time operations, management and sustainment of stateside and overseas installations including utilities, fire protection, and repair and maintenance, base recovery after attack, natural disaster response and humanitarian aid. Their skillsets have been used at the home station to manage permanent Airforce and Joint installations, and while deployed to establish and sustain air bases in austere environments to support military operations.

In support of these wide-ranging mission capabilities, CE CGOs must be able to: plan, design, and direct construction, maintenance and repair of facilities; lead emergency response forces to recover from attacks, major accidents, and natural disasters; plan and execute mitigation and response efforts to chemical, biological, radiological, nuclear and explosive threats, maintain readiness for CE forces, and lead teams of CE Airmen to support Air Force contingency operations (Air Force Reserve, (n.d.)). These capabilities are honed through the career field's published education and training program. This education and training program relies primarily on the Air Force Institute of Technology's Civil Engineer School, which hosts the WMGT 101 Air Force Civil Engineer Basis course This course provides initial skills development and is mandatory for all CE officers. The school additionally hosts nearly 50 other in-resident and web-enabled courses providing education across a wide variety of CE officer roles within the career field.

Aside from the courses offered by the CE school, additional training is mandated by the Air Force Prime BEEF Program in Air Forge Instruction (AFI) 10-210. This training program details 31 mandatory training requirements for CE officers ranging from general contingency responsibilities, to combat skills training, and command and control training. The program also indicates the training material source for each of the listed requirements. Some are completed via computer-based training modules, while other requirements are completed via lectures facilitated using provided lesson plans. Most notably, this program also requires all Civil Engineer Airmen to routinely complete Silver Flag Training (Department of the Air Force, 2022). Silver Flag is a 10-day training course in which Airmen receive classroom instruction and hands on training to establish, operate, and recover an airbase in a contingency environment (Del Oso, 2021). This course culminates into a two-day capstone event which validates the students' skills through a bare-base beddown, base recovery after attack, and airfield recovery exercise (Sanders, 2021).

## 2.3 Agile Combat Employment and Multi-Capable Airmen

Agile Combat Employment, ACE, is defined in Air Force Doctrine Note 1-21 as "a proactive and reactive operational scheme of maneuver executed within threat timelines to increase survivability while generating combat power throughout the integrated deterrence continuum" (DAF, 2021; DAF, 2021a). This concept has its origins from the 2017 I-WEPTAC, Weapons and Tactics Conference, where hundreds of Air Force service members came together for a two-week conference to plan the future of warfare and provide tactics for joint employment of forces (Aerotech News, 2017). At this forum, one of the several Mission Area Working Groups proposed the development of an innovative combat support wing construct. This wing design would enable the Air Force to rapidly deploy smaller, more efficient teams into contested environments (McClendon, 2022). This recommendation was further backed by the 2018 National Defense strategy in which Secretary of Defense Mattis called for the development of a **lethal**, **agile**, and **resilient** force to confound the Department of Defense's, DoD, competitors (Mattis, 2018). While the call for agility and flexibility in DoD force projection began with the 2018 National Defense Strategy, this demand is echoed in priorities, global operational environment and defense strategies laid out in the latest 2022 National Defense Strategy (Austin, 2022).

This demand for a more lethal, agile, and resilient force was motivated by recent advances by the DoD's adversaries in the fields of reconnaissance and weapons capabilities. These advances put at risk the existing power projection platforms that have traditionally been considered by all to be safe havens (Mulgund, 2021). The US can no longer rely on guaranteed air superiority as its adversaries adopt and implement anti-access/area-denial strategies, creating a contested environment (Deptula & Penney, 2019). This core change in the operational environment has resulted in doctrinal shift in the way the US forces will wage war to maintain military competitiveness. At the DoD level, this change would be implemented as Dynamic Force Employment which calls for combat capable, scalable employments of the joint force (Mattis, 2018). This strategic vision would be operationalized by the USAF component as the Air Force Force Generation Model, AFFORGEN. AFFORGEN is a force presentation model designed to fulfill dynamic operational requirements (Winkelmann, 2022), and ACE is the primary method of fulfilling AFFORGEN and generating combat air power. ACE has since become the subject of focus for many Air Force Leaders and working groups to define what ACE will look like and how it will be operationalized at every level of the Air Force hierarchy.

ACE differs from the traditional rotation deployments experienced by USAF Airmen over the past two decades as doctrine transitions from combatting terrorism to inter-state strategic competition (Mattis, 2018). ACE shifts operations from traditional hardened and centralized installations to a network of many smaller, dispersed locations from which to operate while remaining defensible, sustainable and relocatable (DAF, 2021). In the ACE scheme of maneuver, forces and assets are moved between Main Operating Bases (MOB), Forward Operating Sites (FOS), and Contingency Locations (CL) presenting multiple platforms from which to project air power and complicating adversary planning and targeting. MOBs are installations located outside of the US with permanently stationed operating forces and robust infrastructure. These locations have hardened facilities, robust Command and Control (C2) infrastructure, and developed force protection measures. FOSs are locations outside of the US intended for rotational use staging pre-positioned forces, equipment and supplies, and for supporting regional contingencies. These locations generally contain US-owned property and a small permanent presence of support personnel. Finally, CLs are non-enduring locations stood up to support operations during contingencies. These sites are not enduring locations and are designed to be temporary having little, if any, existing infrastructure or facilities (DAF, 2020a). A map of the flow of resources from MOBs, to FOSs, to CLs is available if Figure 1. In this flow chart, we observe that a single MOB supports several FOSs, which in turn can support several CLs from which air-domain operations are generated. In these operations, depicted by the grey lines, aircraft depart CLs and can travel to various mission areas, choosing to return to their origin, a different CL, or to a larger FOS depending on mission requirements.

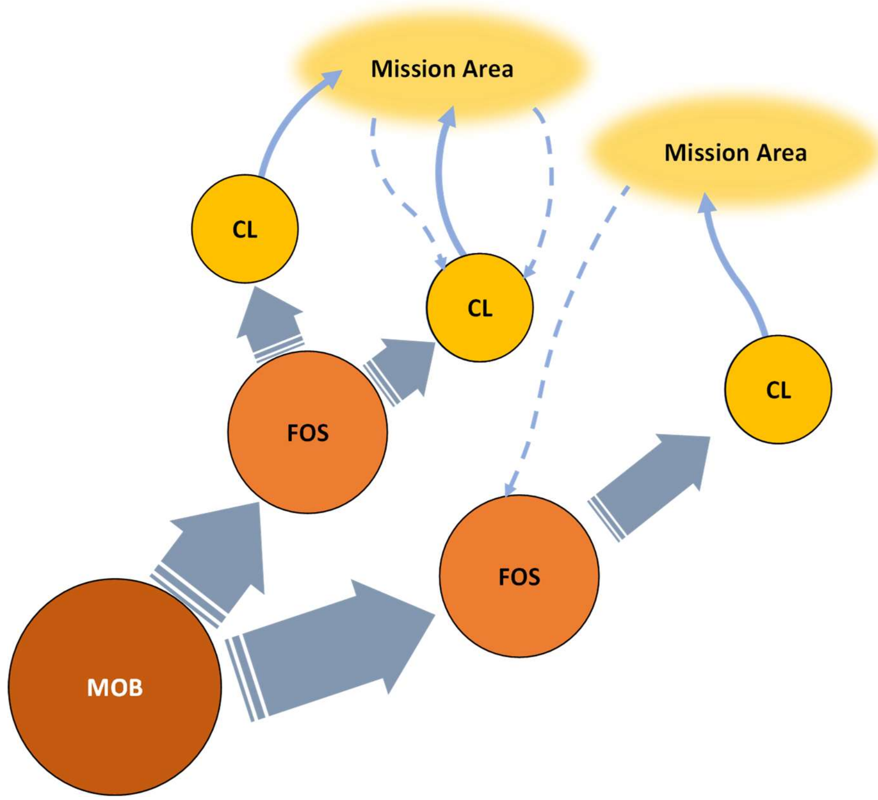



*Figure 1: ACE is an operational scheme of maneuver executed within threat timelines to increase resiliency and survivability. Typically, assets and airmen are positioned at dispersed operating locations with central command and control occurring at a Main Operating Base and aircraft generation occurring at non-enduring contingency locations. This force presentation model is enabled by MCA and scalable force packages.*

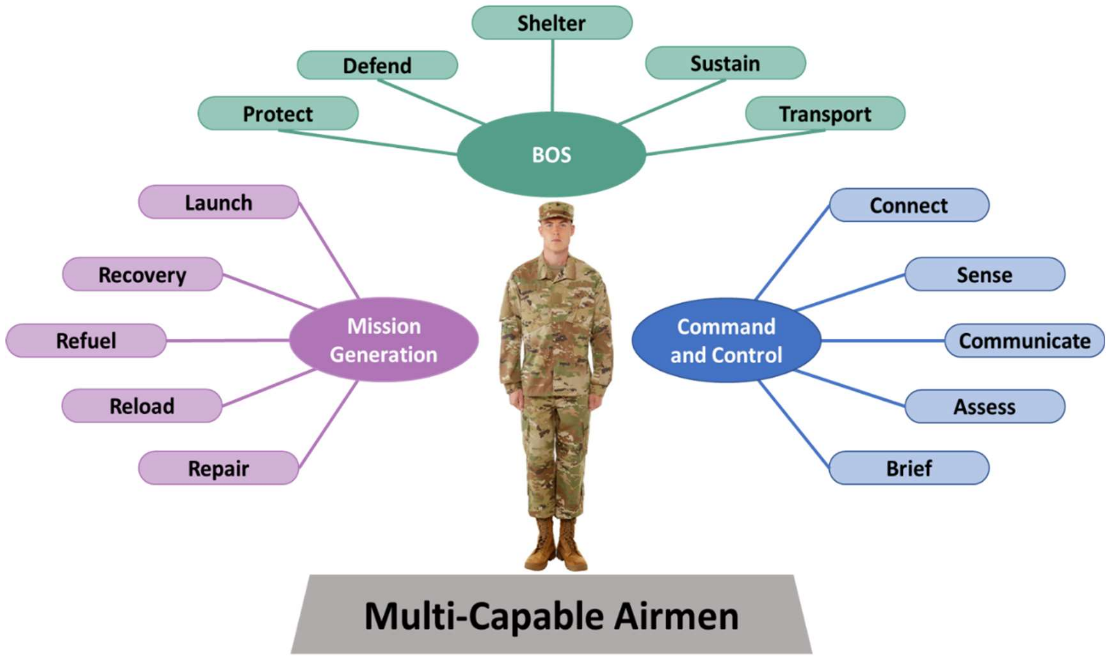
In addition to bringing about change to how the Air Force generates air power and deploys forces in contingency environments, this force generation model also introduces a new concept that quickly became the focus of many committees, working groups and publications: the Multi-capable Airman, MCA. Air Force leaders have defined MCA in the Air Force Agility Common Lexicon as:

> *Airmen capable of accomplishing tasks outside of their core Air Force Specialty. Specifically, these personnel are often trained as a cross-functional team to provide combat support and combat service support to ACE force elements. They are enabled by cross-utilization training and can operate independently in an expeditionary environment to accomplish mission objectives within acceptable levels of risk. (DAF, 2020a; DAF 2021)*

These MCA have diverse foundational and expeditionary skills enabling them to operate in contested environments with minimal support (DAF, 2021). Additionally, they are trained to accomplish complementary tasks outside of their traditional duties, allowing for smaller teams to be deployed into degraded environments while still maintaining mission capabilities with minimal support (Knight, 2021). These small teams of specialized Airmen deliver the flexibility and leanness required by the ACE model. By enabling airmen to accomplish a wider range of tasks, the number of troops required to be positioned at non-enduring locations can be dramatically reduced to several dozen airmen as opposed to several hundred traditionally-scoped personnel required to operate and sustain an enduring air base in the legacy force generation model (Winkelmann, 2022).

Several competency requirements must be met in order for airmen to be considered multi-capable ready. First, they must satisfy AFSC specific training and education requirements. Additionally, they must meet theater-specific requirements (USAF Expeditionary Center, 2021). In integrating ACE and MCA requirements into the Civil Engineer Officer competency list, this research excludes theater specific requirements due to their sensitive nature and to ensure the resulting competency list remains applicable to all Civil Engineer CGOs. AFSC-specific requirements intend to identify complimentary tasks and responsibilities of multiple career fields and enabling the airmen of each of those singular career fields to accomplish all of the complimentary tasks, even those outside the traditional scope of their primary AFSC. This enables the ACE mission by requiring fewer airmen to accomplish mission objectives with acceptable levels of risk (DAF, 2020a). Additionally, having individuals capable of accomplishing tasks other than their traditional AFSC duties build resilience into the ACE mission by enabling operations to continue in the event of personnel attrition.

AFSC-specific training and education requirements are separated into three skill-sets: Mission Generation (MG), Command and Control (C2), and Base Operations Support (BOS), as displayed in Figure 2. Each of these three categories includes several broad mission capabilities that the airmen assigned to those categories will be able to support. As of the writing of this thesis, AFSC-specific requirements are in continuous development as MAJCOMS develop their own ACE concepts of employment and only the education and training programs for AFSCs associated with the MG category have been developed by Headquarters Air Force, HAF (USAF Expeditionary Center, 2021). Consequently, this research intends to identify where the Civil Engineer CGO career field fits into the established MCA training and education structure and integrate these requirements into the CE officer occupational competency framework.




Adapted from USAF Expeditionary Center, 2021

*Figure 2: Multi-Capable Airmen are deliberately selected airmen specifically trained to deliver Mission Generation (MG), Command & Control (C2) and Base Operating Support (BOS) capabilities. MCA are trained to accomplish mission capabilities within their respective function as well as provide support to the other categories.*

The hierarchy of locations in which personnel are stationed creates a wide range in environmental conditions that personnel will have to endure as well as a variety of roles, responsibilities, and duties to which they will have to fulfill. Additionally, the ACE and MCA concepts of employment do not prescribe every airman to be multi-capable (USAF Expeditionary Center, 2021). Instead, only deliberately selected groups designated to accomplish specific mission capabilities at forward locations, FOS and CL, are intended to be developed as MCA. Consequently, identifying the tasks and activities that individual career fields will be most likely to accomplish is complex. This research considers the roles and responsibilities of Civil Engineer CGOs operating at FOS and CL locations to identify the tasks required of them that are outside of their traditional scope of responsibility, and additionally examines the implications of Civil Engineer CGOs leading airmen from other AFSCs.

## 2.4 Competency Based Education

Competency based education, CBE, is an outcome-based approach to education designed to evaluate a student's mastery of learning objectives through demonstration of knowledge, skill, attitudes/attributes, and other behaviors/characteristics, also known as KSAOs (Gervais, 2016). Working definitions for knowledge, skill, ability, and other characteristics were adopted from a study contracted out by the Air Force Institute of Technology to gather knowledge on authoring competency frameworks for various AFSCs (Robson et. al., 2020). These component definitions are found in Table 1 along with criteria their measurement and assessment. CBE is also referred to as proficiency-based learning, standards-based learning, and mastery-based learning (Torres, Brett, & Cox, 2015). Additionally, the Department of Defense also frequently utilizes the term Competency Based Learning as it better acknowledges military training as a separate endeavor than education in building proficiency (Smith, Hernandez, & Gordon, 2018). This model bases student advancement on their mastery of a set of clearly defined competencies (Patrick, 2021; Albanese et. al., 2008), and provides a common language and understanding of the types of behaviors necessary to ensure successful task performance.

The Air Force has formally defined a competency as an "observable, measurable pattern of knowledge, skills, abilities, behaviors and other characteristics needed to perform institutional or occupational functions successfully" (DAF, 2022b). From these several definitions, it is recognized that CBE is a learning approach in which students are assessed on their mastery of these competencies as opposed to learning objectives, and these competencies being assessed are collections of KSAOs required to accomplish tasks and duties. Additionally, these competencies can be foundational or occupational in nature.

**Table 1: KSAO Working Definitions**

| | |
|---|---|
| **Knowledge** | Facts, principles and beliefs expressed as declarative statements through communication |
| **Skill** | The capacity to effectively apply knowledge and abilities to perform a physical or mental task |
| **Ability** | The capacity to perform a task or a set of tasks |
| **Other Characteristic** | Aptitudes, attitudes, self-confidence, interests, inclinations and more. Characteristics come naturally to individuals and manifest themselves in measurable behaviors. |

Adapted from Robson et. al. (2020)

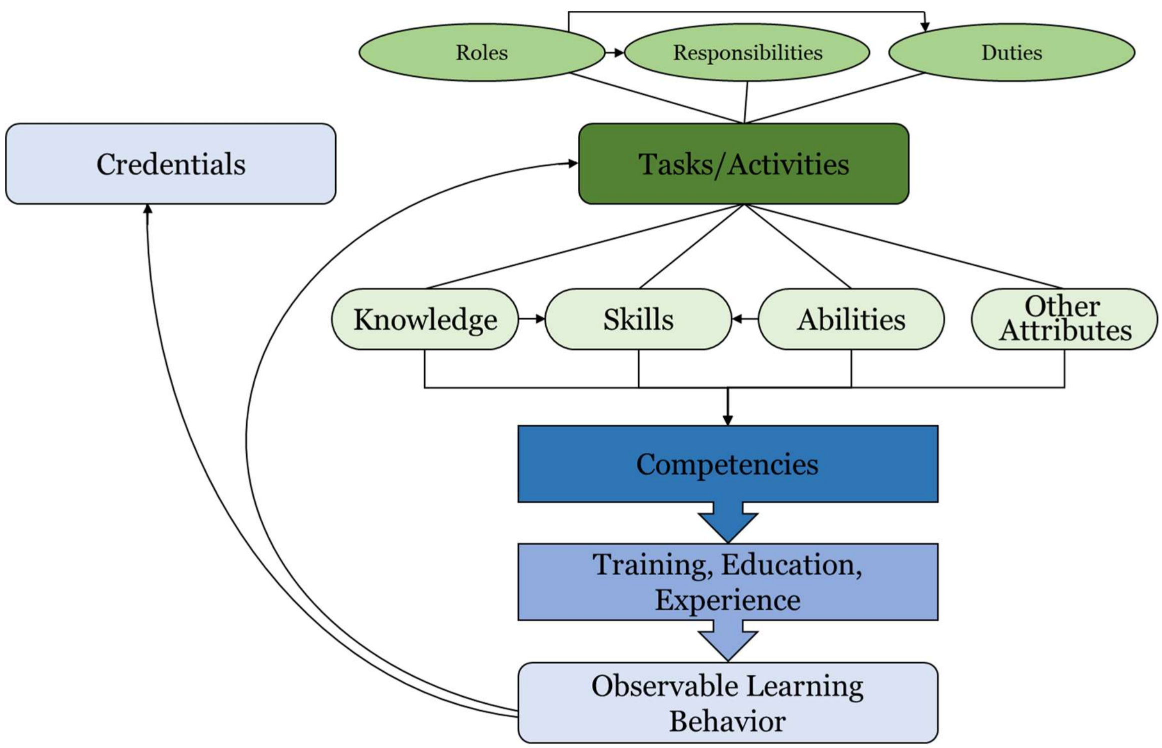
Foundational competencies, previously known as institutional competencies, are those clusters of KSAOs required of all personnel within an institution. These foundational competencies normally consist of concepts such as accountability, teamwork, digital literacy, and resource management. In the case of the USAF, foundational competencies are universally applicable to all Airmen (Officer, Enlisted, and Civilian). These are the core of Airmen development and prepare airmen to operate successfully across the widest array of USAF tasks and requirements (DAF, 2022b). Occupational competencies are those that are associated with a particular function or career field. These competencies describe the KSAOs required by an individual to successful execute a function, role, task or duty specific to a designated career field. For USAF Civil Engineer officers, occupational competencies are those attributes that individuals in the career field possess to successfully deliver engineer capabilities in support of Air Force operational needs (DAF, 2020b).

In addition to identifying the KSAOs required to successfully perform one's tasks and duties, CBE frameworks must also specifically state levels of performance students are expected to master across the curriculum (Gervais, 2016). By assessing the students' levels of proficiency in an operational environment, CBE distinguishes itself from a traditional education model which assesses student outcomes in a purely educational or training environments (Robson et. el., 2020). Proficiency is assessed through student application of the required KSAOs and the required level of proficiency is identified by key performance indicators established during the creation of the competency. These performance indicators should be tied to mission objectives, requiring input from higher level leaders who are well informed on the strategic vision of the institution (Smith, Hernandez, & Gordon, 2018).

Collections of competencies that define successful performance in different roles at different levels throughout the organization are referred to as competency frameworks (Smith, Hernandez, & Gordon, 2018). These frameworks compile competencies into separate categories tying to broad roles or responsibilities within the organization. Additionally, competencies are broken down into subcompetencies and descriptors. These sub-competencies and descriptors provide specific context to each of the competencies and use transparent descriptive language to define the competency and the KSAOs applied (DAF, 2020b; Robson et. al., 2020; DAF, 2022b). Competency frameworks often also indicate multiple proficiency levels for each competency (Smith, Hernandez, & Gordon, 2018). This is observed in the USAF's Foundational Competency framework in which each Airmen competency has Basic, Intermediate, Advanced, and Expert levels of proficiency (DAF, 2022b). This method of framework development allows for individuals to continually self-assess their level of proficiency within each competency and to identify the required KSAOs that they need to further develop to become fully competent in their duties.

## 2.5 Developing Competency Frameworks

Competency based frameworks consist of collections of competencies, which themselves are observable patterns of KSAOs required to successfully perform job related tasks (Department of Defense (DoD), 2016). Several studies have been done to map the process of authoring competencies to create competency frameworks, but in essence, Four tasks are required: identifying the roles, responsibilities, and duties that the students will fulfill, determining the tasks and activities the students will be expected to accomplish in the fulfillment of these roles, deriving the KSAOs required to successfully accomplish those tasks and activities, and finally compiling those KSAO requirements into occupational competencies. These four steps are taken from a larger competency development process map as seen in Figure 3. This larger process map additionally outlines the process of gaining proficiency in competencies through training education and experience, displaying observable learning behavior and ultimately earning credentials and certification proving a mastery of the subject. Finally, these observable learning behaviors lead to improved performance in the tasks and activities performed by the students.




Adapted from Robson et. al. (2020)

*Figure 3: Competency Development Framework. A student's role define both their responsibilities and their duties, which in turn define the tasks and activities they will be expected to perform. These activities are broken down into distinct KSAOs which, together, define a competency. Proficiency in these competencies is achieved through training, education, and experience, which leads to improvements in the student's observed behavior. This develops a mastery of the student's tasks and activities and ideally leads to certification or credentials confirming the student's mastery of the subject.*

To author these competencies, data must be collected from the organization to identify requirements. This data is often initially collected via an examination of available academic and institutional documents reviewing policy, job analysis, and mission objectives (Davies et. al., 2021a; Davies et. al., 2021b). In addition to systematic literature review to competency frameworks, many researchers assert that competencies must be developed based on feedback and contributions from all stakeholders involved with in the profession (Clark, 1976; Johnstone & Soares, 2014; O'Connell & Moomaw, 1975). Additionally, as the needs of the profession change, so too should preparation for the profession. Thus, experts and professionals from the career field should be utilized to inform the curriculum (Gervais, 2016). The continual change in career field objectives warrants an iterative process of soliciting stakeholder feedback to further develop the competency model.

## 2.6 Research Method Selection

Four research methods were explored to serve as a means of validating the KSAOs to be integrated into the Civil Engineer officer core competencies. These were one-on-one interviews, observation, group discussions/focus groups, and the Delphi method (Ainslie et. al., 2015). One-on-one interviews was not selected to be the validation methodology used in this research due to the nature of the feedback requested of the participants providing data. The intent of this phase of research was to collect quantitative feedback on preidentified KSAOs, while the interview methodology is more attuned to eliciting open-ended, qualitative feedback from the participants. Observational research as the primary data collection method was also dismissed due to the recentness of the roll-out of the ACE and MCA models. As Air Force units have not yet participated in rotational ACE operations enabled by MCA, there are not yet any opportunities to observe how these operations will truly transpire and collect data.

The group discussion technique was also investigated as potential quantitative data collection technique. This very popular form of data collection allows a panel of participants to explore ideas, ask questions, and develop solutions for a particular focus or topic (Pope & Mays, 2020). This methodology was not selected as the technique to collect data from the CE career field for two reasons. First, due to the limited number of individuals who could be defined as experts in both Civil Engineer officers and ACE, scheduling conflicts would arise in attempting to coordinate these panel members to participate in a group setting for a prolonged period of time. Second, this technique was not adopted in order maintain anonymity for the panel members. Focus groups can suffer from domineering personalities, unwillingness to abandon position, and fear of introducing ideas which could result in a loss of face (Von der Gracht, 2012). As all the members participating in this data collection belong to the same career field, there is potential for participants to feel pressure to conform with the ideas and intentions of their peers.

The Delphi method was ultimately selected as the data collection technique due to a number of factors. First, this methodology allows for the researcher to establish a set criterion to define experts in the field of study and to collect data from them in a controlled manner (Von der Gracht, 2012). This technique also maintains anonymity of the panel members. This avoids confrontations common among other consensus techniques and can prevent hasty consensus due to preconceived notions, close mindedness, and persuasion (Fink et. al., 1984). The Delphi method also provided the panel members the freedom to provide feedback at their own time. This eliminated scheduling conflicts commonly experienced with interviews and group discussion.

## 2.7 External Career Field References

In the initial phase of this research, USAF and academic literature was reviewed to identify KSAO requirements that may be applicable to Civil Engineer CGOs operating in an ACE and MCA environment. In addition to observing how Air Force Civil Engineer officers interact directly with the ACE and MCA models, two additional references external to the USAF were used to elicit more potential KSAOs: the U.S. Army's Multi-Skilled Solder, MSS; and civilian organizations' multi-functional team leader.

### 2.7.1 Multi-Skilled Soldier

In Spring of 2001, U.S. Army Research Institute began exploring the concept of MSS and address the meaning and implementation strategy of this emerging topic (Nelson & Akman, 2002). This concept was motivated by the need for an operational force with increased overall skill depth and redundancy to improve the overall capabilities of smaller units. A two-part study was initiated to develop a definition for and implementation strategy for the MSS model (Nelson & Chirico, 2003). The Army characterizes their MSS as an adaptive "soldier who can competently perform additional tasks beyond those traditionally defined by their [Military Occupational Specialty]" (Nelson & Akman, 2002). The purpose of this model is to give soldiers the ability to be self-reliant, flexible and adaptable to multiple mission sets, which is analogous to the Air Force's motivation for exploring the concept of MCA.

The two-part study completed to investigate the MSS model voiced several categories of skillsets common of MSS. These skillsets arise from the need to adapt to dynamic environments and operating with personnel from various functional backgrounds. Nelson and Akman (2002) specifically call out the importance of complex problem-solving skills for MSS to promote adaptability. Additionally, the report also highlights the importance of MSS receiving the education and training needed to perform tasks and responsibilities adjacent to their own career fields. Additionally, the second phase of the report identified many expeditionary and combat related skills required for MSS to effectively perform their responsibilities. These skills and abilities included advanced weapon skills, combat casualty care/first aid abilities, vehicle operations abilities, and chemical, biological, nuclear survival skills (Nelson & Chirico, 2003). The skillsets and abilities identified in these reports as crucial to MSS capabilities were incorporated into this research as potential KSAOs applicable to Civil Engineer CGOs operating within the ACE and MCA model.

### 2.7.2 Civilian Multi-Functional Team Leaders

Corporations have promoted cross-functional teams as a means to promote agility and increase the ability of their work force for decades (Parker, 2003; McLaughlin & Ziskin, 2016). These cross-functional teams are also referred to as Multifunctional teams, cross-organizational teams, and cross-trained teams (Allal-Chérif, Guijarro-Garcia, & Ulrich, 2022; Slomp, & Molleman, 2010; McLaughlin & Ziskin, 2016). Cross-functional teams and cross-trained employees have been so advantageous to some industries, that their organizations now view them as more valuable than teams of specialists (Salem & Abdien, 2017). This research assumes that these multi-functional teams will operate similarly to teams of MCA operating in an ACE environment. Both models feature individuals performing jobs outside of their primary duties and operating with coworkers from various functional backgrounds (Volpe, Cannon-Bowers, & Salas, 1996; DAF, 2021). With this understanding, the skillsets of civilian multi-functional team leaders were assumed to be comparable to those of Civil Engineer CGOs leading teams of multi-capable airmen within the ACE model.

A review of academic literature covering the knowledge and skill requirements of multi-functional team leaders revealed a wide variety of skillsets potentially applicable for CE officers operating with MCA. Similar to the reports on the MSS concept, literature on multi-functional team leaders also call out the importance of mental agility and complex problem solving (Clardy, Sarkani, & Mazzuchi, 2017). This branch of literature also identified cross-functional communication skills as critical to leaders of multi-functional teams (Mohsen & Eng, 2016; Carter, Dechurch & Zaccaro, 2014; Allal-Cherif, Guijarro-Garcia & Ulrich, 2022; Cannon-Bowers et. al., 1998).

Another concept observed in a majority of the referenced reviewed was skill-chaining. Skill chaining is characterized by workers being competent in their primary work station as well as the few stations succeeding it (Olivella & Nembhard, 2015). This strategy enables team members to be skilled in their own tasks and duties as well as the responsibilities of their fellow team members, which leads to improved inter-functional coordination, better resource anticipation, and the ability to allocate workers between workstations to level workloads and more effectively use time (Cannon-Bowers et. al, 1998; Slomp & Molleman, 2010). For this research, skill-chaining for Civil Engineer CGOs in the context of ACE is assumed to be competence in the functions adjacent to Civil Engineering. These complementary functions are those participating in BOS: Civil Engineering, Force Support, Logistics Readiness, and Security Forces. These functions also make up four of the six traditional squadrons within the Mission Support Group structure found in traditional USAF Wings: Civil Engineer Squadron, Communications Squadron, Contracting Squadron, Force Support Squadron, Logistics Readiness Squadron, and the Security Forces Squadron. The concept of skill-chaining was used as a basis for several of the KSAOs identified in the early stages of this research.

## 2.8 Civil Engineer Officer Training and Education Opportunities

Air Force Civil Engineers have a variety of training requirements and opportunities ranging from Combat Skills, Command and Control, Expeditionary Skills, and base recovery training (DAF, 2022a). In this investigation, two programs were reviewed: Air Force Instruction (AFI) 10-210, Prime Base Engineer Emergency Force (BEEF) Program; and the USAF Expeditionary Operations School's Multi-Capable Airmen Expeditionary Skill Training Course. The Prime BEEF training program describes lists the mandatory training requirements for all Civil Engineer personnel as well as the frequency that these requirements must be met. With each of these requirements, the document also specifies the training material source. These training materials typically consist of provided lesson plans, virtual learning courses, and hands on training events (DAF, 2022a). These course requirements are managed at the unit level by Prime BEEF managers.

The Tier 1 Multi-Capable Airmen Expeditionary Skills Training course offered by the USAF Expeditionary Operations School is targeted for any airmen identified as Agile Combat Employment multi-capable team members (USAF Expeditionary Center, 2021). This course is instructor led with lectures, hands-on training, and exercise scenarios. The lessons in this course teach the ACE and MCA concept of operations, communications and weapon skills, and air base planning and beddown. This course is not a HAF directed training requirement for Civil Engineer officers but is outlined within the published MCA training program for ACE and is applicable to all Airmen assigned to execute ACE operations (USAF Expeditionary Center, 2021).

# III. Methodology

This chapter details two data collection methodologies used in this research. Additionally, it lays out how the data from each technique was interpreted. This chapter is organized into two sections, denoting the two data collection methods: a systematic literature review section, and an expert elicitation section. In this investigation, the findings from the systematic literature review were used to develop the questionnaires presented to the panel members during the expert elicitation phase. In this manner, the literature review was used to create an extensive list of potential ACE and MCA competency requirements while the expert elicitation was used to quantify and validate these requirements.

Section 3.1 provides details on this study's systematic literature review and defines the purpose for this section as well as describes of the types of literature referenced in this review. This section also details how data from the body of literature were extracted using a thematic analysis. The following section, 3.2, outlines the purpose for the Delphi study, the Institutional Review Board process for study, and the participant selection procedure. This section then details the administration of this expert elicitation, and the development and analysis of each round of Delphi. Finally, this section addresses potential bias within the Delphi panel members and details the document analysis technique used to compare the findings of the Delphi study with training opportunities available to Civil Engineer CGOs and determine if potential new competency requirements can be satisfied with existing courses.

## 3.1 Systematic Literature Review:

### 3.1.1 Aim:

The purpose of this literature review is to explore the existing body of knowledge on topics relating to ACE and MCA and to identify the potential knowledge, skill, ability, and other characteristic, KSAO, requirements associated with Civil Engineer CGOs operating an ACE and MCA environment. The outcome of this review is a preliminary list of applicable KSAOs to later be validated, amended and codified into the occupational competencies needed for Civil Engineer CGOs to perform ACE and MCA operations successfully.

### 3.1.2 Characteristics of Literature Selected:

As this topic is relatively new and has little existing literature specifically covering the cross-section of Civil Engineer CGOs and ACE/MCA, literature covering at least one of these three aspects was selected, resulting in a document set deriving from a variety of sources. Each of these documents were then binned into five broad categories: 1) guidance/publications from the Department of the Air Force on ACE or MCA, 2) academic journal articles covering military officer competencies in contingency environments and articles on the U.S. Army's Multi-Skilled Soldier concept, 3) academic journal articles discussing skills and competencies relating to leading multi-functional teams and cross-functional training, 4) news and magazine articles reporting on ACE exercises and MCA training, and 5) other Air Force documentation related to ACE, MCA, or Civil Engineer Officer responsibilities, including white papers, memorandums, task lists, and briefings. It is anticipated that these documents will contain information on the environmental and operational factors associated with ACE and MCA and will identify the roles, responsibilities, and duties that Civil Engineer CGOs will be likely to fulfill in support of ACE.

### 3.1.3 Document Data Extraction:

In their chapter on identifying methods for literature reviews, Paré & Kitsiou (2017) provide an overview of the major steps and activities involved in conducting a literature review, as well as common examples on various types of literature review. Three key tasks from the general literature review framework were identified that must be accomplished when executing the literature review: assess quality, extract data, and analyze data (Templier & Paré, 2015). To accomplish these literature review tasks, two techniques were considered: close reading, which was not selected because it is generally more applicable for interpreting literary elements such as tone, imagery and literary devices (Kain, 1998; McClennen, 2001), and document analysis, also commonly referred to as thematic analysis. This type of analysis provides a systematic procedure to elicit meaning, gain understanding and develop empirical knowledge from printed and electronic documents (Corbin & Strauss, 2008).

Data extraction in document or thematic analysis involves combining and cataloguing patterns into themes. These themes are defined as units deriving from patterns in "conversation topics, vocabulary, recurring activities, meanings, feelings, or folk sayings and proverbs" (Taylor & Bogdan, 1984, p.131). These themes identify the various fragments of ideas and components to form a comprehensive picture of the author/publisher's argument or intent (Aronson, 1995).

Document analysis relies on the researcher's intuition and skills to filter information through an interpretive lens (Bowen, 2009). To complete the first task of assessing the quality of the data, the document analysis takes two approaches. First, the researcher must determine relevance of the source. This was accomplished by noting the publisher/reporter of the document and considering their authenticity, credibility, accuracy, and representativeness (Bowen, 2009).

The second metric used for assessing the quality of the data is the completeness of the document; based on whether the content of the document is comprehensive (covering the topic broadly), or selective (covering only some aspects). In addition to noting the completeness of each document reviewed, care was also given to ensure that the document set is also balanced in that it does not contain great detail on some aspects while others have little detail. For this research, the referred to aspects are ACE, MCA, and Civil Engineer CGOs. A comprehensive document will detail the overlap between the three, in other words, describe how Civil Engineer CGOs will perform during ACE operations with MCA. A selective document will provide information on only one or two of these specified aspects. To provide a balanced data set, the documents reviewed will evenly cover each of the aspects.

An iterative approach was taken to extract patterns and themes from the reviewed literature. During the first pass, the literature was skimmed through, paying special attention to abstracts, subheadings, and figures/tables. This first pass was used to identify which aspect of the research this document applied to (ACE, MCA, or Civil Engineer CGOs), and to identify broader topics. The second pass through the literature was completed to identify common vocabulary and technical terms used through the various documents and begin to establish patterns in topics sub-themes. Finally, in the third pass through the literature, the documents were carefully reread to identify concepts, ideas, and themes emerging from multiple sources. The result of this iterative approach is a qualitative data set in the form of a list of common themes and key terms associated with each of the three aspects. The concepts found in this list were then expanded upon and rewritten as KSAOs. These resulting KSAOs combine into a list of potential requirements for Civil Engineer CGOs supporting ACE operations enabled by the MCA model.

## 3.2 Delphi Study:

### 3.2.1 Aim:

The aim of this expert elicitation was to corroborate and substantiate the applicable KSAOs identified during the systematic literature phase. This Delphi study sought to measure the level of expert consensus on the competency requirements of Civil Engineer CGOs pertaining to ACE and MCA. Additionally, this methodology will collect input on the extent to which these competencies are essential for Civil Engineer CGOs to effectively operate.

### 3.2.2 Ethics Approval:

Prior to inviting panel members to participate in this Delphi study, an Institutional Review Board (IRB) package was submitted to the Air Force Institute of Technology Human Resources Protection Program Office. Their determination was that the data collected through this expert elicitation was recorded in such a manner that the identities of the human subjects cannot be readily ascertained and that any disclosure of the human subjects' responses outside of this research would not readily place them at risk of criminal or civil liability and would not be damaging to their financial standing, employability, or reputation.

### 3.2.3 Participant Selection:

Because the ACE and MCA models are newly emerging and have yet to be employed operationally, defining true experts on the interaction between Civil Engineering and ACE/MCA has subjective elements. On top of that, these two concepts were developed with a special focus on Air Force Operations and Maintenance functions and emphasis how Mission Support personnel (i.e., Civil Engineering, Communications, Contracting, Force Support, Logistics Readiness, and Security Forces) would play a role. With the lack of technical experts on Civil Engineer CGO operations in an ACE and MCA environment, informed advocates were sought out as opposed to clear-cut, commonly accepted experts. This leads to this expert elicitation taking on characteristics of a policy Delphi. As argued by Manley (2013), the policy Delphi is intended for addressing issues in when there are no clear-cut experts, only informed advocates and referees. Moving forward in this thesis, the terms expert and informed advocate will be used interchangeably as technical experts in this field of study are difficult to defined and identify.

In order to generate a representative group of informed advocates, the panel was made up of members at a level of leadership where they understood the Air Force's strategic level of vision. Additionally, because the Air Force fulfills a variety of distinct functions in several different operational theaters, many of these distinct functions and environments were represented by the panel of advocates. One characteristic of the Policy Delphi is the lack of homogeny in the expert panel, intending to generate opposing views, and that any consensus that does form is purely coincidental (Manley, 2013). However, this is where this methodology diverges from a typical policy Delphi. While this research seeks to elicit a wide range of perspectives and opinions on the ACE and MCA competency requirements of Civil Engineer CGOs, it maintains the intent to achieve consensus from the representatives on the requirements. Accordingly, to form a panel of experts to elicit these opposing views, the Air Force Civil Engineer career field was broken down into several groups, each serving in a different operational environment or providing a specific mission capability. To design this Delphi panel, first these groups, or strata, were defined and then a common definition of an expert across these varying operational environments and mission capabilities was established.

This organizational representation break-out was achieved through employment of the stratified purposive sampling technique as recommended by Hasson, Keeney & McKenna (2000). The Air Force Civil Engineer population was broken down into strata as defined by the nine USAF Major Commands, MAJCOMs, which consist of Air Combat Command (ACC), Air Education and Training Command (AETC), Air Force Global Strike Command (AFGSC), Air Force Materiel Command (AFMC), Air Force Reserve Command (AFRC), Air Force Special Operations Command (AFSOC), Air Mobility Command (AMC), Pacific Air Forces (PACAF), and United States Air Forces in Europe – Air Forces Africa (USAFE-AFAFRICA). Additionally, two other groups with specific missions which were not represented by a MAJCOM: the Air National Guard and REDHORSE, were selected to be additional strata. These 11 groups together encompassed all of the various units from which Civil Engineer CGO manpower may be pulled from in support of ACE Operations, and make up the strata from which the experts will be sampled.

To ensure that expert representatives were invited to participate, several criteria were adopted to select the individuals in each of these organizations who could incorporate both strategic Air Force vision and their understanding of individual unit capabilities to provide feedback on Civil Engineer CGO occupational competencies with respect to ACE and MCA operations. Firstly, these individuals must, at a minimum, be Field Grade Officers or civilian equivalent in the Air Force Civil Engineer career field. Second, the experts must preside over three or more geographically separated civil engineer units. Finally, the individuals suitable for this panel of experts must have been attendees of the Air Force Civil Engineer Readiness Working Group, RWG. The Civil Engineer RWG is one component of the annual CE Board in which senior leaders from the CE career field come together to brief readiness updates, communicate strategy and challenges, and vote on policy changes to present for approval and execution. The RWG is chaired by three USAF Colonels and has a voting body comprised of senior leaders from each of the various backgrounds in Air Force Civil Engineer Career Field (HQ USAF/A4CX, 2022).

With the established criteria and strata, 11 panel members were selected to participate from the Air Force Civil Engineer Center who had attended at least one Readiness Working Group summit, representing: ACC, AETC, AFGSC, AFMC, AFRC, AFSOC, AMC, PACAF, USAFE-AFAFRICA, REDHORSE, and ANG Civil Engineers. These individuals, who are "responsible for providing responsive, flexible full-spectrum installation engineering services" (Air Force Civil Engineer Center, 2022), are senior civil engineer leaders and oversee civil engineer operations and readiness activities from multiple squadrons within their respective organizations, ensuring they have the experience and strategic vision necessary to be considered an expert for this information elicitation. During solicitation of these 11 panel members, they were given the opportunity to recommend additional representatives to participate in the study. These additional participants were all recommended due to their experience with ACE and MCA through extensive involvement in working groups defining these concepts or through participation in multiple ACE and MCA exercises. The Civil Engineer Officer Career Field Manager was also invited to participate in this Delphi due to his expertise in CGO capabilities and his strategic understanding of their role within the overall Air Force structure.

The methodology used in this Delphi study echoes the Glaser Approach (Fink et al. 1984). This approach derived from the medical field and was first implemented to detail the current state of knowledge on Chronic Obstructive Pulmonary Disease. The Glaser technique consists of a small "core" group of representatives to participate in the study. These individuals then nominate additional members to take part in the study due to their prominence in the field of research. While this approach has not been evaluated outside of the medical field, it heavily influenced the decision to request the identified representatives nominate additional participants that they deem are experts in implementing ACE and MCA take part in the study.

Though there is no consensus on the optimal number of experts to be included in a panel to build sufficient prediction accuracy, several studies have been conducted to find an appropriate number. These studies observe diminishing returns of consulting additional experts (Clemen and Winkler, 1985) with some even asserting that much of the improvements in forecasting ability are achieved in the first two or three experts (Libby & Blashfield, 1978). Traditionally, literature on Delphi studies recommend a panel of 10 to 20 experts in conducting qualitative research (Birko et al., 2015)(Dalkey & Helmer, 1963)(Crisp et al., 1997)(Fiander & Burns, 1998). This recommendation is further supported by Clemen (1989), whose findings concluded that between 6 and 20 forecasters should be consulted with the caveat that the more the experts differed, the greater the number of experts that should be consulted.

This selection technique resulted in a total of 15 experts invited to participate in this study: 11 members initially identified to represent each of the MAJCOMs, the Air National Guard and REDHORSE; the Civil Engineer Officer career field manager; and 3 additional participants nominated by original panel members. This puts the panel size within the traditionally recommended range. While a larger number of representatives will obviously generate more data, it also leads to issues in data handling and analysis difficulties (Hasson et al., 2000). The law of diminishing return also applies as the number of participants increases. For this reason, a moderate sample size of 15 was selected to represent the broad USAF Civil Engineer background and generate sufficient data to observe trends, while also being of manageable size. While the experts identified to participate in this study represent a wide range of Air Force mission sets, their level of agreement in their responses was expected to be strong. These experts have relatively similar background and levels of experience in the Civil Engineer career field, which was expected to result strong agreement in their responses. Variance in their feedback was expected to result from differing opinions on a Civil Engineer CGO's positions and responsibilities within the ACE construct, and in differing interpretations of operational theater considerations. These variations in perceptions and beliefs are a result of each MAJCOM developing their own ACE implementation strategy and there being no Civil Engineer career field specific guidance on ACE and MCA.

### 3.2.4 Expert Elicitation Administration:

This Delphi Study consisted of three rounds of expert elicitation. In Round 1, requests for participation were sent to individuals meeting the established criteria via Air Force e-mail and included an attached questionnaire along with a set of instructions on how to provide feedback. This questionnaire facilitated standardized feedback and enabled a statistical analysis on their responses. For each round of elicitation, panel members were given 7 business days to complete and return the questionnaire and it was encouraged that participants reach out to the investigator with clarifying questions via electronic correspondence. Additionally, the day after responses were due, e-mails were sent to any participants who had not yet returned their questionnaires as a reminder and last call to provide their feedback. After the first round of questionnaires were received, two weeks were set aside before issuing the request to participate in Round 2 and again in Round 3. This break was budgeted to allow time to analyze feedback and develop prompts for the subsequent questionnaire. These three questionnaires are available in Appendices B, C, and D.

### 3.2.5 Round 1 Questionnaire Development:

The round one questionnaire was developed in Microsoft Excel using the data generated from the preceding literature review. This elicitation tool was built as a three-part questionnaire to perform three different functions. For Section 1, the 25 potential KSAOs identified in the literature review were written as statements and participants were asked to indicate the level to which they agree with the given statement on a 1-5 (Strongly Disagree-Strongly Agree) Likert scale. In addition to the Likert scale, a space was provided to allow panel members to provide textual feedback for each prompt if they felt the need to give context to their response or provide additional insight. This section allowed participants to provide their opinion on the applicability of each of the KSAOs. In addition to providing their opinion on the applicability of each of the KSAOs, participants were also asked to rank their level of experience with each of the concepts introduced in the prompts on a scale from 1 to 5. This data serves as a means of assessing the participants' knowledge of the concepts and can be used to indicate potential bias or error in the dataset.

Section 2 of the questionnaire reworded and, in some cases, consolidated the potential KSAOs from Section 1 into 23 competencies, subcompetencies and descriptors. Participants were then asked to rate the prompts as foundational competencies, occupational competencies (specific to the 32E career field), or "neutral" (applicable to Mission Support/Agile Combat Support AFSCs including Civil Engineer CGOs). Participants also had the option of selecting "Not Applicable" indicating that the specified prompt is not applicable to Civil Engineer CGOs. This section serves to collect the collective opinion from the panel of experts on whether or not the prompt is an occupational competency and thus should be included in the Civil Engineer officer occupational competency framework.

In the third and final section of the Round 1 questionnaire, participants were invited to provide textual responses to two open ended questions. These two questions solicited ideas for additional KSAOs competencies to be added for validation in the Round 2 questionnaire.

After drafting the Round 1 questionnaire, a pilot study was conducted to test the organization and comprehensibility of the elicitation tool and to ensure that the prompts posed to the panels were unbiased. Two Air Force Civil Engineer Colonels serving in staff positions and who had previously chaired the CE RWG were invited to participate in this pilot study. The feedback provided by these pilot study participants were used to reword several prompts, measure the amount of time that should be allotted for questionnaire completion, and make adjustments to the participation solicitation e-mail which was sent out to all members selected to serve as experts. A copy of this request for participation email is available in Appendix E.

### 3.2.6 Round 2 Questionnaire Development:

The Round 2 questionnaire was developed based on the feedback provided by the expert panel in Round 1. In Parts 1 and 2 of this questionnaire, each of the prompts presented in Round 1 were presented once again and color coded based on the level of consensus achieved. Those prompts with strong consensus were highlighted green. Those with some consensus highlighted yellow, and those where no consensus was reached were highlighted red. In addition, the questionnaire displayed the panel's most popular answer to each prompt as well as the percentage of experts who selected that response. Using the level of consensus achieved and the most popular answer, research conclusions were drawn from each of the prompts. These conclusions were then presented to the panel and they were then asked to indicate if they concur with the presented research conclusion. Finally, panel members were requested to comment on why they disagree with the presented research conclusion.

Round 2 was also used to explore the levels of proficiency for each of the KSAOs presented. Part 3 of the questionnaire was organized by listing each of the KSAOs used in Part 2 and requesting participants assign the appropriate level of proficiency for each rank of CGO. The three identified levels of proficiency were basic, advanced, and master. The definitions of each of these levels were taken from the 2022 Civil Engineer Officer Career Field Education and Training Plan, CFETP, and presented to the participants to serve as criteria for assigning levels of proficiency.

### 3.2.7 Round 3 Questionnaire Development

Round 3 of the Delphi study was created in a similar manner to Parts 1 and 2 of the second round. The intent of this round was to present the participants with the research conclusions drawn from the data collected in Round 2 and measure their level of agreement with each of these conclusions. This round consisted of a single part, which presented the distribution of responses from Part 2, Round 3 as well as the research conclusion made using those results. Participants were again asked to indicate whether or not they agree with the presented conclusion and asked to provide feedback if they disagree with the conclusions made.

### 3.2.8 Questionnaire Analysis:

Two major steps were taken in analyzing the participant responses: 1) evaluating expert consensus, and 2) summarizing the central tendency. This section will state the level of agreement denoting consensus assumed in this research, specify the three metrics used to measure consensus, and detail the two measures of central tendency used to substantiate the validity of the KSAOs presented to the study participants.

To measure the participant's levels of consensus, four metrics were employed: the Cronbach's Alpha, IQR, Mode. The Cronbach's Alpha assess the reliability and internal consistency of a set of test items (Goforth, 2015). Mode (M) is the proportion of experts who chose the most popular score for each prompt. Finally, the interquartile range (IQR) measures the dispersion from the median and indicates were the bulk of the data values lie by subtracting the

75th and 25th percentiles. To determine if consensus has been achieved using IQR, maximum thresholds of interquartile range are established. If the middle 50% of observations range by less than the threshold, i.e., the observed interquartile range is less than or equal to said threshold, the consensus is considered to have been achieved (Birko, Dove, & Özdemir, 2015).

The Cronbach's Alpha coefficient of reliability ranges from 0 to 1 to assess the overall reliability of the participants' responses. When all responses are entirely independent from one another, i.e. participant feedback is not correlated, α=0. If all responses have a high covariance and there is a high level of agreement amongst the panel members, α will approach 1.

The M index is calculated by counting the number of experts ($k$), for each prompt ($i$), whose responses (j) were equal to that of the mode. This count is then divided by the number of participants who responded to that particular prompt to calculate the item-by-item M ($s_i$). Finally, the overall M metric was calculated by taking the mean of all item-by-item Ms. The overall M index was used to measure the extent to which experts responded similarly to each other over all prompts, while the item-by-item M served to identify those prompts in which a majority of participants generated the same ratings.

$$M = \frac{\sum_{i=1}^{n} s_i}{n} \tag{1}$$

where there are a total of $n$ items, numbered i=1…$n$; there are $q$ possible ratings, numbered j=1…$q$; and there are $r$ number of experts, numbered k=1…$r$.

$$s_i = \frac{\sum_{k=1}^{r} s_{ik}}{r}$$

is the item-by-item M

$$s_{ik} = \begin{cases} 1 & if \quad q_{ik} = mode \\ 0 & \quad otherwise \end{cases}$$

is a comparison of the rating provided from each participant/prompt pairing to the most popular rating for that prompt.

IQR is the overall metric for determining the proportion of prompts for which the distribution of expert responses exhibited an interquartile range less than that of the assumed threshold ($IQR_m$), measuring overall expert agreement. For the purposes of this research, the $IQR_m$ was assumed to be equal to 20% of the number of ratings available on the given Likert scale, i.e., 1.0 when using a 5-point scale and 0.8 when using a 4-point scale. At these thresholds of interquartile range, responses were observed to be generally consistent between panel members.

$$IQR = \frac{\sum_{i=1}^{n} IQR_i}{n} \tag{2}$$

$$IQR_i = \begin{cases} 1 & if \quad q_{75\%i} - q_{25\%i} < IQR_m \\ 0 & otherwise \end{cases}$$

where $IQR_i$ is the item-by-item IQR index indicating if the interquartile range for an individual prompt's responses fell below the established threshold, $IQR_m$.

Each of these three indices provide two key metrics: the overall measure of consensus for the panel and the item-by-item level of agreement for each prompt. Each level of metric accomplishes a different goal in analyzing the data. First the metric for overall panel consensus measures the extent to which the panel of experts selected agree with and are of like mind with each other. Second, the item-by-item consensus metrics identify those KSAOs that a majority of the experts agree are necessary for Civil Engineer CGOs to operate under the ACE and MCA models.

For each of these two levels of metrics, two levels of agreement were assumed to denote consensus in expert opinion. For this study, "some" consensus was assumed to be 70% agreement between respondents, and "strong" consensus was defined as 90% agreement (van Hecke et. al., 2015). These two values lie within the upper range of von der Gracht's (2012) findings for generally accepted assumptions of expert consensus. Their research discovered common definitions of consensus ranging from 51% to 95% with several researchers adopting 60% as the indicator for consensus when using a Likert scale (Seagle & Iverson, 2020) similar to the tool used for this expert elicitation. Using this established assumption of consensus, if the overall Cronbach's Alpha, M, or IQR indices are calculated to be greater than or equal to 0.7, some consensus is assumed to have been reached. Similarly, for any individual prompts with an item-by-item $S_i$ or $IQR_i$ greater than or equal to 0.7, some consensus between experts on that singular prompt has been achieved. In two sections of the questionnaires where participants were asked to indicate whether or not they agree with a given research conclusion (i.e., yes or no responses), only Cronbach's Alpha and M were used as group consensus measures due to the binomial nature of the responses. Cronbach's Alpha coefficients can only be calculated for the entire set of responses for each Part, as opposed to the M and IQR metrics that can be used to quantify consensus for each individual question. For this reason, all three metrics, Cronbach's Alpha, M, and IQR, were used to quantify overall part consensus, while only M and IQR were used to also quantify individual promp consensus. Table 2 displays a chart of the type of consensus measure calculated for each round of Delphi as well as the threshold for denoting consensus on an individual prompt.

**Table 2: Delphi Study Consensus Measures & Thresholds**

| | | **Metric taken** | **"Some" Consensus Threshold** | **"Strong" Consensus Threshold** |
|---|---|---|---|---|
| **ROUND 1** | Part 1 | α | >0.7 | >0.9 |
| | | M | >0.7 | >0.9 |
| | | IQR | <1.0 | <0.5 |
| | Part 2 | α | >0.7 | >0.9 |
| | | M | >0.7 | >0.9 |
| | | IQR | <0.8 | <0.4 |
| | Part 3 | None | - | - |
| **ROUND 2** | Part 1 | α | >0.7 | >0.9 |
| | | M | >0.7 | >0.9 |
| | Part 2 | α | >0.7 | >0.9 |
| | | M | >0.7 | >0.9 |
| | Part 3 | α | 1 | 1 |
| | | M | >0.7 | >0.9 |
| | | IQR | <0.6 | < 0.3 |
| **ROUND 3** | Part 1 | α | >0.7 | >0.9 |
| | | M | >0.7 | >0.9 |

Once consensus had been confirmed for each individual prompt, their central tendencies were calculated to identify the collective opinion of the expert panel. To accomplish this task, two measures of central tendency were used: median and mode. The mean was not selected for this analysis as it is more susceptible to the influence of skewed distributions and any remaining extreme data points. Median, when paired with the interquartile range, identifies where the middle 50% of respondents answered and is much more robust to skewed response distributions. Mode was selected as the secondary measure of central tendency as it identified the most popular score for each prompt. These two measures of central tendency should be relatively similar to one another assuming that consensus has been reached for each of the prompts and will indicate the common opinion of the polled experts.

### 3.2.9 Study Bias

To enhance the validity of this research, several types of bias were addressed during the design of the research. As the intent of this research is to elicit the opinion of experts belonging to a singular career field, the data is inherently at risk of authority bias and the bandwagon effect. The bandwagon effect is the tendency for individuals to adopt the opinions and attitudes of other individuals participating in the study. Authority bias has a similar effect in that individuals may be influenced by the opinions and attitudes of those viewed as authority figures. By design, the Delphi method minimizes the bandwagon effect and authority bias through maintaining anonymity, as opposed to utilizing group discussion or focus groups to collect feedback. Participants were also reminded to send their responses only to the primary researcher and not to all of the other participants. Consequently, while the panel members knew who the other participants were, they were able to share their opinions in an unbiased manner without pressure from their peers or authority figures.

Anchoring bias and feature positive bias are two additional biases that were addressed by the design of this research study. Anchoring bias is the tendency for study participants to use outdated data and fixed reference points in the decision-making process. This type of bias would affect the validity of this research if panel members tended to rate the validity of the given KSAOs based primarily on if those KSAOs were viewed as necessary in a historical context. Feature positive bias is the tendency for study participants to focus primarily of the positive aspects of a decision while neglecting the negative aspects. In the case of this research, an example of this type of bias would be if panel members only considered the benefits of enabling Civil Engineer CGOs with the skills to perform a certain task without accounting for the time and resource costs to achieve this competency. Both of these types of bias were addressed in the selection criteria adopted when building the panel of experts. Each of the panel members selected to participate, having either been briefed on ACE during the readiness working group or having been a part of ACE planning or exercising, were knowledgeable on the new requirements necessary to support ACE operations and were primed to reference those requirements when participating in the study versus pulling from their prior experiences with contingency operations and limited the possibility of anchoring bias. Similarly, as the participants selected were senior leaders in the civil engineering career field, they would be more likely to consider the drawbacks of making additions to the civil engineer officer core competency list when providing their feedback. This focus on both the benefits and disadvantages of integrating ACE and MCA requirements into the core competency framework aided in minimizing feature positive bias in the study.

The Delphi Study methodology is also susceptible to non-response bias. By design, invited panel members are not forced to provide feedback and participate on their own volition. However, this poses a risk of missing the feedback and opinions of experts who dropped out of the study before the final round. If the opinions of the experts who dropout differ from the opinions of those who participated in all three rounds of study, this could suggest that a subset of critical expert feedback was not captured in the elicitation, which may invalidate the study results. In order to understand if the opinions of this study's dropouts differed significantly from the experts who provided feedback in all three rounds, the Student's T-test was employed. This test is used to indicate if the mean responses of the participants who dropped out after Rounds 1 or 2 significantly differs from those who participated in all three rounds. For this analysis, the Round 1 feedback of study dropouts was averaged and compared to the average of the panel as a whole. F-tests were conducted on the Parts 1 and 2 data to test for unequal variances. Then the Student's T-test was conducted on the mean responses of the two groups assuming equal variances.

The final type of bias addressed in this study was familiarity bias, which is the tendency for individuals to choose and trust that which they are more familiar with. In the case of this research, familiarity bias would be evident if the participants tended to give KSAOs they were more familiar with higher relevance scores versus those that they were less familiar with. To address this potential bias, participants were asked in Round 1 to rate their experience with the concepts in each of the prompts. These data were then paired with the ratings assigned to each of the prompts for a linear regression analysis. The results of which can be used to identify any correlation between participants' familiarity with a concept and their score ratings, and can be used to detect potential familiarity bias.

This analysis was performed using JMP Pro 15 software to test for any significant relationship between level of experience and the rating given to each prompt. In this analysis of variance, the p-value was recorded and compared with an assumed $\alpha$ value of 0.05 in order to test for any correlation between the panel member inputs.

#### 3.2.10 Comparison of Delphi Findings with Training Opportunities

Two training opportunities available to Civil Engineer CGOs were analyzed to determine if the newly identified ACE and MCA competency requirements could be met by available courses. The training requirements in AFI 10-210 Prime BEEF Program and the lesson plans from the USAF Expeditionary Operations School's Multi-Capable Airmen Expeditionary Skill Training Course were investigated using a document analysis resembling that of the document analysis completed during the systematic literature review. The learning objectives and content of each of these training requirements were reviewed for their primary themes and level of projected proficiency achieved at the conclusion of the course. These themes and proficiency levels were then individually compared with each of the competency requirements identified during the expert elicitation. Courses offering familiarization training were assumed to only offer a basic proficiency within the Civil Engineer occupational competency framework. Similarly, courses offering hands on training were assumed to provide an advanced level of proficiency and courses with exercises to assess a student's performance were assumed to provide master level proficiency.

# IV. Results

This chapter presents the analysis results from the two data collection techniques identified in the Methodology chapter and also compares these findings with the Civil Engineer Occupational Competencies list found in the Career Field Education and Training Plan, CFETP. Furthermore, this section will review several Civil Engineer CGO training and education opportunities to identify those courses already in place which build proficiency in the newly identified competencies. This chapter is broken into three sections. First, the findings from the systematic literature review and document analysis are presented. The output of this phase is a consolidated list of KSAOs applicable to Civil Engineer officers operating within the ACE and MCA models as well as environmental and positional factors that Civil Engineer officers must be prepared for in anticipation of ACE deployments.

The second section of this chapter presents the results of the three-round Delphi study used to validate the findings from the literature review. The output of this phase is a validated list of competency descriptors required of Civil Engineer CGOs operating within the ACE and MCA models. Finally, the third section will compare the validated competency list produced in this study with the competency list found in the CFETP. This section will then introduce the USAF Expeditionary Operations School's Tier 1 MCA course and the training requirements of AFI 10-210, and compare the content of these opportunities with the new ACE and MCA competencies.

### 4.1 Systematic Literature Review:

This section details the findings from each of the five different types of literature reviewed to identify the potential KSAO requirements associated with Civil Engineer CGOs operating an ACE and MCA environment. The findings from each of these distinct sources were then consolidated to form a master list of potential KSAOs. 52 pieces of literature in total were reviewed in this document analysis to uncover potential KSAOs. The document analysis calls for identification of which aspect of the research the article pertains to (ACE, MCA, or Civil Engineer

CGO) and for patterns in thematic elements to be documented. Table 3 presents an overall list of the documents sourced for this review. Additionally, this table identifies which category of literature the document belongs to as well as a list of applicable aspects the document meets.

**Table 3: Literature Review References and Research Aspects**

| Reference | Category* | Aspects |
|---|---|---|
| CAF Mission Generation MCA Team Training Task List. (2021). | 1 | MCA |
| Curtis E. LeMay Center (2022) | 1 | ACE |
| Department of the Air Force (2020a) | 1 | ACE |
| Department of the Air Force (2020b) | 1 | MCA |
| Mulgund (2021) | 1 | ACE |
| USAF Expeditionary Center (2020) | 1 | MCA |
| USAF Expeditionary Center (2021) | 1 | ACE, MCA |
| Boe, O (2015) | 2 | 32E |
| Davis, R. (2013) | 2 | 32E |
| Nelsen, J. & Akman, A. (2002) | 2 | MCA |
| Nelsen, J. & Chirico, M. (2003) | 2 | MCA |
| Allal-Chérif, O., Guijarro-Garcia, M., & Ulrich, K. (2022) | 3 | MCA |
| Brusco, M. J., & Johns, T. R. (1998) | 3 | MCA |
| Cannon-Bowers, J., Salas, E., Blickensderfer, E., & Bowers, C. (1998) | 3 | MCA |
| Carter, D. R., Dechurch, L. A., & Zaccaro, S. J. (2014) | 3 | MCA |
| Chen, L.-C., & Tseng, C.-Y. (2012) | 3 | MCA |
| Clardy, T., Sarkani, S., & Mazzuchi, T. (2017) | 3 | 32E, MCA |
| McLaughlin, L. L., & Ziskin, I. (2016) | 3 | MCA |
| Mohsen, K., & Eng, T. Y. (2016) | 3 | MCA |
| Olivella, J., & Nembhard, D. (2015) | 3 | MCA |
| Parker, G. (2003) | 3 | MCA |
| Salem, I., & Abdien, M. (2017) | 3 | MCA |
| Sangeetha, P., & Kumaran, S. (2018) | 3 | MCA |
| Schar, M., & Lande, M. M. (2012). | 3 | 32E, MCA |
| Shen, X. (2002) | 3 | MCA |
| Slomp, J., & Molleman, E. (2010) | 3 | MCA |
| Volpe, C., Cannon-Bowers, J., & Salas, E. (1996) | 3 | MCA |
| C-130 Makes History by Landing on Highway 287 in Wyoming. (2021) | 4 | 32E, ACE |
| Deptula, D., & Penney, H. (2019) | 4 | ACE |
| Hadley, G. (2021) | 4 | MCA, ACE |
| Herbert et. al. | 4 | MCA |

| Reference | Category* | Aspects |
| --- | --- | --- |
| Knight, K. (2021) | 4 | MCA, ACE |
| McClendon, M. (2022) | 4 | ACE |
| Mizokami, K. (2019) | 4 | 32E, ACE |
| Morgan, R. (2022) | 4 | 32E, ACE |
| Nolte, A. (2021) | 4 | MCA |
| Oprihory, J.-L. (2021) | 4 | ACE |
| Richards, A. (2022) | 4 | 32E, MCA |
| Schanz, M. (2015) | 4 | ACE |
| Secretary of the Air Force Public Affairs. (2021) | 4 | ACE |
| Secretary of the Air Force Public Affairs. (2022) | 4 | ACE |
| Somero, J. (2022) | 4 | 32E, ACE |
| St. Clair, J. (2021) | 4 | 32E |
| Stephens, J. (2020) | 4 | MCA |
| Air Force Civil Engineer Mission Essential Task List (2021) | 5 | 32E |
| Air Force Research Laboratory. (2022) | 5 | 32E, ACE |
| Department of the Air Force. (2022) | 5 | 32E |
| Fourth Fighter Wing. (2019) | 5 | MCA |
| HQ ACC/A4, L. R. D. (2019) | 5 | ACE, MCA |
| Secretary of the Air Force. (2022) | 5 | ACE |
| USAFE-AFAFRICA Mission Capable Airman Core Tasks (2022) | 5 | MCA |
| Winkelmann, P. (2022) | 5 | ACE |

*Category 1: Air Force Guidance/Publications on ACE/MCA
Category 2: Journal Articles on Officer Competencies and the Multi-Skilled Soldier
Category 3: Journal Articles on Leading Multi-Functional Teams
Category 4: Magazine Articles on ACE and MCA
Category 5: Other Air Force Documentation

#### 4.1.1 Air Force Guidance and Publications Concerning ACE and MCA:

Seven documents published by the USAF pertaining to ACE and MCA were investigated. These documents consisted of doctrine notes, training programs, and guidance memorandums distributed to units for implementation. As seen in Table 3, each of these documents included the ACE and/or MCA aspects. However, none included information specifically incorporating the Civil Engineer CGO aspect. These references spoke primarily on the environmental conditions as well as the breakdown of responsibilities factoring into the KSAOs required to operate within the ACE and MCA models.

#### 4.1.2 Journal Articles on Officer Competencies and MSS:

Four articles were found addressing military officer competencies and the Army's MSS model and these pieces of literature referenced a wide variety of applicable KSAOs. Two of these documents address the Civil Engineer CGO aspect by detailing desired officer competencies in contingency environments, and two include the MCA aspect when discussing the Army's interpretation of multi-functional personnel. One commonality of these documents was that they all addressed KSAO requirements in the context of an expeditionary environment, making these references very applicable to this research. Consequently, many of the skillsets called out as necessary stemmed from operating in a contingency environment, such as medical care, advanced weapon skills, and individual troop movement.

#### 4.1.3 Journal Articles on Leading Multi-Functional Teams:

16 journal articles were reviewed which discussed the competencies of individuals leading teams of multi-functional or cross-trained teams. The themes observed in all 16 of these references pertained to the MCA aspect of this research. However, two of the articles also incorporate some applicable information relating to civil engineers. The most influential concept derived from these documents was the idea of skill-chaining. Six of the 16 articles discussed the effectiveness of skill-chaining when operating with multi-functional teams. This concept was applied to the Civil Engineer CGO career field and translated into ACE KSAOs by acknowledging the other BOS functions as complimentary job functions and incorporating those skillsets as applicable KSAOs for Civil Engineer CGOs. In addition to skill-chaining, this literature identified cross-functional communication as a key ability required of multi-functional team leaders.

#### 4.1.4 Magazine Articles on ACE and MCA:

Magazine and news articles covering ACE and MCA were a majority of the references reviewed in this document analysis. 17 articles were found discussing ACE or MCA and these documents covered all three aspects used for this analysis. While several of the individual articles discussed two of the three aspects, none of the 17 incorporated all three. Similar to the literature on officer competencies and MSS, these documents detailed numerous types of necessary skillsets such as expeditionary skills, traditional Civil Engineer abilities, and leadership characteristics.

### 4.1.5 Other Air Force Documentation:

Other types of documentation relating to ACE, MCA, and Civil Engineer CGOs made up 8 of the 52 documents analyzed. These consisted of exercise task lists, briefings and academic-type reports produced by individual Air Force Units after exercising ACE and MCA. Several of these documents incorporated the Civil Engineer officer aspect in their discussions, however, none discussed the interaction between all three aspects. The document analysis completed on these pieces of literature identified several different types of KSAOs applicable to CE officers with respect to ACE and MCA. These included typical expeditionary skills, installation defense techniques, and logistics knowledge.

### 4.1.6 Preliminary KSAO List

Figure 4 presents a bar chart of the KSAOs and themes identified through the document analysis. This figure identifies those themes that were found within more documents and breaks down each bar by the literature type. Through this document analysis, 29 themes and KSAOs were found that may be applicable for Civil Engineer officers operating within the ACE and MCA models. The top three being technical communication skills, the ability to operate in a contested environment, and knowledge of the Hub and Spoke scheme of logistics. From these 29 themes, 23 applicable KSAOs were identified. These synthesized KSAOs were then used to craft the questionnaire used in Round 1 of the Delphi study.

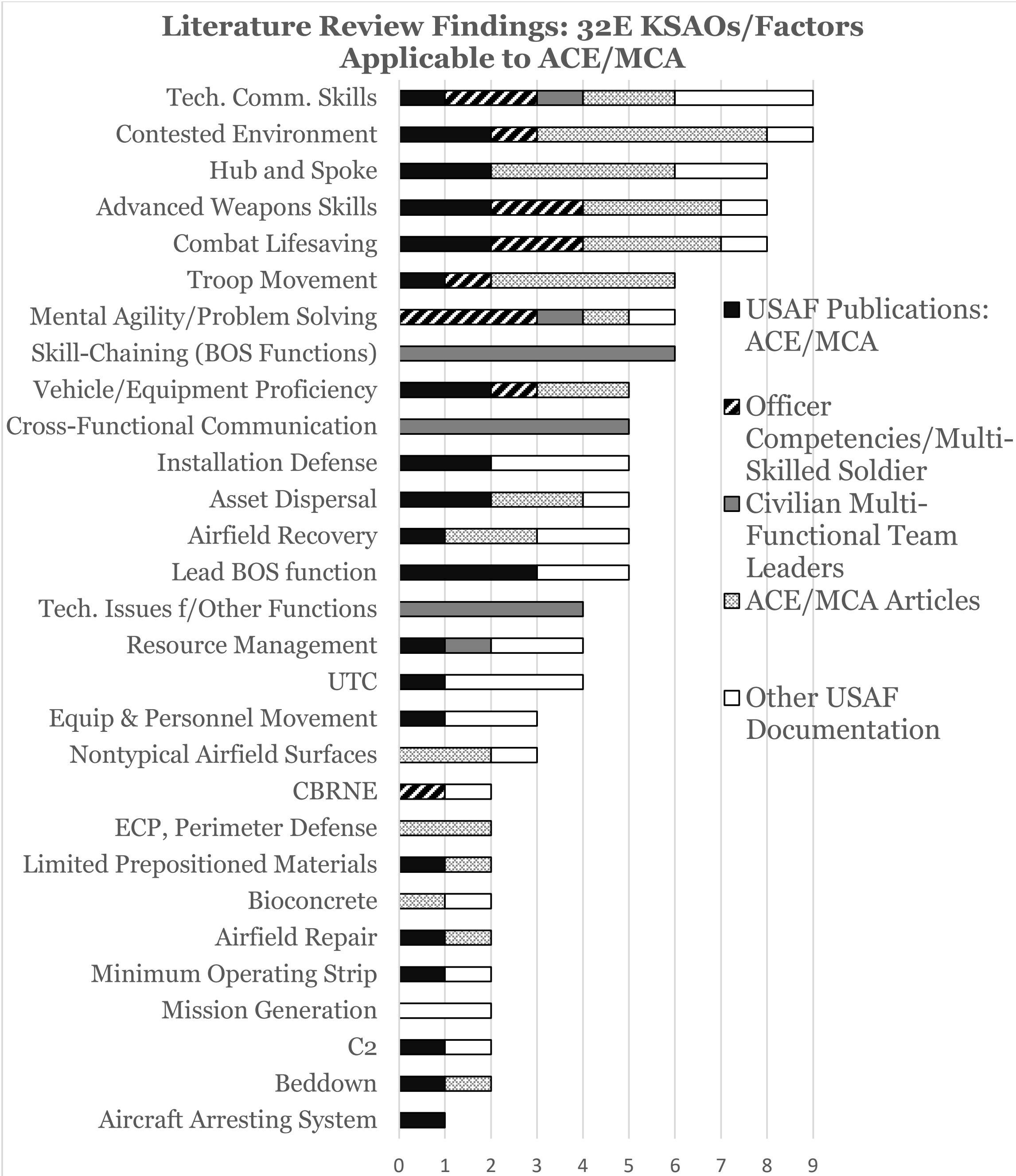



*Figure 4: 29 Factors and KSAOs were found in the literature review that may be applicable for Civil Engineer CGOs operating within the ACE and MCA models. The count of the number of reviewed documents discussing each of these topics is displayed on the x-axis and each bar is broken-out by color to illustrate which types of literature discussed each topic. A total of 52 pieces of literature were reviewed in this document analysis from 5 different document types. From these 29 themes, 23 KSAOs were identified, which were validated during the expert elicitation phase.*

## 4.2 Delphi Study:

### 4.2.1 Delphi Round 1:

Table 4 displays the individual prompt results of Part 1 of Round 1 of the Delphi study. In this part, 25 prompts were presented to the panel who were asked to respond to each prompt using a Likert scale from 1-5. These 25 prompts were synthesized from the potential KSAOs identified from the systematic literature review and are available in Appendix D. Each expert was asked to rate the level to which they agreed that the proposed KSAOs was applicable to 32E CGOs. The individual consensus measures were calculated to indicate the level of consensus achieved by the panel. These levels of consensus achieved for each prompt was assigned using the thresholds found in Table 2 in the methodology section. In addition to the consensus measures, the measures of central tendency (median and mode) were also calculated and presented for each prompt. These individual metrics were then used to draw a research conclusion for each prompt as seen in the rightmost column. In this section of the Delphi, the panel was able to reach an acceptable level of consensus on 68% of the prompts. Additionally, the majority of these prompts in which the panel reached consensus had central tendency measures suggesting that the specified KSAOs were applicable to Civil Engineer CGOs.

Table 5 presents the data collected in Part 2 of the Delphi study's first round. 23 KSAOs were presented to the panel members who responded using a 4-point Likert scale to indicate if the KSAO was part of an Institutional Competency (1), a Mission Support Competency (2), or a Civil Engineer CGO occupational competency (3), or not an applicable competency (4). This table displays the three consensus measures recorded for each prompt as well as their calculated central tendency metrics. Additionally, this table displays the resulting research conclusion drawn from these results in the final column. In this section, the panel only reached consensus on 61% of the prompts. However, for the majority of these prompts in which consensus was reached, the panel members agreed that the specified KSAO was either specific to Civil Engineer CGOs or other mission support function CGOs indicating that the competency would be occupational as opposed to foundational.

**Table 4: Delphi Study Round 1: Part 1 Results**

| Prompt | *Consensus Measures | | Central Tendency | | Consensus Level** | Research Conclusion |
|---|---|---|---|---|---|---|
| | %Mode | IQR | Median | Mode | | |
| **1.1** | 100% | 0.00 | 5 | 5 | Strong | Applicable KSAO |
| **1.2** | 40% | 1.75 | 4 | 5 | None | None |
| **1.3** | 90% | 0.00 | 5 | 5 | Strong | Applicable KSAO |
| **1.4** | 40% | 2.75 | 4 | 5 | None | None |
| **1.5** | 30% | 2.00 | 2.5 | 2 | None | None |
| **1.6** | 70% | 0.75 | 5 | 5 | Some | Applicable KSAO |
| **1.7** | 90% | 0.00 | 5 | 5 | Strong | Applicable KSAO |
| **1.8** | 60% | 1.00 | 5 | 5 | Some | Applicable KSAO |
| **1.9** | 40% | 2.75 | 3.5 | 5 | None | None |
| **1.1** | 50% | 0.75 | 4 | 4 | Some | Applicable KSAO |
| **1.11** | 50% | 0.75 | 2 | 2 | Some | Not Applicable KSAO |
| **1.12** | 100% | 0.00 | 5 | 5 | Strong | Applicable KSAO |
| **1.13** | 40% | 1.75 | 4 | 5 | None | None |
| **1.14** | 30% | 3.25 | 3.5 | 1 | None | None |
| **1.15** | 60% | 1.00 | 5 | 5 | Some | Applicable KSAO |
| **1.16** | 40% | 1.75 | 4 | 5 | None | None |
| **1.17** | 80% | 0.00 | 5 | 5 | Strong | Applicable KSAO |
| **1.18** | 90% | 0.00 | 5 | 5 | Strong | Applicable KSAO |
| **1.19** | 80% | 0.00 | 5 | 5 | Strong | Applicable KSAO |
| **1.2** | 60% | 1.00 | 5 | 5 | Some | Applicable KSAO |
| **1.21** | 70% | 0.75 | 5 | 5 | Some | Applicable KSAO |
| **1.22** | 60% | 1.00 | 5 | 5 | Some | Applicable KSAO |
| **1.23** | 60% | 1.00 | 5 | 5 | Some | Applicable KSAO |
| **1.24** | 80% | 0.00 | 5 | 5 | Strong | Applicable KSAO |
| **1.25** | 40% | 2.50 | 3.5 | 4 | None | None |

* Individual cells have been shaded based on their calculated consensus metric compared to the thresholds outlined in Table 2 in the Methodology Chapter. Shaded cells indicate achieved consensus.
** This study assumes that a prompt's consensus level classification is equal to the highest threshold met by the individual consensus measures.

**Table 5: Delphi Study Round 1: Part 2 Results**

| Prompt | *Consensus Measures | | Central Tendency | | Consensus Level** | Research Conclusion |
|---|---|---|---|---|---|---|
| | %Mode | IQR | Median | Mode | | |
| **2.1** | 60% | 1.00 | 1 | 1 | None | None |
| **2.2** | 50% | 1.00 | 2 | 2 | None | None |
| **2.3** | 50% | 1.00 | 2 | 2 | None | None |
| **2.4** | 70% | 0.75 | 2 | 2 | Some | MSG Occupational Competency |
| **2.5** | 80% | 0.00 | 2 | 2 | Strong | MSG Occupational Competency |
| **2.6** | 60% | 0.00 | 3 | 3 | Strong | 32E Occupational Competency |
| **2.7** | 50% | 1.00 | 2 | 2 | None | None |
| **2.8** | 60% | 0.75 | 3 | 3 | Strong | 32E Occupational Competency |
| **2.9** | 80% | 0.00 | 2 | 2 | Strong | MSG Occupational Competency |
| **2.1** | 50% | 1.00 | 2 | 2 | None | None |
| **2.11** | 60% | 0.75 | NA | NA | Some | Not Applicable KSAO |
| **2.12** | 70% | 0.00 | 3 | 3 | Strong | 32E Occupational Competency |
| **2.13** | 80% | 0.00 | 3 | 3 | Strong | 32E Occupational Competency |
| **2.14** | 80% | 0.00 | 3 | 3 | Strong | 32E Occupational Competency |
| **2.15** | 80% | 0.00 | 3 | 3 | Strong | 32E Occupational Competency |
| **2.16** | 80% | 0.00 | 3 | 3 | Strong | 32E Occupational Competency |
| **2.17** | 80% | 0.00 | 1 | 1 | Strong | Institutional Competency |
| **2.18** | 50% | 2.00 | 3 | 3 | None | None |
| **2.19** | 60% | 1.00 | 1 | 1 | None | None |
| **2.2** | 50% | 1.75 | 1.5 | 1 | None | None |
| **2.21** | 70% | 0.00 | 2 | 2 | Strong | MSG Occupational Competency |
| **2.22** | 60% | 0.75 | 2 | 2 | Some | MSG Occupational Competency |
| **2.23** | 40% | 1.00 | 1.5 | 2 | None | None |

* Individual cells have been shaded based on their calculated consensus metric compared to the thresholds outlined in Table 2 in the Methodology Chapter. Shaded cells indicate achieved consensus.
** This study assumes that a prompt's consensus level classification is equal to the highest threshold met.

Finally, Table 6 presents the data generated from Round 1: Part 3. The data from this round is qualitative in nature and was extracted using a thematic analysis of the feedback provided by the panel members. Panel members offered recommendation for additional KSAOs to be assessed in this research and provided additional motivation for several of the already identified KSAOs. This table presents the themes observed within their feedback, the number of panel members to discuss the specific theme, and additional details on the identified theme.

**Table 6: Delphi Study Round 1: Part 3 Results**

| THEMES | Count | Notes |
|---|---|---|
| **CBRN** | 2 | Excluded from this research as surviving and operating in a CBRN environment is a skillset applicable to all Air Force service members and is a requirement across all career fields |
| **FIRE AND EMERGENCY SERVICES (F&ES)** | 2 | This theme was excluded from this research endeavor due to Civil Engineer CGOs not having traditional roles within the F&ES function. However, operational familiarity with their responsibilities and capabilities is required to obtain proficiency of the concepts introduced in prompts 1.10 and 2.10 |
| **RESOURCEFULNESS** | 2 | This theme is already incorporated into prompts 1.19 and 2.18 |
| **COMPLEX PROBLEM SOLVING** | 1 | This theme is already incorporated into prompts 1.18 and 2.17 |
| **EXPLOSIVE ORDNANCE DISPOSAL** | 1 | This theme was excluded from this research endeavor due to the specialties and capabilities of EOD officers being distinctly different from those of other Civil Engineer officers |
| **LEADERSHIP** | 1 | Excluded from this research as leadership competency is not specific to Civil Engineer officers, rather it is a collection of skills and abilities applicable to all USAF commissioned and noncommissioned officers |
| **LOGISTICS** | 1 | This theme is already incorporated into prompts 1.3, 1.4, 1.6, 2.3 and 2.6 |
| **MISSION GENERATION ACTIVITIES** | 1 | This theme is already incorporated into prompts 1.11 and 2.11 |

#### 4.2.2 Delphi Round 2:

Table 7 presents the results from Part 1 of Round 2 of the Delphi. In this round, participants reviewed the results of Round 1: Part 1 as well as the individual research conclusions for each prompt. Participants were then asked to respond with a "Yes" or "No" to indicate whether or not they agree with the conclusion. These responses were recorded and analyzed to calculate the M and Cronbach's α consensus measures. This table presents the new level of consensus for the given prompts and updated research conclusions. These research conclusions indicate if the KSAO introduced in each prompt is applicable to Civil Engineer CGOs or not. In this part, the panel members reached a satisfactory level of consensus on 78% of the prompts. This increase in consensus level indicates that the panel members' answers are converging on which KSAOs are applicable to Civil Engineer CGOs operating in the ACE model.

**Table 7: Delphi Study Round 2: Part 1 Results**

| Prompt | *Consensus Measures | Central Tendency | Consensus Level** | Research Conclusion |
|---|---|---|---|---|
| | %Mode | Mode | | |
| **1.1** | 1.00 | Concur | Strong | Applicable KSAO |
| **1.2** | 0.50 | Nonconcur | None | None |
| **1.3** | 1.00 | Concur | Strong | Applicable KSAO |
| **1.4** | 0.75 | Concur | Some | Applicable KSAO |
| **1.5** | 0.50 | Concur | None | None |
| **1.6** | 0.88 | Concur | Some | Applicable KSAO |
| **1.7** | 1.00 | Concur | Strong | Applicable KSAO |
| **1.8** | 1.00 | Concur | Strong | Applicable KSAO |
| **1.9** | 0.50 | Nonconcur | None | None |
| **1.10** | 0.88 | Concur | Some | Applicable KSAO |
| **1.11** | 0.50 | Concur | None | None |
| **1.12** | 1.00 | Concur | Strong | Applicable KSAO |
| **1.13** | 0.63 | Concur | None | None |
| **1.14** | 0.75 | Nonconcur | Some | Applicable KSAO |
| **1.15** | 0.88 | Concur | Some | Applicable KSAO |
| **1.16** | 0.75 | Concur | Some | Applicable KSAO |
| **1.17** | 1.00 | Concur | Strong | Applicable KSAO |
| **1.18** | 1.00 | Concur | Strong | Applicable KSAO |
| **1.19** | 1.00 | Concur | Strong | Applicable KSAO |
| **1.20** | 1.00 | Concur | Strong | Applicable KSAO |
| **1.21** | 1.00 | Concur | Strong | Applicable KSAO |
| **1.22** | 0.88 | Concur | Some | Applicable KSAO |
| **1.23** | 0.88 | Concur | Some | Applicable KSAO |
| **1.24** | 1.00 | Concur | Strong | Applicable KSAO |
| **1.25** | 0.75 | Nonconcur | Some | Not Applicable KSAO |

* Cells have been shaded based on their calculated consensus metric compared to the thresholds outlined in Table 2 in the Methodology Chapter. Shaded cells indicate achieved consensus.
** This study assumes that a prompt's consensus level classification is equal to the highest threshold met by the individual consensus measures.

The results for Part 2 of the second round of the Delphi are presented in Table 8. In this section, the participants reviewed the researcher conclusion for Part 2 of Round 1 and responded with a "yes" or "no" to indicate if they agreed with the conclusion. The resulting data was analyzed to calculate updated consensus metrics and draw new research conclusions. The conclusions generated from this part of the Delphi indicate if each of the specified KSAOs are specific to Civil Engineer Officers and are potentially occupational competencies. In this part, the panel members reached a consensus on 96% of the prompts. This indicates that the panel has come to an agreement on which of the applicable competencies are occupational and which are foundational.

**Table 8: Delphi Study Round 2: Part 2 Results**

| Prompt | *Consensus Measures | Central Tendency | Consensus Level** | Research Conclusion |
|---|---|---|---|---|
| | %Mode | Mode | | |
| **2.1** | 100% | Concur | Strong | ****Foundational Competency |
| **2.2** | 75% | Concur | Some | *** |
| **2.3** | 75% | Concur | Some | 32E Occupational Competency |
| **2.4** | 100% | Concur | Strong | MSG Occupational Competency |
| **2.5** | 88% | Concur | Some | *** |
| **2.6** | 88% | Concur | Some | 32E Occupational Competency |
| **2.7** | 75% | Concur | Some | 32E Occupational Competency |
| **2.8** | 63% | Concur | None | None |
| **2.9** | 88% | Concur | Some | *** |
| **2.10** | 75% | Concur | Some | 32E Occupational Competency |
| **2.11** | 75% | Concur | Some | *** |
| **2.12** | 88% | Concur | Some | 32E Occupational Competency |
| **2.13** | 88% | Concur | Some | *** |
| **2.14** | 88% | Concur | Some | 32E Occupational Competency |
| **2.15** | 88% | Concur | Some | 32E Occupational Competency |
| **2.16** | 88% | Concur | Some | 32E Occupational Competency |
| **2.17** | 100% | Concur | Strong | ****Foundational Competency |
| **2.18** | 88% | Concur | Some | 32E Occupational Competency |
| **2.19** | 88% | Concur | Some | ****Foundational Competency |
| **2.20** | 100% | Concur | Strong | ****Foundational Competency |
| **2.21** | 88% | Concur | Some | MSG Occupational Competency |
| **2.22** | 88% | Concur | Some | MSG Occupational Competency |
| **2.23** | 88% | Concur | Some | *** |

* Cells have been shaded based on their calculated consensus metric compared to the thresholds outlined in Table 2 in the Methodology Chapter. Shaded cells indicate achieved consensus.
** This study assumes that a prompt's consensus level classification is equal to the highest threshold met by the individual consensus measures.
*** Panel did not come to consensus that the particular KSAO was applicable to Civil Engineer CGOs and that it is assumed to not be a required competency
**** Panel did not come to a consensus that the particular KSAO was specific to Civil Engineer Officers or other Mission Support officer and that the KSAO is assumed to not be an occupational competency.

**Table 9: Delphi Study Round 2: Part 3 Results**

| Prompt | Consensus Measures | | Central Tendency | Consensus Level ** | Research Conclusion |
|---|---|---|---|---|---|
| | %Mode | IQR | Mode | | |
| **3.1 2LT** | 90% | 0.00 | Basic | Strong | For leading basic beddown UTCs, 2LTs need basic level proficiency, 1LTs need advance level, and Capts need master level proficiency. |
| **3.1 1LT** | 60% | 0.00 | Advanced | Strong | |
| **3.1 Capt** | 90% | 0.00 | Master | Strong | |
| **3.2 2LT** | 90% | 0.00 | Basic | Strong | For articulating Hub and Spoke and allocating engineer teams, 2LTs need basic level proficiency, 1LTs need an advance level, and Capts need a master level proficiency. |
| **3.2 1LT** | 50% | 0.75 | Advanced | None | |
| **3.2 Capt** | 70% | 0.75 | Master | Some | |
| **3.3 2LT** | 100% | 0.00 | Basic | Strong | For leading base operation support, 2LTs need basic level proficiency, 1LTs need advance level, and Capts need master level proficiency. |
| **3.3 1LT** | 60% | 0.75 | Advanced | None | |
| **3.3 Capt** | 80% | 0.00 | Master | Strong | |
| **3.4 2LT** | 90% | 0.00 | Basic | Strong | For anticipating requirements for other support functions, 2LTs and 1LTs need basic level proficiency, and Capts need advanced level proficiency. |
| **3.4 1LT** | 60% | 1.00 | Basic | None | |
| **3.4 Capt** | 50% | 1.00 | Advanced | None | |
| **3.5 2LT** | 70% | 0.75 | Basic | Some | For leading beddown activities, 2LTs need a basic level proficiency, 1LTs need an advance level, and Capts need a master level proficiency. |
| **3.5 1LT** | 80% | 0.00 | Advanced | Strong | |
| **3.5 Capt** | 80% | 0.00 | Master | Strong | |
| **3.6 2LT** | 50% | 1.00 | Advanced | None | For estimating food/water/lodging requirements, 2LTs and 1LTs need an advanced level proficiency, and Capts need a master level proficiency. |
| **3.6 1LT** | 60% | 0.75 | Advanced | None | |
| **3.6 Capt** | 80% | 0.00 | Master | Strong | |
| **3.7 2LT** | 60% | 1.00 | Basic | None | ****Not an *Occupational* Competency |
| **3.7 1LT** | 70% | 0.00 | Advanced | Strong | |
| **3.7 Capt** | 90% | 0.00 | Master | Strong | |
| **3.8 2LT** | 100% | 0.00 | Basic | Strong | ***Proficiency not required for Civil Engineer CGOs |
| **3.8 1LT** | 70% | 0.75 | Advanced | Some | |
| **3.8 Capt** | 60% | 1.00 | Master | None | |
| **3.9 2LT** | 100% | 0.00 | Basic | Strong | For managing emergency control centers and communicating with LMRs, 2LTs need a basic level proficiency, and 1LTs and Capts need an advanced level proficiency. |
| **3.9 1LT** | 60% | 1.00 | Advanced | None | |
| **3.9 Capt** | 50% | 1.00 | Advanced | None | |
| **3.10 2LT** | 90% | 0.00 | Basic | Strong | For managing airfield recovery activities, 2LTs need basic level proficiency, 1LTs need advance level, and Capts need master level. |
| **3.10 1LT** | 60% | 0.00 | Advanced | Strong | |
| **3.10 Capt** | 70% | 0.75 | Master | Some | |
| **3.11 2LT** | 90% | 0.00 | Basic | Strong | ***Proficiency not required for Civil Engineer CGOs |
| **3.11 1LT** | 50% | 1.00 | Basic | None | |

| Prompt | Consensus Measures | | Central Tendency | Consensus Level ** | Research Conclusion |
|---|---|---|---|---|---|
| | %Mode | IQR | Mode | | |
| 3.11 Capt | 50% | 0.75 | Advanced | None | |
| 3.12 2LT | 100% | 0.00 | Basic | Strong | For leveraging nontypical pavements and techniques, 2LTs need a basic level proficiency, and 1LTs and Capts need an advanced level proficiency. |
| 3.12 1LT | 50% | 1.00 | Advanced | None | |
| 3.12 Capt | 50% | 0.75 | Advanced | None | |
| 3.13 2LT | 100% | 0.00 | Basic | Strong | For coordinating inspection and repair of civilian highways, 2LTs need a basic level proficiency, and 1LTs and Capts need an advanced level proficiency. |
| 3.13 1LT | 50% | 1.00 | Advanced | None | |
| 3.13 Capt | 40% | 1.50 | Advanced | None | |
| 3.14 2LT | 100% | 0.00 | Basic | Strong | For leveraging asphalt and concrete alternatives for airfield construction and repair, 2LTs need a basic level proficiency, and 1LTs and Capts need an advanced level proficiency. |
| 3.14 1LT | 50% | 1.00 | Advanced | None | |
| 3.14 Capt | 40% | 1.50 | Advanced | None | |
| 3.15 2LT | 100% | 0.00 | Basic | Strong | For exhibiting resourcefulness for material acquisition and improvising solutions, 2LTs need a basic level, 1LTs need an advance level, and Capts need a master level proficiency. |
| 3.15 1LT | 70% | 0.00 | Advanced | Strong | |
| 3.15 Capt | 70% | 0.75 | Master | Some | |
| 3.16 2LT | 90% | 0.00 | Basic | Strong | ****Not an *Occupational* Competency |
| 3.16 1LT | 70% | 0.00 | Advanced | Strong | |
| 3.16 Capt | 90% | 0.00 | Master | Strong | |
| 3.17 2LT | 90% | 0.00 | Basic | Strong | ****Not an *Occupational* Competency |
| 3.17 1LT | 40% | 1.00 | Advanced | None | |
| 3.17 Capt | 60% | 1.00 | Advanced | None | |
| 3.18 2LT | 100% | 0.00 | Basic | Strong | For articulating tasks and responsibilities for other support career fields and directing BOS manpower, 2LTs need a basic level, and 1LTs and Capts need an advance level proficiency. |
| 3.18 1LT | 50% | 1.00 | Advanced | None | |
| 3.18 Capt | 50% | 1.00 | Advanced | None | |
| 3.19 2LT | 90% | 0.00 | Basic | Strong | For communicating tasks to BOS teams and leveraging skillsets, 2LTs need a basic level, 1LTs need an advance level, and Capts need a master level proficiency. |
| 3.19 1LT | 50% | 1.00 | Advanced | None | |
| 3.19 Capt | 60% | 1.00 | Master | None | |
| 3.20 2LT | 90% | 0.00 | Basic | Strong | ***KSAO not required of Civil Engineer CGOs |
| 3.20 1LT | 60% | 1.00 | Basic | None | |
| 3.20 Capt | 40% | 1.50 | Advanced | None | |

* Cells have been shaded based on their calculated consensus metric compared to the thresholds outlined in Table 2 in the Methodology Chapter. Shaded cells indicate achieved consensus.
** Study assumes that a prompt's consensus level classification is equal to the highest threshold met
*** Panel did not come to consensus that the particular KSAO was applicable to Civil Engineer CGOs
**** Panel did not reach consensus that the particular KSAO was specific to Civil Engineer Officers.

Table 9 presents the results of Part 3 of the second round of Delphi. Respondents provided feedback in the form of ordinal data by indicating the level of proficiency (1. Basic, 2. Advanced, 3. Master) that should be achieved by each rank of CGO for each provided competency descriptor. These levels of proficiency were then used to draw the research conclusions presented in the rightmost column. In this stage, the panel was only able to achieve consensus on required proficiency level on 57% of the KSAOs.

### 4.2.3 Round 3:

The results presented in Table 10 display the updated consensus metrics calculated after allowing the panel to review the results of Round 2 and provide their feedback on their agreement with the conclusions. These Round 3 results present the panel's level of consensus for each of the descriptors as well as the conclusion drawn from their feedback. In this round, the panel members reached satisfactory levels on consensus on each of the valid prompts.

**Table 10: Delphi Study Round 3 Results**

| Prompt | *Consensus Measures | Central Tendency | Consensus Level** | ***Research Conclusion |
|---|---|---|---|---|
| | %Mode | Mode | | |
| 3.1 | 100% | Concur | Strong | Consensus achieved on proficiency levels |
| 3.2 | 100% | Concur | Strong | Consensus achieved on proficiency levels |
| 3.3 | 100% | Concur | Strong | Consensus achieved on proficiency levels |
| 3.4 | 100% | Concur | Strong | Consensus achieved on proficiency levels |
| 3.5 | 100% | Concur | Strong | Consensus achieved on proficiency levels |
| 3.6 | 100% | Concur | Strong | Consensus achieved on proficiency levels |
| 3.7 | - | - | - | ****Not an *Occupational* Competency |
| 3.8 | - | - | - | ***Proficiency Not Required of 32E CGO |
| 3.9 | 100% | Concur | Strong | Consensus achieved on proficiency levels |
| 3.10 | 100% | Concur | Strong | Consensus achieved on proficiency levels |
| 3.11 | - | - | - | ***Proficiency Not Required of 32E CGO |
| 3.12 | 83% | Concur | Some | Consensus achieved on proficiency levels |
| 3.13 | 67% | Concur | Some | Consensus achieved on proficiency levels |
| 3.14 | 67% | Concur | Some | Consensus achieved on proficiency levels |
| 3.15 | 100% | Concur | Strong | Consensus achieved on proficiency levels |
| 3.16 | - | - | - | ****Not an *Occupational* Competency |
| 3.17 | - | - | - | ****Not an *Occupational* Competency |
| 3.18 | 67% | Concur | Some | Consensus achieved on proficiency levels |
| 3.19 | 83% | Concur | Some | Consensus achieved on proficiency levels |
| 3.20 | - | - | - | ***Proficiency Not Required for 32E CGO |

* Cells have been shaded based on their calculated consensus metric compared to the thresholds outlined in Table 2 in the Methodology Chapter. Shaded cells indicate achieved consensus.
** This study assumes that a prompt's consensus level classification is equal to the highest threshold met by the individual consensus measures.
*** Panel did not come to consensus that the particular KSAO was applicable to Civil Engineer CGOs and that it is assumed to not be a required competency
**** Panel did not reach consensus that the particular KSAO was specific to Civil Engineer Officers or other Mission Support officer. The KSAO is assumed to not be an occupational competency.

#### 4.2.4 Overall Panel Consensus

Table 11 presents the calculated consensus metrics for each round and part of the Delphi. This table additionally displays the overall panel member consensus level for each part. This was calculated by taking the percentage of prompts in which the panel members came to a "Some" or "Strong" consensus level. As seen by the cell coloring in Table 11, none of the parts in Round 1 achieved overall panel member consensus. As the prompts in Parts 1 and 2 of Round 1 were used again in Parts 1 and 2 of Round 2, change in the level of panel member consensus for these prompts could be calculated. A 10% increase in consensus was achieved for the prompts in Round 1, while there was a 35% increase in the consensus for the prompts presented in Round 2. In both cases, the increase was sufficient to conclude that consensus had been achieved for these prompts.

Round 3 of the study presented the results of Part 3 of Round 2. During this round, the consensus for these proficiency level prompts rose from 57% to 100%. The consensus achieved in Round 3 validates the research conclusions presented in Round 2 and sets the proficiency levels required for each applicable occupational KSAO.

**Table 11: Overall Part Consensus**

| Round | Part | α | M | IQR | Individual Prompt Consensus | Participation Rate |
|---|---|---|---|---|---|---|
| 1 | 1 | 0.690 | 62% | 68% | 68% | 73% |
| | 2 | 0.940 | 64% | 61% | 61% | |
| 2 | 1 | 0.382 | 84% | - | 78% | 91% |
| | 2 | 0.960 | 86% | - | 96% | |
| | 3 | 0.957 | 70% | 52% | 57% | 60% |
| 3 | 1 | 0.70 | 90% | - | 100% | |

Participation rate for Round 1 was calculated by dividing the number of participating panel members by the total number of experts invited to participate in the study. Each subsequent rounds' participation rates were calculating by dividing the number or participating panel members for that round by the number of participants from the previous round.

### 4.2.5 Familiarity Bias:

Familiarity bias in the panel member data was tested for by using a linear regression. In this regression, the relationship between panel member experience ratings and panel member scores were modeled. The analysis of variance performed on this linear model produced a p-value of 0.0027 and a $\beta_1$ value of 0.27. This p-value leads to conclusion that a relationship **does** existing between panel member experience ratings and their prompt scores. The $\beta_1$ value of 0.27 indicates that for every 1 unit increase in panel member experience with a concept (on a scale of 1-5), there was a 27% increase in the scores assigned by participants for the prompt. These findings indicate that the Delphi data may exhibit slight familiarity bias. However, the $R^2$ value of 0.06 for this model suggests that there are other variables aside from experience level that may be responsible for the majority of variation in participant scores.

### 4.2.6 Nonresponse Bias:

The Student's T-test used to identify any significant differences in the opinions of study dropouts and those who participated in all three rounds of expert elicitation concluded that there was no significant statistical difference in responses between panel members who dropped out and the panel as a whole. For Round 1 Part 1, the mean response for participants who dropped out was 4.11 while the mean response for the panel as a whole was 4.164. This produced a t Statistic of 0.0224005 which fell within the $t_{critical, two-tail}$ value of ± 2.0106. This led to the conclusion that there was no significant difference in responses between the two groups. Similarly, in Part 2, the mean response of those participants who dropped out was 2.286 while the mean response for the panel as a whole was 2.234. This produced a t Statistic of 0.35935 which fell within the $t_{critical, two-tail}$ value of ± 2.0154, which also led to the conclusion that no significant difference in responses was measured. These findings suggest that nonresponse bias from study dropouts did not have a significant effect on the results of this expert elicitation.

## 4.3 Competency List Analysis:

Table 12 presents the final list of KSAOs that the Delphi panel members concluded were applicable to and specific to Civil Engineer CGOs operating in with the ACE and MCA models. The Delphi ID column displays the prompt number used in Round 3 of the expert elicitation. In addition to identifying the necessary KSAOs, this table also displays the agreed upon levels of proficiency required for each of these KSAOs.

**Table 12. Validated KSAOs and Proficiency Levels**

| Delphi ID | Knowledge, Skill, Attribute or Other Characteristic | Proficiency Level | | |
|---|---|---|---|---|
| | | Basic | Advanced | Master |
| 3.1 | Lead and leverage the capabilities of the Basic Beddown/Sustainment Team Unit Type Code (UTC) | 2 Lt | 1 Lt | Capt |
| 3.2 | Articulate the Hub and Spoke system of logistics and facilitate travel and allocation of engineer teams between expeditionary locations | 2 Lt | 1 Lt | Capt |
| 3.3 | Lead Forward Operating Site Base Operation Support | 2 Lt | 1 Lt | Capt |
| 3.4 | Anticipate manpower and resource requirements for ACE Base Operation Support (CES, FSS, LRS, SFS) force elements | 2 Lt | 2 Lt | 1 Lt |
| 3.5 | Lead Beddown planning activities including coordinating logistics activities, assessing infrastructure, and developing bare base design | 2 Lt | 1 Lt | Capt |
| 3.6 | Estimate expeditionary food, water, and lodging requirements | 1 Lt | 1 Lt | Capt |
| 3.9 | Activate and manage emergency control centers and effectively communicate using land mobile radios. Process and control work requirements and manage recovery tasks for Civil Engineer, Force Support, Logistics Readiness, and Security Forces force elements. | 2 Lt | 1 Lt | 1 Lt |
| 3.10 | Direct airfield recovery activities, minimum operating strip selection, spall repair, and crater repair using Expedient and Expeditionary Airfield Damage Repair (E-ADR) techniques | 2 Lt | 1 Lt | Capt |
| 3.12 | Leverage nontypical airfield pavement options and techniques to provide temporary and expedient aircraft maintenance, launch, and recovery platforms | 2 Lt | 1 Lt | 1 Lt |
| 3.13 | Coordinate inspection and repair of civilian highways and unimproved pavements for emergency aircraft launch and landing | 2 Lt | 1 Lt | 1 Lt |
| 3.14 | Lead airfield construction and repair projects using emerging Bioconcrete technology or other concrete/asphalt alternatives | 2 Lt | 1 Lt | 1 Lt |
| 3.15 | Exhibit resourcefulness, obtain materials and improvise solutions to execute repair and construction projects in an environment with limited prepositioned materials | 2 Lt | 1 Lt | Capt |
| 3.18 | Articulate Civil Engineer, Force Support, Logistics Readiness, and Security Forces tasks and responsibilities, and direct Base Operations Support manpower to accomplish expeditionary tasks | 2 Lt | 1 Lt | 1 Lt |
| 3.19 | Effectively communicate tasks and responsibilities to Base Operations Support team members and leverage diverse backgrounds and unique skillsets to execute mission requirements | 2 Lt | 1 Lt | Capt |

### 4.3.1 Civil Engineer Officer CFETP Occupational Competency List:

The Civil Engineer officer CFETP identifies seven core competencies of Civil Engineer CGOs. These competencies are broken down into 20 subcompetencies, which are themselves broken down into 79 descriptors. This list of competencies is available in Appendix F. Each of the KSAOs identified in this research were compared with the 79 descriptors to determine if any of the identified requirements were already encompassed within the competency list. From this comparison, two of the KSAO requirements identified during the Delphi were found to already be captured within the existing competency descriptors within the CFETP: “Lead and leverage the capabilities of the Basic Beddown/Sustainment Unit Type Code (UTC)” and “Lead Beddown planning activities to include coordinating logistics activities, assessing existing infrastructure, and developing a bare base design”. The first of these falls under the 4. Beddown Competency, and the latter falls under the 4.1 Beddown Planning subcompetency of the occupational competency framework.

In this comparison, it was also concluded that two ACE and MCA KSAOs, identified in Table 13, call for only minor updates to existing descriptors within the CFETP to capture new ACE requirements. These KSAOs are “Estimate expeditionary food, water, and lodging requirements”, and “Direct airfield recovery activities, minimum operating strip selection, spall repair, and crater repair using Expedient and Expeditionary Airfield Damage Repair (E-ADR) techniques”. The recommended edits to existing descriptors within the CFETP are displayed in column 3 , Table 13.

In comparing the results of this Delphi with the existing competency framework in the CFETP, it was also discovered that several of the KSAOs identified did not fall within the descriptors defined in the CFETP. Table 14 presents the recommended competencies, subcompetencies and descriptors to be added to the Civil Engineer officer occupational competency framework. This table identifies where the new additions should be located and provides proposed wording derived from the verbiage presented to the Delphi panel.

**Table 13: Updates to Existing Competencies**

| Delphi KSAO | Current 32E CFETP Descriptor Verbiage | Updated Competency Descriptors |
|---|---|---|
| 3.6 Estimate expeditionary food, water, and lodging requirements | **4.1 Beddown Planning** "Develop an expeditionary bare base design" | Estimate food, water, and lodging requirements and develop an expeditionary bare base design |
| 3.10 Direct airfield recovery activities, minimum operating strip selection, spall repair, and crater repair using Expedient and Expeditionary Airfield Damage Repair (E-ADR) techniques | **5.2 Post Attack & Disaster** "Organize and direct Rapid Airfield Damage Recovery (RADR) and Base Recovery After Attack (BRAAT) activities" | Organize and direct Base Recovery After Attack (BRAAT) and airfield recovery activities including minimum operating strip selection and crater repair using Expedient and Expeditionary Airfield Damage Repair (E-ADR) and Rapid Airfield Damage Recovery (RADR) techniques. |

**Table 14: Competency, Subcompetency & Descriptor Additions**

| Location | Competency, Subcompetency, Descriptor |
|---|---|
| **New Competency between 4. Beddown and 5. Recovery and Closure** | **x. Base Operations Support (BOS)** |
| | **x.1 Engineer Force Generation Scheme of Maneuver** |
| | Articulate the Hub and Spoke system of logistics and facilitate travel and allocation of engineer teams between expeditionary locations |
| | **x.2 Lead Forward Operating Site BOS Functions** |
| | Anticipate manpower and resource requirements for Agile Combat Employment BOS force elements |
| | Articulate Civil Engineer, Force Support, Logistics Readiness, and Security Forces tasks and responsibilities, and direct BOS manpower to accomplish expeditionary tasks |
| | Effectively communicate tasks and responsibilities to Mission Support team members and leverage diverse backgrounds and unique skillsets to execute mission requirements |
| | Activate and manage emergency control centers and effectively communicate using land mobile radios. Process emerging work requirements and manage recovery tasks for expeditionary BOS force elements. |
| **New Subcompetency within 4. Beddown** | **4.3 Nontypical Airfield Pavements** |
| | Leverage nontypical airfield pavement options and techniques to provide temporary and expedient aircraft maintenance, launch and recovery platforms |
| | Coordinate inspection and repair of civilian highways and unimproved pavements for emergency aircraft launch and landing |
| | Lead airfield construction and repair projects using emerging Bioconcrete technology and other concrete/asphalt alternatives |
| **New Descriptor within 4.2 Build-Up** | Exhibit resourcefulness, obtain materials, and improvise solution to execute repair and construction projects in an environment with limited prepositioned materials |

#### 4.3.3 Air Force Manpower Analysis Agency Manpower Determinants and Standard Work Documents:

The Air Force Manpower Analysis Agency (AFMAA) maintains the Management Engineer Program (MEP) Library which maintains manpower determinants, and Standard Work Documents, SWDs, for all Air Force Functions. These documents identify required mission capabilities for airmen belonging to each function as well as standard operational responsibilities of the functional team. For the Civil Engineer career field, the MEP library breaks down each of the typical Civil Engineer Squadron's Flights, Elements, and Sections, and for each of these sections provides manpower determinants and SWDs.

When investigating this collection of Civil Engineer Squadron manpower determinants and SWDs, it was discovered that this collection does not specifically address requirements of Civil Engineer Company Grade officers. Additionally, the documents within this library do not provide much detail on Civil Engineer requirements specific to expeditionary or deployed operations, such as varying standard work schedules or operating in an environment with chemical, biological, or nuclear threats, and include **no** reference to ACE or MCA operations. Consequently, there was no overlap between the AFMAA's MEP Library and the 32E ACE and MCA learning requirements identified in this research.

#### 4.3.3 USAF Expeditionary Center's Tier 1 Multi Capable Airmen Course:

Table 15 presents the lesson plan list for the Expeditionary Center's Tier 1 Multi-capable Airmen course. This course was developed to provide airmen identified as MCA team-members with instructor-led discussion, hands-on training, and exercise scenarios to develop expeditionary skillsets and introduce the BOS and C2 roles within the ACE and MCA concepts. Two of the lessons laid out in this course directly relate to the newly identified competencies applicable to Civil Engineer CGOs operating within the ACE and CMA models: Air Base Operational Site

Planning and Bed-down Familiarization, and Basic Communication Fundamentals. The air base operational site planning course help build familiarization in the updated Beddown Planning descriptor observed in Table 13. This lesson integrates ACE and MCA planning factors into Civil Engineer beddown planning procedures and builds proficiency in this subcompetency. The Basic Communication Fundamentals lesson provides hands-on training with land mobile radios and other expeditionary means of communication and build proficiency in the "Activate and manage emergency control centers" descriptor within the newly identified BOS competency. While this lesson does provide training on expeditionary communication, it does not build proficiency in *all* of the KSAOs required within this descriptor, such as managing control centers or processing BOS force element work tasks.

**Table 15: Tier 1 MCA Training Course Lesson List**

| LP # | Lesson | Lesson Length (hr.) |
|---|---|---|
| 1 | ACE/MCA Fundamentals | 1 |
| 2 | Rules of Engagement | 1 |
| 3 | Escalation of Force | 1 |
| 4 | Use of Force | 1 |
| 5 | Basic Communications | 2 |
| 6 | NVD Components and Functions | 5.5 |
| 7 | Weapon Sustainment (M4/M9) Fundamentals | 2 |
| 8 | Weapon Zeroing | 2.5 |
| 9 | Day/Night Live Fire | 5.5 |
| 10 | Tactical Movements Fundamentals | 8 |
| 11 | Tactical Combat Casualty Care | 8 |
| 12 | Self-Protection Fundamentals | 8 |
| 13 | Improvised Explosive Devices/Unexploded Ordinance Recognition | 5.5 |
| 14 | MCA Team Operations | 3.5 |
| 15 | Cargo Preparation Familiarization | 4.5 |
| 16 | Air Base Operational Site Planning and Bed-down Familiarization | 5 |
| 17 | Static Defense | 5 |

#### 4.3.4 AFI 10-210 Prime Base Engineer Emergency Force (BEEF) Program

Table A2.1 of AFI 10-210 Prime Base Engineer Emergency Force (BEEF) Program presents various training requirements for Civil Engineer Officers and other Civil Engineer Airmen. A consolidated list of these requirements which apply to Civil Engineer officers is presented in Appendix G. Several of the training requirements laid out within the document relate to the competencies identified in this research. Three of these training requirements aid in building proficiency for the updated **4.1 Beddown Planning** descriptor: Estimate food, water, and lodging requirements and develop an expeditionary bare base design. These training courses outlined in 10-210 are Planning and Design of Expeditionary Airbases, the Bare Base Conceptual Planning course, and the Bare Base Overview course. While these three training requirements do aid in developing Beddown planning knowledge and skills, the Planning and Design course is introductory in nature and the two Bare Base courses introduce Beddown planning concepts at a basic level of proficiency.

Three training requirements identified in 10-210 apply to one of the descriptors within the newly identified Base Operations Support competency: Activate and manage emergency control centers. These courses are the Tactical Communications Course, the Control Center Operations (CCO) course, and Silver Flag. The Tactical Communications Course introduces the fundamentals of operating with land mobile radios. While this course is offered via computer-based learning at a fundamental level, when paired with hands-on training, it can build proficiency in this skill. The CCO course also builds proficiency in this descriptor by introducing emergency control centers. This course is offered via computer-based learning and only introduces concepts as a basic level and does not develop high levels of proficiency on its own. This skillset is better honed through training exercises and real-world events as opposed to computer-based learning.

The final course required within AFI 10-210 that build proficiency in the newly identified ACE and MCA competencies is Silver Flag. As discussed in the Literature Review Chapter of this thesis, Silver Flag is a 10-day training course in which airmen receive classroom instruction and hands-on training for air base Beddown and recovery. One emphasis of this course is post-attack and disaster recovery, which directly relates to updated descriptor for **5.2 Post Attack & Disaster** in Table 13. This course builds a high level of proficiency in base recovery and aircraft recovery activities, including minimum operating strip selection and crater repair.

# V. Conclusion

## 5.1 Summary of Results

Through this research, the operational requirements of ACE and MCA were assessed in the context of the Civil Engineer Officer occupational competency framework. Utilizing a textual analysis and expert elicitation, the occupational competency requirements for Civil Engineer CGOs were identified and compared with the existing competency framework. Through this comparison, it was discovered that 10 of the 14 occupational competency requirements were not captured in the current 32E occupational competency model. Several new competencies, subcompetencies and descriptors were drafted to capture these identified operational requirements. In order to update the current 32E occupational competency framework, the results of this investigation and these proposed competency additions should be presented to the Air Force civil Engineer Education and Training Review Committee for consideration.

In this investigation, the recommended ACE and MCA competency requirements were compared with the courses available at the USAF Expeditionary Center's MCA course and in AFI 10-210: Prime BEEF program to identify avenues for Civil Engineer CGOs to build proficiency in these newly identified competencies. To further determine if these competency requirements are addressed in available education and training opportunities, the list developed in this study should be compared to the lesson objectives of the courses offered by The Civil Engineer School. These course offering are the primary avenue of professional development for Civil Engineer CGOs. TCES courses are organized into several portfolios which group together courses addressing similar categories of competencies. The Readiness and CE Leadership portfolios of courses is most likely to offer education pertaining to the competencies identified in this investigation.

## 5.2 Recommendation for future research

In addition to exploring the full-scope of educational offered by TCES with respect to these recommended additions to the Civil Engineer officer occupational competencies list, a general reinvestigation of the occupational competencies list as a whole is recommended. Feedback from several panel members suggested a review of the existing occupational competency list was necessary to refine the requirements and meet operational needs. These participants expressed interest in trimming away nonessential skillsets to tailor and align the requirements list to meet emerging DoD and HAF strategies and initiatives. Finally, as the scope of this investigation was limited to Civil Engineer *Company* Grade Officers, it fails to address the occupational competencies of Civil Engineer Field Grade Officers, FGOs, or officers in other BOS career fields operating with Civil Engineers within the ACE construct. Further research should be accomplished to identify the ACE and MCA requirements for these career fields and incorporate new competency requirements into their education and training opportunities. This future research can incorporate the literature review results and expert elicitation methodology used in this study to identify the ACE and MCA requirements of the target BOS career field.

Finally, the methodology, as well as the feedback provided during the expert elicitation should be applied to the Civil Engineer EOD and Red HORSE career fields. ACE and MCA likely bring about new operational requirements for these two organizations which may have not been realized through this investigation. Additionally, this methodology can be used to investigate how Civil Engineer enlisted AFSCs operate withing the ACE and MCA models in order to tailer their training and education to meet new operational demands.

## Appendix A: List of Acronyms

**ACE: Agile Combat Employment**

**AFFORGEN: Air Force Force Generation**

**AFSC: Air Force Specialty Code**

**BOS: Base Operation Support**

**C2: Command and Control**

**CBE: Competency-Based Education**

**CFETP: Career Field Education and Training Plan**

**CGO: Company Grade Officer**

**CL: Contingency Location**

**DoD: Department of Defense**

**E-ADR: Expedient and Expeditionary Airfield Damage Repair**

**EOD: Explosive Ordnance Disposal**

**FGO: Field Grade Officer**

**FOS: Forward Operating Site**

**HAF: Headquarters, Air Force**

**IQR: Interquartile Range**

**IRB: Institutional Review Board**

**KSAO: Knowledge, Skills, Abilities, and Other Characteristics**

**M: Mode**

**MAJCOM: Major Command**

**MCA: Multi-Capable Airmen**

**MG: Mission Generation**

**MOB: Main Operating Base**

**MSS: Multi-Skilled Soldier**

**REDHORSE: Rapid Engineer Deployable Heavy Operational Repair Squadron Engineer**

**RWG: Readiness Working Group**

**TCES: The Civil Engineer School**

**UTC: Unit Type Code**

# Appendix B: Round 1 Delphi Questionnaire

Thank you for your participation in the following Delphi Study for Expert Elicitation.
The results of this study will be used to investigate potential occupational competencies for Civil Engineer Company Grade Officers deploying in support of Agile Combat Employment Operations and operating in a Multi-Capable Airmen environment.
With this information, Civil Engineer Company Grade Officer education and training curriculum may be modified to better prepare the force for newly operationalized Agile Combat Employment and its enabler, the Multi-Capable Airman concept.
Your individual responses to these prompts will remain anonymous and will not be linked with your name, duty title or position. This questionnaire is the first of several in a Delphi study to identify potential new Civil Engineer occupational competencies and will provide the data for an academic thesis to be presented to the Air Force Institute of Technology. The Air Force Civil Engineer Center and The Civil Engineer School are the sponsors of this research and may receive additional literary works deriving from this thesis such as a white paper.

**Part I**

**Instructions** For Part I, please indicate to level to which you agree with the following statements on Civil Engineer Company Grade Officer operating in an Agile Combat Employment and Multi-Capable Airmen Environment by placing an "X" within the applicable cell.
The prompts in part one are derived from suggested expected tasks or applicable Knowledge, Skills, Attributes and Other characteristics, KSAOs, related to Agile Combat Employment and Multi-Capable Airmen.
These tasks and KSAOs were identified through review of Air Force documentation related to ACE/MCA, discussions with individuals that have participated in ACE exercises, a review of existing MCA training curriculum, a review of literature regarding the Army's Multiskilled Soldier, and an academic literature review of competencies required of leaders of multifunctional teams.

| Number | Prompt | 1 Highly Disagree | 2 Slightly Disagree | 3 Neutral | 4 Slightly Agree | 5 Highly Agree | Panel Member Feedback | In the space below, please indicate the level of expertise with or knowledge of the topic |
|---|---|---|---|---|---|---|---|---|
| 1.1 | Civil Engineer Company Grade Officers will be tasked to deploy in support of Agile Combat Employment operations | | | | | | | |
| **1.2** | Civil Engineer Company Grade Officers will be the ranking member of Basic Beddown/Sustain UTCs in support of Agile Combat Employment Operations | | | | | | | |
| 1.3 | Civil Engineer Company Grade Officers should be able to understand the Hub and Spoke system of logistics and be able to manage engineer team allocations between Contingency Locations and Forward Operating Sites and facilitate their travel | | | | | | | |
| **1.4** | Civil Engineer Company Grade Officers will be asked to lead all Base Operation Support tasks during an ACE deployment to include Civil Engineer, Force Support, Logistics Readiness, and Security Forces force elements, i.e. FOS camp commander | | | | | | | |
| 1.5 | Civil Engineer Company Grade Officers should be able to anticipate manpower and resource requirements for all ACE Base Operation Support (CES, FSS, LRS, SFS) force elements | | | | | | | |
| **1.6** | Civil Engineer Company Grade Officers will lead all base Beddown planning activities including coordinating logistics activities, assessing existing infrastructure, and developing a bare base design during an ACE deployment | | | | | | | |
| 1.7 | Civil Engineer Company Grade Officers should be able to estimate food, water, and lodging requirements in support of ACE deployments | | | | | | | |
| **1.8** | Civil Engineer Company Grade Officers will be tasked to lead multi-craft teams of CES, FSS, LRS, and SFS personnel to execute a base buildup in support of ACE operations | | | | | | | |
| 1.9 | Civil Engineer Company Grade Officers should be able to understand and articulate Civil Engineer, Force Support, Logistics Readiness, and Security Forces equipment requirements and be able to facilitate resolution of technical equipment issues | | | | | | | |
| **1.10** | Civil Engineer Company Grade Officers will activate and manage an emergency control center in support of ACE operations requiring: effective communications skills using land mobile radios, processing and controlling of work requirements, and management of recovery tasks for Civil Engineer, Force Support, Logistics Readiness, and Security Forces force elements | | | | | | | |
| 1.11 | Civil Engineer Company Grade Officers will participate in ACE mission generation activities to include aircraft maintenance, flightline operation, and refueling of aircraft | | | | | | | |
| **1.12** | Civil Engineer Company Grade Officers will direct airfield recovery activities to include minimum operating strip selection, spall repair, and crater repair using Expedient and Expeditionary Airfield Damage Repair (E-ADR) techniques | | | | | | | |
| 1.13 | Civil Engineer Company Grade Officers will direct siting and installation of an Aircraft Arresting System in support of ACE operations | | | | | | | |
| **1.14** | Civil Engineer Company Grade Officers will be tasked with managing sustainment operations for nontypical airfield pavements such as civilian highways, unimproved surfaces, or emerging alternatives to traditional concrete or asphalt | | | | | | | |
| 1.15 | Civil Engineer Company Grade Officers will need to coordinate the inspection and repair of existing unimproved pavements or civilian highways to be used as an aircraft launch and recovery platform | | | | | | | |
| **1.16** | Civil Engineer Company Grade Officers will lead airfield construction and repair projects using emerging Bioconcrete technology or other concrete/asphalt alternatives | | | | | | | |
| 1.17 | Agile Combat Employment operations will take place in a contested environment with no guarantee of air superiority | | | | | | | |
| **1.18** | Civil Engineer Company Grade Officers operating in a contested environment will be required to display mental agility by: utilizing critical thinking to deal with complex situations and produce complex solutions, adapting to unpredictability and the unexpected, and viewing situation from multiple perspectives | | | | | | | |
| 1.19 | Civil Engineer Company Grade Officers will be required to exhibit resourcefulness, obtain materials and improvise solutions to execute repair and construction projects in an environment with limited prepositioned materials | | | | | | | |
| **1.20** | Civil Engineer Company Grade Officers will be tasked to develop and execute an asset dispersal plan including personnel, materiel, munitions, fuel, and aircraft | | | | | | | |
| 1.21 | Civil Engineer Company Grade Officers will be asked to execute collective passive defense techniques to include hardening and concealing of critical assets | | | | | | | |
| **1.22** | Civil Engineer Company Grade Officers will lead multi-capable teams of airmen consisting of CES, FSS, LRS, and SFS personnel on Agile Combat Employment operations | | | | | | | |
| 1.23 | Civil Engineer Company Grade Officers leading a multi-capable team must be able to understand Civil Engineer, Force Support, Logistics Readiness, and Security Forces force element tasks and responsibilities and be able to direct BOS-I manpower | | | | | | | |
| **1.24** | Civil Engineer Company Grade Officers must be able to effectively communicate tasks and responsibilities to BOS-I team members and leverage diverse backgrounds and unique skillsets to execute mission requirements | | | | | | | |
| 1.25 | Civil Engineer Company Grade Officers will be required to manage base defense operations including entry control points and perimeter defense and be required to display proficiency in advanced combat skills to include weapons handling, individual troop movement, and combat lifesaving | | | | | | | |

# Appendix B: Round 1 Delphi Questionnaire (Cont.)

| Part II | | | | | | | |
|---|---|---|---|---|---|---|---|
| Instructions | For Part II, please indicate if the following competencies or subcompetencies are foundational competencies universally applicable to all USAF Service Members or Occupational Competencies specific to the Civil Engineer Company Grade Officer career field. If you believe that the given prompt is applicable to mission support personnel (as opposed to operations, maintenance or medical AFSCs), select the neutral category. Place an "X" within the applicable cell to indicate your answer.<br>Provide any necessary feedback in the "Panel Member Feedback" cell to provide details on applicable AFSCs, request clarification, or offer recommendations. | | | | | | |
| **Number** | **Prompt** | **1<br>Foundational<br>(All AFSCs)** | **2<br>Neutral<br>(MSG/ACS AFSCs)** | **3<br>Occupational<br>(32E)** | **4<br>Not Applicable** | | **Panel Member Feedback** |
| 2.1 | Articulate the Agile Combat Employment Scheme of Maneuver | | | | | | |
| **2.2** | Lead and leverage the capabilities of the Basic Beddown/Sustainment Team Unit Type Code (UTC) | | | | | | |
| 2.3 | Articulate the Hub and Spoke system of logistics and facilitate travel and allocation of engineer teams between expeditionary locations | | | | | | |
| **2.4** | Lead Forward Operating Site Base Operation Support | | | | | | |
| 2.5 | Anticipate manpower and resource requirements for Agile Combat Employment Base Operation Support (CES, FSS, LRS, SFS) force elements | | | | | | |
| **2.6** | Lead Beddown planning activities to include coordinating logistics activities, assessing existing infrastructure, and developing a bare base design | | | | | | |
| 2.7 | Estimate expeditionary food, water, and lodging requirements | | | | | | |
| **2.8** | Lead Multi-craft teams to execute base build-up | | | | | | |
| 2.9 | Anticipate and Articulate equipment requirements for Civil Engineer, Force Support, Logistics Readiness, and Security Forces force elements and facilitate resolution of technical issues | | | | | | |
| **2.10** | Activate and manage emergency control centers and effectively communicate using land mobile radios. Process and control work requirements and manage recovery tasks for Civil Engineer, Force Support, Logistics Readiness, and Security Forces force elements. | | | | | | |
| 2.11 | Perform aircraft maintenance, flightline operations, and aircraft refueling tasks | | | | | | |
| **2.12** | Direct airfield recovery activities, minimum operating strip selection, spall repair, and crater repair using Expedient and Expeditionary Airfield Damage Repair (E-ADR) techniques | | | | | | |
| 2.13 | Direct siting and installation of Aircraft Arresting Systems | | | | | | |
| **2.14** | Leverage nontypical airfield pavement options and techniques to provide temporary and expedient aircraft maintenance, launch, and recovery platforms | | | | | | |
| 2.15 | Coordinate inspection and repair of civilian highways and unimproved pavements for emergency aircraft launch and landing | | | | | | |
| **2.16** | Lead airfield construction and repair projects using emerging Bioconcrete technology or other concrete/asphalt alternatives | | | | | | |
| 2.17 | Display mental agility by: utilizing critical thinking to deal with complex situations and produce complex solutions, adapting to unpredictability and the unexpected, and viewing situation from multiple perspectives | | | | | | |
| **2.18** | Exhibit resourcefulness, obtain materials and improvise solutions to execute repair and construction projects in an environment with limited prepositioned materials | | | | | | |
| 2.19 | Develop and execute and asset dispersal plan to include: personnel, materiel, munitions, fuel, and aircraft | | | | | | |
| **2.20** | Execute collective passive defense techniques to include hardening and concealing critical assets | | | | | | |
| 2.21 | Articulate Civil Engineer, Force Support, Logistics Readiness, and Security Forces tasks and responsibilities, and direct Base Operations Support manpower to accomplish expeditionary tasks | | | | | | |
| **2.22** | Effectively communicate tasks and responsibilities to Base Operations Support team members and leverage diverse backgrounds and unique skillsets to execute mission requirements | | | | | | |
| 2.23 | Manage base defense operations, entry control points, and perimeter defense for austere sites and display proficiency in advanced combat skills, weapons handling, individual troop movement techniques, and combat lifesaving | | | | | | |

| Part III | | |
|---|---|---|
| Instructions | For Part III, please use the available space to answer the two following open ended questions | |
| **Number** | **Prompt** | |
| 3.1 | Are there any tasks or responsibilities for Civil Engineer Company Grade officers relevant to Agile Combat Employment or the Multi-Capable Airmen Concept that, in your opinion, should be translated into an occupational competency and added to this preliminary list of potential competencies | |
| **3.2** | Are there any additional knowledge, skills, attributes, or individual characteristics for Civil Engineer Company Grade Officers related to Agile Combat Employment and the Multi-Capable Airman concept which were not encompassed within this preliminary list of competencies | |

# Appendix C: Round 2 Delphi Questionnaire

| | |
|---|---|
| **Part I** | Review of Round 1 Part 1 results |
| **Instruction** | This round presents the results and conclusions of Part 1, Round 1 of the Delphi study. The red boxes within columns D - H indicate the most popular answers provided by the panel for each of the prompts as well as the percentage of experts who selected that value.<br>Each prompt is also color coded. **GREEN** indicates that a strong concensus was observed between experts. YELLOW indicates that there was some concensus in answers between experts. And **RED** indicates that no concensus was reached for that prompt.<br>Please complete columns K and L of this spread sheet to indicate if you agree with the majority's answers and conclusions of Round 1 and to provide feedback on those results that you do not concur with.<br>These prompts were dervied from reviewing ACE and MCA publications, installation ACE exercises and briefings, and a literature review on competencies of military leaders in expeditionary environments and leaders of multi-capable teams. |

| **Number** | **Prompt** | **1 Highly Disagree** | **2 Slightly Disagree** | **3 Neutral** | **4 Slightly Agree** | **5 Highly Agree** | **Research Conclusion** | **Do you concur with the resulting research conculsion? (Y/N)** | **If you non-concur, please comment on why** |
|---|---|---|---|---|---|---|---|---|---|
| 1.1 | Civil Engineer Company Grade Officers will be tasked to deploy in support of Agile Combat Employment operations | | | | | 100% | CE CGOs will deploy for ACE | | |
| **1.2** | Civil Engineer Company Grade Officers will be the ranking member of Basic Beddown/Sustain UTCs in support of Agile Combat Employment Operations | | | | | 38% | No conclusion due to lack of consensus, though majority agrees | | |
| 1.3 | Civil Engineer Company Grade Officers should be able to understand the Hub and Spoke system of logistics and be able to manage engineer team allocations between Contingency Locations and Forward Operating Sites and facilitate their travel | | | | | 88% | CE CGOs should understand hub and spoke and be able to manage movement of CE troops between ACE locations | | |
| **1.4** | Civil Engineer Company Grade Officers will be asked to lead all Base Operation Support tasks during an ACE deployment to include Civil Engineer, Force Support, Logistics Readiness, and Security Forces force elements, i.e. FOS camp commander | | | | | 50% | No conclusion due to lack of consensus, though majority agrees | | |
| 1.5 | Civil Engineer Company Grade Officers should be able to anticipate manpower and resource requirements for all ACE Base Operation Support (CES, FSS, LRS, SFS) force elements | | 25% | | | | No conclusion due to lack of consensus, though majority disagrees | | |
| **1.6** | Civil Engineer Company Grade Officers will lead all base Beddown planning activities including coordinating logistics activities, assessing existing infrastructure, and developing a bare base design during an ACE deployment | | | | | 75% | CE CGOs should be able to lead all Beddown planning activities | | |
| 1.7 | Civil Engineer Company Grade Officers should be able to estimate food, water, and lodging requirements in support of ACE deployments | | | | | 100% | CE CGOs should be able to estimate food, water and lodging requirements for ACE | | |
| **1.8** | Civil Engineer Company Grade Officers will be tasked to lead multi-craft teams of CES, FSS, LRS, and SFS personnel to execute a base buildup in support of ACE operations | | | | | 63% | CE CGOs should be able to lead multi-craft teams of the listed personnel for base buildup | | |
| 1.9 | Civil Engineer Company Grade Officers should be able to understand and articulate Civil Engineer, Force Support, Logistics Readiness, and Security Forces equipment requirements and be able to facilitate resolution of technical equipment issues | | | | | 50% | No conclusion due to lack of consensus, though majority agrees | | |
| **1.10** | Civil Engineer Company Grade Officers will activate and manage an emergency control center in support of ACE operations requiring: effective communications skills using land mobile radios, processing and controlling of work requirements, and management of recovery tasks for Civil Engineer, Force Support, Logistics Readiness, and Security Forces force elements | | | | 50% | | CE CGOs should be able to manage and activate control centers, effectively use LMRs, and manage recovery activities for Base Operation Support functions | | |
| 1.11 | Civil Engineer Company Grade Officers will participate in ACE mission generation activities to include aircraft maintenance, flightline operation, and refueling of aircraft | | 50% | | | | CE CGOs will likely not participate in mission generation functions | | |
| **1.12** | Civil Engineer Company Grade Officers will direct airfield recovery activities to include minimum operating strip selection, spall repair, and crater repair using Expedient and Expeditionary Airfield Damage Repair (E-ADR) techniques | | | | | 100% | CE CGOs should be able to direct airfield recovery tasks | | |
| 1.13 | Civil Engineer Company Grade Officers will direct siting and installation of an Aircraft Arresting System in support of ACE operations | | | | | 38% | No conclusion due to lack of consensus, though majority agrees | | |
| **1.14** | Civil Engineer Company Grade Officers will be tasked with managing sustainment operations for nontypical airfield pavements such as civilian highways, unimproved surfaces, or emerging alternatives to traditional concrete or asphalt | 38% | | | | | No conclusion due to lack of consensus, though majority disagrees | | |
| 1.15 | Civil Engineer Company Grade Officers will need to coordinate the inspection and repair of existing unimproved pavements or civilian highways to be used as an aircraft launch and recovery platform | | | | | 63% | CE CGOs should be able to coordinate inspection and repair of unimproved pavements and civilian highways to be used as launch and recovery platforms | | |
| **1.16** | Civil Engineer Company Grade Officers will lead airfield construction and repair projects using emerging Bioconcrete technology or other concrete/asphalt alternatives | | | | | 38% | No conclusion due to lack of consensus, though majority agrees | | |
| 1.17 | Agile Combat Employment operations will take place in a contested environment with no guarantee of air superiority | | | | | 88% | CE CGOs should be able to operate in a contested environment | | |
| **1.18** | Civil Engineer Company Grade Officers operating in a contested environment will be required to display mental agility by: utilizing critical thinking to deal with complex situations and produce complex solutions, adapting to unpredictability and the unexpected, and viewing situation from multiple perspectives | | | | | 100% | CE CGOs should exhibit mental agility as described | | |
| 1.19 | Civil Engineer Company Grade Officers will be required to exhibit resourcefulness, obtain materials and improvise solutions to execute repair and construction projects in an environment with limited prepositioned materials | | | | | 88% | CE CGOs should exhibit resourcefulness to execute construction and repair projects with limited prepositioned materials | | |
| **1.20** | Civil Engineer Company Grade Officers will be tasked to develop and execute an asset dispersal plan including personnel, materiel, munitions, fuel, and aircraft | | | | | 63% | CE CGOs should be able to develop and execute an asset dispersal plan | | |
| 1.21 | Civil Engineer Company Grade Officers will be asked to execute collective passive defense techniques to include hardening and concealing of critical assets | | | | | 75% | CE CGOs should be able to execute passive defense techniques | | |
| **1.22** | Civil Engineer Company Grade Officers will lead multi-capable teams of airmen consisting of CES, FSS, LRS, and SFS personnel on Agile Combat Employment operations | | | | | 50% | CE CGOs should be able to lead multi-capable teams of support personnel | | |
| 1.23 | Civil Engineer Company Grade Officers leading a multi-capable team must be able to understand Civil Engineer, Force Support, Logistics Readiness, and Security Forces force element tasks and responsibilities and be able to direct BOS manpower | | | | | 63% | CE CGOs should be able to understand the tasks and responsibilities of CE, FSS, LRS and SFS personnel within their multi-capable teams | | |
| **1.24** | Civil Engineer Company Grade Officers must be able to effectively communicate tasks and responsibilities to BOS team members and leverage diverse backgrounds and unique skillsets to execute mission requirements | | | | | 88% | CE CGOs should be able to communicate with, operate with, and lead team members from other support career fields | | |
| 1.25 | Civil Engineer Company Grade Officers will be required to manage base defense operations including entry control points and perimeter defense and be required to display proficiency in advanced combat skills to include weapons handling, individual troop movement, and combat lifesaving | | | | 38% | | No conclusion due to lack of consensus, though majority agrees | | |

# Appendix C: Round 2 Delphi Questionnaire (Cont.)

| | | | | | | | | |
|---|---|---|---|---|---|---|---|---|
| **Part II** | Review of Round 1 Part 2 results | | | | | | | |
| **Instruction** | As above, please complete columns K and L to indicate if you concur with the results of the panel as a whole. | | | | | | | |
| **Number** | **Prompt** | **1 Foundational (All AFSCs)** | **2 Neutral (MSG/ACS AFSCs)** | **3 Occupational (32E)** | **4 Not Applicable** | **Research Conclusion** | **Do you concur with the resulting research conculsion? (Y/N)** | **If you non-concur, please comment on why** |
| 2.1 | Articulate the Agile Combat Employment Scheme of Maneuver | 50% | | | | No conclusion due to lack of consensus, though majority agree skill is foundational | | |
| **2.2** | Lead and leverage the capabilities of the Basic Beddown/Sustainment Team Unit Type Code (UTC) | | | 50% | | No conclusion due to lack of consensus, though majority agree skill is specific to 32E | | |
| 2.3 | Articulate the Hub and Spoke system of logistics and facilitate travel and allocation of engineer teams between expeditionary locations | | | 50% | | No conclusion due to lack of consensus, though majority agree skill is specific to 32E | | |
| **2.4** | Lead Forward Operating Site Base Operation Support | | 75% | | | This skill is applicable to both CE CGOs as well as other MSG officers | | |
| 2.5 | Anticipate manpower and resource requirements for Agile Combat Employment Base Operation Support (CES, FSS, LRS, SFS) force elements | | 88% | | | This skill is applicable to both CE CGOs as well as other MSG officers | | |
| **2.6** | Lead Beddown planning activities to include coordinating logistics activities, assessing existing infrastructure, and developing a bare base design | | | 88% | | This skill is specific to CE officers | | |
| 2.7 | Estimate expeditionary food, water, and lodging requirements | | | 63% | | No conclusion due to lack of consensus, though majority agree skill is specific to 32E | | |
| **2.8** | Lead Multi-craft teams to execute base build-up | | | 88% | | This skill is specific to CE officers | | |
| 2.9 | Anticipate and Articulate equipment requirements for Civil Engineer, Force Support, Logistics Readiness, and Security Forces force elements and facilitate resolution of technical issues | | 88% | | | This skill is applicable to both CE CGOs as well as other MSG officers | | |
| **2.10** | Activate and manage emergency control centers and effectively communicate using land mobile radios. Process and control work requirements and manage recovery tasks for Civil Engineer, Force Support, Logistics Readiness, and Security Forces force elements. | | | 50% | | No conclusion due to lack of consensus, though majority agree skill is specific to 32E | | |
| 2.11 | Perform aircraft maintenance, flightline operations, and aircraft refueling tasks | | | | 63% | No conclusion due to lack of consensus, though majority agree skill is not applicable | | |
| **2.12** | Direct airfield recovery activities, minimum operating strip selection, spall repair, and crater repair using Expedient and Expeditionary Airfield Damage Repair (E-ADR) techniques | | | 88% | | This skill is specific to CE officers | | |
| 2.13 | Direct siting and installation of Aircraft Arresting Systems | | | 88% | | This skill is specific to CE officers | | |
| **2.14** | Leverage nontypical airfield pavement options and techniques to provide temporary and expedient aircraft maintenance, launch, and recovery platforms | | | 88% | | This skill is specific to CE officers | | |
| 2.15 | Coordinate inspection and repair of civilian highways and unimproved pavements for emergency aircraft launch and landing | | | 88% | | This skill is specific to CE officers | | |
| **2.16** | Lead airfield construction and repair projects using emerging Bioconcrete technology or other concrete/asphalt alternatives | | | 88% | | This skill is specific to CE officers | | |
| 2.17 | Display mental agility by: utilizing critical thinking to deal with complex situations and produce complex solutions, adapting to unpredictability and the unexpected, and viewing situation from multiple perspectives | 75% | | | | This skill is applicable to all AFSC | | |
| **2.18** | Exhibit resourcefulness, obtain materials and improvise solutions to execute repair and construction projects in an environment with limited prepositioned materials | | | 63% | | No conclusion due to lack of consensus, though majority agree skill is specific to 32E | | |
| 2.19 | Develop and execute and asset dispersal plan to include: personnel, materiel, munitions, fuel, and aircraft | 50% | | | | No conclusion due to lack of consensus, though majority agree skill is foundational | | |
| **2.20** | Execute collective passive defense techniques to include hardening and concealing critical assets | 38% | | | | No conclusion due to lack of consensus, though majority agree skill is foundational | | |
| 2.21 | Articulate Civil Engineer, Force Support, Logistics Readiness, and Security Forces tasks and responsibilities, and direct Base Operations Support manpower to accomplish expeditionary tasks | | 88% | | | This skill is applicable to both CE CGOs as well as other MSG officers | | |
| **2.22** | Effectively communicate tasks and responsibilities to Base Operations Support team members and leverage diverse backgrounds and unique skillsets to execute mission requirements | | 75% | | | This skill is applicable to both CE CGOs as well as other MSG officers | | |
| 2.23 | Manage base defense operations, entry control points, and perimeter defense for austere sites and display proficiency in advanced combat skills, weapons handling, individual troop movement techniques, and combat lifesaving | | 63% | | | This skill is applicable to both CE CGOs as well as other MSG officers | | |

# Appendix C: Round 2 Delphi Questionnaire (Cont.)

| | | | | | |
|---|---|---|---|---|---|
| **Part III** | Exploring Levels of Proficiency | | | | |
| **Instructions** | In Part III, for each rank of Civil Engineer CGO, please indicate the proficiency level that should be attained for each of the descriptors and subcompetencies listed. Below is the criteria for each of the three defined levels of proficiency as found in the 2020 32E CFETP | | | | |
| | *Basic - Comprehension of basic order of tasks, requires guidance and supervision, skills learned are at a foundational level<br>Advanced - member can perform most tasks with limited guidance and supervision with some errors. Skills learned allow members to apply foundational knowledge with effectiveness in a dynamic work environment.<br>Master - Member can consistently complete tasks with little to no supervision. Member can create products beyond the advanced level. | | | | |
| **Number** | **Prompt** | **2 Lt** | **1 Lt** | **Capt** | **Panel Member Feedback** |
| **ex** | Lead a multi-disciplinary team executing troop construction projects (adapted from 2020 32E CFETP Beddown Competency) | Advanced | Master | Master | |
| **ex 2** | Lead Civil Engineer Unit Control Center (UCC) operations and coordinate response to contingencies (adapted from 2020 32E CFETP Recovery and Closure Competency) | Basic | Advanced | Master | |
| **3.1** | Lead and leverage the capabilities of the Basic Beddown/Sustainment Team Unit Type Code (UTC) | | | | |
| **3.2** | Articulate the Hub and Spoke system of logistics and facilitate travel and allocation of engineer teams between expeditionary locations | | | | |
| **3.3** | Lead Forward Operating Site Base Operation Support | | | | |
| **3.4** | Anticipate manpower and resource requirements for Agile Combat Employment Base Operation Support (CES, FSS, LRS, SFS) force elements | | | | |
| **3.5** | Lead Beddown planning activities to include coordinating logistics activities, assessing existing infrastructure, and developing a bare base design | | | | |
| **3.6** | Estimate expeditionary food, water, and lodging requirements | | | | |
| **3.7** | Lead Multi-craft teams to execute base build-up | | | | |
| **3.8** | Anticipate and Articulate equipment requirements for Civil Engineer, Force Support, Logistics Readiness, and Security Forces force elements and facilitate resolution of technical issues | | | | |
| **3.9** | Activate and manage emergency control centers and effectively communicate using land mobile radios. Process and control work requirements and manage recovery tasks for Civil Engineer, Force Support, Logistics Readiness, and Security Forces force elements. | | | | |
| **3.10** | Direct airfield recovery activities, minimum operating strip selection, spall repair, and crater repair using Expedient and Expeditionary Airfield Damage Repair (E-ADR) techniques | | | | |
| **3.11** | Direct siting and installation of Aircraft Arresting Systems | | | | |
| **3.12** | Leverage nontypical airfield pavement options and techniques to provide temporary and expedient aircraft maintenance, launch, and recovery platforms | | | | |
| **3.13** | Coordinate inspection and repair of civilian highways and unimproved pavements for emergency aircraft launch and landing | | | | |
| **3.14** | Lead airfield construction and repair projects using emerging Bioconcrete technology or other concrete/asphalt alternatives | | | | |
| **3.15** | Exhibit resourcefulness, obtain materials and improvise solutions to execute repair and construction projects in an environment with limited prepositioned materials | | | | |
| **3.16** | Develop and execute and asset dispersal plan to include: personnel, materiel, munitions, fuel, and aircraft | | | | |
| **3.17** | Execute collective passive defense techniques to include hardening and concealing critical assets | | | | |
| **3.18** | Articulate Civil Engineer, Force Support, Logistics Readiness, and Security Forces tasks and responsibilities, and direct Base Operations Support manpower to accomplish expeditionary tasks | | | | |
| **3.19** | Effectively communicate tasks and responsibilities to Base Operations Support team members and leverage diverse backgrounds and unique skillsets to execute mission requirements | | | | |
| **3.20** | Manage base defense operations, entry control points, and perimeter defense for austere sites and display proficiency in advanced combat skills, weapons handling, individual troop movement techniques, and combat lifesaving | | | | |

# Appendix D: Round 3 Delphi Questionnaire

| | |
|---|---|
| **Part I** | Review of Round 2 Part 3: Exploring Proficiency Levels Results |
| **Instructions** | This part presents the results and conclusions of the previous round of this Delphi study in which panel members provided feedback on proficiency levels. The blue boxes within the summary of panel member responses indicate the most popular answers provided by the panel for each of the prompts as well as the percentage of experts who selected that value.<br>Please complete columns **AK** and **AL** of this spread sheet to indicate if you agree with the majority's answers and conclusions from the previous round and to provide feedback on those results that you do not concur with.<br>The prompts presented below (excluding those in red and brown) will be compared to the existing CFETP competency list to see if/where modifications should be made to the career field's core competencies. |

| | Prompt | | Summary of Panel Members' Responses: 2 LT | 1 LT | Capt | Research Conclusion | Do you concur with the resulting research conclusion? (Y/N) | If you non-concur, please comment on why |
|---|---|---|---|---|---|---|---|---|
| 3.1 | Lead and leverage the capabilities of the Basic Beddown/Sustainment Team Unit Type Code (UTC) | Basic | 90% | 20% | | For leading and leveraging basic beddown UTCs, 2LTs need a basic level proficiency, 1LTs need an advance level, and Capts need a master level proficiency. | | |
| | | Advanced | 10% | 60% | 10% | | | |
| | | Master | | 20% | 90% | | | |
| 3.2 | Articulate the Hub and Spoke system of logistics and facilitate travel and allocation of engineer teams between expeditionary locations | Basic | 90% | 30% | 10% | For articulating Hub and Spoke and allocating engineer teams, 2LTs need a basic level proficiency, 1LTs need an advance level, and Capts need a master level proficiency. | | |
| | | Advanced | 10% | 50% | 20% | | | |
| | | Master | | 20% | 70% | | | |
| 3.3 | Lead Forward Operating Site Base Operation Support | Basic | 100% | 30% | | For leading FOS base operation support, 2LTs need a basic level proficiency, 1LTs need an advance level, and Capts need a master level proficiency. | | |
| | | Advanced | | 60% | 20% | | | |
| | | Master | | 10% | 80% | | | |
| 3.4 | Anticipate manpower and resource requirements for Agile Combat Employment Base Operation Support (CES, FSS, LRS, SFS) force elements | Basic | 90% | 60% | | For anticipating requirements for other support functions, 2LTs and 1LTs need a basic level proficiency, and Capts need an advanced level proficiency. | | |
| | | Advanced | 10% | 40% | 50% | | | |
| | | Master | | | 50% | | | |
| 3.5 | Lead Beddown planning activities to include coordinating logistics activities, assessing existing infrastructure, and developing a bare base design | Basic | 70% | 10% | | For leading beddown activities, 2LTs need a basic level proficiency, 1LTs need an advance level, and Capts need a master level proficiency. | | |
| | | Advanced | 30% | 80% | 20% | | | |
| | | Master | | 10% | 80% | | | |
| 3.6 | Estimate expeditionary food, water, and lodging requirements | Basic | 50% | 10% | 10% | For estimating expeditionary food/water/lodging requirements, 2LTs and 1 LTs need an advanced level proficiency, and Capts need a master level proficiency. | | |
| | | Advanced | 50% | 60% | 10% | | | |
| | | Master | | 30% | 80% | | | |
| 3.7 | Lead Multi-craft teams to execute base build-up | Basic / Advanced / Master | Panel feedback did **not** provided consensus that leading multi-craft teams to execute base build-up was a skillset specific to CE CGOs in the context of ACE and MCA | | | | | |
| 3.8 | Anticipate and Articulate equipment requirements for Civil Engineer, Force Support, Logistics Readiness, and Security Forces force elements and facilitate resolution of technical issues | Basic / Advanced / Master | Panel feedback did **not** provided consensus that anticipating equipment requirements and facilitating technical issues for other support career fields was a required competency of CE CGOs. Results conclude that 32E CGOs should be familiar with the other support career fields and their requirements, but do not necessarily need a high level of proficiency in resolving technical issues. | | | | | |
| 3.9 | Activate and manage emergency control centers and effectively communicate using land mobile radios. Process and control work requirements and manage recovery tasks for Civil Engineer, Force Support, Logistics Readiness, and Security Forces force elements. | Basic | 100% | 40% | | For managing emergency control centers and communicating with LMRs, 2LTs need a basic level proficiency, and 1 LTs and Capts need an advanced level proficiency. | | |
| | | Advanced | | 60% | 50% | | | |
| | | Master | | | 50% | | | |
| 3.10 | Direct airfield recovery activities, minimum operating strip selection, spall repair, and crater repair using Expedient and Expeditionary Airfield Damage Repair (E-ADR) techniques | Basic | 90% | 20% | | For managing airfield recovery activities, 2LTs need a basic level proficiency, 1LTs need an advance level, and Capts need a master level proficiency. | | |
| | | Advanced | 10% | 60% | 30% | | | |
| | | Master | | 20% | 70% | | | |

# Appendix D: Round 3 Delphi Questionnaire (Cont.)

| | | | | | | | | |
|---|---|---|---|---|---|---|---|---|
| 3.11 | Direct siting and installation of Aircraft Arresting Systems | Basic / Advanced / Master | Panel feedback did **not** provided consensus that directing siting of MAAS was a required competency of CE CGOs. Results conclude that 32E CGOs should be able to lead teams in MAAS installation and other airfield recovery tasks, but do not necessarily need a high level of proficiency in siting and installation. | | | | | |
| 3.12 | Leverage nontypical airfield pavement options and techniques to provide temporary and expedient aircraft maintenance, launch, and recovery platforms | Basic | 100% | 50% | 20% | For leveraging nontypical pavements and techniques, 2LTs need a basic level proficiency, and 1LTs and Capts need a master level proficiency. | | |
| | | Advanced | | 50% | 50% | | | |
| | | Master | | | 30% | | | |
| 3.13 | Coordinate inspection and repair of civilian highways and unimproved pavements for emergency aircraft launch and landing | Basic | 100% | 50% | 30% | For coordinating inspection and repair of civilian highways for launching aircraft, 2LTs need a basic level proficiency, and 1LTs and Capts need a master level proficiency. | | |
| | | Advanced | | 50% | 40% | | | |
| | | Master | | | 30% | | | |
| 3.14 | Lead airfield construction and repair projects using emerging Bioconcrete technology or other concrete/asphalt alternatives | Basic | 100% | 50% | 30% | For leveraging new asphalt and concrete alternatives for airfield construction and repair, 2LTs need a basic level proficiency, and 1LTs and Capts need a master level proficiency. | | |
| | | Advanced | | 50% | 40% | | | |
| | | Master | | | 30% | | | |
| 3.15 | Exhibit resourcefulness, obtain materials and improvise solutions to execute repair and construction projects in an environment with limited prepositioned materials | Basic | 100% | 20% | | For exhibiting resourcefulness for material acquisition and improvising solutions, 2LTs need a basic level proficiency, 1LTs need an advance level, and Capts need a master level proficiency. | | |
| | | Advanced | | 70% | 30% | | | |
| | | Master | | 10% | 70% | | | |
| 3.16 | Develop and execute and asset dispersal plan to include: personnel, materiel, munitions, fuel, and aircraft | Basic / Advanced / Master | Panel feedback did **not** provided consensus that developing and executing asset dispersal plans was a skillset specific to CE CGOs | | | | | |
| 3.17 | Execute collective passive defense techniques to include hardening and concealing critical assets | Basic / Advanced / Master | Panel feedback did not provided consensus that executing passive defense techniques was a skillset specific to CE CGOs | | | | | |
| 3.18 | Articulate Civil Engineer, Force Support, Logistics Readiness, and Security Forces tasks and responsibilities, and direct Base Operations Support manpower to accomplish expeditionary tasks | Basic | 100% | 50% | | For articulating tasks and responsibilities for other support career fields and directing base operation support manpower, 2LTs need a basic level proficiency, and 1LTs and Capts need an advance level proficiency. | | |
| | | Advanced | | 50% | 50% | | | |
| | | Master | | | 50% | | | |
| 3.19 | Effectively communicate tasks and responsibilities to Base Operations Support team members and leverage diverse backgrounds and unique skillsets to execute mission requirements | Basic | 90% | 40% | | For communicating tasks to base operation support teams and leveraging their skillsets to accomplish mission requirements, 2LTs need a basic level proficiency, 1LTs need an advance level, and Capts need a master level proficiency. | | |
| | | Advanced | 10% | 50% | 40% | | | |
| | | Master | | 10% | 60% | | | |
| 3.20 | Manage base defense operations, entry control points, and perimeter defense for austere sites and display proficiency in advanced combat skills, weapons handling, individual troop movement techniques, and combat lifesaving | Basic / Advanced / Master | Panel feedback did **not** provided consensus that managing base defense operations was a required competency of CE CGOs. Results conclude that 32E CGOs should be familiar with the SFS career field, but not need to lead these tasks. | | | | | |

## Appendix E: Delphi Study Invitation Email

Engineer Leaders,

BLUF: Request your support and participation in an expert elicitation being conducted by Capt Stone Williford (AFIT GEM Student) as part of his research on integrating Agile Combat Employment (ACE) and Multi-Capable Airmen (MCA) requirements into the 32E Company Grade Officer Occupational Competencies. I know you are all extremely busy, but your support is critical to our CE Enterprise.

BACKGROUND: At the request of the CE Readiness Working Group and AFCEC, Capt Williford, has begun research on identifying the occupational competencies of CE CGOs with respect to ACE and MCA. Through his research he has identified 23 potential competencies that will require validation by a panel of experts. The goal of this research is to integrate emerging ACE requirements into the existing CE Core Competencies as seen in the CFETP and to identify gaps in education and training opportunities for our CGOs.

SITUATION: The intent of Capt Williford's Delphi Study is to collect input from CE leaders to validate his list of proposed competencies which he has synthesized through his research. Based on your experience and leadership positions, you are invited to participate in this Delphi study to provide feedback and make this a successful endeavor. This study will involve 2-3 rounds in which you will be asked a series of questions in a multiple-choice format or an open-ended textual response. Each round is expected to take ~25 minutes to complete. In between rounds of questionnaires, Capt Williford will consolidate and synthesize your responses. Overall, this process should take approximately 6 weeks. This study is entirely voluntary and you may choose to drop out at any time by contacting Capt Williford.

DIRECTIONS FOR STUDY PARTICIPANTS:
The attached Excel spreadsheet is the round 1 questionnaire. Please record your answers to each prompt in the appropriate box and save as "Delphi Round 1 – (LAST NAME)". Please send your responses and any questions to Capt Stone Williford at Stone.Williford@us.af.mil NLT 9 Sept 22.

If for any reason you are unable to participate, please provide a recommended senior CE officer or civilian within your MAJCOM to take your place to Capt Williford and I ASAP. Thank you in advance for your time and participation in this study.

v/r,
LKR

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## Appendix F: 32E CFETP Core Competencies

| Categories, Competencies, Subcompetencies, and Descriptors | Basic | Advanced | Master |
|---|---|---|---|
| **Installation Support Category** | | | |
| **1. Planning & Programming** | | | |
| **1.1 Requirements Identification** | | | |
| Anticipate emerging requirements across the installation and incorporate into work plans | 2Lt | Capt | Sr. Capt |
| Identify and define requirements with stakeholders | 2lt | - | 1lt |
| Communicate facility and infrastructure requirements and expected risk to stakeholders | 2lt | Capt | Maj |
| Organize resources to gain and maintain accurate asset visibility, condition assessment, and information requirements | 2lt | 1lt | Capt |
| Perform data analysis using enterprise business tools to optimize infrastructure investments as the e lowest life-cycle operating cost | 2lt | 1lt | Capt |
| **1.2 Requirements Validation** | | | |
| Validate requirements using infrastructure data and analysis with enterprise business tools | 2Lt | 1Lt | Capt |
| Prioritize requirements for execution that are informed by funding strategies, sustainment data, base master planning, schedule, mission requirements, and risk | 2Lt | 1Lt | Capt |
| Organize resources to produce an installation deve3lopment plan | 2Lt | Capt | Sr. Capt |
| **1.3 Scope Development** | | | |
| Define and refine requirements in accordance to applicable codes and standards, and coordinate with stakeholders to determine appropriate scope, cost, and schedule | 2Lt | - | 1Lt |
| Incorporate applicable environmental agreements, laws, and host nation requirements into Civil Engineer activities | 2Lt | 1Lt | Capt |
| Identify installation infrastructure vulnerabilities and mitigate risk to mission assurance by developing options to improve resilience | 2Lt | Capt | Maj |
| **1.4 Funding and Approval** | | | |
| Advocate, support, and defend Civil Engineer resource requirements within assigned program element | 1Lt | Sr. Capt | Lt Col |
| Operate within the Congressional cycle by communicating civil Engineer requirements, resources, and risk to influence the Air Force Program Objective Memorandum (POM) position | 1Lt | Sr. Capt | Lt Col |
| Defend the resources required to execute mission priorities and explain risk to mission for unfunded requirements | 2Lt | Capt | Sr. Capt |
| Identify the legal, appropriate, and effective sources of funds for requirements | 2Lt | 1Lt | Sr. Capt |
| Develop a comprehensive project programming package for funding and approval | 2Lt | - | Capt |

## Appendix F: 32E CFETP Core Competencies (Cont.)

| | | | |
|---|---|---|---|
| **2. Execution** | | | |
| **2.1 Design** | | | |
| Interpret construction drawings and specifications to validate that the design complies with applicable codes and regulations | 2Lt | - | 1Lt |
| Assess commercial construction capabilities, risk and opportunities into design | 2Lt | 1Lt | Capt |
| Design a simplified facility and infrastructure system for construction | 2lt | - | 1lt |
| Adapt standard design to meet user requirements and site considerations where appropriate | 2lt | 1lt | Capt |
| Develop and design airfield requirements for construction or repair | 2Lt | 1Lt | Capt |
| Develop the specifications, technical requirements, and independent government estimate of a construction and service contract solicitation package | 2Lt | - | 1Lt |
| **2.2 Construction** | | | |
| Interpret construction drawings and specification to verify that construction complies with the design | 2Lt | - | 1Lt |
| Lead a multi-disciplinary team executing troop construction projects | 2Lt | - | 1Lt |
| Coordinate stakeholders during the construction stage of a project | 2lt | - | 1lt |
| Evaluate contractor submittals for technical acceptability, execution feasibility, and completeness | 2Lt | - | 1Lt |
| Assess, monitor, and document contractor progress and performance against contract scope of work and recommend corrective actions to the contracting officer | 2Lt | - | 1Lt |
| **3. Operations Management** | | | |
| **3.1 Logistics Management** | | | |
| Direct management of Civil Engineer materials and equipment to meet mission requirements | 2Lt | Capt | Sr. Capt |
| Collaborate with supply and logistics organizations to enable support for mission requirements | 2Lt | 1Lt | Capt |
| Leverage public and private partnerships through community engagement, mutual agreements, and third-party financing in the acquisition of materials and equipment | 2Lt | Capt | Maj |
| **3.2 Work Management** | | | |
| Direct collection of and assess performance measures to optimize organizational performance | 2lt | Capt | Maj |
| Develop a plan that addresses manpower & personnel requirements to have resources that enable the mission | 2Lt | Capt | Maj |

# Appendix F: 32E CFETP Core Competencies (Cont.)

| | | | |
|---|---|---|---|
| **3.3 Services and Utilities** | | | |
| Develop and execute plans to mitigate mission impact during unplanned utility services interruptions | 2Lt | - | 1Lt |
| Validate service or utility performance against contractural and level of services agreements | 2Lt | Capt | Maj |
| Establish and cultivate relationships with community partners to maximize installation readiness capabilities | 2Lt | Capt | Maj |
| **Contingency Operations Category** | | | |
| **4. Beddown** | | | |
| **4.1 Beddown Planning** | | | |
| Coordinate acquisitions, logistics activities, and stakeholders to support an expeditionary base beddown | 2Lt | Capt | Maj |
| Assess and evaluate infrastructure capability, condition, and capacity of potential operating locations | 2Lt | Capt | Maj |
| Develop an expeditionary bare base design | 2Lt | Capt | Maj |
| Lead engineer activities under mission command orders in a contested environment | 2Lt | 1Lt | Capt |
| Assess and conduct pre-attack planning | 2Lt | 1Lt | Capt |
| **4.2 Build-Up** | | | |
| Lead a multi-disciplinary team executing troop construction projects | 2Lt | - | 1Lt |
| Facilitate transition to utilize operational contract support at a contingency location | 2Lt | 1Lt | Capt |
| Establish and cultivate relationships with community partners to maximize installation readiness capabilities and host nation stability | 2Lt | Capt | Maj |
| **5. Recovery and Closure** | | | |
| **5.1 Incident Planning & Management** | | | |
| Develop and maintain engineer portions of installation contingency plans and the Installation Emergency Management Plan 10-2 | 2Lt | 1Lt | Capt |
| Lead Civil Engineer Unit Control Center (UCC) operations and coordinate response to contingencies | 2Lt | 1Lt | Capt |
| Serve as an Emergency Support Function (ESF) Representative in the Emergency Operations Center (EOC) | 2Lt | 1Lt | Capt |
| Serve as Emergency Operations Center (EOC) manager and coordinate response to contingencies | 2Lt | Capt | Sr. Capt |

## Appendix F: 32E CFETP Core Competencies (Cont.)

| | | | |
|---|---|---|---|
| **5.2 Post Attack & Disaster** | | | |
| Validate and interpret Chemical, Biological, Radiological, and Nuclear (CBRN) modeling and mapping for senior leaders | 2Lt | 1Lt | Capt |
| Coordinate installation preparations that enable personnel to survive and operate in a Chemical, Biological, Radiological and Nuclear (CBRN) environment | 2Lt | 1Lt | Capt |
| Organize and direct installation recovery activities | 2Lt | Capt | Maj |
| Organize and direct Rapid Airfield Damage Recovery (RADR) and Base Recovery After Attack (BRAAT) activities | 2Lt | Capt | Maj |
| **5.3 Closure** | | | |
| Organize Civil Engineer efforts when divesting mission, resources, and property to the host nation | 1Lt | Sr. Capt | Maj |
| **Organizational Leadership Category** | | | |
| **6. Employ Engineer Capabilities** | | | |
| **6.1 Engineer Organization Capabilities** | | | |
| Communicate the fiscal, human, material, and information resources and capabilities available within a Civil Engineer Squadron | 2Lt | Capt | Maj |
| Communicate the fiscal, human, material, and information resources and capabilities available within the Air Force Civil Engineer enterprise | 2Lt | Capt | Maj |
| Develop and manage civil engineer plans and programs to achieve mission requirements | 2Lt | Sr. Capt | Maj |
| **6.2 Engineer Joint And Partnership Capabilities** | | | |
| Provide guidance to Air Force, joint, and coalition partners to enable the proper employment of Air Force Civil Engineer capabilities | 1Lt | Sr. Capt | Maj |
| Navigate staff relationships to acquire resources and authority for engineer activities in a joint or coalition organization | 2Lt | Sr. Capt | Maj |
| Leverage public and private partnerships through community engagement, mutual agreements and third-party financing that better support the mission | 2Lt | Capt | Maj |
| **6.3 Individual Engineer Capabilities** | | | |
| Anticipate and adapt in a dynamic operating environment with good engineering judgement and critical thinking skills | 2Lt | 1Lt | Capt |
| Employ references and consultation agencies to determine engineering limitations and options | 2Lt | - | 1Lt |
| Develop documentation to support continuity across rotational turnover | 2Lt | - | 1Lt |
| Actively participate in operational planning teams to continuously improve operational capabilities | 2Lt | Capt | Sr. Capt |

## Appendix F: 32E CFETP Core Competencies (Cont.)

| | | | |
|---|---|---|---|
| Cultivate relationships to build trust and influence across units at the installation and above-wing-level headquarters organizations | 2Lt | Capt | Maj |
| Establish mutually supporting relationships with other squadrons to maximize unity of effort supporting the installation mission | 2Lt | Capt | Maj |
| **7. Manage Resources** | | | |
| **7.1 Resource Stewardship** | | | |
| Communicate Civil Engineer enterprise business rules and rationale to stakeholders | 2Lt | Capt | Maj |
| Communicate status of Civil Engineer resources to stakeholders | 2Lt | Capt | Maj |
| Translate policy and guidance into prioritized operational and tactical objectives | 2Lt | Capt | Sr. Capt |
| Direct execution of Civil Engineer resources to meet operational and functional mission requirements | 2Lt | Capt | Sr. Capt |
| Cultivate a positive command climate based on trust, mutual respect, inclusion, safety consciousness, and stewardship of government resources | 2Lt | 1Lt | Capt |
| Ensure compliance with standards, laws, and regulations through the commander's inspection program | 2Lt | 1Lt | Capt |
| Identify safety hazards and organize response and mitigation options | 2Lt | - | 1Lt |
| **7.2 Force Development** | | | |
| Articulate history and heritage of Air Force Civil Engineers | 2Lt | 1Lt | Capt |
| Establish personal and professional goals to ensure career-long Civil Engineer officer development | 2Lt | - | 1Lt |
| Identify the Occupational Competencies relevant for specific job, position, or duty upon assignment and pursue appropriate Force Development opportunities | 2Lt | - | 1Lt |
| Facilitate the force development for Civil Engineer officers to attain the desired competency level throughout career | 2Lt | Capt | Sr. Capt |
| Facilitate the force development for Civil Engineer officers to attain the desired proficiency level throughout upgrade training | 2Lt | Capt | Sr. Capt |
| **7.3 Posture and Presentation** | | | |
| Translate plans and orders into unit readiness goals and tasks | 2Lt | Capt | Maj |
| Develop and execute a home station training program that meets unit readiness goals and tasks | 2Lt | 1Lt | Capt |
| Ensure higher stat of unit readiness by organizing, training, equipping, and reporting on assigned UTCs and capabilities | 2Lt | Capt | Sr. Capt |

## Appendix G: AFI 10-210 Prime BEEF Program 32E Training Requirements

| SUB-CATEGORY/TOPIC | REQUIRED AIR FORCE SPECIALTY CODES OR UNIT TYPE CODES | FREQUENCY | TRAINING MATERIAL SOURCE |
|---|---|---|---|
| General Contingency Responsibilities | | | |
| Prime BEEF Orientation Course | All | Initial | My Learning |
| Air Force Contract Augmentation Program Overview | 32E, SNCO, 3EXXX Senior AFSC Reps | 36 months | Lesson Plan |
| Vehicle/Equipment Operations | All | 48 Months | - |
| Contingency Training Project | All | 12 Months | - |
| Damage Assessment and Response Team | 32E3, 3E000, 3E071, 3E371, 3E471, 3E571 | 24 Months | CE VLC |
| Prime BEEF 96-Hour Contingency Training Event | All | 18 Months | - |
| Combat Skills Training | | | |
| Tactical Convoy Operations Course | All | 18 Months | My Learning/ Lesson Plan |
| Land Navigation Course | All | 18 Months | My Learning/ Lesson Plan |
| Integrated defense Course | All | 18 Months | My Learning/ Lesson Plan |
| Operating in a joint Environment | All | Initial | Lesson Plan |
| Introduction to Night Vision Devices | All | 48 Months | My Learning |
| Tactical Communications Course | All | 18 Months | My Learning |
| Individual Movement Techniques | All | 18 Months | Lesson Plan |
| Defensive Fighting Positions | All | 18 Months | Lesson Plan |
| Command and Control Training | | | |
| Unit Type Code Management Course | 32E, 3EXXX SNCOs | 48 Months | My Learning |
| Troop Leading Procedures | 32E, SNCO, 3EXXX Senior AFSC Reps | Initial | Lesson Plan |
| Disaster and Attack Preparations | 32E | 48 Months | AFPAM 10-219V2 |
| Control Center Operations (CCO) Course | 32E, 3E000 | 24 Months | My Learning |
| Rapid Damage Assessment (RDA) Teams | 32E, 3EXXX SNCOs except 3E7 and 3E9 | 24 Months | My Learning |
| Rapid Airfield Damage Recovery Overview | All except 3E7 and 3e9 | 24 Months | My Learning |
| Planning and Design of Expeditionary Airbases | 32E, 3EXXX SNCOs | Initial | AFPAM 10-219V6 |

## Appendix G: AFI 10-210 Prime BEEF Program 32E Training Requirements (Cont.)

| SUB-CATEGORY/TOPIC | REQUIRED AIR FORCE SPECIALTY CODES OR UNIT TYPE CODES | FREQUENCY | TRAINING MATERIAL SOURCE |
|---|---|---|---|
| Field Sanitation & Health Training | | | |
| Extreme Climate Deployment | All | 48 Months | My Learning |
| Field Sanitation, Personal Hygiene & and Pest borne Diseases Course | All | 48 Months | My Learning |
| CPR Certification | All | Current | - |
| Expedient Methods Training | | | |
| Bare Base Conceptual Planning Course | 32E, 3EX7X except 3E5 | 36 Months | My Learning |
| Bare Base Overview | All | 36 Months | My Learning |
| Contingency Operational Environment Considerations | All | 36 Months | My Learning |
| Weapons Skills Training | | | |
| M-4 Qualification | All | 12 Months | Base CATM |
| M-9 Qualification | 32E | 12 Months | Base CATM |
| Silver Flag Training | | | |
| Silver Flag | 5-Levels and above/Officers | 36 Months | Silver Flag Site |

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The Air Force Civil Engineer officer career field has made dedicated efforts to the professional development of its company grade officers. In response to the 2015 Air Force Strategic Master plan, the Civil Engineer officer career field adopted a competency-based education approach. In 2020, the Civil Engineer Officer Career Field Education and Training Plan was published, officially integrating the career field's operational requirements into a competency framework. However, since 2020, the Air Force has adopted an updated force generation strategy, and with it, changes to the way the Air Force assets are employed in contingency environments. This new scheme of maneuver for assets and combat forces was titled Agile Combat Employment. In addition to this deployment model, this new strategy also brought about the Multi-Capable Airmen concept. With the adoption of these new strategies and models; the roles, responsibilities, and duties Air Force Civil Engineer officers fulfill when deployed may change in response to changing environmental and operational conditions.
This research purposed to determine if the adoption of Agile Combat Employment and Multi-Capable Airmen models call for modifications or additions to be made to the existing Civil Engineer Officer core competency framework. In this manner, potential new occupational requirements were integrated into the Civil Engineer competency framework. This research also investigated several current education and training opportunities to determine if the newly identified competency requirements could be satisfied with existing courses.
To achieve this research goal, a systematic review of available Agile Combat Employment and Multi-Capable Airmen literature was conducted to identify potential knowledge, skill and ability requirements for Civil Engineer Company Grade Officers. These requirements were then validated using an expert elicitation from a panel of senior USAF Civil Engineer leaders. Finally, this list of requirements was compared with the current Civil Engineer officer competency framework to develop a list of recommended edits and additions.



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