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AIR FORCE CIVIL ENGINEER MOBILIZATION IN A JOINT VISION 2010 WORLD

by

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Preface

The abrupt conclusion of the 45-year long Cold War and the dissolution of the former Soviet Union and Warsaw Pact have unleashed forces in the political, social and military arenas that were held substantially at bay during the Cold War period. Commensurate with these changes, the role of the United States military has evolved as well, shaped more by external influences such as the changing international environment and decreasing budgets than by any internal design, although this too began to change in the mid-1990's. For certain, one fundamental has not changed—the U.S. military will always be tasked to defend American interests across the globe, whether that calls for waging war on aggressors, war on hunger and strife, or something along that spectrum.

When the Air Force deploys, it looks to the civil engineer to provide airfield infrastructure, facilities, utilities, and a host of other functions and services to support the flying mission. These activities do not come cheaply in terms of manpower, resources, or transportation to and within theater. This paper focuses on the fundamental elements involved in providing civil engineering (CE) support during mobilization of combat forces within the evolving military strategies of 'Joint Vision 2010' and the Air Force's 'Global Engagement,' evaluating our current capability and future plans to meet our CE commitments. Analysis centers on the Prime Base Engineer Emergency Forces (BEEF) mobility program, to the exclusion of the Rapid Engineer Deployable, Heavy Operational

Readiness Support Element (REDHORSE) program, in order to concentrate on the broadest and largest element of Air Force Civil Engineer deployments.

This paper is predominantly a compilation of, and testimony to, the great work that so many in the Air Force Civil Engineer career field have contributed to their country for years and continue to contribute today. I can lay claim to only a few original thoughts and would be terribly remiss if I did not recognize the tremendous contributions of so many others. First and foremost, I owe a great deal of gratitude to Mr. Larry Clausen and Mr. Joe Smith, invaluable members of the superb team at the Air Force Civil Engineer Support Agency. Their time, patience, and most importantly, tremendous professional competence courses throughout these pages. Their unselfish contributions are the hallmark of the proud Air Force Civil Engineer. I also extend my many thanks to their bosses, Colonel Bruce McConnell and Major Greg Cummings for offering me guidance early in the effort and for permitting me unrestricted access to their expert staff.

The course of this paper was largely driven by response to the set of questions presented in Annex A of this paper. I received timely and very informative responses from all to whom I sent these questions, and wish to personally thank Colonel Tom Hayden, the Chief of the Readiness Division, Civil Engineer Directorate, in Headquarters, Pacific Air Force; Lieutenant Colonel Bill Macon, the Chief of the Readiness Division, Civil Engineer Directorate, United States Air Forces, Europe; and Chief Master Sergeant Jackson in the Readiness Division, Civil Engineer Directorate, Air Combat Command.

My faith in Air Force Civil Engineering and the quality of our people and those with whom we work has never waivered. It is instead, constantly reinforced by people like

Master Sergeant Miguel Ley, overseer for the entire Civil Engineer War Reserve Materiel program in Headquarters, Pacific Air Forces. His professional response to my queries on his program far exceeded the substance of my questions, and provided invaluable insight into the prepositioning program I might easily have overlooked otherwise.

To my academic advisors, Mr. Grant Hammond and Colonel Ted Hailes, my sincere appreciation for their direction, coaching, pep talks and infrequent kicks, all meant to get and keep me on course and focused.

Finally, to my wife, Samantha…. Whether on a one-year remote assignment, battling the civil engineer issue du jour at Base X stateside, or writing papers, it is all done in hopes of making a genuine contribution to the Air Force. I would long ago have succumbed to these pressures and the self-imposed (read "inflicted") long hours if not for your unwavering support. What little time we have to share is never enough, and though I continue to promise "We'll get more time together in our next assignment," somehow that is never the case and you know it beforehand. This paper is every bit as much your contribution to the Air Force as it is mine. For this and so much more, I am eternally grateful and quite happily forever in your debt.

Abstract

Rapid evolution in the international political, social, and military environment, coupled with budget pressures within the federal government, have created a fluid setting for the military services. As fundamental as aircraft to the Air Force's ability to protect U.S. interests at home and abroad are the support functions that provide deployed basing for aircraft and aircrew alike. What are the factors that influence the civil engineer's ability to launch, support and sustain deployed military operations within the context of this environment and the national military strategy established to meet these challenges? Do current civil engineer capabilities fulfill Joint Vision 2010 and Air Force "Global Engagement" strategies, now and in the future, for interaction in the New World order? What steps are Air Force civil engineers taking, or should they take, to improve their ability to support deployed military operations?

This study concludes that Air Force civil engineering is substantially in step with the evolving character of the current strategies that enable the U.S. military to engage across the spectrum of new and anticipated future world environments. Major progress has been made in adjusting the organizational and doctrinal guidelines for CE mobilization. However, the application of technology readily available today, though actively sought and readily applied in the laboratory, suffers shortfalls in funding to adequately field the resulting advances. This study offers some recommendations in this and other key areas relevant to mobilization of U.S. forces whether joint or Air Force.

Part 1

In Search of Ourselves

People are very open-minded about new things -- as long as they're exactly like the old ones.

—Charles Kettering

With the collapse of the Iron Curtain and the passing of the Cold War, the United States military entered an awkward era where, like a rapidly growing adolescent, it's capabilities grew faster than its knowledge and understanding of how to use them. With weapons and communications technology advancing at an accelerating rate, stagnated policy and doctrine impeded the military's ability to take full operational advantage of these advances. Unprepared to cope with the new world order, the United States military retained much of its historical perspective, much of its strategy and doctrine on the employment of weapons specifically, and of the military in general. In a broader sense, the combat service support element, in which the civil engineer plays a major role, lagged behind operational adjustments to incorporate these technologies.

With the long war won, the essence and foundation on which the military establishment had built its structure and philosophy had vanished. No longer was massing of enormous quantities of troops and supplies in theater appropriate, particularly in the developing international environment that saw rapid expansion of military roles into other, less vigorous arenas than major war. And so, as has consistently been the case after every significant U.S. military engagement of the 20^{th} century, once again the public would call for downsizing of the military and seek to apply the 'peace dividend' to other programs and to improving the solvency of the federal government. The military would be shrunk, voluntarily and otherwise, throughout the coming decade. Geopolitical and economic realities would force the first major Department of Defense wide introspection and revamping in the past 50 years, en route to the new millenium.

The Air Force Civil Engineer Mobility Program, elemental to the rapid global mobilization, beddown, and infrastructure sustainment of Air Force operations, has followed this gradual evolution in lockstep for much of the 1990s, and is well-postured organizationally, if not financially, for the change in the 21^{st} century.

Fighting the Cold War in the 90's

The great national focus and drive under President Reagan in the 1980's, to subdue communism and the former Soviet Union, was a complete success, beyond anyone's wildest dreams. Closure of the Cold War came, however, at a tremendous cost to the American people. The budget was in shambles, the federal government overspent and in debt in the trillions of dollars. While the rapid expansion of the U.S. military in the 1980s had spurred the economy (most notably in the defense industry) to new heights, the cold, hard realities of peace befell the oversized military in the early 1990s. Closure of the Cold War meant it was time to dress the fiscal wounds, come to grips with the staggering debt, and focus the country on reinvigorating and expanding the economy in the global marketplace. The money to do so had to come from somewhere. With so little discretionary spending in the overall budget, the military was the obvious "cash cow" to carve. Downsizing," as it came to be known, took many forms. Base closures to reduce the maintenance bill for infrastructure and reductions in the military and civilian defense workforce were the bane of the day during the mid and late 1990s. This continues today and will likely do so into the foreseeable future through further rounds of Base Reduction and Closure (BRAC), through outsourcing and privatization of people, processes and property, and through more efficient, less expensive means of executing the business of the military.

If the military was slow in evolving to the new conditions, it was understandably cautious in doing so. The end of the Cold War was much desired, but never expected--at least "not in our time." In its wake, conventional wisdom dictated 'far better to err on the high side of defense posture.' Better to have adequate forces no matter what might transpire in the international environment, than to downsize and reorganize too much and too quickly, only to be overrun by unexpected or coalescing adversaries or events. No small wonder that, like driving off a cliff at high speed, momentum, kept us on a horizontal path for a time, doing those things that had always worked well and had won us 'the war.' Eventually, reality, like gravity, began to drag the U.S. military in a downward direction under the sheer magnitude of its own weight. But here the allegory ends, because while the military did decrease substantially in size during the early and mid 1990s, it did not crash to obsolescence as had occurred so many times before.

Several events occurred during the 1990's that drove home for the military the realization that there was a new world order, and that the United States had more influence than ever on just what that world order was and would be. These influences can be consolidated into three groupings: Desert Storm and its technology off-shoots; the rapid expansion in the number and diversity of Military Operations Other Than War; and the drive by the public to compress the military into a more efficient machine, dealing with the present rather than living in the past.

Desert Storm demonstrated overwhelmingly the utter supremacy of the U.S. in virtually all things technological. Consternation among friends and foes alike at the technology gap demonstrated so abundantly with communications and weaponry in 1991 has only grown and matured with each passing year. True enough the United States and its allies had, for most of the latter part of the 20th century, relied on advantages in technology and training over numbers, but like never before, technology was an overwhelmingly decisive factor. As the 1990s progressed, this clear demonstration of supremacy, in combination with subsequent lesser events, would embolden the U.S. military to begin substituting technology for numbers while recognizing the wisdom of engaging coalitions in truly international issues of common concern. Recent events in Kosovo highlight these facts.

In March 1999, Anxious to forestall potential widespread disruption in Europe from burgeoning reactions to ethnic cleansing by minority Serbian forces and mass migration by fleeing majority Albanian refugees from Kosovo, the United States led a NATO coalition to subdue Serbian forces. Airstrikes using high-technology platforms, guidance systems, communications, and precision-guided munitions formed the preponderance of these airborne attacks against Serbian forces and infrastructure. NATO pursued this approach with the express intention of obviating any need for introduction of ground forces into battle. Seventy-eight days into the campaign, this strategy succeeded in gaining acquiescence and abdication from Serbian leader Slobodan Milosevic and reinstated peace, albeit troubled, in the Kosovo province, without the introduction into combat of ground forces.

Certain of the tremendous influence that technology and overwhelming firepower would continue to bring to bear in the evolving nature of warfare, the U.S. military in the early 1990s clung tightly to its Cold War perspective of massive conventional response. The very object of its affection, technological supremacy, would, however, begin to reveal chinks in the U.S. armor. If the U.S. was going to fight from a position of overwhelming technological superiority, then aggressors, destined to take on the U.S. and its 'minions' would simply have to seek their own asymmetric means of countering the U.S. advantage. Hard lessons were learned for example, in Somalia, and continue to be learned in this age of ever-increasing threats of nuclear, biological, and chemical proliferation among third-world countries and non-state players.

Beyond this, though, was the nature of the events themselves, as much about human suffering and strife as about battle. Proportionately, the U.S. military was becoming more engaged the world over in operations less centered on war than on helping others. This would force a new way of looking at organizational structure, purpose, and doctrine within the uniformed services.

The combined effect of these events forced the military to come to grips with it's evolving role in the expression of U.S. policy around the globe, and to do so with diminishing numbers of people, fewer dollars, and less, mostly aging equipment. Admittedly, communications and weaponry were better than ever, but this was by far the exception, rather than the rule. The military no longer had the luxury of responding en masse, according to inflexible plans, as it always had in the past, and besides, the nature of those issues to which it was now responding had changed substantially. New paradigms were in order. The military needed to find new ways of doing different things more efficiently. From this need to deal differently with issues other than major theater war were born the precepts of Joint Vision 2010, the Air Force strategy of Global Engagement, the vision of an Expeditionary Aerospace Force (EAF) and its vehicle for execution, the Aerospace Expeditionary Force (AEF).

Rubbing the Crystal Ball

Joint Vision 2010

By the mid 1990s, the obvious had become abundantly clear: the U.S. military needed to fall back and regroup, to find more efficient ways to engage in the emerging international political, economic, and social environment. The flagship in this sea-change for the military would be the publication, "Joint Vision 2010" (JV 2010). This document publicizes the recognized importance of "…technology trends and their implications for our Armed Forces,"[1] as well as touching on decreasing reliance on overseas presence. JV 2010 highlights that these reductions will be offset by greater, more focused mobilization capabilities from the continental United States (CONUS) and greater lethality (in battle) waged from greater ranges once engaged:

> Increasingly lethal direct and indirect fire systems, with longer ranges and more accurate targeting, will increase the punch of these forces as they maneuver…. The tailor-to-task organizational ability will provide the additional advantage of self-protection—another key element for successfully achieving dominant maneuver. The combination of seamless operations with reduced "buildup time" and a smaller, more widely dispersed footprint will make it much more difficult for an adversary to find and attack our forces.[2]

Four operational concepts, emerging from the old paradigms, form the spear which JV 2010 proposes we carry to the fight: dominant maneuver; precision engagement; full dimensional protection; and focused logistics.[3]

"Focused Logistics" is defined as "...the fusion of information, logistics, and transportation technologies to provide rapid crisis response, to track and shift assets even while enroute, and to deliver tailored logistics packages and sustainment directly at the strategic, operational, and tactical level [sic] of operations."[4] The concept relies heavily on the practical application of a continuous string of emerging, interoperable weapons, information, and support-related technologies. These technologies, properly fused, are expected to substitute for manpower, equipment, time, and space. Combat forces and support that took weeks, even months, to deliver will engage in hours or days, while operating from bases farther from the main area of battle, and will require less continuous support with a smaller logistics footprint. In execution, the concept of Focused Logistics "...will ensure delivery of the precise amount and types of supplies required...,"[5] when needed, where needed. It essentially establishes a demand-pull system, rather than the supply-push operation of the past. Taken holistically, these factors will make our forces less vulnerable to enemy attack.

New equipment and techniques in the hands of poorly trained military using obsolete doctrine in outmoded organizational structures accomplishes nothing, or worse. JV 2010 highlights the need to remain innovative and flexible in structure and employment, training jointly and often to ensure the military retains balanced and sustainable capabilities as 'smaller, lighter, faster' mobilization becomes a reality.

Following conclusion of the Cold War by some 7 years, JV 2010 is the first official, broad-based look across the Department of Defense on how best to prepare for the future. Within Focused Logistics, the implications for the Air Force civil engineer mobility program are clear. In its development and subsequent publication, JV 2010 has helped to launch new vision, direction, and criteria in Air Force engineer mobility from doctrine to operational concepts, from organizational structure to manpower numbers and training, and from acquisition of new technology to the equipment in the field.

Global Engagement

"Global Engagement – A Vision for the 21st Century Air Force," the Air Force's augmenting military strategy to JV 2010, provides a useful comparison of past and future security requirements:

Table 1. The Security Environment

The Security Environment is Changing	
Yesterday	**Tomorrow**
Known adversaries and understood threats	Unpredictable opponents, unknown challenges
National survival at stake	Vital interests at stake
Homeland at risk of Soviet nuclear attack	Homeland at high risk of limited terrorist attacks
Humanitarian and "lesser" operations a sideline	Multiple humanitarian and "lesser" operations the norm
Limited access to "leading-edge" technologies	Global technology proliferation
Slow spread of nuclear, biological and chemical (NBC) weapons	Rapid spread of NBC weapons
Combat oriented to open plains, deserts	Conflict also likely in cities, jungles, and mountains

The Security Environment is Changing	
Extensive forward-basing structure	Project power increasingly from the U.S.
Information an adjunct to weapons	Information as a weapon/ target

Source: Global Engagement: A Vision for the 21st Century Air Force. http://www.xp.hq.af.mil/xpx/21/intro.htm

Yesterday's environment was well defined, with comparatively little uncertainty. We knew who our main enemies were, knew their strategies and philosophies, and knew at least how to hold them in check, if we couldn't defeat them. With our national survival at stake, the government leadership, the public and the military were generally united in focus on our military strategy and the importance of our success.

'Global Engagement...' further recognizes the emergence of non-traditional environments, with missions launched increasingly from the continental United States (CONUS), often against state and non-state players fighting asymmetrically who will quite possibly possess and use weapons of mass destruction (WMD). Our objective: to win the nation's wars quickly and decisively in accordance with national will and policy, while striving to minimize human loss and limit collateral damage and demand on national resources. Employing the best-trained people in the world armed with the best technology and equipment available anywhere, in concert with other services and our foreign allies, we can dominate the battlespace to execute our will.[6]

General Michael E. Ryan, Chief of Staff of the Air Force, best summarized the aim and intention of Global Engagement: to evolve "...from a threat-based Cold War garrison force, focused on containment, to a capabilities-based expeditionary force focused on responsiveness."[7] Air Force Doctrine Document 2-4, Combat Support further guides the consolidation of combat support forces, including those under the purview of the civil engineer: "The traditional practice of moving massive quantities of troops and large stockpiles of supplies into a theater to engage hostile forces is obsolete. Today, CS [combat support] focuses on the rapid movement of small, independent force packages to employ precise combat power anywhere in the world."[8]

Global Engagement increased the number of identifiable core competencies from four to six, all interrelated: Air and Space Superiority; Global Attack (Added); Rapid Global Mobility; Precision Engagement; Information Superiority; and Agile Combat Support (Added).[9] "Global Attack" notes that technological advancements, threats to forward bases, and budgetary pressures will increase reliance on longer-range air and space-based assets. "Precision Engagement" anticipates that we will no longer concentrate on how many aircraft are needed to destroy a single target, but how many targets a single aircraft can destroy with minimal risk and collateral damage. These excerpts clearly indicate greater reliance on CONUS-based operations, with fewer bases of operation in theater, distanced further from the area of combat than has historically been the case.

Collectively, then, various of the core competencies seek to lengthen the legs of our operational assets while reducing the number and vulnerability of deployment bases and deployed human and material assets in support of overseas operations. One in particular, Agile Combat Support, focuses on the role support functions play in their contribution to operational mission accomplishment, and their important reliance on technology to improve their size, weight, and responsiveness:

> In an environment of shrinking resources and expanding responsibilities, the traditional practice of permanently massing large

> numbers of troops and stockpiles of supplies inforward [sic] areas is obsolete. Additionally, extensive build-up time and lengthy resupply and repair pipelines to sustain forces are unrealistic.
>
> ...Fiscal constraints dictate that the military must continue to reduce infrastructure, maintain smaller numbers of both inventory and personnel, and find ways to reduce costs without degrading mission capability. The impact of these constraints may be mitigated by use of new technology."[10]

Agile Combat Support (ACS)

Previously, combat support issues had essentially been subordinated to one of three predominantly operational competencies. Agile Combat Support is intended to highlight and help focus the operational commander's attention on the important role combat support plays in the responsiveness, deployability, and sustainability of his combat forces.[11] It offers a framework, guided by the classical principles of war, with which leadership chooses courses of action for beddown, security, surprise, mass, economy of force, and maneuver and mobility.[12] Agile Combat Support seeks to achieve this by replacing massive, deployed inventories with responsiveness; supporting expeditionary forces; adopting a demand-pull, rather than supply-push resupply concept; using reach-back capabilities to permit fewer forward-deployed functions and personnel; and providing the ability to know the location of critical resources (people and parts) with attendant major gains in efficiency.

To accomplish timely, responsive mobile support to Air Force operational forces, Agile Combat Support employs six basic principles: responsiveness, effective beddown and sustainment, reachback, leveraging of technology, efficient installation support, and time-definite delivery. Each of these principles has particular applicability to civil engineer mobility. Within the framework of analysis for improving CE mobility, all but the last of these principles, which is predominantly a logistics and communication function, will be addressed in greater detail in Part 2.

The Expeditionary Air Force

With an abundance of national military strategy available in JV 2010 and the implementing strategy for the Air Force expressed in Global Engagement, the Air Force needed new doctrine, concepts, and tools to execute these strategies. This approach needed to take into consideration the increasing operations tempo on personnel in the context of the changing international environment, the evolving nature of current and future missions, the dramatic improvements in weaponry and information management, and budget cuts. The solution required a basic paradigm shift.

General Ryan recognized a disjuncture had evolved between the missions in which the Air Force was engaging in the mid 1990s and the methodology it used for doing so. The Air Force corporately responded to missions as though still in the Cold War, using threat-based, fixed parameters to respond to a wide range of scenarios. Focused on containment, the Air Force typically responded with a large forward presence, fighting in place, operating from bases with large infrastructure support systems. He recognized that, conversely, current missions and those in the foreseeable future, called for smaller, capabilities-based responses, still forward-based, but responding around the world, and doing so from bare bases with limited infrastructure.[13] Faced with the realities of a constrained environment, fiscal limits, political realities, operations tempo demands, quality of life needs and readiness challenges, the Air Force still needed to provide forces that were rapidly responsive, trained and ready, modern and capable, lean and agile, and appropriately structured.[14]

Early in 1998, General Ryan launched a study to develop a framework to meet the new mission requirements within current circumstances and with available assets. He tasked this study team to satisfy three underlying requirements:

- To provide U.S. military commanders in chief the right force at the right place at the right time, whether the mission involved humanitarian relief or combat operations;
- To reduce deployment tempo by building more stability and predictability into the way we schedule our people to respond to contingencies;
- And to take full advantage of the vital contributions of the total force—active duty, civilians, Reservists, and Air National Guardsmen.[15]

In General Ryan's view, his planners achieved these goals through development of the Expeditionary Aerospace Force (EAF) concept.[16]

Air Force Doctrine Document 1, "Air Force Basic Doctrine," calls upon the EAF to provide a highly mobile and responsive, integrated team of operational and support functions agile enough to respond to contingencies anywhere in the world within hours.[17] An essential element to building this lean, responsive force is the combat support role:

> The eventual objective of the [technological] improvements designated under the Agile Combat Support concept will be both to support functions more responsively and effectively as well as to reduce the overall "footprint" of forward-deployed support elements. Emphasis on compact and multiuse [sic] equipment, increased dependability and less redundancy, enhanced supply commonality, and the ability to reliably reach back to nondeployed units and agencies for support previously required in-theater will all be central to true agile combat support.[18]

Finally, AFDD-1 notes "**The exceptional speed, range, and lethality of expeditionary air and space forces allow global operations far from the operational areas....** Air and space expeditionary forces will increasingly be able to influence a distant operational area without being physically present.... **Because of the reduction in overseas military presence, expeditionary air and space forces that can mass quickly**

and move globally are critical to future military operations."[19] (Emphases in original text)

In order to give warfighting Commanders-in-Chief (CINCs) the visibility they need into force capabilities, with the knowledge that they are getting forces tailored for their missions and specifically trained and prepared to do their work; to provide airmen stability and predictability that was lacking in the unanticipated evolution of U.S. military affairs in the early 1990s; and to integrate the technological developments and political realities of the 1990s, Air Force leadership devised the concept of the "Expeditionary Air Force."[20, 21] Within the concept, the Air Expeditionary Force is the tool for its implementation. It is intended to be a quick reaction force capable of delivering an operational effect within a short time, using the minimum resources necessary.

As a prime example, the U.S. Central Command Concept of Operations identifies three phases of operational capability for a standard Air Expeditionary Force response to an event within the its Area of Responsibility. Phase I, covering the first 72 hours, is called the Attainment Phase. It begins with issuance of the Strategic Warning, normally followed 24 hours later with the Execution Order. During this time, forces are placed on notice, and begin preparations for deployment. Within 48 hours of issuance of the Execution Order, the first 'Operational Effect' will be delivered by combat forces while combat support forces simultaneously deploy to establish ground operations at the deployment basing location and receive combat aircraft after their initial engagement. Phase II, termed "Initial Combat Capability," extends combat operations an additional 7 days beyond the Attainment Phase, using those resources deployed in the first 72 hours, under Phase I. During Phase III, "Follow-on Combat Capability," operations continue, if necessary, for an additional 23 days with additional resources deployed to support the additional time period.[22]

The Vision Comes to Life

Across these visions, strategies, doctrine and organizational constructs, basic facts and concepts predominate. First, in a rapidly changing international environment that only promises more of the same or worse as weapons of mass destruction proliferate across nation-states and non-state players alike, many of the old missions and ways of accomplishing them have become irrelevant at best, dangerous to our national interests in some instances, and wasteful of resources in most cases. Second, the nature of the missions has not changed so much as have the proportions of each type and the commitment of resources to them. This has, in turn, had a negative impact on operations tempo, for people certainly, but also for resources stretched beyond their life expectancy. Third, fiscal realities have forced us corporately to operate more efficiently across the board, directing the focus of our military personnel increasingly toward their contingency rather than their peacetime roles. Finally, we place our unswerving faith in technology. We possess an undying belief that now and in the future, it will buy us time and space, and substitute for people and resources in the host of circumstances we expect to encounter in the coming quarter century and beyond. This will enable us, if not force us, to transition to the smaller, lighter, faster forces envisioned in the Expeditionary Air Force. With this construct in place, an assessment of Air Force civil engineering's ability to adapt to the new paradigm is in order. This paper focuses strictly on the mobility processes of the Prime Base Engineer Emergency Force program, looking toward opportunities to reduce the size and weight of civil engineer deployments as we become more responsive in mobilization. This paper does so exclusive of any consideration for issues such as pre-deployment training, stateside operations in the absence of deployed forces, or the efficacy of outsourcing, privatization, and eliminating the financial burden of installations neither wanted nor needed.

Notes

1 Joint Vision 2010, May 1996, pg 1.
2 Ibid., 21.
3 Ibid., 19.
4 Ibid., 24.
5 Ibid., 26.
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7 United States Air Force Agile Combat Support Concept of Operations (USAF ACS CONOPS), 1 October 1999, pg 1-1.
8 Air Force Doctrine Document (AFDD) 2-4, Combat Support, October 1998, pg 1.
9 *Global Engagement: A Vision for the 21st Century Air Force*, undated. http://sticky.usu.edu/~afrotc/class/400/Less9/sld014.htm
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11 "Global Engagement…," http://sticky.usu.edu/~afrotc/class/400/Less9/sld027.htm
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15 General Michael E. Ryan, "History Behind Expeditionary Aerospace Force Concept" News release on 25 Aug 1998.
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19 Ibid., pg 72.
20 Mr. F. Whitten Peters, "Today's Air Force – Readiness and the Emergence of the Expeditionary Aerospace Force, 24 Aug, 1998 (delivered at the Nashville Rotary Club). http://www.af.mil/news/speech/current/sph98-18.html
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Part 2

Scaling Down the Force

A problem well stated is a problem half solved.

—*Charles Kettering*

From *United States Air Force Agile Combat Support Concept of Operations* –

> The ready forces must be armed with the insight as to where, with what, how, at what rate, for how long and – [sic] when their specialty will be required. This knowledge is imperative and allows essential strategies to be formulated for using resources that are in place in advance, can be counted on to be available on location, or must be taken to the place of employment. The objective is to minimize the resources required to be deployed. The ability to marshal assets quickly, deploy efficiently, and set up at an employment location in minimum time to support operational tasking is dependent on being properly prepared. The application of the appropriate assets with speed and precision at any location in the world requires tailoring of the operational and support elements to the minimum required to begin operations.[1]

With the abundance of national military strategy, service strategy and doctrine, and reorganization focused on becoming more agile, mobile, and versatile, the combat support structure has already benefited from the trimming of excess mobility resources, even before expending any effort to do so. If fewer direct-mission people and resources deploy farther from the area of focus, then certainly fewer support personnel and resources are required to bed them down. This is undoubtedly true, but early in this evolutionary process, with the first two of ten Air Expeditionary Forces only brought on line in October of 1999, no facts, only speculations, are available to confirm or deny the extent of this reduction.

The well-established, well-documented policy of 'smaller, lighter, faster' reaches throughout the mobility arena within the Air Force. A very fundamental element of any mobilization, the civil engineer is by no means exempt. Virtually every major step in the mobilization process, from planning, to pre-deployment, to deployment, to beddown, to recovery, offers opportunities to shave size and weight from the civil engineer docket. Appendix A offers a comprehensive, though not all-inclusive, table of issues to be considered. This paper focuses on the more general categories listed in the Appendix. How reliable and effective are contractors in providing civil engineer beddown and sustainment services? Where is the line between what they will and will not do? How do we mesh deployment capabilities with contracted services? What can we do to better understand and deal with the circumstances at potential deployment locations? What were our past criteria, and what are our present criteria for prepositioning of assets in or near the theater—how much of what is stored where? Are alternative means of transporting these assets to the deployment location available? Stateside, have we redefined (lowered) minimum standards to reduce initial airlift requirements? What has changed about how we size the civil engineer deployment force? What, if any, initiatives are underway to reduce the size, weight, and maintenance requirements of our equipment, while improving the durability? Are we prudently and aggressively seeking and exploiting currently available commercial technology? Are we fusing federal, academic, and private research to reduce our footprint and improve our sustainability? Appendix A offers a preliminary set of questions and issues to consider when reviewing the deployment program for the bulk of civil engineer mobility forces. The balance of this paper addresses these and related issues, offering some recommendations and closing remarks.

The Air Force Civil Engineer Concept for Mobility Operations

The Prime Base Engineer Emergency Force (Prime BEEF) Program

The Prime BEEF concept was borne of frustrations that arose during the U.S. Air Force response to the Lebanon Crisis in 1958. The Air Force, without a single engineer on mobility status, was completely reliant on contracted maintenance and Army construction units. Support from both was neither timely nor satisfactory and required intense levels of effort to obtain. United States Air Forces Europe ensured this situation would never arise again by placing key engineering personnel on mobility status. The Berlin Crisis in 1961 proved, beyond a doubt, the value of this concept. Within 24 hours of notification, United States Air Forces Europe mobile engineers were deployed to numerous reception bases in theater, working with local national and contractor forces to prepare the installations for arrival of deploying stateside units. Six weeks would pass before Army engineer support became fully effective. From these experiences sprang the Prime BEEF concept, initiated in 1964.

Air Force civil engineer support has historically organized, trained, and equipped forces to provide support for initial beddown; infrastructure (including facilities, operational surfaces, utility generation and processing plants, and distribution systems) setup, operation, maintenance, and repair; fire protection; readiness (for example, nuclear, biological, chemical detection, warning, reporting, and oversight of cleanup);

explosive ordnance disposal; and environmental issues. These missions remain unchanged with the introduction of the Expeditionary Air Force.

In support of deployed operational forces, in-place host nation, U.S., and contracted civil engineer forces, mobile Prime BEEF teams, and Rapid Engineer Deployable, Heavy Operations and Repair Support Element (RED HORSE) teams plan, build, and prepare bases for wartime operations and military operations other than war (MOOTW). Manning for sustainment beyond the first 30 days drops significantly and is satisfied through individual temporary duty rather than team deployment. This paper focuses only on the "worst case" scenario requiring USAF civil engineer support at overseas installations during combat and non-combat contingencies, with no in-place Air Force Civil Engineer personnel available. While Prime BEEF covers a broad range of tasks, firefighting, explosive ordnance disposal, environmental, and nuclear, biological, and chemical management, detection, and cleanup functions are excluded from this study. RED HORSE, which is currently undergoing a major study into restructuring and redefinition of tasks, is also excluded from this assessment.

In concept as in practice, the Prime BEEF program, established to efficiently and effectively accomplish base construction and infrastructure operation, maintenance, and repair, is relatively simple. The program currently consists of 34 different teams, known as Unit Type Codes (UTCs), although in supporting the Expeditionary Air Force, the size and composition of these teams will change. The unit type code concept calls on the tenets of rapid deployability, self-supportability, and unit integrity to provide 'lean and mean' combat elements consistently structured for similar weapon systems across the Air

Force. For the civil engineer, these unit type codes are further standardized, not only for similar weapon systems, but also across weapon systems, with few exceptions.

There are three basic kinds of unit type codes. The lead, or independent unit type code package is capable of establishing combat or other operations at locations with minimal support, and sustaining these operations with little or no additional assistance for 7 days. In some cases, however, destination specific or operational platform specific requirements do call for additional resources beyond this scope—the exception rather than the norm. The active duty civil engineer lead team, with 132 officer and enlisted personnel, is the major unit type code which active civil engineer units posture to provide organic support to aircraft units under their core unit type code. It encompasses active duty engineer, fire protection, and disaster preparedness forces to support missions at contingency operating locations, aerial ports, en-route bases, or critical stateside bases. Its primary mission is to deliver initial beddown for up to 1200 personnel and a lead aviation squadron using expedient or existing facilities, utilities, and other infrastructure. Subsequent to beddown and up to 30 days after initial deployment, the civil engineer lead team, with resupply beyond the first 7 days, provides sustainment and recovery of all base infrastructure, as well as detection, warning, and overall management of the response to introduction of nuclear, biological or chemical weapons.

The active duty follow team unit type code, comprised of 61 officers and enlisted, is designed to incrementally support *additional* squadrons of aircraft. It is not configured to beddown a unit independently, nor to independently sustain a unit. Instead, follow-on unit type codes are used as additives to active and reserve lead packages, and as such, can only deploy to locations where in-place forces are stationed or where there is a lead team.

Supplemental unit type codes augment in-place forces or lead teams by focusing on destination- or platform-specific needs that exceed normal requirements and team capabilities. Supplemental unit type codes often are comprised solely of equipment, with no associated personnel. Civil engineer supplemental teams include, for example, engineer headquarters teams; pavement evaluation teams; and explosive ordnance disposal and readiness high-threat augmentation teams.

To quantify and concisely define the mobility role of Air Force civil engineers:

> One squadron of aircraft typically brings in 138 Prime BEEF personnel (104 engineers, 24 firefighters, 6 EOD, and 4 readiness). At locations with two squadrons of aircraft, a minimum of 203 Prime Beef personnel (150 engineers, 36 firefighters, 10 EOD, and 7 readiness) are available. Three squadrons of aircraft usually bring a minimum of 268 Prime BEEFers (196 engineers, 48 firefighters, 14 EOD, and 10 readiness). Additional Disaster Preparedness Augmentation and EOD round-out teams add 20 people to increase the total Prime BEEF force to warfighting strength....
>
> The CE warfighting force provides the capability to concurrently field a command and control function, damage assessment teams, damage assessment and response teams, NBC reconnaissance teams, explosive ordnance safing and removal teams, utility and facility repair teams, crash rescue and fire suppression crews, and rapid runway repair (RRR) teams.[2]

In order to minimize airlift requirements, Prime BEEF teams were originally conceived to be light in equipment with minimum personnel. They remain this way today. Personnel deploy with only their individual gear and team mobility equipment. Individual gear includes equipment and clothing for personnel protection and personal clothing and supplies for extended temporary tours of duty. Mobility team kits provide only the tools and equipment needed to accomplish initial bare base beddown and base recovery.

A fundamental factor in the civil engineer mobility equation is the availability of assets in theater through a combination of support available from the host nation and local economy at the deployed location, contractor augmentation, prepositioning, and resupply from the United States. Generally, vehicles, heavy equipment, construction materials, supplies, and other airlift and sealift intense assets must come from external sources.

This section has introduced key factors, considerations and orders of magnitude in the role civil engineers play supporting deployed operational forces, from personnel to supplies and equipment. The sections that follow address, in greater detail, potential opportunities that may help reduce mobilization requirements for any one or all of these factors.

Deployment Locations: Site Conditions and Asset Availability

Scaling Back Support Requirements

In a 1998 report published by the United States Air Force Scientific Advisory Board, one of the premier proposals for paring down the deployed logistical footprint and lift requirement was to establish a truly "lean and mean" force—one where people and other resources perform multiple functions across the classic stove-piped structure.[3] Certain critical preconditions must be met, however, for such a concept to work and instill confidence in those deployed to use it. Such a reduction in footprint and lift requirement would only be possible if the deploying operation moves with their full mission support personnel and logistical requirement under this pared-down concept. Timely, dependable resupply responding to priority requirements; rapid replacement of casualties and the sick, and other, similar measures to keep deployed units fully operational at all times, are equally imperative to this concept.

Assuming these parameters can be met, and assuming that Air Expeditionary Forces would deploy for only short periods, as proposed in the original concept, the Board suggested that a number of measures should be taken to downsize mobility requirements, predominantly in the quality of life arena:

Shelters and Environmental Control Units (ECUs). Where weather is essentially nonthreatening (not too wet, not hot, not too cold), the Board suggests that support personnel can survive without tents or other shelters and the associated Environmental Control Units. In conjunction with the substantial lift savings for these assets, further benefits accrue in savings on power production equipment and maintenance personnel and their associated tools and equipment. The Board recognizes, however, that, where available, local hotels would be far preferred to "sleeping under the wings."

Hot Food. Meals-Ready-to-Eat (MREs) provide the full range of nutritional requirements for personnel working under deployed conditions. A wealth of experience in the use of Meals-Ready-to-Eat highlights that after an average of three days eating them, they become unpalatable to most personnel, and they markedly reduce their caloric intake below levels adequate to perform their duties, especially prolonged heavy labor. The Board concedes that, in the absence of local dining facilities, the requisite equipment and personnel to provide hot meals may well be worth the cost in footprint and lift weight.

Basic Amenities. Full mobilization and erection of Harvest Eagle and Harvest Falcon kits can take longer than the presumed duration of an Air Expeditionary Force. Where, for example, facilities for hot showers and shaving, restrooms or porta-potties, calling long distance, and recreational activities such as televisions and quiet rooms for reading are not readily available on base or locally for an extended period, morale, and in turn operational performance, will likely suffer. As with facilities for preparing and serving hot food and dining in a comfortable environment, these other basic amenities may be ignored for initial, brief periods, but operations exceeding more than a few days are better served if such facilities are provided, despite the footprint and lift requirements.

Vehicles. Every effort must be made to obtain vehicles locally, since these are lift-intensive assets when they must be deployed, even if from prepositioned locations. Deploying forces should consistently consider opportunities for consolidating vehicle requirements across organizational boundaries whenever possible.

Water. Where no readily accessible source of drinking water is available locally, strong consideration should be given to deploying a Reverse Osmosis Water Processing Unit (ROWPU) in lieu of lifting potable water. Supplying bottled water for 500 personnel requires roughly one C-141 load per day.[4]

These and other austerity measures may make sense, but planners must exercise caution that, in the drive to deploy teams in their smallest, lightest, and fastest configurations, the teams are not jeopardized when reality fails to track with the plan. Stockpiles of life-sustaining supplies—always food and water, but also, depending on climate, perhaps tents, generators, and Environmental Control Units—make sense.

Site Surveys – Identifying the Requirements

As noted in detail earlier in the excerpt from Air Force Pamphlet 10-219, Volume 8, total operational requirements drive civil engineer support requirements in a substantially predictable manner. Knowing the total civil engineer requirements, planners then must determine what the civil engineers need to bring versus what is already available locally at the deployment location in conjunction with what is available and relocatable (prepositioned) within the theater of focus. As elemental an equation as this may seem, information on availability of resources at the deployment location is not always so readily accessible as it should be.

To improve responsiveness, the focus of combat support systems must move from maintaining and mobilizing massive inventories to minimal mobilization, using local resources to the maximum extent possible, and providing timely resupply on demand, in advance of actual need.[5] The combination of these concepts improves operational capability, while reducing the mobility footprint, simplifying and streamlining logistics and transportation mobility processes and reducing supporting costs, including original purchase cost and depreciation. It also reduces the need for storage, maintenance, and inspection of stockpiled assets and the manpower associated with these requirements.[6, 7]

Some cautionary concerns bear consideration, however. U.S. forces can easily fall prey to over-reliance on host nation resources when local laws, customs and support agreements may limit their availability or employment,[8] incompatibility with U.S. equipment causes problems, or personnel health and security are exposed to increased risk.[9] Additionally, local assets and site conditions must be viewed through several lenses, to include environmental conditions; layout and condition of existing available infrastructure; accessibility to and compatibility of utilities; topography; geography; and security issues. For these reasons, qualified Air Force civil engineer personnel or similarly qualified contractor personnel must be an integral part of any survey team. Past practice has left this function to operational or logistics personnel resulting in scant data of limited use by which civil engineers must plan their piece of the deployment.

Items for evaluation must encompass avenues of local support at deployed locations including contracted equipment rental agreements; facility leasing agreements (e.g., hotels for billeting, restaurants for dining, and sources for portable facilities such as trailers); workforce availability and skill levels; and host nation support agreements for any government-owned facilities, equipment, and labor. Current guidance for base support planning and sight surveys, primarily Air Force Instruction 10-404, Base Support Planning, do not address this level of detail.[10]

Extensive site surveys provide this valuable information.[11] Certainly, for those "deployed" locations where we have tended to establish a presence of indefinite longevity, such as in Saudi Arabia, this information is extremely well known and put to good use. Not so for the multitude of potential deployment locations to which the Air Force has never been, or to which the Air Force visits only infrequently as is the case for much of Africa, Latin America, and Southeast Europe prior to 1996. Any such effort to broadly survey potential deployment sites must narrow the scope, effort, and cost to a reasonable level. Some consideration must obviously be given by operational planners to whether a credible reason exists or could exist in the near- to mid-future to deploy to a particular location. Once that determination is made, surveys should seek to identify total availability of resources locally and through the host nation government, irrespective of the anticipated scale or type (war, humanitarian, etc.) of deployment.

"Assessment of potential battlespace locations is one of the most important concepts of agility, as it will dictate support requirements specifically detailed for the employment location. A robust information-gathering process with continual updates of potential airfields and ports is essential to prepare for rapid-response missions."[12] Site surveys of potential deployment airfields are the purview of the Air Force components of the five regional unified commands and are vital to deliberate planning for prepositioning resources, as well as rapidly deploying light and lean mobility forces. Funding limitations predominate as the main deterrent to developing a robust, ongoing site survey program.

Other Sources of Site Data

Too often, too little is known about locations to which U.S. flying operations deploy. This condition is not unique to the civil engineer, but rather spreads across the spectrum of deploying combat, combat support, and combat service support units. The initial deployments in support of Bosnia in 1996 and 1997, as an example, offer testimony to the inefficiencies inherent in "learning on the fly." In every regard, little was known about Tuzla airfield in Bosnia or Taszar airfield in Hungary—their capacity to support any flight operations at all, day or night; the layout and adequacy of their facilities and utility systems to house, feed and support an influx of thousands of foreigners; the availability of skilled labor, equipment and other resources on the local economy—all were unknowns. Not until initial teams deployed at the beginning of the operation did any of this information begin to materialize. Civil engineers were sent in several times during the initial 4 weeks of the deployment to assess conditions, substantially delaying the beddown and full operation of both locations.

Where site surveys have yet to be conducted or to augment those already performed, much useful geographical information on any given location may well be readily available through other military services, federal and international agencies, private enterprise and foreign governments. Information pertaining to meteorologic, soil, topographic and hydrologic conditions, for example, should be readily and routinely available through the National Atmospheric and Space Administration (NASA), through the National Oceanic and Atmospheric Administration (NOAA) and through the National Imagery and Mapping Agency (NIMA) and the Defense Mapping Agency (DMA). For airfields used by commercial aviation, the International Civil Aviation Organization (ICAO) and the Federal Aviation Administration (FAA) continuously collect data on airfield layout and the condition of airfield infrastructure such as pavement, fuel availability, navigation aids, and lighting. The State Department as a matter of course collects valuable information in foreign countries on social mores and political and economic conditions. Additional sources for information include the CIA, international corporations and trade organizations, even news agencies that compile and maintain information databases.

No single, integrated database (or integration of separate classified and unclassified databases) that could benefit all participants currently exists, although the efficacy of such a concept seems obvious. In fact, Global Engagement IV (1999), the annual U.S. Air Force global wargame, highlighted the critical role played by forward operating locations (FOLs) and forward support locations (FSLs) in the execution of future military operations. Nonetheless, little time, money, or effort has been invested in the requisite preliminary surveys and agreements necessary to identify suitable locations and insure our access to them, let alone to operate from them efficiently and effectively in the future.

Ownership and control of such a database or integrating mechanism of disparate databases would rest with a government agency, either the State Department or the

Department of Defense, which would perform quality control on updates generated from outside the federal government.

For the mobilizing Air Force Civil Engineer, this centralized database could be interrogated with a standard query that provides all relevant information, replete with maps, infrastructure lists (including quantity, condition, availability, etc.), local economic conditions and levels of skilled labor, and so forth. The return on investment for the civil engineer would be both quick and substantial. With virtually full and complete knowledge of the conditions at the deployed location, the civil engineer can truly deploy with a tailored team that minimizes strategic airlift for personnel and their team kits, as well as tactical land, sea, or airlift for delivery of assets prepositioned in theater.

Expedient Planning Tools

Under the best and most peaceful of conditions, installation planning and layout is often a highly volatile issue that can take months, even years, to develop and act upon. Contingency operations obviously cannot afford this luxury. Limited access to installations for surveys or limited time for unanticipated deployments mean limited availability of data from which to develop infrastructure layouts and maximize efficiencies in real estate and interactions among different sectors of the base. Certain basic tenants of base layout can, should, and have been captured in comparatively simple computer-based programs to site facilities and utility systems in order to gain the most out of real estate and resources, as well as determine level of effort, resources, and time needed to accomplish each task. The concept of such programs is nothing new, but the fact that they are now consistently demonstrating impressive degrees of success and responsiveness is a quantum improvement over previous attempts.

Air Mobility Command's "Contingency Aircraft Parking Planner" (CAPP) which, with minimal site data, prepares maximized aircraft parking and taxiing plans in just hours, rather than the days it took just 4 years ago, works extremely well on a laptop computer under field conditions.

"GeoBase" and "GeoReach," developed by Air Combat Command, are currently under implementation in the Pacific region, in Space Command, and at Air Combat Command installations. GeoBase creates a common picture by integrating technologies such as the Global Positioning System, satellite imagery, and Computer-Aided Drafting and Design to establish a basic map depicting the installation. Various criteria are integrated, or layered, onto a digitized map providing a common operating picture with which users can view the interrelationships among different criteria. Users can, for example integrate data across functional areas, such as bombing range management, explosive safety criteria, and environmental parameters, and across data types, for example, linking and overlaying tabular safety distance data on top of the basic map. GeoReach provides a deployable version of GeoBase, aiding immeasurably in the rapid layout of initial, temporary, and permanent facilities to maximize interconnections and interrelationships among functions on base while, for example, maintaining safety and health parameters.

The Automated Airbase Contingency Estimator (AACE) program, written in Microsoft Excel by Air Force Institute of Technology students, identifies total requirements based on the type of weapon system and Air Force standard facility criteria. It then factors in any data known on the location regarding existing assets that may satisfy these requirements, calculating the shortfall by type of facility. In step-wise fashion, it then provides such detail as a bill of materials and scheduling of numbers of craftsmen by skill types to complete the beddown process.

In the face of contingency operations, such programs can rapidly offer tremendous insight into resources, level of effort, and time required to raise a base to fully operational status. In a theater-wide engagement, this may not only enable deploying forces to more accurately gauge what needs to be brought along, but also help planners and lift schedulers reprioritize and redirect critical air and sealift to other, possibly more urgent and productive needs.

Several additional areas of base beddown merit consideration for rapid, automated planning and layout. The more productive among these would be placement of utilities and utility distribution systems, land use based on unit mission, topography, threat assessment and meteorology, and resource dispersal and hardening based on mission value and most efficient use with security and threat assessment taken into consideration. Such programs could aid early identification of opportunities or limiting factors, and help expedite specific resources as needed to address these issues.

In addition, base level efforts to develop automated expedient beddown planning tools should be advertised and monitored more closely at the command and corporate Air Force Civil Engineer levels. Disparate efforts at various bases generate needless duplication of effort, where centralized management could assimilate the best of what is currently available, and direct future efforts as bases volunteer to develop them. The fact of historical underfunding for centralized, contracted development of such programs lends further merit to the concept of centralized management of base-level initiatives.

Reachback

The concept of reachback employs integrated communications and information systems to enable 'demand-pull' availability, accountability, and delivery of resources at deployed locations, similar to the 'just-in-time' logistics concept employed increasingly in US manufacturing. The reachback concept supersedes the former 'supply-push' principle typical in past deployments. Where in the past, supplies, equipment, and materials were deployed integrally with the mobilization of forces and stockpiled en masse, only minimal resources are identified for current deployments.

Recent dramatic improvements in military tracking and transporting of resources that mirror common practice in private industry have similarly improved reliability in the military logistics supply system to the point that 'stockpiles' in the classic sense are no longer needed at deployed locations. Depending on priority and urgency, assets may originate in the United States or anywhere else in the world from which they may be delivered more quickly. Attendant benefits include reduced storage, maintenance, management, transportation, and personnel requirements, along with associated cost savings. Additionally, the reduced initial draw on home base resources helps minimize the impact of deployments, significantly tempering the gap or dip in capability at the home station while arranging for replacement capability through the reserves or through contracts, as necessary.

Air Force civil engineering has corporately placed significant weight on the reachback concept in anticipation of accruing the same benefits noted above. Unit type codes, whether people or equipment, have been pared to the absolute minimum commensurate with each respective primary role. Reachback provides the 'delta,' or difference, between the anticipated need and the actual requirement, should it exceed standardized projections. This is as vital for manpower as it is for equipment and supplies.

Support from Other Services

Joint Publication 4-04, Joint Doctrine for Civil Engineering Support, notes throughout a certain global interoperability within the civil engineer arena across the various services, and gives regional commanders-in-chief "...authority to transfer civil engineering functions between Service components."[13, 14]

Current and near-term technological advancements promise to bring untold dramatic and synergistic improvements to weapons platforms (improved survivability, increased range), to weapons (increased accuracy enabling the transition from 'multiple missions to destroy a target' to 'multiple targets destroyed on a mission'), to data acquisition and its assimilation into information, and to the combat support function in reducing the mobility footprint. By all accounts, this translates into fewer civil engineer support requirements, farther from the battlefield, for a shorter period than has historically been the case. By corollary, 'farther from the battle' implies less battle damage in general, but more importantly, less battle damage to specialized systems supporting air operations, thus requiring less of the special skills Air Force civil engineers bring to the fight.

The question "Which service should provide civil engineer support to a deployed location?" becomes less focused on specialized requirements and more focused on economy of effort. The better question, then, is "Who among the Services is better postured, and which among the options is better suited, in that particular area of the world to provide the type of civil engineer logistical[15] and operational support anticipated at that location?" Such support may be based on Host Nation agreements, contractor availability, in-service resources, or some combination of these. The possibility of sister service support also suggests consideration of deployment of small, specialized Air Force teams to augment the other services for those civil engineer support systems unique to the Air Force (for example, aircraft fuel distribution systems and mobile aircraft arresting systems).

Arguably, the Air Force is better suited than the other services for initial, land-based beddown of air operations in a combat environment. Sustainment of airfields under combat scenarios, however, merits a closer look at inter-service cooperation, given the drive to increase interoperability between the services and to locate basing operations farther from the scene of the fight.

If a certain enthusiastic parochialism continues to prevail between the services on this issue, it is due in large degree to the fact that the promise of technology to further 'separate the base from the battle' has yet to be placed fully into practice. Nonetheless, the concept is broadly agreed to be attainable in the near-term and therefore merits open, concentrated discussion among the services now.

Contracting Civil Engineer Support at Deployed Locations

The Air Force Contract Augmentation Program (AFCAP)

The Air Force Contract Augmentation Program is intended to fill a supplemental role primarily in *non-combat* military operations other than war and during exercises, contingencies, deployments and humanitarian relief operations. Certain non-operational, material resource elements of the program may also be employed during a major theater war. In its broadest application, it serves as a force multiplier for Civil Engineer, Services, and Logistics functions worldwide. Contractors in this program can provide the same level and quality of major installation support provided by military and civil service resources.

Focusing on civil engineer capabilities, the contract augmentation program can be used to augment or to relieve Prime BEEF teams as they progress into the sustainment role and through the subsequent base recovery, reconstitution, and restoration phases of a deployment. It can even be used entirely in lieu of military civil engineers to support certain types of military operations other than war. For example, the Air Force currently wholly employs a contractor to provide complete civil engineer support functions for U.S. drug control air operations in several South America countries. Contractors also provide the preponderance of civil engineer support for Northern Watch operations based out of Incirlik Air Base, Turkey.

Two important civil engineer functions are excluded from this program. By law, U.S. explosive ordnance disposal operations anywhere in the world must be performed by military personnel and U.S. fire fighting operations on U.S. Air Force aircraft must be performed by a combination of military and civilian Department of Defense employees.

The Air Force Contract Augmentation Program offers numerous benefits. Chief among these, the program provides quick, responsive support anywhere in the world with a highly flexible contractor workforce that can be tailored from 1 to 10,000 or more people across as many as eight separate geographic locations simultaneously. In addition, the contractor is self-sufficient, providing all materials, tools, equipment, vehicles, and personnel, with the capability, independently of the government, to deliver any combination of these anywhere they are needed around the world. With global capabilities come global knowledge and global ties to other commercial entities, enabling the government to leverage these contractor advantages, often with commensurate savings in manpower and dollars. Finally, and no less importantly, the federal government benefits from such contractual arrangements through the contractor's full use of commercially available, off-the-shelf products and leading edge technology and efficiencies.[16]

By its nature, the Air Force Contract Augmentation Program suffers two problematic curses which, for example, frequently frustrate the far broader outsourcing and privatization initiative underway across the Department of Defense. First, it is extremely difficult to accurately capture all military costs by individual person, by activity, or (somewhat less difficult) by piece of equipment, and compare that equitably alongside a contract proposal to deliver the same capability. On the surface, and even through the first layer or two of investigation, contractors are hard-pressed to appear to cost-effectively provide the same level of service as the military when they must account, up front, for every cost from medical benefits, to transportation and storage of resources, to visa fees in foreign countries.

Second, to award an Air Force Contract Augmentation Program contract, the funds must be identified and allocated up front, before contract award. Functions desirable for contracting through this program, as often as not, are in response to unforeseen events. Such unforeseen events beget unforeseen costs for which funds were invariably not budgeted. Compensation of such unforeseen depletions of already tight Operations and Maintenance (O&M) funding is generally unlikely to be forthcoming from outside the organization seeking the support, so that cuts must be made internally. Both of these issues, perceived cost comparisons and up-front, often unbudgeted funding, serve as major disincentives for users to contract out such work, though in reality, the ultimate cost to the federal government may well be less through the contractor.

A third, far less extensive consideration further limits use of this unique contracting program. Once established in a country or region, the contractor, and the Air Force, could take advantage of any economies of scale the contractor might enjoy. However, in some countries contracted support for U.S. Air Force operations would, for a plethora of reasons, be tightly held as the purview and rightful responsibility of the Host Nation, thus barring outside contractors the opportunity to compete for providing services. Such is the case with Saudi Arabia, for example.

One final point from a broader perspective merits consideration as well. Civil engineering is one of the broadest and most intense contracting environments in the Air Force—even moreso during deployments. With limited contracting authority and the attendant training, responsible leadership in the civil engineer community could dramatically expedite overall beddown efforts with the ability to establish initial, low-cost, limited-quantity purchase contracts and one-time or short-term services and equipment rentals.

Until experience with the program grows and the military acquires better tools to assess the true federal cost of doing business, the Air Force Contract Augmentation Program will continue to suffer application substantially restricted to such non-comparable activities as the relief of military personnel from their heightened operations tempo. Additionally, adjustments to contracting, budgeting, and funding principles, enabling them to react far more quickly and flexibly in today's global environment, would substantially improve the ability to equitably employ contract support through the Air Force Contract Augmentation Program.

Prepositioned Assets

The Right Things

Prepositioning of assets within, or as close as possible to, anticipated theaters of operation and points of use afford the obvious advantage of savings in strategic airlift and sealift, as well as timeliness of delivery. Delivery of these assets follows a predetermined beddown timetable based on task priorities. Initial focus concentrates on preparation of the airfield environ for flight operations and on critical utilities. The second phase addresses support functions in the airfield environment, such as fuel storage, and aircraft arresting systems, as well as base support functions such as ammunition storage, vital shops, and billeting, dining and shower facilities. Phase Three expands base infrastructure such as utilities and roads and includes facility hardening and camouflage, concealment and deception measures, if required. The final phase addresses day-to-day activities such as operations and maintenance, training, and quality of life improvements.[17]

Different geographic air components address these needs differently. Pacific Air Forces, for example, relies solely on War Reserve Material (WRM) generally prepositioned not simply in theater, but actually at the anticipated point of use. United States Air Forces, Europe, on the other hand utilizes a dual prepositioning system with WRM as in the case of Pacific Air Forces, but also with Forward Deployed Material to augment the War Reserve Material program.

The War Reserve Material (WRM) Program is owned, operated, and funded by the Air Force Component Logistics Directorate in the respective theater of operations, and assets are usually maintained by contract, funded through the logistics community. Items identified for storage through this program correlate directly to requirements identified in existing operations plans for two major theater wars (MTWs), as well as individual base support plans, intelligence estimates, and Air Force Pamphlet 10-219, Bare Base Conceptual Planning Guide. Storage levels of supplies, equipment, vehicles, and materials generally satisfy the worst case, most demanding anticipated requirements. Candidates for War Reserve Material include large, heavy items such as bulldozers, mobile aircraft arresting systems, and reverse osmosis water processing units, and portable facilities; general purpose vehicles such as pickup trucks and buses; and smaller items that require large numbers, such as portable generators, area lighting units, and tents.

Forward Deployed Material is identified, owned, maintained, and funded by civil engineer units at main operating bases in United States Air Forces, Europe. These assets extend resources identified and funded under the command logistics program and include items that may be unique to the particular theater of operation. These resources are moved to forward operating locations associated with a particular main operating base as required. Examples of forward-deployed material include smaller, organizational tools and equipment that would nonetheless add excessive weight and volume to stateside teams deploying overseas.

War Reserve Material assets are usually managed and maintained by contract, and their content is reviewed annually to evaluate the continuing requirement, as well as the overall condition of the resources. Biannual assessments of adequacy of storage locations are typical.

While War Reserve Material equipment has, in recent years, been adjusted away from the Cold War philosophy of massing forces and tailored more to fit the global mobility posture of today's forces, opportunities do exist to reduce the types and numbers of items prepositioned in theater. The U.S. Air Force Agile Combat Support Concept of Operations emphasizes "...precise forward-deployed inventories..." as a key element in successfully developing a responsive, high-velocity logistics process.[18] For example, in some cases, better site surveys would aid in identifying the full range of host nation and contracted capability and resources, as well as the likelihood these would be forthcoming under various conceivable scenarios, for example, taking into consideration local laws, customs, health issues, host nation politics, and so forth.[19]

The Right Numbers

To a large degree, 'more is better,' but only to a point. Theater modes of transportation, particularly tactical airlift, will quickly be tasked to their maximum operating schedule in the early stages of mobilization. Transport of civil engineer resources must then fall within the prioritized list of asset movement. Following another line of thought, excessive storage of resources compounds an already highly taxed and expensive maintenance and repair program. Excess assets mean greater costs in initial purchase and in long term maintenance.

The same site surveys employed to identify what is needed for prepositioning, should concurrently identify how much to preposition, based on what is available locally. As advancing technology lengthens the legs on our weapons platforms and enables us to place our bases of operations ever further from the battle area, these requirements should naturally decrease, even to zero in many cases. Reviews of anticipated requirements for all prepositioned assets should be conducted routinely with consideration given to the actual threat reduction attendant with improved U.S. weapons and weapon delivery systems.

The Right Places

The decision on placement for prepositioned assets is often driven more by international politics and U.S. funding than by the pragmatics of the best location. Obviously, the ideal situation would be a fiscally and politically unconstrained environment in which to buy, store, and maintain all anticipated requirements at their anticipated point of use. Barring that highly unlikely circumstance, hub locations, centrally located within each theater would allow more responsive distribution of fewer assets on an as-needed basis, similar to reachback but with a far shorter line of communication. Such an approach would offer savings in reduced volume of initial purchases as well as in time, money, manpower, and maintenance. More realistically, prepositioned assets are placed as close to the anticipated trouble zones as we are politically and financially able to negotiate. The current, evolving international environment merits recurring reassessment through the State Department of the feasibility for permanent, reliable, economical relocation of prepositioned assets.

Stateside Opportunities

Redefining Requirements

Air Force civil engineer doctrine embraces the notion that mobility requirements vary across the spectrum of military operations and across time. In the context of the Expeditionary Air Force, flexibility in response to military operations other than war is ingrained in the size of any single Air Expeditionary Force, as is the ability to pare and tailor a force as circumstances dictate. However, there is another dimension to consider and not so readily addressed in civil engineer literature: technological advancement, especially in relation to time. While a detailed discussion of technological advancement, in particular, technology transfer, in civil engineering follows later in this paper, some general comments are appropriate at this point.

Air Force civil engineer mobility doctrine has already taken advantage of certain technological advances in weapons, weapons platforms and command, control, communications, computers, and intelligence (C^4I). When near parity ruled the Cold War, the focus of capabilities in engineering mobility centered on rapid runway repair, with an immediate, massive flow of forces to perform beddown and rapid runway repair. The demise of the Soviet Union and Warsaw Pact substantially reduced this threat of parity with our enemies. Our greatest threat for the preceding 45 years markedly diminished, the likelihood that, at least in the near-term future, we would engage in conflicts where our adversary could penetrate our air defenses (ballistic missiles excepted) was also greatly reduced.

Furthermore, by most accounts, technological advancements in weaponry, delivery systems, and communications will "carry the fight" further in wartime. Similarly, innovation in maintenance, logistics, transportation, and related communications will lengthen our "legs" in peacetime as in wartime. Even if only near-term predictions come true, basing can and will move farther and farther from the site of conflict. As with many contests, we, like our sister services, "must be present to win," although manned "presence in spirit" may suffice if unmanned vehicles come to fulfill expectations. Unlike our service brethren, however, in the future we may not need to mire or anchor our airbases within the theater of operations and therefore within the range of vulnerability to enemy action (notwithstanding development by our enemies of increasingly accurate and lethal ballistic missiles or employment of terrorist attacks).

This combination of factors that effectively served to reduce the physical threat of an accurate strike on critical airfield assets, most particularly airfield pavements, in turn fostered a broad reassessment of civil engineer support roles in mobility operations. From a posture poised to confront global conflict emerged a policy and strategy grounded on regional level operations using a reduced overall force structure. Forward presence and massive response gave way to lighter, modular forces able to respond rapidly anywhere in the world. With a reduced physical threat to installations, rapid runway repair, one of the most equipment and people intense tasks among the panoply of civil engineer mobility missions, would naturally garner less emphasis. Civil engineers are also charged with the physical protection of resources, for example, barriers for aircraft, sortie generation equipment, facilities and utilities; berms for facilities, utilities, and equipment; and camouflage for buildings and equipment. With the changing nature of the threat environment, many of these labor and resource intense tasks could be eliminated from the standardized response forces of the past, incorporated into deployment team capabilities only on those rare occasions when they may be required.

As technology continues to progress, civil engineer support requirements overseas are likely to continue to diminish, exclusive of the potential for the employment of ballistic missiles and terrorism as asymmetric tools of political choice. Greater range for U.S. offensive forces gives greater options for the choice of a base of operations, as well as the means for providing combat service support. Rhetorically, given such options, why or when would we choose a bare base within easy striking range of the enemy if a fully operational location well removed offers the same advantages and none of the disadvantages?

Now is certainly not the time to act upon any anticipated fruits of future technological advancements—the ramifications of error or over-enthusiastic, premature adaptation are far too high. Nonetheless, greater consideration should be given to alternative futures where deployed civil engineer support could quite readily equate to little more than a contract manager or liaison with the host nation.

Sizing the Civil Engineer Military Force for Mobility

Prime BEEF Comes of Age

A concise history portraying the philosophy behind the inception, development, and sizing of Air Force civil engineer mobility teams helps to frame the thought processes currently employed to support deployed operational units. From its first inception in the early 1960s to the post-Cold War era of the 1990s, engineer deployment team structure was threat-based. So much so, in fact, that in the wake of the Vietnam War, the Air Force corporately refocused on the Soviet Union and Warsaw Pact threats emanating from Eastern Europe. For the first time, engineers undertook a study to determine, based on threat, what was the full extent and impact of their anticipated wartime requirements. Continuing frustrations with Army support of Air Force civil engineer requirements throughout Vietnam and during the Pueblo incident intensified enthusiasm for autonomous Air Force engineering mobility forces. Furthermore, there was an attractive cost benefit in civilian positions saved by using Air Force engineers slotted against wartime roles to help perform peacetime base maintenance. On paper, the concept looked great. In reality, it proved a failed strategy—there were insufficient resources, particularly military manpower, to satisfy the unrealistic requirements during the post-Vietnam years, especially in concert with the launching of the all-volunteer force. Furthermore, the wartime requirements became so extensive that some questioned the continued operability of stateside bases in the event of major deployments by military engineers.

Focus on Rapid Runway Repair

In true strategy-to-task form, civil engineer mobility teams, such as rapid runway repair (more widely known as "Triple R" or "RRR") and force beddown, were structured to support specific functions which themselves were designed to ensure continued base operability in executing theater and, ultimately, national strategy. Teams were built on the nucleus of rapid runway repair capability, quite properly seen at that time as our most urgent and compelling task in war, followed very closely on its heels by the more general and encompassing task of force beddown. The Air Force's Civil Engineer Support Plan (CESP) identified within warfighting theaters the total, worst-case, wartime requirements at each of numerous locations (at main operating bases or "MOBs," collocated operating bases, or “COBs” and forward operating locations, or “FOLs”). Under this scenario, shortfalls in civil engineer manpower numbered in the tens of thousands--there simply were not enough personnel to fulfill this unrealistic requirement.

Evolution in the composition of rapid runway repair teams offers the most illustrative example of this threat-based approach to sizing standardized civil engineer mobility forces through the 1970s and 1980s, up to the early 1990s. As the threat grew, so did team size, without consideration of the realistic limitations imposed on execution of the plans.

Two worst-case scenarios set the stage for the threat assessment, which in turn drove civil engineer mobility team sizing. The first was the introduction of U.S. forces into conflict--the initial 24-72 hours following notification until the U.S. and its allies could establish combat air patrol and air superiority. The second worst-case scenario was departing an installation under enemy fire. The greatest perceived threat and challenge to combat support operations in either of these settings was the potential inability to launch aircraft from a bare base due to effective enemy offensive attack on airfield pavement. Without a clear, unencumbered launch surface, aircraft parking, and paved aircraft access between the two, there could be no combat operations. Even worse, aircraft on the ground would be land-locked and all the more vulnerable to subsequent enemy attack. Translated, the clear and unequivocal challenge to which deployed civil engineers were set, first and foremost, was to get and keep the runway, parking, and access pavement operational. Intelligence estimates in the early to mid-seventies indicated that, on average, enemy strength and accuracy in bombing would generate the requirement to repair three bomb craters on critical airfield paved surfaces within 4 hours, ensuring a 50-by-5000 foot minimum operating strip for the launch and recovery of combat aircraft.

The threat thus defined, the Prime BEEF "R-1" team was structured with personnel and equipment to deliver the requisite repair rate of three craters in 4 hours. Borne of the need to support this R-1 team, two task-defined "sub" teams were created. The first, comprised of 21 highly-trained and skilled heavy equipment operators, formed the nucleus of the rapid runway repair team. The second, 70-person team consisted of civil engineers highly trained and skilled in other vital combat support areas, while secondarily trained to augment the 21-person rapid runway repair core. Civil engineer War Reserve Material (WRM) requirements were identified, acquired, stored, and maintained for main operating bases and their associated collocated operating bases and forward operating bases by the logistics units at each of the major installations in-theater. These reserves provided the necessary wartime operational requirement for sets of bulky, heavy equipment (for example, bulldozers, front end loaders, generators, and mobile aircraft arresting, or "barrier," systems) as well as tents, mobile kitchens, and other equipment sets. Similar to the manned teams, these equipment sets were sized based on perceived threat.

By the late 1970's, the threat to airfields, and particularly critical airfield pavement, was seen to double and by the end of the 1980s to quadruple in some theaters, from repair of three craters in 4 hours to 12 craters in those same 4 hours and eventually, within 2-1/2 hours. The corporate civil engineer response was to establish additional, augmenting teams to conjoin with the basic R-1 team to meet these increased threats on a case-by-case basis. Roughly half the size of the R-1 team, the "R-2" team enhanced repair capabilities to accommodate six craters in the allotted 4-hour period. By the late 1980s, these "R" teams were structured somewhat differently, though still based on rather fluid assessments of the ability for potential enemies to inflict damage on fixed-base flight operations. To accommodate the even larger assessed threat, composites and combinations of teams of 50, 100, 150, or the maximum of 200 people (newly designated the "R-3" team and designed to fix 12 craters in 2-1/2 hours) were employed to respond to specific, anticipated threats at specific locations. Similar sizing adjustments took place in the prepositioned asset packages that supported these teams.

Through the 1980s and into the 1990s, team structure and engineer mobility doctrine would be adjusted several times. To maximize flexibility and capability, team sizes were reduced in the early 1980s, yet this fractured unit integrity so vital to the intricate, detailed operations that made rapid runway repair "rapid" and, with individuals performing only one mobility role, manpower requirements skyrocketed. Fragmented teams from different stateside bases spelled disaster, if not manifested in accidents, then most certainly in markedly, and unacceptably, extended times for repair operations under battle conditions. Personnel requirements to satisfy these wartime support duties created engineering mobility shortfalls anywhere from 30,000 to 50,000 personnel.

These problems were addressed in the mid and late 1980s by introducing the concept of "multi-skilling," whereby individuals were trained to perform more than just their primary function, and by packaging force modules tying specific support function teams to specific flying units, usually from the same home station. Multi-skilling enabled individuals to fill roles on multiple teams, substantially reducing the manpower requirements. Focus remained on the critical requirement to keep the runway open or repair it immediately if damaged. All other functions were secondary, but with repair times on the order of 4, and then 2-1/2, hours, the reduction in lift that accompanied the reduction in personnel and equipment made this delay in performing other combat engineering functions acceptable. Force packaging centered on maintaining home station integrity introduced significant efficiencies inherent in fighting alongside those with whom one has trained.

Beddown Takes Center Stage

A combination of factors would bring to a close this threat-based approach to sizing civil engineer mobility teams. First, the rapid implosion of communism in the former Soviet Union and Eastern Europe began to chip away at the threat-based foundation on which Prime BEEF teams were built. No longer was there a credible potential opponent who could match U.S. airpower and deny control of friendly airspace. Neither did any credible potential enemies enjoy significant standoff capability worth considering a major threat to the Air Force deployed basing structure. If these were preconditions for altering perspectives on civil engineer mobility team structuring, then the 1991 Gulf War was the catalyst that began the actual process. The war with Iraq radically altered the U.S. view of the nature and impact of "the threat" and of the tremendous role technology had come to play in the military. It also revealed the fullest implications of military dominance for the world's sole remaining superpower.

Within months following conclusion of the 1991 Gulf War, the very seeds that sewed defeat for the vanquished aided in sprouting some degree of demise for the victor. Combined with the "peace dividend" resulting from the end of the Cold War, the unmitigated, overwhelming U.S. military success in leading the coalition against Iraq portended national introspection into the roll, structure, size and efficiency of the military.

While the types of U.S. military missions performed during the 1990s were nothing new, a significant change did occur in the migration of world events and national security strategy away from Cold War deterrence and big battles toward small scale, regional conflicts, policing actions, and humanitarian efforts. Such activity sent more U.S. military people to more places in smaller, "tailored" groups. The civil engineer community responded to this call for smaller groups by instituting additional, highly-specialized teams of one to ten people.

By the mid-1990's the basis for sizing civil engineer mobility teams had transformed quickly, though subtly to a capability-based perspective. This was due in part to changes in perceived threat, but more so based on very real reductions in funding levels, manpower, and equipment. No longer did rapid runway repair enjoy center stage as the single most critical function for civil engineer mobility. The threat to airfield pavements had become nearly negligible, since under almost any conceivable scenario, U.S. and coalition forces would achieve overwhelming dominance in air superiority nearly instantaneously upon arrival in theater if not already held by permanent (or rotating) in-theater forces. Granted that cruise and ballistic missile attacks posed a general threat to our forces, but poor accuracy and range of the weapons owned by our adversaries most likely to use them placed populations and areas, rather than specific infrastructure such as runways, at threat.

Concurrently, the post-Cold War "peace dividend" meant reduced budgets, reduced numbers of personnel and the need for greater accountability of, and justification for, what was left. Justification on the basis of capability offered several advantages over the previous philosophy for mobilization structure. First it accommodated reality—the new challenge was no longer penetration of friendly air space and bombing of friendly airfields by the enemy. It was instead, rapid beddown of deploying forces to bring as much firepower to bear on the enemy as quickly as possible, for as long as necessary. Second, the new team structure gave broader capabilities to individual teams. Finally, by packaging civil engineer mobility teams according to capabilities, Air Force leadership could more readily illustrate the individual capacity of teams and the total capacity of civil engineering Air Force-wide to support national will and policy. This in turn helped tremendously in clarifying the budget process for mobility issues. This capability-driven approach also aided in defining Air Force limitations for policymakers.

Previously, although individual Prime BEEF lead teams had an abundance of manpower and so, through shear numbers, were capable of performing beddown and early sustainment (first 30 days), they were not properly configured to do so. Under the new construct, which officially remains in effect today, a single lead team, properly structured, trained, exercised and equipped at a single home station, can fully beddown, and for the short term (30 days), sustain, a deploying unit of aircraft. Since teams take only that material and equipment needed for the first 7 days of a deployment, the ability to logistically sustain up to 23 additional days assumes resources to do so will begin flowing no later than day 7 after initial deployment.

The worst-case scenario for deployment calls for beddown of operations and support personnel at a "bare base," where only a runway, aircraft parking areas and connecting taxiways, and a source of potable water are already available. Typically, a lead squadron of deploying fighter aircraft requires beddown of 1100-1200 operational, maintenance, and support personnel. Under these circumstances, deployed civil engineers must provide all utilities (potable and non-potable water, sewerage, electricity, heat, air conditioning) and facilities (billeting, office space, dining, recreation, etc.) in addition to any existing bare base assets. Facilities and most of the utility systems and other assets are provided in the standardized "Harvest Eagle" (housekeeping) and "Harvest Falcon" (housekeeping, industrial, and flightline support) kits. Eight 550-person Harvest Eagle kits are stationed in the European theater, eight in the Pacific theater, and eight stateside at Holloman Air Force Base, New Mexico for quick mobilization worldwide. Forty-six 1100-person Harvest Falcon kits are located in Southwest Asia, with four staged at Holloman for rapid global deployment. The balance of the equipment and material requirements are provided from additional stored assets prepositioned in theater or available locally on the economy at the deployed location.

Multiple flying unit beddowns at the same location garner a second Prime BEEF team, the "follow" team, comprised of 61 personnel. Progressively larger deployments attract progressively smaller "additive" teams as synergy and duplicative use of existing facilities and systems introduces economies into base support operations. For deployments extending beyond 30 days, Air Force Civil Engineer policy dictates support by individuals on temporary duty, rather than through team deployments.

The Air Force Prime BEEF program now contains some 34 different types of manpower, equipment, or combined Prime BEEF unit type codes, or teams, retaining the original 132-person lead team and 61-person follow team for flying unit beddowns.[20, 21] (See Appendix B)

Support for the Air Expeditionary Force

Restructuring of mobility forces commensurate with the new, Expeditionary Air Force program takes a major step forward in providing stability and predictability to deployments and Temporary Duty for our military forces. By spreading taskings uniformly across the Air Force in phased segments, it also dramatically improves equity of overseas duty within a given career field. Unfortunately, for some low density, high demand career fields such as explosive ordnance disposal and firefighter personnel, the relief is only slight. Nonetheless, restructuring into Air Expeditionary Forces, retaining wing and unit integrity, as well as cross-training, to a much higher degree than was previously the case, buys substantial benefits. Among these is the flexibility to further reduce and tailor civil engineer deployment teams to meet the specific demands of particular taskings.[22]

By September, 2000, the civil engineer community across the Air Force will have completed the first of a two-phase restructuring of Unit Type Codes into modular, capability-based building blocks. In Phase One, eleven new Unit Type Codes are drawn from the former 132-person lead team, 61-person follow team, fire protection teams, and readiness teams. These teams will be able to deploy in their smallest configuration or combine to build teams nearly identical to the core 132-person lead team and 61-person follow team currently in use. Phase Two introduces six new teams within the nuclear, biological, and chemical specialty. These tailored civil engineer mobility teams embody the philosophy behind the Expeditionary Air Force, and, integrate into a stable Air Expeditionary Force under a modified "home-station" concept where they train with the teams with whom they deploy. Combined with continuing advances in technology, "Air and space expeditionary forces will increasingly be able to influence a distant operational area without being physically present.[23] (See Appendix C)

U.S. Central *Command's Concept of Operations for a CENTCOM Air Expeditionary Force (AEF)* illustrates this ongoing shift in civil engineer to align with the Air Expeditionary Force structure. Support and team structuring are designed around four phases of beddown and redeployment. Each of these phases is fluid, with elements reaching completion and closure at different times and running concurrently with other phases, although they do follow a general timeline.

Phase I, "Attainment," and Phase II, "Initial Combat Capability" run concurrently, covering the first 7 days after arrival on station. A single lead team of 32 personnel (vice current lead teams of 132 personnel) arrives on Day 1. This team's top priority is to ensure all aspects of the airfield environ are fully operational. Detailed system checks and operational tests are conducted on aircraft refueling systems, airfield pavement, airfield lighting, and aircraft arresting barriers (for fighter aircraft). Firefighters on the lead team standup operations and ensure that adequate fire protection is provided to all aircraft operations, while explosive ordnance disposal personnel on the team scour the base for any potential accidental explosive hazards. During this time, the second, enabling team, tailored to 13 personnel, arrives to augment the first, and launch round-the-clock, combat service support for the first 7 days of operation, still focused exclusively on combat operations and direct support.

At the conclusion of the first 7 days, the base has already been operational for 5-7 days, and Phases I and II have gradually drawn to a close, while Phase III, Follow-on Combat Capability, gradually has gradually replaced the first two phases. An additional team of 44 personnel arrives to complete the beddown process, building facilities, concluding, through the Contracting Officer, contracts locally and stateside for various functions, and establishing routines for day-to-day sustainment operations. During this phase, base service support infrastructure commences, such as construction of tent city (billeting); services activities, shops, and offices take shape; environmental oversight begins; and fire protection and explosive ordnance disposal operations expand to encompass all base activities. In concert with the rotational precept of the Air Expeditionary Force, this basic force of three tailored teams with 89 personnel, augmented as necessary based on local conditions, provides sustainment through the first 90 days of base operation, until relieved by the next, Air Expeditionary Force deploying team.

Phase IV, "Redeployment," involves orderly mission and base draw down following mission completion or reassignment elsewhere. It involves the tear down and removal of temporary facilities; the disassembly and repalletizing of recoverable assets and preparation for transport; phase-out of contracts as base population diminishes; and the return of the installation to its original state prior to initial deployment. Disassembly and repackaging of Harvest Eagle and Harvest Falcon sets is augmented by specialized teams from Holloman Air Force Base, New Mexico in order to inventory, inspect and preserve these valuable assets. Engineer support for these redeployment activities declines proportionately with the remaining population, and generally, a handful of civil engineer specialists are among the last to leave a bare base location.[24]

The Long-Range Future for Civil Engineer Mobility

Implementation of the Expeditionary Air Force concept does not imply that civil engineer mobility team structures themselves will remain constant—indeed, quite the opposite is likely. A number of dynamics such as the evolving global environment, political and economic realities stateside, and technological advances will continuously mold military requirements and engineer mobility team formats. In fact, current vision considers the possibility for integration of Prime BEEF, RED HORSE, and other special teams into a single aerospace combat engineer force by 2025.[25] Under this plan, today's multi-tiered teams, grounded in static requirements such as the number of deployed fighter aircraft, will evolve into integrated teams with equitably distributed capabilities supporting equitably distributed operational requirements in accordance with the concept of the Expeditionary Air Force.

A number of assumptions are elemental to this plan for a single, integrated combat engineer force, equally divided among expeditionary teams:

1) The Expeditionary Air Force concept, with it's deployable Air Expeditionary Forces, will remain the model for operations through 2025;
2) Advancing technology will continuously offer opportunities for civil engineer deployable teams to grow smaller, lighter, and faster;
3) Sufficient funding will be available to re-equip civil engineer forces;
4) The operations tempo will remain little changed over the next 25 years; and,
5) Air Expeditionary Forces will become the construct of choice for response across the spectrum of conflict, including major wars. Air Expeditionary Forces are currently designed only to accommodate limited scale conflicts and similar military operations other than war. Current doctrine dictates that, Curing major

theater wars, the limited response expeditionary force structure succumbs to massive mobilization.

Already, technological advancements nearly within our grasp offer the promise of further reducing deployed manpower and prepositioned material and equipment to support theater operations. In line with the initiatives expressed in JV 2010 Focused Logistics and the Air Force's complementary Global Engagement, Air Force Civil Engineer (AF/CE) leadership continues to seek technologies enabling modular, tailored combat service support packages.

Summary

At every stage in the Air Force civil engineer mobilization process, opportunities exist to further reduce mobility team size, weight, and response times. For the majority of these opportunities, dedicated, forward-looking members of the engineer community are working hard to improve civil engineer responsiveness to contingency operations. Furthermore, ongoing restructuring of Prime Base Engineer Emergency Force teams will enable leadership to take further advantage of major steps forward beyond those already taken in many of the areas discussed. Given adequate resources to do so, additional funding and management oversight in certain key areas such as site surveys and prepositioning of assets could pay impressive dividends.

Advancing technology may also offer special opportunities to improve civil engineer mobility team responsiveness with a reduced footprint and logistics tail. Part 3 will take a detailed look at these opportunities, as well as mechanisms currently in use by Air Force civil engineers to seek out and transfer technologies across organizations and professional disciplines.

Notes

[1] USAF ACS CONOPS, pg 2-3.

[2] Air Force Pamphlet (AFP) 10-219, Volume 8, *Prime BEEF Management*, 1 September 1999, pg 15.

[3] United States Air Force Scientific Advisory Board, *Report on United States Air Force Expeditionary Forces Volume 2: Appendices E - H*, sponsored by SAF/OS and AF/CC, Washington, D.C., February 1998, pg H-26.

[4] Ibid., pp H-26 to H-27.

[5] AFDD 2-4 (Draft), pp 13-14.

[6] ACS CONOPS, pp 1-4 to 1-6.

[7] AFDD 2-4.4 (Draft), pp 8; 17-18; 22-23; 26; 30.

[8] AFDD 2-4.4 (Draft), pg 26.

[9] *United States Air Force Agile Combat Support Concept of Operations*, 1 October 1999, pg 1-7.

[10] Air Force Instruction (AFI) 10-404, *Base Support Planning*, 16 November 1994, pp 19-22; 35.

[11] United States Air Force Scientific Advisory Board, *Report on United States Air Force Expeditionary Forces Volume 2*, pg H-14.

[12] ACS CONOPS, pg. 2-6.

[13] Joint Publication 4-04, *Joint Doctrine for Civil Engineering Support*, 26 September 1995, pp I-4 to I-6.

[14] IBID., pg vi.

[15] United States Air Force Scientific Advisory Board, *Report on United States Air Force Expeditionary Forces Volume 1: Summary*, sponsored by SAF/OS and AF/CC, Washington, D.C., November 1997, pg 38.

[16] *Air Force Contract Augmentation Program (AFCAP) Concept of Operations*, Volume I, undated, pg 5.

[17] Air Force Pamphlet (AFP) 10-219, Volume 5, *Bare Base Conceptual Planning Guide*, 1 June 1996, pp 21-24; 27-29.

[18] *United States Air Force Agile Combat Support Concept of Operations*, pg 1-5.

[19] Ibid., pg 1-6; 1-7.

[20] Air Force Instruction (AFI) 10-210, *Prime Base Engineer Emergency Force (BEEF) Program*, 1 July 1998, pg 23.

[21] Air Force Pamphlet (AFP) 10-219 (Draft), *Prime BEEF Management*, 1 September 1999, pp 22-23; 262-282.

[22] Colonel Bruce F. McConnell, Director of Civil Engineer Contingency Support, Headquarters Air Force Civil Engineer Support Agency, memorandum to major command civil engineer contingency support staffs, subject: Transition to new Unit Type Codes (UTC), 12 January 2000.

[23] Air Force Doctrine Document (AFDD) 1, *Air Force Basic Doctrine*, September 1997, pg 72.

[24] Concept of Operations for a CENTCOM Air Expeditionary Force (AEF), no date, pp 33-38.

Notes

[25] Civil Engineer Strategic Plan, Volume Two (Draft), "*Mission and Modernization 2000-2025*" as of 19 Dec 1999.

Part 3

In Search of Technology

We have a lot of people revolutionizing the world because they've never had to present a working model.

—*CharlesKettering*

With the abundance of national military strategy, service strategy and doctrine, and reorganization focused on becoming more agile, mobile, and versatile, the combat service support structure has already benefited from the trimming of excess mobility. If, as pundits for the Revolution in Military Affairs predict, fewer direct-mission people and resources will deploy farther from the area of focus, then certainly fewer service support assets will be similarly required, substantially, if not wholly, removed from the immediate area of battle.

Continuing advances in technology should enable us, in the near future, to apply the massing of *effects* on the battlefield without the need to physically beddown (and therefore, mass) all combat and support forces in close proximity to the area of conflict—indeed, quite the contrary.[1] Greater range and survivability in weapon delivery systems and greater precision targeting and lethality in the weapons themselves (and hence fewer sorties to achieve the objective) push the need for combat service support farther and farther from the fields of conflict—hence fewer fixed assets farther from harm's way. In addition to this reduction, technology should further reduce in size, weight, and numbers, that which we do deploy to bed our forces down. Less vulnerability to attack means less dependence on specialized recovery equipment and skills. Extending this notion even further, separated far enough from the battle area, perhaps even outside the theater, most equipment-intense, personnel-intense base support operations, if needed at all, could be contracted.

In today's environment, with rapidly proliferating weapons of mass destruction and well-trained, well-practiced terrorists, be they individuals or nations, ready to use those weapons, the enemy's reach can be global indeed. In this changing face of uncertainty, at least one constant holds—we must be prepared to fight under a broad spectrum of circumstances, and take our fight to wherever needed in the quickest, most efficient manner possible. True enough that as our own weapon accuracy increases and the range of delivery systems increases, our options for beddown locations also increase. Yet in truest American fashion, we must be prepared today for the worst case. That scenario today and at least for the near future calls for deployment of forces well within the range of enemy combat operations and assumes use by the enemy of weapons of mass destruction. The need for continuing technological advancement in mobile combat service support, and more specifically, civil engineering, therefore continues unabated.

Deployments to provide combat service support, more recently termed "agile combat support," obviously will not simply vanish. Multi-use equipment, lighter materials, smaller packages, and greater integrated protection of personnel and key equipment from attack—all require corporate Air Force engineering involvement. In consonance with the other military services, the Air Force engineering community must continually push, pull, and otherwise expand by any means available, the technology envelope for the combat engineering arena. The Air Force Civil Engineer program that seeks, develops, and employs such technology therefore merits a full measure of evaluation on a continuous basis. Given the long-range goals of the Air Force's Agile Combat Support program, it is also useful to consider where, in the evolutionary chain, Air Force civil engineering stands at present and in the near-term in its pursuit for technological advancement and advantage.

The Technology Acquisition Process for Air Force Civil Engineering Mobility Issues

General Overview

The process by which the Air Force Civil Engineer seeks, explores, and acquires new technologies ties into the Air Force-wide system through several points along the process from inception of a need to its satisfaction. Air Force Instruction 63-118, *Civil Engineer Research, Development, and Acquisition,* provides definitive guidance on the processes for "...identifying, validating, approving, prioritizing, and executing..."[2] technology research and development, as well as acquisition activities, for the civil engineer. These processes are described in detail Section B, paragraphs 4 and 6, and are depicted on page 6 of the Air Force Instruction referenced previously. A more generalized description is provided below.

The Air Force Civil Engineer Support Agency launches the technology identification, investigation, and acquisition process each year through its Annual Technology Needs Call to major command staffs and their base civil engineers in the field. The commands consolidate, prioritize, and return their lists to the Air Force Civil Engineer Support Center.

The Center, in conjunction with Air Force Material Command's Air Base Systems (ABS) Technical Planning Integrated Product Team (TPIPT), identifies those prioritized deficiencies for which technology is already available. Members on this team include representatives from the Air Force Civil Engineer Support Agency. Where technological capabilities exist to satisfy certain requirements, this information is passed backed to the respective command(s), and the deficiency is removed from the Center's consolidated list. For those deficiencies remaining on the list, the team searches for information and possible solutions. Acting as a clearinghouse or broker, the team canvasses the Air Force laboratory system, other services, other government agencies, industry, universities, and even overseas research institutes in search of possible solutions or proposed concepts that could lead to resolution of the deficiency. Based on the best information available, they estimate research, production, and life cycle costs for each remaining item.

This consolidated list is then forwarded to the head of the Air Force Civil Engineer Operations Division, who chairs the Air Force Civil Engineer Readiness Board, comprised of Operations Division and Readiness Division Chiefs from each of the major commands and a representative from the Center's Readiness Division. The Readiness Board reviews and recommends to the Air Force Civil Engineer, a finalized, consolidated Air Force-wide list of technology research initiatives. The approved list is then forwarded for incorporation into the Contingency Base Operations (CBO) Mission Area Plan (MAP) for which Air Combat Command is the Air Force focal point. From this point, these initiatives for technology research compete with other Air Force funding requirements in the normal budgeting process.[3] This process is depicted in Appendix D.

Technology Transfer

The process detailed above also describes the substance of the Air Force Civil Engineer's technology transfer program. Although technology transfer is highlighted in Air Force Policy Directive 61-3, *Domestic Technology Transfer,* as a responsibility borne equally across "...all Air Force science and engineering professionals,"[4] Air Force civil engineering is admittedly not manned to do so. There is neither a formalized process wholly contained within the civil engineer community to seek innovative new technologies in arenas outside the Air Force, nor a focal point within civil engineering through which any such investigation, formal or otherwise, is channeled. Full reliance is placed on the corporate Air Force technology transfer process, the preponderance of which operates through Air Force Materiel Command's Air Force Laboratory program.

The Air Force technology transfer process is codified in Air Force Policy Directive 61-3, *Domestic Technology Transfer*, and Air Force Instruction 61-301, *The Domestic Technology Transfer Process and the Offices of Research and Technology Application,* and is further detailed in Air Force Instruction 61-302, *Cooperative Research and Development Agreements* (CRDA) and in Air Force Instruction 61-303, *Licensing Inventions Made Under Cooperative R&D Agreements.* The first two of these four publications highlight several methods by which technology transfer takes place, to include the Cooperative Research and Development Agreement process with educational institutions, industry, private enterprise, and state and local government, patent licenses or assignments and grants.[5, 6]

It appears, however, that rather than actively scanning the horizon for new technologies and creatively seeking ways to apply these to civil engineering operations, the community instead only seeks those cutting-edge technologies that can solve a pre-identified discrepancy or deficiency through the preordained process already described. Undoubtedly at various levels throughout the Air Force civil engineer profession, some individuals play at least a passive role in trying new technologies at the local level on a comparatively small-scale basis. Nonetheless, in the absence of a more formalized program, even these limited test cases are generally not up-channeled to at least a corporate "lessons learned" program that may save others time and effort when facing similar challenges.

Hope for the Future

The November 1997 publication of the Air Force Scientific Advisory Board regarding "United States Air Force Expeditionary Forces" offers strong optimism in the Air Expeditionary Force. In the executive summary, the members of the Board express their corporate belief that, under this concept, the Air Force will be able to "Respond in less than half the time currently needed, with less than half the airlift, with less than one-third the people forward, to unprepared locations throughout the world." It will accomplish this while operating "...about an order-of-magnitude more effectively... with relatively small marginal cost to the current Air Force program and in the near future."[7] The attendant benefits are obvious: greater flexibility for decision-makers; smaller commitment of resources; and more combat mass on target quicker. This smaller, lighter, faster and more deadly force of the future relies heavily on a steady diet of technological advancement. This is true for combat support and combat service support, the same as it is true for weapons and for delivery systems.

One significant benefit comes through leveraging information technology. Discussed earlier, both agile combat support and civil engineer support will trim volume, weight, and time through the exploitation of advances in the integration of technology, communications, and information systems. Civil engineer mobilizing forces will gain significantly from enhanced logistics supply and resupply systems employed through the "reachback" concept. Implementing a "just-in-time" logistics system similar to that widely used in industry today, responsive supply and resupply will dramatically lighten the initial deployment load.

In similar fashion, technological advancement must include the requirement to improve durability, reliability, maintainability, and reparability of deployed equipment. Reduced life-cycle costs for equipment can be leveraged to further reduce immediate, as well as long-term, lift requirements.

Current Initiatives in Research and Applied Technology

The Air Force Civil Engineer has launched numerous initiatives to enhance civil engineer support on deployed operations, while reducing weight and size. These are in various stages of research, review, or production. Appendix E provides a detailed list of these initiatives (excluding those in the areas of fire protection, nuclear, biological and chemical warfare detection and defense, and explosive ordnance disposal), while Annex F presents a sample of the research, funding, and production processes through which civil engineer technology initiatives progress. These initiatives specifically target the tasks of lightening the load for deploying forces, while improving operability, durability, and maintainability.

Summary

Integrated into the Air Force corporate structure for research and applied technology, the Air Force Civil Engineer has a well-structured, aggressive program to seek, pursue, and acquire technologies which focus on satisfying identified shortfalls in the civil engineer mobility process. Initiatives span the entire breadth of approaches to reducing engineer lift requirements, footprints, and support tails. Additional opportunities may present themselves by actively seeking advancements in other fields not classically related to engineering disciplines in the Air Force Civil Engineer structure.

Furthermore, by leveraging certain advancements outside the civil engineer career field, mobilizing civil engineer teams will be able to deploy with substantially fewer people, and less equipment and material, with the certainty that these resources will be forthcoming upon demand.

Notes

[1] Concept for Future Operations, pg i.
[2] Air Force Instruction 63-118, *Civil Engineer Research, Development, and Acquisition (Draft)*, 1 August 1996, pg 1.
[3] Air Force Policy Directive 10-14, *Modernization Planning,* 1 November 1996, pp 1-2.
[4] Air Force Policy Directive 61-3, *Domestic Technology Transfer*, pg 1.
[5] Ibid., pg 1.
[6] Air Force Instruction 61-301, *The Domestic Technology Transfer Process and the Offices of Research and Technology Application*, 25 July 1994, pg 2.
[7] United States Air Force Scientific Advisory Board, *Report on United States Air Force Expeditionary Forces Volume 1: Summary*, sponsored by SAF/OS and AF/CC, Washington, D.C., November 1997.

Part 4

Recommendations

> *I don't want men of experience working for me. The experienced man is always telling me why something can't be done. The fellow who has not had any experience is so dumb he doesn't know a thing can't be done - and he goes ahead and does it.*
>
> —Charles Kettering

- Site surveys are a vital element in slimming deploying forces. Funding for accomplishment, either in-house or by contract, is insufficient to adequately conduct full and recurring site surveys on all locations to which we may have a reasonable expectation of deploying. Additionally, Air Force civil engineer interests in beddown site surveys must be served by Air Force civil engineers, not by proxies as in the past. (pg 24-26)

- Barring full, or at least adequate in-service knowledge of locations across the globe, other agencies and entities have knowledge that could prove useful in preparations for deployment. A single, integrated database (or alternatively, integration of separate classified and unclassified databases) could benefit a broad range of contributors across military services, federal agencies, international organizations, and private industry. Ownership and control of such a database or integrating mechanism of disparate databases would rest with a government agency, either the State Department or the Department of Defense, which would perform quality control on updates generated from outside the federal government. (pg 27)

- Events as recent as the mobilizations for Bosnia and Kosovo have illustrated repeatedly that engineering mobility capabilities in each of the services are particularly good at particular tasks under particular circumstances. None is particularly well suited to handle all conditions that may confront a mobilizing force. Current multiplicity of effort among the services is wasteful of resources, while it masks shortfalls in capability of one service compared to another under certain conditions. These shortfalls can, and at times, do have significant operational impact by relying on forces or contractors ill-suited to a given set of circumstances. The services should launch a new, concerted effort to integrate service engineering capabilities around the globe and identify the most efficient yet expeditious means for accomplishing force beddown, especially in those locations with minimal specialized requirements. (pg 30)

- Several additional areas of base beddown merit consideration for rapid, automated planning and layout. The more productive among these would be placement of utilities and utility distribution systems, land use based on unit mission, topography, threat assessment and meteorology, and resource dispersal and hardening based on mission value and most efficient use with security and threat assessment taken into consideration. Such programs could aid early identification of opportunities or limiting factors, and help expedite specific resources as needed to address these issues. (pg 30)

- Base-level efforts to develop automated expedient beddown planning tools should be advertised and monitored more closely at the command and corporate Air Force Civil Engineer levels. Disparate efforts at various bases generate needless duplication of effort, where centralized management could assimilate the best of what is currently available, and direct future efforts as bases volunteer to develop them. The fact of historical underfunding for centralized, contracted development of such programs lends further merit to the concept of centralized management of base-level initiatives. (pg 30)

- Adjustments to contracting, budgeting, and funding principles, enabling deploying forces to react far more quickly and flexibly in today's global environment, would substantially improve the ability to equitably employ contract support through the Air Force Contract Augmentation Program. (pp 34-35)

- At locations where previous contractual arrangements for civil engineer-type equipment, materials, vehicles, and services have not been established in advance of deployments, delegation of limited contracting authority to responsible civil engineer leadership in the field would markedly improve the rapidity of operational beddown.

- Air Force Contracting, in conjunction with Air Force Civil Engineer, Personnel and Manpower leadership must find a more effective model for pricing Air Force activities performed by civilian and military government employees. No model currently exists to adequately capture the entire spectrum of costs associated with either group. As a result, fair and open competition by contractors for government service and service support work is unfairly penalized, and government funds are needlessly wasted unwittingly continuing potentially inefficient, costly federal employee practices. (pg 35)

- While technological advancements across operational and support activities have aided significantly in decreasing risk and "lightening the load," it is unwise to bank on technology in the works or as yet untested—the ramifications of error or over-enthusiasm are far too high. Nonetheless, greater consideration should be given to alternative futures where deployed civil engineer support could quite readily equate to little more than a contract manager or liaison with the host nation.

- Although there is a robust, well-defined program in place at the corporate Air Force level that continues to pursue and highlight technological advancements to solve pre-identified civil engineer materials, systems, and equipment deficiencies, there appears to be no formalized system to scour commercial, private, academic, or state and local government sources, for "cutting-edge" technology that could have application to civil engineer issues. The system as currently configured is needs-based, formulated solely on the basis of shortfalls and requirements identified and provided annually upon request. The system should be adjusted to *include* an opportunities-based process, to formally engage Air Force civil engineering in searching "outside the box" in other disciplines such as medicine, agriculture, and nano-technology for cross-pollenization of concepts and initiatives. Though not a full-time position, such a task does require significant effort and should garner support from Air Force Civil Engineer leadership to offset other tasks not accomplished. The first task to accomplish in this role would be to establish a comprehensive program that collects and collates trials and tests conducted at the local level by Base Civil Engineers and their staff. At the very minimum, an established "lessons-learned" program could save money and manpower at installations across the Air Force as peers face similar problems at divergent location and times. (pp 61-62)

- 'Smaller, lighter, faster' will substantially reduce both strategic and theater tactical lift requirements to mobilize civil engineer forces, but these three interactive dimensions must coalesce with a fourth, that of sustainability through extended maintainability and prolonged service life. Just as the automotive industry has broken the 100,000 mile maintenance-free barrier for automobiles, civil engineers must continue to seek out and encourage further development of those technologies and manufacturing capabilities that minimize the maintenance tail and extend the useful life of the contingency systems they employ. These are key considerations firmly engrained in today's civil engineer acquisition program, based on past experiences with prepositioned equipment.

Part 5

Conclusions

The decade of the 1990s has produced a host of political, social, and military dichotomies in the global environment that not merely challenge, but attack the way the United States military has historically engaged in the world theater to pursue its national interests during the preceding 90 years of the century. The sheer size of the U.S. involvement, stationing, and response to trouble overseas created an inertia that served quite well during the Cold War era. It failed miserably in the 1990s in the face of budget cuts, downsizing, and a rejuvenated international environment. No longer was the world divided in two where there were only two sides for friends or enemies to choose from. Rather, in its place emerged a plethora of bodies and ideologies seeking to gain a voice in their own destiny and, in some cases, the destinies of those around them.

So too changed the mix of military operations conducted by U.S. forces. The range of military operations did not change. Humanitarian assistance and peacekeeping operations were nothing new, but the proportion of U.S. resources committed to these types of operations changed dramatically, as did our inability to extract ourselves from certain types of operations.

These internal and external pressures converged to force a radical realignment of the U.S. military, toward more integrated operations among the services with smaller, lighter, and faster responses. For its part, the Air Force civil engineer community has looked broadly and hard at every stage of the mobility process to seek opportunities to "lighten the load." By restructuring mobility teams to enable a measured response to world events at any level; by continuously reassessing site specific resource availability and theater-specific asset prepositioning requirements; and by aggressively identifying shortfalls and pursuing research and available technologies to further reduce lift requirements, footprints, and logistics supply lines, the civil engineer community has made great strides in contributing to the highly responsive force dictated by our national strategy. Other opportunities not so aggressively pursued exist, however, as with all activities in government, in academia, or in private business, leadership must apportion manpower, money, and time where they will most efficiently and effectively serve the customer.

Appendix A

CE Mobilization Considerations

1.	What can AFCAP do? What are AFCAP's limits?

A. What are restrictions? Government imposed? Why?
B. Is AFCAP frequently not able to perform due to remoteness? Why?
C. Is AFCAP frequently not able to perform due to cost? Why?
D. Is the contractor occasionally not interested? Why?

2.	Local conditions in Host Nation (HN)? (i.e., results of site survey)

A. What is the environmental baseline?
B. What is likely scenario?
C. What is likely local/regional threat condition? Likely threats?
D. What is likely level of HN and national support/enthusiasm for mission?
E. What are likely requirements?
   1) Type, level, and size of anticipated operations?
   2) # of personnel to be supported?
   3) Engineering support req'ts (e.g., crash/fire/utilities/facilities/pavement)
   4) Hardening? Camouflage?
   5) Heavy equipment needed?
F. Meteorology (weather)?
G. HN infrastructure, e.g., facilities, utilities, pavement, soil, topology, etc.
   1) Look particularly at billeting and feeding on station and locally
   2) How much? Suitable to our needs? Available when, for how long?
   3) Condition?
H. Host Nation personnel/labor
   1) Appropriately trained to meet which of our needs?
   2) How many? Available when, for how long?
I. HN equipment
   1) How much? Suitable to our needs? Available when, for how long?
   2) Condition?
J. Availability of resources through HN? (i.e., wood, pavement, etc.)
K. All of the above HN support at what cost to the U.S.?
L. Support from Local Economy - same questions as G thru K above

3. Prepositioning

A. Historical (How was it done in the past?)
1) Guidance/philosophy (formal or otherwise) on where?
2) Guidance/philosophy (formal or otherwise) on what?
3) Guidance/philosophy (formal or otherwise) on how much?
4) Level of maintenance? Quality? How? (Contract/in-house/HN?)
5) Timing to get each group of assets on scene?
6) Accessibility to indigenous lines of communication vs tactical airlift?
7) Guidance/philosophy on priority to mobilize against other theater assets?
8) Cost analyses

B. Expeditionary Air Force (EAF)
1) Guidance/philosophy (formal or otherwise) on where?
2) Guidance/philosophy (formal or otherwise) on what?
3) Guidance/philosophy (formal or otherwise) on how much?
4) Level of maintenance? Quality? How? (Contract/in-house/HN?)
5) Timing to get each group of assets on scene?
6) Accessibility to indigenous lines of communication vs tactical airlift?
7) Guidance/philosophy on priority for mobilizing against other theater assets?
8) Cost analyses

4. Stateside Issues (Mobilization, Research, Doctrine, etc.)

A. Historical (How was it done in the past?)
1) Sizing the response--manpower, personal/professional tools & eqpt?
2) Efforts to reduce size, increase flexibility of prepositioned/stateside assets?

B. Expeditionary Air Force (EAF) - Tailored response
1) Tailoring the response--manpower, personal/professional tools & epqt?
2) Active technology transfer.
3) Rely more on CE strengths in sister services and other fed'l agencies
4) Better intel from multiple sources on conditions, state at end destination

C. Research - Overall status of research in CE mobilization
1) Funding?
2) Current initiatives from Scientific Advisory Board (Expeditionary Forces)
   a) Deployable Pavement Repair System (DPRS)
   b) Lightweight Material/Rapid Base Stabilization for pavement
   c) Advanced Man-Portable Airfield Pavement Evaluation System
   d) Bare Base Power (e.g., solar, wind, fuel cells, etc.)
   e) Water
   f) Runway and Ramp Repair
   g) Base Decoys
3) Smaller, lighter, more powerful generators?
4) Smaller, lighter portable facilities? With greater force protection?
5) Any other initiatives under study now or in the near future?

5. Other

A. Current guiding criteria on response time for mobilization from states?

B. Do we need to substantially modify training? How?

   1) Do we need to broaden training, in even more functions than already?

C. Have we considered regional support from Sister Services as an offset at certain locations or for an entire region?

D. Are there any new, accelerated tools available for short-order planning?

E. Are we planning to use just-in-time logistics? How? If not, why not?

F. Current studies, publications (draft or otherwise), AFIs, etc. that at least partially address CE Mobility? Command guidance?

G. Can we further consolidate functions on a given piece of equipment (similar to what AGE is doing for the future, with multi-function attachments to a single power supply).

H. Are we specifying greater durability (less maintenance) for new eqpt?

I. What plans exist to accomplish airfield surveys for all (reasonable) deployment locations so we know what Host Nation can make available to us and what's available on local economy?

J. Opportunities to increase use of "reachback" to decrease the number of personnel and amount of equipment on initial deployment?

K. Are we redefining minimum standards to reduce short-term footprint?

Appendix B

Current Civil Engineer Unit Type Codes (UTCs)

Reference: Air Force Pamphlet 10-219, Volume 8 (Draft), 1 September 1999, pp 263-282.

Appendix C

Phased, Additive Civil Engineer Unit Type Codes (UTCs)

Reference: Colonel Bruce F. McConnell, Director of Civil Engineer Contingency Support, Headquarters Air Force Civil Engineer Support Agency, memorandum to major command civil engineer contingency support staffs, subject: Transition to new Unit Type Codes (UTC), 12 January 2000, Attachment 4.

Appendix D

The Air Force Civil Engineer
Readiness Modernization Process

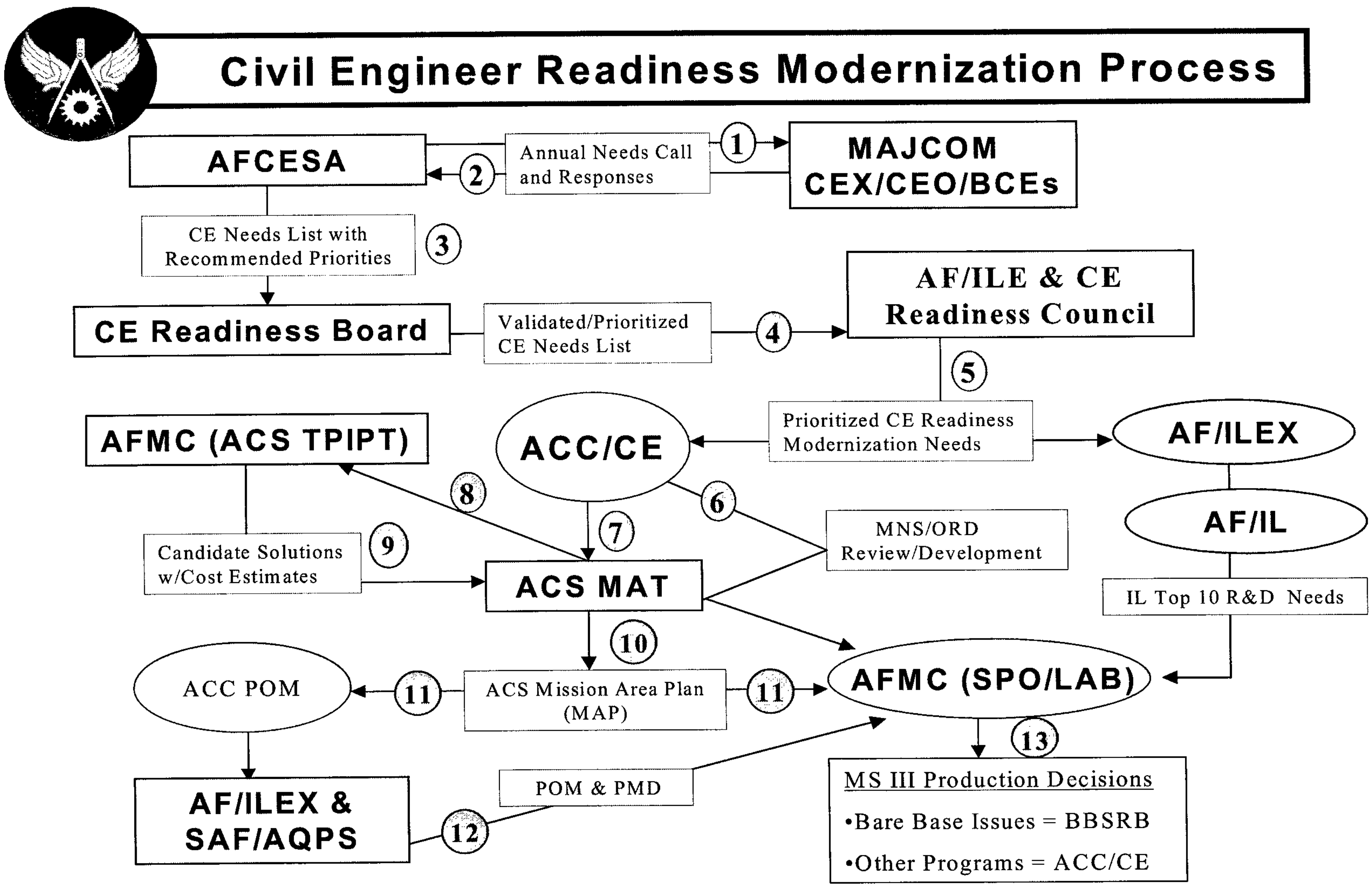

Figure 1: Proposed Civil Engineer Readiness Modernization Process

Civil Engineer (CE) Readiness Modernization Process

Attached CE Modernization Flow Chart and this paper outline major steps to identify, validate, organize, prioritize, and insert CE readiness modernization needs into the Air Force Modernization Planning Process. The overarching Air Force process is detailed in AFPD 10-14, AFI 10-1401, and AFI 10-601.

NBC modernization needs are jointly managed and funded in accordance with Public Law 103-160.

Step 1&2 - AFCESA/CEX issues and MAJCOM/CE's respond to an annual call for identification of CE readiness modernization "needs."

Step 3&4 - AFCESA, working with appropriate organizations, reviews and evaluates MAJCOM submissions for possible non-material/non-developmental solutions.

- Where solutions exist, appropriate information is issued to MAJCOMs; where none exist, needs are referred to the CE Readiness Board (CERB)
- AFCESA, working with appropriate organizations, prepares a draft prioritization of existing and new modernization needs and a recommended prioritization to the CERB
- Final CERB prioritization becomes the "Top 10 CE Readiness R&D Priorities" and is included as an attachment to CERB minutes

Step 5 - Following AF/ILE approval of CERB minutes, the "Top 10 CE Readiness R&D Priorities"

- Are released to ACC/CE for inclusion in ACC modernization planning process (MPP)
- Are used by AF/ILEX as an input to AF/IL "Top 10 R&D Priorities" which are provided to AFRL/CC

Step 6&7 - ACC/CE will staff ILE-approved "Top 10 CE Readiness R&D Priorities" within ACC

- Review/updated/develop/staff requirements documents (Fm 1067/MSN/ORD) as appropriate.
- Work with the ACC Requirements Directorate and the Agile Combat Support (ACS) Mission Area Team (MAT) to include CE readiness modernization needs in ACC MPP and ACS Mission Area Plan (MAP).
- Advocate funding requirements through ACC POM process as required.

Step 8&9 - ACC's ACS MAT provides "Top 10 CE Readiness R&D Priorities" list to the ACS Technical Planning Integrated Product Team (TPIPT). The ACS TPIPT

- Compiles information on solution sets through contacts with DoD, industry, academia, and labs
- Prepares costs estimates for viable solution sets
- Provides technical/cost information back to ACS MAT for use in ACC MAP and POM builds

Step 10&11 - The ACS MAT develops and publishes a MAP.

- A result of careful consideration of many variables designed/weighted to maximize improvements in combat capabilities, the ACS MAP is a ranked compilation of solutions that address ACS vs CE needs
- The ACS MAP, along with other ACC MAPs, compete in ACC POM deliberations for resources

Step 12 - AF/ILEX and SAF/AQPS

- Advocates for research, development and procurement dollars within the AF corporate structure
- Develops/coordinates/publishes/distributes Program Management Direction

Step 13 - Final production decisions, will be made as follows:

- Decisions for Bare Base (BB) assets = BB System Review Board (ACC/CEX and AF/ILEX are voting members; AFCESA/CEX is an advisor)
- Decisions for non-BB assets such as EOD robots and tools will be made by ACC/CEX

Acronyms

ACC = Air Combat Command

ACS = Agile Combat Support

AF/ILE = Air Force Directorate for Infrastructure and Logistics, Civil Engineer Division

AF/ILEX = Air Force Directorate for Infrastructure and Logistics, Civil Engineer Division, Readiness Branch

AFCESA = Air Force Civil Engineer Support Agency

AFMC = Air Force Material Command

BBSRB = The Bare Base Systems Review Board is an 0-6 level group allocates limited resources across all the Bare Base (BB) community. The bare base community is comprised of all functional areas that provide infrastructure for a bare base. For example, civil engineers are responsible for power, water and erection of facilities; the communications community (SC) provides communications and the public address system; Services (SV) operates the dining facility, laundry, Base Exchange, and Morale, Welfare and Recreation; Security Forces (SF) provide base security and force protection; the medical group (SG) provides medical capabilities, and so forth.

CE = Civil Engineer

CEO = Air Force or major command Civil Engineer Directorate, Operations Division

CEX = Air Force or major command Civil Engineer Directorate, Readiness Division

MAJCOM = Major Command

MAT = Mission Area Team. Each MAP (Mission Area Plan) has a team of individuals responsible for publishing their respective MAPs. The various MAPs compete for the funding within funds available for that command's mission responsibilities.

MNS = Mission Needs Statement

MSIII = "Milestone 3" decision. This is a decision in the solution development process that authorizes movement toward acquisition of a particular system or solution. A contract for production is consummated, and production funds are obligated at this point.

ORD = Operational Requirements Document

PMD = Program Management Decision

POM = Program Objective Memorandum

SAF/AQPS = is the Secretary of the Air Force (SAF), Assistant Secretary for Acquisition, Global Power Directorate, Agile Combat Support Division. This function is responsible for, among other things, publishing Program Management Directives (PMDs) that provide direction to the various System Program Offices (SPOs). These in turn execute user money in attempts to field solutions for user needs. They also play a significant role in securing Science and Technology (S&T) funds for the Air Force Laboratory.

TPIPT = Technical Planning Integrated Product Team

Appendix E

Air Force Civil Engineer Research and Technology Initiatives

Initiative Title: Deployable Power Generation and Distribution System
Initiative Description: Replaces existing Harvest Eagle/Harvest Falcon bare base power production systems. Near-term solution provides a new system design employing the best commercial equipment, while providing interoperability with existing power equipment. Use of commercially available equipment and parts will achieve reduced fuel consumption and improved low-load performance. Twenty-five percent smaller than existing sets, the initiative will reduce the airlift required to deploy Harveswt Eagle/Harvest Falcon kits. Mid and far-term solutions will focus on advanced technologies and equipment that can economize/improve near term solutions. The future effort will focus on reducing or eliminating distribution systems by generating power at the point of use by employing solar cells and fuel cells.

Initiative Title: Deployable Waste Management System
Initiative Description: Will employ commercially available, advanced technology collection and treatment units to reduce the amount of wastewaterm solid, medical, and other hazardous wastes that must be managed/disposed of at a bare base. Near-term solution will focus on a small unit incinerator for hazardous materials, medical, and other solid wastes. Also includes a commercial shredder and compactor to help reduce the volume of materials to be disposed of in land fills/contract removal. Mid and far-term solution will focus on advanced technologies and equipment that can economize/improve near term solutions.

Initiative Title: Next Generation Mobile Aircraft Arresting System (MAAS)
Initiative Description: Will provide an air transportable capability to arrest, and engage fighter aircraft. Will modernize braking subsystem and employ lightweight materials to reduce airlift requirements.

Initiative Title: Portable Ground-Penetrating Radar to Evaluate Airfield Pavements
Initiative Description: Will provides an enhanced capability to perform rapid, high-confidence level traffic capacity assessments for existing surfaced and unsurfaced runways, taxiways, and aprons at remote locations. Ultimate solution is to provide a man-portable evaluation capability.

Initiative Title: Lightweight Matting/Soil Stabilization
Initiative Description: Will provide the capability to rapidly expand taxiways/ramps at deployed locations. Will also support Harvest Falcon bare base assets and provide a rugged flooring for aircraft shelters and maintenance facilities.

Initiative Title: Water Purification and Distribution System
Initiative Description: Will leverage established Army/other service efforts to test and evaluate advanced filtration/purification technologies and materials to increase purified water production capability at deployed locations.

Initiative Title: Bare Base Systems Cold Weather Package
Initiative Description: Will provide freeze protection for a limited number of existing Harvest Falcon water distribution systems. Will also provide tent/shelter heaters to support deployment contingencies to extreme cold weather environments.

Initiative Title: Next Generation Emergency Airfield Lighting System (EALS)
Initiative Description: Will provide lighter/leaner deployable airfield lighting systems to support Harvest Eagle/Harvest Falcon contingencies. Contains edge lights, threshold end lights, approach lights, approach strobe lights, distance-to-go marker lights, taxiway lights/markers, generators, regulators, control panels, and cabling. Will employ advanced technologies to reduce airlift and setup time at deployed location.

Initiative Title: Deployable Pavement Repair System (DPRS)
Initiative Description: Provides a deployable mixing and dispensing system to repair spalls, craters, and substandard operating surfaces. Supports civil engineering pavement repair and maintenance operations and employs rapidly setting cement slurries/grouts and Portland cement concrete. Capable of adverse weather, day/night repairs. Fourteen units were distributed to the field approximately one year ago. Will evaluate existing, commercially available technology.

Initiative Title: Medium Shelter System	
Initiative Description: Will replace existing, airlift-intensive portable shelter systems with new generation systems that require less lift, and provide the same or better performance than existing shelters. Will be used predominantly for maintenance back shops, command and control, and administrative facilities. Will evaluate existing, commercially available technology.	

Initiative Title: Small Shelter System	
Initiative Description: Will replace existing, airlift-intensive portable shelter systems with new generation systems that require less lift, and provide the same or better performance than existing shelters. Will be used predominantly for billeting facilities. Will evaluate existing, commercially available technology.	

Additional Scientific Advisory Board Initiatives of Benefit to Civil Engineer Mobilization

Initiative Title: Survey Tool for Employment Planning (STEP)	
Initiative Description: Provides an automated and integrated tool to collect reception site information using multimedia collection tools, and then allows for worldwide access of the data for contingency support analysis. Includes three-dimensional optical storage and retrieval capability	

Initiative Title: Beddown Capability Assessment Tool (BCAT)	
Initiative Description: Allows deploying forces to analyze their supportability and sortie generation capabilities and deficiencies in advance of deployment to plan best fit for logistics deployement and continuing support and resolve issues at home station or while en route.	

Appendix F

Roadmaps for Engineering Mobility Modernization

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