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I N S T I T U T E F O R D E F E N S E A N A L Y S E S

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Executive Summary

The U.S. Department of Defense (DOD) workforce is made up of approximately 3.7 million people. One-third (1.3 million) are Active Duty, while the remaining two-thirds are divided among the Selected Reserve, DOD civilian employees, and contracted services/support full-time equivalents (FTEs). To shape a "larger, more capable, and more lethal joint force," the Secretary of Defense requested a comprehensive review of personnel force structure and utilization polices. This includes evaluating the potential for permanently separating non-deployable Service members, assessing the warfighting relevance of professional military education and mandatory training requirements, and examining hiring practices for the civilian workforce.[1]

These topics are complex and far reaching. Can novel workforce structures be used to extend the reach and lethality of DOD resources by using different combinations of the workforce? How might DOD implement its Workforce Rationalization Plan[2] and optimize investments across the dimensions of military personnel, civilian employees, and contractor support; active duty, reserve, and National Guard personnel; officer, warrant officer, and enlisted personnel; and human performers versus technology substitution? We consider changes to workforce mix practices, policies, regulations, and statutes that may produce greater readiness and lethality across the department's human capital portfolio. Focusing on the expeditionary, training, and medical workforces, we summarize what is currently known about which labor types are best suited for a given objective, illuminate knowledge gaps, highlight currently actionable research insights, and outline strategic research questions to pursue now in advance of tomorrow's information demands.

[1] Secretary of Defense Memorandum, *Administrative and Personnel Policies to Enhance Readiness and Lethality*, 21 July 2017.

[2] The DOD Workforce Rationalization Plan, submitted to the Office of Management and Budget on September 18, 2017, in response to OMB memorandum M-17-22, "provides a strategic roadmap for how DoD will work to optimize its Total Force to achieve the direction from the President and Secretary of Defense to maximize lethality, recover readiness, grow the force, and increase capability and capacity."

Mix for the Expeditionary Workforce

Ground Forces

The existing literature is inconclusive as to whether the reserve and active components are equally effective, in part because active and reserve component performance data[3] are not collected uniformly across the DOD. More research is needed to determine the current relative effectiveness of active, reserve, and guard forces, and consider whether alternative workforce mixes might lead to comparable or better readiness postures at a lower cost. This includes conducting systematic evaluations of how well reserve units accomplish different assigned mission sets. Risk analyses based on changes to mobilization and deployment tempos can also be used to assess the risk/cost trade-offs implicit in various force structures.[4]

In recent years, contractor support has been employed nearly to the front lines of the battlefield for logistics support and construction needs. While contractor support can offer considerable savings—largely by avoiding Service member life-cycle costs, such as employment during periods of peace and retirement benefits—its use also introduces risks that can potentially undermine U.S. military operations. Recent improvements to DOD's contract acquisition program have made contracting more efficacious in the battlefield environment. These include increases to the civilian acquisition workforce, as well as incorporating operational contract support training into joint exercises. Dunigan, et al. (2017) recommends a mix of contracted services, military personnel, and civilian employees in staffing positions planning, integrating, and managing operational contract. Throughout the expeditionary workforce, military personnel provide credibility and leadership, civilian employees provide expertise and continuity, and contractor support provides flexibility.

Air Warfare Forces

Although there is a historical precedent for having airplane pilots from the enlisted ranks, the profession has been limited to officers for more than 70 years. In 2017, the Air Force opened a combat training pilot program for enlisted airmen that may bridge this divide, but its effects have yet to be evaluated. Based on missions in Iraq and Afghanistan, Robbert (2013) suggests that greater use of reserve forces for manned aircraft missions

[3] Examples of performance data for operational units might include a broad range of information on mission or training outcomes, including whether the objective was accomplished, over what timeline relative to expectations, and what costs and casualties were incurred by and on the parties involved. The SIGACTS data provide an example of some of these features. Developing relevant metrics and a collection mechanism for each functional area or mission type will require research. A set of metrics for training units might be adapted from the Kirkpatrick learning evaluation model.

[4] The Institute for Defense Analyses' (IDA's) Structure and Readiness Assessment model is designed to assess active/reserve posture trade-offs.

would allow operational demands to be met with fewer total flying hours, less stress on active component forces, and lower costs. For unmanned aircraft systems, Norton (2016) finds that workforce responsibilities could be better allocated if mission elements are disaggregated throughout the operation of a flight. Involving a higher fraction of enlisted operators and using government civilians for non-combat portions of the flight (such as launch and recovery) could yield savings of more than $150 million over the Future Years Defense Program (FYDP) without increasing mission risk.

Maritime and Other Forces

To reduce crew size and costs without sacrificing readiness, Moore, et al. (2002) recommended investments in workload-reducing technology, using fewer individuals who are more highly skilled and experienced, and eliminating unnecessary crew member work and training. The authors cite the Military Sealift Command (MSC), with its primarily civilian mariner force, as an example where small but highly experienced crews free up personnel from supervision and training. MSC can operate the same type of ship with 65% fewer personnel than the Navy.

Ayers (2017) finds that reserve component units are likely to excel in predictable mission types with long training pipelines and a requirement for unit longevity and stability.[5] A mission space that may be open to guard conversion is the Army's unmanned short-range air defense and cyber/electronic warfare supporting Army air and missile defense. These operations require highly skilled personnel who may be more attracted to the Guard model of service.

Mix for the Training Workforce

Who should do the training?

The DOD provides a high level of formal and on-the-job training. This investment frequently extends beyond the (student) Service members' time to providing instructors (who are often Service members) and other resources. Holistic examinations of the training workforce should consider:

- How many instructor billets are needed and what fraction are filled by active duty personnel?
- Does the instructor inherently need to be someone who is currently in uniform? Are there esprit de corps, internal leadership development, or other capabilities

[5] James Ayers, Joseph Adams, Claire Archer, Christine Bucher, et al., *The Army National Guard's Role in Meeting the Demand for Air and Missile Defense.* IDA Paper P-8504. Alexandria, VA: Institute for Defense Analyses, 2017.

that stem from having an instructor who is currently in uniform that could not be developed otherwise?

- If active duty personnel return to an operational unit after completing a tour as an instructor, are they more or less proficient in an operational setting than prior to the instructor tour?
- What are the retention effects for filling an instructor billet? What are the retention effects for (student) Service members who are taught by less experienced or more experienced instructors?

For optimizing student outcomes, the civilian teaching literature demonstrates that developing pedagogical skills takes time. For many subjects, a two- or three-year teaching tour does not allow enough time to develop instructor proficiency.

Technology can meaningfully enhance instruction

The Defense Advanced Research Projects Agency (DARPA) Digital Tutor harnesses pedagogical techniques of expert tutors to provide Information Systems Technology (IT) training for incoming Navy sailors. After just 16 weeks with the Digital Tutor, incoming sailors with no previous IT experience could significantly outperform those who had received 35 weeks of classroom instruction in terms of IT knowledge and troubleshooting capabilities. Fletcher and Morrison (2014) found that recent Digital Tutor graduates could often even outperform Navy IT technicians with at least four years of experience. Fully implementing the Digital Tutor in Navy IT training and extending its use to IT training in other parts of the DOD would likely result in high operational returns to investment. The Digital Tutor's underlying technology and method can be applied to many other skills training areas within the armed services specialties.

While not as developed as their aviation counterparts, ground combat simulators show great promise in enabling infantrymen to experience potentially dozens of simulated battles before engaging in actual combat. Studies should seek to document the value of the training at the group and individual level (and how much of the training value is lost when the composition of the group changes).

Better managing careers to improve the return on investment from training

The Army staffs helicopter pilots using a roughly even mix of warrant officers (on a "flying track" career) and regular line officers (on a "leadership track" career). The other Services solely use regular line officers for helicopter pilots. Horowitz (2018) identifies that helicopter pilots on the Army "flying track" tend to serve longer in the military and spend a greater portion of their military career flying than those on the "leadership track" in any Service. Consequently, the Army's training cost per year of helicopter flying is nearly half the cost that the other Services pay. Extending the career model of a "flying

track" to the other Services could dramatically improve the return to their training investment. Allowing potential pilots to choose a career path that more closely aligns with their personal ambitions ("flying track" versus "leadership track") would also likely lead to higher pilot retention. Similar programs could be applied to pilots more generally.

Foreign Area Officers[6] (FAOs) spend upwards of three years in training to become experts on regionally focused political-military issues, and the demand for FAOs exceeds the supply. Due to the intensive training, the Army and Navy permit an individual who becomes an FAO to continue to serve as a FAO for the rest of their career. The Air Force and Marine Corps, however, have a two-track program where the FAO can be pulled in to perform the duties of their previous billet. Alrich, et al. (2013) note that this under-use of FAOs prevents the DOD from reaping the full return to the lengthy and costly training investment and further exacerbates the gap between supply and demand for FAOs.

Mix for the Medical Workforce

The DOD's distinct medical missions of providing combat support on the battlefield and beneficiary care on the home front present unique challenges for structuring a responsive, capable workforce. Unfortunately, the beneficiary care caseload is insufficient to meet medical readiness training requirements for deployable medical personnel. Frequently, active duty providers are assigned to a military treatment facilities with a low volume of the traumatic injury cases needed to maintain key battlefield skills. Such a physician may be "ready" in the sense of being deployable, but not in the sense of having a well-exercised set of medical skills for battlefield injuries.

The current paradigm too often treats medical specialties as interchangeable, resulting in need-skill mismatches like "a gynecologist managing major trauma on male patients" (De Lorenzo et al. 2011). Resolving these misalignments can substantially lower mortality rates; experiences in Iraq and Afghanistan demonstrated that a better match of medical skillsets on the battlefield resulted in a 30 to 66 percent decrease in mortality rates (Lettieri, et al. 2009; Gerhardt, et al. 2009; Mabry, et al. 2012).

Medical readiness can be enhanced by better using and recruiting reserve component members who work in trauma and critical care areas that regularly treat battlefield-like injuries. Attracting the right skill sets may entail adapting policies to allow time spent on the job in pertinent treatment areas to count toward drilling requirements. The DOD could also partner with reputable trauma centers to enable active-duty physicians to serve for a time in those centers.

Unlike the Medical and Dental Corps, the Nurse Corps is not exempt from the "up or out" requirements of the Defense Officer Personnel Management Act of 1980 (DOPMA).

[6] FAOs are known as Regional Affairs Strategists in the Air Force.

Consequently, nurses must leave clinical practice to fulfill leadership assignments to be promotable. To ensure that enough nurses are promotable, a progressively expanding number of leadership positions have been created for Nurse Corps officers. Current DOPMA requirements thus result in a Nurse Corps with fewer years of clinical experience at a higher overhead cost due to assignments that are waived for their medical and dental counterparts.

Summary

Overall, the body of evidence considered here demonstrates that opportunities for considerable efficiency and improvement in workforce mix are available to military leaders. As policy makers consider potential reforms, we suggest a greater willingness to confront and reconsider the cultural and regulatory norms that have produced the status quo. This will necessitate action from the highest levels, as many inefficient and ineffective practices are deeply entrenched. Considerable scope exists for expanding the knowledge available to decision makers; these opportunities are discussed throughout the paper, and collected in Appendix A. Finally, leaders should consider how current incentive structures—such as the budget process for staffing civilian versus military individuals—have contributed to the observed status quo, and take action to align cost information, budget impact, and decision authority at the same levels that enable natural market forces to produce a more effective and efficient workforce allocation.

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1. Readiness-Enhancing Workforce Rationalization

The U.S. Department of Defense (DOD) workforce is made up of approximately 3.7 million people. One-third (1.3 million) are Active Duty, while the remaining two-thirds are divided among the Selected Reserve, DOD civilian employees, and contracted services/support full-time equivalents (FTEs). Due to a variety of competing demands and practices, the inventory of Service members in high-demand deployable positions is only a fraction of those in uniform. To shape a "larger, more capable, and more lethal joint force," the Secretary of Defense requested a comprehensive review of personnel force structure and utilization polices. This includes evaluating the potential for permanently separating non-deployable Service members, assessing the warfighting relevance of professional military education and mandatory training requirements, and examining hiring practices for the civilian workforce.[7]

These topics are complex and far-reaching. DOD recognizes the challenges inherent in force mix optimization, and has outlined steps toward a more effective and efficient mix in its Workforce Rationalization Plan.[8] In this paper, we consider changes to workforce mix practices, policies, regulations, and statutes that may produce greater readiness and lethality across the DOD's human capital portfolio.[9] We summarize what is currently known about which labor types are best suited for a given objective; illuminate knowledge gaps; identify policies that are within the scope for immediate action; and outline strategic research questions to pursue now in advance of tomorrow's information demands.

Improving performance and reducing costs in a system as multifaceted and dynamic as the defense personnel enterprise can require vast stores of information—often necessitating more time to amass and synthesize than short-term decision timelines permit. Policymakers must frequently rely upon research initiated by their predecessors, and the accumulation of evidence over time. Current leaders must decide what information-

[7] Secretary of Defense Memorandum, *Administrative and Personnel Policies to Enhance Readiness and Lethality*, 21 July 2017.

[8] The DoD Workforce Rationalization Plan, submitted to the Office of Management and Budget on September 18, 2017, in response to OMB memorandum M-17-22, "provides a strategic roadmap for how DoD will work to optimize its Total Force to achieve the direction from the President and Secretary of Defense to maximize lethality, recover readiness, grow the force, and increase capability and capacity."

[9] President Trump announced a freeze on U.S. government civilian hiring in January 2017. On April 12, 2017, the Office of Management and Budget (OMB) issued Memorandum M-17-22, "Comprehensive Plan for Reforming the Federal Government and Reducing the Federal Civilian Workforce," which lifted the freeze but directed all agencies to develop reform plans including long-run reductions in their civilian workforces. On September 18, 2017, DOD responded by submitting its "DOD Workforce Rationalization Plan" to OMB.

gathering investments to make today in support of tomorrow's management challenges. This paper provides currently actionable policy insights that follow from previous work, and lays out strategic research steps for providing future leaders with game-changing insights.

Figure 1. Four Interrelated Dimensions of Workforce Mix

A. Dimensions of Workforce mix

Given the breadth of DOD's manpower apparatus, we focus this review on expeditionary, training, and medical workforces to illustrate how novel workforce structures might be used to extend the reach and lethality of DOD resources using different combinations of the workforce dimensions in Figure 1. These dimensions can hone and amplify the U.S. Government's guiding principles for manpower management, as set forth in Office of Federal Procurement Policy (OFPP) Policy Letter 11–01, "Performance of

Inherently Governmental and Critical Functions."[10] To assess the military/civilian/ contract dimension, Norton (2016) suggests the following core questions for guiding manpower allocations (as illustrated in Figure 2):

1. Is the task inherently governmental?
2. Is military incumbency required?
3. Is the level of risk to force acceptable for civilians?

Per OFPP Policy Letter 11–01, several aspects of budgeting, policy and regulatory development, human resources management, and acquisitions contain inherently governmental roles. Even so, contractors have ample room to perform a wide variety of tasks within the DOD sphere, even on the front lines of battle (for example, to provide logistics or construction support).[11]

For military-essential roles, there are two additional dimensions for workforce mix: the active, reserve, guard dimension and the officer, warrant officer, enlisted dimension. Questions of military workforce mix require not only a discussion of cost and competence, but the risk posture that leaders are willing to accept. Rostker (2013) writes that structural active/reserve workforce mix decisions depend on "the resources the United States is willing to spend to train the reserves in peacetime to achieve a given state of readiness, the missions assigned to the reserves, and the limited time that reservists can devote to military training." Klimas (2017) further claims that decisions relating to the active/reserve workforce mix should be informed by cost, capabilities, and the scenario under which forces are mobilized.[12] Along the officer, warrant officer, enlisted dimension, meaningful realignment of tasks and responsibilities will require cultural evolution. The demonstrated quality of today's enlisted All-Volunteer Force (AVF) far exceeds that of the draft-era force, and can be relied upon to accomplish increasingly technical missions previously reserved for officers.[13]

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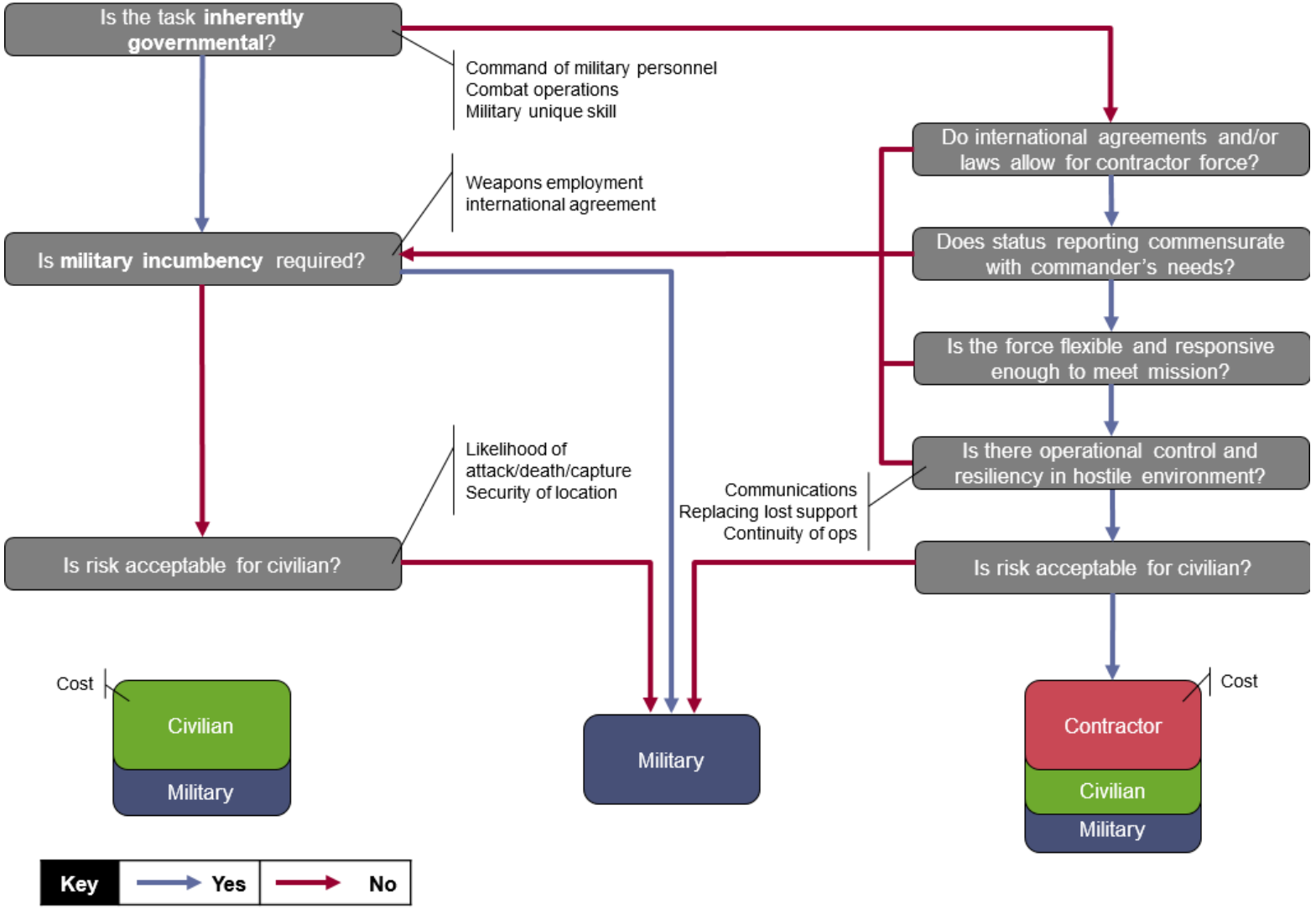
[10] Office of Management and Budget, Office of Federal Procurement Policy (OFPP) Policy Letter 11–01, "Performance and Management of Inherently Governmental and Critical Functions," *Federal Register* 76, no. 176 (September 12, 2011): 56227, https://www.gpo.gov/fdsys/pkg/FR-2011-09-12/pdf/2011-23165.pdf.

[11] See Congressional Budget Office (CBO), *Logistics Support for Deployed Military Forces*, Washington, DC, October 2005. Based on operational risk, wartime assignment, esprit de corps, rotational purposes, career progression, continuity of operations, or other purposes, some tasks may not be eligible to be contracted to private sector entities. DOD Instruction 1100.22, *Policy and Procedures for Determining Workforce Mix*, revised 1 December 2017.

[12] Josh Klimas et al, *Assessing the Army's Active-Reserve Force Mix*, Santa Monica, CA: RAND, 2017

[13] For instance, Kirby and Thie (1996) noted that "as the military transitioned from a force using general military skills to one that needed more specialized skills" there was "a precipitous decline in the number of jobs classified as general military, accompanied by a marked increase in technical occupations and craftsmen." See Sheila Nataraj Kirby, Harry J. Thie, *Enlisted Personnel Management: A Historical Perspective*, Santa Monica, CA: RAND, 1996.



Source: Norton, Travis L. (Lt Col USAF). *Staffing for Unmanned Aircraft Systems (UAS) Operations*. 2016.

Figure 2. Core Questions Guiding Choice of Performer

B. Barriers to Force Rationalization

Balancing the force along the dimensions in Figure 1 requires a holistic approach to DOD staffing decisions. Even when leaders agree that a civilian would be a more effective or efficient staffing choice than a uniformed Service member, current departmental policies and incentive structures act as barriers. Recurring staffing cuts targeting civilians significantly hinders leaders' willingness to rely on civilians. The phenomenon of converting a military job to a civilian job, only to have the civilian job cut, has been termed "mil to nil." Additionally, at the local command or unit level, uniformed Service members can appear to be a free resource because their labor is budgeted at a level not experienced by the local decision maker. Allocating uniformed Service members to commanders at no cost and pushing civilian and contractor costs to the commander's budget, in combination with the perceived inflexibilities in managing civilian or contractor labor sources, produces an incentive structure wherein commanders routinely lean on Service members for non military-essential jobs. To employ workforce mixes that improve mission effectiveness while reducing costs, personnel management and budget process and reforms are needed to inform all managing commanders of the true costs of each labor source, push budgetary impacts to the level where staffing choices are made, and provide leaders greater control over the workflows and duties of civilians and contractors.

C. Scope and Organization

Our focus on expeditionary, training, and medical workforces illustrates opportunities for alternative workforce mixes that can enhance readiness at the "tip of the spear." For each of these three areas, we review the recent mission-specific literature, identify areas where DOD might immediately implement alternative cost-saving or readiness-enhancing workforce mixes, and outline the research needed to increase the deployable inventory of Service members and effectively employ the right combinations of talent throughout the DOD.

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2. Mix for the Expeditionary Workforce

Within the expeditionary forces mission space, reallocations among personnel types can free up resources without sacrificing efficacy, readiness, or lethality. We focus on the expeditionary mission areas described below in Table 1. Persistent budgetary constraints encourage cost-saving workforce reallocations; a recent memo from the Secretary of Defense underscores the importance of implementing cost-saving measures where possible.[14] At the same time, the DOD seeks to maintain or enhance its capabilities. Our examination considers both readiness enhancing and cost-saving workforce reallocations.

A. Ground Forces

1. Active, Reserve, National Guard Workforce Mix

The existing literature is inconclusive as to whether the reserve and active components are equally effective, in part because active and reserve component performance data are not collected uniformly across the DOD.[15] Buterbaugh (1996) notes that during the Gulf War, the Army was reluctant to use its National Guard forces, due to doubts about their quality.[16] Since 9/11, however, the reserve and guard have been used more intensely. The National Commission on the Future of the Army (2015) notes that since 2004, there is no known instance of the Army Reserve or National Guard failing to complete its pre-deployment preparations on time.[17] Rostker's 2013 analysis of Army reserve component efficacy finds that reserve forces are less ready and less effective than active forces. However, Horowitz et al. (2014) observe that Rostker does not consider guard and reserve performance in the Balkans, Iraq, or Afghanistan.[18] Analyzing data on military casualties and mishaps in Operation Iraqi Freedom (OIF), Adams et al. (2016) find no sizable differences in performance between active and reserve components across the

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14 U.S. Secretary of Defense, memorandum, *Be Peerless Stewards of Taxpayers' Dollars*, by James Mattis (Washington DC, 26 March 2018).

15 Joseph Adams, Amy Alrich, John Brinkerhoff, et al., *Sharing the Burden and Risk: An Operational Assessment of the Reserve Components in Operation Iraqi Freedom.* IDA Paper P-4362. Alexandria, VA: Institute for Defense Analyses, 2016.

16 Kevin N. Buterbaugh, "Similar Organizations – Different Performances: Performance, Conflict and the Air and Army National Guards," (PhD diss., Washington University, 1996)

17 National Commission on the Future of the Army, *Recent Experience in Reserve and Guard Readiness, Mobilization, and Operational Employment.* Arlington, VA: National Commission on the Future of the Army, 2015.

18 Stanley Horowitz, John Brinkerhoff, Alec Wahlman, *Summaries of Selected Studies on the Active – Reserve Component Mix.* IDA Document NS D-5150. Alexandria, VA: Institute for Defense Analyses, 2014.

Services when comparing like missions. Resolving the debate on the quality and substitutability of the reserve and guard would help the Army and Joint Forces better use these components of the force. More research is needed to verify the relative effectiveness of active, reserve, and guard forces, and whether alternative workforce mix ratios might lead to comparable or better readiness postures at a lower cost. This includes conducting systematic evaluations of how well reserve units accomplish their assigned missions, as well as experimenting with different mission sets.[19,20]

Army Directive 2012-08, *Army Total Force Policy*, instructs the Army to streamline and standardize reserve mobilization and deployment processes to better integrate reservists into Army missions. This policy came in the wake of a 2010 shortfall, where demands for forces required a rotational deployment of 269,400 soldiers, exceeding the 257,200 soldiers available at the time. Graham and Magruder, et al. (2010) identified that the Army could mitigate this shortfall by reducing the dwell time between mobilizations for reserve personnel from 60 months to 51 months—a change that would add 15,600 deployable personnel to the total available Expeditionary Force.[21]

IDA's Structure and Readiness Assessment (SARA) model addresses how the Services might more efficiently allocate between reserve and active units, given various flows in the demand for forces related to contingency operations of various types.[22] Future research might leverage the SARA model to better understand risk/cost trade-offs implicit in various force structures.

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19 Buterbaugh, "Similar Organizations – Different Performances: Performance, Conflict and the Air and Army National Guards," 1996

20 R. Royce Kneece, Waldo Freeman, Joseph Adams, *Enduring Requirements for Counterinsurgency-Related Capabilities.* IDA Paper P-4362. Alexandria, VA: Institute for Defense Analyses, 2012.

21 David Graham, Robert Magruder, John Brinkerhoff, James Adams, Richard Diehl, Colin Doyle, and Anthony Hermes, *Managing Within Constraints: Balancing U.S. Army Forces to Address a Full Spectrum of Possible Operational Needs.* IDA Paper P-4579. Alexandria, VA: Institute for Defense Analyses, 2010.

22 Colin Doyle, Nancy Huff, Laila Wahedi, Jerome Bracken, John Brinkerhoff, David Graham, Stanley Horowitz, Shaun McGee, *The Stochastic Active-Reserve Assessment (SARA) Model: Force Planning under Uncertainty*. IDA Document NS D-5470. Alexandria, VA: Institute for Defense Analyses, 2015. The model has since been renamed the Structure and Readiness Assessment model.

Table 1. Select Categories and Functional Areas of Expeditionary Forces[23]

Category	Functional Area
Ground Forces: Expeditionary forces and closely related activities designed primarily for the defeat of opposing conventional ground forces and for the establishment of control over land areas.	Defeat opposing conventional ground forces and establish control over land areas, including operating weapons technology (such as close-range missiles and automatic weaponry) to achieve dominance in ground battles, operating close-support aircraft (such as A-10, Marine Corps AV-8, cargo helicopters, attack helicopters), and operating close-support Naval amphibious ships.
Air Warfare Forces: Expeditionary forces and their dedicated supporting elements that control and exploit the airspace to achieve military objectives, including protection against ballistic missiles.	Make use of airspace using manned and unmanned aircraft to engage targets in enemy-controlled territory and deny use of airspace by opposing forces. Provide air support for assigned strike aircraft.
Maritime Forces: Expeditionary forces and their dedicated supporting elements operating in the maritime/littoral domain to achieve military objectives.	Control and/or exploit maritime/littoral domain for combat operations, including denying maritime/littoral use to opposing forces and secures its use by friendly forces and operating surface combatants, submarines, anti-sub warfare resources.
Irregular/Special Operations Forces: Expeditionary forces designed for or dedicated to the prosecution of irregular warfare.	Conduct irregular warfare (special operations), including long-duration unconventional warfare, foreign internal defense, counterterrorism, counterinsurgency capabilities, and working with local populations to establish order and restore civil infrastructure

[23] Selections reproduced from Daniel Cuda, Arthur Yengling, Ronald Porten, *DOD Force & Infrastructure Categories: A FYDP-Based Conceptual Model of Department of Defense Programs and Resources (2008 Update).* IDA Paper P-4362. Alexandria, VA: Institute for Defense Analyses, 2008.

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2. Military-Contractor Workforce mix

In recent conflicts, contractors have been located nearly everywhere that the military has deployed units.[24] The decision of whether and how to use contractors on the battlefield is naturally complicated by safety considerations and wartime regulations. Many combat Service support functions are exempt from contractor performance, due to the risks involved. Inherently military functions include operational command and control of forces; security of resources under high threat as part of combat operations; and medical Services performed in hostile areas.[25]

During periods of peacetime, contractor costs can be significantly lower than those for Army units. Contractors are also marginally less expensive during wartime periods. The Congressional Budget Office (CBO) further estimates that the Army's annual cost to maintain three units assigned to security functions (two at home station and one deployed) was $11.5 million more expensive than having a private security contractor perform the same functions as a deployed unit.[26] A 2005 CBO report found that contractors and Army units often perform the same functions in parallel, due to a relative lack of deployable uniformed units.[27]

While contractors can offer considerable savings—largely because they do not have the life-cycle costs of a Service member (employment during periods of peace, retirement benefits, long-term health care costs, etc.)—they also introduce risk. These risks include the possibility of undermining the credibility of or endangering U.S. military operations. Schwartz and Church (2013) cite contractor abuses that strengthen anti-American insurgents as an example.[28] They further observe that DOD did not anticipate the extent of contractor support needed during Operation Enduring Freedom (OEF) and OIF, which inadvertently created an ad-hoc environment ripe for contractor fraud and abuse.

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[24] As of March 2013, DOD recognized approximately 108,000 contractor personnel in Afghanistan, representing 68% of the total force at that time (Schwartz and Church, 2013). A 2008 CBO report estimated that from 2003 to 2007, the Army spent $57 billion on contracts performed in the Iraq theater.

[25] DODI 1100.22, *Policy and Procedures for Determining Workforce Mix,* 2017.

[26] Congressional Budget Office, "Contractors' Support of U.S. Operations in Iraq," 2008. The $11.5 million is in 2008 dollars.

[27] CBO, *Logistics Support for Deployed Military Forces,* 2005.

[28] Moshe Schwartz and Jennifer Church, *Department of Defense's Use of Contractors to Support Military Operations*. Washington, DC: Congressional Research Service, 2013.

A 2005 RAND study proposed a framework for determining whether and how to use contractors for a given task, based on the following guiding questions:[29]

1. Do the residual risks outweigh the benefits?
2. Do the residual risks vary across activities and locations?
3. Which source of support best suits the circumstances?

Recent improvements to DOD's contract acquisition program have made contracting more efficacious in the battlefield environment. These include increases to the civilian acquisition workforce, as well as incorporating operational contract support training into joint exercises and military personnel training.[30] Dunigan (2017) recommends a mix of contractors, military, and civilians in staffing operational contract support positions.[31] Military personnel provide credibility and leadership support, civilians provide expertise and continuity, and contractors provide flexibility.

B. Air Warfare Forces

The U.S. Army Air Forces (the predecessor of the Air Force) used enlisted Service members as pilots from 1912 to 1942. However, the practice of using enlisted pilots ended, due to cultural divides between officers and enlisted pilots.[32] The Air Force is now hoping to bridge this cultural divide though a 2017 combat training pilot program for enlisted airmen. This program has yet to be evaluated.

Balancing the active/reserve workforce mix for manned aircraft can reduce costs and allow the Air Force to meet operational demands with fewer total flying hours and less stress on active component forces. Robbert (2013) finds that Air Force operational missions during OEF and OIF could have been accomplished with fewer total flying hours and lower costs by allocating a larger proportion of the force structure to active units.[33] The author recommends that future Air Force workforce mixes be more carefully optimized between active and reserve components to maximize cost reductions.

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29 RAND Arroyo Center, *Civilian or Military? Assessing the Risk of Using Contractors on the Battlefield*. Santa Monica, CA: RAND, 2005.

30 Schwartz, *Department of Defense's Use of Contractors to Support Military Operations*, 2013.

31 Molly Dunigan, Michael Schwille, Samantha Cherney, Katherine Hastings, Brian Nichiporuk, Peter Schirmer, *Human Capital Needs for the Department of Defense Operational Contract Support Planning and Integration Workforce.* Santa Monica, CA: RAND, 2017.

32 MAJ Harry Mamaux, *The Enlisted Pilot Program in the USAF 1941-1942: Was it Successful?* Masters thesis, Air Command and Staff College, 1984.

33 Albert Robbert, *Costs of Flying Units in Air Force Active and Reserve Components*. Santa Monica, CA: RAND, 2013.

An additional area for exploration is staffing unmanned aircraft system (UAS) operations. Norton (2016) finds that if UAS mission elements are disaggregated throughout the operation of a flight, workforce responsibilities can be better allocated.[34] If the Air Force transitioned 60% of UAS pilot positions to enlisted operators, it would yield savings of $1.8 million per squadron and $91 million over the Future Years Defense Program (FYDP). Further, if the Air Force established a warrant officer program for operating remotely piloted aircraft, it could save $1.3 million per squadron over the FYDP.

Using DOD civilians as UAS operators could also produce considerable savings. Norton identifies non-combat portions of the flight, such as launch, recovery, and elements of mission command, where DOD civilian operators may yield cost savings without increasing mission risk.[35] Norton finds that using a mix of government civilians and uniformed military to operate the Air Force MQ-1/9 launch and recovery system would save approximately $26 million across the FYDP.[36] If the Air Force integrated government civilians into all contiguous United States (CONUS)-based UAS operations, it could save another $68 million over the FYDP.[37]

C. Maritime Forces

The Navy allocates its workforce between at-sea billets and at-shore billets to effectively use and train sailors when they return from sea duty. Monroe (2008) found that the Navy could, at that time, select more efficient workforce mixes than resulted from its shore manpower requirements determination process (SMRDP).[38] The SMRDP incentive structure prevented the Navy from reducing military shore billets. Monroe found that the Navy's budgeting offices assigned too many billets to sailors (rather than other types of labor) because sailors appear to be essentially free to force planners. The Navy saw savings of 35% on average by assigning billets previously filled by sailors and Navy civilians to contractors from 1978 to 2005, but Monroe observed that those savings could have been even larger if SMRDP was more efficient.

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34 Lt. Col. Travis Norton. *Staffing for Unmanned Aircraft (UAS) Operations.* IDA Paper P-5253. Alexandria, VA: Institute for Defense Analyses, 2016.

35 DOD Instruction 1401.10 states that civilians are preferred to military personnel for non-warfighting missions only. Launch, recovery, and parts of mission command may be termed non-warfighting.

36 This mix would be composed of the following across 15 Air Force launch and recovery elements (LREs): four units with all military personnel, five units with a 60-40 military-civilian split, three units with a 20-80 military-civilian split, and three units with all civilian employees.

37 Norton, *Staffing for Unmanned Aircraft (UAS) Operations*, 2016.

38 Albert Monroe. *Creating a Framework for a New Shore Manpower Requirements Determination Process*. CNA Paper CRM D0017047.A2. Alexandria, VA: CNA, 2008.

To reduce crew size and costs without sacrificing readiness, Moore, et al (2002) recommended investments in workload-reducing technology, using fewer individuals who are more highly skilled and experienced, and eliminating unnecessary crew member work and training.[39,40] The authors cite the Military Sealift Command (MSC), with its primarily civilian mariner force, as an example where small but highly experienced crews free up personnel from supervision and training. When comparing Navy and MSC personnel allocations for the same type of ship (an AOE-6), the authors find that MSC operates with 376 fewer personnel.[41]

D. Integrated Air and Missile Defense and Cyber/Electronic Warfare Forces

Integrated Air and Missile Defense capabilities are crucial to power projection, anti-access/area denial, and homeland defense. Manning of active duty Ground-based Midcourse Defense (GMD) positions through the Army National Guard (ARNG) has demonstrated a novel application of reserve forces. Ayers (2017) finds that reserve component units are likely to excel in predictable mission types with long training pipelines and a requirement for unit longevity and stability.[42,43] GMD typifies such a mission. Another mission space open to guard conversion is the Army's unmanned short-range air defense and cyber/electronic warfare supporting Army air and missile defense. These operations require highly skilled personnel who may be more attracted to the Guard model of service. However, modifications to address complaints raised by Guardsmen about financial hardship caused by current PCS policies may potentially offset any cost savings from employing the Guard in this manner.

E. Special Forces

The Army National Guard contains 29% of the Special Forces Groups in the Army. When activated, these groups are subordinated under Army Special Operations

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39 Carol Moore and Anita Hattiangadi, *Inside the Black Box: Assessing the Navy's Manpower Requirements Process.* CNA Paper CRM D0005206.A2. Alexandria, VA: CNA, 2002.

40 Technological innovations include using remote specialists and centralized monitoring systems.

41 MSC operated the ship with 31 licensed (officer-like) personnel and 176 unlicensed (enlisted-like) personnel. The Navy operated it with 28 officers and 555 enlisted personnel.

42 James Ayers, Joseph Adams, Claire Archer, Christine Bucher, et al., *The Army National Guard's Role in Meeting the Demand for Air and Missile Defense.* IDA Paper P-8504. Alexandria, VA: Institute for Defense Analyses, 2017.

43 Another example of a mission with longevity, stability, and long-term training requirements is the National Guard's State Partnership Program, wherein state guards form long-lasting, cooperative, and mutually beneficial security partnerships with allied nations.

Command.[44] Peters, Shannon, and Boyer (2012) recommend that the Army rely more heavily on ARNG Special Forces to manage operating tempo (OPTEMPO) demands, and they assert that ARNG Special Forces are best suited to tasks that directly correspond to their civilian skills. Skills such as negotiation, accommodation, compromise, and persuasion enhance ARNG Special Forces communication with local populations in operating areas. ARNG Special Forces soldiers overwhelmingly feel ready to support ongoing operations; 84% surveyed indicated that they would deploy individually to fill a needed slot. The authors recommend that the Army employ Special Forces soldiers for tasks such as theater security and joint training operations.

F. Potential actions based on existing research

a. Ground Forces

- Reform current manning, organizational, and training plans regarding operational contract support positions. Establish and staff a dedicated operational contract support workforce. Create an operational contract support career field for both military personnel and civilian employees to institutionalize contract support infrastructure within the department.
- Institutionalize operational contract support training across the defense enterprise.

b. Air Warfare Forces

- Integrate civilians into UAS operations.
- Test the feasibility of employing enlisted or warrant UAS operators in the Navy.
- Initiate a pilot program using Reserve Component (RC) F-16 squadrons as the Air Force Commission recommended.
- Expand the use of flying warrant/senior enlisted personnel.

c. Maritime Forces

- Conduct pilot projects to test the concept of partially manning non-MSC ships with experienced civilians (in the spirit of the MSC model).

[44] John Peters, Brian Shannon, and Matthew Boyers, *National Guard Special Forces: Enhancing the Contributions of Reserve Component Army Special Operations Forces.* Santa Monica, CA: RAND, 2012.

G. Next research steps

a. Ground Forces

- Begin systematic, sustained collection of active and reserve component performance data across the DOD. The Army's National Training Center is a possible source of performance data.
- Expand evaluation of active versus reserve unit performance in recent overseas contingency operations.
- Systematically examine additional operational areas where a more RC-intensive force may be more efficient. Existing tools such as IDA's SARA model could be employed to identify areas for deeper examination. Areas suggested for initial examination based on existing work include Air Force and Navy tactical aviation, Naval Construction Battalions (CBs), as well as battalion-level combat forces in the Army and Marine Corps.
- Determine how Active Component-Reserve Component (AC/RC) decision-making processes could be modified to better ground policy in an analytic understanding of costs and benefits.
- Expand IDA's SARA model to incorporate contractor units and explore potential savings at various levels of expected contingency activity.
- Examine the feasibility and desirability of adopting a sponsored reserve concept under which contractors would be paid a retainer to provide people or capabilities of specified types as demanded for contingencies. This could cover a wide range of capabilities including cyber, transportation, maintenance, language, and cultural liaison. The people involved could be militarized upon activation, as needed.

b. Air Warfare Forces

- Investigate whether widespread contractor use across the UAS enterprise is feasible.
- Evaluate the effect of the Air Force's enlisted drone pilot program on operational costs and efficacy.[45] Investigate whether UAS operator transitions from officer to warrant officer or enlisted will affect operational efficacy.
- Evaluate the 2017 Air Force enlisted pilot program for impacts on operational efficacy and costs.

[45] Stephen Losey, "Enlisted Combat Pilots? The Air Force Is Launching A Test That Could Lead To That," *Air Force Times*, (December 6, 2017).

- Compare total costs per flight hour at various levels of contingency between Air Force reserve and active units. Investigate the possibility of integrating reservists into active duty facilities to take advantage of economies of scale.
- Analyze extending the use of civilians in combat aviation maintenance units; many of these units are either CONUS based, deploy in pieces, or deploy to secure environments.

c. Maritime Forces

- Develop a process to revise policies to realign budgeting office incentives, including making labor prices reflect the cost to the Navy of military billets and charging end users for military manpower that they use.

d. Integrated Air and Missile Defense and Cyber/Electronic Warfare Forces

- Investigate the advantages and disadvantages of a larger role for the RC in providing cyber/electronic warfare manpower.
- Investigate the extent to which the RC can operate unmanned air defense systems.
- Consider the advantages and disadvantages of full-time RC manning for Intercontinental Ballistic Missile sites.

e. Special Operations Forces

- Investigate the extent to which the RC can provide more of the location-specific language and cultural skills needed by the Special Operations Forces community. Examine whether civilians or contractors can support these needs.

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3. Mix for the Training Workforce

DOD provides a high level of both formal and on-the-job training. Unlike the commercial workplace where job applicants frequently arrive with some specialized skills in hand, DOD fully trains and pays for the development of numerous career specialties in return for service commitments. This investment is not limited to the (student) Service members' time. It extends in many cases to providing instructors (who are themselves frequently Service members), schoolhouses, curricula, and other training resources. The sheer scope and magnitude of this endeavor warrants careful consideration so that the returns to this training investment can be improved and optimized.

As a central part of their "organize, train, and equip" responsibilities, the military Services are no strangers to training and invest heavily in it. However, three strategic aspects of training appear to be both understudied and ripe for potential revectoring.

- Who should do the training? In particular, to what degree should active duty personnel be used as instructors in order to optimize student outcomes, effective end strength, and retention?
- Where can advanced training technologies substantially improve the quality of training, reduce training time, or reduce the need for trainers?
- How can careers be better managed to improve the return on investment from training? This is particularly relevant for fields where training is especially costly but personnel rotation polices or other factors limit the extent to which the training is actually used.

A. Who should do the training?

Weighing the costs and benefits of using active duty personnel as instructors (as opposed to reservists, former Service members, or others) involves numerous considerations. Ideally, the mix of trainers should be aligned around the goal of increasing the lethality and effectiveness of the force. Two steps are to identify the instructor characteristics that are most likely to foster high performance outcomes in students and then assess what population mix is best able to provide those characteristics.

The civilian literature, for instance, has explored the impact of K-12 teaching experience on student outcomes. Rice (2013) finds that the greatest return to teaching

experience happens early in an instructor's career and tapers off around six years.[46] This implies that K-12 teachers reach a critical level of effectiveness—becoming seasoned, in a sense—after six years of teaching. Active duty Service members are rarely able to serve as instructors for more than two or three years. Yet, depending on the subject matter, that may not be enough time to develop proficiency as an instructor.

Another challenge is that that many military training environments (such as combat exercises or other forms of operationally focused training) often lack meaningful criteria for assessing performance, making it difficult to assess the impact of the training itself, as well as the effectiveness of the trainer. In advocating for more systematic metrics, Hiller (1994) noted that "criteria for successful performance" were typically omitted from unit training guides.

Evaluating the importance of current and alternative sets of training inputs requires outcome measures to compare against.[47] For example, it would be worthwhile to explore the effects of various DOD instructor characteristics on student outcomes. How much of the instructor's success is based on classroom management skills, pedagogical methods, experience as an instructor, career experience in the particular occupation, instruction time per student, non-cognitive skills, general intelligence, or other factors?

In addition to improving student outcomes, the effective end strength of the military may be thought of as the number of trained military personnel serving in military essential positions. If an instructor billet could be filled at least equally well by someone not currently in uniform, then the effectiveness of the force would arguably be enhanced by keeping those who are in uniform in military essential positions and letting others fill instructor billets.

Along these lines, Doyle, et al. (2014) found that when active duty Air Force pilots vacate operational billets to fill instructor billets, it creates two major costs. First, when instructor pilots return to operational billets, they must be retrained on the operational platform (which can be nearly $3 million for fighter pilots). Second, more pilots need to be trained and in the career pipeline to fill the vacated operational billets. As one potential alternative, Doyle, et al. suggested that using Air Reserve Component (ARC) pilots may be a more efficient solution, since they could serve as instructors without needing to incur

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[46] The degree to which returns to experience tapers off has been questioned. Papay and Kraft (2015) confirm that the greatest returns to experience happen early in the instructor's career, but they also identify that the returns from late career experience build at a higher rate than previously thought.

[47] The Kirkpatrick model, for instance, is a standard approach for evaluating training programs (see Kirkpatrick and Kirkpatrick 2006). The model has four levels of increasing depth (reaction, learning, behavior, and results) and can be used to estimate the relevance and efficacy of training programs for achieving operational objectives. Fletcher (2009, p. 452) interprets the Kirkpatrick levels in the context of DOD training.

retraining costs. Additionally, since ARC pilots typically begin their career and receive pilot training while on active duty, then if they are not currently in operational billets, using them as instructors may allow the size of the aggregate training pipeline to decrease (enabling savings both in terms of new pilot training and annual compensation costs required to maintain a larger pipeline).[48]

Thorough assessments of the workforce mix of instructors need to consider questions such as the following for specific or groups of occupations:

- How many instructor billets are needed and what fraction are filled by active duty personnel?
- Does the instructor inherently need to be someone who is currently in uniform? Are there esprit de corps, internal leadership development, or other capabilities that stem from having an instructor who is currently in uniform that could not be developed otherwise?
- If active duty personnel return to an operational unit after completing a tour as an instructor, are they more or less proficient in an operational setting than prior to the instructor tour?
- What are the retention effects for filling an instructor billet? For people of similar abilities and experience, does serving as an instructor lead to a higher or lower likelihood of retention? What are the retention effects for (student) Service members who are taught by less experienced or more experienced instructors?

Such holistic examinations are crucial to achieve greater returns to training investments and are necessary for building a more lethal force with a limited set of resources.

B. Where can innovative technologies substantially improve training?

Many technological aids have demonstrated that technology can be used to augment and improve instruction, resulting in both cost reductions and learning gains. Two examples are the Defense Advanced Research Projects Agency (DARPA) Digital Tutor and simulator training. The Digital Tutor is no longer used but showed great promise and is strongly supported by scientific evidence. Simulators are still used and are continually improving.

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[48] Other alternatives may be to shorten the length of Active Duty instruction tours so that retraining on their operational platform is not needed. For instance, if a training and operational unit were co-located, an active duty pilot could alternate spending a short time as an instructor and a short time in their operational platform. Another alternative is to maintain active duty pilots as instructors, but dramatically lengthen their teaching tours. This may have benefits in terms of developing instructors and also reduce the frequency of retraining costs.

As a pilot program, the DARPA Digital Tutor was designed to provide adaptive one-on-one instruction in order to accelerate and enhance Information Systems Technology (IT) training for incoming Navy sailors. Harnessing the pedagogical techniques of expert tutors and employing authentic hands-on problems, it enables students to quickly absorb and retain a deep understanding of IT systems. The tutor adjusts to the rate that the students master topics. For those who learn more quickly, it is able to engage the students with more challenging problems. After 16 weeks of training with the Digital Tutor, incoming sailors with no previous IT experience could significantly outperform those who had received 35 weeks of classroom instruction in terms of their IT knowledge and troubleshooting capabilities. Moreover, Digital Tutor graduates frequently even outperformed Navy IT technicians who had at least four years of experience (Fletcher and Morrison 2014).[49]

Simulator technologies are a common educational aide within the military and have been successfully implemented for pilot and ground combat training. Literature supports the efficacy and cost effectiveness of using simulators for various aspects of initial and ongoing pilot training.[50] While not as developed as their aviation counterparts, ground combat simulators show great promise in enabling infantrymen to experience potentially dozens of simulated battles before engaging in actual combat.[51] Studies should seek to document the value of the training at the group and individual levels (and how much of the training value is lost when the composition of the group changes).

C. How can careers be better managed to improve the return on investment from training?

Training is an investment for Service members to become more productive in a specific skill. If Service members are not using the skills for which they are trained, the return on investment for the training will be low. In that case, two pertinent courses of action are to decrease the training investment (i.e., reduce or stop the training) or, if the skill is truly in demand, find ways to better use the training to increase the return on the

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[49] A modified version of the Digital Tutor, adjusted for veterans seeking IT employment in civilian jobs, demonstrated similar success (Fletcher 2014). A meta-analysis of 50 controlled evaluations of computer tutoring systems spanning varied levels of sophistication over nearly three decades (1984–2013), found that the DARPA Digital Tutor was a strong outlier in terms of the quality of results it produced (Kulik and Fletcher 2016).

[50] For instance, in an early meta-analysis, Hays et al. (1992) confirm that relative to aircraft training only, the use of simulators consistently produced improvements in training for jet aircraft. In examining the impact on performance of recent flying hours, recent simulator time, and career flying hours, Hammon and Horowitz (1996) found that simulator training specifically made a "significant, cost-effective contribution to performance." In a more recent meta-analysis, de Winter et al. (2012) find that using whole body flight simulators (rather than fixed-base simulators) have a noticeably greater learning impact during initial pilot training than for experienced pilots learning maneuvering techniques.

[51] See, for instance, the Naval Research Advisory Committee's "Immersive Simulation for Marine Corps Small Unit Training," September 2009, http://www.dtic.mil/dtic/tr/fulltext/u2/a523942.pdf.

investment (i.e., adjust career paths or job assignments to employ the skill more intensively or over longer periods of time). Two such areas where costly training is being underused are helicopter pilots and foreign area officers.

The Army is unique among the military Services in its model for staffing helicopter pilots. It uses a roughly even mix of warrant officers (with a "flying track" career) and regular line officers (with a "leadership track" career). All other Services solely use regular line officers as helicopter pilots. In terms of the return to training investment, the Army model pays tremendous dividends. Horowitz (2018) identifies that helicopter pilots on the "flying track" tend to serve longer in the military than those on a "leadership track" (in any Service). They also spend a much greater portion of their military career flying: 90% of their time in service is spend in flying positions, compared to 40% to 75% for those on a "leadership track" who must fill more non-flying positions. Due to its ability to better retain "flying track" pilots and employ them in flying positions more consistently, the Army's training cost per year of flying is nearly half the cost that the other Services pay. Extending the career model of a "flying track" to the other Services could dramatically improve the return to their training investment.

The same could be said of military pilots more generally. It costs approximately $11 million to put a fighter pilot through the year-long training course.[52] Grooming every single pilot to potentially become a senior officer, however, causes them to spend less time flying. The cost is compounded even further if non-flying assignments create retention risks for pilots who have a strong desire to fly.

Foreign Area Officers (FAOs) or Regional Affairs Strategists (RASs) are regionally focused experts on political-military issues.[53] FAOs are highly skilled, highly trained individuals who typically spend more than three years in training. The demand for FAOs at present (as represented by the number of FAO billets) exceeds the supply of trained FAOs. The Army and Navy have single track FAO programs, meaning once an individual becomes a FAO, they can continue to serve as a FAO for the rest of their career. The Air Force and Marine Corps instead have a two track program (where the FAO also maintains their previous billet). Thus, the FAOs and RASs from the Air Force and Marine Corps can be pulled from their FAO/RAS billet to perform duties for their previous billet. This underuse of FAOs prevents the DOD from reaping the full return to the lengthy and costly training investment and further exacerbates the gap between supply and demand for FAOs.[54]

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[52] Fighter pilots make up over three-quarters of the current pilot shortage. The loss of human capital from pilots leaving the Air Force is estimated to be at least $12 billion. See Stephen Losey, "The Air Force is thinking about paying pilots up to $455,000 to stay in uniform," *Air Force Times*, Mar. 29, 2017.

[53] The RAS is the Air Force's equivalent to the FAO.

[54] Amy Alrich, Joseph Adams, and Claudio Bitloc. *The Strategic Value of Foreign Area Officers*, IDA Document D-4974. Alexandria, VA: Institute for Defense Analyses, 2013.

D. Immediate actions available based on existing research

The digital tutor has already been shown to be a highly effective instructional tool for Navy IT training. The return on investment extends well beyond cutting the training time in half. With better trained sailors who need fewer years of on-the-job experience before reaching a high level of proficiency, the risk of IT system failures on Navy ships decreases. Fully implementing the Digital Tutor in Navy IT training and extending its use to IT training in other parts of the DOD would likely result in high operational returns to investment. With further research and development, the Digital Tutor could be adapted to facilitate instruction outside of IT (such as in other technical and mechanical training fields).

The returns to training for pilots can be greatly improved. Since warrant officers are not subject to the "up or out" system originating from the Defense Officer Personnel Management Act (Public Law 96–513), their career paths are much more flexible. If the Air Force, Navy, and Marine Corps expanded their pilot program to include a warrant officer ("flying track") route, then their returns to training could be enhanced by using warrant officer pilots who spend more time in flying positions throughout their career. Allowing potential pilots to choose a career path that more closely aligns with their personal ambitions ("flying track" versus "leadership track") would likely lead to higher pilot retention.

The Air Force and Marine Corps RAS/FAO model can be modified to be single track so that larger returns to their training investment can be harvested.

E. Next research steps

The effectiveness of instructor quality can be examined along multiple dimensions. What are the optimal instructor characteristics for improving student outcomes? What portfolio of instructors (e.g., active duty, reserve, retired or former military) can best meet those optimal characteristics? What are the cost tradeoffs? What technologies, such as the Digital Tutor, can enhance the quality and speed of training?

Assessments of instructor characteristics on student outcomes (at both the individual and unit level) could be conducted across the many schoolhouses and training facilities throughout the armed forces. This could be done with administrative data and advanced econometric techniques.[55] Results could then be used to inform staffing decisions.

Staffing decisions have effects that ripple throughout the entire force. It is important to consider how instructor staffing policies and practices impact the operational forces.

[55] The match between an instructor and a class is quasi-random, conditional on the particular schoolhouse. This quasi-random assignment can be exploited to mimic experimental conditions to measure and test the effects of instructor characteristics on student outcomes. Outcomes of interest could follow the four levels of the Kirkpatrick model, tailored to the specific training area of interest.

Administrative data could be harnessed immediately to gain insights into optimal mixes of instructor characteristics for the various schoolhouses. Follow-on research could then answer questions such as the optimal timing in a Service member's career to serve as an instructor and how long that service should be.

Research can also explore career management policies that may improve the returns to training investments, along the lines of the helicopter pilot and FAO examples. What are the legal, cultural, or other barriers to alternative career management frameworks? Research should seek to identify career management frameworks that already exist in one or more of the Services that have significant readiness, retention, or cost benefits over the frameworks used in the others.

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4. Mix for the Medical Workforce

A. Overview

The medical workforce is an essential element of DOD readiness capability, saving life and limb on the battlefield and maintaining the effectiveness of warfighters in the field. The medical workforce also provides beneficiary care in military treatment facilities (MTFs) to maintain their readiness (clinical proficiency) and meet the nation's obligation to military families. Approximately one-third of beneficiary healthcare is provided in MTFs; the remainder is purchased from the private sector.

The military medical workforce is large—and by several estimates too large (as discussed in Appendix A). Table 2 provides the number of AC personnel, RC personnel, and civilian employees at the end of Fiscal Year (FY) 2015. In this section, we illuminate the literature documenting a wide range of workforce mix challenges and opportunities to improve readiness, reduce costs, and improve the quality of health benefits.

Table 2. Medical workforce size as of 30 Sep 2015

Service/DOD	AC	RC	Civilian	Total
Army	50,612	50,411	27,644	128,667
Navy	36,533	12,370	6,760	55,663
Air Force	30,300	19,601	3,858	53,759
DOD	N/A	N/A	3,287	3,287
Total	117,445	82,382	41,549	241,376

Source: Health Manpower Personnel Data System Fiscal Year Statistics 2015, Defense Manpower Data Center, and Defense Health Agency.

B. Matching skills to needs, and maintaining those skills

Recruiting and maintaining the clinical readiness of the right medical specialist mix is challenging. Whitley et al. (2014) examined the nature, causes, and potential solutions to these challenges, and found that despite wartime improvements, excessive end strength and specialty misalignment persists. Specialty misalignments have consequences on the battlefield. Examples from the Iraq and Afghanistan clinical literature illustrate the importance of specialty alignment:

- Lettieri et al. (2009) found a 40% drop in mortality from using the right provider to staff the intensive care beds at a combat support hospital (critical care

physician/intensivist versus a general medical officer, such as a pediatrician or family practice physician).

- Gerhardt et al. (2008) found a 30% drop in mortality from using the right provider at the battalion aid station (emergency medicine physician or physician assistant versus a general medical officer).
- Mabry et al. (2012) found a 66% reduction in mortality for using the right provider in helicopter patient movement (critical-care trained flight paramedic versus an emergency medical technician – basic).

Maintaining medical providers' clinical readiness during peacetime represents a second major readiness challenge. The current approach is to maintain clinical skills by providing beneficiary healthcare. The Military Compensation and Retirement Modernization Commission (MCRMC) identified concerns with this approach:

> Beneficiary care may not sufficiently provide ideal training opportunities to maintain and sustain the military medical capabilities developed…. A survey of general surgeons from all military Services who deployed between 2002 and 2012 found that 80 percent of respondents desired additional training on particular surgical disciplines or injury types prior to deployment. The most commonly requested types of training were extremity vascular repairs, neurosurgery, orthopedics, and abdominal vascular repairs. Surgeons overwhelmingly cited vascular surgeries as the most difficult cases, followed by neurosurgical procedures, burns, and thoracic cases. Surgeons reported they had difficulty with these procedures because *they had not performed them in non-deployed clinical settings*, and because there had been a substantial time lapse since they had last treated these types of injuries.[56]

To illustrate this mismatch, Table 3 lists the top ten inpatient diagnoses in Iraq, which is a partial representation of conditions that the DOD needs the medical workforce to be clinically ready to treat.[57] These bear little resemblance to the top ten inpatient diagnoses in the military hospital system in 2015, presented in Table 4. It seems unlikely that the peacetime clinical workload in Table 4 can support clinical readiness for the warfight as illustrated in Table 3. Existing research supports immediate action on specialty realignment toward medical capabilities demanded in theater—both inpatient and outpatient—and away from capabilities less often needed to support the deployment or post-deployment recovery and rehabilitation of Service members.

[56] MCRMC, *Final Report*, Jan. 2015: 63–64 (emphasis added).

[57] We present 2007 because it is recent enough to have reasonably complete data, and also a peak casualty year. Note that a significant amount of outpatient care is also required in theater, and is not captured in Table 3.

Table 3. Top Ten Inpatient Diagnoses in Iraq, 2007

Clinical Classification Software (CCS) Grouping	Dispositions
Open wounds of head, neck, and trunk	3,488
Open wounds of extremities	2,650
Other injuries and conditions due to external causes	2,274
Fracture of lower limb	992
Nonspecific chest pain	986
Abdominal pain	683
Crushing injury or internal injury	589
Other specified and classifiable external causes of injury	571
Fracture of upper limb	563
Skin and subcutaneous tissue infections	543

Source: Theater Medical Data Store

Table 4. Top Ten Inpatient Diagnoses in Military Hospitals, 2015

Clinical Classification Software (CCS) Grouping	Dispositions
Newborn Care	48,490
Normal Pregnancy and Delivery	46,947
Complications of Pregnancy	45,427
Unclassified Care	44,281
High Blood Pressure	43,701
Perinatal Conditions	37,695
Screening/History of Mental Health and Substance Abuse	36,403
Complications of Pregnancy - Care of Mother	32,708
Disorders of Lipid Metabolism	31,305
Nutritional, Endocrine, and Metabolic Disorders	27,887

Source: *Essential Medical Capabilities and Medical Readiness*, IDA Paper NS P-5305

The choice of what personnel type will serve as the lead medical services provider in a unit is another skill-to-need matching challenge. This challenge exists at the intersection of what level of civilian and military training and skills are required to accomplish the mission, and the influence of the military rank structure.[58] Currently, military rank exerts disproportionate influence on the choice, which arguable instead should be determined according to clinical proficiency and complexity of care. For example, in some key casualty

[58] Lead service provider options include physicians of different skill levels, or non-physician credentialed providers, including classic civilian substitutes of physician extenders (e.g., physician assistants, nurse practitioners, and nurse anesthetists) and military-unique substitutes such as Independent Duty Corpsmen (IDCs) and Special Operations Medical personnel.

care positions, DOD currently assigns general physicians – general medical officers or non-trauma specialists like pediatricians – when an emergency medicine or critical care physician is required. Conversely, for other positions, DOD may use a physician where a lower-level provider (e.g., physician assistant or Independent Duty Corpsman (IDC)) would be sufficient to meet the requirement.

C. Challenges stemming from DOPMA

The military nursing force highlights challenges associated with current workforce management practices stemming from the Defense Officer Personnel Management Act of 1980 (DOPMA).[59] Recent research finds that civilian best practice typically involves nurses working in a clinical setting most of their careers; however, DOD force management policies make this impossible.[60] Unlike the Medical and Dental Corps, members of the Nurse Corps are not exempt from the "up or out" length of service, rank, and promotion structure embodied in DOPMA.[61] Nurses must leave clinical practice to remain in military Service, wasting clinical training and experience. Also, to ensure that some nurses are promotable, progressively expanding leadership positions are created for Nurse Corps officers, leading to higher overhead costs.

D. Choice of performer

1. Make vs. Buy

Significant savings may be derived from reforming beneficiary healthcare delivery. A large portion of dependent care contributes minimally to building medical readiness for contingency environments. From that perspective, there is an overallocation of military personnel dedicated to the provision of CONUS beneficiary healthcare. Many of these functions could be performed at lower cost by government civilians or contracted out entirely, while military Service members could better prepare for contingencies by working in medical trauma facilities that treat high volumes of combat-like injuries. Multiple studies found that the Services could make greater use of civilian employees as full-time providers, particularly for CONUS beneficiary care. These studies and the cost implications are discussed in Appendix A.

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[59] Mary T. Sarnecky, *A Contemporary History of the US Army Nurse Corps* (Washington, DC: The Borden Institute, April 2010).

[60] John E. Whitley, et al., *Medical Total Force Management: Assessing Readiness and Cost,* IDA Paper P-8805 (Alexandria, VA: Institute for Defense Analyses, 2018).

[61] The Medical and Dental Corps are exempt from DOPMA grade limitations in all grades up to O6 because of "the unique problems of obtaining and retaining physicians and dentists," doctors and dentists are eligible for "accelerated promotion as a retention incentive."

A systemic challenge in balancing the medical workforce across military personnel, civilian employees, and contractor support is that true personnel costs are not visible to local decision makers, or paid out of their budgets. Hospital commanders frequently receive military personnel on an assignment basis and consequently experience no budgetary cost. Civilian employees, on the other hand, are paid for out of their operating budget. This creates an incentive at the local level to use military personnel even when civilians would be cheaper to the taxpayer. Incorrect cost signals result in a more expensive workforce mix than necessary. IDA research completed in 2014 found that if the Navy and Air Force adjusted their medical workforce to mirror the Army's military-to-civilian ratio in its medical workforce, the DOD would save $1 billion per year from a full-cost perspective (or $500 million per year from a DOD cash flow, short-term budgetary perspective).[62]

The trade-off between civilian and contractor personnel is simpler, in some ways, because readiness is no longer a direct factor. Contractors can be considered in two ways: a personal services contract that provides a "body in place" or a contract for a function. The medical community extensively uses contracted individuals to provide medical care in MTFs. Contractors tend to be more expensive than civilian providers, but are more flexible to manage. The trade-off thus tends to focus on the staffing of stable, enduring needs (with civilians being the preferred personnel type) versus episodic, surge, or other variable needs (with contracts often being the only viable option).

The choice of whether to provide medical care directly in MTFs ("direct care") or purchase that care from the civilian sector under managed care support contracts ("purchased care") represents another aspect of the choice between military personnel, civilian employees, and contractor support. There has been significant study on producing health care services in-house versus contracting functions out to the civilian sector. Past research has shown that it is generally more expensive for DOD to produce care in-house as opposed to purchasing it. Appendix C provides further discussion.

2. Active vs. Reserve

Comparing the readiness of active duty physicians and reserve physicians differs from the typical military active-reserve comparison. For infantry, active duty personnel train full time, and are presumably more ready than reservists who train intermittently. But an active duty physician that is practicing in a medical area that sees fewer combat injuries is likely less ready than a reserve physician who works in a trauma center. The degree of regular experience in specific medical areas is critical to defining readiness for both active duty and reserve component members of the medical force.

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[62] Savings are in fiscal year 2013 dollars. John Whitley, Brandon Gould, Nancy Huff, Linda Wu, *Medical Total Force Management.* IDA Paper P-5047. Alexandria, VA: Institute for Defense Analyses, 2014.

E. Immediate actions available based on existing research

- Exempt the Nurse Corps from DOPMA grade limitations in all grades up to O6.
- Examine administrative leadership use of nurses and eliminate excess.
- Create a team from stakeholder offices (including Military Personnel Policy, Civilian Personnel Policy, and Cost Assessment and Program Evaluation (CAPE)) to support the Services with planning and implementing a military-to-civilian conversion for medical personnel. This team should:
    - Identify long-standing challenges to implementing medical conversions.
    - Establish a streamlined costing for medical conversions.
    - Develop integrated solutions to support total force management.
    - Establish a policy allowing the Services to retain savings from conversions.
    - Issue guidance for prioritizing medical conversions.
- Increase the use of the Reserve Component for uniformed medical personnel. To that end, the Deputy Assistant Secretary of Defense for Reserve Integration, the National Guard Bureau (NGB) and the Service Reserve commands could pursue the following:
    - Use surveys or focused interviews to identify issues that currently hamper successful reserve medical recruitment (for instance, drilling requirements might be structured differently to reduce the barrier to entry for certain medical specialties).
    - Develop policy reforms and, if necessary, proposals for legislative change to create reserve options that are better aligned to meet medical readiness requirements and are more suitable to medical professionals.
    - Prioritizing appropriate realignments of the medical workforce from the active to the reserve component.

F. Next Research Steps

- Assess the potential returns to investment from restricing the medical specialties that individuals completing their medical education using government or DOD funding may pursue.
- Explore the potential to partner with reputable trauma centers to enable active duty physicians to serve for a time in those centers.

- Expand on existing research to more finely estimate the costs of the military and civilian DOD nursing force by age, rank, and specific function.[63]
- Explore the costs and benefits of contracting for specific functions within the direct care system. This includes evaluating contracted medical personnel relative to civilian or military personnel, as well as contracting for work centers, such as pharmacies, clinics, oncology centers, etc.
- To improve recruiting and retention for high-demand medical professionals, investigate ways to more efficiently use medical reservists during drilling periods (e.g., not just using the reservists to perform medical administrative work, routine medical care, or backfill low-volume MTFs). Evaluate whether alternatives, such as time spent in their regular job in trauma treatment and surgery, could count toward the drilling requirement.

[63] Due to overhead costs from educational investments and a mismatch between these investments and the current military force management system, the total cost of the nursing force is difficult to estimate. See Whitley, et al., "Medical Total Force Management: Assessing Readiness and Cost."

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5. Conclusion

Overall, the body of evidence considered here demonstrates that opportunities for considerable efficiency and improvement in workforce mix are available to military leaders. As policy makers consider potential reforms to the system, we suggest a greater willingness to confront and reconsider the cultural and regulatory norms that have produced the status quo. This will necessitate action from the highest levels, as many inefficient and ineffective practices are deeply entrenched. Considerable scope exists for expanding the knowledge available to decision makers; these opportunities are discussed throughout the paper, and presented in Appendix A. Finally, leaders should consider how current incentive structures—such as the budget process for civilian versus military individuals—have contributed to the observed status, and take action to align cost information, budget impact, and decision authority at the same levels to enable natural market forces to produce a more effective and efficient workforce allocation.

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Appendix A.
Next Research Steps

This appendix consolidates the research questions suggested for future investigation throughout this paper.

Expeditionary Forces

a. Ground Forces

- Begin systematic, sustained collection of active and reserve component performance data across the Department of Defense (DOD). The Army's National Training Center is a possible source of performance data.
- Expand evaluation of active versus reserve unit performance in recent overseas contingency operations.
- Systematically examine additional operational areas where a more Reserve Component (RC)-intensive force may be more efficient. Existing tools such as the Institute for Defense Analyses' (IDA's) Structure and Readiness Assessment (SARA) model could be employed to identify areas for deeper examination. Areas suggested for initial examination based on existing work include Air Force and Navy tactical aviation, Naval Construction Battalions (CBs), as well as battalion-level combat forces in the Army and Marine Corps.
- Determine how Active Component-Reserve Component (AC/RC) decision-making processes could be modified to better ground policy in an analytic understanding of costs and benefits.
- Expand IDA's SARA model to incorporate contractor units and explore potential savings at various levels of expected contingency activity.
- Examine the feasibility and desirability of adopting a sponsored reserve concept under which contractors would be paid a retainer to provide people or capabilities of specified types as demanded for contingencies. This could cover a wide range of capabilities including cyber, transportation, maintenance, language, and cultural liaison. The people involved could be militarized upon activation, as needed.

b. Air Warfare Forces

- Investigate whether widespread contractor use across the Unmanned Aircraft System (UAS) enterprise is feasible.
- Evaluate the effect of the Air Force's enlisted drone pilot program on operational costs and efficacy. Investigate whether UAS operator transitions from officer to warrant officer or enlisted will affect operational efficacy.
- Evaluate the 2017 Air Force enlisted pilot program for impacts on operational efficacy and costs.
- Compare total costs per flight hour at various levels of contingency between Air Force reserve and active units. Investigate the possibility of integrating reservists into active duty facilities to take advantage of economies of scale.
- Analyze extending the use of civilians in combat aviation maintenance units; many of these units are either contiguous United States (CONUS) based, deploy in pieces, or deploy to secure environments.

c. Maritime Forces

- Develop a process to revise policies to realign budgeting office incentives, including making labor prices reflect the cost to the Navy of military billets and charging end users for military manpower that they use.

d. Integrated Air and Missile Defense and Cyber/Electronic Warfare Forces

- Investigate the advantages and disadvantages of a larger role for the RC in providing cyber/electronic warfare manpower.
- Investigate the extent to which the RC can operate unmanned air defense systems.
- Consider the advantages and disadvantages of full-time RC manning for Intercontinental Ballistic Missile sites.

e. Special Operations Forces

- Investigate the extent to which the RC can provide more of the location-specific language and cultural skills needed by the Special Operations Forces community. Examine whether civilians or contractors can support these needs.

Training Forces

- The effectiveness of instructor quality can be examined along multiple dimensions. What are the optimal instructor characteristics for improving student outcomes? What portfolio of instructors (e.g., active duty, reserve,

retired or former military) can best meet those optimal characteristics? What are the cost tradeoffs? What technologies, such as the Digital Tutor, can enhance the quality and speed of training?

- Assessments of instructor characteristics' effects on student outcomes (at both the individual and unit level) could be conducted across the many schoolhouses and training facilities throughout the armed forces. This could be done with administrative data and advanced econometric techniques. Results could then be used to inform staffing decisions.
- Staffing decisions have effects that ripple throughout the entire force. It is important to consider how instructor staffing policies and practices impact the operational forces. Administrative data could be harnessed immediately to gain insights into optimal mixes of instructor characteristics for the various schoolhouses. Follow-on research could then answer questions such as the optimal timing in a Service member's career to serve as an instructor and how long that service should be.
- Research can also explore career management policies that may improve the returns to training investments, along the lines of the helicopter pilot and Foreign Area Officer (FAO) examples. What are the legal, cultural, or other barriers to alternative career management frameworks? Research should also seek to identify career management frameworks that already exist in one or more of the Services that have significant readiness, retention, or cost benefits over the frameworks used in the others.

Medical Forces

- Assess the potential returns to investment from restricting the medical specialties that individuals completing their medical education using government or DOD funding may pursue.
- Explore the potential to partner with reputable trauma centers to enable active duty physicians to serve for a time in those centers.
- Expand on existing research to more finely estimate the costs of the military and civilian DOD nursing force by age, rank, and specific function.
- Explore the costs and benefits of contracting for specific functions within the direct care system. This includes evaluating contracted medical personnel relative to civilian or military personnel, as well as contracting for work centers such as pharmacies, clinics, oncology centers, etc.
- To improve recruiting and retention for high-demand medical professionals, investigate ways to more efficiently use medical reservists during drilling

periods (e.g., not just using the reservists to perform medical administrative work, routine medical care, or backfill low-volume military treatment facilities (MTFs)). Evaluate whether alternatives, such as time spent in their regular job in trauma treatment and surgery, could count toward the drilling requirement.

Appendix B.
Medical Force Sizing

Multiple studies have examined the size and specialty distribution of the military medical workforce and have found that, historically, it has been larger than its total requirement and not well-aligned across specialties. Completed in 1994, the 733 Study projected operations casualties and determined the number of physicians required to support those operations, concluding that the physician force projected for FY 1999 could be reduced by 24 percent.[64,65] A controversial 1999 update found that the physician force could decrease by 28 percent and still meet all requirements, and placed greater emphasis on training and maintaining physicians.[66,67]

DOD's 2008 Medical Readiness Review (MRR)[68] modeled casualties given new casualty care delivery systems and projected warfighting scenarios. Through a comprehensive evaluation of requirements for each medical occupation, the MRR identified an excess of about 20 percent in medical end strength, and highlighted the misalignment between executed end strength and identified requirements. An illustrative example taken near the start of the wars in Iraq and Afghanistan and highlighted in the MRR report is reproduced in Table B-1.

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64 The Office of the Under Secretary for Personnel and Readiness (OUSD(P&R)) and what is now the Office of Cost Assessment and Program Evaluation (CAPE) completed the co-led "733 Study" in 1994 as directed by Section 733 of the National Defense Authorization Act (NDAA) for Fiscal Years (FY) 1992 and 1993 (Pub. Law 102-190, December 5, 1991).

65 Department of Defense (DOD) Office of Program Analysis and Evaluation, "The Economics of Sizing the Military Medical Establishment: Executive Report of the Comprehensive Study of the Military Medical Care System" (Washington, DC: Department of Defense, April 1994). CAPE and OUSD(P&R) received considerable study support from the Office of the Assistant Secretary of Defense (Health Affairs) and the Surgeon Generals for the three Military Departments.

66 DOD Office of Program Analysis and Evaluation, "Section 733 Update: Report of the Working Group on Sustainment and Training" (Washington, DC: Department of Defense, April 1999).

67 The Services disputed these findings and the topic of the optimal medical force size is still under debate. Section 721 of the 2017 NDAA directed a new medical requirements estimate.

68 DOD, "Final Report: DOD Force Health Protection and Readiness—A Summary of the Medical Readiness Review, 2004–2007," June 2008.

Table B-1. FY 2004 Specialty Mix Imbalance

	Readiness Requirement	FY 2004 Executed End Strength	End Strength Minus Requirement
Pediatrics	286	645	359
Obstetrics	208	387	179
Anesthesiology	318	259	−59
General Surgery	685	443	−242

Source: "Final Report: DOD Force Health Protection and Readiness—A Summary of the Medical Readiness Review, 2004–2007," June 2008.

Note: The FY 2004 requirement is for fully trained providers. The total requirements (including trainers and students) were: Pediatrics 484; Obstetrics 351; Anesthesiology 444; and General Surgery 947.

Appendix C.
Healthcare Provider Costs

Costs of military personnel and civilian employees are distributed across the Department of Defense (DOD) and federal budgets, making it a challenge to accurately estimate the costs of alternative mixes for the medical workforce. To address this challenge, DOD Instruction (DODI) 7041.04 directs DOD Components to estimate the full cost of military personnel and civilian employees to inform total workforce mix decisions and provides guidance on how to estimate the full costs of military and civilian personnel so that analysts and decision makers can correctly compare staffing inputs.[69]

As outlined in DODI 7041.04, there are facets of medical costs that must be understood:

- **Composite Rate.** Office of the Under Secretary of Defense, Comptroller (OUSD(C))-issued composite rates that average the entire annual military personnel (MILPERS) budget account across all military personnel by grade. This rate is simple to compute and use, but by averaging across all personnel in a grade (by Service), it significantly understates the true cost of medical personnel.
- **Cash Flow DOD Costs.** This cost includes all costs in the composite rate and adds additional variable costs to DOD, such as active duty health benefits and training costs. It also differentiates specialty-specific special pays, an important consideration for medical personnel who generally receive larger special pays than the average amounts calculated in the composite rates.
- **DOD Cost.** This cost incorporates all major short-run and long-run personnel costs to DOD, including notional accrual estimates of future costs of retiree healthcare and costs that are fixed in the short run, like day-care centers.
- **Full Cost.** This cost reflects the total cost of personnel paid by taxpayers, including both DOD and non-DOD costs and both near-term and future costs (on a notional accrual basis). Non-DOD costs include items like veterans'

[69] In support of DODI 7041.04, Cost Assessment and Program Evaluation (CAPE) is also developing the Full Cost of Manpower (FCoM), a software tool designed to display alternative cost views for military and civilian employees with given specialties, grades, and years of service. CAPE provided IDA access to the test version of FCoM for use in this report.

benefits and the tax revenues foregone by the Treasury because certain allowances are tax-exempt.

Table C-1 provides estimates of the average annual cost of a military or civilian medical provider in each medical corps, according to each of the above four cost views. The estimates are taken from 2014 Institute for Defense Analyses (IDA) research and are for fiscal year 2013.[70] Some key insights revealed by the comparisons include:

- The composite rate substantially understates the full cost of military medical personnel.
- Civilian medical personnel generally cost less than military medical personnel across all four cost views.
- Comparisons of military composite rates to civilian DOD cash flow costs for physicians and dentists cause uniformed providers to appear to be artificially less expensive than civilians.

The choice of whether to provide medical care directly in MTFs ("direct care") or purchase that care from the civilian sector under managed care support contracts ("purchased care") represents another aspect of the choice between military personnel, civilian employees, and contractor support. There has been significant study on producing health care services in-house versus contracting functions out to the civilian sector. Past research has shown that it is generally more expensive for DOD to produce care in-house as opposed to purchasing it. IDA examined the costs of MTFs in a 2016 paper.[71] Table C-2 presents a cost comparison for inpatient workload across contiguous United States (CONUS) MTFs. For each MTF, the facility and Service is listed followed by the costs. First, the actual direct-care cost of the facility for its workload is provided (fiscal year 2013). The next column provides the total cost of purchasing that same amount of workload from the private sector in that local market. In purchased care, however, there are cost shares that the beneficiary must pay and the DOD does not pay the full cost of purchasing the care. The final column shows the cost to the DOD of purchasing the workload after cost shares are taken into account.

This research concluded that, on average, MTF workload could be purchased for 35 percent less than it costs to produce in-house. The higher cost of in-house care may be justified if it delivers a readiness training benefit. However, as previously discussed, many MTFs (and, more relevant here, many work centers within MTFs) may not deliver a significant training value.

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[70] Whitley et al., "Medical Total Force Management," IDA paper P-5047, 2014.

[71] Lurie, Philip, "Comparing the Costs of Military Treatment Facilities with Private Sector Care," IDA Paper P-5262, February 2016.

Finally, Table C-3 through Table C-5 display total cost and DOD cash flow cost differences between Active Component (AC) and Reserve Component (RC) medical forces in selected physician specialties.

Table C-1. Estimated Average Annual Medical Personnel Costs Per Person ($FY13)

Corps	Military/ Civilian	Composite Rate	DOD Cash Flow	DOD	Full Cost
		Army			
Medical	Military	$179,323	$403,604	$413,330	$460,838
	Civilian	—	$301,526	$307,347	$327,760
Dental	Military	$175,366	$297,525	$307,216	$354,154
	Civilian	—	$259,967	$265,113	$282,878
Nurse	Military	$141,965	$182,645	$192,006	$233,472
	Civilian	—	$132,538	$135,318	$143,821
Medical Services	Military	$140,759	$174,946	$184,296	$225,589
	Civilian	—	$131,684	$134,470	$142,995
Enlisted	Military	$71,587	$88,965	$97,633	$125,373
	Civilian	—	$68,492	$70,236	$74,679
		Navy			
Medical	Military	$183,354	$377,433	$387,116	$434,504
	Civilian	—	$302,685	$308,185	$328,561
Dental	Military	$182,860	$291,002	$300,685	$348,066
	Civilian	—	$261,588	$266,413	$284,143
Nurse	Military	$151,777	$186,540	$195,895	$237,849
	Civilian	—	$136,919	$139,479	$148,341
Medical Services	Military	$160,272	$188,996	$198,433	$241,725
	Civilian	—	$134,290	$136,822	$145,569
Enlisted	Military	$77,247	$96,468	$105,158	$133,805
	Civilian	—	$67,212	$68,612	$72,926
		Air Force			
Medical	Military	$166,796	$346,448	$356,038	$401,305
	Civilian	—	$291,954	$297,668	$317,760
Dental	Military	$170,545	$285,491	$295,129	$341,198
	Civilian	—	$253,781	$258,857	$276,455
Nurse	Military	$144,050	$179,384	$188,730	$229,965
	Civilian	—	$130,220	$132,998	$141,595
Medical Services	Military	$147,497	$176,019	$185,403	$227,260
	Civilian	—	$133,303	$136,155	$145,044
Enlisted	Military	$72,763	$90,219	$99,069	$130,141
	Civilian	—	$71,741	$73,531	$78,260

Note: Military and civilian average costs are weighted by the distribution of military end strength across specialties in each corps. Military end strength by specialty was collected from the FY 2011 HMPDS.

Table C-2. Direct Care Inpatient Costs and Value of Care by MTF ($ Thousands)

Facility	Service	Actual Direct Care Cost	Total Direct Care Workload	DOD Share of Direct Care Workload
Bassett ACH-Ft. Wainwright	Army	$18,194	$23,109	$21,755
673rd Medical Group-Elmendorf	Air Force	$29,339	$33,292	$25,557
60th Medical Group-Travis*	Air Force	$99,611	$84,488	$43,333
NH Camp Pendleton*	Navy	$37,400	$27,311	$24,398
NH Lemoore	Navy	$7,002	$3,008	$2,909
NMC San Diego*	Navy	$199,773	$174,377	$138,055
NH Twentynine Palms	Navy	$11,858	$7,780	$7,400
Evans ACH-Ft. Carson	Army	$37,356	$33,229	$30,422
NH Pensacola*	Navy	$31,181	$13,748	$9,722
NH Jacksonville*	Navy	$42,368	$20,169	$17,439
96th Medical Group-Eglin*	Air Force	$35,013	$21,887	$17,222
Eisenhower AMC-Ft. Gordon*	Army	$62,536	$44,936	$27,074
Martin ACH-Ft. Benning*	Army	$32,227	$19,864	$18,024
Winn ACH-Ft. Stewart	Army	$25,927	$16,983	$15,817
Tripler AMC-Ft Shafter*	Army	$189,519	$133,795	$101,741
366th Medical Group-Mountain Home	Air Force	$5,235	$1,793	$1,686
Irwin ACH-Ft. Riley	Army	$14,211	$12,441	$12,016
Blanchfield ACH-Ft. Campbell	Army	$32,490	$20,702	$19,171
Ireland ACH-Ft. Knox	Army	$15,593	$8,034	$7,434
Bayne-Jones ACH-Ft. Polk	Army	$14,727	$6,604	$6,289
Walter Reed NMMC*	JTF CapMed	$355,780	$187,783	$138,598
81st Medical Group-Keesler*	Air Force	$40,787	$23,667	$12,490
L. Wood ACH-Ft. Leonard Wood	Army	$18,455	$28,666	$25,497
99th Medical Group-O'Callaghan*	Air Force	$34,624	$29,909	$18,959
Keller ACH-West Point*	Army	$13,475	$6,825	$6,667
Womack AMC-Ft. Bragg*	Army	$95,095	$56,150	$47,251
NH Camp Lejeune*	Navy	$44,697	$52,204	$49,062
88th Medical Group-Wright-Patterson*	Air Force	$40,667	$24,790	$15,437
Reynolds ACH-Ft. Sill	Army	$18,671	$9,318	$8,358
NH Beaufort	Navy	$6,341	$2,799	$2,742
Moncrief ACH-Ft. Jackson	Army	$10,039	$6,156	$5,985
William Beaumont AMC-Ft. Bliss*	Army	$105,180	$70,132	$50,918

Facility	Service	Actual Direct Care Cost	Total Direct Care Workload	DOD Share of Direct Care Workload
San Antonio MMC-Ft. Sam Houston*	Army	$427,670	$230,226	$159,906
Darnall AMC-Ft. Hood*	Army	$78,265	$55,534	$52,030
633rd Medical Group Langley-Eustis	Air Force	$27,717	$15,272	$13,839
Ft. Belvoir Community Hospital	JTF CapMed	$109,238	$50,966	$41,636
NMC Portsmouth*	Navy	$211,278	$120,394	$106,419
Madigan AMC-Ft. Lewis*	Army	$162,350	$128,542	$93,548
NH Bremerton*	Navy	$25,141	$14,025	$11,148
NH Oak Harbor	Navy	$6,662	$3,136	$3,027
Weed ACH-Ft. Irwin	Army	$8,382	$18,791	$18,189
Total		**$2,782,074**	**$1,842,835**	**$1,429,167**

* These sites offer some form of Graduate Medical Education (GME). There is considerable variation in the scope and size of GME programs at these facilities.

Abbreviations:
ACH = Army Community Hospital
AMC = Army Medical Center
JTF CapMed = Joint Task Force National Capital Region Medical
MMC = Military Medical Center
NH = Navy Hospital
NMC = Navy Medical Center
NMMC = National Military Medical Center

Table C-3. Army Costs by Occupation and Personnel Type, in Thousands of 2017 Dollars per Person-Year

	Total Cost			DOD Cash Flow Cost		
Occupation	AC	RC	Civilian	AC	RC	Civilian
Anesthesiology	513	84	413	455	52	380
Cardiac/Thoracic Surgery	591	83	509	526	51	468
Emergency Medicine	455	83	320	397	52	295
General Surgery	511	84	412	452	52	379
Neurological Surgery	570	82	510	513	50	469
Oral Maxillofacial Surgery	506	80	373	446	48	343
Orthopedic Surgery	589	83	514	530	51	473
Peripheral Vascular Surgery	607	85	411	543	53	378

Table C-4. Navy Costs by Occupation and Personnel Type, in Thousands of 2017 Dollars per Person-Year

	Total Cost			DOD Cash Flow Cost		
Occupation	AC	RC	Civilian	AC	RC	Civilian
Anesthesiology	515	86	415	453	53	383
Cardiac/Thoracic Surgery	556	85	513	490	52	473
Emergency Medicine	449	85	322	388	52	297
General Surgery	503	86	414	442	53	382
Neurological Surgery	542	84	514	480	51	473
Oral Maxillofacial Surgery	503	83	375	442	50	346
Orthopedic Surgery	549	85	517	489	52	476
Peripheral Vascular Surgery	579	87	414	516	54	381

Table C-5. Air Force Costs by Occupation and Personnel Type, in Thousands of 2017 Dollars per Person-Year

	Total Cost			DOD Cash Flow Cost		
Occupation	AC	RC	Civilian	AC	RC	Civilian
Anesthesiology	456	77	407	399	44	374
Cardiac/Thoracic Surgery	481	79	503	424	45	462
Emergency Medicine	407	76	315	350	43	290
General Surgery	453	77	406	396	44	373
Neurological Surgery	500	77	503	439	44	462
Oral Maxillofacial Surgery	512	79	368	439	45	338
Orthopedic Surgery	499	77	506	464	44	465
Peripheral Vascular Surgery	506	79	405	446	46	372

Appendix D.
Illustrations

Figures

Tables

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Appendix E.
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Appendix F.
Abbreviations

AC	Active Component
ARC	Air Reserve Component
ARNG	Army National Guard
CAPE	Cost Assessment and Program Evaluation
CBO	Congressional Budget Office
CONUS	Contiguous United States
DARPA	Defense Advanced Research Projects Agency
DOD	Department of Defense
DODI	DOD Instruction
DOPMA	Defense Officer Personnel Management Act of 1980
FAO	Foreign Area Officers
FCoM	Full Cost of Manpower software
FTE	Full-Time Equivalents
FYDP	Future Years Defense Program
GMD	Ground-based Midcourse Defense
IDA	Institute for Defense Analyses
IDC	Independent Duty Corpsmen
IT	Information Systems Technology
MCRMC	Military Compensation and Retirement Modernization Commission
MILPERS	Military Personnel
MRR	Medical Readiness Review
MSC	Military Sealift Command
MTF	Military Treatment Facility
NDAA	National Defense Authorization Act
NGB	National Guard Bureau
OEF	Operation Enduring Freedom
OIF	Operation Iraqi Freedom
OUSD(C)	Office of the Under Secretary of Defense, Comptroller
OUSD(P&R)	Office of the Under Secretary of Defense for Personnel and Readiness
RAS	Regional Affairs Strategists
RC	Reserve Component
SARA	Structure and Readiness Assessment model (formerly the Stochastic Active-Reserve Assessment model)
SMRDP	Shore Manpower Requirements Determination Process

UAS	Unmanned Aircraft System
USTRANSCOM	United States Transportation Command