Targeted Interoperability

A New Imperative for Multinational Operations

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Preface

In recent years, the U.S. 82nd Airborne Division and the British 16th Air Assault Brigade ventured to build a combined unit where the two organizations could conduct high-end airborne operations with "seamless" integration. In many ways, this targeted effort was a departure from past interoperability aspired to by airborne units and brought tactical units closer than ever before. Targeted interoperability of this type is rare; however, interest in it seems only to grow as more nations interact at lower echelons on shorter time lines than in the past.

In September 2014, the 82nd Airborne Division asked RAND Arroyo Center to look into the broader context in which their activities were being conducted. This study, produced under a project entitled "Towards a Coalition Global Response Force," highlights trends in and motivations for interoperability and constructs a framework for moving forward with future interoperability.

This study should be of interest to tactical units building multinational interoperability, headquarters offices that are tasked with constructing the requirements and securing the resources for such interoperability, and the combatant commands who might best benefit from advancing interoperability in the U.S. Army.

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Summary

In modern warfare, hardly a conversation about military capabilities occurs where interoperability with another organization—multinational or not—does not come up. Significant literature exists on all types of interoperability, with the common refrain being that *more and better interoperability is needed*. And, with few exceptions in recent decades, the United States tends to engage with multinational partners and allies in military operations, thus bringing multinational interoperability to the fore.

So, with all this interest, why is the United States not interoperable when and how it wants? There are several reasons why, including a lack of understanding of the significant resources it takes, a reluctance to expend time and money when the value of doing so is not clear, and a one-size-fits-all attitude when it comes to finding solutions. This report looked at what motivations do exist, and defined a reasonable framework from which to work if and when interoperability needs and investments meet strategic language.

Trends in Interoperability

Several trends guide how interoperability might look in the future, and have changed how interoperability has been seen in the recent past. They generally fall into the following categories:

- The move toward more tactical exchange of services among nations;

- Being interoperable with more and different nations in a greater variety of operations;
- Desire for interoperability at the onset of operations.

These trends imply challenges and opportunities, bringing in new organizations to meet the needs, and being able to understand the dependencies thus created on readiness, bespoke solutions, costs, and other factors.

Overcoming Challenges

The main challenges to building interoperability are quite well known. They have existed since nations began working together, and are highlighted time and time again in lessons-learned documents generated after operations or through training and exercises. Though often described in disparate language, there is no argument that both the challenges and by extension the desired interoperability outcomes are:

- **Communications and Information Systems (CIS) interoperability:** the ability for CIS between nations able to connect and work together;
- **Individual interoperability:** the ability for soldiers to understand each other;
- **Art of Command (AoC) interoperability:** the ability of commands to share a sense of purpose and command style;
- **Procedural interoperability:** the ability to follow similar procedures, be they tactical or strategic, without detrimental misunderstanding;
- **Equipment interoperability:** to have equipment that works together on the battlefield.

The relative importance of these varies greatly. Through casual polling of operators, the importance of each would vary considerably

based on mission, partner, and warfighting function, among other factors. A look at the literature seemed to favor overcoming CIS challenges, but that was more likely linked to the common definitions of interoperability being more technical in nature. And interviews with higher-level leaders in our partner countries seemed to focus more on growing relationships among commands and individuals. With that, so it goes, all other problems can be worked out. In the end, a balance of technical and social aspects of interoperability will be necessary, and that balance will be highly nuanced on what you hope to get from it.

So how do you build it? The U.S. Army has a wide variety of activities that in part lead to some interoperability outcomes as described above. The programs range widely, across at least ten activity categories. And our look at 192 underlying programs within those activity categories defined a top five that stood out for building interoperability (in order of ranking): Unit-to-Unit Relationships, Staff Exchanges, R&D, Training and Exercises, Consultations.

As expected, practical activities that promote cohesion and understanding between military staff (staff exchanges) and military units of different nations (unit-to-unit type) are of the highest relevance for building interoperability. R&D-related programs, consultations, and training and exercises also were significant, indicating the need for programs that rely on both compatible infrastructure (such as weapons systems and communications tools developed through R&D partnerships), frequent information exchange between armed forces, and active participation in exercises and training events.

There is no clear consensus or empirical evidence for which activity types make the greatest contributions to building interoperability. It is generally agreed, however, that the activities themselves necessarily aid in increasing knowledge of cultural affinities, building individual and group relationship, and overcoming or at least identifying procedural or technical differences. Our elicitation of subject-matter experts on the contribution of activity types to interoperability outputs, however, does shed some light on how programs could be put toward outcomes desired (Figure S.1).

Figure S.1
Schematic Description of Key Contributors to Interoperability Outcomes

	Aligned Procedures	Art of Mission Command	Individual Interoperability	CIS	Compatible Equipment
Training and Exercises	✓	✓		✓	
Multinational Operations	✓	✓	✓	✓	
Education			✓		
Staff Exchanges			✓		
LNOs			✓		
Unit-to-Unit Activities			✓		
R&D				✓	✓
Equipment Transfers				✓	✓

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General Versus Targeted Interoperability

To date, these activities have, with only limited counterexamples, provided for what we termed *General Interoperability*—a force and leadership predisposed to and effective at solving the complex operational and tactical challenges of working with disparate foreign partners. Focused on general interoperability, units prepare and operate with foreign partners as needed, employing institutional and ad hoc solutions to overcoming interoperability challenges. And this can take time in advance of operating together, or limit the functions that can be shared among partners.

In a few instances, there is what we have termed *Targeted Interoperability*—a unit or collection of units that have overcome the cultural, technical, and procedural barriers to operating with its foreign counterpart for specific functions. This targeted interoperability allows for units to come together quickly to perform operations, with expectations for how much and what type of services will be provided from one

to another. While general interoperability is being picked up from the ambient atmosphere of building relationships, multinational training, and operating with foreign militaries, targeted interoperability tends to be deliberately planned, executed, and sustained for a period of time. As a capability that is built within and among forces, both general and targeted interoperability will also have a half-life and will lose effectiveness over time if the right sustainment plan is not implemented.

In this study we also defined four broad, nonexclusive categories to begin parsing the types of relationships the U.S. Army might wish to have with partners. They were:

- **Usual Suspects:** those partners commonly operating with or beside the United States, and who may be technically capable, generally expeditionary, and often politically aligned.
- **Plan-Focused:** those partners implied by known war plans and near-term needs.
- **Hedging:** those partners as part of alliances and who have special relationships that warrant closer operational and tactical relationships for mutual support.
- **Ops du Jour:** those partners that arise from surprise or evolving operations that may not have been known ahead of time.

The categories naturally delineate two examples each of targeted and general interoperability, though with spillover. The first two most directly depend on targeted interoperability insomuch as a priori plans can be made to provide services from one to another in support of operations. The latter two mostly adhere to general interoperability, though they can lead to targeted interoperability solutions—in the first case as units are built from member states, like NATO's VJTF, and in the latter case as interoperability solutions are generated in real time to support operations.

With the types of interoperability being built, the activities underpinning it, and the delineation of what types of partners the United States wants them to be, this data can be used in support of planning for operations, programming for cooperation support, and better understanding the goals and limitations of current activities toward building interoperability.

Recommendations

With the framework as described, there are several possible actions senior leaders should take to move interoperability forward.

Require Interoperability

To move beyond extant strategy and doctrinal documents that generally call for more of it, interoperability needs to be a requirement levied on units, equipment, and training with appropriate top-down direction of what kinds, with whom, and how they should both fund and sustain it. Interoperability requirements for the near term should come from the ASCCs[1] (and COCOMs), but should also be driven by a longer-term view of the environment and relationships the United States would like to build with key partners.

Because of the nature of the values from interoperability—from tactical through strategic and political—senior policy makers from many offices may need to be involved with setting the right requirements. Binning partners across the typology proposed here, and defining the functions on which Army forces should be interoperable, should be iterative and evolve as more information as to how much, of what type, with whom is possible.

Assign Agency for Building Interoperability

Responsibilities associated with interoperability currently exist in many places within the U.S. Army. Tactical units remain responsible in ongoing operations to connect with foreign partners, under strict guidelines levied from partners and U.S. commands. Combatant commands have to determine how much and with whom interoperability should be a

[1] The ASCCs already have the role to "Develop and propose Army [Multinational Force Interoperability] MFI issues for inclusion in their respective regional combatant commanders' integrated priority lists, theater security cooperation plans, regional strategies and/or country support plans, and respective sections of the Army Campaign Support Plan. . . . Develop and inform the DCS, G–3/5/7 of the combatant commanders' Army MFI requirements, objectives, and priorities . . . [help] periodically assess progress . . . and identify causes of shortfalls and propose measures to address them." See U.S. Army Regulation 34-1, "Multinational Force Interoperability," July 10, 2015, p. 9.

priority. Requirements and doctrinal writers have to include interoperability into plans for the future. And HQDA needs to prioritize and program for all of this activity in the context of the near- and far-term force. As and if interest in interoperability grows, an overarching agent will be necessary that can balance the long-term needs of the force, with the near-term expenditure of funds to meet operational requirements. Discussions should ensue from a great number of stakeholders as to how much, with whom, and what type, with ultimate decision making being held at HQDA four-star level to ensure unity of purpose and command.

Orient Activities

To support interoperability better, currently available activities can be oriented to better support building interoperability. This will come at the expense, perhaps, of other goals. And those activities can be positioned differently depending on whether "general" or "targeted" interoperability is most desired.

Develop "General Interoperability" Widely

The United States needs forces attuned to the troubles and values of working with partners. This means maximizing opportunities for soldiers to experience working with foreign partners and overcoming the challenges inherent in multinational operations. Top leadership will drive these initiatives through additional opportunities for exchanges, multinational training and exercises, and subscriptions to coalition interoperability solutions, among others. Funding will need to follow, should general interoperability grow in line with senior leader expectations.

Deliberately Build "Targeted Interoperability"

Building more targeted interoperability is possible, and finding the right sets of motivations and support from the partners will ultimately drive how far the Army can push it. The Army can deliberately build targeted interoperability by integrating partner units into military plans and providing the additional resourcing to foster deeper relationships.

First off, this will entail defining specific, unit-to-unit relationships to aid in providing direction to units. This will mean having to choose which units focus on which foreign counterparts, which will be more difficult for the United States with a larger rotational force than with foreign counterparts, which typically have more individual dedication to units.

Built interoperability will atrophy quickly, so you will need a plan to keep relationships together and continue to refresh them, and means of testing how interoperable and effective the relationships are. For targeted interoperability especially, sustainment plans will need to be built that cover the expectations for the units involved.

And, for all but the most robust of relationships, goals for interoperability should start small, with a few functions, then grow from there. There is a propensity to search for one overarching solution to meet all functional needs, be they an experience like a training event, or a software system or piece of equipment. But in recent experiences, interoperability has only been built through the hard slog of interoperability outcomes, tailored to the partners, functions, and time lines involved.

Actively Measure and Monitor Interoperability Levels

For leadership to know what they have built (what services, from where, etc.), there will need to be a means for monitoring and testing interoperability. This will undoubtedly lead to discussions about readiness and monitoring (and defining) of interoperability readiness. However, some sort of scorecard or assessment card (like the one developed here) could go a long way in at least asking the right questions to begin with, and collecting appropriate information.

Develop Turnkey Solutions

Some solutions can be widely applied to specific, common functions across many disparate partners. Commonly discussed are finding communication solutions which can easily be transferred and connected, means for a common operational picture, and general understandings of how command and control will work in particular combat operations. Each has the potential for turnkey-like solutions, where the

United States alone, or with its partners, develops solutions which can be transferred or shared among disparate actors. These turnkey solutions, be they hardware or detailed procedures, can create conditions to reduce the time necessary to bring forces together. Because of the extent of possible interoperability among forces, there should be no expectation that all functions can be made turnkey for all partners; however, some of the more regularly used functions should be considered to help build a baseline from which more targeted interoperability could be built.

Final Word

Building multinational interoperability can be technically challenging and politically charged, and often takes longer than expected. To date, ad hoc work-arounds to interoperability, like liaison teams or bespoke communication systems, tend to dominate the solution space and typically at the cost of additional money, time, or reduced capabilities. As the U.S. Army looks toward interoperability in the future, with more varied partners on shorter time lines and at more tactical levels, a different set of activities and focus will likely be needed.

This will begin with additional top-down direction on how much interoperability, with whom, and on what time lines is required of the forces, along with subsequent changes to force structure and programming. The general interoperability that has been built through various activities has enabled our forces to solve many difficult interoperability challenges, usually at the expense of longer time lines and more limited functional utility. As we look toward the future, and the potential for increased targeted interoperability with specific partners, more careful and deliberate planning will need to occur. Without that deliberate work, the senior leadership should prepare for less integration of our partners that take even longer time lines for operational effectiveness in the future.

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Abbreviations

ABCA Armies	American, British, Canadian, Australian and New Zealand Armies' Program
AFB	Air Force Base
AMN	Afghanistan Mission Network
AOC	U.S. Army Operating Concept
AoC	Art of Command
ARCIC	U.S. Army Capabilities Integration Center
BG	Battle Group or brigadier general
C2	Command and Control
CALL	Center for Army Lessons Learned
CINC	Commander in Chief
CIS	communications and information systems
COL	Colonel
COMSEC	Communication Security
CONPLANs	Contingency Plans
FY	Fiscal Year
G7	U.S. Army Training Directorate

G9	U.S. Army Family and Morale, Welfare and Recreation
HA/DR	Humanitarian Assistance/Disaster Relief
HN	host nation
ISIL	Islamic State of Iraq and the Levant
ISR	intelligence, surveillance, and reconnaissance
JMRC	Joint Multinational Readiness Center
LANDCOM	Allied Land Command
LCI	layers of coalition interoperability
LNO	liaison officer
LTC	lieutenant colonel
LTG	lieutenant general
MAJ	Major
MTW	Major Theater War
NATO	North Atlantic Treaty Organization
NETOPS	Network Operations
NIE	Network Integration Experiment
NMI	NATO C3 Technical Architecture Reference Model for Interoperability
NMS	National Military Strategy
NSS	National Security Strategy
PKK	Kurdistan Workers' Party (from Partiya Karkerên Kurdistanê in Kurdish)
PME	professional military education
QDR	Quadrennial Defense Review

R&D	Research and Development
RDT&E	Research Development Test and Evaluation
ROE	Rules of Engagement
SC	Security Cooperation
SOF	Special Operations Forces
SSTRO	Stabilization, Security, Transition, and Reconstruction Operations
YPG	People's Protection Units (from Yekîneyên Parastina Gel in Kurdish)

CHAPTER ONE

Introduction

In modern warfare, hardly a conversation about military capabilities occurs in which interoperability with another organization—multinational or not—does not come up. This might include intraservice (aviation working better with fires); among services and commands (Army and the Air Force working better together, or Army general purpose forces and SOF); interagency (Army and National Intelligence, State Department and similar); or international (the U.S. Army working with various partners and allies). Significant literature exists on all of these, with the common refrain being that *more and better interoperability is needed*.

With few exceptions in recent decades,[1] the United States tends to engage with multinational partners and allies in military operations and thus has worked alongside and sometimes in intimate contact with many nations. And one need not look far in modern times to see multinational interoperability at play. As operations against the Islamic State (ISIL) have labored on for several months, the interactions of the U.S. forces supporting Iraqi forces in theater show all the telltale signs of the desires for interoperability and concomitant challenges therein. As Cooper[2] aptly summarizes:

> No matter how fast and expensive and advanced the American air campaign . . . warfare in Iraq remains a slow and grinding

[1] Examples tend to include Operation Just Cause in Panama (1989) and Operational Urgent Fury in Grenada (1983).

[2] Helene Cooper, "U.S. Jets Meet Limit as Iraqi Ground Fight Against ISIS Plods On," *New York Times*, August 12, 2015.

> business. [The air campaign] can go only as fast as their partners on the ground. In the new American way of warfare, those partners are not highly trained American troops, with more than a decade of combat experience in Iraq and Afghanistan under their belts, communicating directly on the telephone in English with the American pilots overhead. They are the Iraqi security forces, who tell their Iraqi commanders in Arabic where they need airstrikes. Those commanders then relay that information to command centers in Baghdad and Erbil, where American controllers then call the pilots in the air, in a convoluted game of telephone that can add crucial minutes to the overall enterprise.

Many recent operations have been predicated on liaison officers from one country being embedded in units from another country, facilitating operations as best they can. This is a common way of operating with partners, which has been used throughout warfare to create interoperable forces.[3] And it is a means of interoperating which many senior officials would like to move away from, the rhetorical argument behind this desire, heard often during the course of this work, being that modern warfare moves too quickly for such antiquated means of working with partners. Too many seams exist between forces working at arm's length, and the ability to mass power against a determined enemy will simply entail a much closer working relationship with multinational partners.

An example from our partners illustrates the point. According to one French officer, the problems with the historical "deconfliction" of forces, versus actual interoperability, was played out in French Army's interactions with the United States–led Regional Command-East (RC-E) in Afghanistan. According to the officer, the French Army's

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[3] See, for instance, Terry J. Pudas, *Preparing Future Coalition Commanders*. Washington, D.C., National Defense University, Institute for National Strategic Studies, 1994; and Keith E. Bonn and Anthony E. Baker, *Guide to Military Operations Other Than War: Tactics, Techniques, and Procedures for Stability and Support Operations: Domestic and International*, Mechanicsburg, Pa., Stackpole Books, 2000.

Task Force Lafayette began operating according to the "old way": The French coordinated with the Americans—largely relying on a robust liaison presence—but generally worked separately from them, relying on French resources to conduct operations in the French AOR and turning to American assistance on a limited basis. This mindset changed in the aftermath of the so-called "Uzbin Ambush" of August 2008, when insurgents overwhelmed a French patrol and killed ten French soldiers. After the battle, the French began to avail themselves more fully of American support, using more and more of the various services the U.S. military and RC-E in general could provide and integrating them into their operations.

From senior leadership, interoperability among multinational partners has gained increased attention in recent years.[4] The 2015 National Security Strategy[5] clearly leans on building relationships, stating:

> We will lead with capable partners. In an interconnected world, there are . . . few [problems] that can be solved by the United States alone. . . . Our closest partners and allies will remain the cornerstone of our international engagement. Yet, we will continuously expand the scope of cooperation to encompass other [partners]." (NSS, p. 3)

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[4] This study will necessarily stay away from "joint" interoperability, which is the subject of considerable study elsewhere, replete with its own set of problems and benefits. National strategy documents, like the current U.S. national security policy postulates a joint, multinational approach to military operations, and this is nothing new. Faughn underscored this in his work on joint interoperability in early 2000s (Faughn, 2002, 17): "The United States no longer plans to fight in such a way that the individual services would each conduct their own operations, as they did in Korea or Vietnam. Instead, prompted in large measure by the lack of interoperability during the Grenada invasion, Goldwater–Nichols established that all future operations would be joint. This means that the forces will require joint C2, and that interoperability will be a key enabler for the conduct of effective, collaborative, multi-service military operations." In many ways, there is a trend toward wanting the same with interoperating among partners, albeit without the laws dictating such arrangements. Anthony W. Faughn, "Interoperability: Is It Achievable?" Cambridge, Mass.: Center for Information Policy Research, Harvard University, 2002.

[5] The White House, "National Security Strategy," February 2015.

While the term "interoperability" is used only once in the NSS, the assumption here is that the United States will drive to create closer relationships among key partners for operationally relevant forces and work with other partners to, over time, do the same. Interoperability among those forces is an assumed aspect of future engagements and coalitions, albeit one that lacks any definitive metrics or measures for accomplishing it.

The Army's Operating Concept (AOC) provides the expectation for a future governed by coalition-based operations, and a requirement that the Army build interoperability at the tactical level: "These [information] systems must be interoperable with joint, interorganizational, and multinational partners and be designed to improve human cognition and decision-making."[6] The 2015 National Military Strategy (NMS) describes the importance of operationally relevant connections to our allies and partners and the importance of interoperability with them to support our collective goals: "Success [in the future environment] will increasingly depend on how well our military instrument can support the other instruments of power and enable our network of allies and partners."[7] In the case of NATO, the NMS goes on to say our connections to NATO allies will support "their interoperability with U.S. forces" as an indication of our commitment.

The reasons for the focus on interoperability are numerous. At the top of the list recently is what is happening in real time in Europe. Interoperability has had renewed focus because of Russian aggression in Crimea and its subsequent operations in eastern Ukraine. Russia's aggression has set off a bevy of responses from U.S. partners and allies in the region, who desire a larger U.S. footprint in the region; specific support from the United States for services like intelligence, surveillance, and reconnaissance services; access to U.S. technologies; and more key leader engagement as assurance to them and deterrence

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6 TRADOC Pamphlet 525-3-1, "The U.S. Army Operating Concept," Army Capabilities Integration Center, October 31, 2014.

7 Joint Chiefs of Staff, "United States National Military Strategy, 2015."

to their enemies.[8] Russian aggression has highlighted the shrinking U.S. presence in the region, and thus greater dependence on member states to provide forces and work closer with the United States should hostilities break out. These are largely tactical and operational reasons for interoperability, resting on the clear inadequacy[9] of prepositioned U.S. forces or ready NATO forces for deterring or defending against a potential incursion on the periphery of NATO.

At the time of this writing, the United States is increasing its involvement in Europe quickly. As part of the 2017 defense budget proposal, Secretary Carter has requested additional $3.4 billion for European defense, which would cover a number of areas including building interoperability. The commitment is predicated on multinational forces providing conventional deterrence[10] of Russia, and thus will necessarily have to focus on whether those forward-deployed units are truly working together at the onset of operations, and whether potential follow-on units can integrate in as necessary.

Perhaps equally important in the recent conversations of interoperability are the vast operations in Iraq, Afghanistan, and several other countries since 9/11 as part of the global war on terror. In each case, the United States has been working closely with her partners and allies in sophisticated ways at the tactical level of war. This has then highlighted the contributions of her allies and partners—of varying significance—and how those contributions are a result of poor or excellent interoperability among nations.[11]

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[8] Derek Chollet and Julianne Smith, "America's Allies Want More from the U.S.," *Defense One*, August 3, 2015.

[9] For an examination of possible future scenarios and necessary force levels for the defense of the Baltics, see David A. Shlapak and Michael Johnson, *Reinforcing Deterrence on NATO's Eastern Flank: Wargaming the Defense of the Baltics,* Santa Monica, Calif.: RAND Corporation, 2016.

[10] Mehta, Aaron, "At NATO, a Focus on Modern Deterrence," *Defense News*, February 10, 2016.

[11] See, for instance, John C. Trepka, *Coalition Interoperability: Not Another Technological Solution*, Newport, R.I.: Naval War College, 2005; or Kimberly Zisk Marten, "Defending Against Anarchy: From War to Peacekeeping in Afghanistan," *Washington Quarterly*, Vol. 26, No. 1, 2002, pp. 35–52.

Why Hasn't This Been Fixed to Date?

Why then, with all this interest, is the United States not interoperable with its partners when and how it wants to be? The proximal cause for why interoperability is still so rare is that, except in rare cases, U.S. units are not specifically tasked and resourced to build interoperability with particular partners for particular functions. Thus the actual requirement for building interoperability—the formal admission from the resourcing authority that it needs to be done and funds will be expended to do so—and the tasking—top-down guidance on *how much* of *what type* and *with whom* those units should be building interoperability—is not there. The use of the term "interoperability" in strategy documents and doctrine aside, without resourcing and a formal tasking to units, there is nothing pushing them to be interoperable with anyone else.

There are many reasons why the United States has not pushed harder for unit-level interoperability with its partners. In 2002, Anthony Faughn (U.S. Air Force) in discussing interoperability both among U.S. services and between the United States and foreign militaries, cites "competing priorities" as one of four main drivers for why interoperability has never quite been reached and that "despite the tremendous planning and expenditure of funds to ensure interoperability, major problems remain in the theaters with the greatest potential for conflict."[12] Furthermore, even then, he notes the complete awareness of the importance throughout the military and higher levels of the government: "Joint Vision 2020 . . . mandates interoperability; the CINCs of the unified and specified commands, the four service chiefs, and members of Congress all espouse its importance."[13] He ends with yet another set of fixes being implemented, which, yet again, as the lessons learned in the past several years have illustrated, did not fix this issue of insufficient interoperability.

The lack of top-down push for interoperability may also partially be arising from the incorrect understanding of what it takes to get

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[12] Faughn, "Interoperability: Is It Achievable?"

[13] Faughn, "Interoperability: Is It Achievable?"

units interoperable. On one hand, no one in the tactical community believes any of the problems are unsolvable. Whether talking about technical lash-ups of computer systems among two units, or understanding procedures and risk in a command cell of multinational soldiers, no soldiers we spoke with believed and no lessons learned document concluded there was a showstopper to getting the United States interoperable with its partners. Indeed, policies and culture may not easily allow it, but all of those constraints can be dealt with.

On the other hand, what is often poorly understood are the significant efforts that are involved, and specific and often ad hoc workarounds and solutions that are implemented to make multinational units interoperable. Studies show that even within a single-nation context, achieving interoperability among individual services is no easy feat. John Jogerst succinctly summarizes this in his discussion of interoperability in SOF: "Interoperability comes by interoperating regularly, routinely, and often. No royal road exists."[14]

Furthermore, the vast majority of activities that help build interoperability in the United States do so only indirectly and through proximity to the problem. While the U.S. Army manages several dozen security cooperation programs, many that are designed to foster unit-to-unit relationships, cultural understanding, compatible equipment, and other components of interoperability, only a fraction of them truly build long-term solutions and achieve the degree of trust and compatibility at the unit-level, both of which are key for multinational operations.

The Secretary of State and Secretary of Defense provide a report to Congress each year[15] tabulating military training provided to foreign military personnel by their departments. In total, about 155 countries are reported upon, with NATO members, Australia, New Zealand, and Japan only included by exception. For each country, State Department foreign policy objectives are listed. Of those 155 countries included in the 2013–2014 report, only 23 include interoperability

[14] John Jogerst, "What's So Special About Special Operations? Lessons from the War in Afghanistan," *Air & Space Power Journal*, Summer 2002, Vol. 16, No. 2.

[15] "Foreign Military Training," Joint Report to Congress, Vol. 1, Fiscal Years 2013 and 2014.

(specifically, "Interoperability with U.S. And Coalition Forces"), and of those, four have it ranked first, and six have it ranked fourth or lower in the prioritized list. The typical goals are more institutional than operational in terms of "professionalizing" the military, teaching "civilian control" of the military, and other civic building blocks. In general, building interoperability outside close allies and NATO partners (to the extent it exists there), is not a highly prioritized goal of military training from the DoS and DoD.

There is also a value to interoperability that may not be wholly understood from a U.S. perspective, which then limits the funding and interest in taking the time to build it. It is not clear whether the benefits of increased interoperability outweigh its costs, primarily in the form of increased strategic or operational dependence on partner forces, higher cost of training and exercising, greater investment in compatible equipment, and a potential source of political friction in lethal conflicts. Without the benefits from interoperability easily understood or conveyed, expending time or resources will necessarily slow or stop. Understanding those possible benefits will help to determine just how much and with whom that interoperability should be built.

Not knowing the real value of interoperability to operations manifests itself in how it is portrayed in formal requirements generation and force planning. In her discussion of coalition interoperability and the extent to which it was prioritized in the early 2000s, Michelle Schmith (2001) of the U.S. Air Force argues that coalition interoperability has not always been a priority for the United States, with a heavy emphasis on coalition operations emerging in the early 2000s with renewed engagement in the Middle East: "The Defense Planning Guidance FY 01-05 did not contain any coalition interoperability language. However, the Defense Planning Guidance FY 02-07 addressed coalition interoperability as a critical enabler."[16] Schmith also adds to the literature arguing that much of the value of interoperability is "intangible

[16] Michelle D. Schmith, "Do We Make Interoperability a High Enough Priority Today?" Research Report, Maxwell Air Force Base, Ala.: Air Command and Staff College, 2001.

and not easily measured or quantified,"[17] citing research of RAND's Myron Hura et al. (2000):

> Interoperability supports US national security and US national military strategies. It can *enable coalition building* with coalition partners. It can sustain coalitions by *reducing the costs of participation and increasing burden sharing*. And it offers an opportunity to *enhance future coalition operations*. This final benefit confers additional advantages beyond the specific coalition operation. For example, effective allied forces will be better able to *carry the continued burden of peace operations* while US forces can be re-deployed to a major crisis or to an MTW. Furthermore, effective and efficient coalitions will *improve the prospects that coalition partners will join future coalitions*.

Discussions with current Army planners[18] indicate many of the same missing pieces today. The U.S. Army does not tend to do force planning assuming that coalition partners will provide any mission-critical services. To do so would mean that those services could not be provided by the U.S. Army (or U.S. military) itself or that the U.S. Army would intentionally rely on a partner force to provide it, possibly putting U.S. troops at risk by knowingly lessening their capabilities. This is countercultural to the Army. Thus, without the operational requirement that interoperability exist, and the operationally relevant situations in which that interoperability might be used, the motivation to expend dollars for building it and to let American forces depend on partners for services is limited.

Changing the current direction thus requires not only additional (or realignment of) resources that will build tangible and effective interoperability in the first place, but also a strategic and political decision to engage in multinational operations and rely on partners for specific services.

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[17] Schmith, "Do We Make Interoperability a High Enough Priority Today?" p. 5.

[18] Interview, September 22, 2015.

About This Study

In this report, we propose a simple, logical framework for planning and building interoperability between the United States and her partners. The framework is built from several sources. First, we spoke with stakeholders in the U.S. Army tasked with setting the strategy and doing the planning for possible coalition operations, and forces engaged in training and working with multinational partners. Many of those are listed in the acknowledgments, but as the interviews were done nonattribution, we leave numerous names affiliations out. They provided an understanding of the current activities and current intent for interoperability.

Second, we reviewed several dozen lessons learned documents from the past several years of training and exercises that focused on multinational operations. Those are summarized partially in the appendices to this report, but are referenced throughout. Those spoke to the enduring problems—many of which have been around hundreds of years—that interoperability poses.

Third, we included historical cases of interoperability from recent operations (Iraq and Afghanistan), ongoing operations against ISIL, and cases further back like Korea. Those are referenced throughout and provide practical examples of successes and failures.

We also developed a survey for those involved with building interoperability that allowed us to further explore how the activities related to interoperability actually build specific kinds of interoperability, and where the programs lie within the U.S. Army in terms of their focus.

Last, we performed some more in-depth case studies through the eyes of a key partner to the United States, the French, and several of their efforts to build interoperability with their partners. Those cases are summarized in the appendices, and are referenced throughout.

The framework we propose has three main parts. First, we catalogued nearly 200 programs into ten categories, which comprise what we termed "Activities" that in one way or another increase interoperability between United States and her partners. Those activities help to build five main interoperability "outputs," namely having common

equipment, sharing the art of command, having individual interoperability, having interoperable CIS equipment (a specific and important subset of all equipment), and having interoperable processes.

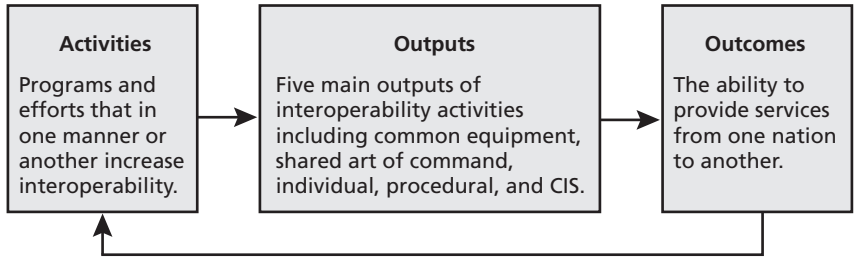
The outputs are important pieces of interoperability, but are not the ultimate goals of interoperability efforts. Instead, the "outcomes" are what those outputs lead to. Those are predicated on having specific abilities to share services between at least two partners. The general framework is shown in Figure 1.1.

The framework necessarily stops short of broader operational outcomes—like winning a war or deterring conflict—as the basic interactions that translate interoperability (e.g., the provision of services from one partner to another) into qualitative goals of legitimacy or deterrence are not known. Therefore, our outcomes are really about tangible interoperability outcomes.

This logical framework necessarily has feedback and need not happen in sequence. As we know better with which partners we wish to have what kind of interoperability for what reasons, that should be fed back into the activities and outputs to better align resources to ultimate outcomes.

The nature of interoperability varies considerably depending on the functions, participants, and overall operational goals. Thus, we limit the following discussion to the U.S. Army in this report, and leave the rich and equally difficult areas of air, air defense, naval, and other

Figure 1.1
Logical Framework for Building Interoperability



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interoperability problems to separate studies. Those have been detailed elsewhere, and continue to evolve at their own pace and with their own set of challenges and opportunities. Nonetheless, the ideas and framework proposed here may be applied elsewhere as appropriate.

Structure of the Report

The report is broken into five more chapters. Chapter Two defines what we mean by interoperability and discusses some of the recent interoperability-related trends in multinational operations. Chapter Three discusses the rationale for building interoperability, assessing the operational value of multinational interoperability and other reasons for investing in it, including its contribution to the legitimacy of joint, multinational operations. In Chapter Four, we address the types of interoperability that should be built, using five specific interoperability outcomes as a driver of specific activities and efforts that contribute to building interoperability with allied land forces. Then, in Chapter Five, we study the specific activities in detail, including a survey of current activity types and assessing their contributions to multinational interoperability. In Chapter Six, we discuss what we see as a critical distinction in interoperability outcomes—general versus targeted interoperability—and address the ways in which the United States can prioritize its interoperability-building efforts based on the types of operational needs. Finally, Chapter Seven offers a summary of our findings and makes recommendations for both future research and multinational interoperability-related efforts.

CHAPTER TWO

What Is Interoperability?

With increasing diversity of military operations the United States engages in—from small-scale contributions to stability operations to vast land campaigns—the complexity of partnerships and level of interoperability required to achieve U.S. strategic goals have expanded markedly. This chapter examines existing definitions of interoperability, outlines principal drivers of a greater demand for interoperability, and takes stock of justifications for building it used by representatives of the U.S. and foreign armed forces we have interviewed.

Definition

Many definitions of interoperability exist. The Joint Publication 1-02,[1] which contains military definitions for common words, uses a two-part definition:

> 1. The ability to operate in synergy in the execution of assigned tasks. 2. The condition achieved among communications-electronics systems or items of communications-electronics equipment when information or services can be exchanged directly and satisfactorily between them and/or their users.

Given the focus of this study, we consider this definition to have two weaknesses: the first part of the definition suffers from the imprecise

[1] Joint Chiefs of Staff, *Department of Defense Dictionary of Military and Associated Terms*, JP 1-02, Washington D.C.: Joint Chiefs of Staff, 2010.

use of "synergy," which is not defined in that same publication, while the latter part of the definition is focused only on technical information systems interoperability, which is only one of many components of interoperability.

In contrast, NATO's Glossary of Terms and Definitions (AAP-6)[2] defines the term "force interoperability" as "the ability of the forces of two or more nations to train, exercise and operate effectively together in the execution of assigned missions and tasks." Referencing this definition, U.S. Army Regulation (AR) 34-1, "Multinational Force Interoperability," from August 2015 defines interoperability as:

> "the ability of the forces of two or more nations to train, exercise, and operate effectively together in the execution of assigned missions and tasks . . ." and "the ability to act together coherently, effectively and efficiently to achieve Allied tactical, operational, and strategic objectives."

This definition is much more all-encompassing, and focused on the process for building interoperability and testing it, emphasizing the role of interoperability on the tactical and operational levels while highlighting its critical function as an enabler of tactical, operational, as well as strategic objectives. This definition only touches on the need to evaluate the degree to which multinational forces are interoperable by suggesting it should lead to achieving Allied objectives "coherently, effectively and efficiently" and omits describing the specific enabling mechanisms of functional multinational interoperability.

Technical Definitions of Interoperability

Several definitions in the literature get into nuances and types of interoperability, building a connection between technical and operational interoperability.

For instance, Andreas Tolk's model describes nine layers of coalition interoperability (LCI): (1) Physical Interoperability, (2) Protocol Interoperability, (3) Data/Object Model Interoperability, (4) Information Interoperability, (5) Knowledge/Awareness, (6) Aligned Proce-

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[2] NATO, "NATO Standardization Agency (NSA) 2008," AAP-6.

dures, (7) Aligned Operations, (8) Harmonized/Strategy Doctrines, and (9) Political Objectives.[3] Tolk defines interoperability as "the ability to make use of functionality offered by other components to increase the functionality offered by the own system." This definition underscores communications and information systems (CIS)-related compatibility of forces that connects the technical with organizational levels. Tolk builds on other models, including the LISI (Level of Information System Interoperability) concept, which defined five levels of interoperability: isolated, connected, distributed, integrated, and universal (plug-and-play-like), and the NATO C3 Technical Architecture Reference Model for Interoperability (NMI), which emphasizes the role of information technology for common NATO systems.

The problem with this view of interoperability is the assumption that accepting or providing a function necessarily increases a function of the receiving. The operational value of having a partner providing high levels of service may not be operational or tactical, but could be political or strategic. The use of the term "increase the functionality" would be bastardized in those cases.

Thomas Ford et al.[4] surveyed 34 definitions of interoperability, showing that the most widely used definition was also the oldest (first forged in 1977 by the defense community and later recorded in JP 1-02[5]):

> The ability of systems, units, or forces to provide services to and accept services from other systems, units, or forces and to use the services so exchanged to enable them to operate effectively together.

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[3] Andreas Tolk, "8th International Command and Control Research and Technology Symposium," Norfolk, Va.: Virginia Modeling, Analysis & Simulation Center, Old Dominion University.

[4] Thomas Ford et al., "A Survey on Interoperability Measurement," Proceedings of the 12th International Command and Control Research and Technology Symposium. Newport, R.I., June 19–21, 2007.

[5] It is no longer part of JP 1-02 but can be found in its previous versions, including the one from 1994 (as amended through January 2000—see Department of Defense, "Dictionary of Military and Associated Terms," Joint Pub. 1-02, January 10, 2000.

This definition is easy to understand and suffers less from vague language or qualifiers like the other definitions, including the current definition used in JP 1-02. "Services," however, needs some clarification for the purposes of this discussion. From the standpoint of the Army, individual services fall under the seven warfighting functions and are essentially synonymous with tasks and subtasks the United States might provide to another force or accept from another force. Those functions are: Mission Command, Intelligence, Movement and Maneuver, Fires, Protection, Sustainment, and Engagement.

A warfighting function is "a group of tasks and systems (people, organizations, information, and processes) united by a common purpose that commanders use to accomplish missions."[6] Each of those warfighting functions can be further broken down into tasks and subtasks. So the "movement and maneuver" function includes tasks[7] such as "occupy an area" and subtasks such as "occupy an attack and assault position." At this level of detail, one can imagine a unit performing those tasks in support of another unit. Indeed, several nations participating in recent campaigns in Iraq and Afghanistan would perform those services for another partner on a regular basis.[8]

In this study, we choose to follow the oldest and most commonly used definition, mainly as a result of its inclusion of services exchange and our emphasis on unit-to-unit relationships (Figure 2.1).

Highlighting that interoperability is a key enabler for the exchange of services between multinational systems, units, and forces underscores the practical nature of interoperability. Interoperability, therefore, is done to enable the provision of services from one or many other nations, and if those services are so desired to meet overall national or military objectives, should directly connect to the multinational force's ability to effectively deter and defeat an adversary. By choosing this def-

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6 Headquarters, Department of the Army, "ADP 3-0: Unified Land Operations," October 2011, p. 13.

7 The Army Universal Task Lists provides breakdowns of the warfighting functions. Headquarters, Department of the Army, "The Army Universal Task List," May 20, 2011.

8 Stephen A. Carney, *Allied Participation in Operation Iraqi Freedom*, Washington, D.C.: Government Printing Office, 2012.

Figure 2.1
Definition of Interoperability Used

> The ability of systems, units, or forces to provide services to and accept services from other systems, units, or forces and to use the services so exchanged to enable them to operate effectively together. (Ford et al., 2002)

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inition, we do not reject others presented in the literature, particularly the composite recent definition used in AR 34-1 and other documents.

Trends in Interoperability

There are trends that change how interoperability might look in the future, and have changed how interoperability is seen in the recent past. They generally fall into the following categories, three of which we discuss in detail:

- The move toward more tactical exchange of services among nations—partially driven by smaller units being provided by partners and partially driven by operations moving to more tactical levels in general;
- Being interoperable with more and different nations in a greater variety of operations, including high-intensity kinetic operations and against increasingly more sophisticated opponents;
- Desire to rely on interoperability at the onset of operations, and not built on the fly, leading to delays and inefficiencies.

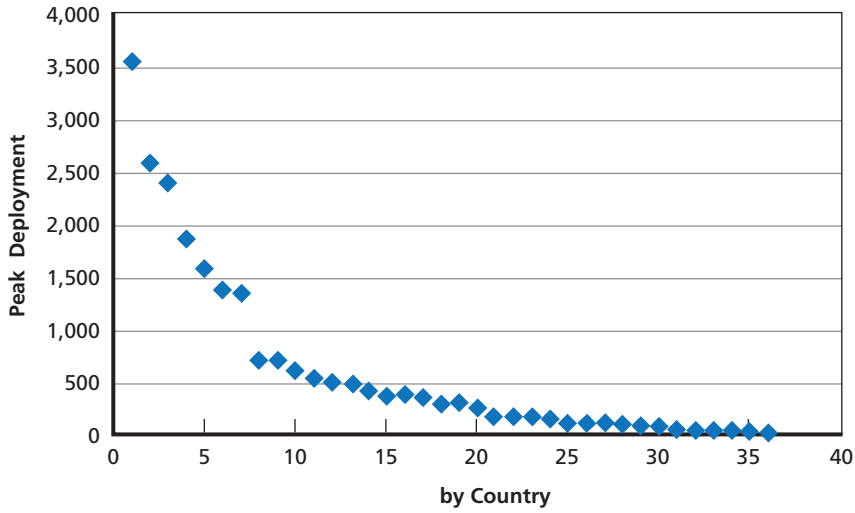
More Tactical Interoperability

There is a trend toward having interoperability at lower echelons, thus more tactical interoperability (e.g., exchange of services among units at lower echelons).[9] This trend is playing out in NATO currently, and was

[9] European Union Battlegroup Manual, Finabel Study A.25.R-T.37.R, Brussels: European Land Forces Interoperability Center, 2014, p. 51.

evident during recent operations in Iraq and Afghanistan.[10] Additionally, several nations supported U.S. efforts in Iraq with battalions and smaller contributions.[11] A historical look[12] at coalition contributions in the Iraqi war showed that aside from the United Kingdom, the 37 nations tabulated contributed fewer than 4,000 troops at a time, with 24 of the 37 maxing out at less than 500 troops deployed (see Figure 2.2. for details). That means that about two-thirds of the coalition partners were sending much less than a battalion's worth of soldiers, and those forces would then need to be absorbed into a larger unit and somehow integrated into operations.

Figure 2.2
Maximum Number of Troops Deployed by Coalition Members in OIF



SOURCE: Carney, 2012.
NOTE: United Kingdom and United States are not shown. *X*-axis represents each of the 37 nations tabulated in Carney, 2012.
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[10] Michael L. Downs, *Rethinking the CFACC's Intelligence, Surveillance, and Reconnaissance Approach to Counterinsurgency*, Newport R.I.: Naval War College, Joint Military Operations Department, 2007.

[11] NATO, "Troop Numbers and Contributions," *Resolute Support.*

[12] Carney, *Allied Participation in Operation Iraqi Freedom*.

Contributions to coalitions are governed by many factors, one of which is the practical reality of declining budgets and force sizes. Confirming other observations, U.S. Army General Odierno noted that as a result of military downsizing in Europe, interoperability is moving to lower tiers, at which it is harder to achieve.[13] This current trend, however, may not persist. Great Britain, for instance, states in its *National Security Strategy and Strategic Defence and Security Review 2015* that its expected expeditionary force will reach 50,000 by 2025, up from the 30,000 it committed to in 2010.[14] Nonetheless, the troop numbers and equipment European forces could realistically deploy have been decreased in recent years due to austerity measures,[15] in most cases amounting to only a small fraction of their full national force component, and certainly are a small fraction of what they were at the height of the Cold War when a different kind of interoperability was en vogue.

Table 2.1 shows the most recent unclassified estimates of the force sizes that selected European militaries could deploy and sustain in combat outside of their territories.

As we have noted, commitments on paper may not be fully honored even in time of crisis. The reform processes in Germany and the United Kingdom, for instance, have not been fully completed, and many countries in Europe face a challenge of inadequately resourced units that would not be self-sufficient in foreign deployments. For instance, General Pavel, former Chief of General Staff of the Czech Military Forces (and current Chairman of the NATO Military Committee), stated earlier in 2015 that the Czech Army would not be able to honor its commitment of sustaining an expeditionary brigade in a NATO operation for six months as it has pledged to the Alliance.[16]

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[13] Sydney Freedberg Jr., "What the US, NATO Must Do to Counter Russia: Breedlove, Gorenc, & Odierno," *Breaking Defense*, September 22, 2015.

[14] HM Government, *National Security Strategy and Strategic Defence and Security Review 2015: A Secure and Prosperous United Kingdom*, presented to Parliament by the Prime Minister by Command of Her Majesty, November 2015 (ISBN 9781474125963).

[15] Stephen F. Larrabee et al., *NATO and the Challenges of Austerity*, Santa Monica, Calif.: RAND Corporation, MG-1196-OSD, 2012.

[16] Petr Honzejk, "Generál Petr Pavel: Tančíme na palubě Titaniku, musíme se probudit," *Hospodarske noviny*, February 18, 2015.

Table 2.1
Estimated Size of Rapidly Deployable Land Component of Selected European Militaries

Country	Size	Future Goals	Source(s)	Notes
United Kingdom	~30,000 (by 2020)	50,000 (by 2025), consisting of: • a maritime task group, • land division with three brigades, including a new Strike Force, • an air group of combat, transport, and surveillance aircraft, • a Special Forces task group.	*National Security Strategy and Strategic Defence and Security Review* 2015 (November 2015)	The UK Government highlights that "*While our Armed Forces can and will whenever necessary deploy on their own, we would normally expect them to deploy with allies such as* ***the U.S. and France****; through NATO; or as part of a broader coalition.*" Its goal by 2020 was to have a "capacity to deploy at up to division scale: three maneuvre brigades with associate enablers and aviation, and to sustain a brigade on operations indefinitely."[a]
France	~72,000 (but just ~15,000 for "coercive operations," consisting of 2 brigades and special force units)[b]	60,000 by 2025, consisting of: • reinforced special forces (an increase of 1,000 men), • 7 brigades with support units (a decrease by 1 brigade), • a contribution to the Franco-German brigade, • support units.	Military Programme for 2014 to 2019 related to defense and national security[b] (2013)	The document notes that in Operation Serval in Mali, the "*help of the United States and the United Kingdom was indispensable.*" In other places of the document, it refers to the use of transport aircraft of **British, Belgian, Canadian, American and German, Danish, Spanish and Dutch** origin in this operation.
Germany	more than 3,300 (number of forces deployed in 2013)[c]	10,000, out of which a "sustainable contribution" of 4,000 from the Army by 2016,[c] consisting of: • two reinforced task forces, • the nucleus of a multinational command and control element,	The Reorientation of the Bundeswehr (2013)	The German Defense Strategy of 2013 argues that "*Multinationality is a distinctive feature of the German Army. It implies and promotes mutual understanding and appreciation, creates the preconditions for enhanced interoperability and is the major foundation for the successful conduct of operations.*"

Table 2.1—Continued

Country	Size	Future Goals	Source(s)	Notes
Germany (cont.)		• the Army component of a mixed helicopter task force, • forces in support of foreign armed forces (for example, mentors and instructors), as well as personnel for multinational headquarters.		Among key partners cited are **France** (including the French-German Brigade), the **Netherlands** (including 1 German-Netherlands Corps), the **United States** (with an active "network of Army liaison and exchange officers [that] ensures the exchange of experience for the purpose of increasing interoperability on a continuous basis"), **Israel, Great Britain, Austria, and other European nations**. A new White Paper for Defense has been under preparation since early 2015.[d]
Italy	Estimates range from 10,000[e] to 12,000 troops[f] (with 5 more brigades available in contingencies)	N/A	Espresso.it, RAND	The new White Book for Defense[g] (2015) does not refer to specific allies or describe specific deployment capabilities.

SOURCES: [a] UK Ministry of Defence, "Transforming the British Army, An Update," July 2013.

[b] "Assemblee Nationale," Consitution du 4 octobre 1958, Enregistré à la Présidence de l'Assemblée nationale le 12 novembre 2013.

[c] Federal Ministry of German Defence, "The Reorientation of the German Army," 2nd updated ed.

[d] DW Bundeswehr, "Germany Kick-Starts Work on a New White Paper," Deutsche Welle, February 18, 2015.

[e] Gianluca Di Feo, "Pronti per la guerra? Oggi sì, domani no," *L'Espresso*, March 10, 2015.

[f] Stephen F. Larrabee et al., *NATO and the Challenges of Austerity*, Santa Monica, Calif.: RAND Corporation, MG-1196-OSD, 2012.

[g] Italian Ministry of Defense, "Libro Bianco: Per la sicurezza internazionale e la difesa," 2015.

In addition to partners contributing smaller tactical units, there is also a trend toward operations occurring on a much more tactical level. In recent operations in Iraq and Afghanistan, brigade and larger formations were there to support battalion and smaller formations that did the actual moving and fighting. Services like providing intelligence support or fire support or logistical support were provided to lower echelons than ever before.[17] And it stands to reason that when conducting coalition operations at that level, there is a good chance that some services will be provided by forces from a different country.[18]

And this trend toward more tactical interoperability may have a lower practical limit according to some. As an example, French Army doctrine balks at interoperating at the battalion level or below. It is at the battalion level, the doctrine asserts, that interoperating stops being useful. It prevents units from operating effectively, which in combat translates into significant risk.[19] One reason is that interoperating at low echelons is difficult and represents entirely different sets of challenges that can only be worked out through extensive exchanges and combined training. For example, the technical aspects of interoperability are different at different echelons. At higher echelons, technical interoperability has to do with CIS. At lower levels, "it's about soldiers communicating orally with a guy in a tank," or simply "a guy with FÉLIN [France's personal networking gear, which the French Army has been issuing to infantry units on a gradual basis] communicat-

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[17] Downs, *Rethinking the CFACC's Intelligence, Surveillance, and Reconnaissance Approach to Counterinsurgency*.

[18] This has been the French experience in Operation Barkhane (in the Sahel) and Operation Sangaris (in the Central African Republic), both of which feature company-scale task forces with huge AORs coordinating fires and working closely with ISR that, in the case of Barkhane, is provided by the United States. See "L'Opération SANGARIS 1 en Centrafrique: Inteview des chefs de corps des GTIA AMARANTE et PANTHERE," *FANTASSINS: Le magazine d'information de l'infanterie*, 2014, p. 99; Capitaine Raoul, "Evaluation de la 2e compagnie au CENTAC," *Béret Rouge: Le magazine des parachutistes* 2014, p. 12. And see Lieutenant-Colonel Pierre-Benoit Clement, "L'interopérabilité aux plus petits échelons," *Doctrine: Revue d'études générales*, No. 11, 2007, p. 44.

[19] Colonel Yves Beraud, "Vers un ébauche de politique 'interopérabilité' de l'armee de terre," *Doctrine: Revue d'études générales*, No. 11, 2007. French Officer 1, interviewed at Lille, France, on February 2, 2015.

ing with someone who doesn't have FÉLIN."[20] There also has to be a deep degree of mutual understanding and trust. That said, the French Army, because of its understanding of modern warfare and the kind of interoperability it implies, assesses that interoperability increasingly takes place at lower echelons.

The increasingly more frequent delegation of interoperability solutions to lower echelons is inevitably leading to higher costs for both the United States and its allies. New technical solutions such as compatible C2 systems, harmonization of procedures, and additional training will likely drive the costs of this trend,[21] with a proportionally larger share of the cost shouldered by U.S. allies which will be typically required to adapt to U.S. standards.[22]

Interoperability to the French, as an example, is a particular challenge due to the U.S. investment in high technology and "networked warfare." The faster the U.S. Army rushes to embrace technology and new ways of operating associated with that technology, the greater the burden placed on potential partners to keep up. Keeping up is, among other things, expensive. They also believe that greater investment in technology will make it more difficult to interoperate with less sophisticated partners.[23] They observe, for example, that even within the French Army units that have integrated some of the newer networked technologies (such as the FÉLIN suite of personnel communications

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[20] Clement, "L'interopérabilité aux plus petits échelons," p. 45.

[21] Charles L. Barry, *Army S&T Investment in Interoperability*, Washington D.C.: National Defense University, Center for Technology and National Security Policy, 2009.

[22] This statement, however, is not absolute, and the United States may choose to provide incentives in the form of exercises and equipment to some partner nations, reducing the total adaptation cost shouldered by them. For instance, the United States provided about $240 million in equipment, meals, transportation, and medical supplies to Poland following its deployment to Iraq in 2003; the cost per Czech soldier was $43,478 in FY 2005.

[23] French views on technology echo comments made in 2001 by a British officer in a School for Advanced Military Studies monograph. The officer argued that the more the Americans embrace digital technologies and take advantage of all they offer, the less valuable the contributions of partners who do not have the technologies or who cannot hook up their technologies with American systems will be. See Major Douglas M. Chalmers, ed., *British Army Units Under US Army Control: Interoperability Issues,* Fort Leavenworth, Kans.: School of Advanced Military Studies, U.S. Army Command and General Staff College, 2001, p. 46.

and sensor gear that the French have been issuing to infantry units) are finding working with units that have not been issued the gear a challenge.[24] Nonetheless, the French in effect have resigned themselves to the expense, which they regard as the price of membership in the "big leagues." In their eyes, investing in the technology is part of what separates those NATO members who are serious about defense and those who are content to subordinate security to others.

Specific arrangements can be developed to bridge this gap—such as through U.S. investment in allied training at JMRC or the provision of more affordable off-the-shelf equipment.[25] Nonetheless, additional military expenses have generally been met with resistance across most partner states (as Appendix C shows, most NATO countries have maintained relatively small defense budgets and only a few have increased them in light of new tensions on the European continent), and some analysts have even raised doubts that multinational forces produce cost savings and generate additional benefits, such as legitimacy gains.[26]

More and Varied Partners and Operations

The past 25 years of warfare have also highlighted a different set of problems with regard to interoperability, wherein the United States expects to have more and varied partners with whom to interoperate. Before 1990, interoperability was largely thought of in the context of NATO—a set of specific allies sharing a singular threat and associated mission in which that interoperability would be put to use. As Palin put it in 1995: "Fissiparous tendencies within NATO, for example, were neutralized by the perception of an overwhelming threat from the East."[27] This allowed for common interest in building interoperability for a specific fight. That interoperability, however, was historically

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[24] Colonel Philippe Berne, "La problématique de l'interopérabilité," *Doctrine: Revue d'études générales*, No. 11, 2007, p. 12.

[25] *Realizing the Potential of C4I: Fundamental Challenges*, Washington, D.C.: National Academies Press, 1999.

[26] Patricia Weitsman, "With a Little Help from Our Friends? The Costs of Coalition Warfare," *Origins*, Vol. 2, No. 4, January 2009.

[27] Palin, 1995, p. 5.

focused on *main defense* rather than *rapid reaction* missions.[28] Moving from building interoperability at the corps and above to more tactical formations, in addition to finding missions on which to focus, will take a different set of processes and commitments.

Nowadays, the U.S. military is working with a broader set of partners across more varied operations, from high-intensity offensive operations to humanitarian assistance and disaster relief. Most of these new partners do not have formal defense treaties with the United States or even a history of working together.[29] Lieutenant General Bowman notes that future coalitions will require cooperation with NATO and non-NATO nations alike, necessitating technical solutions that are deployable within much shorter time frames than the ones used in the recent wars.[30] The U.S. Army is thus challenged to build the capability to accommodate disparate actors who might play quite unique roles in a multinational operation.

On the same battlefield, the U.S. Army might want to bring one partner in very close, sharing detailed intelligence and providing significant logistical support, while keeping another partner at arm's length and only geographically deconflicting operations with them. The actual situation (tactical through political) will dictate how to balance the closeness of the partners involved, but the interoperability outcomes will be different for different partners.[31]

In the ongoing operation against ISIL, for instance, the United States needs to cooperate with virtually all stakeholders, including both states and non-state actors. The following chart (Table 2.2) offers

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[28] Thomas-Durell Young, *Multinational Land Formations and NATO: Reforming Practices and Structures*, Carlisle Barracks, Pa.: Strategic Studies Institute, 1997.

[29] Derek S. Reveron, "Old Allies, New Friends: Intelligence-Sharing in the War on Terror," *Orbis*, Vol. 50, No. 3, 2006, pp. 453–468.

[30] Sydney Freedberg Jr., "NATO Wargame Proves Better Networks Needed to Deter Russia," *Breaking Defense*, July 14, 2015.

[31] Picking and choosing among the overlapping interoperable networks to suit a particular national interest is in many ways akin to how international frameworks, in general, are used by states. See, for instance, Stephen G. Brooks and William C. Wohlforth, *World Out of Balance: International Relations and the Challenge of American Primacy*, Princeton, N.J.: Princeton University Press, 2008.

Table 2.2
Relationships and Interoperability Challenges in Intervention Against ISIL (as of November 2015)

Actor	Type	Acknowledged as an Ally	Baseline Interoperability Needs	Targeted Interoperability Needs	Objective for the United States
Turkey	state	yes	Sharing information, using AFBs for coalition aircraft, border and airport monitoring for foreign fighters	Sharing intelligence on targets, coordination of air strikes, maintenance and operations at AFB	Provide assurance to a NATO ally, defeat adversary
Other allied forces[a]	state	yes	Sharing information, using AFBs for coalition aircraft, border and airport monitoring for foreign fighters	Sharing intelligence on targets, coordination of air strikes, maintenance and operations at AFB	Provide assurance to a NATO ally, defeat adversary
PKK (Iraq and Syria)	non-state	no	Cooperate with PKK's affiliates	None	Leverage PKK's contributions to fight against ISIL and prevent atrocities
YPG (Syria)	non-state	vaguely	Developing common objectives and sharing information	Coordination of individual missions, sharing intelligence on targets, helping build a safe zone for Syrian Kurds	Coordinate with YPG to enable retaking ISIL-controlled territory in Syria, create safe areas for civilians
Peshmerga Force (Iraq)	non-state	yes	Developing common objectives and sharing information	Coordination of individual missions, sharing intelligence (less than with YPG)	Coordinate with the Peshmerga Force to enable retaking ISIL-controlled territory in Iraq, increase stability in Iraq
Russia	state	no	Deconfliction, high-level information sharing	None	Prevent air collisions and prevent Russia from undermining allied objectives

SOURCE: RAND analysis.

NOTE: [a] As of November 2015, this group included Australia, Canada, France, Bahrain, Jordan, Morocco, Qatar, Saudi Arabia, Turkey, United Arab Emirates, and the United Kingdom.

a high-level description, for a snapshot in time, of the nature of relationships and interoperability challenges that U.S. forces have to deal with in their intervention against the Islamic State in Syria and Iraq.

The Syrian conflict poses significant challenges in both bilateral interoperability between the United States and all stakeholders as well as interoperability among the individual actors themselves. For instance, Turkey has long had a strained relationship with both PKK and YPG (and has directly attacked the former), but it has trained Kurdish Peshmerga in northern Iraq to fight ISIL. Additionally, while YPG is affiliated with the PKK (which carries a terrorist designation in the United States, Turkey, and the European Union) as a Kurdish organization, it has actively supported U.S. airstrikes against ISIL and worked with Peshmerga to save Yezidis from ISIL in 2014. The Peshmerga in Iraq has a tense relationship with the PKK and the YPG but shares their objective of defeating ISIL and has also provided support to U.S. air strikes. Finally, Russian involvement in the country seems to follow different objectives, particularly in its support for the Assad regime, and as a result has quickly generated mistrust of most other stakeholders. In sum, the United States needs to maintain open channels of communication with all involved parties and has built specific capabilities, often involving peer-to-peer interactions, with selected partners while deconflicting with others in its fight against ISIL.

The varied partners and array of potential operations opens communication issues if and when interoperability is built. Building greater interoperability, whether clear alliances are involved or not, can be seen as signaling the wrong intent[32] or may be misinterpreted by potential competitors. In enhancing interoperability, nations would be walking lines which previously were signals of intent for war, and which, without appropriate communication, could be so interpreted. As an example, multinational units engaged in training exercises in Europe might wish to train with secure, interoperable FM radios. In addition to the hardware that is necessary, they would also need to request and install communication security software, which may come

[32] This is described as the "dynamic of alliance paradox" by Patricia Weitsman, *Waging War: Alliances, Coalitions, and Institutions of Interstate Violence*, Stanford, Calif.: Stanford University Press, 2014.

from NATO. A NATO COMSEC key is requested only formally, and each nation would have to request it on their own in order to bring it to an event with other NATO partners. The process of that request could certainly be misinterpreted as something more than just a training exercise and may then stop certain nations from wanting to train in such a way. That potential for misunderstanding of the activities involved in enhancing interoperability will have to be managed appropriately at the political and strategic level and may be degraded until such allowances can be worked.

Standing Interoperability

Forces may need to be interoperable much sooner in an operation as well. In his discussion of multinational interoperability with a focus on ABCA, Robert L. Maginnis (2005) argued that

> Today's threat environment, including the war on terror, requires multinational forces that can interoperate anywhere in the world, in multidimensional responses, against adversaries who give little or no warning of an attack. It is too late to start focusing on interoperability after the "balloon goes up."

ABCA leaders identified interoperability among its conventional forces as something "needing attention."

Leaders lament the time it took to develop the Afghan Mission Network (AMN), which had to balance security and access across several dozen participants and be built during ongoing operations in Afghanistan. From the time AMN was conceived at the Qatar NETOPS Conference in 2008, it took three years before AMN became operational for the use of 48 partner nations in 2011.[33]

Going back much further, one can easily see the same theme in major wars. In the Korean War, for instance, British and American troops had only a few days to operationalize a joint strategy, with the first units deployed within a week of the North Korean invasion on

[33] Chad C. Serena et al. *Lessons Learned from the Afghan Mission Network: Developing a Coalition Contingency Network*, Santa Monica, Calif.: RAND Corporation, RR-302-A, 2014.

June 25, 1950.[34] The United Kingdom provided over 81,000 troops during the three-year-long conflict. The 29th British Infantry Brigade was later integrated into the multinational 1st Commonwealth Division alongside Canadian, Australian, New Zealand, Indian, and Korean forces.[35] Some of the challenges Allies faced in this conflict included rotation rates of officers disrupting relationships, organizational differences between countries creating friction, different processes, lack of digital communication links, differences in command styles, and language barriers—all very common problems that have persisted until today.[36]

Experience from JMRC, where thousands of foreign troops train alongside U.S. forces every year, has shown that for logistics interoperability. "Task organization, equipment allocation, logistics infrastructure, and planning priorities vary from country to country and must be addressed early in the collaboration," and further that these are not things easily detailed in doctrine ahead of time and thus it is "up to the commanders on the ground to ensure cooperation throughout the echelons."[37] The point here is that direct engagement between two units that might fight in the future is necessary to ensure all the details are worked out.

Current discussions on the threats to the periphery of NATO reflect on just how fast Russia invaded eastern Ukraine and annexed Crimea—several days to a few weeks at most.[38] Furthermore, the rapidly growing capabilities of potential adversaries around the world (including sophisticated A2/AD, cyber, electronic, and space warfare capabilities) signal that a higher level of multinational interoperability will be required to deter and if needed defeat them. Growing demands

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[34] Douglas M. Chalmers, *Faction Liaison Teams: A Peacekeeping Multiplier*, Fort Leavenworth, Kans.: School of Advanced Military Studies, U.S. Army Command and General Staff College, 2001.

[35] Chalmers, *Faction Liaison Teams*.

[36] Chalmers, *Faction Liaison Teams*.

[37] Theresa Christie, "Multinational Logistics Interoperability," *Army Sustainment*, Vol. 12, September–October 2015.

[38] Shlapak and Johnson, *Reinforcing Deterrence on NATO's Eastern Flank*, estimate that a Russian incursion into the Baltic states could be over with a NATO loss in several days.

on building such solutions for standing interoperability have been put on U.S. forces interacting with NATO partners in particular. General Hodges, commander of U.S. Army land forces in Europe, argues that in future conflicts, a "plug and play" solution to interoperability will be needed.[39] Similarly, NATO has invested in developing a highly agile, brigade-sized Very High Readiness Joint Task Force (VJTF), a "Spearhead force" whose existence is predicated on needing standing, expeditionary, and highly interoperable multinational forces to be used as necessary in the defense of NATO member states before follow-on troops can reach the region.

The cost of developing interoperability solutions on the go, the difficulty of doing so in a limited time period, and the greater prowess of potential adversaries of the United States and her allies have driven policy makers to ask for some degree of readiness and standing interoperability—having multinational units that are already interoperable when the operation kicks off. This entails working out the interoperability challenges well ahead of time and coming up with a force-generation solution to make it a credible capability and deterrent. This significantly changes how forces should think about interoperability. Having standing units ready for immediate action entails a more complex set of policies and activities when compared with the alternative, which may be a set of multinational units fighting alongside each other or creating ad hoc interoperability solutions.

Implications of Interoperability Trends

There are several implications of the trends in interoperability we have noted. First, greater demand for interoperability at increasingly lower echelons is likely to imply that:

- readiness of tactical forces becomes more important to reaping the benefits of built interoperability. With large formations, some decrements in readiness might be readily conveyed and risks reduced; yet with smaller formations, their engagement with

[39] Freedberg, "NATO Wargame Proves Better Networks Needed to Deter Russia."

multiple partners will be difficult to manage and optimize lest relationships are built prior to deployment;
- with smaller multinational formations—brigades and below—being deployed, international institutions (like NATO) will need to work more tactically across the alliance, or new institutions and processes will be necessary to assure troop rotations, changes in national mandates, and other processes are tracked and understood in terms of their effects on alliance capabilities;
- even small differences in how interoperability is interpreted by multinational forces, such as slightly different procedures, minor misinterpretations of language, etc., could have profound implications on operational success;
- the increasing system costs involved with interoperating at the tactical level—from the significant number of command and control systems, varied radios and communication gear, and particular country solutions—will need to be appropriately considered and managed;[40] and
- allied armed forces will depend on senior policy guidance and sufficient resourcing in building tactical, unit-to-unit interoperability solutions.

As a result of the increasing numbers of partners to engage with in more diverse multinational missions than ever, U.S. armed forces will need to address:

- the fact that cooperation with some partners will not be well rehearsed, or the time to prepare multinational units for joint deployment will be extremely limited, resulting in greater demand for baseline levels of interoperability and some understood expectations for how and what type of interoperability must be achieved;

[40] While interoperability at the strategic level typically involves the embedding of liaisons and senior leader exchanges, tactical interoperability involves specific multinational units whose interactions must be based on a common understanding, compatible procedures and equipment, and mutual trust. In order to achieve such goals, significant investment in training, equipment, and building relationships between unit commanders is necessary.

- the U.S. military will be exposed to partners of different readiness and capability levels, requiring an understanding that perfect interoperability is not achievable with limited resources; rather, technological and procedural solutions will need to be developed to "meet partners halfway";
- engagement with less common partners in nontraditional types of operations (such as GWOT missions) will be hampered by national caveats, force limitations, and other constraints imposed on collaboration, requiring the flexibility to scale the intensity of joint collaboration on the fly and based on the feedback of operators directly engaged in such collaboration; and
- the emergence of unexpected challenges and unmet needs will demand that interoperability solutions are tailored in real time, depending on some degree of autonomy of operators and provision of sufficient resources to develop "work-arounds."

In addition to challenges identified earlier, the drive toward *standing interoperability* will also require:

- building compatible, plug-and-play solutions and appropriate policies that can be used a posteriori to exchange information with a broad array of foreign troops, and maintaining a high degree of awareness about the potential roadblocks individual forces might need to overcome;
- forging targeted relationships a priori with forces that are likely to be engaged in future missions and developing specific roadmaps for increasing levels of interoperability with partners to access capabilities, geopolitical leverage, or willingness to contribute to U.S. operations contribute to U.S. national security interests; and
- tracking the levels of actual and desired interoperability with partners around the world and tailoring existing collaborative programs to intentionally build standing interoperability where short-term objectives were pursued in the past.

CHAPTER THREE

Why Build Interoperability?

There is still high-level interest in interoperability, which seems only to be expanding. Trends shows how the interoperability solutions are looking more tactical, could be more expensive, and could imply a much larger number of potential partners across more varied operations. In light of the challenges and trends attending interoperable forces, it is critical to identify what the U.S. Army should expect to get out of interoperability and what it might take to actually realize it.

In recent decades,[1] single-nation military operations have become relatively rare, largely a result of the highly intertwined nature of military alliances globally, the existence of transnational security threats that often affect several nations at once, the reliance on partners for key capabilities not readily available to our forces, and of the need for legitimacy in operations which may not have broad political or public support. The rationale for working through coalitions and alliances in warfare have generally run the gamut of intents from ideological to tactical objectives.[2]

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[1] Previous research using primary and secondary sources: Since the Persian Gulf War, the past fourteen years have seen a dramatic rise in the use of multinational forces, and events in the early twenty-first century suggest that multinational military operations will become more common" (Bateman and Dalvi, 2004).

[2] Ample literature exists positing and exposing the values of coalition building vis-à-vis the costs. As Weitsman summarized, states do so "for ideological ends, to signal international legitimacy, or they may do so for strategic ends, to augment resources—or some combination of both aims." See Weitsman, *Waging War*, p. 25.

In general, though, the reasons for building interoperability within partnerships have changed only slightly from years past, and those reasons fall into roughly the same two arguments: First, that there is an operational benefit for warfighting to being able to provide services to or accept services from another nation. Being interoperable allows access to additional forces the United States might wish could either lead or be in support of operations aligned with U.S. interests. The second is that there are political and other reasons for building interoperability (strengthening the legitimacy of a military operation or building stronger relationships with partner nations in general), which are also often linked to having alliances and building coalitions. This latter argument may not be clearly visible on the battlefield, but nonetheless drives senior leaders toward interoperability. Each is discussed in turn.

Building for Operational Value

Building interoperability with partners provides military leaders options from several different points of view. First, it provides options for burden sharing among partners for collective security interests. By being able to operate together, at times closely, a larger collective force can reduce the costs of deterrence and war. This is part of the operational basis for alliances such as NATO in Europe, and in bilateral relationships such as the United States and the Republic of Korea. In each case, plausible scenarios require building sufficient forces from a collection of partners to deter aggression, with the burden being shared among multiple nations.

And because of those trends mentioned earlier in this report, alliances and partnerships which foster interoperability among their participants will do so with increasing value. By the late 1990s, it was apparent in NATO that there was a need to be able to operate much more closely because of diminishing force levels. As Young described, there were three main purposes of the land headquarters portions: achieving efficiencies from remaining forces, preserving higher-level

command structures for smaller nations, and maximizing residual military capabilities, especially of smaller nations.[3]

Access to Locations

As permanent basing of U.S. troops in key regions of the world illustrates, prepositioning of troops and supplies has a significant operational value, serves as a key strategic deterrent, and provides assurance to U.S. allies. Previous RAND research has identified three key benefits of basing U.S. troops overseas and its spillovers to multinational interoperability:[4]

- Contingency Responsiveness: locally deployed forces can counter major acts of aggression by U.S. adversaries, en route infrastructure (such as facilities, access agreements, fuel storage, and others) increases resiliency of locally deployed forces and provides key support in operations with no permanent U.S. presence.
- Deterrence and Assurance: overseas posture shows U.S. commitment to the region, the global commons, and its allies before and during any conflict. Local U.S. forces, in partnership with allies and supported by follow-on U.S. forces, project significant substantial combat power around the world.
- Security Cooperation: frequent collaboration with foreign partners increases mutual cultural awareness and the capacity to develop higher levels of interoperability. While security cooperation comprises only a very small fraction of total overseas operating costs, it can have a significant role in building partner capacity, increase mutual trust, engage in training and other activities, etc. However, the use of rotational and temporary deployments is generally most efficient solely for such purposes.

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[3] In addition, Young considers the building of multinational units as a "low cost, high profile" way of showing solidarity in Europe after the end of the Cold War. See Young, *Multinational Land Formations and NATO*.

[4] Michael J. Lostombu et al., *Overseas Basing of U.S. Military Forces: An Assessment of Relative Costs and Strategic Benefits*, Santa Monica, Calif.: RAND Corporation, RR-201-OSD, 2013.

Moreover, cooperation with allies in regions where the United States has limited permanent presence provides the United States with strategic advantage while lowering the risk and cost of potential deployments. As a result, even partners to which U.S. defense guarantees are not extended may play a significant role in the military operations the United States may choose to engage in; thus, it will often be critical to achieve baseline interoperability with them (through access to foreign airfields, refueling of U.S. cargo aircraft, and the provision of other support services).

Bridging Capability Gaps

In addition to access to remote locations via overseas bases and access agreements, the United States may decide to draw on regional (such as language and cultural) or other capabilities of its partners. This argument may be especially salient in time of waging several high-intensity campaigns at once—an unlikely yet not an impossible prospect—and additional resources may be needed to fill U.S. capability gaps in a particular region or a type of operation.

A capability gap, moreover, can be self-imposed by limiting the size of U.S. deployment overseas. As a result, the United States may need to work with partner nations to contribute additional troops to achieve qualitative superiority, yet such contributions may be relatively small (in Afghanistan, for instance, some countries contributed only tens or hundreds of troops, which were authorized for only narrowly defined tasks, resulting from national caveats and capability levels, requiring significant provision of resources from the U.S. military).

In the 2010 Quadrennial Defense Review, the Department of Defense highlighted a shift from planning for "major regional conflicts" to developing strategy to counter a broader array of threats from state and non-state adversaries alike. This shift of thinking, manifested by campaigns against adversaries such as ISIL, underscores the growing need to work with regional partners who simultaneously understand the specific operational environment and can complement U.S. military capabilities or bridge specific capability gaps.

Augmenting U.S. Capabilities

In addition to bridging capability gaps, senior U.S. leaders may be increasingly more inclined to draw on foreign capabilities in military operations as a result of budgetary and other domestic pressures. While relying on foreign troops to provide tactical services to the U.S. military may not always be the most cost-effective option (especially with partners not on par with the United States who require significant oversight or provision of resources), it may provide a much needed relief to U.S. troops in long, protracted campaigns; enable better intelligence collection; create better conditions for a political settlement of a conflict; and enable the U.S. military to adjust its posture to face emerging threats. Recent operations in Afghanistan and Iraq illustrated the ability of partner nations to conduct limited tasks with little to moderate U.S. support (such as Stability, Security, Transition & Reconstruction [SSTR] missions), and such collaboration may be preferred in future operations as well.

In our interviews with U.S. force planners, the lack of U.S. capability in one area or another has rarely, if ever, been cited as a reason for operating with allies. Rather, cultural, political, and economic factors were raised as justifications for using foreign capabilities in a U.S.-led operation. These three types of factors, in turn, are closely associated with providing U.S. leadership with additional tactical and operational options requiring some degree of interoperability.

Providing Operational Support to Partner-Led Missions

In some cases, the United States may be asked to provide support to a partner that is directly threatened by an adversary. While not putting U.S. troops in harm's way, the United States may choose to engage in other forms to support allied objectives (such as providing training and other assistance, recently illustrated in the conflict in Ukraine). In addition, this type of engagement is much more acceptable to the U.S. population and may provide critical operational value without risking the lives of U.S. service members.

For instance, French interoperability with the United States in the provision of logistical services in support of Operation Serval in Mali was born of necessity. While the French did not have their own organic lift and ISR readily available to prosecute the war, the ability of her allies

to provide such services[5] facilitated the deployment of French forces. It also allowed the United States to provide capabilities to an important ally, help them to reach ends that were conducive to U.S. strategic interests, and do so with little risk to U.S. personnel. Other NATO partners, particularly those most exposed to potential state and non-state adversaries on the European periphery, may ask the United States for support in defending their territorial integrity and other interests. This would require targeted interoperability in some areas (country-specific but likely including airlift, ISR support, C2, and other services) while continually increasing the levels of general interoperability should the United States decide to deploy its forces in defense of its NATO allies.

Moreover, while few individual partners are able to offer individual capabilities that significantly augment U.S. military power, multination coalitions of several allied forces can muster significant troop and equipment numbers. As a result, even smaller partners can provide unique expertise, technology, or troop capabilities that broaden the range of strategic options available to U.S. military and political leaders.

Toward Legitimacy

Greater legitimacy is one of the principal products of engaging allies in U.S. military operations in addition to enhancing U.S. capabilities in the theater. Although legitimacy itself never trumps national security and thus the demands for sufficient capability of the force, it has been an increasingly more important consideration for U.S. deployment abroad following the deadly land campaign in Iraq.

While interoperability and coalition warfare are often discussed in the same breath, they are, however, not a two-way street. Multinational interoperability, by definition, requires operating with partners who

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[5] According to Shurkin (2014), "allies supplied 75% of the military airlift used for Serval and transported three-quarters of the personnel and materials during the first three weeks of the operation; allies provided 30% of the aerial refueling; and the United States supplied an unspecified portion of the ISR that French forces used." See Michael Shurkin, *France's War in Mali: Lessons for an Expeditionary Army*, Santa Monica, Calif.: RAND Corporation, RR-770-A, 2014.

share U.S. objectives, or are willing to provide support for achieving them through some partnership. On the other hand, coalition warfare is possible with even low levels of interoperability and can be predicated on national-level political support through statements rather than operational and tactical level services being delivered. One of the most recent examples is the air support the United States has offered to YPG, SDP, and the Peshmerga Force in the fight against ISIL in Syria and Iraq, despite not having "provided any weapons of any kind" to the former.[6] In recent months, it was revealed that U.S. weapons have been in use by some rebel groups in their fight against ISIL.[7]

The drive for interoperability is almost inextricably tied with the drive toward building coalitions.[8] This tie is not empirically described anywhere in the literature, but certainly has considerable support from senior leaders and academics alike. The idea here is that because the United States wants to operate through the use of coalitions, they need to be more interoperable. This argument ties the legitimacy thought to be brought to coalitions to achieving a sufficient level of interoperability.

It has been posited that interoperability is a measure of commitment in a coalition, which then conveys decision-making priority on the interoperator. Gause et al. (2000) argued that (emphasis added) the "level of interoperability . . . will have to be high, possibly bordering on *seamless*" for those allies that "want to operate with the U.S. in *prominent* positions," but lower for "other allies." The implication here is that simply showing up to the fight as a coalition partner may not be

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6 Ece Toksabay, "Turkey Says Obama Shares Syria Concerns with Erdogan, Affirms Support," *Reuters*, February 19, 2016.

7 Thomas Gibbons-Neff, "This Highly Advanced U.S.-Made Anti-Tank Missile Could Now Be on Syria's Frontlines," *Washington Post*, February 23, 2016.

8 As an example, John Deni (2014, p. 586) from the U.S. Army War College links coalitions and interoperability by arguing that "interoperability appears to be fairly important to the United States, particularly as a means of enabling coalition operations," citing the 2010 Quadrennial Defense Review, which stipulates: "Whenever possible, the United States will use force in an internationally sanctioned coalition with allies, international and regional organizations, and likeminded nations committed to these common principles" (U.S. Department of Defense, 2010, p. 10). See John R. Deni, "Maintaining Transatlantic Strategic, Operational and Tactical Interoperability in an Era of Austerity," *International Affairs*, Vol. 90, No. 3, 2014.

enough. Being able to provide forces that can fight, accept risks, or play operationally relevant roles may be necessary to be considered actually part of the solution. Interoperability enables those forces to do so, and thus there is a drive on the partner side to be more tactically interoperable with United States and other dominant forces.

The perceived value of the legitimacy that coalitions bring, however, must be balanced against the costs. As Brooks and Wohlforth observed, multilateralism is strategic when "doing so is easier or especially advantageous, but never as an end in itself, and certainly not one whose pursuit merits bearing high costs."[9] The costs and benefits arguments may not be easily surmised, and therefore the vast majority of senior leaders we spoke with simply assume that interoperability and legitimacy that multilateral operations bring to the battlefield are presently worth the costs, and that, accordingly, interoperability between and among nations is not currently conceptualized as limited by operational effectiveness arguments. The demand for interoperability, as described in U.S. Army doctrine and strategy, the seemingly rote use of the term "interoperability" in any multinational setting, the lack of any clear guidance from the senior leaders in terms of how much and with whom and for what effect, are all consistent with this.

Building tactical interoperability in support of potential future operations is, however, not always advantageous for political legitimacy. As Weitsman puts it: "The more global the institution, the more political benefit it yields; regional organizations with less diverse memberships have less neutrality and thus fewer political advantages."[10] This argument would favor interoperability for the sake of legitimacy only on broad levels—NATO or the UN, for instance—and less so in bilateral and other small groupings. However, there is still a debate on the ability of institutions to grant legitimacy, and ultimately what value that legitimacy brings. Yet, in most cases, there is a consensus that operating in coalitions increases the legitimacy of an operation.[11]

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9 As quoted in Weitsman, *Waging War*, p. 24.

10 Weitsman, *Waging War*, p. 18.

11 Weitsmann notes: "although multilateralism is 'cumbersome, slow, and sometimes unnecessary,' it accords enormous value in terms of legitimacy."

Instead of interoperability being the means toward a more tactical or operationally effective force, it could be used as a means toward some other strategic end. Building tactical interoperability brings forces close together, with shared experiences and intimate knowledge of other forces, and can create relationships that far outlast the ability of two units to exchange services. Indeed, it can be part of a much larger engagement and cooperation framework focused on completely different ends.[12]

The intimate contact of two units working side by side can have learning potential for either side. As of the writing of this report, the U.S. Army is working closely with Ukrainian forces on training in response to Russian aggression in Crimea and eastern Ukraine. The Commander of Army forces in Europe, LTG Ben Hodges, has been explicit in the importance of what U.S. forces have learned from their experiences with Ukraine. When discussing[13] what the United States learned from them, he responded:

> We have provided [the Ukrainians] with the lightweight counter-mortar radar, and they were very, very effective in employing that. In fact, they used it in ways that we had not used it ourselves, and discovered that it made it more effective than I think we knew was possible.
>
> What we have learned from them is what it is like, the amount of jamming capability from distance as well as types that the Russians have employed. . . . It is something that we used to do but over the last 10 years or so have been focused on [other operations], while the Russians continued further down the road of high-powered jamming. . . . So that is something that we have an opportunity to learn from them. Now that UAVs are ubiquitous, it changes a little bit how you avoid detection.

[12] As the building of interoperability is seen as part of engagement in the Army (Department of the Army, 2014), it begins to look less like operational effectiveness and more aligned with broader strategic goals of security cooperation and other foci.

[13] Joe Gould, "Interview: US Army Europe's Lt. Gen. Ben Hodges," *Defense News*, August 18, 2015.

The United States is not in a war with Russia, but working with the Ukrainians, who currently are, means they reap the benefit of close contact with a recently hostile power in Europe.

Implications of Interoperability Drivers

With an increasing complexity of warfare and the type of operations the U.S. Army may be tasked with carrying out, there is no indication that the demand for multinational interoperability will decline. In turn, we anticipate that specific relationships will continue to be strengthened, particularly in light of adversarial action, and thus new challenges for developing more capable multinational forces emerge.

To reap the benefits of interoperability, however, the key will be in understanding:

- what services U.S. allies and partners are able to provide today (and what their projected capacity is in the future);
- defining the key contributions of selected partners for different operations and assessing mutual capability gaps in actual problems that need to be solved;
- understanding existing obstacles to effective interoperability and defining desirable levels for interoperability with individual partner countries;
- developing a specific plan, in cooperation with the partner country, to address existing gaps and challenges and reach the desirable level of interoperability.

Clearly, the road to interoperability will rarely ever be straightforward, yet, without an understanding of what services need to be exchanged between the United States and its allies, many of the efforts undertaken to strengthen the partnership could produce unsustainable results and waste limited resources. In addition, balancing multiple interoperability commitments—across individual partners as well as geographical regions—will continue being a dynamic process that will require coordination of the U.S. Army with the broader defense community and senior decision makers.

CHAPTER FOUR

What Kind of Interoperability Is Being Built?

Interoperability is built for both operational and broader strategic purposes. While the purposes and means of achieving a desired level of interoperability differ, the key principle is typically analogous: specific activities are undertaken to allow multinational troops to exchange services with each other. In this chapter, we discuss the five critical outputs of such activities: CIS, aligned procedures, individual interoperability, shared art of command, and compatible equipment. The relative importance of each of these interoperability outputs varies by partner and the operational context, yet all of them are typically required (on some level) to successfully execute multinational operations.

The classification proposed in this chapter is not mutually exclusive with other dimensions of interoperability. For instance, NATO uses three broad dimensions of interoperability: human (terminology, training); technical (hardware, equipment, armaments, and systems); and procedural (doctrine and procedures);[1] other authors propose a tiered approach or develop technology-centric models (as we discussed in Chapter Two). The focus on five broad interoperability outputs allows us to discuss the types of services that need to be exchanged between multinational troops in carrying out joint operations. This model, furthermore, is less susceptible to political constraints—it does not automatically assume that "more" interoperability along any single dimension is preferable to "less"—rather, it conceptualizes interoperability as

[1] NATO, "Interoperability: Connecting NATO Forces," May 11, 2012.

a set of building blocks which, if needed, can serve as a foundation for successful operations with partner nations. By virtue of understanding the ability of U.S. partners to provide specific services to U.S. forces (or vice versa), military planners and senior decision makers alike will be able to make more robust decisions about engaging specific partners in multinational operations. In the section to follow, we discuss the specific interoperability outputs and their utility in multinational operations.

Interoperability Outputs

Communications and Information Systems

Communications and information systems (CIS) are a particular subset of equipment, which enables so many warfighting functions to occur that it is pulled out as its own category. Some communication among nations is necessary, and CIS interoperability is a common challenge when bringing multinational units together.[2] CIS interoperability is the ability of the force to communicate and pass information using technical means to create a shared understanding within the organization, while also providing the infrastructure to quickly disseminate the intent.

CIS interoperability can come in many forms, from sharing of exact equipment to having work-arounds with very disparate equipment. And the pace at which these technologies change, the markets in which they are purchased on a state-by-state basis, and the spread of modernization across nations make CIS interoperability a significant challenge.

In his study of interoperability, Anthony W. Faughn[3] argued that due to the technical difficulty of achieving seamless communication between allies and secrecy between allies, it is "difficult" or "essentially

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[2] Jerry Boffen, "Allied Spirit II Strengthens NATO Interoperability, Relationships," Defense Video and Imagery Distribution Center, August 10, 2015.

[3] Faughn, "Interoperability: Is It Achievable?" p. 27.

impossible" to achieve CIS interoperability among multinational coalitions (emphasis added):

> *National pride* leads most nations to favor indigenous military procurement of C4I systems, which reduces the likelihood that multinational systems will readily operate with U.S. systems. . . . The United States places many restrictions on the types of information it is willing to share with certain coalition partners, but it is difficult to develop interoperable information systems that allow only *selective passage of information*. Multiply this requirement by the number of nations involved and the difficulty of building interoperable systems becomes overwhelming.

Hardware can vary widely among typical partners, where some might have analog radios and no common picture in their headquarters, and others like the United States might have high-end digital communications equipment and sophisticated (and proprietary) command and control software. And even if the hardware is common—like having the same digital radios from a given manufacturer—those units may not be able to speak if the underlying security keys are not similar. Big impediments to CIS interoperability are cost (of advanced CIS equipment), which will limit overall abilities, and policies for sharing specific data and crypto keys for secure communications. These are exacerbated by the rapidity at which CIS system technologies progress, which puts additional costs and policy hurdles as ongoing challenges.

Aligned Procedures

The ability of the force to use standardized tactics, techniques, procedures, and products for anticipated tasks or situations that can be dealt with effectively by using routine, structured responses is underpinned by the shared understanding of a professional language, an understanding of each contributing nation's units' military organization, doctrine, equipment, and inherent capabilities and limitations. This understanding helps to achieve unity of effort.

Commanders and staff of multinational units aim to have a common understanding of professional terms, nomenclature, and processes so that a subordinate unit from one country can nest within

a higher commander from another country's planning and decision-making cycle. This entails knowing processes for requesting support, being able to supply the requisite reports to support the routine battle rhythm, and concurrently planning with the staff of their higher headquarters.

The chief challenge to the procedural interoperability is the sheer scope of procedures that govern military operations. There is no expectation that all procedures can be known ahead of time, and even what could be very similar procedures—military decision-making process—can be completely different from one nation to another. In operations, subordinate units from one nation will need to adopt higher headquarters procedures from another nation, which may not have multinational consensus (for instance, as shared doctrine arising from NATO). Those procedures will need to be taught and understood by the nations working together. Growing an understanding of those procedures, and understanding a nation's standards for those procedures, is a focus of considerable effort among any nations aiming to work together in the future.

Individual Interoperability

Individual members of the force possess respect, rapport, knowledge of partners, patience, mission focus, trust, and confidence in multinational partners, built upon the foundation of language skills, regional expertise, and cultural understanding. Commanders, subordinates, and staffs understand each other's military and command cultures. This builds to an understanding of each other's roles and responsibilities within the operations process and yields an understanding of expectations.

As an example, individual members of the force may have attended partners' professional military education (PME) courses, trained with partner nations' forces, and spent time on a one-on-one basis with foreign counterparts. Individuals that are "individually interoperable" can readily identify potential friction points caused by differences in ways of doing things and gaps in understanding. They are able to serve as "interpreters" or "translators" to smooth out potential friction points, chiefly among those processes that might not be codified anywhere or might arise because of specific tactical situations.

Shared Art of Command—Unit-Based Interoperability

Arguably the most difficult to define, *art of command* interoperability is the ability of the force to operate with a tactical and operational unity of purpose and recognized unity of command that allows the commander to exercise authority and direction using mission orders to achieve the desired objective. As the level of risk attendant to a particular operation varies, so too will the likelihood that a commander takes the necessary steps to establish trust and understanding and maintain unity of purpose. It is dependent upon subordinates' and staff's motivation and commitment, strengthened by active participation and responsibility.

It can be facilitated by the use of a combined staff or operations center. Young (1997) offers several salient recommendations regarding how command is done. Chiefly, he recommends for combined units that the commander of the multinational unit should have complete operational command over those units in deployments and training and readiness oversight during peacetime. This has not historically—and even currently in the Korea case—been done. It in fact has led to considerable angst in terms of how ROEs are inserted into units, which precludes seeing all units as the same and employing as if of one mind.

Having similar doctrine and procedures, sharing language and knowledge of each other's culture, and generally having compatible CIS and other equipment may still not produce high levels of interoperability owing to the style of command. As the level of risk attendant to a particular operation varies, so too will the likelihood that a commander takes the necessary steps to establish trust and understanding and maintain unity of purpose.

In the case of interoperating with a host nation during a combined operation, time is of the essence. If a U.S. unit arrives in theater to work with the HN, the U.S. commander may not have confidence in how commands might be carried out by the HN, and may create inefficiencies or even deprioritization of HN units in support of overall operations. Even if the two units share SOPs for operations, the U.S. unit might wish to take the lead on each line of effort until it is determined whether the HN units are responding to commands as expected. There is no reason this type of shared "art of command" principle would be any different if the HN were in charge, and had U.S. forces in support.

In the end, the military is a hierarchical organization, and how commands are interpreted across the battle space is a nuanced and at times unscientific endeavor. How commands are interpreted and executed cannot be completely prescribed by standard operating procedures or doctrine. It takes time to build a shared understanding of the art of command, which pulls all other aspects of interoperability together to greatest effect. Multinational units will undoubtedly create significant inefficiencies without that shared AoC, and open the units to risks in ways that may not ultimately be knowable.

Compatible Equipment

Forces from two or more partnered nations use common pieces of equipment, equipment that relies upon interchangeable repair parts and/or components, or equipment that requires consumable items that are interchangeably equivalent without adjustment.

For example, the U.S. and UK forces both use the AH-64E which simplifies logistical resupply of POL, ammunition, and repair parts when the forces employ their respective Apaches as part of a combined task force. In terms of interchangeable repair parts, components, and consumables, U.S. and UK field artillery forces employ the M119 and L118 howitzers, respectively. While different end items, many of the components are similar if not the same. Similarly, the K1A1 main battle tank is a South Korean–built version of the U.S. M1A1 MBT. The K1A1 has the same M256 main gun tube used in the U.S. M1A1, allowing the K1A1 to fire the same ammunition as the U.S. M1A1.

Which Are the Most Important Outputs?

The question is: Which of these interoperability outputs does one focus on and why? If thought of broadly, the CIS and equipment interoperability outputs are more technical in nature—a system or piece of equipment that needs to physically lash up between nations. This can be accomplished through commonality in actual equipment, standards, and compatibility in disparate systems, or in ad hoc work-arounds. All of these are seen regularly in actual multinational operations as a

means of connecting CIS and other equipment among nations. High-level policies can be involved, particularly in intelligence sharing, but nonetheless there is a hardware-focused view of this interoperability.

Two other areas—individual, unit-based interoperability, and procedures—are more difficult to define in terms of actual hardware or quantitative metrics, but arise from shared experiences, backgrounds, and norms of operation. While many procedures can be written down, the vast majority of details of tactical operations have to do with individual and small group dynamics that rest on shared understanding of the environment.

The question that arises is, is there a different in importance among these five areas such that the focus of U.S. activities should favor one over the other?

Interoperability Through History and Lessons Learned

One way to prioritize these areas is to consider the gaps that might exist across them, and use that as a proxy for prioritizing efforts. CIS is the most often *cited* gap in lessons learned documents (see appendices and bibliography for a list of lessons learned documents surveyed) and after action reports from multinational operations. This may be because CIS interoperability is often the preferred way to describe interoperability—a communication or command and control link between two soldiers or units.[4] It is also a technical and matériel-focused solution, which is easier to envision being corrected through a specific (procurement) action.

A closer reading of historical multinational operations and our detailed interviews with select partners tell a different story. Rather than the focus on CIS and equipment, many perceive the important interoperability outputs are the individual and group interoperability. With that, so it goes, all other problems can be worked out.

As Douglas Chalmers observed, one of the key challenges British troops faced in working with U.S. forces in the Korean war was the frequent switching between formations and the fact that this prevented

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[4] For example, recall the Joint Chiefs' definition for interoperability being focused on technical lash-ups among nations.

them from building long-term relationships.[5] Chalmers noted that these inefficiencies consequently led to a weakened *respect and rapport* between the various staffs and the mutual misunderstandings resulting from a British perception of micromanagement by the American commanders and the consequent lack of American visits to the British brigades under their command.[6] Chalmers concludes the most significant challenge both forces faced in the Korean war was "the lack of an *implicit understanding* of the other's ways, which exacerbated the national and cultural factors."[7] Some of the steps that have since then helped bring the forces closer, including adoption of NATO standards, regular combined exercises, exchange officers ("rather than keeping them in a liaison cell," thus increasing "accurate knowledge transfer"), and procurement of common digital communication equipment.[8]

Similarly, our look at French interests in interoperability illustrates one particular view of how to balance technical and other types of interoperability. They argue that while technological interoperability is important—necessary, even—it is a mistake to regard it as the "be-all and end-all" of interoperability and focus one's resources on developing it. As one French general put it, technical interoperability "should not be considered a panacea with respect to the new challenges" of interoperating.[9] It is, according to the general, necessary but not sufficient to obtain operational interoperability.

One reason is that the time and money required to create optimal technological solutions to facilitate interoperations represents, for the French, a case of diminishing returns, if not a losing proposition. The French regard the pursuit of things like "black boxes" or gateways linking different systems as something that costs a great deal of money, results in a bespoke system that cannot be used for a different

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5 Chalmers, *British Army Units Under US Army Control*.

6 Chalmers, *British Army Units Under US Army Control*, p. 26.

7 Chalmers, *British Army Units Under US Army Control*, p. 33.

8 Chalmers, *British Army Units Under US Army Control*, pp. 31–41.

9 Général de l'Armée Bernard Thorette, "La vision française d'une interopérabilité renforcée," *Doctrine: Revue d'études générales*, No. 11, 2007, p. 31.

partner, and risks being made inoperable as soon as one of the partners upgrades its own system. Any solution one develops for working with any particular partner is unlikely to have a long shelf life. On the other hand, creating solutions as needed requires a great deal of time, making such an approach a poor fit for rapid deployments. The French in effect argue for aiming for "good enough" technical solutions, something that is true of their approach to high technology in general.[10] Aim for good enough but then move on and focus on areas in which one can make an enduring and meaningful improvement.

The French cite as an example their experience putting together technological solutions to link British and French CIS systems during the Rochambeau exercise held in May 2014, which the two armies conducted as part of their CJEF effort (see Appendix D for more information). The goal was to be able to automate information exchanges and ensure a common operational picture (COP) within the same command post on both British and French computers, with the headquarters using primarily French systems.[11] The French Army largely achieved this goal, but the effort required relatively large numbers of people at a significant cost in terms of time and money.[12] It took several days over the course of the exercise to work out ways to link different systems, share files and attachments, conduct electronic chat, etc.[13] They also judged that the solutions they developed were perishable given that in a few years one of the two countries or both would deploy new equipment or software.[14] The French Army concluded that from then on the preferred approach was simply to use one of the two nations' CIS systems and find ways for soldiers from the other country

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[10] General Vincent Desportes, "Combats de demain: Le futur est-il possible?" *Doctrine: Revue d'études générales*, No. 11, 2007, p. 9.

[11] French Officer 1, interviewed at Lille, France, June 2, 2015.

[12] French Officer 1, interviewed at Lille, France, February 2, 2015; French Officer 1, interviewed at Lille, France, June 19, 2015.

[13] Marc Bertucchi, ed., *Rochambeau 2014, CJEF-LC, FR EMF 1 and UK 3rd Div, 11 to 23 May 2014*, Cahiers du RETEX, Paris: Centre de Doctrine d'Emploi des Forces, 2014, p. 31.

[14] French Officer 1, interviewed at Lille, France, February 2, 2015; French Officer 1, interviewed at Lille, France, June 19, 2015.

to access it. They judge that it is cheaper, faster, and more effective to do what it takes, for example, to train British officers to operate the French CIS or vice versa, and work out all the various legal and political issues related to classification and information sharing, among others.[15]

There is far more to interoperability than hooking up CIS or synching radios. The other forms of interoperability are at least as important. The French we spoke with insist on "mutual understanding" and "mutual confidence," which they associate with, above all, a degree of familiarity that results from long experience working and training together.[16] "Interoperability," according to General Vincent Desportes, "is above all a question of mutual comprehension. It's a question of cultural understanding and doctrinal compatibility. That's where the essential effort should be."[17]

In the words of one French colonel,

> The degree of interoperability depends above all on the ability of men to understand one another . . . it then comes from the compatibility of doctrines and procedures. Also on the compatibility of equipment. Finally, interoperability becomes concrete through common practices, the fruit of collective training.[18]

Or, in the words of another colonel,

> Even if we had a black box to connect two systems, we don't have the same decision-making processes, and we do not necessarily have the same interpretation of the mission, which is why we need to speak a common tactical language; if we want to be fully interoperable, we need to understand what the others mean when

[15] In the case of the Franco-German Brigade, the choice similarly was made to stick with one nation's CIS system—in this case the German one—and have German liaison equipped with the German system integrated inside French command posts. Obviously, this solution would be difficult to apply rapidly to a new partner, given all the administrative, legal, and policy-related hurdles involved in giving even a trusted ally access to a secure information system. French Officer 2, interviewed at Lille, France, February 2, 2015.

[16] Thorette, "La vision française d'une interopérabilité renforcée," pp. 30, 32.

[17] General Vincent Desportes, "Editorial," *Doctrine: Revue d'études générales*, No. 11, 2007.

[18] Berne, "La problématique de l'interopérabilité," p. 11.

> they use this word or that one; we need to have a common vocabulary but also common concepts and doctrines. Thus, hooking up our systems doesn't necessarily help.[19]

Similarly, an officer serving with the French 11th Parachute Brigade, which is one of the units at the center of Anglo-French military cooperation, compared the French Army's ability to work with the British favorably to its work with the Germans, notwithstanding the comparatively high level of technological interoperability achieved by the Franco-German Brigade. "From a tactical point of view," he said, "we are closer to the British and have a better relationship with them."[20]

A French Army lessons learned study of the Rochambeau exercise, though noting the technological achievements attained, emphasized "non-technical interoperability," which it assessed as having "advanced significantly." "Shared understanding," the study continued, "and close co-operation at all levels were fundamental to the success" of the exercise.[21] Interestingly, most of the lessons learned text focuses on nontechnical matters, specifically issues related to procedures—knowing how to plan together, for example—and organizational matters related to how the physical space of a binational headquarters should be organized, or how liaison elements should be distributed across different echelons.

As to how interoperability is built, the French Army's emphasis on mutual understanding is reflected in their insistence that real interoperability—especially if it is to be conducted at levels below that of a corps headquarters function—requires a long-term bilateral arrangement involving repeated exchanges and exercises over many years. Thus, although interoperability matters most at high levels, the French think it worthwhile to cultivate it at lower levels. "The level we need to be investing in," one officer insisted, "is captains."[22] Captains later become colonels and generals who can draw on personal experience and personal connections with partner countries. The French do

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[19] French Officer 1, interviewed at Lille, France, June 19, 2015.

[20] French Officer 5, interviewed at Toulouse, France, June 22, 2015.

[21] Bertucchi, *Rochambeau 2014*, p. 57.

[22] French Officer 3, interviewed at Lille, France, June 15, 2015.

this routinely with several African militaries, and, as will be discussed below, they are doing it with the British and the Germans as well.[23]

Historical literature, lessons learned documents, and current thinking on the matter indicate a balance of interest in the five outputs of interoperability, with no dominant position overall.

Interoperability Across Warfighting Functions, Scenarios, and Partners

In several high-level discussions with senior leaders involved with building interoperability, we took a different tack. We asked a simple hypothetical question of individuals to help spark a conversation about what the U.S. Army should be focused on in terms of building interoperability. The hypothetical[24] is as follows:

> If you had $100 to spend across the five interoperability outputs—individual, group, procedures, CIS, and equipment—where would you invest that money?

What we found was that each answer was *highly nuanced* based on what service they expected to provide (or be provided) from one force to another, what mission or scenario they were focusing on, and which partners they were thinking about.

For instance, if a respondent was thinking about sharing *intelligence* among coalition members in Afghanistan in 2007, they might see it as mostly a technical problem of lashing up communications systems and getting the right policies in place to have partners access common computer systems. Another respondent was thinking about future maneuver warfare in Europe, and that they might focus more on individual and group interoperability, as they envisioned a coalition member providing maneuver support on the battlefield and the trust and understanding that would be necessary to allow forces to work together. The former might be most concerned with the constraints on

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[23] French Officer 3, interviewed at Lille, France, June 15, 2015.

[24] The amount of money is inconsequential as we are only interested in the relative amounts of investment necessary. Similarly, we were not asking about investments in specific activities (like "training and exercises") to hopefully reduce biases for programs over outputs.

intelligence sharing and was using CIS interoperability as a proxy for overcoming them. The latter might be assuming that even rudimentary radios, supplied by one unit to another, could be his work-around for interacting with the foreign unit in a maneuver context, so long as he understood the foreign commanders and the capabilities of that unit.

Underlying biases and personal experiences of individuals dominate discussions about interoperability. And the context for building interoperability—what functions, with which partners, for what missions—does as well. The implication is that, without knowing what interoperability is being built for, it is impossible to come up with a rational set of investments. Interoperability is not an end in itself, but a mean to some other end.

For example, at what level is one, realistically speaking, expecting to interoperate? What units or functions are expected to be "mixed"? What capabilities is each side going to bring to the project? What are the means and the kinds of training one is going to dedicate? In the words of one colonel with long experience working with the FGB, "if the objectives are agreed upon at the highest level, and the missions that will be given to the division . . . that eases everything."[25] "If that's not the case," even at "the tactical level there will be challenges."[26]

The European officers interviewed for this study often used the comparison between the FGB and the CJEF to illustrate their point. In the case of the FGB, the French regard the Germans as not being interested in many of the kinds of missions that interest the French, or at least they are not prepared to engage in them quickly. "Germany . . . is not today a country willing to deploy its forces—maybe for stabilization operations, but not for anything quickly, not for first response."[27] The CJEF, in comparison, represents shared goals, in particular a shared interest in and political ability to conduct rapid response forcible entry operations. The relative clarity of purpose translates into an easier task of prioritizing target capabilities and training activities. "All the rest

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[25] French Officer 2, interviewed at Lille, France, February 2, 2015.

[26] French Officer 2, interviewed at Lille, France, February 2, 2015.

[27] French Officer 2, interviewed at Lille, France, February 2, 2015.

becomes easier."[28] Politics, moreover, have dictated certain important constraints for the CJEF. Politics, not military requirements, mandated that CJEF be binational at nearly all the command levels and that all the important decisions and planning operations be conducted jointly. Policy also required that the CJEF maintain a 70 percent–30 percent ratio, with one of the countries acting as lead and providing the lion's share. (In practice, CJEF operates at about 70 percent–40 percent because the splitting up of command and staff functions requires a degree of redundancy.)

Conclusions

Doctrine, policy guidelines, and recommendations alike have all highlighted the importance of reaching certain levels of interoperability in multinational coalition operations. The level of such interoperability, however, has not been universally agreed on, and many factors—operational to political—can drive those decisions. Some analysts believe only a highly interconnected and well-trained multilateral force can be effective in achieving complex operational goals.[29,30] Others argue that actual interoperability solutions are one, but not the only, key to success in multinational operations.[31]

While it may be impossible to prescribe the optimal level of interoperability without a consideration for specific mission objectives and participants involved, we have found that while technical solutions, compatibility of equipment, and other physical aspects of interoperability are critical for making a multinational force more effective, these are not sufficient conditions for a successful mission. Rather, a much

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[28] French Officer 2, interviewed at Lille, France, February 2, 2015.

[29] Kenneth Gause et al., *U.S. Navy Interoperability with Its High-End Allies*, Alexandria, Va.: Center for Naval Analyses, Center for Strategic Studies, 2000.

[30] ETH Zurich, Department of Humanities, Social and Political Sciences, Center for Security Studies.

[31] Elizabeth Royall, "Shifting Focus from U.S. Technological Dominance to U.S.-Allied Dominance," *Small Wars Journal*, January 5, 2016.

broader set of factors, including strategic and political clarity about the goals and resources at hand, personal trust between national components of the coalition force, as well as agility to develop ad hoc solutions tailored to the most pressing needs, are vitally important.

The question arises then: What activities are necessary to build the right balance of technical and other interoperability outputs? This we address in the next chapter.

CHAPTER FIVE

How Do You Build It?

Interoperability is currently a product of many activities. In our survey of close to 200 different U.S. Army security cooperation programs, we have classified all of the programs by different activity types. As we show in Appendix B, these programs range from small ones to large, multinational exercises, and the different activities contribute variously to building multinational interoperability (some build none at all by the definition of multinational interoperability we use). In this chapter, we describe the activity categories in detail.

Ten Activity Categories

Training and Exercises: both short- and long-term programs aimed at building the capacity and capability of partner nations and organizations that credibly simulate operational conditions and prepare armed forces for live combat and other types of missions. Military experiments are included in our study as a subset of military training and exercises.

Staff Exchanges: a way of familiarizing military personnel with the culture and practices of allied armed forces; may be formalized into regular exchange programs or take place on an ad hoc basis. They may also be technical or scientific in nature and contribute to the development of specific capabilities. Additionally, certain exchange programs have the education of foreign military personnel as their primary goal.

Consultations and Information Exchanges: senior leader engagement, conferences, workshops, needs and capabilities assessments, and similar efforts involving communication, collaboration, and cooperation.

Education: may involve formal education programs focused at specific target groups and ad hoc information dissemination that fills the needs of a specific multinational engagement. International military education and training is defined as "formal or informal instruction provided to foreign military students, units, and forces on a non-reimbursable (grant) basis by offices or employees of the United States, contract technicians, and contractors. Instruction may include correspondence courses; technical, educational, or informational publications; and media of all kinds" (Department of the Army, 2013).

Research, Development, Test, and Evaluation: encompasses a wide array of programs aimed at building future technological capabilities, understanding the capacity and capability of the adversary, and providing allied military units with state-of-the-art equipment. In multinational settings, R&D and RDT&E programs engage leading researchers and scientists of foreign militaries, discuss technical standards, foreign military sales, as well as other scientific and technical aspects of modern warfare.

Armaments and Arms Control: includes weapons systems that may be subject to exports to and utilization by allied armed forces. Weapons systems are defined as "a combination of one or more weapons with all related equipment, materials, services, personnel, and means of delivery and deployment (if applicable) required for self-sufficiency" (Joint Chiefs of Staff, 2011b). The system of arms control consists of four areas: treaty language that forms the core of a verification regime, monitoring systems that collect relevant data, analysis processes, and evaluation (Woolf, 2011).

Unit-to-Unit Relationships: interpersonal relationships between international military units that extends beyond commanding officers. This category primarily involves deliberate relationships between members of cooperating units before, during, and after multinational engagements that allow participants to develop sensitivity to language, cultural, and interpersonal dynamics in partnering units for longer (than typical training events) periods of time.

Equipment Transfers: equipment is a broad category that includes tools, machines, vehicles, and other assets to support military operations. "The term 'military equipment' includes all weapons systems, weapon platforms, vehicles, and munitions of the Department of Defense, and the components of such items" (United States Code, 1956, §2228). In the context of this study, this definition can be generalized to all such assets that are owned by the U.S. and allied armed forces and may be sold, used, and utilized for multinational military purposes.

Liaison Officers (LNOs): liaison is a "contact or intercommunication maintained between elements of military forces or other agencies to ensure mutual understanding and unity of purpose and action" (Joint Chiefs of Staff, 2011a). In the context of this study, liaison teams and individuals "represent the interests of the sending commander to the receiving commander," and their primary function is to "promote understanding of the commander's intent at both the sending and receiving HQ" (Joint Chiefs of Staff, 2011b).

Multinational Operations: "a series of tactical actions with a common purpose or unifying theme" (U.S. Army, 2013) as well as "military actions or the carrying out of a strategic, operational, tactical, service, training, or administrative military mission" (Joint Chiefs of Staff, 2011b). In the context of this study, multinational operations are defined broadly as multinational engagements that have a specific goal outside of training, education, research, and consultations purposes. Typical examples of multinational military operations include peace, humanitarian, combat, and stabilization (SSTRO) operations.

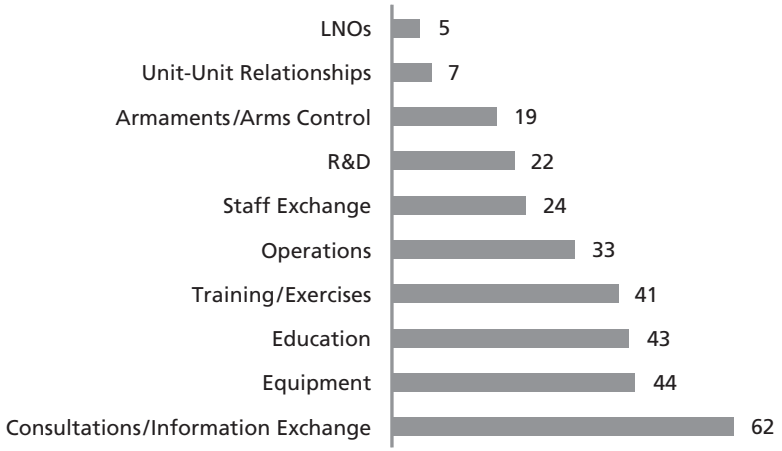
One Hundred Ninety-Two Underlying Programs

The U.S. Department of Defense invests significant resources into efforts to build relationships, modernize its partners' armed forces, and rehearse joint operations. The U.S. Army manages close to 200 programs (see Appendix B for a more complete treatment) related to security cooperation with its allies, most of which fall into four categories: information exchanges, military education, defense and military contacts, and training.

As part of our analysis, we compiled a list of 192 security cooperation programs originating from two sources: the *Army Security Cooperation Handbook* (Department of the Army, 2015) and previous RAND research on security cooperation (Moroney, Thaler, & Hogler, 2013). This list is not exhaustive as additional efforts may take place within the context of programs not captured by one of the two sources; however, it is representative of the vast array of international outreach efforts of the U.S. Army. Each program has been classified into relevant program types, and summarized in an appendix. Figure 5.1 shows how the programs relate to the activity categories; note that each program could be coded by more than one activity type, and the limits on the project did not allow for detailed discussions with each program to determine how and if interoperability plays a role. This should be seen as an attempt to test the programs and activity categories for logic.

We then coded each program by its contribution to building interoperability for multinational missions (more details are available

Figure 5.1
Programs by Activity Types



NOTE: The size of the bars only conveys the number of programs, and not the size of the efforts in terms of dollars or other measures.

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in the appendix). We estimated that five activity types have significance in building interoperability in this approximate order:

- Unit-to-unit relationships
- Staff exchange
- Research and development
- Training and exercises
- Consultations

As expected, practical activities that promote cohesion and understanding between military staff (staff exchanges) and military units of different nations (unit-to-unit type) are of the highest relevance for building interoperability, and only about 12.4 percent and 3.6 percent of programs, respectively, fall into these categories. Other factors to take into consideration include budget constraints and the willingness and ability of partner armed forces to engage in such programs. Second, R&D-related programs (10.8 percent of all programs), consultations (33.2 percent of all programs), and training and exercises (22.8 percent of all programs) increase the odds ratio by smaller yet still high enough amounts, indicating the need for programs that rely on both compatible infrastructure (such as weapons systems and communications tools developed through R&D partnerships), a frequent information exchange between armed forces, and active participation in exercises and training events.

In interpreting our data, several caveats need to be made. First, programs are classified into ten broad categories, yet significant variation exists within categories themselves. Second, the scope of the program within a category is not always the same—and the contribution to building interoperability not equally large. Yet, if they contribute to building multinational interoperability, they are classified as such. Last, the limited size of our sample and the fairly low granularity of our data provide opportunities for further improvements in the model. Despite these limitations, our study provides an important starting point for additional analysis—including qualitative study—of different program types and how they can practically contribute to building interoperability.

Combining Activities to Build Interoperability

While conducting a detailed analysis of bilateral relations is not in the scope of this project, we find that many countries are involved in a broad spectrum of cooperative programs that aid in building high levels of interoperability with the United States. Yet, as most practitioners would observe, interoperability with foreign armies is not seamless, and significant individual issues often arise as nations prepare for specific operations. Moreover, while interoperability is commonly seen as a bilateral concept, our interviews with representatives of partner nations have indicated that their interoperability with third countries can benefit U.S. interests despite limited military engagement between the United States and the third country.

There is no clear consensus or empirical evidence for which activity types make the greatest contributions to building interoperability. It is generally agreed, however, that the activities themselves necessarily aid in increasing knowledge of cultural affinities, building individual and group relationships, and overcoming or at least identifying procedural or technical differences. Our elicitation of subject-matter experts on the contribution of activity types to interoperability outputs, however, does shed some light on how programs could be put toward outcomes desired (Figure 5.2).

However, the ultimate interoperability outcome goals are often not known ahead of time. For instance, staff exchanges provide the mobile officer with a very specific and detailed view of a partner unit. By virtue of being integrated into the unit staff (to the extent security restrictions allow that) and functioning as part of that staff—not as a liaison—exchange officers can gain substantive insights into partner units' procedures and organizational culture and develop personal relationships. The initial impetus of that exchange, however, may not even be on building specific functional interoperability between the two countries.

The point here is that determining a priori whether a given activity or set of activities is aiming toward targeted or general interoperability between and among nations would go a long way toward helping programmers and operational units to take appropriate action while engaged in that activity. Without that knowledge, confusion can be easily created.

Figure 5.2
Schematic Description of Key Contributors to Interoperability Outcomes

	Aligned Procedures	Art of Mission Command	Individual Interoperability	CIS	Compatible Equipment
Training and Exercises	✓	✓		✓	
Multinational Operations	✓	✓	✓	✓	
Education			✓		
Staff Exchanges			✓		
LNOs			✓		
Unit-to-Unit Activities			✓		
R&D				✓	✓
Equipment Transfers				✓	✓

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It is safe to conclude that no magic bullet exists to build advanced and seamless multinational interoperability. Additionally, a look through existing efforts illustrates the breadth and depth of activities that are and could be directed toward specific interoperability outcomes. However, some types of cooperation may be more practical than others. In our research, we find that interoperability of the type described in this paper is best achieved by:

- delivering high-level authorization to the units involved to invest in building long-term relationships;
- understanding each other's procedures, cultural norms, and communication protocols; and
- achieving a sufficiently high level of equipment compatibility to enable the provision of services as desired by senior military and political leadership.

Naturally, the degree to which these conditions need to be satisfied varies nation by nation as well as over time. As we discuss in the next chapter, the United States has achieved "general interoperability" with many of its security partners (or has been investing recently into building it); however, some types of multilateral operations may require much more: in our assessment, this is investment into "targeted interoperability" buttressed by a sufficient political mandate and provision of resources.

CHAPTER SIX

Interoperability Outcomes

In this section, we describe the qualitative differences in interoperability outcomes while making a distinction between targeted and general interoperability. We then address the differences between partners with whom the United States may decide to build some degree of interoperability and different types of anticipated missions that may influence the type of targeted interoperability built.

Justifications for Tiered Interoperability

As in the past, the United States is likely to operate with land forces of varying capability in the future. Yet, even with the most advanced land forces, the United States has had to develop new solutions to interoperability challenges in the recent operations.

Even prior to the recent large-scale campaigns, in July 2001, the chiefs of the Australian and U.S. defense ministries directed the Chief of the Defence Forces (Australia) and U.S. Pacific Command to conduct an in-depth review of U.S.-Australian interoperability. The report,[1] released in 2003, captured the "significant commitment" required to build and maintain a high level of interoperability even among close partners. The report went on to explain that while interoperability had been demonstrated in early operations in

[1] "Review of Operational Level Interoperability Between the Military Forces of Australia and the United States of America," October 2004, 060614 OLR Unclassified.

Iraq and Afghanistan, it was not "fully tested" because of the lack of peer-like opposition. Without sincere testing, it remained unclear just how interoperable the United States and Australia were, and what kinds of risks they could face if senior leaders make invalid assumptions about combined capabilities and their forces' ability to carry out joint missions.

Australian-U.S. interoperability is at the top tier of how much interoperability can be built with major formations. The interoperability study put high value on those existing and early relationships, personal connections, and shared language and values:

> it was apparent that all of the deployed Australian forces are well integrated into the International Coalition's command and operational structures. Of particular note is the close working relationship that has developed between the ADF and the various elements of the United States military . . . the relationship with the United States is built upon *language and cultural similarities* and, importantly, a long history of conducting *joint training exercises* and *sponsoring personnel* exchanges . . . without this level of interoperability and mutual respect, it would not be possible for Australian forces to have achieved the level of integration that has been evident in [OEF]."[2]

Australia, with its membership in ABCA Armies, represents one of the highest-intensity relationships with the U.S. Army, yet the United States must be able to develop working relationships with other allies around the world. Clearly, the level of interoperability desired is not uniform across the board, yet as we show in this chapter, "general interoperability" can serve as a foundation for more advanced levels of cooperation, developed in the form of "targeted interoperability."

This is indirectly reflected in existing policy guidance (such as AR 34-1), which generally refers to interoperability as a means of achieving better tactical, operational, and strategic outcomes, with

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[2] "Review of Operational Level Interoperability Between the Military Forces of Australia and the United States of America," pp. 22–23, emphasis added.

additional benefits regularly considered as well. Yet it is not always true that "more" interoperability will necessarily improve desired outcomes, particularly with partners whose contributions to multinational missions are limited by capability or political constraints. Furthermore, there is no precisely defined "amount" of interoperability that can be applied to all partners in a specific type of mission. In other words, as operations and partners differ vastly, the United States may engage with them on substantially different levels. Several of these considerations are highlighted in AR 34-1 and other Army documents.

U.S. Army Interoperability Guidance

Through official documents such as AR 34-1, senior leader statements and the type of engagement the U.S. Army has with its foreign partners through more than 190 cooperative programs, there is little doubt that building functional relationships with our partners can significantly contribute to political, diplomatic, and military objectives. As AR 34-1 indicates, there are at least four key factors that determine the level of interoperability the United States builds with individual partner nations:

- national and DoD objectives for the partner nation;
- the expected missions the partner is likely to perform;
- its current and projected military capabilities; and
- the partner's national objectives.[3]

Furthermore, AR 34-1 notes that interoperability built with partners spans the range of very low to extremely high interoperability (emphasis added):

- I-0: Partner Army has *no demonstrated interoperability* with Army; command and control (C2) interface with the Army is *only at the national level*; has *no regular engagement* with the Army.

[3] U.S. Army Regulation 34-1, "Multinational Force Interoperability," 2015.

- I-1: Partner Army shares information or situational awareness *through liaison teams* with U.S. systems (analog-to-digital conversion required); requires *alignment of capabilities and procedures* to establish operational norms; has *some routine engagement* with Army.
- I-2: Partner Army has *digital C2 capabilities*; *actively participates* in interoperability solutions with the Army; *routinely exercises or operates* with the Army.
- I-3: Partner Army's interoperability is *network-enabled* through: shared situational awareness; command and control on-the-move; collaborative planning; networked fires; combat identification; and information collection.

The presented interoperability logic from AR 34-1 is depicted in Table 6.1, noting an intermediary step consisting of different types of activities building interoperability.

Table 6.1
Factors and Levels of Multinational Interoperability

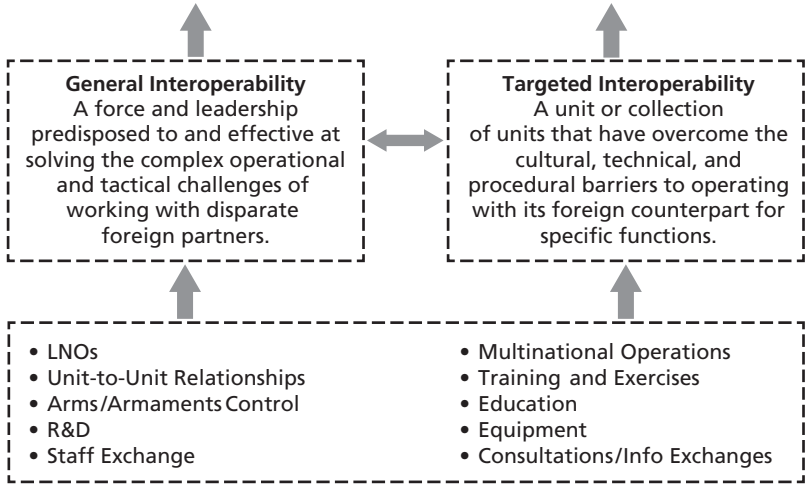
Key Considerations (INPUTS)		Interoperability Activities		Levels of Interoperability Achieved (OUTPUT)
National and DoD objectives for the partner nation				Level 0: No demonstrated interoperability with Army
Expected missions the partner is likely to perform				Level 1: Shares information or situational awareness, establishes operational norms, has some engagement with the Army
Its current and projected military capabilities	→	Consultations, training events, and other relevant activities	→	Level 2: Digital C2 capabilities; actively participates in interoperability solutions with the Army, both through exercises and operations
The partner's national objectives.				Level 3: Highly interconnected force that engages in collaborative planning; networked fires; combat identification; and information collection.

Targeted Versus General Interoperability

In discussing the interoperability activities and outputs, there are two types of outcomes that have arisen (Figure 6.1 below). First is *general interoperability*. We define general interoperability as "a force and leadership predisposed to and effective at solving the complex operational and tactical challenges of working with disparate foreign partners." The activities leading to this kind of interoperability come from nearly all the activity types discussed previously, which provide the force with experiences and knowledge to flexibly solve, work around, or operate despite some interoperability challenges.

The general interoperability that is the result of so many activities also creates many of the problems noted earlier. To reach a level of interoperability where specific functions can be provided from one nation to another takes time as those units come together to work out the CIS, equipment, individual, group, and procedural interoperability necessary for the situation they are in. And, if those units are solving problems and finding work-arounds at the beginning of an

Figure 6.1
Targeted Versus General Interoperability



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operation, that time can be precious. Alternatively, if time is not available, the result will tend to be that fewer functions will be provided from one nation to another, or forces will be sidelined until solutions are worked out.

Nonetheless, having a force adept at solving interoperability issues quickly provides benefits. Several examples from recent operations in Iraq and Afghanistan reflect the U.S. Army's growing capability in general interoperability with its partners (see Appendix A for a discussion). In our interviews, we collected stories of battalion and brigade commanders essentially being handed a foreign unit when in command to be added to their force structure. It was put on them to understand what the foreign unit's capabilities were, how to integrate it into operations, navigate the particular rules of engagement and national caveats, and enable it to operate as a useful part of the coalition. This ability to solve those problems and make best use of all forces comes from having leadership adept at taking on such tasks, built through exchanges, training and exercises, and other activities.

While some countries have standing relationships with the U.S. military, many multinational units in Iraq and Afghanistan depended on the ability of their commanders to integrate disparate equipment, procedures, and command styles. As a result, most operators only met each other in situ, and solutions to interoperability challenges were addressed ad hoc (consider the Afghan Mission Network mentioned earlier). Often, commanders cite relying on significant liaison presence—essentially a means of working around many of the interoperability outputs—to deliver the ability of multinational troops to effectively exchange services.

General interoperability would in an ideal case be achieved prior to deployment with high levels of trust, and an ability to exchange information and make expedient decisions in a multinational setting. However, this "best-case" scenario is almost never realized, leaving the forces with the demand for leadership to adapt to the realities on the ground. This clearly poses several risks to operational success: there is a shortage of time to develop working relationships; it is impossible to procure sufficiently compatible equipment and CIS, leaving the force with a higher degree of vulnerability to interception and sabotage by

hostile forces; and the ability of forces to function "as one" is significantly undermined by cultural, language, and procedural barriers. In short, it takes significant effort to bring two (or more) forces together, which can undermine operational success. In the section to follow, we argue that the only way this can be remedied is to build targeted interoperability with selected partners that are interoperable prior to operational deployment.

The alternative to general interoperability is *targeted interoperability*. This is a result of deliberate decisions from leadership which bring two units (or more) together to interoperate for some set of missions on a particular time line. We define targeted interoperability as "a unit or collection of units that have overcome the cultural, technical, and procedural barriers to operating with its foreign counterpart(s) for specific functions." Both types of interoperability and their interactions are described in Figure 6.1.

Generating General Interoperability

Using the definitions presented above, we find that most activities the U.S. Army currently supports result in general interoperability. More specifically, these activities are not building, tracking, or maintaining a specific relationship which allows for future use in operations. Instead, these activities build a force more predisposed to solving the problems, and perhaps with fewer problems to solve, when coming together with foreign troops.

This implies an important caveat for interoperability: one cannot solve *all* problems of interoperability for *all* potential partners. This is amply evident in the difficult balance of technical (equipment, CIS, procedures) and human (individual and group dynamics) outputs that are needed. Some functions can indeed be made "turnkey" for any partner, the example being how far U.S.-led coalitions have come in solving interoperability in calling for close air support. Yet a nontrivial number of policies, such as those on blood product use (see Appendix D for more discussion of that policy), have prevented building general interoperability. Other problems arise for different reasons,

including the resistance to using partners' ammunition, including NATO-compliant 5.56 × 45 mm rounds.

Few programs have interoperability as their primary goal, and even fewer lead to standing, interoperable units that can be used to fight. For example, in our conversations with American and foreign troops, we found that while foreign units may attend joint exercises and training, their focus (rightly so) is on the training and readiness of the forces and less so on developing and maintaining lasting relationships between and among units—a critical component of operational and tactical interoperability.

Moreover, the communication networks they currently train and exercise on are not necessarily reflective of the networks that they might need in some future operations. This is not necessarily a criticism of specific training activities, but rather speaks to the nascent systemization of international communications, which is a significant technical as well as policy undertaking. In addition, the forces that come together in those events do not typically maintain contact with their counterparts once they depart the training event. If a coalition were to be put together, those units would not easily build on those specific experiences and the interoperability that was achieved during joint exercises and training, but rather would pull from their general understanding of interoperability to solve their next challenges quickly.

Nonetheless, some activities are indeed focused on specific aspects of interoperability. The standardization boards for technical messaging formats, as a specific example, aim to develop those standards, have them adopted by member nations, and therefore increase the amount of CIS interoperability among those nations. Adopting these standards and integrating them into a nation's service and joint equipment and operations is a clear indication of the operational demands for interoperability.

In addition to building some foundations for interoperability, existing security cooperation activities also make significant contributions to developing partner capacity and aligning strategic interests, key determinants of successful military cooperation in the future.

NATO Doctrine: An Example

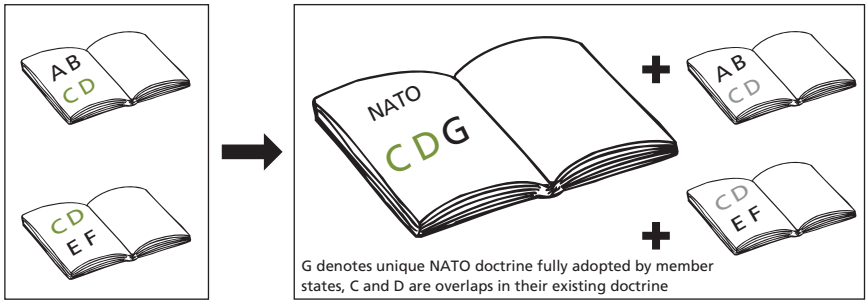
A particular activity to build interoperability is the engagement among doctrine writers in NATO and the increasing efforts to achieve consistency on lower echelons than in the past. NATO doctrine has historically been high-level, typically focusing on the division or corps levels and above. Tactical doctrine below has traditionally been left to individual member states, with some exceptions (such as specifications for message formatting and information requirements that we described earlier). This is consistent with the way that NATO was originally conceived, envisioning large formations—divisions, corps, and armies—to come together in countering Warsaw Pact armies, naturally prioritizing interoperability-building efforts on higher echelons. This focus has also shielded NATO members from looking too critically at each other's tactical formations and their abilities to execute specific TTPs and SOPs.

NATO doctrine is a common set of terms, ideas, and concepts that are ratified by NATO members and then used either as a whole (for countries with less developed doctrine) or to influence specific doctrinal approaches in the individual member states. The intent is to achieve *consistency* of member states' own doctrine with the NATO doctrine. In turn, the NATO doctrine is an amalgamation of individual members' doctrine (particularly of those with larger military power) but can also be written from scratch where there are gaps. To be ratified, the doctrine is necessarily "watered down"[4] from its original, single-nation form to make it acceptable to all 28 members of the alliance. This creates, at times, a gap between what the doctrine can provide to a well-developed military and what they see as being necessary to train for and potentially fight a war. Such a gap is then filled with individual member states' doctrine, leading to inconsistencies and difficulties in joint operations. We notionally describe the process in Figure 6.2.

As an example, AJP 3.2 (Land Operations) is similar to the latest U.S. Army Doctrine Publication 3-0 (Unified Land Operations).

[4] Several doctrine developers familiar with the development of NATO doctrine used this term. NATO LOWG, October 12–16, 2015.

Figure 6.2
Notional NATO Doctrine Development



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When querying doctrine experts, they agree they are about 60–80 percent similar.[5] Differences exist in specific roles and responsibilities, for instance, in what tactical command of a unit allows or disallows the higher unit to do to it. The U.S. Army doctrine might allow one to split up units to cover missions and tasks pertinent at the time—taking a company for which a BN has TACOM and putting a platoon in one place and another in a different place with a different set of tasks. Such flexibility is less acceptable in a collection of 28 nations who might be concerned how their units would be used as part of a coalition, and thus the NATO doctrine would place that kind of control at a much higher echelon.

The differences in a nation's service doctrine and NATO common doctrine may not be wholly detrimental to interoperability. Given the intent of doctrine to convey ideas and concepts and lead to coherence among nations, it is not a prescribed set of actions to conduct war. Thus, those prescriptions are necessarily left to the specific instantiation of a multinational unit, when a host of constraints are in play, least of which is what was written down in doctrine.

From an interoperability standpoint, NATO doctrine helps to make high-level doctrine similar among states, but leaves the details

[5] Various interviews, as part of the NATO LOWG, October 12–16, 2015.

of tactical and operational doctrine, TTPs, and SOPs (collectively the "procedures") to the exact instantiation of a multinational effort. To generate the low-level procedures, deliberate activities among those multinational nations, whether during initial unit formation (as part of an ongoing war), or during advanced training and exercises, is necessary since those simply do not exist as standards anywhere. Those low-level procedures should, in theory, be derived from the consistent higher-level doctrine, though the translation from top to bottom is not an exact science and considerable variation often exists in how countries turn that high-level doctrine into specific procedures. In effect, harmonizing doctrine among allied nations is an important effort to build general interoperability, but targeted interoperability is generally built through other means.

Recommendations for Building General Interoperability

In the previous discussion, we have highlighted that an interesting paradox—many activities aimed at building interoperability yield other, although complementary, results; developing partner capacity and aligning strategic interests—while other activities not intended to build interoperability in the first place, such as staff exchanges, have interoperability as a by-product. In our analysis, we have also highlighted that while doctrine harmonization is increasingly involving lower echelons, its broad and selective nature does not result in a complete overlap in how specific tasks are carried out—and does not address the intrinsic cultural and organizational differences between multinational units.

We conclude that building general interoperability would best be supported by:

- more frequent unit and leadership experiences with those activities that are deemed most useful to building interoperability, namely unit-to-unit relationships, staff exchanges, research and development, training and exercises, and consultations;
- reorienting the goals of those interoperability activities more toward building a general understanding of how soldiers and leadership should overcome interoperability challenges;

- providing sufficient resources and responsibility to units participating in joint events to resolve technical and procedural gaps and to replicate effective solutions they devise in other multinational engagements;
- tracking and disseminating lessons learned from multinational operations and activities, particularly when they require significant adjustments in existing operating procedures;
- assessing the readiness and capabilities of partner units and addressing specific gaps that may pose challenges in multinational deployments (further discussed in our discussion of targeted interoperability); and
- intensifying the deployment of exchange officers and supporting their contact with partner units once the exchange is completed.

Generating Targeted Interoperability

General interoperability typically involves a broader set of nations with which the United States has limited military interactions but whose support or collaboration it may require in the future. In other cases—particularly with its closest allies in NATO and ABCA—the United States has undertaken efforts to build "targeted interoperability," including the partnership between the 82nd Airborne Division and the United Kingdom's 16th Air Assault Brigade. Currently, the United States is contributing to the formation of NATO's Very High Readiness Joint Task Force (VJTF)—an ambitious concept requiring contributions of several partner nations and placing significant demands on participating units to deploy under short time lines and carry out highly lethal missions on NATO's periphery (we discuss VJTF in detail in Appendix C).

While multinational deployments are even further constrained by limited time and resources, they may result in targeted interoperability being achieved: consider the development of Afghan Mission Network (or AMN)[6] or American provision of complex services to French and British forces in Operation Unified Protector in Libya in 2011.

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[6] RAND's analysis of lessons learned from the AMN can be found in: Serena et al., *Lessons Learned from the Afghan Mission Network*.

In our interviews with U.S. Army and foreign officers, we learned that any remaining challenges to interoperability are often "worked out" on the battlefield, although at additional risk and often higher cost by slowing down the advances of multinational forces and creating a gap in mutual trust and ability to react to unexpected circumstances. In case of a conflict with a highly capable opponent, there may not be enough time to bridge all interoperability gaps. Moreover, while many current multinational events and exercises track lessons learned and solutions for specific interoperability challenges, many officers have voiced concerns that these are not always used to inform future interoperability-building efforts, or that frequent rotation of commanders leads to difficulties in sustaining interoperability between two units for a longer period of time. In short, while "solutions" often exist and have been identified by battalion and brigade commanders, the motivation or resources to implement them are often scarce.

Types of Units Built and Interoperability Demanded

Among North American Treaty Organization (NATO) partners and with European nations in particular, multinational units appear to be increasingly more the preferred option, driven in most cases by a desire to share the financial burden of operational readiness and foster political buy-in of allied nations. Indeed, in most cases, they are intended to provide a rapid response capability (consider VJTF and bilateral European initiatives), something that is particularly expensive, that would provide the EU or NATO with the ability to respond collectively to a crisis.

Generally speaking, there are two kinds of multinational units built through targeted interoperability—provisional and standing. The provisional units are those formed to provide on-alert reaction forces and are provisional in the sense that they exist for a period of a few years and then are disbanded (such as VJTF[7] and other components of the NATO Response Force). Standing units are set up for longer periods that reflect multilateral interests (such as the Franco-German Brigade [FGB] and the Franco-British Combined Joint Expeditionary Force [CJEF]).

[7] In the case of the VJTF, each instantiation of it would be stood up and service its purpose before being replaced by another instantiation with a different leadership and potentially different set of nations.

The Push Toward the Few

In the section to follow, we emphasize the importance of strong bilateral relationships over broader partnerships—built within a framework like NATO and ABCA. This is not intended to diminish their importance but to appreciate the limitations of large multinational alliances: they are indeed much more complex, cumbersome, slow, and at times ineffective when needed quickly, compared to their more nimble bilateral counterparts. This, naturally, has significant implications for interoperability. Some researchers have even called for treating multilateral alliances as a set of bilateral dyads: "Bilateral relations render multilateral cooperation less complex. Further multilateral cooperation may be understood dyadically or in the bilateral relations that compose the whole."[8]

It is important to understand the nation-specific nature of building interoperability and to appreciate trade-offs and trends in smaller networks of handpicked partners versus larger collections of allies in providing the highest operational and tactical value in operations. Interviews with ASCC personnel[9] highlighted the significant preference of U.S. partners to develop bilateral relationships with the United States relative to building multilateral coalitions. Most notably, building one-on-one relationships with the United States, through interoperability or otherwise, works around regional rivalries which can plague multilateral activities. Nonetheless, those bilateral relationship build from collective understandings of operations often built in a multilateral setting.

Long-term planning will rarely ever anticipate all interoperability requirements for each bilateral partnership, yielding certain differences between those most solidly prepared for multinational missions and those that will require additional resources to become fully interoperable. In conflict, different partners may choose to work within international frameworks at times, emphasize bilateral links at times, and

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8 Weitsman, *Waging War*, pp. 20–21.

9 Christopher G. Pernin, "What Is the Global Landpower Network and What Value Might It Bring," 2016.

even prefer complicated arrangements. As explained in the appendices, our look at French interoperability[10] expressly differentiated between working with and without the United States, and working within and outside of formal alliances (like NATO) to cover various potential ways an operation might unfold. Interoperability goals will similarly need to have such a variety.

Is Targeted Interoperability Short-Lived?

Tactical multilateral interoperability outside of an established alliance or agreement (like NATO) simplifies to sets of procedures and shared views of how an operation will be conducted, subject to prior national caveats. However, each individual decision made to create functional relationships and enable services to be taken and given among nations may not transcend that moment, mission, or group of units. Naturally, there are many individual decisions that can be made to bring nations together tactically; some are purely political, while others may offer critical value to the allied force. This unpredictability creates a difficult conundrum—targeted interoperability by nature depends on predefined requirements in specific partnerships, yet the U.S. military and its allies may not be able to predict and anticipate the precise nature of all operations they may be asked to carry out.

Value-Added of Targeted Interoperability

The general interoperability which comes from various security cooperation programs, enhancing our engagement with partners and allies, makes for good leaders and facilitates the transitioning to interoperable units. However, it mostly does not build actual, standing interoperable units. There are three critical reasons for building

[10] Specifically, the 2004 strategy for interoperability cites four scenarios in which the French may operate: with the United States (under U.S. lead) but outside NATO; with the United States (under U.S. lead) but within NATO; a European Union coalition (without the United States), with NATO; a European or ad hoc coalition (without the United States), without NATO. See Colonel Christian Cosquer, "L'interopérabilité au niveau stratégique," *Doctrine: Revue d'études générales*, No. 11, 2007, p. 28.

targeted interoperability in addition to ongoing efforts to build general interoperability.

First, the general efforts have not solved the well-known issues that have plagued interoperability for decades. For most personnel involved in multinational operations, interoperability is both difficult and time-consuming to build. More and more expensive technologies are involved with modern warfare, and the complexity of operations and allied involvement adds to the challenge.[11]

Second, given the different pace of change in each nation, the level of sophistication and technology renewal, and different force generation processes, the half-life of targeted interoperability—when it is built—is limited. Building enduring relationships between multinational units, and tracking and keeping those relationships active, is important to differentiate between standing (e.g., targeted) and general interoperability.

Third, there is evidence in the cases we have examined that several nations (including the United States) have resorted to the use of bilateral targeted units or units composed of a small number of nations as their solution to the interoperability problem. These have been proposed or built in addition to the general interoperability structures but have been an important addition, and one that has indicated the tactical and operational value of close partnerships.

In addition to these reasons, there are others supporting the need for targeted interoperability. For instance, cultural, language, and philosophy need to be aligned, yet such understanding is not generated through theoretical education and table-top exercises. Rather, it originates in habitual relationships that are built over long periods.

Moreover, given the preference for modularity in American land forces, expectations associated with U.S. flexibility in replacing one unit with another one cannot be translated to its allies' realities, where only a small number of units are trained for the highest levels of expeditionary and combat capacity, and the majority of European land

[11] See Brian K. Bass, David K. Bartels, Samuel A. Escalante, Dale R. Fenton, and Kurt J. Rathgeb, "Overcoming Joint Interoperability Challenges," *Joint Force Quarterly*, Vol. 74, July 1, 2014, pp. 136–140.

forces, for instance, still are best prepared for territorial defense. The differences in interoperability for expeditionary operations on the part of all partners, versus interoperability to enhance U.S. support to the territorial integrity of a partner, will necessarily be different.

The U.S. Army aims to keep units modular, which in theory should help with transitioning one "interoperability" type between units to another set of units. This, however, assumes that the bottlenecks for interoperability reside primarily in technical systems (CIS) and protocols. In our interviews with foreign units, and surveys of those responsible for building interoperability done in this project, however, we learned that interpersonal relationships and the complexity of the decision-making process are seen as key obstacles to multinational interoperability.

In our research, we have noted increased attention to building interoperability and limited clarity on what this entails: the U.S. Army has engaged partners in extensive training and exercises (tactical-level activities at NIE and JMRC), developed guidance emphasizing multinational deployments (including the Army's Operating Construct), and engaged senior leaders in developing high-level, strategic frameworks. Such increased interest in interoperability should, however, lead to a consensus on the specific types of services that individual forces are expected to exchange—and to defining the benchmarks for measuring that interoperability has been reached. In this section, we show how different operational loci and bilateral partnerships can be framed to understand where targeted interoperability gaps are.

Building targeted interoperability would best be served as an outgrowth of a force generally disposed to interoperability, although taking units that have never been exposed to the challenges of working with foreign partners could still occur, but at the expense of time and depth of relationships. In addition to the efforts to increase general interoperability, targeted interoperability would best be supported by:

- increased use of unit-to-unit relationships among foreign partners, directed and supported by Army senior leadership, to facilitate the ongoing and deep relationships that are necessary to be interoperable;

- a commitment to sustaining the interoperability built, with adequate resourcing;
- requirements adaptations, whether in personnel or equipment or training, that allow for units to build and sustain the necessary relationships between and among partners;
- investments in bespoke as well as common turnkey solutions to interoperability challenges.

CHAPTER SEVEN

Choosing Partners for Interoperability

In August 2014, the U.S. Army released strategic guidance for security cooperation which lists "Build Interoperability" as the third of four priorities for Security Cooperation (SC). The other three are: Operationalize and Institutionalize SC; Build the Capacity and Capability of Allies and International Partners; and Maximize Army Security Cooperation.

In the guidance, a framework is provided for the interoperability goal which illustrates nine types of potential partners, each having one of three levels of interoperability and one of three levels of capability/capacity. The framework further breaks the potential partners into three tiers in terms of interoperability. The three tiers are directly based on technical interoperability of communications and information systems, and indirectly based on recent experience. In the parlance of our framework, the temporal proximity of an engagement may be a proxy for individual, group, and procedural interoperability.

The framework as presented in the guidance does not insinuate a preferred "box" in which to reside. Furthermore, it does not indicate what actions might be necessary to move from one box to another. We propose that there are preferred combinations of interoperability and capability/capacity for any given partner, and that in order to get to that preferred position, a series of deliberate activities needs to be performed by the United States and partner nations.

Up until now, it seems that the position any partner may reside in is a result of many decisions made in light of numerous other goals, and not directly related to building interoperability for specific functions

and missions. As a result, interoperability is often an artifact of several other efforts (e.g., building a state's internal capacity may increase interoperability naturally by dint of the expertise, doctrine, equipment, etc. being transferred from one to another, which then makes them more compatible in the future). If the U.S. Army desires to be more deliberate about building interoperability, it faces an imperative of knowing where that preferred position for each partner resides and what it takes to build such capacity.

Such frameworks, admittedly, imply limited autonomy for a partner and expect U.S. leadership in a multinational campaign. Yet, as we emphasize in this study, interoperability is highly dependent on a partner's capacity and willingness to invest in force generation, modernization, and shared training. These decisions, naturally, are an outcome of a political process and have yielded less-than-desirable outcomes in the past. As a result, to build interoperability with partners, the United States will at times have to take a proactive role in defining force requirements and providing close support in reaching them.

Targeting What Kinds of Interoperability with Which Partners

Several considerations guide what kinds and with whom the United States should target interoperability. We list four broad, nonexclusive categories in Table 7.1, which can be used to help guide relationships with partners.

Hedging

The United States hedges through relationships with key geographic partners, either individually or as collections. Hedging partnerships are often associated with long-term military-to-military relationships built through alliances. Important venues for such efforts include NATO, ABCA, and FVEY, where specific agreements have been reached on technical solutions, operational requirements, and in some cases tactical procedures. This category includes a broader set of partners than the next category but also provides the United States with the great-

Table 7.1
Four Demand Sources for Interoperability

Category	Description	Examples	Challenges
"Usual Suspects"	Commonly operating with/beside United States, technically capable, generally expeditionary, generally politically aligned	Partners might include: UK, France, Australia, Italy, Canada	Perceived dismal historical record and limiting preconditions
"Plan-Focused"	Fill needs/ requirements in known war plans and near-term needs	Key plans include: Baltics, Korea	Few explicit interoperability requirements
"Hedging"	Alliance partners, bilateral, and special relationships	Agreements might include: NATO, ABCA, FVEY; mutual defense treaties; capability MOUs	Unclear scenarios, missions; unclear/ disparate interoperability goals
"Ops du Jour"	Real-time provision of services among nations	Operations might include: confronting ISIS	Difficult to predict and plan; varied preconditions; disparate partners

est geographic reach and combined capability. Individual relationships can also have the tenor of broader hedging policies. For instance, the U.S. force posture in northern Australia entails "collaboration between their planning processes to strengthen interoperability and cooperation, with a focus on submarine systems and weapons, helicopters, and combat and transport aircraft."[1]

Hedging partnerships include partners that are generally politically and strategically aligned for some set of potential future activities, and likely have experience operating with the United States. Because these alliances and partnerships do not necessarily span all types of operations and functions, the partners may or may not be technically advanced or able to "plug into'" U.S. units easily. With at times broad

[1] Quadrennial Defense Review, 2014, p. 24.

mandates for the alliances, the specific missions and functions across which members would need to be interoperable may not be easily discerned or broadly accepted. Thus, defining what specific functions members need to be interoperable for can be a challenge.

Given the breadth of this definition, this group includes partners of varying capability and readiness while facing the greatest ambiguity about the types of missions to carry out. General interoperability is a precondition for successful collaboration with all partners in this category, with targeted solutions needed or built on a case-by-case basis.

"Usual Suspects"

This category focuses on a subset of partners with whom the United States has experience operating jointly and receiving close support from. While the threshold for such level of collaboration is difficult to define, we use the term "Usual Suspects" to describe partners like the United Kingdom, France, Australia, Italy, and Canada. Other partners may be included in this group given specific contributions to previous missions, generally satisfying these conditions on top of those for hedging partners:

- are technically capable and able to plug in (either quickly or with some amount of effort) with only minor adaptations;
- are expeditionary and able to sustain troop presence for the duration of a large-scale campaign;
- are politically and strategically aligned in a way that enables them to take losses where other allied partners would exercise significant national caveats.

In recent operations, smaller nations like Denmark and New Zealand have made significant contributions to U.S. military operations and incurred human and economic losses.[2] As a result, both small and large nations may be part of this group: interoperability-building in these relationships will take advantage of previous experience and highly

[2] Consider Danish commitment to stability operations in the Helmand province of Afghanistan and New Zealand's contributions to U.S.-led operations since the Korean War era.

developed infrastructure, as well as political willingness to undertake significant operational risk.

However, as the recent retreat of Canada from a military campaign in Syria illustrates, the support of even the closest U.S. allies is not blind, and many other factors, including domestic ones, are typically at play. As a result, building interoperability with partners in this category should be driven by:

- realistic assessment of targeted interoperability needs, gaps, and feasibility of solutions to bridge them (see the forthcoming section *Tracking and Maintaining Interoperability* for specifics);
- lessons learned from past operations, most critically the human element of interoperability; emphasis on fostering trust and cultural understanding will enable multinational troops to resolve technical and other "hard" challenges;
- provision of sufficient resources to regularly train and exercise jointly and to capture "institutional memory" between units whose personnel may be rotating out over time;
- development of turnkey interoperability solutions for certain functions that commonly are provided from one partner to another.

Plan-Focused

In region-specific war plans, the United States may expect to engage with partners or allies in specific ways where interoperability can be defined a priori. Such plans can be the key drivers of targeted interoperability-building efforts, and the foundation for assessing specific interoperability needs. Thus, during the planning process, military planners can detail what services are expected from those partners, ensure that those requirements are validated and resourced, and then track how those investments fare to complement overall readiness of the force. This takes communication between the United States and her partners as to what is expected from the relationships in an operational context. It also entails working through the sensitive nature of war planning, which often is not readily shared with potential partners.

Several potential scenarios motivate plan-focused interoperability: defense of the Baltics from Russian incursion; protecting Seoul[3] from long-range artillery and eliminating WMD in North Korea; integrating U.S. and partner anti-access and area-denial capabilities to deter China; and others. In each case, there are no unilateral U.S. means of prosecuting operations, and each has significant consequences if interoperability is not properly executed.

Plan-focused interoperability need not be as detailed as a war plan, but rather could be based on a set of specific missions which have ongoing importance, but an evolving set of potential partners and geographic locations. For instance, as part of a now 15-year set of operations, the global war on terror entails specific types of missions to occur across the globe. Those missions generally entail working with partners of all types, but through sharing known, finite functions. Knowledge of how those interactions occur with varied partners exists, and a set of interoperability partners, processes, and requirements can be developed.

The problem with driving interoperability from war plans is that, from the standpoint of the United States, very few may have actual requirements for interoperability detailed in them that can be resourced. In our interviews, interoperability requirements—except for broad statements—are not detailed. This is for a variety of reasons mentioned earlier, yet it contributes to a planning ambiguity in the United States and abroad, leading to an asynchronism in acquisitions, exercises, and other interoperability activities.

"Ops du Jour"

We coin the broadest and most diverse group of partners as those engaged in "Operations du Jour": ad hoc military collaborations that have limited or no foundation in previous engagements and planning,

[3] The United States and South Korea have been working together for nearly 60 years but have only recently created a combined division (which is in addition to the Combined Forces Command at the strategic level). And those units within the combined division are still under the control of their national structure. See Joshua Tverbert and Jennifer Bocanegra, "The 2nd Infantry Division," *Army*, July 2015.

and often have significant political in addition to tactical and operational value. There are three key reasons to engage such partners:

- political and strategic rationale in the United States or third country (this may include a territorial dispute in which the United States is not directly involved but whose nature may have broader implications in the international order);
- a need to use a third country to successfully prosecute war for which limited allied resources are available, particularly in hard-to-reach locations and in operations conducted at short notice with little prepositioning of troops and supplies possible;
- collaboration in HA/DR-like operations in which the United States decides to provide military means to assist a country in national emergency but little previous military-to-military experience has been collected.

In all these situations, the United States may resort to finding the lowest common denominator solutions for interoperability—such as analog technology, deployment of liaison officers to bridge cultural or equipment (CIS) differences, a temporary basing of maintenance and refueling services on a third country's territory with limited infrastructure in place, etc. Provided that no or limited resources are available from the third country, the requirements of these missions will typically differ significantly from those outlined earlier as most of the solutions will need to be provided by the U.S. military.

As a result, the type of engagement will require some of the following:[4]

- reaching a political agreement on the type of assistance required;
- setting up communication links with local military units to exchange information in real time or with limited latency;

[4] Examples of challenges faced in HA/DR and other similar operations in Asia-Pacific have been described in Scott Griffin, "Multinational Communications Interoperability Program Brief to Disaster Management Initiative Workshop," U.S. Pacific Command, November 5, 2012.

- providing financial and technical resources to third country in exchange for services provided to U.S. troops;
- coordinating with civilian, international, and nongovernmental authorities to optimize the deployment of combined resources, achieving as much unity of effort as possible;
- disseminating information to the public as needed, particularly in mass-casualty events, and preparing for a broader international engagement in the future.

Yet, despite the strategic unpredictability, specific technical solutions are possible in select functions that are typically envisioned, like prepackaged communication and repeater systems built and trained on for fast deployment in contingencies.

Targeted Versus General Interoperability with Partners

The four categories naturally delineate two examples each of targeted and general interoperability, though with spillover. U.S. Usual Suspects and Plan-Focused partnerships will most directly depend on targeted interoperability solutions developed well in advance of a joint deployment with select groups. The difference will be in the scope of functions targeted for interoperability. With Usual Suspects, a broader view of functions across joint operations may be included, with ultimate goals to be fairly sophisticated and inclusive in the interoperability built. As high-end tactical command and control systems are built in the United States it may be a requirement for us to coordinate and ensure that they are interoperable with a small collection of partners with whom we usually operate. For the Plan-Focused partnerships, the list of functions may be more limited—providing limited ISR support or fire support to a select group of partners—in which case the solutions themselves may be simpler and more easily maintained and updated.

In turn, hedging may entail broader collections of partners, which may or may not have specific functions identified for interoperability, but rather be working toward general understanding and cogni-

zance of interoperability challenges and solutions. Through the lens of hedging, approaches to overcoming interoperability challenges might be adopted, and opportunities may arise from those engagements for more targeted interoperability solutions. As an example of the latter, the VJTF instantiation (targeted interoperability in support of specific missions) arose out of the significant NATO work on building general interoperability, and blossomed to include more nuanced and targeted solutions.

Ops du Jour will likely rely only on some limited, general interoperability, with specific solutions tailored to mutual needs after an operation commences (or immediately prior). This distinction, however, does not ignore the importance of baseline general interoperability in broad alliances such as NATO, where the capability and readiness of forces varies significantly, and within those alliances where typically only a handful of partners will offer the resources and commitment to truly develop targeted interoperability solutions. Moreover, plan-based partnerships can, in theory, be conducive to developing targeted interoperability solutions, yet their breadth and potential variation has in the past prevented U.S. and partner forces from creating fully integrated multinational units. Thus, among the three types of partnerships most in need of targeted interoperability solutions, the second category—Usual Suspects—are best predisposed to achieving truly sustainable interoperability outcomes.

General interoperability will also entail building some matériel solutions to overcome equipment, particularly CIS, incompatibility. As LTG Ben Hodges recently described from his vantage point working with NATO allies on specific missions (as quoted in Freedberg[5]), the priorities should be secure FM radios so U.S. troops can talk securely and to allies without being jammed, and shared data that allows troops to see a common operating picture (COP), so that U.S. and allied commanders see the same situation on their screens.

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[5] Sydney J. Freedberg Jr., "Upgraded Radios, Networks Needed for Russian Challenge; Troops Fine: Lt. Gen. Hodges," *Breaking Defense*, September 24, 2015.

Tracking and Maintaining Interoperability

In the previous discussion, we made a distinction between general and targeted interoperability, different types of partnerships, as well as standing and provisional interoperability. Yet all this would be limited to the realm of theory if accurate tracking of interoperability levels and gaps was not put in place. With knowledge of the desired interoperability objectives and the status quo, military planners and multinational partners can develop pathways to achieve desired outcomes.

In many cases, building interoperability is very closely correlated with building partner capacity. As a result, interoperability is not a product of U.S. decisions—rather, its development must be addressed by partners jointly, with significant commitments made by both or all partner nations. Political willingness to build interoperability solutions, however, does not guarantee long-term success. In other words, interoperability has a fairly short half-life and mutual commitment is necessary.

For instance, following protracted conflicts in Iraq and Afghanistan, NATO allies reached a level of interoperability that has few parallels in history, yet many have voiced concerns that it would be lost if these relationships were not sustained and used to strengthen the Alliance. In addition, specific solutions developed in these operations—such as the Afghanistan Mission Network—are likely to require significant resources to stand up in another conflict.[6]

Interoperability Tracking Tool

In our discussions with multinational troops, we have not learned about a universal tool to track the level of partners' interoperability with U.S. forces. In this section, we propose how such an Interoperability Tracking Tool could be structured, and what the benefits of its use would be. We acknowledge that while each operation will have slightly different requirements on U.S. multinational partners, col-

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6 Freedberg, "NATO Wargame Proves Better Networks Needed to Deter Russia."

lecting information about partners' capabilities underpinning mutual interoperability would serve as an important component of decision making in multinational operations. A general assessment framework, shown in Table 7.2 could further be developed to establish a metric for interoperability across several dimensions. A composite index could then be formed to assess the resulting interoperability across five key interoperability outcomes:

- Aligned Procedures (unit-centric interoperability);
- Compatible Equipment (equipment-centric interoperability);
- Interoperable Communications and Information Systems (systems-centric interoperability);
- Individual Interoperability (staff-centric interoperability); and
- Shared Art of Mission Command (commander-centric interoperability).

As presented above, calculations for the composite index do not weigh individual scores and individual subfunctions of warfighting functions (which could have further subcomponents), but specific weighting could be easily implemented (particularly by partner and operation type). By nature, every composite score reduces the fidelity of any assessment; however, a systematic approach of this nature offers significant benefits: it can identify strengths and weaknesses across a portfolio of interoperability activities and outcomes, linked to the functions and types of operations, and contrast several partners and their ability to accommodate future interoperability needs. In addition, it can serve as a tool in discussions with policy makers as they consider different partnerships and types of operations.

If implemented, each of the "future operational needs" could set minimum scores for a potential partner nation in order to be considered for collaboration—and with real-time data collected in operations, these could be adjusted over time. This tool could also provide JMRC and other training centers with important information about strengths and weaknesses that the partner nation must address on its own, those that the United States can remedy itself, and those whose solutions will require joint effort. Most importantly, any effort to build

Table 7.2
Tool for Tracking Partner Interoperability

Country/Unit: _____ **Last Updated:** _____

Functional Role		**Past Operational Experience**		**Past Operational Experience**	
Plan-Focused	☐	High-Intensity Combat	☐	High-Intensity Combat	☐
Hedging	☐	Direct Combat-Support Role	☐	Direct Combat-Support Role	☐
Usual Suspects	☐	Non-Kinetic Role	☐	Non-Kinetic Role	☐
Ops du Jour	☐	Auxiliary Role/Political Support	☐	Auxiliary Role/Political Support	☐

Scoring of (Actual Ability) / (Desired Ability) Scale from 0 (low) to 5 (high)		**Aligned Procedures**	**Compatible Equipment**	**Interoperable CIS**	**Individual Interoperability**	**Shared Art of Mission Command**	**Status**
Fires	Integrate Fires[1]	3/3	3/3	3/3	3/3	3/3	
	Provide Fire Support	5/5	4/5	4/5	5/5	5/5	
	Integrate Air-Ground Operations	1/1	1/1	1/1	1/1	1/1	
Movement and Maneuver	Projection and Deployment						
	Tactical Troop Movements						
	Occupy an Area						
Intelligence	Etc.						

Table 7.2—Continued

Scoring of (Actual Ability) / (Desired Ability) Scale from 0 (low) to 5 (high)		Aligned Procedures	Compatible Equipment	Interoperable CIS	Individual Interoperability	Shared Art of Mission Command	Status
Warfighting Functions	Etc.						
Mission Command	Etc.						
Sustainment	Etc.						
Protection	Etc.						
	Status						
	Recent Activities	Two exchange officers in 2/1 AD as of 15 Mar 2016 (DAMO-SS) FM 5/109th participated in Bde ops in Iraq with 3ID Strong attendance in "Allied Spirit" and "Allied Endeavor" (JMRC) Some discussions of PRC-117 purchases (DSCA)					
	Future Directions	Need to focus on our ability to provide them fire support in maneuver operations • Should redirect missions/scenarios in exercises • Should encourage them to adopt our C2 system • Should …					

[1] Department of the Army, "The Army Universal Task List," FM 7-15, February 2009.

toward some interoperability outcomes would have a consistent set of motivations and structure underpinning them so that expectations can be set ahead of time.

Conclusions

To date, very little is known about how interoperable the U.S. Army should be with its partners, and any interoperability that is seen tends to result from decisions made in light of numerous other goals, and not directly related to building interoperability for specific functions and missions. As a result, interoperability as defined in this report is often an artifact of several other efforts rather than a goal unto itself. To build interoperability with partners, the U.S. Army will at times have to take a proactive role in defining goals and requirements and provide closer support to units on both sides in reaching them.

Several considerations guide what kinds of and with whom interoperability should be built. We defined four broad, nonexclusive categories which add precision to the relationships we might want with partners: usual suspects, plan-focused, hedging, and ops du jour. The first two typically lead toward targeted interoperability with specific partners, functions, time lines, and other factors planned and executed; the latter two are more general interoperability focused, building the relationships and knowledge to overcome interoperability challenges should they need to be in the future.

With the types of interoperability being built, the activities underpinning it, and the delineation of what types of partners the United States wants them to be, this data can be used in support of planning for operations, programming for cooperation support, and better understanding the goals and limitations of current activities toward building interoperability.

CHAPTER EIGHT

Findings and Recommendations

In modern warfare, hardly a conversation about military capabilities occurs where interoperability with another organization—multinational or not—does not come up. Significant literature exists on all types of interoperability, with the common refrain being that *more and better interoperability is needed*. And, with few exceptions in recent decades, the United States tends to engage with multinational partners and allies in military operations, thus bringing multinational interoperability to the fore.

So, with all this interest, why is the United States not interoperable when and how it wants? There are several reasons why, including a lack of understanding of the significant resources it takes, a lack of motivation to expend real time and money from not knowing the real value in doing so, and a one-size-fits-all attitude when it comes to finding solutions. This report looked at what motivations do exist, and defined a reasonable framework from which to work if and when interoperability goals and investments meet strategic language.

Trends in Interoperability

Several trends guide how interoperability might look in the future, and have changed how interoperability was seen in the recent past. They generally fall into the following categories:

- The move toward more tactical exchange of services among nations;

- Being interoperable with more and different nations in a greater variety of operations;
- Desire for interoperability at the onset of operations.

These trends imply challenges and opportunities, bringing in new organizations to meet the needs, and being able to understand the dependencies thus created on readiness, bespoke solutions, costs, and other factors.

Overcoming Challenges

The main challenges to building interoperability are quite well known. They have existed since nations began working together, and are highlighted time and time again in lessons learned documents generated after operations or through training and exercises. Though often described in disparate language, there is no argument that both the challenges, and by extension the desired interoperability outcomes, are:

- **Communications and Information Systems (CIS) interoperability:** the ability for CIS between nations able to connect and work together;
- **Individual interoperability:** the ability for soldiers to understand each other;
- **Art of Command (AoC) interoperability:** the ability of commands to share a sense of purpose and command style;
- **Procedural interoperability:** the ability to follow similar procedures, be they tactical or strategic, without detrimental misunderstanding;
- **Equipment interoperability:** to have equipment that works together on the battlefield.

The relative importance of these varies greatly. Through casual polling of operators, the importance of each would vary considerably based on mission, partner, and warfighting function, among other

factors. A look at the literature seemed to favor overcoming CIS challenges, but that was more likely linked to the common definitions of interoperability being more technical in nature. And interviews with higher-level leaders in our partner countries seemed to focus more on growing relationships among commands and individuals. With that, so it goes, all other problems can be worked out. In the end, a balance of technical and social aspects of interoperability will be necessary, and that balance will be highly nuanced on what you hope to get from it.

So how do you build it? The U.S. Army has a wide variety of activities that in part lead to some interoperability outcomes as described above. The programs range widely, across at least ten activity categories. And our look at 192 underlying programs within those activity categories defined a top five that stood out for building interoperability (in order of ranking): Unit-to-Unit Relationships, Staff Exchanges, R&D, Training and Exercises, and Consultations.

As expected, practical activities that promote cohesion and understanding between military staff (staff exchanges) and military units of different nations (unit-to-unit type) are of the highest relevance for building interoperability. R&D-related programs, consultations, and training and exercises also were significant, indicating the need for programs that rely on both compatible infrastructure (such as weapons systems and communications tools developed through R&D partnerships), a frequent information exchange between armed forces, and active participation in exercises and training events.

There is no clear consensus or empirical evidence for which activity types make the greatest contributions to building interoperability. It is generally agreed, however, that the activities themselves necessarily aid in increasing knowledge of cultural affinities, building individual and group relationships, and overcoming or at least identifying procedural or technical differences. Our elicitation of subject-matter experts on the contribution of activity types to interoperability outputs, however, does shed some light on how programs could be put toward outcomes desired (Figure 8.1).

Figure 8.1
Schematic Description of Key Contributors to Interoperability Outcomes

	Aligned Procedures	Art of Mission Command	Individual Interoperability	CIS	Compatible Equipment
Training and Exercises	✓	✓		✓	
Multinational Operations	✓	✓	✓	✓	
Education			✓		
Staff Exchanges			✓		
LNOs			✓		
Unit-to-Unit Activities			✓		
R&D				✓	✓
Equipment Transfers				✓	✓

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General Versus Targeted Interoperability

To date, these activities have with only limited counterexamples, provided for what we termed *General Interoperability*—a force and leadership predisposed to and effective at solving the complex operational and tactical challenges of working with disparate foreign partners. Focused on general interoperability, units prepare and operate with foreign partners as needed, employing institutional and ad hoc solutions to overcoming interoperability challenges. And this can take time in advance of operating together, or limit the functions that can be shared among partners.

In a few instances, and certainly as implied by the trends in demand for interoperability above, there is what we have termed *Targeted Interoperability*—a unit or collection of units that have overcome the cultural, technical, and procedural barriers to operating with its

foreign counterpart for specific functions. This targeted interoperability allows for units to come together quickly to perform operations, with expectations for how much and what type of services will be provided from one to another. While general interoperability is being picked up from the ambient atmosphere of building relationships and working in multinational operations, targeted interoperability tends to be deliberately planned and executed, and as such can wither and die without plans for sustainment.

In this study we also defined four broad, nonexclusive categories to begin parsing the types of relationships the U.S. Army might wish to have with partners. They were:

- **"Usual Suspects":** those partners commonly operating with or beside the United States, and who may be technically capable, generally expeditionary, and often politically aligned;
- **Plan-Focused:** those partners implied by known war plans and near-term needs;
- **Hedging:** those partners as part of alliances and who have special relationships that warrant closer operational and tactical relationships for mutual support;
- **"Ops du Jour":** those partners that arise from surprise or evolving operations that may not have been known ahead of time.

The categories naturally delineate two examples each of targeted and general interoperability, though with spillover. The first two most directly depend on targeted interoperability insomuch as a priori plans can be made to provide services from one to another in support of operations. The latter two mostly adhere to general interoperability, though they can lead to targeted interoperability solutions—in the first case as units are built from member states, like NATO's VJTF, and in the latter case as interoperability solutions are generated in real time to support operations.

With the types of interoperability being built, the activities underpinning it, and the delineation of what types of partners the United States wants them to be, this data can be used in support of planning for operations, programming for cooperation support, and better

understanding the goals and limitations of current activities toward building interoperability.

Recommendations

With the framework as described, there are several possible actions senior leaders should take to move interoperability forward.

Be More Specific About Interoperability Requirements

To move beyond extant strategy and doctrinal documents that generally call for more of it, interoperability needs to be a requirement levied on units, equipment, and training, with appropriate top-down direction of what kinds, with whom, and how they should both fund and sustain it. Interoperability requirements for the near term should come from the ASCCs[1] (and COCOMs), but should also be driven by a longer-term view of the environment and relationships the United States would like to build with key partners.

Because of the nature of the values from interoperability—from tactical through strategic and political—senior policy makers from many offices may need to be involved with setting the right requirements. Binning partners across the typology proposed here, and defining the functions on which Army forces should be interoperable, should be iterative and evolve as more information as to how much, of what type, and with whom is available.

Assign Agency for Building Interoperability

Responsibilities associated with interoperability currently exist in many places within the U.S. Army. Tactical units remain responsible

[1] The ASCCs already have the role to "Develop and propose Army [Multinational Force Interoperability] MFI issues for inclusion in their respective regional combatant commanders' integrated priority lists, theater security cooperation plans, regional strategies and/or country support plans, and respective sections of the Army Campaign Support Plan. . . . Develop and inform the DCS, G-3/5/7 of the combatant commanders' Army MFI requirements, objectives, and priorities . . . [help] periodically assess progress . . . and identify causes of shortfalls and propose measures to address them." See U.S. Army Regulation 34-1, "Multinational Force Interoperability," July 10, 2015, p. 9.

in ongoing operations to connect with foreign partners, under strict guidelines levied from partners and U.S. commands. Combatant commands have to determine how much and with whom interoperability should be a priority. Requirements and doctrinal writers have to include interoperability into plans for the future. And HQDA needs to prioritize and program for all of this activity in the context of the near- and far-term force. As and if interest in interoperability grows, an overarching agent will be necessary that can balance the long-term needs of the force with the near-term expenditure of funds to meet operational requirements. Discussions should ensue from a great number of stakeholders as to how much, with whom, and what type, with ultimate decision making being held at HQDA four-star level to ensure unity of purpose and command.

Orient Activities

To support interoperability better, currently available activities can be oriented to better support building interoperability. This will come at the expense, perhaps, of other goals. And those activities can be positioned differently depending on whether "general" or "targeted" interoperability is most desired.

Develop "General Interoperability" Widely

The United States needs forces attuned to the troubles and values of working with partners. This means maximizing opportunities for soldiers to experience working with foreign partners, and overcoming the challenges inherent in multinational operations. Top leadership will drive these initiatives through additional opportunities for exchanges, multinational training and exercises, and subscriptions to coalition interoperability solutions, among others. Funding will need to follow, should general interoperability grow in line with senior leader expectations.

Deliberately Build "Targeted Interoperability"

Building more targeted interoperability is possible, and finding the right sets of motivations and support from the partners will ultimately drive how far the Army can push it. The Army can deliberately build

targeted interoperability by integrating partner units into military plans and providing the additional resourcing to foster deeper relationships. First off, this will entail defining specific, unit-to-unit relationships to aid in providing direction to units. This will mean having to choose which units focus on which foreign counterparts, which will be more difficult for the United States with a larger rotational force than with foreign counterparts, which typically have more individual dedication to units.

Built interoperability will atrophy quickly, so you will need a plan to keep relationships together, continue to refresh them, and means of testing how interoperable and effective the relationships are. For targeted interoperability especially, sustainment plans will need to be built that cover the expectations for the units involved and address the issue of rotations.

And, for all but the most robust of relationships, goals for interoperability should start small, with a few functions, then grow from there. There is a propensity to search for one overarching solution to meet all functional needs, be they an experience like a training event or a software system or piece of equipment. But in recent experience, interoperability is only built through the hard slog of interoperability outcomes, tailored to the partners, functions, and time lines involved.

Communicate with Partners

Letting partners know, either generally or specifically, what capabilities and interoperability on which functions are most useful (and eliciting the same information from them) would serve many purposes and help to generate unity of purpose as efforts are expended.

Actively Measure and Monitor Interoperability Levels

For leadership to know what they have built (what services, from where, etc.), there will need to be a means for monitoring and testing interoperability. This will undoubtedly lead to discussions about readiness and monitoring (and defining) of interoperability readiness. However, some sort of scorecard or assessment card (like the one developed in this report) could go a long way in at least asking the right questions to begin with, and collecting appropriate information.

Develop Turnkey Solutions

Some solutions can be widely applied to specific, common functions across many disparate partners. Commonly discussed are finding communication solutions which can easily be transferred and connected, means for a common operational picture, and general understandings of how command and control will work in particular combat operations. Each has the potential for turnkey-like solutions, where the United States alone, or with its partners, develops solutions which can be transferred or shared among disparate actors. These turnkey solutions, be they hardware or detailed procedures, can create conditions to reduce the time necessary to bring forces together. Because of the extent of possible interoperability among forces, there should be no expectation that all functions can be made turnkey for all partners; however, some of the more regularly used functions should be considered to help build a baseline from which more targeted interoperability could be built.

Final Word

Building multinational interoperability can be technically challenging and politically charged, and often takes longer than expected. To date, ad hoc work-arounds to interoperability, like liaison teams or bespoke communication systems, tend to dominate the solution space, and typically at the cost of additional money, time, or reduced capabilities. As the U.S. Army looks toward interoperability in the future, with more varied partners on shorter time lines and at more tactical levels, a different set of activities and focus will likely be needed.

This will begin with additional top-down direction on how much interoperability, with whom, and on what time lines is required of the forces, along with subsequent changes to force structure and programming. The general interoperability that has been built through various activities has enabled our forces to solve many difficult interoperability challenges, usually at the expense of longer time lines and more limited functional utility. As we look toward the future, and the potential for increased targeted interoperability with specific partners, more careful

and deliberate planning will need to occur. Without that deliberate work, the senior leadership should prepare for less integration of our partners that take even longer time lines for operational effectiveness in the future.

APPENDIX A

Short Discussion of Interoperability Successes and Failures in Iraq and Afghanistan

Interoperability—or a lack thereof—has been at the forefront of military planners' minds for several decades. When commenting on the SFOR mission in Bosnia and Herzegovina, for instance, Admiral Johnson (a former Commander U.S. and Allied Naval Forces) argued that not technical but rather political obstacles were a major challenge he faced: "prohibitive national caveats [are like] a cancer that eats away at the effective usability of troops" (Kreps, 2008, p. 562). In the following section, we review scant academic and other literature on coalition operations and interoperability, with a particular focus on the recent coalition campaigns in Iraq and Afghanistan, and suggest that the distinction between technical and "other" aspects of interoperability is often emphasized, with most authors agreeing that personal relationships between multinational units as well as political will are the key driving forces of interoperability in coalition operations worldwide.

Iraq

In his analysis of the international arms industry, Austin (2008) argued that operations in Iraq and Afghanistan showed that "national security constraints restrict the transfer of cutting edge technology, which in turn limits technical interoperability between nations." Besides the lack of technical interoperability between allies, he also pointed out that "despite fighting alongside each other since 2001, U.S. and UK forces have conducted limited pre-deployment training together."

This lack of unit-to-unit cohesion is argued to have been the reason for misunderstandings and errors in Afghanistan and Iraq (p. 42).

In their work on coalition interoperability in high-tech environments, Paul T. Mitchell (2007) from the Canadian Forces College distinguishes between coalitions and alliances. While the former are described as those based on "a limited number of [shared] interests," the latter denotes shared interests of greater length and depth. He claims that "coalition partners may be competitors in other issue areas, or may choose to oppose the interests of each other even on related issues," citing the lead-up to the Iraq war in 2003 and disagreements with key U.S. allies. Yet he underscores that cooperation "does not imply a perfect harmony of interests," but rather a "mutual adjustment of policy by two or more states" (p. 94).

In his analysis of coalition interoperability, Trepka (2005) argues that while technology is "a key contributor to the achievement of interoperability; the operational commander must balance between technology and information to gain an acceptable level of interoperability." He also suggests that imperfect information sharing was a prime obstacle hindering interoperability in Iraq (Trepka, 2005, p. 2). This was echoed by Admiral Giambastiani, U.S. JFCOM, in a 2004 statement on Operation Iraqi Freedom Lessons Learned to the House of Armed Services Committee (emphasis added):

> Capabilities that fell short of expectations or requiring new initiatives to redress shortfalls include: Battle Damage Assessment, Fratricide Prevention, Deployment planning and execution, reserve mobilization, and coalition *information sharing*. (Trepka, 2005)

Trepka argues that liaison officers were the prime driver of interoperability in the Operation Iraqi Freedom:

> During Operation IRAQI FREEDOM, US CENTCOM relied on LNO's at the tactical level to gain coalition interoperability. Additionally, in Operation IRAQI FREEDOM, the LNO concept expanded to include LNO C2 equipment. The U.K. Royal Navy accessed information on SIPRNET via a U.S. C2 system with the LNO providing the security and operation of the terminal.

Leonid I. Polyakov (2004, str. 61) highlights the importance of predeployment preparation for interoperability between the United States and Ukraine (as well as other allies) in Iraq, including the joint peacetime training and courses for multinational staff officers in Kyiv.

Afghanistan

In their discussion of Swedish participation in ISAF (Sweden was in charge of one of the 25 PRTs), Östberg et al. (2013) highlight the difficulties in communication between civilian and military members of the PRTs and in communicating and sharing lessons learned with other PRTs in the country. They underscore that "interoperability is a hallmark for a community of interest (COI), i.e. units sharing and exchanging information in the pursuit of common goals or missions" and that "interoperability anomalies [were] believed to be present in most of the 25 PRTs at work in Afghanistan" (p. 399). While they do not focus primarily on international collaboration, some of the lessons learned from civil-military relations apply to multinational coalition operations. Östberg et al. refer to a 2011 government report that makes the following observations (emphasis added):

> Advised by the Swedish Defense Research Agency (FOI), Sweden in 2010 established a civil PRT office co-located with the Swedish military forces. The office is headed by an ambassador from the Ministry of Foreign Affairs, and the rest of the staff are advisers from various Governmental agencies (including FOI). Formally, and contrary to the military office, the civil office reports to the Embassy in Kabul. One negative consequence of this organization is that the *advisers don't know if they "belong" to the embassy or to their respective agencies in Sweden*. The general view is that this is a hindrance to synergy between the agency capabilities. Another often-voiced view is that the *civil office was established too late and is understaffed*. As to the civil-military synergy, a major drawback is that there are *no common Terms of Reference for the two colocated offices and their meetings.* Besides the valued informal information exchange at the meetings, the primary function of the meetings is that the military side can ask the civil side on

> its views on the military planning and can ask for support for ongoing and planned operations. With regard to Chasing Civil-Military Synergy, the primary obstacles are (i) that there *is no formal synergy-enhancing structure in place*, and (ii) that there *are at least two different chains of command in place*. Synergies often evolve on a person-to-person base, but now and then[1] *agencies change their PRT representatives*. An even more problematic situation is the Swedish International Development Cooperation Agency (SIDA), the most important civil agency in Sweden's PRT, *does not have a seat at the PRT ISAF table*—nor does SIDA want their aid projects to be militarily "tainted."

When discussing the ways of building interoperability, Fellinger (2013, p. 12) cites the following anecdote to illustrate difficulties of achieving interoperability between ISAF forces in Afghanistan:

> In 2007 in Ghazni province Afghanistan [*sic*] a company of Polish Infantry was responsible for, amongst other tasks, manning guard towers for an American Infantry battalion. Two rockets fired into the base were observed by one of the Polish towers. They immediately determined the point of origin and called it to their company command post. In turn the company command post translated the position into English and called the American Infantry Battalion Tactical Operations Center. This information was relayed to the Battalion Fires Effects Cell, where clearance of fire for both the Poles and American forces commenced. It took over 30 minutes to clear fires because the Polish Company did not understand the task and their visually identified point of origin was more than 400 meters from the electronically acquired point of origin. After clearance had been achieved, the call for fire mission was relayed back to the Polish company command post and to the tower to observe for effects. Again, delays ensued as it was explained first in English, then in Polish to the command post and the tower. After another 30 minutes the American Battalion Commander cancelled the counter-fire mission.

[1] This most likely refers to frequent changes of PRT representatives by different agencies.

The findings of an AAR that the U.S. battalion commander conducted suggested the following issues caused the delay:

- language differences that included military terminology;
- lack of common call for fire procedures;
- lack of cultural empathy;
- limited understanding of force capabilities;
- lack of common target reference points known to the tower guards and the command posts;
- misunderstandings of national caveats. (pp. 12–13)

The remedies to address these challenges included:

- a greater focus on improving personal relationships with the Polish officers;
- participation of Polish soldiers in counter-fire battle drills; and
- the use of panoramic images of the terrain in towers and command centers to establish common target reference points. (pp. 12–13)

Fellinger concludes by underlining that this effort did not pay off very well as the Polish infantry company rotated out of Afghanistan shortly after a small degree of interoperability was achieved (p. 13).

Fellinger further argues that the Brigade Combat Teams remaining in Europe—the 173rd Airborne Brigade Combat Team (ABCT, Germany and Italy) and the 2nd Cavalry Regiment (CR, Germany)—have had (emphasis added):

> few genuine opportunities to train with NATO allies unless it was during a Mission Readiness Exercise (MRX) prior to a deployment to Afghanistan or Iraq. *Relationships built at the BCT or battalion level with host nation forces or other NATO allies is encouraged but is neither formalized nor funded*. It is generally left to the *discretion of each commander* to select and nurture partnerships based on personal preference, unit location, or type of unit. *Daily garrison interaction with allies is virtually non-existent.* In general, *customs, courtesies, and capabilities are not understood*. This is partially a result of the training and preparation cycle

> American units undergo prior to deployment, and partially a result of American arrogance. There is very *little time for a deploying unit to do anything other than training prescribed by higher headquarters*, and time spent with a unit with a foreign unit is generally considered to be time not well spent. With the drawdown in Afghanistan, Europe based units will not be as constrained by pre-deployment requirements. Using this time wisely allows for enhanced interoperability during the next operational employment of NATO forces. (p. 14)

Fellinger emphasizes in detail the difficulty of building interpersonal relationships between multinational forces prior to deployment (emphasis added):

> Few American service members stationed either in the United States or Europe have the opportunity to work with foreign armies until they are themselves sharing a base in a combat zone. This often leading to *misunderstandings or worse, mistrust when the consequences are most significant*. While training events like [the 173rd Airborne Brigade Combat Teams' (ABCT) Full Spectrum Training Event (FSTE)] and others listed in the 2012 EUCOM Posture Statement are a good start towards interoperability, they are most effective if these *relationships are maintained following the event*. The 173rd ABCT returned to the same training area for another training exercise 5 months later, with none of the multinational partners from the previous FSTE. One solution for more timely development of these relationships is to require the Europe-based units to maintain formalized training relationships with similar units in allied countries. (pp. 15–16)

In his discussion of challenges that NATO faces in the area of C4ISR, Georges D'Hollander (2011), the general manager of the NATO Consultation, Command and Control Agency, highlighted several of the problems NATO has faced in achieving interoperability. He describes:

- NATO's *lack of agility*: "it still takes far too long between the war fighter requesting a capability and NATO being able to deliver

this into theatre. . . . We have had to find short term fixes to interoperability challenges and this has led to concerns over resilience, reliability and our ability to sustain and support";

- a *lack of coherence*: "we still focus on projects rather than programmes or capabilities. We fail to take a 'system of systems' view and recognize that 'end to end' interoperability is the real goal. . . . [Our processes and funding structures] all too often result in operational stovepipes . . . with no single body taking responsibility for coherency and interoperability.

He cites the Afghanistan Mission Network and a revitalized role of a NATO Chief Technology officer as some of the new solutions developed to address these deficiencies. Yet, describing the challenges in Afghanistan, he argues that when coalition forces worked together in theater, it was "difficult (if not impossible) to add-in interoperability on or after the event," highlighting both technical interoperability as well as aspects that include "people, process or ways of working" (p. 17). Instead of using a system designed as "plug and play," he argues NATO rather resorts to "plug and pray" (p. 17).

Fellinger's emphasis on the human element is reiterated in the work of Rubinstein et al. (2008), who focus on the cultural aspect of achieving multinational interoperability, arguing that (emphasis added):

> while it is relatively straightforward to describe and try to accommodate surface cultural differences between groups (e.g. hierarchical versus decentralized), it is much harder to harmonize *deep* cultural differences. Yet these deep cultural differences—which particularly involve the ways in which *people understand and feel about what they experience, and whether they believe and feel that they are being taken seriously or not*—are significant complicating factors to horizontal interoperability.[2]

[2] Horizontal interoperability is defined as one "among various kinds of international actors," while vertical interoperability "denotes work with local populations."

To underscore the difficulty of building vertical interoperability with the local stakeholders, Rubinstein et al. also cite the example provided by recognized humanitarian Michael Bhatia (2008), who observed that:

> In addition to the over 30,000 soldiers deployed to Afghanistan as part of ISAF, NATO and the United States, there are thousands of expatriates in Afghanistan, predominantly concentrated in Kabul. Yet many foreign "helpers" live sheltered from daily life in Afghanistan—rarely traveling outside of Kabul and only interacting with Afghans as colleagues, servants or beneficiaries. Closeness is prevented by guard posts, compound walls, restaurants and the closed doors of white land cruisers.

Executive Director Ewell from the U.S. European Command argues that the command structure diversity has been one of the challenges for interoperability in Afghanistan—for instance, over 100 different dialing procedures existed for calling within ISAF command structure (Ewell, 2009, str. 4). He argues it took three years to build a reliable ISAF information domain consisting of NATO Secret, ISAF Secret, CENTRIXS-ISAF, and CENTRIXS-GCTF platforms (str. 8). As of his writing, information sharing among NATO allies was noncentralized with "long lead times, low flexibility and limited functionality" (str. 11).

Charles L. Barry from the National Defense University agrees with Ewell in putting emphasis on communications that help build interoperability (Barry, 2009, p. v):

> The most critical interoperability systems are those that link forces together, that provide secure and continuous network integration, both voice and data. These are the networks that support the *six operational functions of: command and control, intelligence, fires, movement and maneuver, protection and sustainment*.

He also comments on the demands put on civilian-military cooperation in multinational operations similar to Iraq and Afghanistan (p. vi, emphasis added):

> Interoperability with a civilian agency poses relatively new concerns. Most civilian agencies use commercial systems that may be difficult to connect to Army technologies for *procedural and policy reasons as well as technology*. However such connectivity has become more critical in theaters such as Iraq and Afghanistan. The Army needs more research on technological solutions to this requirement. However, the only immediate solution may be continued investment in commercial *off the shelf systems* for Army users who have to interoperate with civil agencies.

As Barry noted, to evaluate CIS interoperability, NATO considers these four levels, out of which most allies are at level 2 while the midterm goal for the Alliance is level 3:

- Level 4: Seamless sharing of information—integrated data transfer applications;
- Level 3: Seamless sharing of data—common data exchange model;
- Level 2: Structured data exchange—manual and automated read;
- Level 1: Unstructured data exchange—manual read only.

Focusing on other than technical challenges, an STA report authored by Diane Boettcher asserts that the focus in building interoperability is on people, not machines (however essential they are for netcentric warfare) (Boettcher, 2008, p. 1). She underscores the difficulty nonnative speakers of English face when interacting with American forces (including French-speaking Canadian units), as well as the "digital divide" between active duty members who are familiar with digital communication tools and those who are not (she refers to young recruits and the active duty force under the age of 26 as "digital natives"). In her assessment, the solution for this challenge is to institute training in

collaboration tools at all levels and schoolhouses (p. 2). However, she underscores that it is often cultural barriers that are the "most daunting" (p. 4), referencing previous scholarship by Tapscott and Williams. Together with language and cultural differences, the existence of multiple communication platforms may lead to misunderstandings in combat—as the following example used by Boettcher illustrates (p. 7):

> Today, staff officers in both Baghdad and Kabul regularly have over five computers on their desks to coordinate with the various coalition partners. In addition to NIPRnet (an unclassified DoD network connected to the Internet) and SIPRnet (a classified DoD network), the typical warfighter may need CENTRIX (Combined Enterprise Regional Information Exchange System), a NATO-classified system and other local or regional networks.

APPENDIX B

U.S. Army-U.S.M.C. Interoperability Problems in the Battle of Fallujah

The Second Battle of Fallujah (November–December 2004) is illustrative of the kinds of problems that arise when two different militaries conduct a combat mission together as an integrated force. The two forces in question were the U.S. Army and the U.S. Marine Corps. Although there is no evidence tying the problems they encountered to any mission failures or particular casualties, some of the problems represented significant risk and could well have led to catastrophe. At the very least, there is reason to believe that the soldiers and Marines in Fallujah could have operated more effectively had there been fewer problems, or had the two forces been better prepared to interoperate. The Fallujah case illustrates the difficulties and risk involved in interoperations: If the U.S. Army and Marine Corps encountered problems working closely together, logic dictates that the forces of different nations almost certainly would have more problems with even greater associated risk.

"Reinforced Interoperability"

Operation Al Fajr often is usually written about as a Marine Corps operation, and certainly it is something Marines can justly refer to with pride given the sheer courage, grit, and valor Marines demonstrated in what was their toughest urban fight since Hue. The battle was, however, a joint Army-Marines operation, with a number of Army units playing a central role, in addition to numerous others operating in a

wide variety of support capacities. At the center of the fight were two Marine Regimental Combat Teams (RCTs), each with a subordinate Army armored task force (ATF) providing a significant portion of the RCTs' combat power (see Table B.1). The two ATFs were equipped with Abrams tanks and Bradley Infantry Fighting Vehicles.

What should be stressed was that the battle plan for Fallujah did not call for dividing the city into distinct Areas of Operation (AO) and assigning different sectors to "like" Army and Marine units. In that case interoperations would have consisted of deconfliction and measures taken to prevent fratricide. Rather, Fallujah was a case of what one French general has described as "reinforced interoperability," meaning that the two elements were integrated, worked in close coordination, and offered one another complementary services.[1] More specifically, the plan called for dividing the city between the two separate RCTs. Within each sector the Army ATFs were called upon first to punch through the sectors toward objectives in the center of the city and then work with the Marines as they backfilled and made repeated efforts to clear territory of insurgents. They began with separate tasks but then focused on joining forces to achieve common objectives. The two forces, moreover, brought different but complementary capabilities to bear, with the Army providing the firepower and protection associated with heavy mechanized infantry.

Table B.1
The Northern Assault Force Regimental Combat Teams

RCT 1	RCT 7
3rd Battalion, 5th Marines (LTC Patrick Malay)	1st Battalion, 8th Marines (LTC Gareth Brandl)
3rd Battalion, 1st Marines (LTC Willard Buhl)	1st Battalion, 3rd Marines (LTC Michael Ramos)
Army Task Force 2nd Battalion, 7th Cavalry (LTC James Rainey)	Army Task Force 2nd Battalion, 2nd Infantry (LTC Peter Newell)

SOURCE: McWilliams and Schlosser, 2014, p. 7.

[1] Thorette, "La vision française d'une interopérabilité renforcée," p. 83.

Interoperability Problems

There was some effort prior to the battle to ensure smooth interoperations, most notably with respect to planning. The Marine commanders welcomed Army input regarding the best use of the Army's armor.[2] Once the operation kicked off, however, the Army units working with the Marines encountered a number of problems, at least according to a study written by Matt Matthews for the Combat Institute Press in 2006.

According to Matthews, there were problems related to technical matters, but mostly it was a question of different practices and doctrines. They might have had the same equipment but used it differently, or simply made different choices regarding which equipment to rely on for doing the same tasks. In other instances, the two forces worked together without specific problems, but, at least according to some in the Army, the Marines might have been more effective and suffered fewer casualties if they had made fuller use of the capabilities the Army units offered. Mostly the Marines who failed to make full use of the Army or were slow to figure out how were simply unfamiliar with Army capabilities and thus needed to learn. In a few others, the Marines refused help, perhaps out of parochialism or pride, suggesting the importance of teaching unit commanders not just how to interoperate but also the importance of being willing to ask for help.

Communications Problems

The most significant—and potentially dangerous—problems that Matthews identified related to communications networks and the flawed effort to build a common operational picture. The problem was part technical, but part institutional or procedural (i.e., which equipment one uses and how one uses it).

For example, the two forces used different equipment to communicate or used it differently. The Army relied on radios and other equipment, whereas the Marines tended not to use radios and instead used

[2] Matt M. Matthews, ed., *Operation AL FAJR: A Study in the Army and Marine Corps Joint Operations*, Global War on Terrorism Occasional Paper, Fort Leavenworth, Kans.: Combat Studies Institute Press, 2006, pp. 27–35.

other equipment, above all Internet chat. More specifically, the Army used FM, Force XXI Battle Command, Brigade and Below (FBCB2), and Blue Force Tracker, whereas the Marines used tactical satellite radio, mIRC, Internet Relay Chat (mIRC CHAT), and command and control for the PC (C2PC). "At the very least," Matthews observes, "these competing systems caused friction."[3]

The Marines relied on Microsoft Chat, and they had a wireless chat capability that the Army lacked. According to one source cited by Matthews, the Army was slow to realize what the Marines were doing and why the RCT radio networks were so quiet.

> I'm not sure what system it was or how they did it, but the RCT-7 FM command net was a pretty quiet net. We were pretty much the only people that talked on it because the RCT conducted command and control over chat. . . . But we didn't have that ability forward with us. I think that's one of the things that, had I recognized that fact earlier, it would have paid huge dividends for us in the fight. . . . We couldn't monitor what the other battalions were telling the RCT because they didn't call them on the FM net; they told them on SIPR chat. We had the ability to monitor that SIPR chat back at our TOC in Fallujah, but the only effective system we had to transmit messages from the TOC at Camp Fallujah to the TC—which is where the colonel and S3 were forward was the Blue Force Tracker. This is a good system but slow. . . . Even though our TOC and TC were only separated by less than 10 kilometers, we had almost no FM communications between them. . . . The TOC had situational awareness at the RCT level but I would say the TAC didn't have it as good as it should have, had I figured out that we needed that SIPR chat system forward.[4]

Complicating the problem was a lack of compatibility between the Army and Marine SIPR systems. To put matters simply, the Army could not plug its SIPR terminals into Marine SIPR drops, and in any

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[3] Matthews, *Operation AL FAJR*, p. 79.

[4] Matthews, *Operation AL FAJR*, pp. 58–59.

case there were few Marine drops available.[5] The Army S6 was able to work out the problem, but it took time and effort in the middle of a battle.

Army commanders in the TOC also struggled with communications problems related to the fact that the Army and Marines had different versions of the same phone, with the Army phone being a newer version. The two were not compatible. According to one source cited by Matthews,

> Initially, we couldn't dial an Army number from the Marine Corps phone at all. It took a couple of days but, eventually, the RCT-7 signal guys were able to figure out how to let us call back to FOB Normandy, but they could only give us one line that they could configure that way. They had to use all the others to talk to their chain of command. So the number we got, we established as the 2-2 TOC. But to call anybody else, like brigade or any other Army phone number, we had to go back through Germany, to a switchboard in Germany, to have them patch us into the Army network, which limited our ability but at least we were still able to communicate.[6]

One Army unit obtained a Marine phone connected to the Marine network. That worked, but that also limited the unit's mobility. They had to stay where their Marine phone was.[7]

Commenting on the communications problem, one commander said that "there were a couple of times when it got hairy and there were a couple close calls with blue on blue, or fratricide, just because the common operating picture between the Army and the Marines is not there."[8] Matthews said that the most significant problems with communications occurred at the company level, where Army company commanders found it difficult, if not occasionally impossible,

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5 Matthews, *Operation AL FAJR*, p. 23.

6 Matthews, *Operation AL FAJR*, p. 23.

7 Matthews, *Operation AL FAJR*, p. 56.

8 Matthews, *Operation AL FAJR*, p. 79.

to communicate with adjacent Marine companies.[9] One Army commander noted that "it was extremely difficult to conduct adjacent unit and cross-boundary coordination."[10]

Army officers also complained about the difficulty of getting Marine air support, for they found that, technical matters aside, what they lacked were Marine air liaison officers. "Not having somebody who was actually tapped into the system, who knows people in the system and how it functions, that made air not an option for us unless it was something big."[11]

One problem that might have had catastrophic consequences was confusion related to the Marines' insistence, as per Marine standard operating procedures, on ordering a communications security change (that is, having everyone switch over to new frequencies and codes) in the middle of the fighting in compliance with a preestablished schedule. Army commanders learned about the scheduled changes during the fight and resisted, believing that making the changes was a tricky proposition in the best of circumstances and was downright dangerous in the middle of a battle.[12] The Marines went ahead with the changes, while different Army units responded differently. Matthews comments that rectifying the changes and getting everyone on the same page "did not significantly impede mission progression," although it did "prove time consuming and difficult."[13] Indeed, the details he provides make clear that the communications problems represented a significant distraction and obstacle to efficient operations at a particularly inconvenient moment. Matthews cites one Army commander who describes having to wrestle with the frequency issues amid an ambush:

> The insurgents came to life and started shooting. When several minutes later no one from TF 2-2 answered an RCT net call, they started checking the nets looking for us. Within minutes of that,

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9 Matthews, *Operation AL FAJR*, p. 80.

10 Matthews, *Operation AL FAJR*, p. 55.

11 Matthews, *Operation AL FAJR*, p. 49.

12 Matthews, *Operation AL FAJR*, pp. 27–35.

13 Matthews, *Operation AL FAJR*, p. 50.

> LTC [Gary] Brandl from 8th Marines dropped a radio back to the old 7th RCT fill and contacted me to remind me they were changing fills. At that moment I had literally just watched one of my tanks hit by an RPG and another skip across the ground in front of me and hit one of A/2-2's HMMWV's (the RPG did not detonate and ended up lodged in the HMMWV's back tire). Once I explained that I was in the midst of an ambush and could not change fills right away, LTC Brandl contacted 7th RCT who then dropped a radio back to the old fill to allow them to monitor our fight until we were done.[14]

There were also reports indicating that intelligence between the two sides did not flow as easily and as quickly as desired owing to connectivity issues as well as procedural matters. Deconfliction problems also allegedly led to the crash of Army UAVs.[15]

Doctrinal Issues

There were also issues related to different tactics and the use of the kinds of capabilities the heavy Army units brought to the fight. Army commanders, for example, found that the Marines used what were to them outdated tactics.[16] The Marines also appear to have been slow to understand how best to make use of the capabilities Army units offered. They persisted in a number of tactics that resulted in high casualties rather than avail themselves of Army firepower and protection. According to one observer, the problem was quite simply a lack of familiarity with what the Army could do and how one might incorporate the Army's assets into Marine urban warfare tactics. Similarly, others complained that the Marine commanders never fully grasped how quickly heavy mechanized infantry could move through the city, which caused problems with respect to the timing and coordination of movements.[17] In some instances, Marines refused offers of assistance

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[14] Matthews, *Operation AL FAJR*, p. 51.

[15] Matthews, *Operation AL FAJR*, pp. 42–83.

[16] Matthews, *Operation AL FAJR*, pp. 55–56.

[17] Matthews, *Operation AL FAJR*, p. 82.

by the Army, a problem Matthews chalks up to parochialism, or perhaps quite simply pride.

Conclusion

The problems associated with Army-Marine interoperations during the Second Battle of Fallujah appear minor in the context of the larger success story. However, they are highly suggestive of the kinds of problems that two forces from different countries are likely to encounter, with the caveat being that forces from two different countries are likely to encounter more problems and thus run greater risk.

A number of the problems were of a purely technical nature—such as plugging Army SIPR terminals into Marine SIPR drops or getting Army encrypted telephones to talk to Marine encrypted telephones. Others had more to do with institutional practices, such as the Marines' preference for Internet chat over FM radios, or their communications security practices. What is striking about those problems is that they bespoke unfamiliarity with one another and a lack of joint training or operational experience of the sort that would have enabled the two forces to identify problems and deal with them prior to joining battle. As it happened, they successfully addressed the problems, but they had to do so at the most inopportune time possible (i.e., in the middle of a battle). One cannot assume, moreover, that holes in the common operating picture resulting from communications breakdowns or the inability of a company commander to call for help might not result in calamity in a future fight.

Doctrinal issues similarly point to problems with training. The Marine units at Fallujah cannot be blamed for failing to anticipate having to interoperate with Army mechanized units in an intense urban fight. However, clearly there is a benefit to be gained in ensuring a greater familiarity with a partner's capabilities and art of war if there is an expectation of working together. Better Marine tactical coordination with Army armor in the battle would not have changed the outcome of the battle, and certainly not of the war, but it might have resulted in fewer Marines killed.

APPENDIX C

Very High Readiness Joint Task Force

At the 2002 Summit in Prague, NATO agreed to form the NATO Response Force (NRF), "consisting of a technologically advanced, flexible, deployable, interoperable and sustainable force including land, sea, and air elements ready to move quickly to wherever needed, as decided by the Council."[1] One of the explicit goals of this new force was to improve the military capabilities of the Alliance. NRF is intended to be deployed within 30 days of activation. Select NRF capabilities have been used on various occasions in the past—but never in a combat environment (an example of a NRF deployment is an air-bridge function in the aftermath of the Pakistan earthquake in 2006). Both NATO and non-NATO nations have been involved in NRF, with Ukraine and Georgia, notably, pledging their troops to the response force.[2,3]

Less than ten years after NRF was activated, NATO member states agreed at the 2014 Wales Summit to create a new "spearhead" rapid reaction force as part of the Alliance's Readiness Action Plan (RAP).[4] The spearhead force would be a part of the larger NRF and has been named the Very High Readiness Joint Task Force (VJTF).

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1 NATO, "Prague Summit Declaration," *NATO OTAN*, May 6, 2014.

2 "Rasmussen: NATO Accepted Georgia's Offer to Join Response Force," Civil.ge, October 10, 2013.

3 Ministry of Foreign Affairs of Ukraine, "Distinctive Partnership Between Ukraine and NATO."

4 Daniel Wasserbly, "NATO 'Spearhead' Force to Take Shape by February 2015," *International Defence Review*, October 7, 2014.

Its mission is to provide NATO with an agile brigade-size response force that could deploy its "lead elements" within 48 hours to NATO's periphery and thus "significantly enhance the responsiveness of the NATO Response Force." Figure C.1 provides an overview of the main initiatives that have been part of RAP.[5]

While it originally consisted of European contributions, the United States pledged its support in June 2015, contributing functions to VJTF's land, air, maritime, and special operations forces components. Moreover, RAP has called for an overhaul and the doubling in size of the larger NRF, which would consist of four parts:

1. a **command and control** (C2) structure,
2. the **spearhead** (brigade-size VJTF),
3. an initial **follow-on forces** group (VJTF troops and assets just rotating into or out of active spearhead standby duty),
4. a pool of **allied response forces** (outer-lying assets and capabilities across the allies that could be seconded if needed).[6]

A military official at SHAPE has described VTJF as a "deterrent to escalation, and this makes it particularly suitable for hybrid warfare. If we see infiltrators or terrorist attacks creeping into a situation, the VJTC could be sent to work alongside a country's police, security, and border authorities to halt the activity before it reaches a crisis."[7]

Since its inception, NRF has never reached a full state of readiness and deployability as originally envisioned, which may change with the creation of VJTF[8] (NRF 8, which was declared fully operational in 2006, was filled to only 81 percent of the scheduled capacity, with a

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5 "How Is DoD Responding to Emerging Security Challenges in Europe?" Testimony of Under Secretary of Defense Christine Wormuth, House Armed Services Committee Hearing, February 25, 2015.

6 "NATO Ramping Up Military Exercises in 2015," *IHS Jane's Defence Weekly*, March 12, 2015.

7 "NATO Ramping Up Military Exercises in 2015."

8 "NATO Ramping Up Military Exercises in 2015."

Figure C.1
Main Components of NATO's 2014 Readiness Action Plan (RAP)

- Enhancing the NATO Response Force (NRF) to make it more responsive and capable;
- Establishing a Very High Readiness Joint Task Force that will consist of a multinational brigade, supported by air, maritime, and special forces;
- Creating new, small NATO headquarters units—known as NATO Force Integration Units (NFIUs)—in Bulgaria, Estonia, Latvia, Lithuania, Poland, and Romania;
- Raising the readiness and capabilities of the Headquarters Multinational Corps Northeast in Poland;
- Enhancing NATO's Standing Naval Forces with greater numbers and more types of ships.

RAND *RR2075A-C.1*

long-term average reaching just 47 percent of full capacity[9]). This has been often attributed to the ongoing ISAF mission in Afghanistan, the 2008 global financial crisis and defense budget cuts in most NATO member states,[10] and an absence of "serious U.S. participation."[11] Significant criticism of the original NATO Response Force focused on its time to deploy (estimated to require two to four weeks for the whole NRF and a week for the Immediate Response Force—a VJTF predecessor created in 2010).[12]

Origins

Arguably, the primary driver for the creation of VJTF was Russian military actions on NATO's eastern flank, particularly in Georgia and Ukraine. The Alliance has also cited ISIS and other less conventional

[9] ETH Zurich, Department of Humanities, Social and Political Sciences, Center for Security Studies.

[10] "NATO Ramping Up Military Exercises in 2015."

[11] ETH Zurich, Department of Humanities, Social and Political Sciences, Center for Security Studies.

[12] Wasserbly, "NATO 'Spearhead' Force to Take Shape by February 2015"; and ETH Zurich, Department of Humanities, Social and Political Sciences, Center for Security Studies.

threats as other reasons for its inception. However, given the regional focus in training exercises, the development of logistical support networks in the Baltics, Poland, Romania, and Bulgaria are a clear indication that VJTF is designed most specifically to address the threat of Russian incursion into NATO's eastern member states.

In May 2014, NATO commenced "Assurance Measures," consisting of intensified air policing, AWACS surveillance, maritime patrol, as well as increased exercise and bilateral training activity.[13] The creation of VJTF was one of the key "Adaptation Measures," alongside the enhancement of NRF as a whole, establishment of multinational NATO command and control presence in eastern member states (through a creation of six NATO Force Integration Units[14]), and enhancements to the NATO Naval Forces capabilities.[15]

NRF has arguably helped build a degree of interoperability not previously demanded.[16] With qualitative standards for training, most units and headquarters have passed the relevant certifications; however, some argue this has been reached by NATO's ISAF operation rather than by a specific focus on building interoperability through NRF alone.[17]

Participation

Contributions of varying size and capability have been made in 2014 and 2015. Nine NATO nations participated in the June 2015 exercise, with others pledging future support. The list of commitments made so far is outlined in Table C.1.

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[13] NATO, "NATO's Readiness Action Plan," Fact Sheet, February 2015.

[14] Each is expected to host "several dozen" NATO personnel (NATO, "NATO's Readiness Action Plan").

[15] NATO, "NATO's Readiness Action Plan."

[16] Guillaume Lasconjarias, "The NRF: From a Key Driver of Transformation to a Laboratory of the Connected Forces Initiative," Research Paper 88, NATO Defense College, January 2013.

[17] ETH Zurich, Department of Humanities, Social and Political Sciences, Center for Security Studies.

Table C.1
Early Commitments to VJTF

Participation in Exercises	Pledges of Future Support
Czech Republic (air mobile troops)	United States (special operations forces, intelligence, and other high-end military assets)[a]
Netherlands (air mobile troops)	United Kingdom (leadership role in 2017 and up to 1,000 troops from 16th Air Assault Brigade and four RAF Typhoon jets for air policing)[b]
Germany (mechanized infantry, up to 2,700 troops, transport aircraft, HQ in 2015)[c]	Turkey (leadership role in 2021)[d]
Norway (mechanized infantry)	Romania (regional headquarters and force integration units)
Poland (special forces)	Bulgaria (force integration units)[e]
Lithuania (special forces)	France (leadership role)
Belgium (artillery)	Italy (leadership role)
United States (helicopter lift)	Spain (leadership role)
Hungary (civil-military cooperation unit)	

NOTES: [a] Phil Stewart, "U.S. Pledges Troops, Equipment for NATO Rapid Response Force," *Reuters*, June 22, 2015.

[b] Tim Ripley, "Ready to Go: UK Rapid Reaction Forces Return to Contingency," *IHS Jane's Defence Weekly*, June 17, 2015.

[c] "German Troops to Tip the New NATO Spearhead," *The Local*, December 2, 2014.

[d] Sevil Erkus, "Turkey Will Lead NATO Spearhead Force in 2021," Atlantic Council, May 14, 2015.

[e] "Defense Minister Fallon: Britain to Lead 'High Readiness' NATO Force," Atlantic Council, February 5, 2015.

Structure of VJTF

Three multinational brigades will be devoted to the VJTF concept at any time:

- one brigade will be preparing for activation (stand-up VJTF capacity),

- one brigade has a very high readiness for rapid deployment (standby VJTF capacity), and
- one brigade is still available after the standby phase (the stand-down VJTF capacity).[18]

The first and the third are meant to serve as "reinforcements" for the standby, high-readiness VJTF brigade. The brigade-size force is expected to consist of up to five battalions.[19]

Operational command of the NRF currently alternates between NATO's Joint Force Commands in Brunssum, the Netherlands, and Naples, Italy, and these centers will also be responsible for commanding the VJTF.[20] France, Germany, Italy, Poland, Spain, the United Kingdom, and Turkey have pledged to assume lead roles for the VJTF on a rotational basis in the coming years, with further contributions from the United States, Czech Republic, Netherlands, Denmark, and other member states.

Characteristics of VJTF

As a unique component of NRF, VJTF is designed to be activated within seven days, with its leading units ready for deployment within 48 hours.[21] Logistical support of the NRF and the Spearhead force is currently being formed as NATO Force Integration Units (NFIUs) are being established in the Baltic countries, Poland, Romania, and Bulgaria (this includes prepositioning of equipment and command units).[22] NFIUs will "work in conjunction with host nations to identify

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[18] Dutch Department of Defense, "Geannoteerde agenda bijeenkomst Navo-ministers van Defensie op 24 en 25 juni 2015 te Brussel," June 12, 2015.

[19] Daniel Wasserbly, "NATO Exercises to Hone 'Spearhead' Rapid Reaction Force Plans," *IHS Jane's Defence Weekly*, March 27, 2015.

[20] "NATO Response Force," *NATO OTAN*, May 11, 2015.

[21] Polish Armed Forces General Command, "Poland Prepares to Support Exercise NOBLE JUMP," *NATO OTAN*, June 11, 2015.

[22] Daniel Wasserbly, "NATO's Stoltenberg Chides Russia's Snap Exercises," *IHS Jane's Defence Weekly*, May 27, 2015.

logistical networks, transportation nodes, and supporting infrastructure to ensure NATO high-readiness forces can deploy into an assigned region as quickly as possible."[23]

The North Atlantic Council will be the ultimate authority on its deployment, reiterating the need for consensus among member states on potential deployment. Once the NAC makes a decision, the NATO's Military Committee (consisting typically of three-star generals) reviews the actions to be taken and works with SACEUR and NAC until a final operational plan is ready.[24]

Current Developments

Throughout spring and summer 2015, the first VJTF exercises took place, with nine NATO nations participating in a large-scale exercise in western Poland under the code "Noble Jump."

The largest exercise so far, Trident Juncture 2015, took place between September and November 2015 in Italy, Portugal, and Spain and involved 36,000 NATO and allied troops with the primary goal to test the NATO Response Force.[25,26] The scenario was set in the fictional African country of "Sorotan," with General Hans-Lothar Domröse indicating the goal was to prepare VJTF for more than just "the eastern threat."[27] Nonetheless, the exercise was to include elements directly derived from Russia's potential actions against NATO member states:

- outside aggression against Sorotan;
- terrorist and disguised military activity;

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[23] Wasserbly, "NATO's Stoltenberg Chides Russia's Snap Exercises."

[24] Brooks Tigner, "NATO Looks to Speed Up Its Decision Making," *IHS Jane's Defence Weekly*, June 26, 2015.

[25] Supreme Headquarters Allied Powers Europe, Exercise Trident Juncture 2015 Academics, January 16, 2015.

[26] Wasserbly, "NATO Exercises to Hone 'Spearhead' Rapid Reaction Force Plans."

[27] Brooks Tigner, "NATO's Largest Exercise in Over a Decade to Focus on Expeditionary Warfare," *IHS Jane's Defence Weekly*, July 16, 2015.

- rapid and covert positioning of weaponry such as artillery;
- subterfuge to undermine the country's government;
- cyber-attacks and other aspects of hybrid warfare;
- chemical warfare effects;
- amphibious operations; and
- information and propaganda campaign.[28]

The command and control elements of the NRF were certified during this exercise and VJTF was tested as part of this broader NRF exercise.[29] Key functions exercised included ISTAR, C2, interoperability, STRATCOM, and sustainment for the VJTF.

Operational Focus

The Alliance has stressed quality over quantity, limiting exercises to realistic sizes while adding "cyber elements, ballistic missile defense, and 'hybrid' threats that include everything from information warfare to high-end conventional military maneuvers" to exercise scenarios.[30]

French General Jean-Paul Palomeros, NATO's Supreme Allied Commander for Transformation, has argued for a strong need to involve "decision making" chains in the exercises as an expedient decision-making process first approving VJTF's and NRF's action is crucial for VJTF to achieve its goals.[31]

Timeline

It is expected that full operational readiness will be achieved in 2016–2017, with high levels of preparedness achieved in the fall of 2015.[32] The 2016 NATO Summit in Warsaw is expected to make

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[28] Tigner, "NATO's Largest Exercise in Over a Decade to Focus on Expeditionary Warfare."

[29] Brooks Tigner, "NATO Ramping Up Military Exercises in 2015," *IHS Jane's Defence Weekly*, March 12, 2015.

[30] Wasserbly, "NATO Exercises to Hone 'Spearhead' Rapid Reaction Force Plans."

[31] Wasserbly, "NATO Exercises to Hone 'Spearhead' Rapid Reaction Force Plans."

[32] Claudia Major, "NATO's Strategic Adaptation," SWP Comments 16, March 2015.

decisions on final shape and form following a number of exercises in 2015 and 2016.[33,34]

Level of Interoperability Required

Given its multinational character, interoperability among allies will be critical for VJTF's success. Several interoperability challenges may be identified as directly linked to VJTF's mission and structure:

- political obstacles and delays in mandating VJTF's deployment (similar to EU's Battle Group concept);[35]
- ability to effectively project strength on its own;[36]
- dependence on U.S. strategic airlift capability;[37]
- missing infrastructure in Europe that hinders rapid deployment of heavy armaments by rail (incompatible rail connections);[38]
- complex border clearances that require up to two weeks to obtain approvals to transport a brigade across continental Europe;[39]
- high cost of keeping troops in a state of high readiness;[40] and
- training and capability deficits of some allies' armed forces.[41]

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[33] Major, "NATO's Strategic Adaptation."

[34] Wojciech Lorenz, "2016 NATO Summit on Strategic Adaptation," Polish Institute of International Affairs, No. 58 (790), June 9, 2015.

[35] Wasserbly, "NATO's Stoltenberg Chides Russia's Snap Exercises."

[36] Menno Steketee, "Interview: US Air Force General Philip M Breedlove, NATO Supreme Allied Commander Europe (SACEUR)," *IHS Jane's Defence Weekly*, April 10, 2015.

[37] Tigner, "NATO Ramping Up Military Exercises in 2015."

[38] Tigner, "NATO Ramping Up Military Exercises in 2015."

[39] Brooks Tigner, "NATO Rapid-Reaction Force Needs Faster Political Decision Making," *IHS Jane's Defence Weekly*, May 7, 2015.

[40] Tigner, "NATO Rapid-Reaction Force Needs Faster Political Decision Making."

[41] Tigner, "NATO Rapid-Reaction Force Needs Faster Political Decision Making."

Similar to other comparable forces, VJTF will face other key challenges:

- overcoming the complexity of funding rules for NATO standby forces (potential remedies include increased common funding in NATO[42]); in the initial stage of VJTF's standing up, Germany, the Netherlands, and Norway are bearing the majority of cost;[43]
- building a robust and agile command and control system; and
- establishing broad political support for the concept.[44]

To support rapid deployment of the VJTF force, NATO Force Integration Units (NFIUs) in the Baltics, Poland, Romania, and Bulgaria will serve as key logistical support centers.

Given the importance for VJTF to deploy rapidly with the greatest possible force, political obstacles may prove to be the most difficult to overcome. *ISH Jane's* notes that "unless the NAC moves away from its absolute-consensus approach to authorizing military decisions—and it never will do that—then a dissenting ally can always bog down or block a decision."[45]

Building Interoperability for VJTF

Interoperability is being dealt with on a case-by-case basis, at the responsibility of the lead nation. This role is assigned several years in advance, with the participating member states selected in advance as well. The lead nation will work through structured meetings and events to build an appropriate amount of interoperability for that instantiation of the VJTF.

Based on previous combat and exercise experience, partnerships are expected to develop organically (based on a robust working rela-

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[42] ETH Zurich, Department of Humanities, Social and Political Sciences, Center for Security Studies.

[43] Major, "NATO's Strategic Adaptation."

[44] ETH Zurich, Department of Humanities, Social and Political Sciences, Center for Security Studies.

[45] ETH Zurich, Department of Humanities, Social and Political Sciences, Center for Security Studies.

tionship between the United Kingdom and Denmark from the Helmand province in Afghanistan, for instance, both nations are likely to cooperate in VJTF as well).

Traditionally, NATO does not get involved in building interoperability below the corps level. In fact, most nations do not allow NATO to conduct evaluations below this level. It is therefore expected that interoperability building in VJTF will be fully dependent on the lead nation and will be tailored to the capabilities of the nations involved, resources expended, and outcomes expected in each iteration of the Spearhead force. In other words, no prescribed level of interoperability is in place and no established evaluation procedures for how much interoperability has been built exist in current NATO Response Force structures.

Analysis of VJTF's Capabilities

During Gen. Breedlove's (USAF) March 2015 visit to the Netherlands, further reinforcements of European defense were announced, together with a renewed focus on readiness, deployability, and better intelligence sharing in NATO.[46] In response to questions on the sufficiency of VJTF ability to deter Russian or other threats, General Breedlove highlighted the fact that its effectiveness is tied directly to the strength of the larger NATO Response Force. Additionally, NATO Secretary General Stoltenberg has underlined the need for national forces to "remain strong" to potentially serve as first responders in case an Article 5 response is required, suggesting that the 48-hour window to deploy is not fully realistic given political decisions.[47]

Others have noted that the 48-hour window is a high bar for many NATO member states' most agile response forces, not least a multinational force dependent on a complex decision-making environment.[48] In May 2015, the Dutch ambassador to NATO said: "We have

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[46] Steketee, "Interview: US Air Force General Philip M Breedlove, NATO Supreme Allied Commander Europe (SACEUR)."

[47] Wasserbly, "NATO's Stoltenberg Chides Russia's Snap Exercises."

[48] Tigner, "NATO Rapid-Reaction Force Needs Faster Political Decision Making."

to shorten our decision-making processes, and learn to make decisions under high pressure with incomplete information."[49] The fastest precedent for a quick and robust military action by NATO was the Operation Unified Protector over Libya in 2011.

IHS Jane's and others note that the distribution of VJTF's forces across the Alliance makes the notion that SACEUR will be able to gain "quick-fire control over the command" of these units relatively unrealistic despite the NATO Secretary General's June 2015 announcement that the Alliance has taken "measures to speed up our political and military decision-making, while maintaining political control."[50,51] Following the establishment of this restructuring, SACEUR will have the authority to put elements of the NATO Response Force (NRF) on standby alert (but not deploy them).[52,53] Further military, political, and institutional adaptations are expected to be put in place at the 2016 NATO Summit in Warsaw, Poland.[54]

Some have voiced skepticism about the true mission of VJTF—whether its primary objective is to deter adversaries or to reassure allies.[55] Based on the existing setup of the force and the challenges associated with rapid deployment, it is clear that the force has a predominantly reassurance-related character, but has the potential to deter aggression if fully operational and deployable within a short time window.

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[49] Tigner, "NATO Rapid-Reaction Force Needs Faster Political Decision Making."

[50] Tigner, "NATO Looks to Speed Up Its Decision Making."

[51] Luis Simón, "NATO's Rebirth: Assessing NATO's Eastern European Flank," *Parameters*, Vol. 44, No. 3, Autumn 2014, pp. 67–79.

[52] Simón, "NATO's Rebirth: Assessing NATO's Eastern European Flank."

[53] Others make a distinction between deployment and employment (with the former potentially delegated to SACEUR and the latter to NAC).

[54] Wasserbly, "NATO's Stoltenberg Chides Russia's Snap Exercises."

[55] Lasconjarias, NATO's Posture After the Wales Summit."

APPENDIX D

French Army Approaches to Interoperability

> The degree of interoperability depends above all on the ability of men to understand one another . . . it then comes from the compatibility of doctrines and procedures. Also on the compatibility of equipment. Finally, interoperability becomes concrete through common practices, the fruit of collective training.
>
> French Army Colonel Philippe Berne, "The Problem of Interoperability," 2007.[1]

Given the importance of interoperability for our NATO allies—for whom interoperability is a strategic priority—it seems appropriate to turn to them for insights into what interoperability is, how it works, and how one builds it. They look to interoperability not just for the political legitimacy it imparts but also because they have all but abandoned the capacity to act unilaterally, meaning that they expect to have to fight as part of a multinational coalition if they are going to fight at all. Interoperability is, therefore, fundamental to their operations and something about which they give a great deal of thought.

This chapter focuses on the approach to interoperability of one NATO ally that wants to be an active partner in future coalitions and play an active role in them: France. In particular, we examine how the French Army conceives of interoperability generally and three major interoperability-building efforts: the Franco-German Brigade (FGB), the Franco-British Combined Joint Expeditionary Force (CJEF), and France's Rapid Reaction Corps (RCC-F), which is part of the network

[1] Berne, "La problématique de l'interopérabilité," p. 11.

of NATO-certified multinational rapid reaction headquarters elements associated with the NATO Response Force (NRF). After discussing each in turn, we will conclude with a discussion of resulting insights.

French Interest in Interoperability

France during much of the Cold War was committed to maintaining an autonomous foreign policy and was wary of close cooperation with the United States and NATO.[2] Since then it has largely abandoned its stance and welcomes close cooperation. The military in particular views interoperability as a priority, including and above all with the United States and NATO. Several considerations motivate the French aside from what might be described as a generational shift away from the country's Cold War leaders. One is what the French consider the political imperative of acting within multinational coalitions because of the legitimacy it bestows. Another is an appreciation of the limitations of their own national capabilities. The French fret about the small size of their military and worry about remaining relevant on the world stage. In light of their diminished means they have scaled back their ambitions. Rather than go it alone, they aspire at least to ensure their seat at the table by being an effective and valued coalition partner. They believe, moreover, that by acting together with others they will be able to accomplish more than they could alone. This marks an important difference between the French and the Germans, who are also keen on building interoperability by means of numerous bilateral and multilateral arrangements. The Germans appear primarily motivated by the desire for legitimacy and the larger political goal of strengthening, politically, the European Union and NATO.[3] They are building interoperability as a means to a political end. The French, in contrast,

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[2] For a good overview of France's relationship with NATO, see Marc Trachtenberg, "France and NATO, 1949–1991," *Journal of Transatlantic Studies,* Vol. 9, No. 3, September 2011.

[3] For German perspectives on the purpose of interoperability, see, for example, Minister of Defense Ursula von der Leyen's telling remarks about the Franco-German Brigade and German cooperation with Poland. "Brussels Forum 2015: Welcome and Conversation with Ursula von der Leyen and Zbigniew Brzezinski," German Marshall Fund, 2015.

are also motivated by their interest in legitimacy and their desire to strengthen "European Defense" and the Atlantic Alliance; however, they also want to build a warfighting capability greater than what they can muster alone.

The French in 2004 developed a strategy for interoperability that conceives of four basic scenarios:

1. With the United States (under U.S. lead), but outside of NATO;
2. With the United States (under U.S. lead), but within NATO;
3. A European Union coalition (i.e., without the United States), with NATO;
4. A European Union or ad hoc coalition (i.e., without the United States), without NATO.[4]

If the United States is involved, the French objective is to make sure that French tactical units can insert themselves into an American-led organization and function appropriately, which means being able to interoperate fully with the Americans and anyone else who might be in the coalition.[5] If NATO is involved, the French are concerned primarily with the NRF. If the United States is not involved, the French have identified as their priority the capacity to act as a lead nation; they also set as priorities "early entry" operations and a "close partnership with the United Kingdom and Germany."[6] For reasons that will be explained below, it appears to be the case that France since 2007 has dropped Germany from that list unofficially and focuses instead almost exclusively on Britain.

The Franco-German Brigade (FGB)

The Franco-German Brigade represents both the height of interoperability as well as some of the obstacles to making a binational force

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[4] Cosquer, "L'interopérabilité au niveau stratégique," p. 28.

[5] Cosquer, "L'interopérabilité au niveau stratégique," p. 28.

[6] Cosquer, "L'interopérabilité au niveau stratégique," p. 28.

truly effective. Namely, the genesis of the Brigade was purely political, and however much the Brigade has managed to achieve with respect to interoperability, politics frustrate the Brigade's ambitions and limit its usefulness. As we shall see below when we discuss the CJEF, the FGB is indicative of what happens when there is no clear consensus at the highest levels regarding the purpose of investing considerable resources in building interoperability.

France and Germany formed the Brigade in 1987 in response to a purely political requirement, not a military one. The idea was to promote and symbolize Franco-German postwar unity while also placing that unity at the center of a distinctly European (rather than Atlantic) defense arrangement. The two governments deliberately located the Brigade's regiments in bases straddling the historically contested border of the French province of Alsace. They also deliberately stationed German troops in France, and until recently French troops in Germany.

A glance at the Franco-German Brigade order of battle (Table D.1) indicates that at the core of the Brigade are three mechanized infantry units with comparable capabilities, two French and one German, as well as a French light armor/reconnaissance regiment. The command and logistics elements are binational, while artillery and combat engineering units are German. The preference is to divide the troops largely because of the risk represented by having to overcome the language barrier in combat, but the Brigade appears to have embraced the strong likelihood that in the field soldiers from both sides will have to be able to work together. Interactions between forces from both nations are therefore all but inevitable even at the company level, at least when French units wish to avail themselves of artillery or combat engineering support.[7] The French units in the Brigade, for example, have mortars up to 120 mm, and French tanks in the Brigade have 105-mm guns, but if they want the firepower offered by 155-mm howitzers or MLRS, they have to call on the Germans. In any case, the French at least customarily pull apart their regiments to stitch together ad hoc company- and battalion-level task forces, drawing small units with different capabilities together depending on what is available and

[7] French Officer 2, interviewed in Lille, France, February 2, 2015.

Table D.1
Franco-German Brigade Order of Battle (November 2014)

Unit (Nationality)	Type	Primary Vehicle/ Weapon Systems
1e Régiment d'infanterie (F)	Mechanized Infantry	VAB
3e Régiment de Hussards (F)	Light Armor	AMX-10RC, VAB
Jägerbataillon 291 (D)	Mechanized Infantry	Boxer, Fennec
Jägerbataillon 292 (D)	Mechanized Infantry	Boxer, Fuchs, Wiesel MK 20
Artelleriebataillon 295 (D)	Artillery	PzH 2000, MLRS
Panzerpionierkompanie 550 (D)	Armored Combat Engineer	Biber, Dachs, Skorpion, Keiler

SOURCE: http://www.df-brigade.de/struktur.htm, http://www.defense.gouv.fr/terre/presentation/organisation-des-forces/brigades/brigade-franco-allemande.

what is required for a specific mission. There is a strong possibility that during an operation a commander assembling a task force for some specific mission might want to borrow different elements from whatever units happen to be at hand, which in the Brigade's case could very well be units from both countries. Indeed, Brigade exercises commonly put small units together both to practice operations and to build mutual understanding and cooperation.[8] Videos about the Brigade on YouTube, for example, show German armor working together with French infantry and vice versa, or soldiers from both forces evacuating simulated wounded soldiers.[9]

For example, the French units in the brigade have mortars up to 120 mm, antitank rockets, and light tanks with 105-mm guns. But if they need the firepower offered by 155-mm howitzers, more specifically the devastating effects of rapid-fire PzH 2000 self-propelled howitzers, they must call on the Brigade's German units. According to one French Army source, FGB commanders during exercises occasionally pull together

[8] Ina Held, "Im Gleichschritt—Die Deutsch-Französische Brigade," SWR, 2013; "Entrainement majeur pour la Brigade franco-allemande," 2013.

[9] Held, "Entrainement majeur pour la Brigade franco-allemande," 2013.

units from both armies in order to form company-level task forces.[10] It is simply something that makes sense in certain circumstances.

According to an officer with extensive experience in the FGB, the two sides built interoperability by developing a strategic roadmap that identified specific operational lines and decisive points. These focused on specific sets of problems such as technical interoperability, doctrinal interoperability, etc. Technical interoperability has been a persistent challenge, with the Brigade experimenting at various points with integrating the different CIS, finding ways to enable officers from one service to use the CIS of the other, and at some levels relying on liaison. Currently, the FGB relies on German CIS at the Brigade level and has German officers with German CIS embedded in French regiments; there are also some French CIS elements at the Brigade level and a technical means for transferring information.[11] With respect to doctrine and general cultural issues related to how the different services conduct operations, what the French and German Armies have done is institutionalize the practice of attending each other's training schools, such that many officers, over the course of their career, are well versed in the other's art of warfare, not to mention the other's language. They also rotate commands. Every two years command of the Brigade switches back and forth from a French to a German officer, with the commander's deputy always being from the other country (i.e., when the commander is French, his or her deputy is German). Each, moreover, has attended the appropriate commander's course offered by the other country. French commanders are graduates of the German War College, for example.

This matters for a number of reasons, among them the fact that the two militaries do, in fact, fight differently. For example, the French Army practices a more extreme version of decentralized operations than the German Army, even with the latter's famed doctrine of *Auftragstaktik*. The French give subordinate units greater autonomy and authority than the Germans, and they write less detailed orders. French commanders in the FGB, thanks to their training, become adept at writing

[10] Clement, "L'interopérabilité aux plus petits échelons," p. 44.

[11] French Officer 2, interviewed in Lille, France, February 2, 2015.

for German subordinates the kinds of orders they know the Germans expect, and vice versa. As for non-officers, the Brigade creates opportunities for soldiers from both sides to train and operate together.[12]

As good as the FGB has become at interoperating, there are problems stemming from a lack of agreement at the highest level regarding the missions for which the FGB is intended and the Germans' willingness to deploy overseas or conduct combat operations. These things matter because preparing specific capabilities in a binational context is more difficult and takes more time than it would otherwise. The former FGB officer interviewed for this study gave the example of a time when the Brigade was asked to deploy a detachment to Kosovo to conduct crowd control operations. The officer said that he ended up calling off the deployment because preparing a binational element for that specific mission would have required more time and resources than were available, more time and resources than a single-nation unit would have required.[13]

Another problem identified by the officer is that of synchronizing the two forces' generation and deployment cycles. The French Army has a high operational tempo, with units required to deploy and interested in deploying. The French regiments in the FGB are fully integrated into the French Army's generation cycle and contingency alert system. That means that at any given time, a certain number of units in the FGB may be deployed in support of France's various overseas operations or on deck in case of an emergency. The danger for the FGB is that French units may be deployed while German units are training.

As to how well the Brigade works, the indications are mixed. The only negative note offered by the French officers interviewed for this study have to do with the complications associated with the high-level political problems afflicting Franco-German military cooperation. Otherwise they appear to believe the Brigade works, as does their approach to building interoperability. One French Army publication, however, reports that the results of the FGB's ad hoc company-level

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[12] Held, "Entrainement majeur pour la Brigade franco-allemande," 2013.

[13] Interestingly, it appears to be the case that the FGB since has conducted binational crowd control training. See "Exercice bilatéral franco-allemand au CENTAC Allemand," 2014.

mixed formations have been discouraging.[14] "There appears to be a threshold below which it is illusory to want to make units from different countries interoperable," the document asserted.[15]

The political problems mentioned above rather than readiness concerns are the reason why the Brigade has so little operational experience, at least as a binational force. Elements of the Brigade have deployed to Afghanistan and Kosovo, though not as part of the Brigade command structure, and they did not operate as part of a binational effort. The Brigade's real binational deployment did not come until 2014, when it was deployed to Mali to participate in the European Union Training Mission (EUTM).[16] This is not a combat mission, however, and consists of conducting classes for Malian soldiers in tactical skills. In other words, it is not a particularly meaningful test of the interoperability cultivated by the Brigade. It also is not a particularly useful deployment for France, which needs help with its combat missions in Africa more than it needs additional contributors to EUTM.

CJEF

This Anglo-French initiative—slated to be operational by 2016—has the goal of being able to deploy rapidly a binational joint force featuring a ground force up to a division in size that is capable of the full spectrum of operations, including forcible entry and high-intensity operations. The CJEF presents a revealing contrast with the FGB because of the CJEF's altogether different purpose, which permits a greater degree of clarity regarding the capabilities it requires and the missions it must plan for.

The CJEF originates with the 2010 Lancaster House treaties between France and the United Kingdom that called for sharing military resources. Whereas the purpose of the FGB is entirely political—

[14] Clement, "L'interopérabilité aux plus petits échelons," p. 44.

[15] Clement, "L'interopérabilité aux plus petits échelons," p. 44.

[16] Christoph Hickmann and Stefan Kornelius, "Deutschland bereitet Militäreinsatz in Afrika vor," sueddeutsche.de, January 17, 2014.

the point was to build a symbol, not a real capability—the Lancaster House treaties were born of pragmatism and the two countries' desire to remain militarily relevant despite diminishing resources. Britain and France signed on to build a real capability, one that would enable each country to do more than it could alone. What the two countries have in mind, moreover, is also relatively clear: They want an expeditionary force that can deploy quickly to intervene in even the most intense conflicts, something that requires not just numbers—more troops than either country separately can muster—but the ability of brigades, regiments, battalions, and even lower echelons to interoperate in a combined and joint framework. Moreover, whereas the Franco-German Brigade was created to advance a political agenda (fostering Franco-German reconciliation and European defense), in the case of CJEF the French at least sincerely wish to build a military capability.

According to a 2012 joint document, the *Combined Joint Expeditionary Force (CJEF) User Guide*, the CJEF "will be able to conduct offensive and defensive operations on land, in the air, and at sea, wherever UK and French national security interests are aligned."[17] The total force will include a "scalable land component of at least a UK battle group and a French battle group," a maritime component as well as an "expeditionary air wing," and a "logistical component capable of supporting the totality of the CJEF deployment." The land component, moreover, is to be an "early entry" and combined UK/France division "capable of conducting non-enduring, complex intervention operations, facing multiple threats up to high intensity."[18] It will, moreover, be a "high-readiness force using existing national high readiness force elements—including lead elements at very short notice."

One of the more interesting aspects of the planning for CJEF is the attention paid to the political decision-making and military planning processes in both nations and the need to establish mechanisms and protocols to link them together to ensure timely joint action.

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[17] *Combined Joint Expeditionary Force (CJEF) User Guide*, Shrivenham and Paris: Development, Concepts, and Doctrine Center/Centre Interarmée de Concepts, de Doctrine et d'Expérimentations, 2012, p. 11.

[18] *Combined Joint Expeditionary Force (CJEF) User Guide*, p. 13.

Although the *User Guide* does not refer directly to France's experience with the FGB, one can perceive it at work in the *Guide*'s conclusions that France and the UK can work rapidly together given their short decision-making cycles and the relatively free hand both nations' heads of state have with respect to engaging in military operations prior to obtaining parliamentary sanction.

The CJEF *Guide* calls for the creation of a joint commission to identify and address all the issues related to interoperability, and it recommends referencing the products of the American, British, Canadian, Australian and New Zealand Armies (ABCA) program.[19] Among the matters that remain to be addressed, according to the *Guide*, are those related to the sharing of digital information and tactical communications.[20] Interestingly, with regard to unit integration, the *Guide* calls for integrating the component headquarters, but not the subordinate force elements, which would operate "under their own national doctrine." "Essential to the mission will be a clear understanding of each other's doctrine."[21]

One of the more interesting aspects of the *Guide* as well as the work that has gone into building the CJEF has been identifying points of divergence between France and the UK as well as between them and NATO with respect to doctrine and standards. It clearly states that NATO doctrines and standards are to be the starting point for CJEF operations: Whenever possible, the CJEF should rely on NATO doctrines and standards. However, the *Guide* recognizes that both nations do not consistently comply with NATO doctrines and standards, often with reason, and it identifies instances in which each or both diverge.[22] Indeed, the *Guide* notes that out of 42 NATO documents it has identified, only 19 have been ratified by both countries.[23] The *Guide* further identifies points of divergence between national doctrine and NATO doctrine with respect to human intelligence,

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19 *Combined Joint Expeditionary Force (CJEF) User Guide*, p. 28.

20 *Combined Joint Expeditionary Force (CJEF) User Guide*, p. 37.

21 *Combined Joint Expeditionary Force (CJEF) User Guide*, p. 41.

22 *Combined Joint Expeditionary Force (CJEF) User Guide*, pp. 31–34.

23 *Combined Joint Expeditionary Force (CJEF) User Guide*, p. 33.

information operations, psychological operations, engineering support, force protection, land operations, military policing, air and space operations, counter-air operations, close air support and interdiction, joint airspace control, counterinsurgency, electronic warfare, joint targeting, and logistics.[24] Another more specific example the *Guide* gives is Comprehensive Operations Planning Directives (COPD). According to the *Guide*, the NATO COPD is detailed but cumbersome and tailored to NATO structures. France is developing its own national COPD, and in any event, the *Guide* recommends that CJEF stick to the NATO way until some agreement is reached regarding the way forward.

As mentioned above, no British or French units technically are dedicated to the CJEF. It could involve any units in either military, and all French units are paired with a British unit to foster at least some interactions, exchanges, etc. The extent of interactions varies, although generally speaking there is a constant flow of units back and forth, participating in training exercises. These are often just companies or even smaller units. The company-scale exchanges at least are "founded on reciprocity and free food and housing."[25] On any given day there might be a French tank or VBCI section training with a British company, for example. Also, the British look to the French for urban warfare training, particularly the use of armor. As mentioned before, elements participating in the CJEF at the battalion level or below are not supposed to be binational; however, force planners assume interoperability will have to take place at lower levels, and in any event there is an interest in focusing on captains rather than higher-ranking officers as a way of investing in long-term capabilities. "We work on the acculturation of our young leaders, their acculturation to a British environment, for they will be the deciders of tomorrow."[26] Often the exchanges are informal and can best be described not as training but simply interacting or socializing. This could include participating in each other's ceremonies, playing sports together, etc.[27]

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[24] *Combined Joint Expeditionary Force (CJEF) User Guide*, pp. 33–34.

[25] French Officer 1, interviewed at Lille, France, June 16, 2015.

[26] French Officer 1, interviewed at Lille, France, June 16, 2015.

[27] French Officer 1, interviewed at Lille, France, June 16, 2015.

At the core of the CJEF, however, are two sets of paired British and French units that are investing in particularly intensive interactions. The British 16th Air Assault Brigade is paired with the French 11th Parachute Brigade, and the British 3 Commando Brigade, Royal Marines, is paired with the French 9th Marine Infantry Brigade. The 11th and the 16th, moreover, were chosen to form what is referred to as the Interim Combined Joint Expeditionary Force, which was basically a test-bed intended to clear a path for the larger construct. These four units are more or less "like" units that would have an important role in any rapid reaction, with the 16th and the 11th concentrating the two countries' respective airborne capabilities, and the 9th and the 3 Commando maintaining their amphibious capabilities. These pairings make sense in that the paired regiments readily understand one another. According to one commander, "like" units simply are more open to working closely with one another than dissimilar units for reasons having to do with institutional culture and prejudices. For example, he suggested that the U.S. 82nd Airborne Division would have a relatively easy time working with the French 11th, but it would have a hard time working with the French 9th.

The relatively facility with which "like" units interoperate, however, should not detract from the value of having units that are more complementary than identical work together. The French, for example, consider light infantry inadequate for early entry operations, and their readiness system is designed so that there is always medium-weight mechanized infantry company on 12-hour alert—along with a paratrooper company from the 11th—and other medium and heavy-weight units available to policy makers during an emergency. This is a problem for the CJEF, according to one source, because the British units on high alert are exclusively light, with heavy units not expected to deploy until later.[28]

CJEF Lessons Learned

Efforts to build the CJEF to date, including a series of exercises, have served to reveal a number of challenges and obstacles to building

[28] French Officer 3, interviewed at Lille, France, June 15, 2015.

interoperability. Many of the problems revealed by the CJEF project are the kinds of things that can be resolved easily with time and effort; however, a principal assumption of the CJEF is that the imperative of rapid action necessitates working out ahead of time as much as possible. The idea is to minimize the risk of misunderstandings between the two forces and reduce the possibility that any complication might arise that slows effective interoperations or simply distracts from the task of accomplishing the mission.

One example related to the integration of CIS has to do with classification, and the fact that British and French handle classification differently. According to one source, French battalions and below use systems designated for one classification level, "mission restricted" (MR).[29] Brigades use both MR and the higher level, "mission secret" (MS). They use the MR to communicate with subordinates, but the MS to work with higher echelons. The British, in contrast, use the equivalent of MS at all levels. This is a problem because, whereas connecting British and French MS systems represents one set of challenges—but it is done—the British balk at connecting any MS to an MR system. Consequently, if a British division wants to communicate with a French brigade, that is fine because both use MS. However, there might be French enablers that are divisional, or the division staff might need to communicate with French battalions or companies, all of which use French MR. The British commanders have to figure out a way to get MS information to French units on MR, something that, according to one source, remains a challenge. If the division level is French, there is no problem because the French have already worked out how to connect their MS systems to MR ones, so it is relatively easy for the French division to work with MR enablers.

Technological matters aside, the British and French over the course of their combined exercises under the CJEF rubric have encountered a host of challenges related to different doctrines and processes. Many of the CJEF "findings" are going into a handbook presently being compiled by both sides. One example has to do with prisoners of war and other detainees: Each country has its own rules and

[29] French Officer 1, interviewed at Lille, France, June 19, 2015.

laws regarding how they are to be handled and whether or not either country is willing to hand detainees off to third parties. As it happens, the British and French concluded that their doctrines, laws, and other policies were compatible, so there were no real hitches (which was not the case when operating with the United States in Afghanistan, however). At the CJEF Griffon Rising exercise held in June 2015, British and French Army legal advisors were on hand to identify and deal with these sorts of issues. There were similar problems related to blood supply (each military has its own regulations and protocols related to the matter), rules of engagement, targeting policies, and countless procedures such as how to conduct planning, or how much information one needs to provide when requesting fires. Sometimes one army has higher requirements regarding the precision of targeting information, which can become a problem if, for example, the French identify a target they want the British to strike, or vice versa. Because British and French helicopters have different rules for opening fire, it was discovered that British Apaches and French Tigres have a hard time working together. Similar problems arise when pairing a Tigre with a UK Chinook. Similarly, the two countries have different rules regarding the kinds of troops that are assigned to escort convoys. They have, moreover, different interpretations regarding the "golden hour" of medical support, with one country relying on forward medical support (France) and the other on evacuating to rear positions (UK). The French also insist on full doctors, whereas the British are lest strict. These and other issues all fall under the category of problems that can be dealt with as required; however, the French insist on the importance of working them out ahead of time given that the focus of the CJEF is on rapid response.

Language naturally is an important issue. Both sides have agreed that headquarters functions should be conducted in English, imposing on the French the requirement to achieve and maintain a high level of proficiency in the language. The French, for their part, complain that the British do not understand the need to be aware of the potential limitations of their French interlocutors' language skills and make an effort to speak more clearly. (The British are not the only ones to be faulted for not speaking more clearly—one French general complained his U.S. counterpart is nearly impossible to understand.) A related

challenge is understanding one another well enough to grasp the connotations of words as well as to be aware that each side as its own "spirit and culture" and "thinks about tactical problems" differently. The officer suggested, for example, that often the British, drawing on Liddell Hart, prefer an "indirect approach," whereas the French prefer more direct approaches. There can be misunderstandings such that French officers, for example, might not understand why a British plan might call for something. Behind the British decision might be a line of reasoning that's obvious to British officers but not to French ones.

Developing Standards

Part of the work of the CJEF has consisted of establishing commonly agreed-upon standards. According to those interviewed for this study, the British and French have used NATO standards as a primary point of reference and a place to begin the conversation. However, over the course of their work together and their exercises, they have been able to identify divergences between NATO and national practices and work out what amounts to an Anglo-French hybrid. This makes sense, according to one officer, given the strictly binational nature of the CJEF, the fact that the two countries have similar interests, and the conviction that the effectiveness of the CJEF on the battlefield ultimately will depend on the level of mutual understanding between the two sides. According to the officer involved in Anglo-French interoperability, "the idea is not to lose any effectiveness because" of the binationality of the CJEF's command structure, "which requires a common understanding of the mission and a common vocabulary with a shared understanding of that vocabulary."[30] According to the officer, a mission term in English is not necessarily understood the same way by the French, and vice versa. In effect, what this means is that the CJEF aspires to build a greater degree of interoperability than what is achieved in most NATO coalitions (see the discussion of the RRC-FR below) facilitated by a higher degree of mutual understanding. For that reason, both sides have found it best to move beyond NATO standards and work to understand each other's standards.

[30] French Officer 1, interviewed at Lille, France, February 2, 2015.

Building in Interagency Interoperability

Another aspect of CJEF that merits noting is the effort on the part of the French and their British partners to build cooperation into the binational interagency. With both governments committed at least on paper to having a "whole of government" approach to deal with crises, meaning that they believe their militaries must work hand in glove with civilian government agencies and even nongovernmental organizations, they conclude that they need to make it a capability of the CJEF as well. In practice, this translates into including representatives from government and nongovernmental organizations in CJEF planning events and exercises. At the June 2015 Griffon Rise exercise conducted outside Paris, for example, there were participants from British and French civilian aid and development agencies and a few international nongovernmental organizations.

Rapid Reaction Corps-France (RRC-FR)

France's third major interoperability effort is its Rapid Reaction Corps, a corps-level headquarters element based in Lille that is one of several NATO-certified rapid reaction headquarters associated with the NRF. The RRC-FR is a permanent French general staff, although it has 70 foreign officers embedded in it, including ten Americans.[31] In contrast with the FGB and CJEF, the RRC-FR is a NATO-centric effort, meaning that it fully embraces NATO standards and the entire edifice of NATO-defined doctrines and practices. It is on one level a school for teaching how to fight the NATO way, but above all it is intended to be a fully operational entity: The RRC-FR is geared to be able to deploy a reconnaissance team within two to three days, followed by a forward command element and then two other echelons until the entire operation (complete with a logistical element) is finally in place within 90 days.[32]

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[31] French Officer 4, interviewed in Lille, France, June 18, 2015.

[32] French Officer 4, interviewed in Lille, France, June 18, 2015.

The RRC-FR's emphasis on NATO standards can be understood as a lowest common denominator approach: Relying on NATO creates the highest likelihood that one can work with other NATO commands and any NATO member contingent. According to a senior RRC-FR officer interviewed for this study, the CJEF can develop its own bespoke hybrid because it is not designed to work with NATO. The RRC-FR, however, must work with NATO and has to remain within the universe of NATO standards. The RRC-FR, for example, though it technically is a French national staff, chose to conduct planning according to NATO-defined procedures rather than stick with French Army procedures. "The better we know" NATO ways, "the better chance we have to understand others." After all, explained the senior officer, "interoperability is a mixture of common culture and knowledge of the other and how he works." NATO represents at the very least a common set of references. The officer also observed that there is a significant difference between the French and the American militaries with respect to NATO. France, he asserted, "has to step outside itself to foster interoperability"—meaning it cannot presume that others will operate according to French ways, and the French Army therefore has to meet its potential partners at least halfway, either by learning their ways or by turning to NATO. The U.S. military, in contrast, does not need NATO in the same way, for it can assume that others will adapt to work with it.

The RRC-FR's commitment to NATO provides an example of how a generic interoperability capability might be built: France cannot cultivate with all NATO members the kind of interoperability it is developing with Germany and the UK. That simply is impossible. NATO, however, provides a way to develop a basic yet useful level of interoperability with all who agree to adhere to NATO standards.

Conclusions

From the French Army's experience with building interoperability, we learn a number of insights:

The Primacy of Politics

Building interoperability requires a clear political agreement regarding the purpose of the capability and the level of ambition. All sides must see eye to eye regarding what they intend to do together. Having such an agreement facilitates the entire effort of building interoperability because it informs specific questions regarding precise requirements and capabilities. The absence of such an agreement results in uncertainty and ambiguity, with real consequences for implementation.

Technical Interoperability Should Not Be the Main Line of Effort

Some technical interoperability is essential but should not be regarded as a panacea and should not distract from the more important objective of attaining mutual trust and understanding and developing the other forms of interoperability: individual, group, and procedural. One reason, at least for the French, is that technological interoperability is expensive, with the investment often yielding bespoke solutions with a limited shelf life. They believe the correct strategy is to aim to build no more than an adequate degree of technical interoperability. Rather than aiming higher than that and trying for an optimal solution, they prefer to focus on building other kinds of interoperability where effort and resources invested are more likely to produce durable and meaningful results.

Technical Difficulties of Information Sharing Should Not Be Underestimated

The difficulties the French have had working out how to share information with the British and the Germans—both close and trusted allies—underscore the complexity of information sharing. The stumbling blocks are numerous. First, there are the purely technical considerations involved in getting different computer systems, different radios, different encryption practices, etc., to work together. Second, issues related to classification are considerable, such that neither the British, the French, nor the Germans are willing to share information freely and give each other open access to their information systems. They can and have found working solutions and work-arounds, but they are imperfect at best and in any case have required effort, money, and time to establish.

Targeted Interoperability Requires Long-Term Bilateral Effort

The goals for targeted interoperability of the kind identified by the French—with forces exchanging services while operating in the same space and time—appears achievable when prepared by years of mutual effort involving exchanges and exercises intended to develop familiarity and trust. For the French, this seems plausible given their limited number of partners, namely Germany and the United Kingdom, with the United Kingdom emerging as the coalition partner of choice for non-U.S.-led operations because, among other things, of the two countries' similar willingness to engage in military adventures abroad.

NATO Provides Template for General Interoperability

For those countries for which investing in building robust bilateral relations makes little sense, the NATO infrastructure and the universe of NATO standards facilitates the creation of general interoperability. Even if NATO standards represent nothing more than a starting point for a conversation between soldiers from different armies, the French appear to regard that as sufficiently helpful to justify cultivating familiarity with NATO-prescribed procedures, methods, and other efforts.

The Requirement of Rapid Reaction Mandates Robust Preparation

A lot hinges on how rapidly one wishes to be able to commit a multinational force. The less urgent the scenario, the more time there is to work out the details of interoperating as needed. If the aim is to be able to build a multinational rapid reaction force—which is the case with both CJEF and the RRC-FR—it is advantageous to identify and address as many potential problems ahead of time as possible. Afghanistan provides an excellent example of what can be achieved when time is not of the essence. Coalition partners were able to work out numerous problems such as information system connectivity as they encountered them and eventually developed a high degree of interoperability. An early entry mission of the type the CJEF is supposed to be capable of handling will not afford that luxury. British and French forces will need to know how to work together before they are wheels up.

Building in Interagency Interoperability

In light of a growing consensus about the need for militaries to work in close cooperation with civilian agencies and even nongovernmental organizations in a variety of different conflict scenarios, the French see a need to build interagency interoperability.

Weighing Options

Ultimately, what the French experience with interoperability reveals is that there are choices to be made between working toward general interoperability of the sort NATO fosters or trying to build targeted interoperability. The latter, however, requires long-term commitment to partner with other countries and often specific units within their forces. It requires working to achieve all the various nontechnical forms of interoperability the French highlight as critical, along with one other essential ingredient: trust. The French enjoy the advantage of having a short list of potential partners for this kind of targeted interoperability (i.e., the United Kingdom, the United States, and, to a lesser extent, Germany). Nearly all the rest are members of NATO, which makes NATO an obvious and effective arena for developing general interoperability.

For the United States, the list of possible partners is long. Moreover, because of the United States' global commitments, NATO is useful as a catchall, a means of fostering interoperability with all those who did not make the cut as a partner for "deep" interoperability along the Franco-British or Franco-German model.

The French Army's three efforts described here provide examples of different levels of interoperability, ranging from a high degree of integration as exemplified by the FGB and the CJEF, and a more neutral, general interoperability. The FGB and the CJEF represent something of an extreme, one that entails picking a partner or small number of partners with whom to work closely. For France, it boils down to really just one, the UK. Moreover, what makes the FGB and the CJEF work as well as they do is the political commitment, which speaks to the fact that the two efforts are of strategic importance for France and its two partners.

APPENDIX E

Interoperability Programs

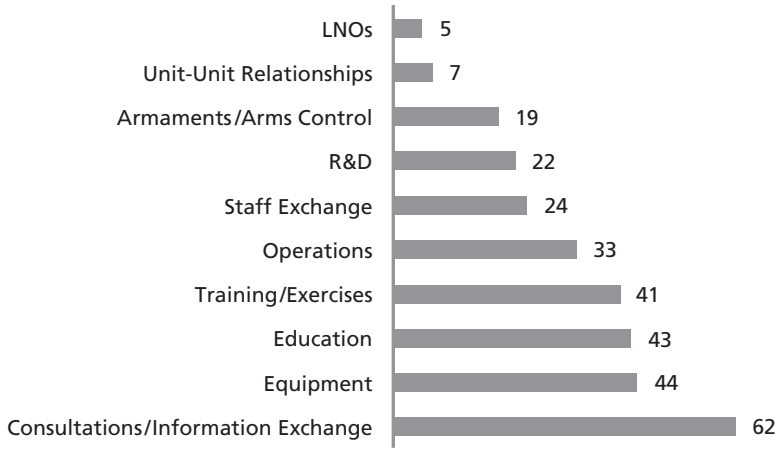
Dataset Description

As part of our analysis, we have compiled a list of 192 security cooperation programs originating from two sources: the *Army Security Cooperation Handbook* (Department of the Army, 2015) and previous RAND research on security cooperation (Moroney, Thaler, & Hogler, 2013). This list may not be fully exhaustive as additional efforts may take place within the context of programs not captured by one of the two sources; however, it is representative of the vast array of international outreach efforts of the U.S. Army. Each program has been classified into relevant program types, summarized in Figure E.1.

Regression Analysis

When coded by their contributions to building interoperability for multinational missions, we used robust logistic model regression to test for individual categories' association with this outcome. We find that no arms-related programs directly develop interoperability for multinational missions but find significant relationships between the desired outcome and staff exchange, consultation, R&D, training and exercises, and unit-to-unit relationship-building programs. As shown in Appendix G, we use the Hosmer-Lemeshow goodness of fit test and the Pearson's Chi-Squared Test to test for adequacy of fit, neither of which indicate a problematic fit. We do not observe multicollinearity among our independent variables. The receiver operating characteristic shows a fairly strong pairing of sensitivity and specificity results in our model.

Figure E.1
Programs by Activity Types



RAND *RR2075A-E.1*

As expected, practically focused programs that promote cohesion and understanding between military staff (staff exchanges) and military units of different nations (unit-to-unit program type) are of the highest relevance for building interoperability, and a closer look at potentially expanding such programs would be desirable. Other factors to take into consideration include budget constraints and the willingness and ability of partner armed forces to engage in such programs. Second, R&D-related programs, consultations, and training and exercises increase the odds ratio by smaller, yet still significant amounts, indicating the need for programs that rely on both compatible infrastructure (such as weapons systems and communication tools developed through R&D partnerships), frequent information exchange between armed forces, and active participation in exercises and training events to build common operating procedures as well as trust and rapport.

Table E.1
Program Types and Interoperability

Builds Interoperability for Multinational Missions?	Program Name	Arms Control	Information Exchange	Education	Equipment	LNOs	Operations	R&D	Staff Exchange	Training/ Exercises	Unit-Unit Relationships
yes	American, British, Canadian, Australian and New Zealand Armies' Program	no	yes	yes	no	no	yes	no	yes	yes	no
	Combatant Commander Initiative Fund (CCIF)	no	yes	yes	no	no	yes	no	no	yes	no
	Command and General Staff College International Fellows Program	no	no	yes	no	no	no	no	no	no	no
	Distribution to certain foreign personnel of education and training materials and information technology to enhance military interoperability with the armed forces	no	no	yes	yes	no	no	no	no	yes	no
	Institutional Training/ Education of Foreign Military and Selected Civilians	no	no	yes	no	no	no	no	no	yes	no
	International Military Education and Training (IMET)	no	no	yes	no	no	no	no	no	no	no
	Military Reserve Exchange Program	no	yes	yes	no	no	no	no	yes	no	no

Table E.1—Continued

Builds Interoperability for Multinational Missions?	Program Name	Arms Control	Information Exchange	Education	Equipment	LNOs	Operations	R&D	Staff Exchange	Training Exercises	Unit-Unit Relationships
yes	Multinational Military Centers of Excellence (COE)	no	no	yes	no	no	yes	no	no	no	no
	Reserve Officer Foreign Exchange Program	no	no	yes	no	no	no	no	no	no	no
	Sergeants Major Academy International Fellows Program	no	no	yes	no	no	no	no	yes	no	no
	U.S. Army Corps of Engineers Interagency and International Services	no	yes	yes	no	no	no	no	no	no	no
	U.S. Army Schools of Other Nations Program	no	no	yes	no	no	no	no	yes	no	no
	U.S. Military Academy Foreign Academy Exchange Program	no	no	yes	no	no	no	no	yes	no	no
	Western Hemisphere Institute for Security Cooperation	no	no	yes	no	no	no	no	no	no	no
	ACSA-Enhanced (1202)	no	no	no	yes	no	no	no	no	no	no
	Administrative and Professional Personnel Exchange Program	no	no	no	no	no	no	no	yes	no	no
	Army International Visitors Program	no	yes	no	no	no	no	no	yes	no	no

Table E.1—Continued

Builds Interoperability for Multinational Missions?	Program Name	Arms Control	Information Exchange	Education	Equipment	LNOs	Operations	R&D	Staff Exchange	Training Exercises	Unit-Unit Relationships
yes	Army-to-Army Staff Talks	no	yes	no	no	no	no	no	no	no	no
	Asia-Pacific Regional Initiative (APRI)	no	yes	no	no	no	no	no	no	yes	yes
	Center for Army Lessons Learned—International Engagements	no	yes	no	no	no	no	no	no	yes	no
	Chairman of the Joint Chiefs of Staff's (CJCS) Exercise Program (CEP)	no	no	no	no	no	no	no	no	yes	no
	Chief of Staff of the Army Counterpart Visit Program	no	yes	no	no	no	no	no	no	no	no
	Conference of European Armies	no	yes	no	no	no	no	no	no	no	no
	Cooperative military airlift agreements	no	no	no	no	no	yes	no	no	no	no
	Deputy Secretary of the Army (Research & Technology)/Chief Scientist Forums	no	yes	no	no	no	no	yes	no	no	no
	Distinguished Foreign Visits	no	yes	no	no	no	no	no	no	no	no
	Engineer and Scientist Exchange Program	no	yes	no	no	no	no	yes	yes	no	no

Table E.1—Continued

Builds Interoperability for Multinational Missions?	Program Name	Arms Control	Information Exchange	Education	Equipment	LNOs	Operations	R&D	Staff Exchange	Training Exercises	Unit-Unit Relationships
yes	Foreign Area Officers In-Country Training	no	no	no	no	no	no	no	no	yes	no
	Foreign Liaison Officer Program	no	yes	no	no	yes	no	no	no	no	no
	Global Peace Operations Initiative (GPOI)	no	no	no	no	no	yes	no	no	yes	no
	International Cooperative Research, Development, and Acquisition	no	yes	no	no	no	no	yes	no	no	no
	Joint Combined Exchange Training (JCET) Program	no	no	no	no	no	no	no	yes	yes	yes
	Leases of Defense Articles (Section 61)	no	no	no	yes	no	no	no	no	no	no
	Loans of Defense Equipment (Section 65)	no	no	no	yes	no	no	no	no	no	no
	Multilateral Interoperability Program	no	yes	no	no	no	no	yes	yes	yes	no
	National Guard Bureau's State Partnership Program	no	yes	no	no	no	yes	no	yes	yes	yes
	NATO Army Armaments Group	no	yes	no	no	no	no	yes	no	no	no

Table E.1—Continued

Builds Interoperability for Multinational Missions?	Program Name	Arms Control	Information Exchange	Education	Equipment	LNOs	Operations	R&D	Staff Exchange	Training Exercises	Unit-Unit Relationships
yes	NATO Military Committee Land Standardization Program	no	yes	no	no	no	no	yes	no	no	no
	Participation of NATO naval personnel in submarine safety programs	no	no	no	no	no	yes	no	yes	no	no
	Reciprocal Unit Exchange Program	no	no	no	no	no	no	no	yes	yes	yes
	Senior National Representative (Army) Meetings	no	yes	no	no	no	no	yes	no	no	no
	The Technical Cooperation Program (TTCP)	no	yes	no	no	no	no	yes	no	no	no
	Training and Doctrine Conferences	no	yes	no	no	no	no	no	no	no	no
	U.S. Army Medical Department International Programs	no	yes	no	yes	yes	no	yes	yes	no	no
	U.S. Army Military Personnel Exchange Program	no	no	no	no	no	no	no	yes	no	no
	USN Southern Partnership Station (SPS)	no	yes	no	no	no	no	no	no	yes	yes

Table E.1—Continued

Builds Interoperability for Multinational Missions?	Program Name	Arms Control	Information Exchange	Education	Equipment	LNOs	Operations	R&D	Staff Exchange	Training Exercises	Unit-Unit Relationships
partially	Army War College International Fellows Program	no	no	yes	no	no	no	yes	no	no	no
	Cadet Culture and Language Immersion Deployments	no	no	yes	no	no	no	no	no	no	no
	Distinguished Visitors Orientation Tours (DVOT) and Orientation Tour (OT) Program	no	yes	yes	no	no	no	no	no	no	no
	Flight Training Exchanges	no	no	yes	no	no	no	no	yes	no	no
	Foreign officers' admission to Naval Postgraduate School	no	no	yes	no	no	no	no	no	no	no
	Inter-American Air Forces Academy	no	no	yes	no	no	no	no	no	no	no
	Professional Military Education (PME) Exchanges	no	no	yes	no	no	no	no	yes	no	no
	U.S. Military Academy International Cadet Program	no	no	yes	no	no	no	no	no	no	no
	U.S. Military Academy International Programs	no	no	yes	no	no	no	no	no	no	no
	Acquisition and Cross-Servicing Agreements (ACSA)	no	no	no	yes	no	no	no	no	no	no

Table E.1—Continued

Builds Interoperability for Multinational Missions?	Program Name	Arms Control	Information Exchange	Education	Equipment	LNOs	Operations	R&D	Staff Exchange	Training Exercises	Unit-Unit Relationships
partially	Aircraft supplies and services for foreign aircraft	no	no	no	yes	no	no	no	no	no	no
	Army Cyber Security Engagement	no	yes	no	no	no	no	no	no	yes	no
	Civil-Military Emergency Preparedness (CMEP)	no	yes	no	no	no	yes	no	no	no	no
	Coalition Readiness Support Program (CRSP)	no	no	no	yes	no	no	no	no	yes	no
	Conference of American Armies	no	yes	no	no	no	no	no	no	yes	no
	Defense Personnel Exchange Program (DPEP)	no	yes	no	no	no	no	no	yes	no	no
	Developing Country Combined Exercise Program (DCCEP)	no	no	no	yes	no	no	no	no	yes	no
	Disaster Relief	no	no	no	no	no	yes	no	no	no	no
	Drawdown Special Authority	no	no	no	yes	no	no	no	no	yes	no
	Electronic Combat International Security Assistance Program (ECISAP)	no	no	no	yes	no	no	no	no	no	no

Table E.1—Continued

Builds Interoperability for Multinational Missions?	Program Name	Arms Control	Information Exchange	Education	Equipment	LNOs	Operations	R&D	Staff Exchange	Training Exercises	Unit-Unit Relationships
partially	Excess Defense Articles	no	no	no	yes	no	no	no	no	no	no
	Extended Training Services Support (ETSS)	no	yes	no	no	no	no	no	yes	yes	no
	Foreign Comparative Testing Program	no	no	no	no	no	no	yes	no	no	no
	Foreign Military Sales	no	no	no	yes	no	no	no	no	no	no
	Global Train and Equip Program (Section 1206)	no	no	no	yes	no	no	no	no	yes	no
	Imagery intelligence and geospatial information	no	yes	no	no	no	yes	no	no	no	no
	International Cooperative Research and Development (ICR&D) Program	no	no	no	no	no	no	yes	no	no	no
	International Technology Centers	no	no	no	no	no	no	yes	no	no	no
	Joint Contact Team Program (JCTP)	no	yes	no	no	yes	no	no	no	no	no
	Liaison officers of certain foreign nations	no	no	no	no	yes	no	no	no	no	no

Table E.1—Continued

Builds Interoperability for Multinational Missions?	Program Name	Arms Control	Information Exchange	Education	Equipment	LNOs	Operations	R&D	Staff Exchange	Training Exercises	Unit-Unit Relationships
partially	Logistics Support, Supplies, and Services for Allied Forces Participating in Combined Operations (formerly known as "Global Lift & Sustain")	no	no	no	yes	no	no	no	no	no	no
	Non-Reciprocal Exchanges of Defense Personnel between the United States and Foreign Countries	no	no	no	no	no	no	no	yes	no	no
	Participation in NATO Forums	no	yes	no	no	no	no	no	no	no	no
	Procurement of Communications Support and related supplies and services	no	no	no	yes	no	no	no	no	no	no
	Security Cooperation Training Teams	no	yes	no	yes	no	yes	no	no	yes	no
	Service-Sponsored Exercises and Competitions	no	no	no	no	no	no	no	no	yes	no
	Space situational awareness services and information	no	yes	no	no	no	no	no	no	no	no
	Training and Doctrine Talks	no	yes	no	no	no	no	no	no	no	no
	Unified Engagement Building Partnership (BP) Seminars	no	yes	no	no	no	no	no	no	no	no

Table E.1—Continued

Builds Interoperability for Multinational Missions?	Program Name	Arms Control	Information Exchange	Education	Equipment	LNOs	Operations	R&D	Staff Exchange	Training Exercises	Unit-Unit Relationships
partially	USN FMS Training Support	no	no	no	no	no	no	no	no	yes	no
	USN Maritime Engagements	no	no	no	no	no	yes	no	no	yes	no
	USN Pacific Partnership (PP)	no	no	no	no	no	yes	no	no	no	no
	Weapon System Partnership Agreements	no	no	no	yes	no	yes	no	no	no	no
	Worldwide Warehouse Redistribution Services (WWRS)	no	no	no	yes	no	no	no	no	no	no
no	Center for Military History International History Program	no	yes	yes	no	no	no	no	no	no	no
	African Cooperation	no	no	yes	no	no	no	no	no	no	yes
	African Partnership Station (APS)	no	yes	yes	no	no	no	no	yes	no	no
	Aviation Leadership Program (ALP)	no	no	yes	no	no	no	no	no	no	no
	Center of Excellence in Disaster Management and Humanitarian Assistance (COE-DMHA)	no	no	yes	no	no	yes	no	no	yes	no
	DoD Senior Military College international student program	no	no	yes	no	no	no	no	no	no	no

Table E.1—Continued

Builds Interoperability for Multinational Missions?	Program Name	Arms Control	Information Exchange	Education	Equipment	LNOs	Operations	R&D	Staff Exchange	Training Exercises	Unit-Unit Relationships
no	Education and Training in information security	no	no	yes	no	no	no	no	yes	no	no
	Field Studies Program (FSP) for International Military and Civilian Students and Military-Sponsored Visitors	no	no	yes	no	no	no	no	no	no	no
	Foreign Participation in the Senior Reserve Officers' Training Corps	no	no	yes	no	no	no	no	no	no	no
	Foreign Participation in the Uniformed Services University of the Health Sciences	no	no	yes	no	no	no	no	no	no	no
	Foreign Service Academy Semester Abroad Exchanges	no	no	yes	no	no	no	no	no	no	no
	Foreign Students Attendance at the Service Academies	no	no	yes	no	no	no	no	no	no	no
	Humanitarian Mine Action (HMA) Program	no	no	yes	no	no	no	no	no	no	no
	Interdiction of Materials and Radiation Academy (INTERDICT/RADACAD)	yes	no	yes	no	no	no	no	no	yes	no
	International Counterproliferation Program (ICP)	yes	yes	yes	yes	no	no	no	no	no	no

Table E.1—Continued

Builds Interoperability for Multinational Missions?	Program Name	Arms Control	Information Exchange	Education	Equipment	LNOs	Operations	R&D	Staff Exchange	Training Exercises	Unit-Unit Relationships
no	National Guard Counterdrug School Program (NGB Title 10 Program)	no	no	yes	no	no	no	no	no	yes	no
	Regional Centers for Security Studies	no	yes	yes	no	no	no	no	no	no	no
	Regional Defense Counterterrorism Fellowship Program (RDCTFP)	no	no	yes	no	no	no	no	no	yes	no
	Service Academy foreign and cultural exchange activities	no	no	yes	no	no	no	no	yes	no	no
	U.S. Army Center of Military History (CMH) Intern Program	no	yes	yes	no	no	no	no	yes	no	no
	Afghanistan Infrastructure Program (AIP)	no	no	no	yes	no	no	no	no	no	no
	Afghanistan Security Forces Fund (ASFF)	no	no	no	yes	no	no	no	no	yes	no
	Africa Contingency Operations Training and Assistance (ACOTA)	no	no	no	no	no	yes	no	no	yes	no
	African Land Forces Summit 2012	no	yes	no	no	no	no	no	no	no	no
	Air and Maritime Sector Development (AFRICOM)	no	no	no	no	no	no	no	no	no	no

Table E.1—Continued

Builds Interoperability for Multinational Missions?	Program Name	Arms Control	Information Exchange	Education	Equipment	LNOs	Operations	R&D	Staff Exchange	Training Exercises	Unit-Unit Relationships
no	Air and Trade Shows	no	no	no	yes	no	no	no	no	no	no
	Andean Counterdrug Initiative (ACI)	yes	no	no	no	no	yes	no	no	no	no
	Anti-Terrorism Assistance (ATA) Program	no	no	no	no	no	no	no	no	yes	no
	Army Global Civil-Military Emergency Preparedness	no	yes	no	no	no	no	no	no	yes	no
	Authority for Assignment of Civilian Employees of the Department of Defense as Advisors to Foreign Ministries of Defense (MoDA)	no	yes	no	no	no	no	no	no	yes	no
	Authority of DoD to Provide Additional Support for Counterdrug Activities of Other Governmental Agencies (Section 1004)	no	no	no	no	no	yes	no	no	no	no
	Border Commanders Conference	no	yes	no	no	no	no	no	no	no	no
	Building the Capacity of the Pakistan Frontier Corps	no	no	no	no	no	yes	no	no	no	no
	Coalition Solidarity Funds (CSF)	no	no	no	no	no	yes	no	no	no	no

Table E.1—Continued

Builds Interoperability for Multinational Missions?	Program Name	Arms Control	Information Exchange	Education	Equipment	LNOs	Operations	R&D	Staff Exchange	Training Exercises	Unit-Unit Relationships
no	Coalition Solidarity Funds (CSF)	no	no	no	no	no	yes	no	no	no	no
	Coalition Support Funds (CSF)	no	no	no	yes	no	no	no	no	no	no
	Coalition Warfare Program	no	no	no	no	no	no	yes	no	no	no
	Commander's Emergency Response Program (CERP)	no	no	no	yes	no	yes	no	no	no	no
	Container Security Initiative (CSI)	no	no	no	no	no	yes	no	no	no	no
	Cooperative Research, Development, Testing, Evaluation (RDT&E) and Production	no	no	no	no	no	no	yes	no	no	no
	Cooperative Threat Reduction (CTR), Biological Threat Reduction Project (BTRP)	yes	no	no	no	no	no	no	no	no	no
	Cooperative Threat Reduction (CTR), Chemical Weapons Destruction (CWD)	yes	no	no	no	no	no	no	no	no	no
	Cooperative Threat Reduction (CTR), Defense and Military Contacts (DMC) Program	no	no	no	no	no	no	no	no	no	yes

Table E.1—Continued

Builds Interoperability for Multinational Missions?	Program Name	Arms Control	Information Exchange	Education	Equipment	LNOs	Operations	R&D	Staff Exchange	Training Exercises	Unit-Unit Relationships
no	Cooperative Threat Reduction (CTR), Weapons of Mass Destruction-Proliferation Prevention Initiative (WMD-PPI)	yes	no	no	no	no	no	no	no	no	no
	Defense HIV/AIDS Prevention Program (DHAPP) in support of the U.S. President's Emergency Plan for AIDS Relief (PEPFAR)	no	no	no	no	no	yes	no	no	no	no
	Defense Institution Reform Initiative (DIRI)	no	yes	no	no	no	no	no	no	no	no
	Defense Research, Development, Test and Evaluation (RDT&E), Information Exchange Program (IEP)	no	no	no	no	no	no	yes	no	no	no
	Defense Resource Management Study Program (DRMS)	no	yes	no	no	no	no	yes	no	no	no
	Direct Commercial Sales (DCS)	no	no	no	yes	no	no	no	no	yes	no
	Disposal of naval vessels to foreign nations	no	no	no	yes	no	no	no	no	no	no

Table E.1—Continued

Builds Interoperability for Multinational Missions?	Program Name	Arms Control	Information Exchange	Education	Equipment	LNOs	Operations	R&D	Staff Exchange	Training Exercises	Unit-Unit Relationships
no	DoD Support for Counter-Drug Activities of Certain Foreign Governments (Section 1033)	no	no	no	yes	no	no	no	no	no	no
	European Security Agreements	yes	no	no	no	no	no	no	no	no	no
	Exchange of mapping, charting, and geodetic data	no	yes	no	no	no	no	no	no	no	no
	Exercise Related Construction (ERC)	no	no	no	no	no	no	no	no	no	no
	Export Control and Related Border Security (EXBS) Program	yes	yes	no	no	no	no	no	no	no	no
	Foreign Military Construction Sales (FMCS)	no	no	no	yes	no	no	no	no	no	no
	Foreign naval vessels and aircraft: Supplies and services	no	no	no	yes	no	yes	no	no	no	no
	Foreign Technology Assessment Support Program	no	no	no	no	no	no	yes	no	no	no
	Funds for foreign cryptologic support	no	no	no	no	no	no	no	no	no	no
	Future Battlefield Annual Talks	no	yes	no	no	no	no	no	no	no	no

Table E.1—Continued

Builds Interoperability for Multinational Missions?	Program Name	Arms Control	Information Exchange	Education	Equipment	LNOs	Operations	R&D	Staff Exchange	Training Exercises	Unit-Unit Relationships
no	Global Research Watch Program	no	no	no	no	no	no	yes	no	no	no
	Global Threat Reduction Initiative (GTRI)	yes	no	no	no	no	no	no	no	no	no
	Humanitarian and Civic Assistance (HCA)	no	no	no	no	no	yes	no	no	no	no
	Humanitarian Assistance (HA)	no	no	no	no	no	yes	no	no	no	no
	Humanitarian Assistance Excess Property Program (HAP-EP)	no	no	no	yes	no	no	no	no	no	no
	Humanitarian Assistance Space Available Transportation	no	no	no	no	no	yes	no	no	no	no
	Humanitarian Daily Rations (HDRs)	no	no	no	yes	no	no	no	no	no	no
	Humanitarian Demining Research and Development (HD R&D) Program	no	no	no	no	no	no	yes	no	no	no
	International Border Interdiction Training (IBIT)	no	no	no	no	no	yes	no	no	yes	no
	International Container Security (ICS) Project	yes	no	no	no	no	no	no	no	no	no
	International Engine Management Program (IEMP)	no	no	no	yes	no	no	no	no	no	no

Table E.1—Continued

Builds Interoperability for Multinational Missions?	Program Name	Arms Control	Information Exchange	Education	Equipment	LNOs	Operations	R&D	Staff Exchange	Training Exercises	Unit-Unit Relationships
no	International Narcotics Control and Law Enforcement (INCLE) Program	no	no	no	yes	no	no	no	no	yes	no
	International Nonproliferation Export Control Program (INECP)	yes	no	no	no	no	no	no	no	no	no
	Iraq Security Forces Fund (ISFF)	no	no	no	yes	no	yes	no	no	yes	no
	Joint Task Force (JTF) Support to Law Enforcement Agencies Conducting Counter-Terrorism Activities	no	no	no	no	no	no	no	no	yes	no
	Latin American Cooperation (LATAM Coop)	no	yes	no	no	no	no	no	no	no	no
	Lift & Sustain (Iraq & Afghanistan)	no	no	no	yes	no	yes	no	no	no	no
	Material, Protection, Control, and Accountability (MPC&A)	yes	yes	no	no	no	no	no	no	no	no
	Megaports	yes	no	no	yes	no	no	no	no	yes	no
	Operator Engagement Talks (OET, formerly "Ops-Ops Talks")	no	yes	no	no	no	no	no	no	no	no
	Pakistan Counterinsurgency Capability Fund (PCCF)	no	no	no	yes	no	no	no	no	no	no

Table E.1—Continued

Builds Interoperability for Multinational Missions?	Program Name	Arms Control	Information Exchange	Education	Equipment	LNOs	Operations	R&D	Staff Exchange	Training Exercises	Unit-Unit Relationships
no	Pakistan Counterinsurgency Fund (PCF)	no	no	no	yes	no	no	no	no	no	no
	President's Emergency Plan for AIDS Relief	no	no	no	no	no	yes	yes	no	no	no
	President's Malaria Initiative	no	no	no	no	no	yes	yes	no	no	no
	Program for Proliferation Prevention (PPP)	yes	no	no	no	no	no	no	no	no	no
	Proliferation Security Initiative (PSI)	yes	no	no	no	no	no	no	no	no	no
	Sale of surplus war material	no	no	no	yes	no	no	no	no	no	no
	Second Line of Defense (SLD)	yes	no	no	no	no	no	no	no	no	no
	Service Participation in Bilateral and Multilateral International Armaments Cooperation (IAC) Forums	yes	yes	no	no	no	no	no	no	no	no
	Small Arms/Light Weapons (SA/LW) Program	yes	no	no	no	no	no	no	no	no	no
	Terrorism Information Sharing	no	yes	no	no	no	no	no	no	no	no
	Train and Equip to Assist Accounting for Missing USG Personnel	no	no	no	yes	no	no	no	no	yes	no

Table E.1—Continued

Builds Interoperability for Multinational Missions?	Program Name	Arms Control	Information Exchange	Education	Equipment	LNOs	Operations	R&D	Staff Exchange	Training Exercises	Unit-Unit Relationships
no	Transfer of Excess Construction or Fire Equipment	no	no	no	yes	no	no	no	no	no	no
	Transfer of Technical Data	no	yes	no	no	no	no	no	no	no	no
	Transition Initiatives (TI)	no	yes	no	no	no	no	no	no	no	no
	U.S. Army Center of Military History International History Programs	no	yes	no	no	no	no	no	no	no	no
	U.S. Army Training and Doctrine Command Liaison Officers	no	no	no	no	yes	no	no	no	no	no
	United States Military Observer to United Nations Missions	no	yes	no	no	no	yes	no	no	no	no
	Use of Funds for Unified Counterdrug and Counterterrorism Campaign in Colombia (Plan Colombia)	no	no	no	yes	no	no	no	no	no	no
	USN Africa Partnership Station (APS)	no	yes	no	no	no	no	no	no	no	no
	USN Continuing Promise (CP)	no	yes	no	no	no	no	no	no	no	no
	War Reserve Stocks for Allies (WRSA)	no	no	no	yes	no	no	no	no	no	no
	WMD Nonproliferation Agreement Implementation	yes	no	no	no	no	no	no	no	no	no

APPENDIX F

NATO Defense Spending Data

A Change in the Threat Level Is Reversing Defense Budget Cuts in Europe

From an American perspective, the singular threat which drove major efforts at interoperability for decades among NATO allies was removed over two decades ago and replaced with a series of challenges that, while entailing coalitions cooperating and working together, have left the actual demand for specific functional interoperability opaque and enshrined in loftier goals of legitimacy through engagement with multinational partners.

In addition, NATO spending in general on defense has dropped in total terms and as a percentage of the gross domestic product (GDP) in most member states. There have been several reasons for this development: budget cuts during the global economic crisis, long-lasting perception of a lack of threats in many European states (particularly before the emergence of the Russian threat in Ukraine and extremist threats from the Middle East), and a withdrawal from large-scale conflicts in Iraq and Afghanistan that necessitated significant defense expenditures by European and American allies alike.[1]

[1] The long-term decrease in military spending of European NATO allies, however, may soon be offset by increased defense spending in European countries triggered by Russian invasion of Crimea and eastern Ukraine and the increasing involvement of NATO forces in Syria and Iraq. In fact, some have dubbed year 2014 a "game-changer" for European defense spending. See Olivier De France, "Defence Budgets in Europe: Downturn or U-Turn," *ISS Europa*, May 2015.

Naturally, changes in absolute spending on national defense do not automatically translate into rapid changes in national defense capabilities and readiness. However, with a greater proximity of instability to the homeland, many European countries have decided to bolster their land, air, navy, and special forces capabilities. European defense powers, particularly the United Kingdom and France, are maintaining high levels of readiness, some of which is attributed by some to their imperial history—a reality not shared by other European states that almost exclusively pursue territorial defense strategies.[2] With a history of declining defense budgets in countries like Germany, the general direction has shifted as defense spending has become more politically acceptable (German lawmakers announced they would pursue increased defense spending from 2016 on[3]). Despite the fragmentation of capabilities and trends in defense spending across the continent, the combined European defense capability is approximately three times as strong as Russia's despite its massive modernization efforts.[4]

Defense Spending by NATO Has Been Declining

As documented in the following charts, defense spending by most NATO member states has followed a declining trend since the end of the Cold War. Moreover, only several small and medium-sized nations, including Estonia, Poland, and Romania expect to spend more on defense in 2015 than they did in 2010, at the height of the economic and financial crisis (see Table F.1).

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[2] Richard Reeve, "Cutting the Cloth: Ambition, Austerity and the Case for Rethinking UK Military Spending," Oxford Research Group, May 13, 2015.

[3] Patrick Donahue, "German Lawmakers Seek to Raise Defense Spending from 2016," *Bloomberg*, October 23, 2014.

[4] Reeve, "Cutting the Cloth."

Table F.1
Defense Expenditures in Millions of Dollars (Current Prices and Exchange Rate)

	2010	2011	2012	2013	2014	2015	2015 Versus 2010
Albania	186	197	183	180	184	130	less than 2010
Belgium	5,245	5,500	5,169	5,264	5,192	4,036	less than 2010
Bulgaria	832	758	722	811	747	523	less than 2010
Canada	18,690	22,040	19,994	18,221	18,150	15,634	less than 2010
Croatia	920	996	865	850	805	631	less than 2010
Czech Republic	2,660	2,437	2,185	2,147	1,974	1,899	less than 2010
Denmark	4,504	4,518	4,423	4,216	4,056	3,267	less than 2010
Estonia	332	389	437	480	513	442	more than 2010
France	51,971	53,441	50,245	52,317	52,006	42,100	less than 2010
Germany	46,255	48,140	46,470	45,932	46,102	37,531	less than 2010
Greece	7,902	6,858	5,633	5,310	5,226	4,581	less than 2010
Hungary	1,351	1,472	1,322	1,272	1,205	1,041	less than 2010
Italy	28,656	30,223	26,468	26,658	24,448	17,536	less than 2010
Latvia	251	289	248	281	293	272	more than 2010
Lithuania	326	345	324	355	427	456	more than 2010

Table F.1—Continued

	2010	2011	2012	2013	2014	2015	2015 versus 2010
Luxembourg	248	232	214	234	257	270	more than 2010
Netherlands	11,220	11,339	10,365	10,226	10,332	8,592	less than 2010
Norway (e)	6,499	7,232	7,143	7,407	7,336	6,077	less than 2010
Poland	8,493	9,106	8,710	9,007	10,104	10,301	more than 2010
Portugal	3,540	3,652	3,040	3,262	2,990	2,676	less than 2010
Romania	2,086	2,380	2,100	2,452	2,692	2,223	more than 2010
Slovak Republic	1,138	1,065	1,020	968	997	859	less than 2010
Slovenia	772	666	543	507	486	394	less than 2010
Spain	14,743	13,984	13,912	12,607	12,614	10,381	less than 2010
Turkey	14,134	13,616	13,895	14,534	13,686	12,425	less than 2010
United Kingdom	60,329	62,852	58,016	62,263	65,827	58,529	less than 2010
USA	720,423	740,744	712,947	680,825	654,264	649,931	less than 2010
NATO Total	1,013,706	1,044,471	996,593	968,586	942,913	892,737	less than 2010

SOURCE: http://www.nato.int/nato_static_fl2014/assets/pdf/pdf_2015_06/20150622_PR_CP_2015_093-v2.pdf.

NOTE: Units: Current prices and exchange rates (million U.S. dollars).

Defense Spending of NATO Allies Is Negligible Relative to the United States

The following figure shows relative dollar amounts spent by NATO member states on defense between 2010 and 2015. Aside from a clear lead of the United States, other significant investments in defense are made by Canada, France, Germany, Italy, and the United Kingdom. No other country spends more than $15 billion annually on defense. In 2015, the United States will account for approximately 73 percent of Allied defense spending, and the six leading countries in NATO (United States and the five aforementioned ones) are expected to account for 92 percent of total defense spending, forming the backbone of the transatlantic defense Alliance (see Figure F.1).

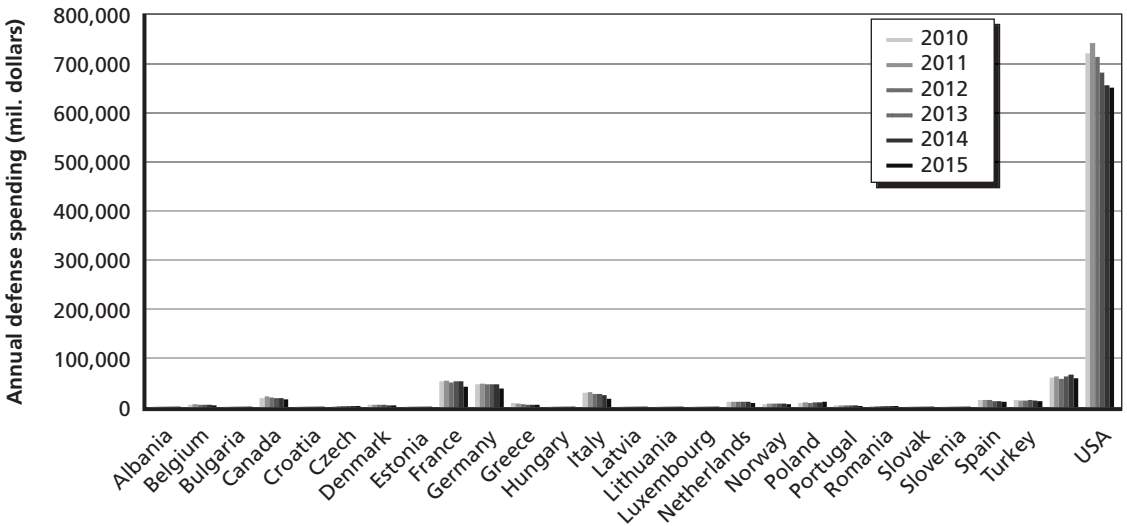
Only a Few Small and Medium-Sized Countries Are Increasing Defense Spending

With the exception of a few small to medium-sized countries, most defense budgets have been declining in absolute terms and stayed stagnant or declined in relative terms, too (proportionally to national GDP). These trends are captured in the following two graphs and table (Figure F.1, Figure F.2, Table F.2).

The Share of Defense Spending on GDP Has Been Mostly Declining, Too

Proportional to gross national product, defense spending has followed a generally negative trend in NATO since 2011 (mostly driven by a relative decline of defense spending in the United States), with notable expected increases only in countries affected by Russian actions in Ukraine and other parts of Eastern Europe (such as in Poland, to an anticipated 2.2 percent of GDP, and Lithuania, to an expected 1.1 percent of GDP). The majority of countries, however, are expected to fail

Figure F.1
NATO Spending per Country Between 2010 and 2015



SOURCE: NATO, http://www.nato.int/cps/en/natohq/topics_49198.htm.

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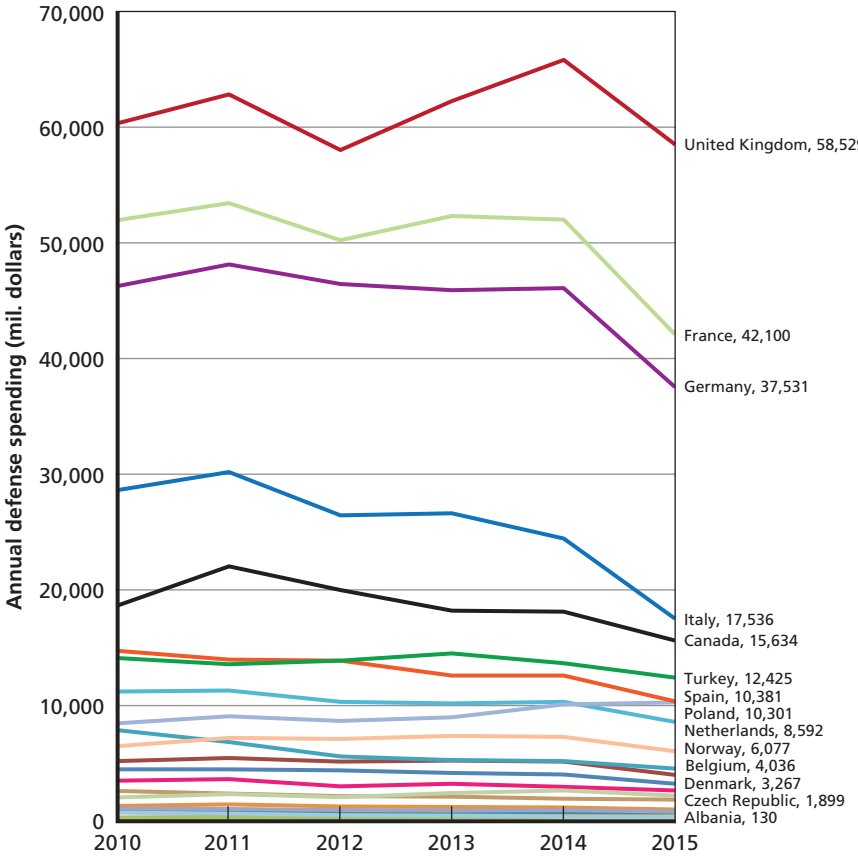
Figure F.2
NATO Defense Spending 2010–2015 (Excluding the United States)



SOURCE: NATO: http://www.nato.int/cps/en/natohq/topics_49198.htm.

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Table F.2
Defense Expenditures as a Percentage of GDP

Country	1995–1999	2000–2004	2005–2009	2010	2011	2012	2013	2014	2015
Albania				1.6	1.5	1.5	1.4	1.3	1.2
Belgium	1.5	1.2	1.1	1.1	1	1	1	1	0.9
Bulgaria			2.1	1.6	1.3	1.3	1.5	1.3	1.3
Croatia				1.5	1.6	1.5	1.5	1.4	1.4
Czech Republic		1.8	1.5	1.3	1.1	1.1	1	1	1.0
Denmark	1.6	1.5	1.3	1.4	1.3	1.3	1.2	1.1	1.1
Estonia			1.6	1.7	1.7	1.9	1.9	2	2.1
France	2.8	2.5	2.3	2.0	1.9	1.9	1.9	1.8	1.8
Germany	1.5	1.4	1.3	1.4	1.3	1.3	1.2	1.2	1.2
Greece	3.9	3.1	2.8	2.6	2.4	2.3	2.2	2.2	2.3
Hungary		1.6	1.3	1.0	1.1	1	1	0.9	0.9
Italy	1.8	1.9	1.5	1.3	1.3	1.2	1.2	1.1	1.0
Latvia			1.4	1.1	1	0.9	0.9	0.9	1.0
Lithuania			1.1	0.9	0.8	0.8	0.8	0.9	1.1
Luxembourg	0.7	0.7	0.5	0.5	0.4	0.4	0.4	0.4	0.4

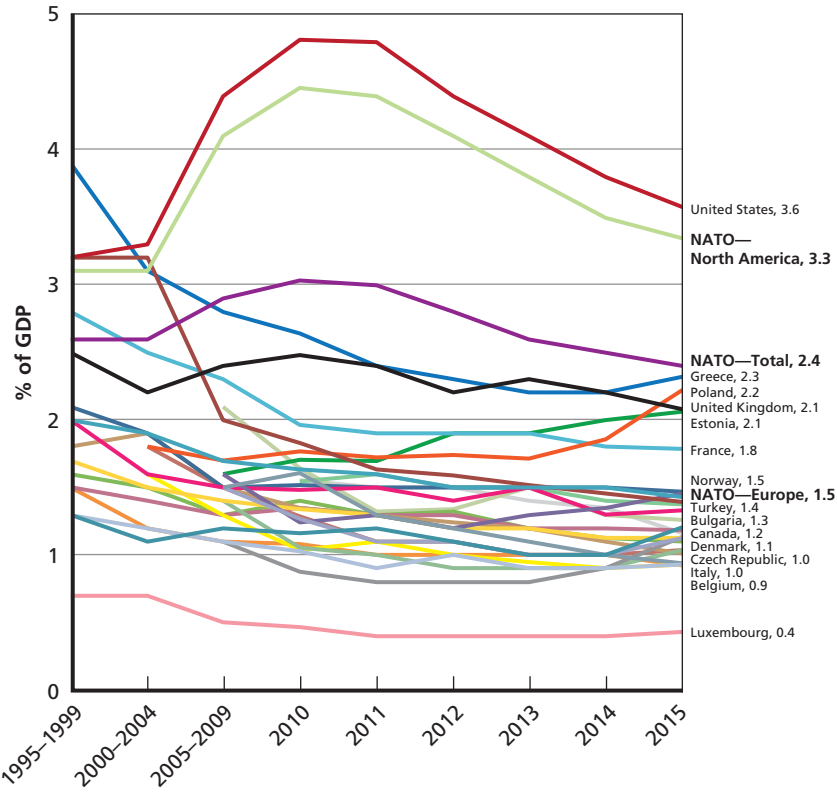
Table F.2—Continued

Country	1995–1999	2000–2004	2005–2009	2010	2011	2012	2013	2014	2015
Netherlands	1.7	1.5	1.4	1.3	1.3	1.2	1.2	1.1	1.1
Norway	2.1	1.9	1.5	1.5	1.5	1.5	1.5	1.5	1.5
Poland		1.8	1.7	1.8	1.7	1.7	1.7	1.9	2.2
Portugal	2	1.6	1.5	1.5	1.5	1.4	1.5	1.3	1.3
Romania			1.6	1.2	1.3	1.2	1.3	1.3	1.5
Slovak Republic			1.5	1.3	1.1	1.1	1	1	1.1
Slovenia			1.5	1.6	1.3	1.2	1.1	1	0.9
Spain	1.3	1.2	1.1	1.0	0.9	1	0.9	0.9	0.9
Turkey	3.2	3.2	2	1.8	1.6	1.6	1.5	1.5	1.4
United Kingdom	2.5	2.2	2.4	2.5	2.4	2.2	2.3	2.2	2.1
Canada	1.3	1.1	1.2	1.2	1.2	1.1	1	1	1.2
United States	3.2	3.3	4.4	4.8	4.8	4.4	4.1	3.8	3.6
NATO—North America	3.1	3.1	4.1	4.5	4.4	4.1	3.8	3.5	3.3
NATO—Europe	2	1.9	1.7	1.6	1.6	1.5	1.5	1.5	1.4
NATO—Total	2.6	2.6	2.9	3.0	3	2.8	2.6	2.5	2.4

SOURCE: NATO spending data as of July 2016, http://www.nato.int/cps/en/natohq/topics_49198.htm.

NOTE: Units: Percentage of gross domestic product (based on 2010 prices).

Figure F.3
NATO Defense Spending (as Percentage of GDP)



SOURCE: NATO, http://www.nato.int/cps/en/natohq/topics_49198.htm.

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to reach the agreed-upon defense spending per GDP threshold of 2 percent in 2015 (according to NATO estimates, only the United States, Estonia, Poland, United Kingdom, and Greece surpassed this level in 2015, as Figure F.3 illustrates).

APPENDIX G

Subject Matter Expert Survey on Interoperability Outcomes

The U.S. Army is funding a large number of programs that are specifically aimed at improving interoperability. But what is the potential impact of that portfolio of programs on interoperability, specifically on the five desired interoperability outcomes identified by the project team? Those outcomes are:

Aligned Procedures (unit-centric interoperability): ability of the force to use standardized tactics, techniques, procedures, products, and values for anticipated tasks or situations that can be dealt with effectively by using routine, structured responses. It is underpinned by a common professional language, an understanding of each contributing nation's units' military organization, doctrine, equipment, and inherent capabilities and limitations; this understanding helps to achieve unity of effort. Elements of the force are capable of operating alongside each other to achieve a synergistic effect necessary to accomplish the objective.

Compatible Equipment (equipment-centric interoperability): Forces from two or more partnered nations use common pieces of equipment, equipment that relies upon interchangeable repair parts and/or components, or equipment that requires consumable items that are interchangeable without adjustment.

Interoperable Communications and Information Systems (systems-centric interoperability): Ability of the force to communicate and pass information using technical means to create a shared understanding amongst the organization, while also providing the infrastructure to quickly disseminate the intent. Technical aspects of CIS include five layers: platforms and sensors, applications, services, transport infrastructure, and standards.

Individual Interoperability (staff-centric interoperability): Individual members of the force/staff possess respect, rapport, knowledge of partners, patience, mission focus, trust, and confidence in multinational partners, built upon the foundation of language skills, regional expertise, and cultural understanding. Commanders, subordinates, and staffs understand each other's military and command cultures. This builds to an understanding of each other's role and responsibility within the operations process and yields an understanding of expectations.

Shared Art of Mission Command (commander-centric interoperability): Ability of the force to operate with a tactical and operational unity of purpose and recognized unity of command that allows the commander to exercise authority and direction using mission orders to achieve the desired objective. It is dependent upon subordinates' and staff's motivation and commitment, and strengthened by their active participation and responsibility. Can be facilitated by the use of a combined staff or operations center.

We used a two-step mapping process involving elicitation from subject-matter experts (SMEs) in order to estimate this. In the first step, the Army's interoperability programs were identified and mapped to one or more activity categories. Based on this, a score was calculated for each activity category that captured both the number and the magnitude of interoperability programs falling under that activity category. In the second step, we asked 18 SMEs to rate the impact of each activity category on each of the five interoperability outcomes. Combining the average impact ratings from this step with the activity category scores from the first step allowed us to estimate the impact of the portfolio of programs on the desired interoperability outcomes.

Step One: Calculating Activity Category Scores Based on Interoperability Programs

We identified 192 interoperability-related Army programs (cf. Appendix B). For each program, we decided if it was part of one or more of the following activity categories:

Training and Exercises: both short- and long-term programs aimed at building the capacity and capability of partner nations and organizations that credibly simulate operational conditions and prepare armed forces for live combat and other types of missions. Military experiments are included in our study as a subset of military training and exercises.

Staff Exchanges: a way of familiarizing military personnel with the culture and practices of allied armed forces; they may be formalized into regular exchange programs or take place on an ad hoc basis. They may also be technical or scientific in nature and contribute to the development of specific capabilities. Additionally, certain exchange programs have the education of foreign military personnel as their primary goal.

Consultations and Information Exchanges: senior leader engagement, conferences, workshops, needs and capabilities assessments, and similar efforts involving communication, collaboration, and cooperation.

Education: may involve formal education programs focused at specific target groups and ad hoc information dissemination that fills the needs of a specific multinational engagement. International military education and training is defined as "formal or informal instruction provided to foreign military students, units, and forces on a non-reimbursable (grant) basis by offices or employees of the United States, contract technicians, and contractors. Instruction may include correspondence courses; technical, educational, or informational publications; and media of all kinds" (Department of the Army, 2013).

Research, Development, Test, and Evaluation: encompasses a wide array of programs aimed at building future technological

capabilities, understanding the capacity and capability of the adversary and at providing allied military units with state-of-the-art equipment. In multinational settings, R&D and RDT&E programs engage leading researchers and scientists of foreign militaries, discuss technical standards, foreign military sales, as well as other scientific and technical aspects of modern warfare.

Armaments and Arms Control: includes weapons systems that may be subject to export to and utilization by allied armed forces. Weapons systems are defined as "a combination of one or more weapons with all related equipment, materials, services, personnel, and means of delivery and deployment (if applicable) required for self-sufficiency" (Joint Chiefs of Staff, 2011b). The system of arms control consists of four areas: treaty language that forms the core of a verification regime, monitoring systems that collect relevant data, analysis processes, and evaluation (Woolf, 2011).

Unit-to-Unit Relationships: interpersonal relationships between international military units that extends beyond commanding officers. This category primarily involves informal interactions between members of cooperating units before, during, and after multinational engagements that allow participants to develop sensitivity to language, cultural, and interpersonal dynamics in partnering units.

Equipment Transfers: equipment is a broad category that includes tools, machines, vehicles, and other assets to support military operations. "The term 'military equipment' includes all weapons systems, weapon platforms, vehicles, and munitions of the Department of Defense, and the components of such items" (United States Code, 1956, §2228). In the context of this study, this definition can be generalized to all such assets that are owned by the U.S. and allied armed forces and may be sold, used, and utilized for multinational military purposes.

Liaison Officers (LNOs): liaison is a "contact or intercommunication maintained between elements of military forces or other agencies to ensure mutual understanding and unity of purpose and action" (Joint Chiefs of Staff, 2011a). In the context of this

study, liaison teams and individuals "represent the interests of the sending commander to the receiving commander," and their primary function is to "promote understanding of the commander's intent at both the sending and receiving HQ" (Joint Chiefs of Staff, 2011b).

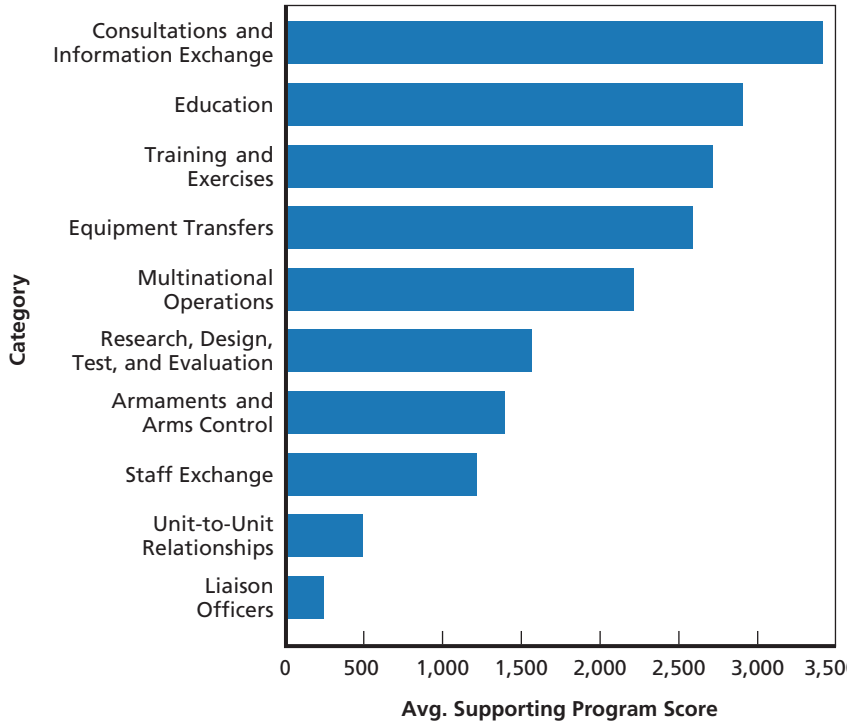
Multinational Operations: "a series of tactical actions with a common purpose or unifying theme" (U.S. Army, 2013) as well as "military actions or the carrying out of a strategic, operational, tactical, service, training, or administrative military mission" (Joint Chiefs of Staff, 2011b). In the context of this study, multinational operations are defined broadly as multinational engagements that have a specific goal outside of training, education, research, and consultation purposes. Typical examples of multinational military operations include peace, humanitarian, combat, and stabilization (SSTRO) operations.

We also approximated the level of effort of a program by estimating its "magnitude" on a scale from "large" to "very small," with associated weights spanning two orders of magnitude. For each activity category, magnitude scores were multiplied by the number of respective program-to-category matches and added across all programs, resulting in a numerical weighting score for each activity category (cf. Figure G.1). These scores represent how many interoperability programs support each activity category, and what size those programs are. Note that the absolute values for those scores are meaningless; only the relative magnitude of a category compared to the other categories counts.

Step Two: Rating the Impact of Activity Categories on Interoperability Outcomes

The subject-matter experts were asked to provide a qualitative rating for the impact of each activity category on each of the desired interoperability outcomes, using a rating scale ranging from "high" to "medium" to "low" to "none." These qualitative ratings were converted to a numerical scale (9/3/1/0 for the baseline, in accordance with expert elicitation

Figure G.1
Activity Category Scores



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best practices). Figure G.2 shows the resulting average numerical ratings for each impact; the red circles indicate the activity categories with the highest average impact ratings for each interoperability outcome. Figure G.3 shows the standard deviation across SME responses that is associated with each average rating; Figure G.4 shows box plots of the associated response distributions.

Multiplying these impact ratings for each activity category and outcome with the activity category score of the respective activity category (cf. Figure G.1) shows how well the programs in each activity category support each interoperability outcome (Figure G.5).

Finally, summing up those scores across activity categories shows how the portfolio overall supports the desired outcomes (Figure G.6).

Figure G.2
Average Impact Ratings Based on Responses from 18 SMEs

Category	Aligned Procedures	Compatible Equipment	Outcome Interoperable CIS	Individual Interoperability	Art of Mission Command
Training and Exercises	8	3	5	6	7
Staff Exchange	4	2	2	6	6
Consultations and Information Exchange	4	2	4	3	3
Education	5	1	1	6	6
Research, Design, Test, and Evaluation	2	6	7	1	1
Armaments and Arms Control	2	3	3	1	1
Unit-to-Unit Relationships	5	3	3	6	6
Equipment Transfers	2	7	5	2	1
Liaison Officers	4	2	3	7	5
Multinational Operations	8	4	5	6	7

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Figure G.3
Standard Deviation of Impact Ratings Across SMEs, Color Coded by Average Rating

Category	Aligned Procedures	Compatible Equipment	Outcome Interoperable CIS	Individual Interoperability	Art of Mission Command
Training and Exercises	2.24	3.15	3.05	3.00	3.10
Staff Exchange	1.98	1.19	2.55	3.40	3.15
Consultations and Information Exchange	2.98	1.96	3.05	2.41	2.41
Education	3.15	0.94	0.89	3.40	3.12
Research, Design, Test, and Evaluation	1.94	3.51	3.21	0.66	0.62
Armaments and Arms Control	3.11	3.33	3.55	2.08	2.13
Unit-to-Unit Relationships	2.95	2.45	2.37	3.42	2.99
Equipment Transfers	1.95	3.21	3.35	2.04	1.07
Liaison Officers	3.07	2.09	2.96	3.08	3.27
Multinational Operations	2.24	3.04	3.16	3.14	3.02

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Figure G.4
Distribution of Impact Ratings Across SMEs

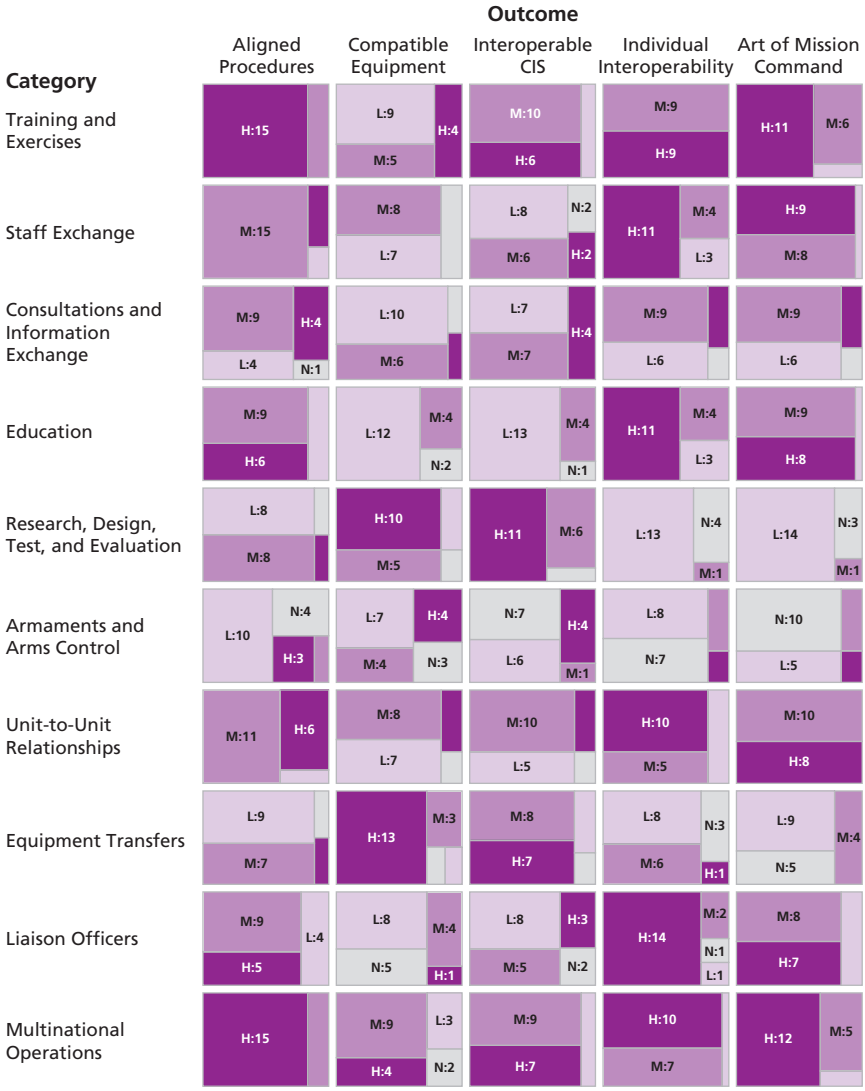

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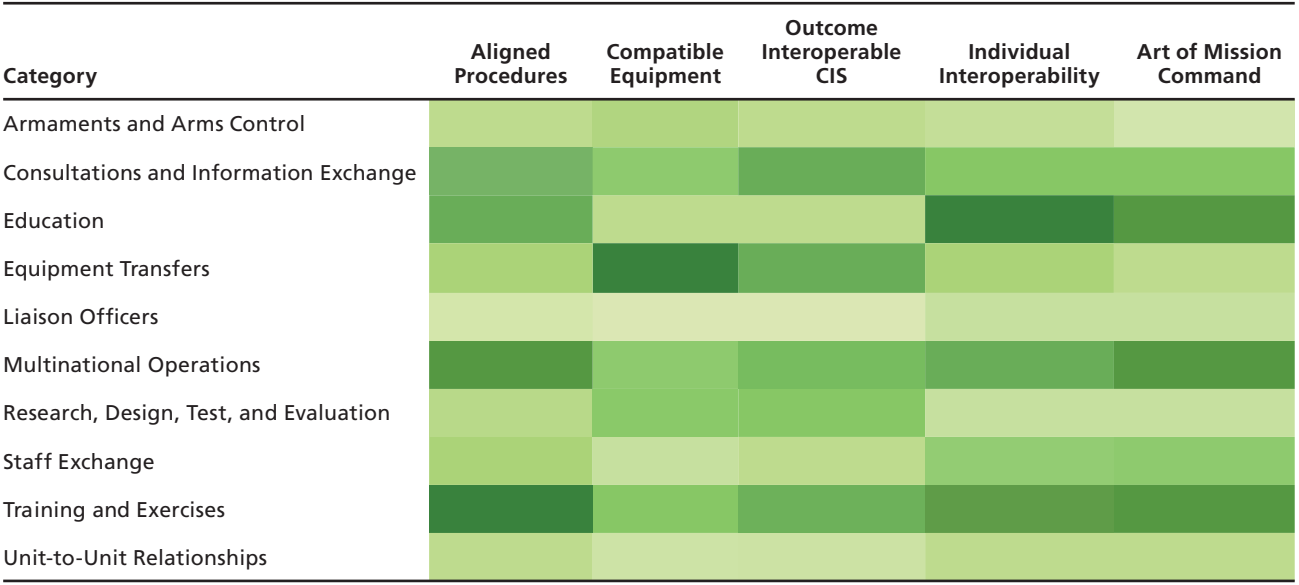
Figure G.5
Impact of Activity Categories on Outcomes Based on Programs



NOTE: Darker colors represent how well the programs in each activity category support each interoperability outcome.

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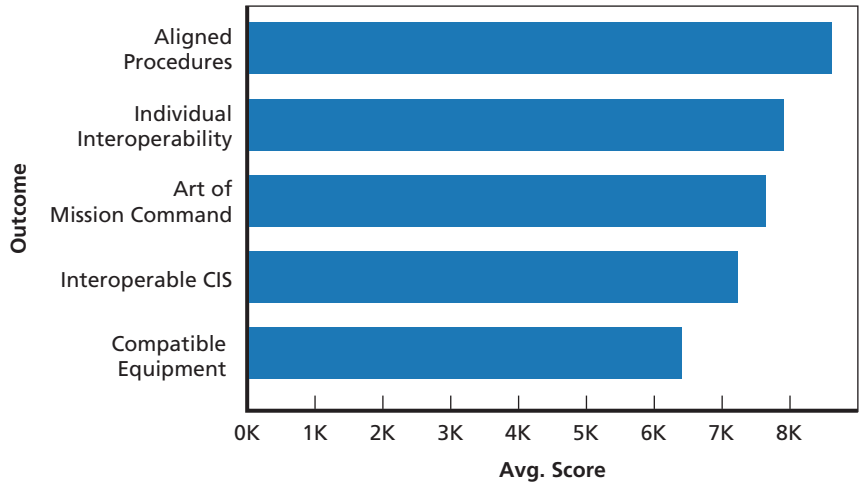
Figure G.6
How Well Does the Portfolio of Programs Support the Desired Outcomes?



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As for the activity category scores, the absolute values for those scores are meaningless; only the relative magnitude of an outcome compared to the other outcomes counts.

Sensitivity Analysis

Since the above results are based in part on weighting factors that were chosen by the research team, we repeated the analysis outlined above with different values for those factors, in order to determine the sensitivity of the results to those factors. We conducted two alternative calculations: one with the scale for the SME's "H/M/L/N" ratings set to 3/2/1/0 (instead of the original 9/3/1/0), and another one with the scale for the program magnitude factors set to 10/5/2/1 (instead of the original 125/25/5/1).

Figure G.7 shows the results for the activity category impact chart (cf. Figure G.5). Figure G.8 shows the results for the outcome

Figure G.7
Sensitivity of *Activity Categories Impact on Outcomes Based on Programs* to Weighting Factors
(Top: Baseline; Center: H/M/L/N Weights; Bottom: Program Magnitude Weights)

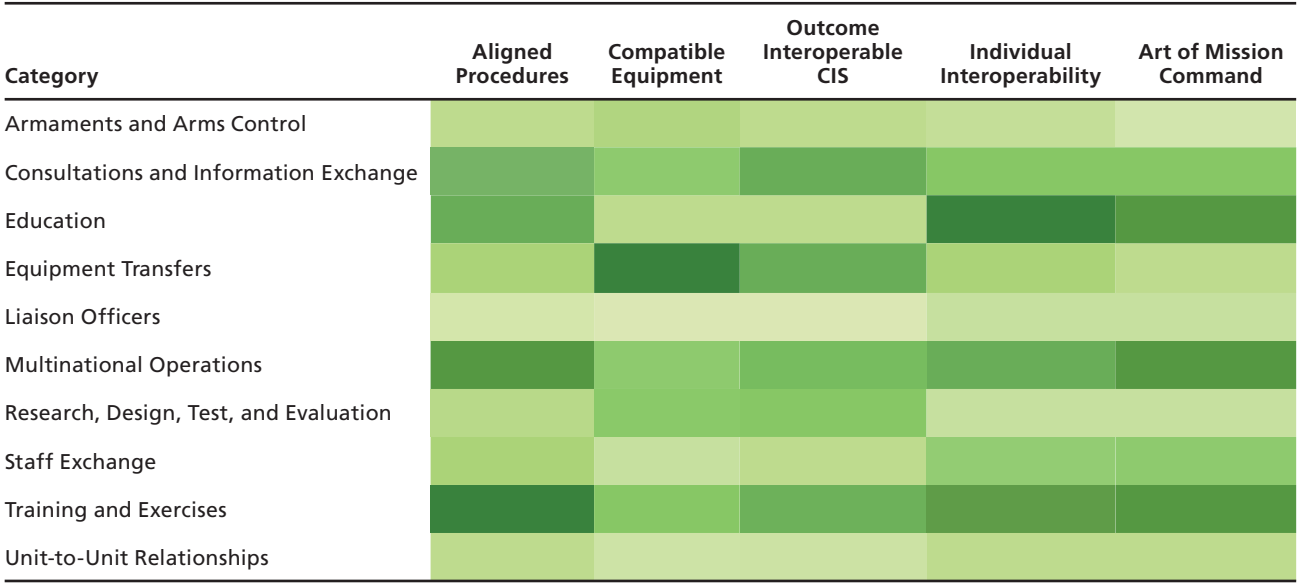
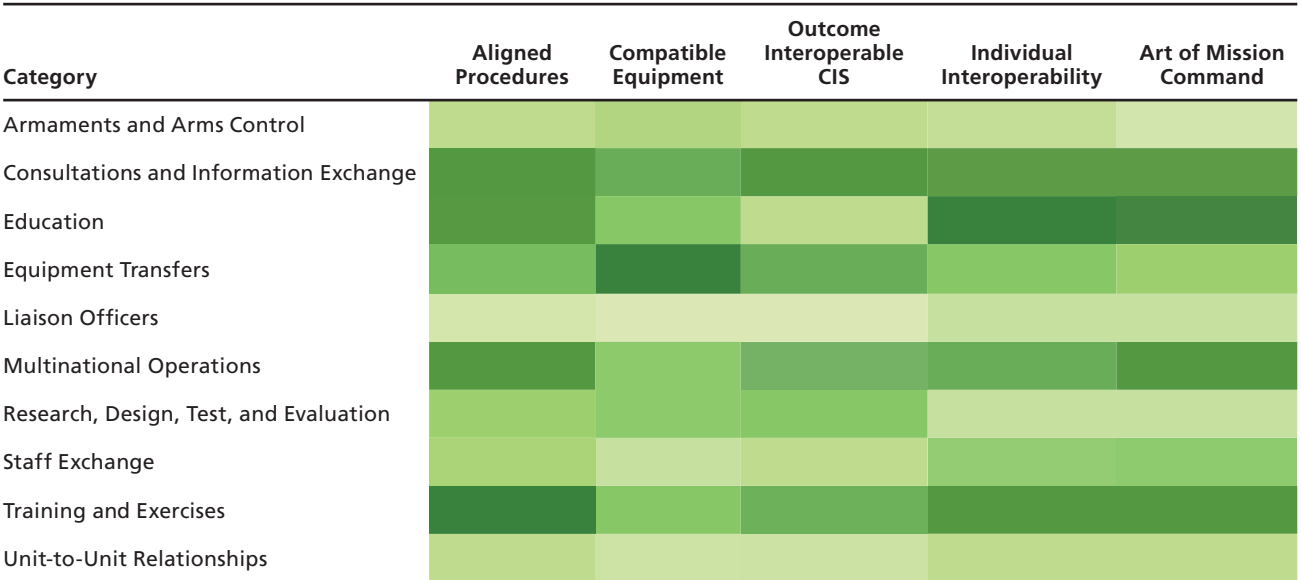
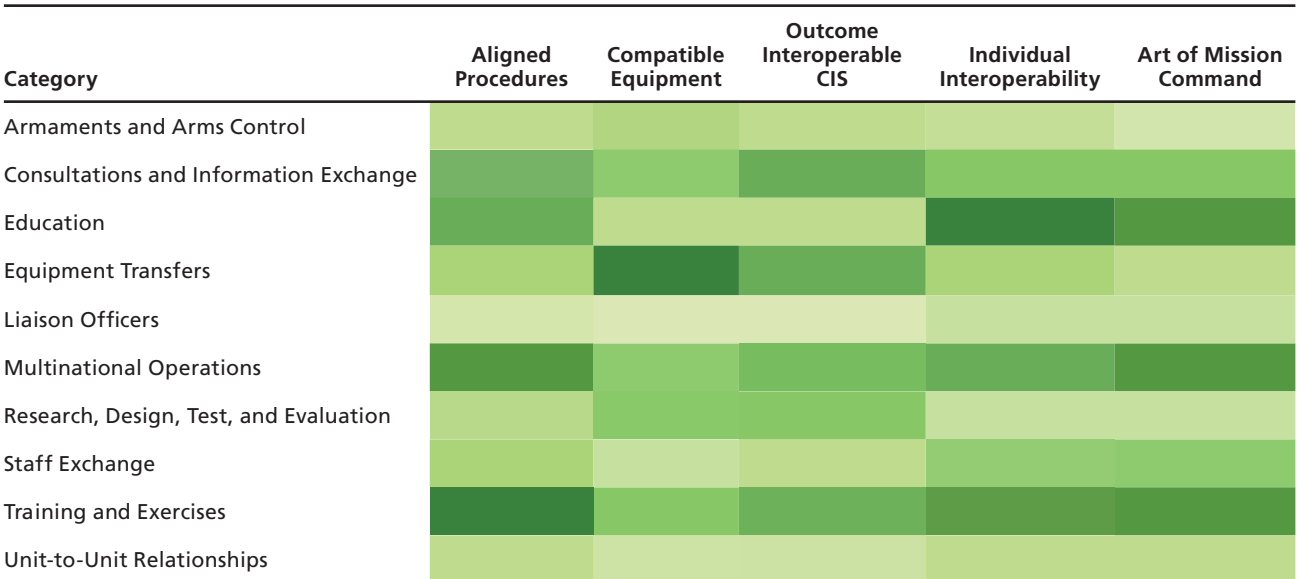


Figure G.7—Continued



Category	Aligned Procedures	Compatible Equipment	Outcome Interoperable CIS	Individual Interoperability	Art of Mission Command
Armaments and Arms Control					
Consultations and Information Exchange					
Education					
Equipment Transfers					
Liaison Officers					
Multinational Operations					
Research, Design, Test, and Evaluation					
Staff Exchange					
Training and Exercises					
Unit-to-Unit Relationships					

Figure G.7—Continued



Category	Aligned Procedures	Compatible Equipment	Outcome Interoperable CIS	Individual Interoperability	Art of Mission Command
Armaments and Arms Control					
Consultations and Information Exchange					
Education					
Equipment Transfers					
Liaison Officers					
Multinational Operations					
Research, Design, Test, and Evaluation					
Staff Exchange					
Training and Exercises					
Unit-to-Unit Relationships					

NOTE: Darker colors represent how well the programs in each activity category support each interoperability outcome.

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Figure G.8
Sensitivity of *Portfolio Support of Outcomes to Weighting Factors* (Top: Baseline, Center: H/M/L/N Weights, Bottom: Program Magnitude Weights)

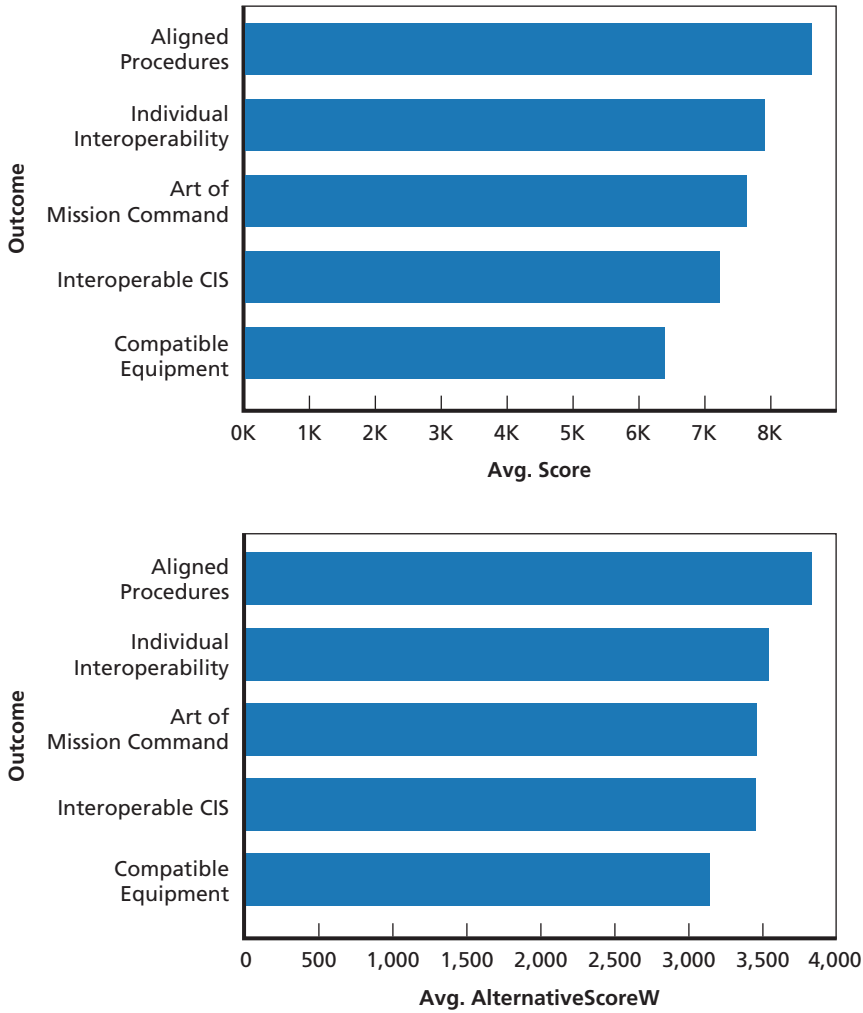
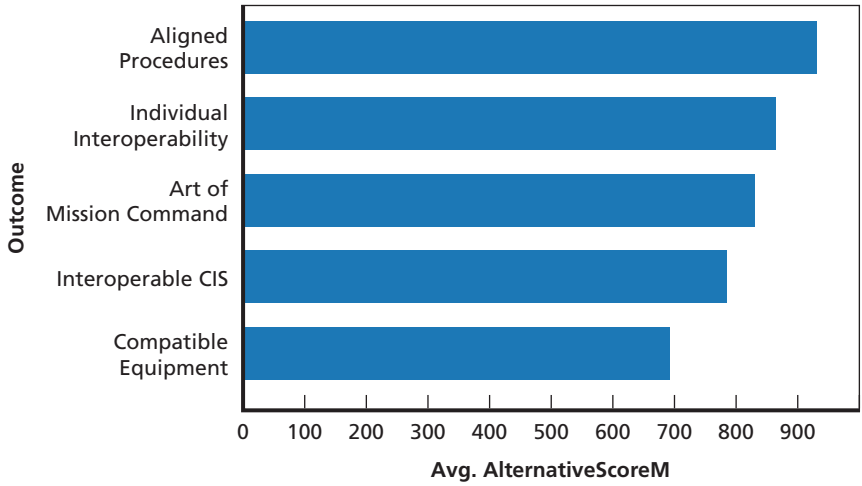


Figure G.8—Continued



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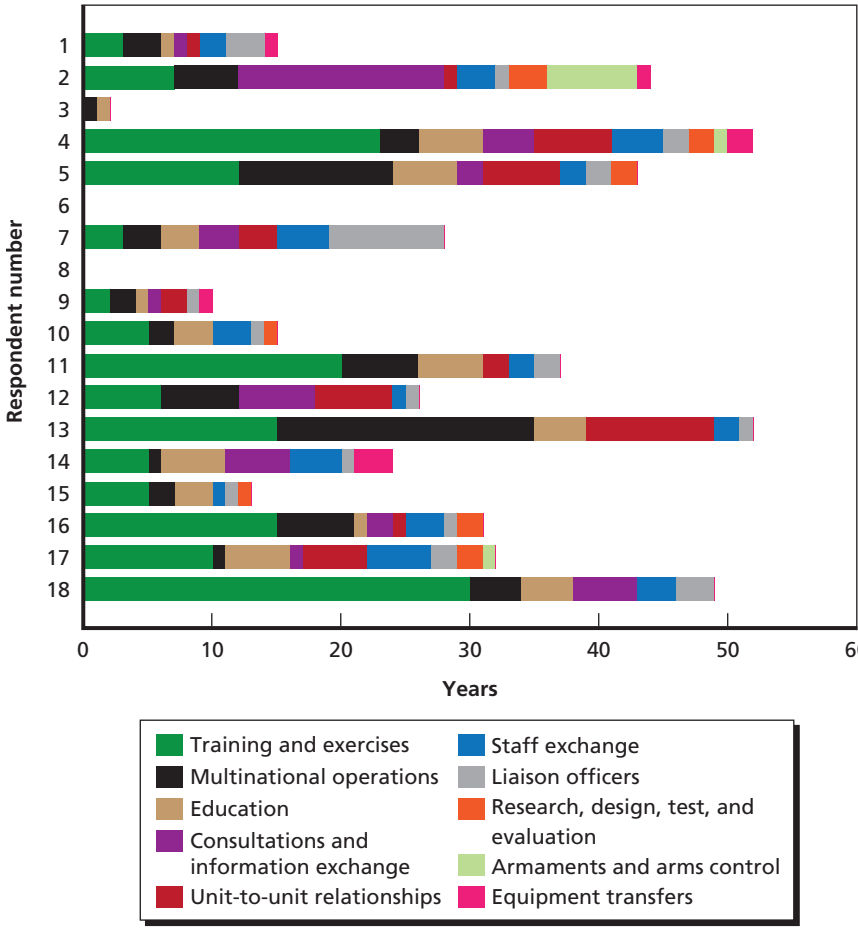
support chart (cf. Figure G.6). The baseline results are included as well to facilitate comparison. It is evident that, despite changes in some details, the results are not significantly affected by the changes in those two sets of weighting factors.

Impact of SME Experience

In addition to the sensitivity analysis described above, we also weighted the SME inputs based on each SME's amount of experience in the interoperability field. As part of the survey, we had asked each SME about how many years of experience he or she had in each interoperability category. Figure G.9 shows those inputs.

We then summed up the years of experience for each SME, and calculated the response weighting factor based on a logarithmic mapping function in order to approximate a learning curve. Figure G.10 shows the distribution of experience and resulting weighting factors for each SME.

Figure G.9
SME Experience by Activity Category



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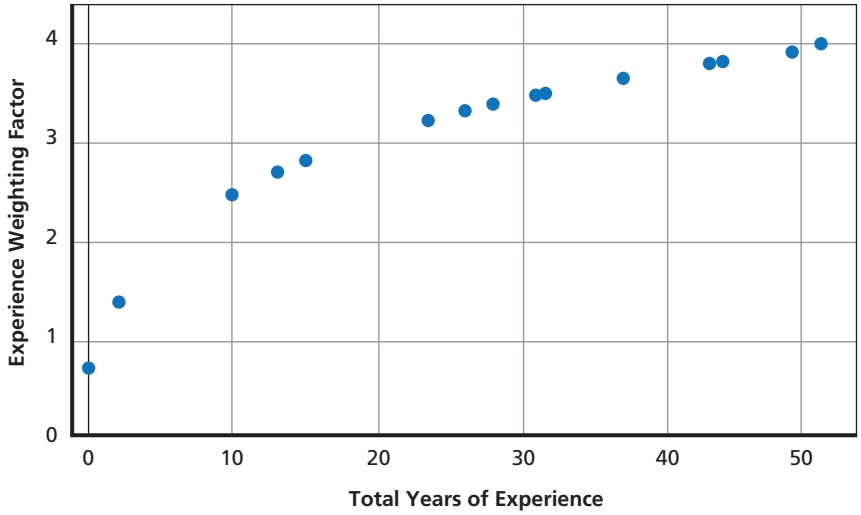
Figures G.11 and G.12 show the results after adding the experience weighting factors to the calculations. As in case of the sensitivity analysis, while there are differences in the details, no significant changes to the overall results are evident.

Figure G.10
Sum of SME Experience and Resulting Weighting Factors



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Discussion

As can be seen in Figures G.2 and G.4, activities related to training and exercises, as well as those related to multinational operations, are rated as having the highest overall impact, and both significantly affect the *Aligned Procedures* and *Art of Mission Command* outcomes. It is critical to observe that these types of activities are typically the most costly—and multinational operations, particularly, expose coalition forces to significant risks if sufficiently high degrees of interoperability are not achieved prior to deployment.

Other interesting patterns have emerged—education, staff exchanges, liaison officers, unit-to-unit activities, as well as multinational operations are particularly important for the development of *individual interoperability.* However, as we learned from follow-on interviews, individual interoperability is most at risk of being lost over time, with rotations from postings overseas and the collaboration across multiple units, leading to unpredictability about their joint deployment in the

Figure G.11
Effect of SME Experience on *Activity Categories Impact on Outcomes Based on Programs*
(Top: Baseline, Bottom: SME Ratings Weighted Based on Experience)

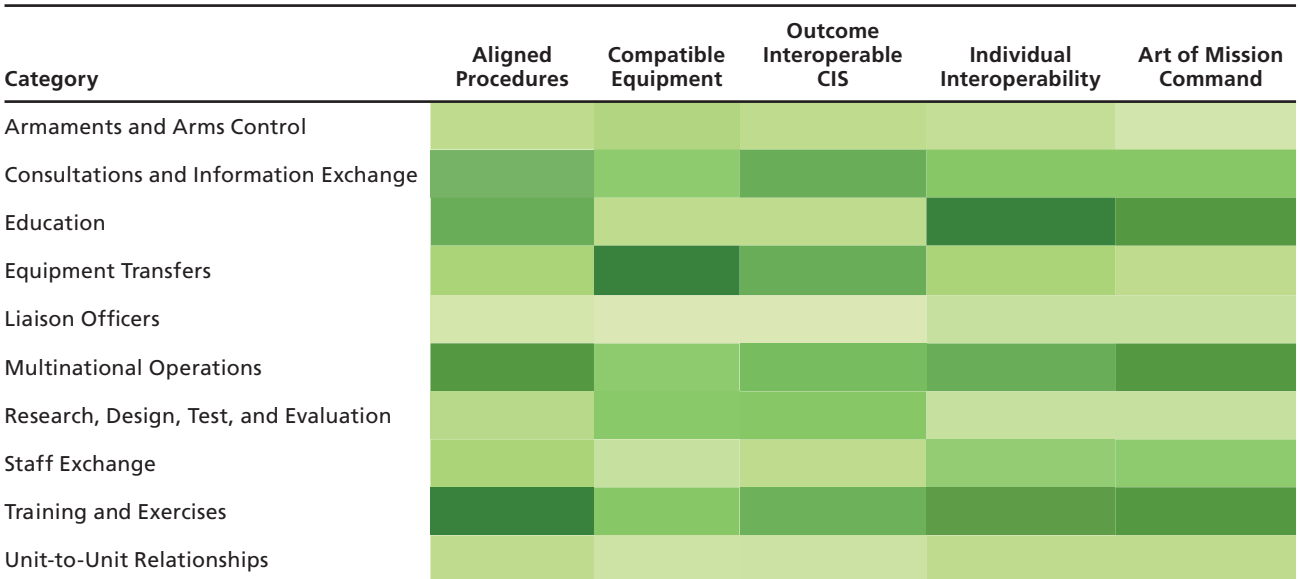
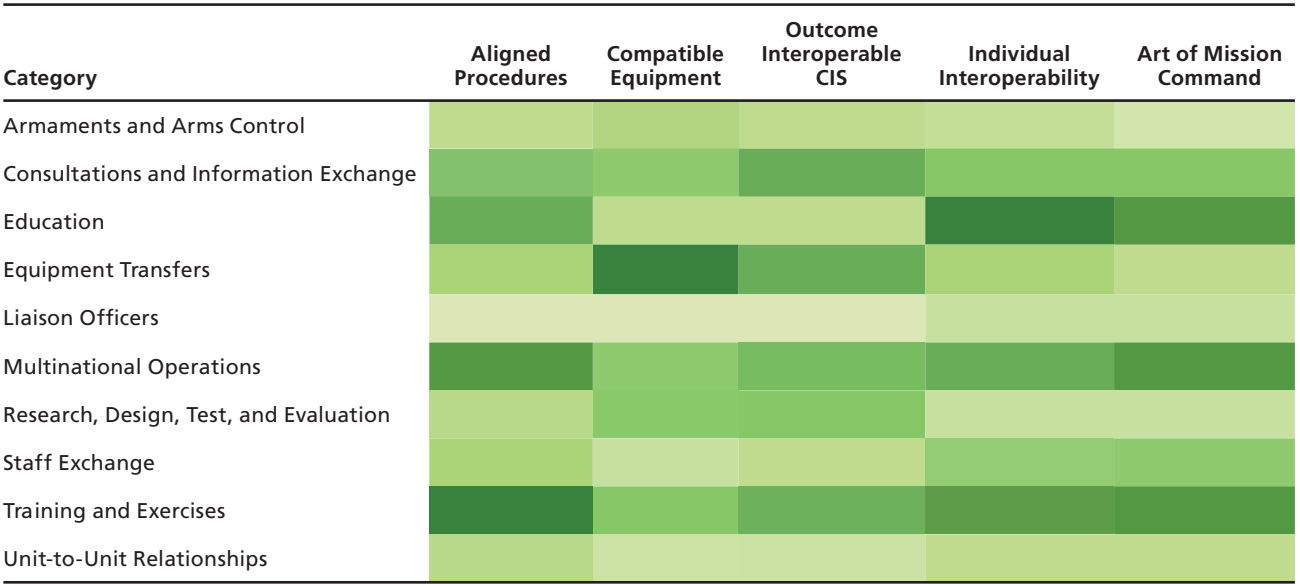


Figure G.11—Continued



NOTE: Darker colors represent how well the programs in each activity category support each interoperability outcome.

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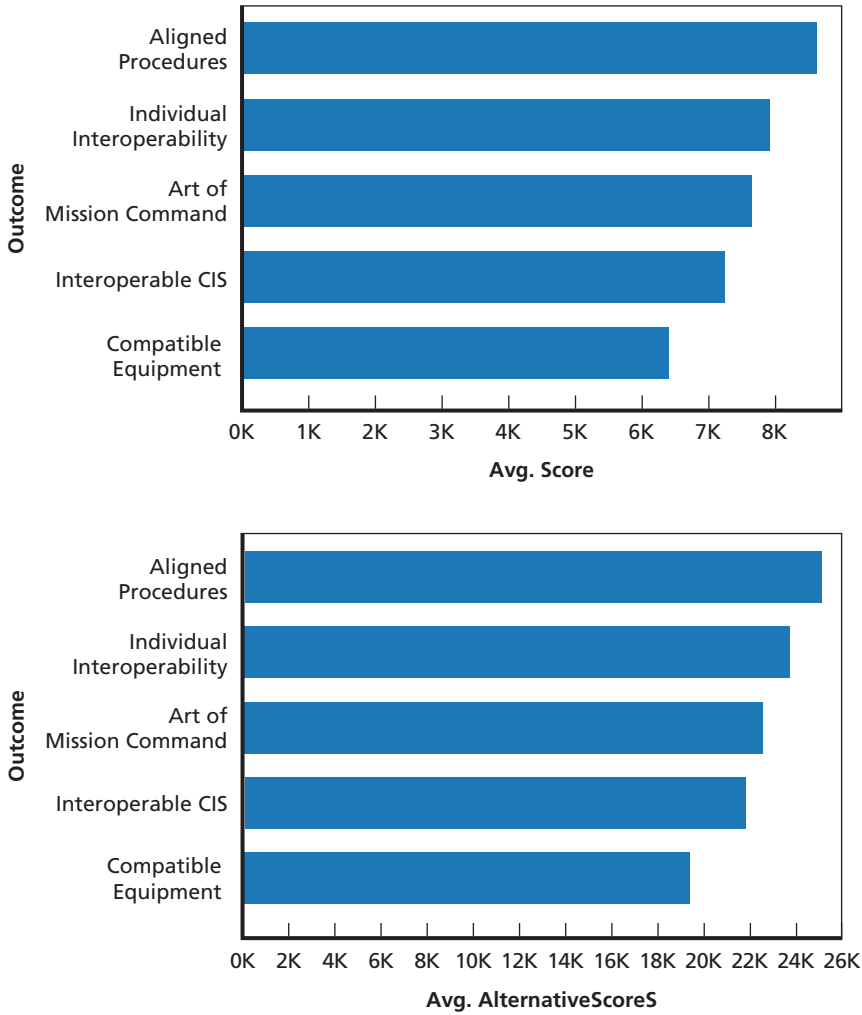
Figure G.12
Effect of SME Experience on *Portfolio Support of Outcomes* to Weighting Factors (Top: Baseline, Bottom: SME Ratings Weighted Based on Experience)



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future. While perfect predictability and sustainability of such relationships is unlikely to ever be achieved, additional focus should be centered on the ability of officers and operators to develop longer-term relationships with their international counterparts, and on the identification of personnel that can convey "institutional memory" to follow-on forces when rotations are inevitable.

Moreover, we find that for developing *interoperable CIS*, R&D activities, as well as training and exercises, equipment transfers and multinational operations are particularly salient. These results confirm a largely intuitive understanding of what building CIS interoperability requires; however, one can also note what activities are seen as least conducive to building it: liaison officers, armament programs, and staff exchange. Yet, in many previous operations, we observed an increased number of liaison officers serving as critical C2 links between multinational forces. This finding supports the notion that while less expensive work-around solutions are typically found, effective communication between multinational forces requires at least some capital investment in technology, training, and exercising with the U.S. military.

Finally, we note that *compatible equipment* is best achieved by R&D and equipment activities—an intuitive finding similar to the previous case. Yet particularly weak contributions to building this interoperability outcome are observed in the liaison exchange category, consultations, and staff exchanges. As we have earlier noted, however, these three categories represent close to half of the 192 programs we analyzed. Given budgetary and political pressures, it may not be possible to equip the United States and its partners with fully compatible equipment; however, prioritization of equipment that supports specific partnerships and types of operations should be carried out and such technology procured by the United States and partner nations.

The following figure (G.13) schematically describes what activity types make the most important contributions to different interoperability outputs.

In our survey of the current interoperability activity portfolio, we find that most emphasis is given to building aligned procedures and individual interoperability, with least emphasis given to compatible equipment and CIS. The analysis of the current portfolio's contribution

Figure G.13
Schematic Description of Key Contributors to Interoperability Outcomes

	Aligned Procedures	Art of Mission Command	Individual Interoperability	CIS	Compatible Equipment
Training and Exercises	✓	✓		✓	
Multinational Operations	✓	✓	✓	✓	
Education			✓		
Staff Exchanges			✓		
LNOs			✓		
Unit-to-Unit Activities			✓		
R&D				✓	✓
Equipment Transfers				✓	✓

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to interoperability is not significantly sensitive to different analytical weighting of programs by size and importance assigned by respondents. The current portfolio does not show a significant bias to any specific interoperability outcome (although it seems to favor procedural and interpersonal interoperability over technical solutions), yet, as we have discussed, qualitative content of the programs as well as the sustainability of their results may be more important than general quantitative metrics (such as program cost).

In our analysis, we considered the differences in professional experience among respondents and found no significant variation between weighted and unweighted scores.

APPENDIX H

Activity Categories

This appendix provides a longer description and references for the activity types discussed throughout.

Training and Exercises

By far, the most commonly considered activity when discussing interoperability is that which is built through multinational training and exercises. Multinational training and exercises are both short- and long-term programs aimed at building the capacity and capability of partner nations and organizations (Department of the Army, 2013). Training with foreign troops helps "improve coordination and minimize misunderstanding during MNF operations" (Joint Chiefs of Staff, 2013, pp. II–13). Multinational exercises serve to credibly simulate operational conditions and prepare armed forces for live combat and other types of missions and take place at U.S. national training centers "when appropriate" (Joint Chiefs of Staff, 2013, pp. III–10). They vary significantly in length, scope, and the budget required.

Military experiments or evaluations are included in this group as they bring multiple nations together to some end. Multinational activities such as these are designed to coordinate political, economic, and military measures that will contribute to the development of concepts and capabilities necessary for a particular type of engagement (Norwegian Institute of International Affairs, 2011).

There is no central repository to understand the vast training activities that bring multinational partners together. The Joint Multinational Readiness Command (JMRC) has two main tracks for training, with the focus largely on training and readiness of forces. However, building interoperability is evidently a focus in their lessons learned documents and handbooks, which help to codify lessons from those experiences. And some interoperability, albeit transient at times, is expected from those close interactions among nations. A U.S. unit that has arrived might spend several weeks with a foreign partner or ally, and create a deep relationship and understanding, which prepares them for possibly working together in the future. Tracking where those forces go, and where that intimate knowledge of the other resides is currently not done.

The Army also conducted several Network Integration Evaluations (NIE[1]). Their involvement in multinational training is more recent, and tends to focus on the technical hurdles of bringing two forces together, but by the nature of working closely with tactical units, is expected to necessarily build some level of individual and group interoperability as well. In 2011, for instance, soldiers from the United States, Canada, Australia, and Great Britain trained at the White Sands Missile Range, New Mexico, and tested the compatibility of their network communication systems during NIE 5 (White Sands Missile Range, 2011). Aside from working with foreign partners, NIEs have also been used to test and evaluate new technical solutions offered by the industry to fill specific capability needs (Freedberg, 2013).

Last, there is significant unit-level training, where units integrate multinational partners into their typical training and readiness cycles. In these cases, the training is part of a unit's typical process of building readiness, but has the added artifact that a multinational partner is involved and some of the goals in terms of building specific functional interoperability might be available.

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[1] The acronym has changed meaning twice: from the "Network Integration Experiment" in 2011 to "Network Integration Exercise" to "Network Integration Evaluation" in 2013 (Freedberg, 2013).

Staff Exchange

Staff exchanges are a way of familiarizing military personnel with the culture and practices of allied armed forces, and take place on many different levels of seniority. Staff exchanges may be formalized into regular exchange programs or take place on an ad hoc basis. By helping build trust, share information, facilitate the development of compatible standards, and increase cultural awareness, staff and personnel exchanges play a significant role in fostering unit-to-unit relationships and increasing units' mutual interoperability. Moreover, repeated exchanges lead to socialization, a critical success factor in security cooperation (Marquis et al., 2006). Staff exchanges may also be technical or scientific in nature and contribute to the development of specific capabilities. Additionally, certain exchange programs have the education of foreign military personnel as their primary goal.

The Military Personnel Exchange Program (MPEP) is a well-known program for bringing a foreign officer into a unit. These officers fill actual positions within units, and therefore are not liaison officers (more on LNOs later). The intimacy of that involvement in a tactical unit means they will be able to build specific relationships among their peers and leaders, and better understand how that unit (and by extension, the Army) operates.

The 82nd Airborne Division, since 2010, has included an O-7 Deputy Commanding General for Interoperability from the United Kingdom. The first of these was Major General Giles Hill. At the time, he was a one-star, having commanded at every echelon in the British paratrooper regiments.

Consultation

Through the means of senior leader engagement, conferences, workshops, needs and capabilities assessments, consultations create the necessary conditions for information sharing, development of compatible standards and practices, and for planning of future multinational engagements. Within NATO, consultation is a vital "part of NATO's decision-making process since all decisions are made by consensus"

(NATO, 2014). Consultations contribute significantly to the development of personal relationships between specific Army officials of different ranks from partner countries and involve various forms of engagement.

The U.S. Army engages in several multinational interoperability forums, including:[2]

- NATO (including several working groups and committees focused on political, doctrinal, and technical harmonization and standardization).
- ABCA (American, British, Canadian, Australian and New Zealand Armies' Program); including several committees and groups focused on using "doctrine, technology and materiel solutions to close or mitigate [interoperability] gaps" (AR 34-1, p. 16).
- Other ABCA-like organizations: the Air and Space Interoperability Council, the Technical Cooperation Committee, the Combined Communications Electronics Board, and others.
- Regional Chiefs of Army Conference: to discuss a variety of subjects to enhance cooperation and understanding, including specific groups of key leaders like Conference of American Armies, Conference of European Armies, Pacific Armies Chiefs Conference, Land Forces Symposium, and African Land Forces Summit.
- The Five Power National Armaments Directors forum and Five Power Senior National Representatives forums (France, Germany, Italy, United Kingdom, and the United States).
- Bilateral forums: various formal and informal staff talks, training and doctrine talks, SME exchanges, and other engagements.

Education

Military education may involve formal education programs focused at specific target groups and ad hoc information dissemination that fills the needs of a specific multinational engagement. Moreover, educational exchanges offer "opportunities to develop lasting relationships with promising officers who might later rise to prominent positions in

[2] Adapted from U.S. Army Regulation 34-1, "Multinational Force Interoperability," 2015.

their home countries" (Moroney et al., 2011, p. 45). Similar to joint education, education of multinational forces contributes to the sharing of a "broad body of knowledge and develops the cognitive skills essential to the military professional's expertise in the art and science of war" (U.S. Army, 2013, pp. VI4–VI6).

Military education complements training and exercises in the form of "international military education and training" that is defined as "formal or informal instruction provided to foreign military students, units, and forces on a nonreimbursable (grant) basis by officers or employees of the United States, contract technicians, and contractors. Instruction may include correspondence courses; technical, educational, or informational publications; and media of all kinds" (Department of the Army, 2013).

R&D

Research and development (R&D), and research, development, test, and evaluation (RDT&E), encompass a wide array of programs aimed at building future technological capabilities, understanding the capacity and capability of the adversary, and providing allied military units with state-of-the-art equipment. In multinational settings, R&D and RDT&E programs provide an opportunity to engage leading researchers and scientists of foreign militaries, discuss technical standards, foreign military sales, as well as other scientific and technical aspects of modern warfare.

Armaments/Arms Control

The category of armaments includes weapons systems that may be subject to export to and utilization by allied armed forces. Weapons systems are defined as "a combination of one or more weapons with all related equipment, materials, services, personnel, and means of delivery and deployment (if applicable) required for self-sufficiency" (Joint Chiefs of Staff, 2011b). The provision of armament may increase the

capacity and compatibility of international military units, thus building a foundation for multinational and other operations.

Arms control, conducted most typically by means of inspections and visits, contributes to treaty verification processes and is designed to sustain credibility of international agreements. The system of arms control consists of four areas: *treaty language*, forming the core of the verification regime; *monitoring systems*, designed to collect relevant data; *analysis processes*; and *evaluation* (Woolf, 2011). Two critical components of an active arms control mechanism are *detection*, the "process of ascertaining the occurrence of a violation of an arms control agreement," and *identification*, a "process of determining which nation is responsible for the detected violations of any arms control measure" (Joint Chiefs of Staff, 2010, p. 69). An arms control agreement is most generally defined as a "written or unwritten embodiment of the acceptance of one or more arms control measures by two or more nations (JP 2-01)" (Joint Chiefs of Staff, 2010, p. 15).

Equipment

Equipment is a broad category that includes tools, machines, vehicles, and other assets to support military operations. A more specific definition is outlined in the United States Code: "The term 'military equipment' includes all weapons systems, weapon platforms, vehicles, and munitions of the Department of Defense, and the components of such items" (United States Code, 1956, §2228). In the context of this study, this definition can be generalized to all such assets that are owned by the U.S. and allied armed forces and may or may not be sold, used, and utilized for multinational military purposes.

Liaisons (LNO)

Liaison is generally defined as a "contact or intercommunication maintained between elements of military forces or other agencies to ensure mutual understanding and unity of purpose and action" (Joint Chiefs of Staff, 2011a). Liaison teams and individuals (here we use LNO for

either the individual or the team) "represent the interests of the sending commander to the receiving commander" and their primary function is to "promote understanding of the commander's intent at both the sending and receiving HQ" (Joint Chiefs of Staff, 2011b). Similar to joint operations, liaisons have an important role to play in multinational operations.

LNOs do not necessarily fix interoperability problems. They do not figure out the CIS solutions necessary and implement them, or make the two forces understand each other directly. Instead, LNOs provide a way of operating within those constraints.

Multinational Operations

Operations are generally defined as "a series of tactical actions with a common purpose or unifying theme" (U.S. Army, 2013) and as "military actions or the carrying out of a strategic, operational, tactical, service, training, or administrative military mission" (Joint Chiefs of Staff, 2011b), and multinational operations engagements that have a specific goal outside of training, education, research, and consultations purposes. Major categories of multinational military operations include peace, humanitarian, combat, and stabilization (SSTRO[3]) operations.

Iraq and Afghanistan provided significant opportunity for the U.S. Army to build interoperability with a very large swath of nations. Those militaries, while under a NATO command, came from many places outside of that alliance. The experiences from building interoperability for that specific type of operation were both good and bad. The forces solved many interoperability challenges (for instance, building a shared network like the Afghanistan Mission Network), that will help with the next time such a multilateral operation kicks off. And the educational value of having troops solve the interoperability challenges helps significantly in making a force more attuned to the next situation that might present similar challenges.

Those specific operational circumstances also had a downside in terms of interoperability. A common refrain heard is of the *negative*

[3] Stabilization, security, transition, and reconstruction operations.

lessons learned. Operations in Iraq and Afghanistan were peculiar in many ways compared to prior conceptions of multinational interoperability. The procedures concocted needed to be consistent with the rules of engagement, which may not be precedence for the future.

Operations can take all forms. Right now, as part of training in Europe, the U.S. Army has engaged in long-range transportation of major equipment and units in a show of ground access across Europe. The Army's road march from Estonia to Germany after conducting operations there in support of reassuring allies in the region was dubbed "Operation Dragoon Ride."[4] It exercised key logistical operations, aided in multinational training and interoperability, helped assure allies, and provided strategic intent post-Russian activities in the region, among other benefits. In many ways, this was an exercise similar to the REFORGER operations of the 1980s, albeit smaller in scale, with the intent of illustrating and exercising U.S. relationships and support to gain access at will. It is not clear to what extent the interoperability solutions during peacetime—procedures for crossing borders or communication with allies along the way, for instance—translate to solutions for an actual troop movement during hostile operations. Nonetheless, exercising such procedures even during peacetime helps to acclimate the forces and regionally engage with other forces, which helps with general interoperability.

Unit-to-Unit Relationships

A critical component of interoperability is dependent on interpersonal relationships between international military units that extend beyond commanding officers. This category primarily involves informal interactions between members of cooperating units before, during, and after multinational engagements. By developing sensitivity to language, cultural, and interpersonal dynamics in partnering units, U.S. and foreign armed forces are able to establish foundations for future success in multinational missions.

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[4] Michelle Tan, "Strykers Begin 'Road March' Across Eastern Europe," *Army Times*, March 21, 2015.

APPENDIX I

Targeted Interoperability Unit Types

Among North American Treaty Organization (NATO) partners and European nations, multinational units appear to be a growing phenomenon, driven in most cases by a desire to share the financial burden of operational readiness and foster integration between nations or among European Union (EU) or NATO members. Indeed, in most cases they are intended to provide a rapid response capability, something that is particularly expensive, that would provide the EU or NATO with the ability to respond collectively to an emergency.

Generally speaking, there are two kinds of multinational units built through targeted interoperability—provisional and standing, the provisional units being those that are formed to provide on-alert reaction forces and are provisional in the sense that they exist for a period of a few years and then are disbanded. Standing units are set up for longer periods that reflect multilateral interests.

Provisional Units

Provisional units are formed to provide an on-alert reaction force. These are provisional in the sense that they exist only for a period of a few years, the time required for them to form, train, get certified, and then serve "on alert" for six (EU) or 12 (NATO) months. After they have served, they disband, ostensibly to re-form at some point in the future. The EU and NATO each sponsor the formation of rapid response forces (RRF) that is usually if not always multinational in nature; often there is a single "framework" nation that provides the vast majority of a formation, with only notional contributions from other countries. The EU and NATO forces are not strictly separated;

many of the units that participate in EUBGs might also take their turn in the NRF, and vice versa. Some of these, moreover, are standing multinational forces. More recently, the VJTF was formulated and will follow a similar process.

The European Union Battle Groups (EUBG) date to 2004, when EU members committed to providing troops for an EU RRF capability. They have been operating since 2007.[1] There have been more than a dozen EUBGs so far. Most appear entirely provisional, formed ad hoc by whichever nations step forward to make the commitment at a particular time and disbanded after concluding their six-month rotation. Some, as will be discussed below, appear to have more substance to them.

The EUBG manual defines the purpose of EUBGs primarily as providing the EU the means to respond to UN requests for troop deployments, primarily for humanitarian and stability operations.[2] The intention, which emerged in 1999, is to generate brigade-sized formations that are capable of deploying within ten days and with enough autonomy to be able to function for 30 days without resupply (see Figure I.1).[3] They are also meant to be deployable to within 6,000 km of the European Union. In reality, the EBGs can best be described as battalion-sized task forces with about 1,500 troops, built around three infantry companies together with headquarters, fires, and reconnaissance elements, and a variety of possible support and sustainment elements.[4]

Each EUBG has a single "framework nation" responsible for organizing the unit and ensuring its readiness.[5] The EUBGs operate under EU political control and technically have nothing to do with NATO; however most EU members and EUBG participants are NATO partners; many of the same units that participate in EBGs participate in NATO's RRF, known as the NATO Response Force (NRF); and

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1 *European Union Battlegroup Manual*, Finabel Study A.25.R-T.37.R, Brussels: European Land Forces Interoperability Center, 2014, p. 9.

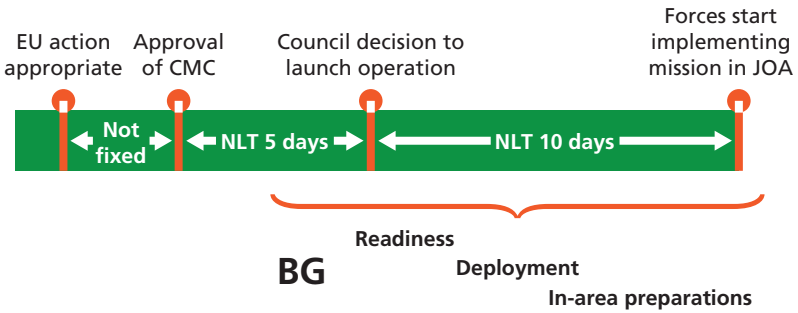
2 *European Union Battlegroup Manual*, p. 8.

3 *European Union Battlegroup Manual*, p. 9.

4 *European Union Battlegroup Manual*, p. 11.

5 *European Union Battlegroup Manual*, p. 9.

Figure I.1
EUBG Deployment Timeline



SOURCE: http://www.consilium.europa.eu/uedocs/cms_data/docs/pressdata/en/esdp/91624.pdf.

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there is a memorandum of understanding between the EU and NATO according to which NATO is committed to providing the EUBG its airlift.[6] Moreover, the EUBG manual makes clear that EBGs are to be run entirely according to NATO standards.[7] Interestingly enough, one of the distinctions the EUBG manual draws between EUBGs and the NRF is that the EBG is intended for operations on the lighter end of the intensity spectrum, leaving more intense, conventional warfare to NATO.

> The activities for which the NATO Response Force (NRF) and EU BGs are designed are complementary, rather than being duplicative. The NRF is designed to participate in the full range of Alliance operations, up to and including high intensity warfighting. This may include a show of force, stand-alone use for crisis response, or initial forcible entry for a larger operation. EU BG is a part of the EU's total effort to mitigate or solve a crisis and therefore it should be capable of robust peace enforcement on a limited scale.[8]

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6 *European Union Battlegroup Manual*, p. 10.

7 *European Union Battlegroup Manual*, p. 27.

8 *European Union Battlegroup Manual*, p. 10.

Also of note is the manual's reserve toward multinationality. Although the manual asserts multinationality is important because it pools resources, it is not necessarily conducive to operational effectiveness. The manual's answer is to limit the degree of multinationality within the larger formation:

> For the core Battalion (Bn) and all other units below company level multinationality would not be appropriate. For other elements (the (F)HQ, CS, CSS of the BG and the operational and strategic enablers) a specific level cannot be defined as this depends on effectiveness and interoperability. This statement is based in the fact that at the tactical level actions to be developed by the EU BG need close coordination among all their elements, as well as a common training to attain required efficiency and an excessive multinational organization below the level recommended may be harmful. We consider that the level of multinationality could descend to lower echelons only when very specific capabilities are required and their tasks do not involve a high level of collective training (CBRN teams, bridge platoons, signal, MPs, PSYOPS, etc.).[9]

According to one EU source, the program has not gone smoothly: Cash-strapped European nations are not as willing to contribute to the battlegroups as had been hoped:

> The high operational tempo, the substantial costs associated with the preparation and the possible deployment of Battlegroups, combined with current financial crisis and austerity, pose, however, challenges to fill the Battlegroup Roster. This situation has triggered intensive work and initiatives to mitigate existing shortfalls.[10]

A 2013 study of the EUBGs adds that many countries that could contribute are unwilling to, in part because of an unwillingness to bear

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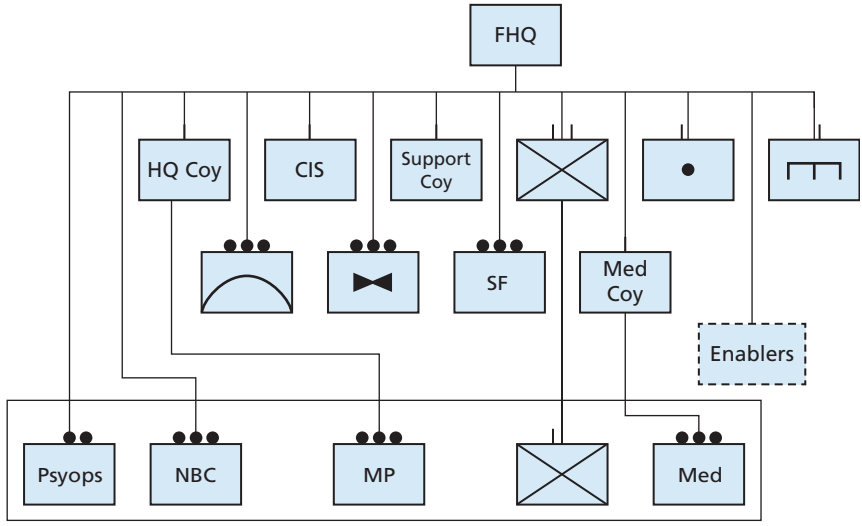
9 *European Union Battlegroup Manual*, p. 51.

10 "Common Security and Defense Policy: EU Battle Groups," European Union, April 2013. p. 4.

a burden that is unevenly shared.[11] There is another important problem with the EUBGs: Although their deployment has been considered, namely in response to a variety of overseas crises, they have yet to be deployed, chiefly because the EU has yet to achieve the kind of consensus and course of action that would make a deployment possible.[12]

A few of the EUBGs appear to have more substance to them than others. These are the HELBROC Battlegroup, the Nordic Battle Group, and the Visegrád Battle Group. The HELBROC Battlegroup is a Greek-led unit with contributions from Bulgaria, Cyprus, and Romania. It has served three "tours" as the EU's rapid response force, one in 2007, another in 2011, and finally in 2014 (see Figure I.2).[13]

Figure I.2
HELBROC Order of Battle



SOURCE: http://www.globalsecurity.org/military/world/europe/battlegroup-helbroc.htm.

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[11] Anna Barcikowska, *EU Battlegroups—Ready to Go?* Issue Brief, European Union Institute for Security Studies, November 2013, p. 4.

[12] Barcikowska, *EU Battlegroups*, p. 4.

[13] "HELBROC Battlegroup," *Globalsecurity.org*; "EU Battlegroup," *Globalsecurity.org*.

The Nordic Battle Group (NBG) is a primarily Swedish formation involving Finland, Norway, Estonia, Ireland, Lithuania, and Latvia. Sweden arguably takes the NBG particularly seriously because, as one of the few non-NATO members of the EU, the NBG gives it a vehicle for strengthening its relationship with NATO and NATO members and strengthens its interoperability with them.

The NBG was first operational in 2008, when it served on 24-hour standby from January 1 to June 30.[14] It served again in 2011 and was slated to return to standby status for the first half of 2015.[15] It is a relatively light force designed to be expeditionary, meaning that it is endowed with organic sustainment and logistics elements as well as aviation assets and dedicated lift (see Figure I.3)

Given that 2015 will see the third iteration of the NBG, it is possible that there is some continuity with respect to the units involved, particularly given the small size of the contributing nations' militaries. We have not, however, been able to identify the specific units.

The Visegrád Battle Group (VBG) consists of contributions from Poland, Hungary, the Czech Republic, and Slovakia. Poland contributes the largest contingent, but in contrast to the mostly Swedish NBG, the VBG is not dominated by a single nation. Thus *Jane's Defense Weekly* on November 29, 2013, reported that the VBG's 2,900 troops were 35 percent Polish, 29 percent Czech, 20 percent Hungarian, and 16 percent Slovakian. The VBG is set to serve as the EU standby force in 2016. What makes the VBG unique is the intention of its members, announced this year, to make it a permanent, standing force.[16] The V4 make no secret of their motivation: combining strength to counter Russia.[17] *Jane's* on September 18, 2014, also reported that the so-called Visegrád Four (V4) were working on joint procurement.[18]

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[14] Government Offices of Sweden.

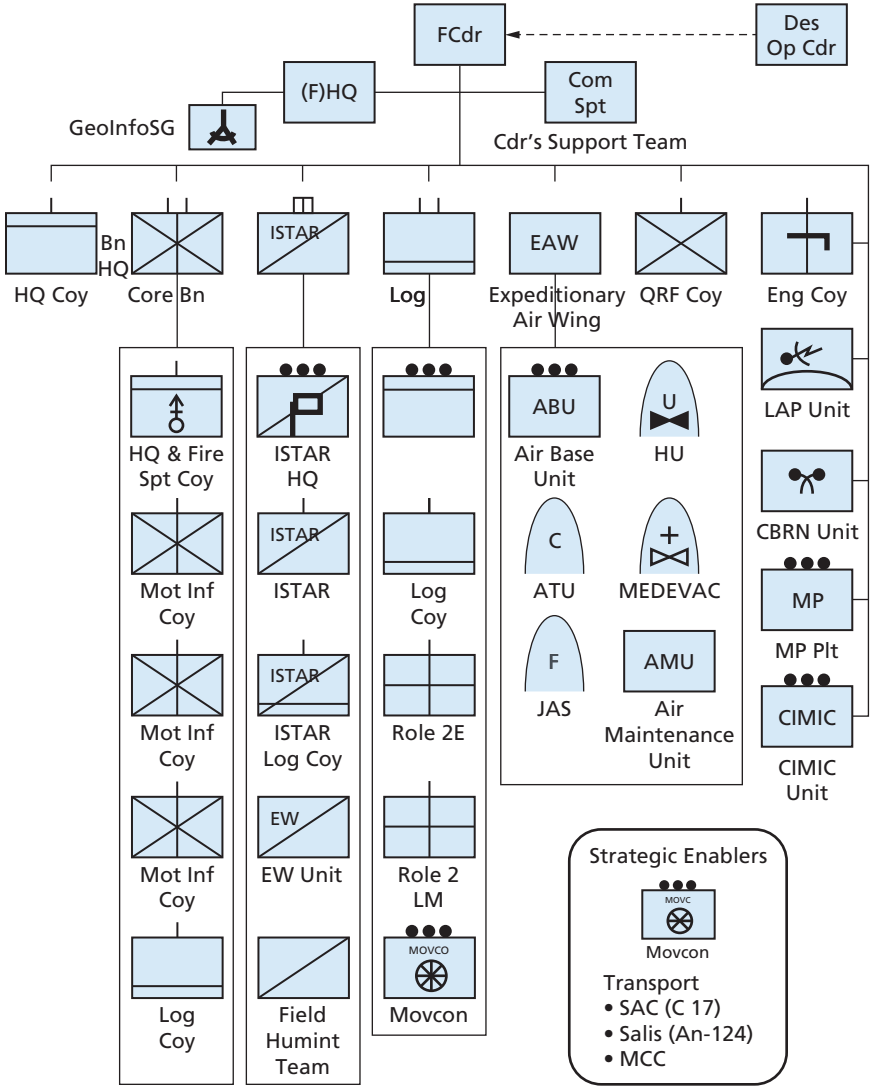
[15] Government Offices of Sweden.

[16] Visegrád Group, "Visegrád Countries May Turn EU Battlegroup into Permanent V4 Rapid Reaction Force," Atlantic Council, July 3, 2014.

[17] Visegrád Group, "Visegrád Countries May Turn EU Battlegroup into Permanent V4 Rapid Reaction Force."

[18] For information about the Visegrád Group in general, see http://www.visegradgroup.eu/about.

Figure I.3
2015 Nordic Battle Group Order of Battle



SOURCE: http://www.forsvarsmakten.se/en/about/our-mission-in-sweden-and-abroad/international-activities-and-operations/nordic-battle-group/.

RAND *RR2075A-I.3*

We have not found any information regarding the composition of the VBG or its order of battle. One would suspect it would be less expeditionary than the NBG and more oriented toward conventional warfare.

The NATO Response Force (NRF) represents a larger and more robust force. They include an "Immediate Response Force," consisting of 13,000 troops (air, ground, and naval combined) and are expected to be able to deploy within between five and 30 days. Unlike the EGBs, which are "on-call" for six months, the NRF is available for a full year. NRF forces are not always multinational; the one consistently multinational element of the NRF appears to be the seven NATO-certified High Readiness Corps that provide the NRF with its headquarters elements on a rotational basis.

Of note are two constraints on the NRF's effectiveness. One is that it must compete with the other demands that are placed on contributing nations, who have shrinking pools of soldiers from which to draw for their own purposes while also setting aside troops for NRF. The other is that all NATO members must agree to a deployment, suggesting that a truly rapid response is unlikely.

The NRF dates to 2002, when NATO members decided to develop a robust air, land, and sea force some 13,000 strong and a mandate to be ready to deploy within five to 30 days.[19] The land component at least officially is brigade-sized and consists of three "battlegroups."[20] The degree to which the NRF is multinational varies from year to year, as each year one or several nations agree to contribute units. At the very least, the seven NATO-certified High Readiness Corps that provide headquarters elements are multinational in composition even if generally they are dominated by a single framework nation. Thus, with the arguable exception of the High Readiness Corps, NRF formations—to the extent that they are multinational and not simply one nation's force—have a strictly

[19] Nicolas Gros-Verheyde, "La NRF c'était bien lent, cette fois on vous le promet ca sera rapide," *Bruxelles2*. September 4, 2014.

[20] "The NATO Response Force: At the Centre of NATO Transformation," NATO, October 2013, p. 2.

provisional existence. In 2014, the NRF ground force is commanded by France, which is also providing the lion's share of the force.

The NRF has faced resource challenges, among them competing requirements driven by NATO's mission in Afghanistan. That said, arguably the most significant obstacle to the NRF's effectiveness has been the fact that all 28 NATO members must agree to deploy the force, a political challenge that at the very least makes a rapid response unlikely.

Standing Formations

In addition to the provisional formations represented by most EUBGs and the NRF, there are a number of standing multinational formations, some of which have contributed to EUBGs and the NRF.

The United Kingdom/Netherlands Amphibious Force (UKNLAF) is described as Europe's oldest integrated force; it began in 1973 in an effort by both nations to preserve amphibious capabilities in the face of budget cuts.[21] Dutch Marines began training with Royal Marines, and now Dutch Marines are fully integrated into 3 Commando Brigade's "Landing Force"; the Dutch contribution is some 1,100 strong and usually consists of an infantry battalion and additional combat and combat service support elements. The total size of the Landing Force is 5,000.[22] The UKNLAF—Dutch troops included—served under UK command in Iraq in 1991 as part of Operation Haven, Sarajevo in 1995, again in Iraq in 2003–2004, and in Afghanistan.[23]

Although the UKNLAF's amphibious focus might make it too exotic to provide lessons learned for general purpose forces, the fact that the UKNLAF is a frontline formation that operates at a small scale might in fact make it an ideal case study. It is not clear, however, at precisely what echelon the UKNLAF conducts binational interoperations.

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[21] Major Marc Brinkman, "The Dutch Contribution to the UKNL Amphibious Force: Adapting to Changes in the Global Security Situation," *RUSI Military Operations Today*, Summer 2006, p. 70.

[22] Brinkman, "The Dutch Contribution to the UKNL Amphibious Force."

[23] Brinkman, "The Dutch Contribution to the UKNL Amphibious Force."

The Franco-German Brigade was formed in 1987 and is located on German and French military bases straddling the border in Alsace and Baden; there are German troops in France, and until recently French troops in Germany. The unit's formation was a response to purely political requirements, not military ones, meaning that it is possible that there is little about the brigade that meets any military logic. However, the fact remains that the participating units are by all appearances normal French and German frontline units, and it seems unlikely that the brigade would not at least be compliant with French and German doctrine.

A glance at the Franco-German Brigade order of battle (Table I.1) indicates that although the infantry battalions can be considered comparable or "like" units and perhaps are not expected to operate closely with one another, both French and German units are expected to rely on the German artillery and engineering elements. This suggests at that at the very least the French units in the Franco-German Brigade have to be adept at coordinating with German units for fires and engineering support, presumably at a low echelon, given the fact that the French place fires coordination responsibilities with company commanders, and the networking technologies being deployed in both armies are intended to foster information sharing and fires coordination at the lowest levels. This hypothesis is supported by YouTube videos of brigade exercises showing French and German soldiers going through urban operations training together and working out (in French, German, and English) how to clear a house.[24] The implication is that if anyone has had practical experience interoperating at sub-brigade echelons, it is the Franco-German Brigade.

The Franco-German Brigade has served as the NRF and provided the core element of an EUBG. It has also participated in deployments to Sarajevo and Kosovo in the 1990s and Afghanistan on at least one occasion since 2004.[25] Elements of the brigade have deployed to Afghanistan and Kosovo—however, not as part of the Brigade com-

[24] *La BFA au CENZUB*, https://www.youtube.com/watch?v=5H4C0brP7LI, February 19, 2014.

[25] "Historique," *Brigade Franco-Allemande*, n.d.

Table I.1
Franco-German Brigade Order of Battle (November 2014)

Unit (Nationality)	Type	Primary Vehicle/ Weapon Systems
1e Régiment d'infanterie (F)	Mechanized Infantry	VAB
3e Régiment de Hussards (F)	Reconnaissance	AMX-10RC, VAB
Jägerbataillon 291 (D)	Light Infantry	Boxer, Fennec
Jägerbataillon 292 (D)	Light Infantry	Boxer, Fuchs, Wiesel MK 20
Artelleriebataillon 295 (D)	Artillery	PzH 2000, MLRS
Panzerpionierkompanie 550 (D)	Armored Combat Engineer	Biber, Dachs, Skorpion, Keiler

SOURCES: http://www.df-brigade.de/struktur.htm, http://www.defense.gouv.fr/terre/presentation/organisation-des-forces/brigades/brigade-franco-allemande.

mand structure—and they did not operate as part of a binational effort. The brigade's real binational deployment did not come until 2014, when it was deployed—with Germany's blessing—to Mali to participate in the European Union Training Mission (EUTM).[26] What is not clear is the extent to which the brigade elements that participated in those operations acted as a binational unit, with component parts interoperating.

The Division Schnelle Kräfte (DSK) is a German Army unit that dates only to 2014 and brings German special forces together with its airborne and airmobile units. Also starting in 2014 is the complete integration of the Dutch 11th Airmobile Brigade. The units in the DSK include:

- Special Forces Commando
- Airborne Brigade 26
- Airborne Brigade 31
- 11th Airmobile Brigade
- Long Range Reconnaissance Patrol Company 200

[26] Hickmann and Kornelius, "Deutschland bereitet Militäreinsatz in Afrika vor."

- Combat Helicopter Regiment 36
- Transportation Helicopter Regiment 10
- Transportation Helicopter Regiment 30

It remains to be seen to what extent these units interoperate. The Dutch 11th does not appear to have organic aviation assets, suggesting that at the very least it will work closely with the three German helicopter regiments that are part of the DSK.

The Multinational Land Force (MLF) emerged in 1997 as a trilateral initiative joining the militaries of Italy, Slovenia, and Hungary.[27] Italy's Alpine Brigade Julia provides the core of the unit (i.e., most of its command element and an infantry regiment); Hungary and Slovenia provide an infantry battalion each.[28] The MLF has a primarily alpine vocation (Italy's and Slovenia's contributions are mountain troops), while Hungary provides heavy equipment to give the brigade additional firepower on easier terrain, according to one source.

The Tisza Multinational Engineer Battalion was formed in 1999 by Hungary, Romania, Slovenia, and Ukraine, apparently to pool engineering resources to respond to disaster relief and prevention in the region of the Tisza River.[29] It reportedly reached full operational readiness in 2002.[30] Each nation provides between 100 and 200 troops and equipment, and the battalion is available to each partner upon request. The unit has conducted multiple full-scale exercises. It is not clear if it has ever been mobilized to respond to a real-life crisis. Although small in scope, the Tisza Battalion stands as a good example of the possibilities of sharing resources to achieve a common objective.

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[27] Papp Gyula, "The Military Engagement of Multinational Units in the Interest of European Security and Defense Capability Enhancement," *Hadmérnök*, Vol. 3, No. 1, 2008, p. 2.

[28] Gyula, "The Military Engagement of Multinational Units in the Interest of European Security and Defense Capability Enhancement," p. 3.

[29] Gyula, "The Military Engagement of Multinational Units in the Interest of European Security and Defense Capability Enhancement," p. 4.

[30] Gyula, "The Military Engagement of Multinational Units in the Interest of European Security and Defense Capability Enhancement."

The Combined Joint Expeditionary Force (CJEF) is an Anglo-French initiative slated to be operational by 2016. According to the 2012 joint document, the *Combined Joint Expeditionary Force (CJEF) User Guide*, the CJEF "will be able to conduct offensive and defensive operations on land, in the air, and at sea, wherever UK and French national security interests are aligned."[31] The total force will include a "scalable land component of at least a UK battlegroup and a French battlegroup," a maritime component as well as an "expeditionary air wing," and a "logistical component capable of supporting the totality of the CJEF deployment." The land component, moreover, is to be an "early entry" and "combined (UK/France) force" "capable of conducting non-enduring, complex intervention operations, facing multiple threats up to high intensity."[32] It will, moreover, be a "high-readiness force using existing national high readiness force elements—including lead elements at very short notice."

This last line makes clear that rather than being a standing relationship between specific units on the model of the Franco-German Brigade, the CJEF will represent an association between those British and French units that participate in their nations' high-readiness formations.

One of the more interesting aspects of the planning for CJEF is the attention paid to the political decision-making and military planning processes in both nations and the need to establish mechanisms and protocols to link them together to ensure timely joint action. It is not clear if comparable planning exists for the DSK, for example, or the Franco-German Brigade, although the latter is unlikely to be tapped for a rapid response force. The CJEF *Guide* also calls for the creation of a joint commission to identify and address all the issues related to interoperability, and it recommends referencing the products of the American, British, Canadian, Australian and New Zealand Armies' (ABCA) program.[33] Further, the document explores British

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[31] *Combined Joint Expeditionary Force (CJEF) User Guide*, p. 11.

[32] *Combined Joint Expeditionary Force (CJEF) User Guide*, p. 13.

[33] *Combined Joint Expeditionary Force (CJEF) User Guide*, p. 28.

and French compliance with NATO doctrines, identifying specific doctrinal matters with regard to which France or the UK have not adopted the relevant NATO publication.[34] Among the matters that remain to be addressed, according to the *Guide*, are those related to the sharing of digital information and tactical communications.[35] Interestingly, with regard to unit integration, the *Guide* calls for integrating the component headquarters, but not the subordinate force elements, which would operate "under their own national doctrine." "Essential to the mission will be a clear understanding of each other's doctrine."[36]

Given the *Guide*'s stipulation regarding the use of each nation's rapid reaction forces, it makes sense that at the heart of the CJEF is a growing working relationship between the UK 16th Air Assault brigade and the French 11th Parachute Brigade, each of which plays a major role in the provision of rapid response forces for their respective nations.[37] Thus, the units that have been exercising together in preparation for standing up the CJEF are mostly if not entirely taken from the 16th and 11th Brigades. Regiments from both nations have been conducting joint exercises in each other's training centers.[38]

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[34] *Combined Joint Expeditionary Force (CJEF) User Guide*, pp. 31–34.

[35] *Combined Joint Expeditionary Force (CJEF) User Guide*, p. 37.

[36] *Combined Joint Expeditionary Force (CJEF) User Guide*, p. 41.

[37] UK Ministry of Defence, "British and French Soldiers Train Together at Otterburn," Announcement, February 17, 2012.

[38] UK Ministry of Defence, "British and French Troops Jump into Joint Warrior," GOV.UK.

APPENDIX J

Regression Modeling of Security Cooperation Activities and Interoperability Outcomes

In this appendix, we present an alternative approach to quantitatively assessing the degree to which selected activity types of programs surveyed contribute to building multinational interoperability. While simplified, this approach shows results consistent with our qualitative findings and indicates that a more detailed analysis could yield additional significant findings.

Research Approach

The research question we aim to answer is: What types of security cooperation programs directly contribute to building interoperability for multinational military missions? We use a logistic regression model to describe the relationship between the dependent variable (interoperability) and independent variables (activity types selected programs fall into).

The ten categories of international security cooperation programs we have surveyed are described in Table J.1. The dependent variable we are explaining is multinational interoperability, a binary variable (0: program does not contribute to building operational interoperability, 1: program builds operational interoperability), which for the purposes of this pilot research approach was manually double-coded

Table J.1
Variables Used in Analysis

ID	Variable	Identifier in Regression	Description
0	Multinational Interoperability	interoperability	dependent variable (values 0/1 originate from expert solicitation)
1	Training and Exercises	trainingexercises	independent variable: program involves a short- or long-term training and exercise component
2	Staff Exchanges	staffexchange	independent variable: program involves reciprocal exchange of military staff
3	Consultations and Information Sharing	consultations	independent variable: program facilitates information sharing at conferences and other venues
4	Education	education	independent variable: program educates national or foreign military officials
5	Research and Development	randd	independent variable: program develops national or foreign capabilities by conducting research and development or facilitating R&D interactions
6	Arms and Arms Control	arms	independent variable: program transfers arms or weapons system, or prevents their transfer
7	Unit-to-Unit Relationships	unitunitrelationships	independent variable: program facilitates personal interactions between international military units
8	Equipment Transfers	equipment	independent variable: program funds or transfers equipment and infrastructure for defense purposes
9	Liaison Officers	lnos	independent variable: program brings a liaison officer
10	Multinational Operations	operations	independent variable: program is implemented as a combat, humanitarian, or other real-world operation on the ground by multinational forces

by the authors of this report.[1] Overall, 46 programs were identified as *directly* building multinational interoperability.

Exploratory Analysis

Given the fact that both dependent and independent variables are binary, we cannot use a visual representation of the correlation between pairs of variables. Yet the following correlation table (Table J.2) shows that the different types of programs have fairly limited correlation, with the highest positive correlation coefficient being 34.20 percent and 32.42 percent in the negative territory.

Table J.3 describes basic characteristics of both independent and dependent variables.

Regression Analysis and Diagnostics

Our full model can be described as:

$$logit\,(P(Interoperability{=}1 indep.variables)) = \beta_0 + \sum_{(i=1)}^{10} \beta_i X_i,$$

where all X_i's describe all ten independent variables (program types) and the β_i's their respective coefficients. This robust logistic model yields the following results shown in Table J.4.

First, we observe that the variable "arms" has been omitted given the fact that none of the arms control programs by itself increases or decreases the odds ratio of a program building multinational interoperability. This model is significant on a 95 percent confidence interval and a total of four activity types are associated with an increased odds ratio of multinational interoperability on the same confidence level.

[1] While subjective, we aim to err on the side of being liberal and code as "1" any program that develops skills, understanding, or technology to directly support a multinational mission. A more robust coding effort, using consensus building, for instance, could be implemented.

Table J.2
Correlation Between Independent Variables

	Interop-erability	Training Exercises	Staff Exchange	Consulta-tions	Education	R&D	Arms	Unit-Unit Relation-ships	Equip-ment	Liaison	Opera-tions
Interoperability	1.000										
trainingexercises	0.1598	1.000									
staff exchange	0.3420	0.0198	1.000								
consultations	0.2259	0.0370	0.1014	1.000							
education	0.0804	0.0058	0.1756	–0.0597	1.000						
R&D	0.1170	–0.1502	0.0196	0.0720	–0.1471	1.000					
arms	–0.1682	–0.1186	–0.1133	–0.1319	–0.1158	–0.1051	1.000				
unitunitrelationships	0.2167	0.2249	0.1788	0.0400	–0.0373	–0.0678	–0.0583	1.000			
equipment	–0.1534	0.0652	–0.1640	–0.3242	–0.2567	–0.1471	–0.1158	–0.1039	1.000		
liaison	0.0619	–0.0886	0.0374	0.0930	–0.0873	0.0478	–0.0490	–0.0316	–0.0089	1.000	
operations	–0.0129	0.0650	–0.0366	–0.0983	–0.0986	–0.0622	–0.0803	–0.0094	–0.0647	–0.07	1.000

Table J.3
Descriptive Statistics

Variable	Observations	Mean	Std. Dev.
trainingexercises	193	0.2279793	0.4206203
staffexchange	193	0.1243523	0.3308413
consultations	193	0.3316062	0.4720148
education	193	0.2227979	0.417206
randd	193	0.1088083	0.3122084
arms	193	0.0829016	0.2764505
unitunitrelationships	193	0.0362694	0.187446
equipment	193	0.2227979	0.417206
lnos	193	0.0259067	0.1592702
operations	193	0.1606218	0.3681367
interoperability	193	0.238342	0.4271774

These are highlighted by asterisks in the *p*-value column (all values that are ≤ 0.05) and include these four activity types:

- staff exchanges (odds ratio 5.68)
- consultations and information sharing (odds ratio 2.34)
- research and development (borderline) (odds ratio 2.71)
- unit-to-unit relationships (odds ratio 4.82)

The interpretation of these results is analogous for each independent variable. For instance, all held equal, by virtue of falling into a *Staff Exchange* category, the program's odds ratio of contributing to building multinational interoperability is 5.68 (an individual program's probability of contributing to building interoperability would have to be calculated for every single program separately). Given the relatively small dataset and the variance observed, we notice a fairly wide confidence interval for individual odds ratios in many cases (from 2.0 to 15.9 for *Staff Exchange* programs, etc.). We now proceed with a minor model adjustment and present new findings in the next section.

Table J.4
Results of a Robust Logistic Regression Model

Variable	Odds Ratio	Robust Standard Error	*p*-Value	95% Confidence Interval
trainingexercises	2.363514	1.068903	0.057	0.9740942, 0.734761
staffexchange	5.683248	2.986266	0.001*	2.029235, 15.91699
consultations	2.337036	0.9563123	0.038*	1.047984, 5.21166
education	1.420874	0.7481138	0.505	0.5062718, 3.987744
randd	2.710829	1.377118	0.050*	1.001582, 7.33699
arms	1	(omitted)		omitted
unitunitrelationships	4.815982	3.390708	0.026*	1.211696, 19.1415
equipment	0.689159	0.4357621	0.556	0.1995704, 2.379812
lnos	2.212483	2.047593	0.391	0.3606753, 13.572
operations	1.111447	0.5678672	0.836	0.4083078, 3.025449
constant	0.1131507	0.04848	0.000	0.0488602, 0.2620349

Model Adjustment

Given the finding that programs falling into the *Arms and Arms Control* category do not contribute to building multinational interoperability, we can drop them from our model. This adjusted robust logistic regression model yields the results shown in Table J.5.

As the table shows, five predictors are significant at a 95 percent confidence level (the new significant program type is *Training and Exercises*).

Table J.5
Results of a Robust Logistic Regression Model

Variable	Odds Ratio	Robust Standard Error	*p*-Value	95% confidence interval
trainingexercises	2.577235	1.196241	0.041*	1.037679; 6.400959
staffexchange	6.366563	3.450369	0.001*	2.200873; 18.41684
consultations	2.550356	1.024631	0.020*	1.160439; 5.60505
education	1.557656	0.8066332	0.392	0.564516; 4.298004
randd	3.188427	1.596228	0.021*	1.195193; 8.505798
unitunitrelationships	5.324345	3.713838	0.017*	1.356863; 20.89279
equipment	0.7731043	0.4997114	0.691	0.2177945; 2.744285
lnos	2.520173	2.419848	0.336	0.383808; 16.54804
operations	1.216822	0.6273508	0.703	0.4429734; 3.342541
constant	0.0896342	0.0347914	0.000	0.0418872; 0.1918081

Model Diagnostics

First, we evaluate the risk of introducing a specification error. Using the "linktest" option in Stata, we observe the significance of the "_hat" predictor and insignificance of the "_hatsq" predictor—exactly as theory dictates for correctly specified models. The numerical results are included in Table J.6.

Second, we proceed to the Hosmer-Lemeshow goodness of fit test and observe a *p*-value > 0.05, a value of 0.6509. Therefore, there is no apparent reason to doubt the adequacy of the fit of our model.

Model diagnostics of deviance and Pearson's χ^2 yield the following results for this adjusted model.

Table J.6
Results of a Linktest Controlling for a Specification Error

			Number of Obs	193		
			LR chi2(2)	39.60		
			Prob > chi2	0.0000		
Log Likelihood	−86.188804		Pseudo R2	0.1868		
Interoperability	**Coef.**	**Std. Err.**	**z**	**P>|z|**	**95% Conf.**	**Interval**
_hat	1.126858	0.2972053	3.79	0.000	0.5443467	1.70937
_hatsq	0.085657	0.1354583	0.63	0.527	−0.1798359	0.351151
_cons	−0.048064	0.3003204	−0.16	0.873	−0.6366815	0.5405529

Table J.7
Hosmer-Lemeshow Goodness of Fit Test

Number of Observations	**193**
Number of groups	10
Hosmer-Lemeshow chi2(8)	5.97
Prob > chi2	0.6509

Table J.8
Logistic Model Deviance Goodness of Fit Test

Number of Observations	**193**
Number of covariate patterns	41
Deviance goodness-of-fit	51.13
Degrees of freedom	31
Prob > chi2	0.0129

Deviance would be expected to decrease as we add more variables to the model: this would be possible if we introduced a more granular classification of programs into, say, 15 or 20 activity types. The *p*-value, however, suggests that the fitting of the model is not substan-

Table J.9
Pearson's Chi-Squared Test

Number of Observations	193
Number of covariate patterns	41
Pearson chi2(31)	42.65
Prob > chi2	0.0793

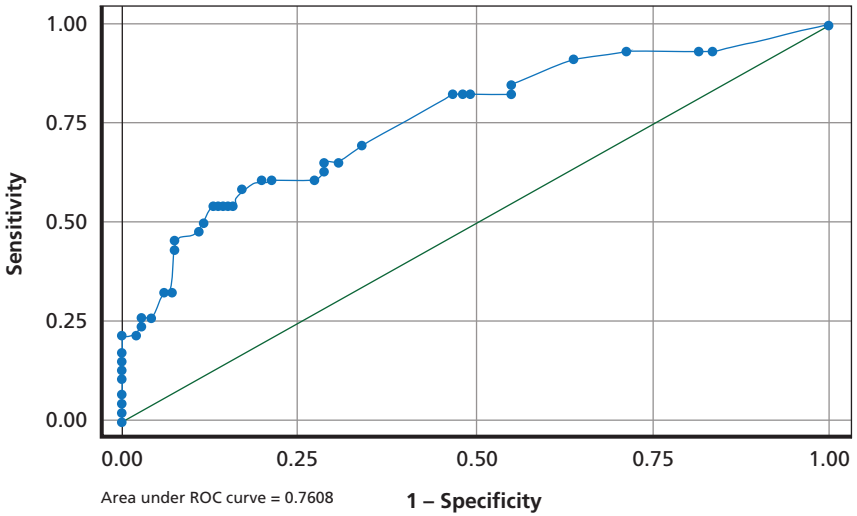
tially similar to that of the most completed model that can be built. As we have noted, a more granular approach might yield a better fit and lower deviance. We can also conduct the Pearson's Chi-squared Test to further test the model fit. Given the relatively high *p*-value, we find no evidence to reject the null hypothesis, which is that the fitted model is correct (similar to the Hosmer-Lemeshow goodness of fit test).

Testing for collinearity among all variables, we obtain the following results that do *not* suggest multicollinearity among our variables.

Table J.10
Collinearity Testing

Variable	VIF	$\sqrt{\text{VIF}}$	Tolerance	*R*-Squared
interoperability	1.27	1.13	0.7859	0.2141
trainingexercises	1.12	1.06	0.8901	0.1099
staffexchange	1.19	1.09	0.8389	0.1611
consultations	1.23	1.11	0.8112	0.1888
education	1.23	1.11	0.8133	0.1867
randd	1.12	1.06	0.8896	0.1104
unitunitrelationships	1.15	1.07	0.8727	0.1273
equipment	1.34	1.16	0.7471	0.2529
lnos	1.04	1.02	0.9657	0.0343
operations	1.07	1.03	0.9382	0.0618
interoperability	1.27	1.13	0.7859	0.2141
Mean VIF	1.18			

Figure J.1
Additional Model Diagnostics



RAND *RR2705A-J.1*

Finally, we present additional model fit diagnostics (Figure J.1) as well as the Receiver Operating Characteristic (ROC) curve, which shows a fairly strong pairing of sensitivity and specificity results (see Table J.11): the *C*-statistic amounts to 76.08 percent, a fairly good result given the limitations of our data.

Conclusions and Policy Implications

In this paper, a logistic regression studying the significance of different activity types of security cooperation programs has yielded promising results. We estimated that five program types have significance in building interoperability, with those in categories "unit-to-unit relationships" and "staff exchange" having the greatest impact on the increase in the respective odds ratios. These are followed by "research and development," "training and exercises," and "consultations" program types.

Table J.11
Additional Model Diagnostics

Log-Lik Intercept Only:	–105.988	**Log-Lik Full Model:**	–86.405
D(183):	172.810	**LR(9):**	39.166
McFadden's R2:	0.185	**Prob > LR:**	0.000
Maximum Likelihood R2:	0.184	**McFadden's Adj R2:**	0.090
McKelvey and Zavoina's R2:	0.282	**Cragg & Uhler's R2:**	0.276
Variance of y*:	4.583	**Efron's R2:**	0.218
Count R2:	0.803	**Variance of error:**	3.290
AIC:	0.999	**Adj Count R2:**	0.174
BIC:	–790.262	**AIC*n:**	192.810
		BIC':	8.198

As expected, practical programs that promote cohesion and understanding between military staff (staff exchanges) and military units of different nations (unit-to-unit type) are of the highest relevance for building interoperability—and as only about 12.4 percent and 3.6 percent of programs, respectively, fall into these categories, a closer look at potentially expanding such programs would be desirable. Other factors to take into consideration include budget constraints and the willingness and ability of partner armed forces to engage in such programs. Second, R&D-related programs (10.8 percent of all programs), consultations (33.2 percent of all programs), and training and exercises (22.8 percent of all programs) increase the odds ratio by smaller, yet still significant amounts, indicating the need for programs that rely on both compatible infrastructure (such as weapons systems and communications tools developed through R&D partnerships), a frequent information exchange between armed forces and active participation in exercises and training events.

In interpreting our data, several caveats need to be made. First, programs are classified into ten broad categories, yet significant variation exists within categories themselves. Second, the scope of the program within a category is not always the same—and the contribution to

building interoperability not equally large. Yet, if the authors deemed that they directly contribute to building multinational interoperability, they are classified as such. Last, the limited size of our sample and the fairly low granularity of our data provide opportunities for further improvements in the model. Despite these limitations, this pilot research approach provides an important starting point for a further quantitative analysis of different program types and how they can practically contribute to building multinational interoperability.

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Significant literature exists on all types of interoperability, with the common refrain being that *more and better interoperability is needed*. And, with few exceptions in recent decades, the United States tends to engage with multinational partners and allies in military operations, thus bringing multinational interoperability to the fore. So, with all this interest, why is the United States not interoperable when and how it wants? There are several reasons, including a lack of understanding of the significant resources that interoperability takes, a reluctance to expend time and money when the value of doing so is not clear, and a one-size-fits-all attitude toward finding solutions. This report looks at what motivations exist for building interoperability and defines a reasonable framework from which to work if and when interoperability needs and investments meet strategic language. The framework proposed has three main parts. First, the authors catalogued nearly 200 programs into ten categories, which comprise "activities" that in one way or another increase interoperability between the United States and its partners. Those activities help to build five main interoperability "outputs": having common equipment, sharing the art of command, having individual interoperability, having interoperable communication and information systems equipment, and having interoperable processes. The "outcomes" are what those outputs lead to. Those are predicated on having specific abilities to share services between at least two partners. The framework necessarily stops short of broader operational outcomes—like winning a war or deterring conflict—as the basic interactions that translate interoperability into qualitative goals of legitimacy or deterrence are not known.

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