A Mixed-Methods Approach to Force Estimation in Military Operations Other Than War

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ABSTRACT

This thesis presents a new method for estimating force size and composition for Military Operations Other than War. While military planners have tools for planning these kinds of operations, they are largely inaccessible or unsuitable for civilian use. The most common tool for force estimation in MOOTW, force ratios, is inaccurate and based on questionable assumptions. The new method presented here, operational inference, is a mixed-methods approach which uses a multivariate distance measure in order to determine which military operations are similar to each other. Using this information, a researcher can identify similar cases for focused comparison, allowing for both qualitative and quantitative improvements in force estimates.

The utility of the method is demonstrated for two separate forms of MOOTW. It is applied to humanitarian military intervention by estimating a force for a hypothetical EU intervention in Libya. It is then applied to noncombatant evacuation operations by estimating forces required for the American evacuation of Afghanistan in August 2021, showing its ability to mimic real-world decisionmaking. The method produced estimates that were more accurate than those produced by force ratio methods, and in both cases the method and the campaign analysis it enabled are able to answer important, policy-relevant questions.

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Chapter 1: Introduction

This paper develops and demonstrates a new method for estimating force size and composition in Military Operations Other than War (MOOTW). While militaries have procedures in place for force sizing, these methods often rely on classified information, advanced simulation software, planning staffs, and iterative qualitative methods like wargaming which are either unavailable to or impractical for civilian researchers. It is important to improve the tools for analysis of these operations outside of the military because MOOTW operations are often highly contentious: they are often operations of choice and civilians (for example, those employed by human rights NGOs) may be more interested in their conduct than the military per se. The most widely-used technique in the academic literature, force ratios, tends to perform poorly, says nothing about force *composition*[1] and is no longer included in official US military doctrine.

In lieu of the military's specialized tools, then, I suggest a new method, *operational inference*, which implicitly incorporates insights from the military planning process to suggest force size and composition for hypothetical or historical MOOTW. Using a dataset of comparable operations, operational inference selects those which are closest to the hypothetical operation in terms of their military goals and operational environment. Using this *reference set* of operations, it is then possible to perform a focused study of the cases in the reference set in order to determine whether the forces which were committed to the operation were successful in achieving their objectives, using the findings from this study to guide the sizing and composition of the force for a hypothetical operation. Since these forces were created using military planning methods, it is plausible to claim that estimates constructed this way are closer to those which a

[1] What *kinds* of forces are needed, as opposed to how many.

hypothetical military planner would design, and that the criteria for selecting cases to guide the analysis offer improved performance over looking at a class of operations as a whole. Overall, basic diagnostic tests of the model suggest its improved performance over force ratios used widely in the literature, while in general the method offers significant improvement in performance due to its ability to provide more details on force composition, rather than simply force size.

Campaign Analysis and MOOTW

The analysis of military questions is a key area of policy-relevant international relations research, and indeed is a core area of inquiry for scholars focused on security studies. What is the likely outcome of conflict in a particular area? How effective should we expect a fighting force to be? Militaries have developed tools and techniques to answer these questions, as have civilian analysts in academic and policy circles. Scholars within the discipline are developing a range of new methods and refining existing ones.[2] One of the most longstanding civilian tools, campaign analysis, has only recently been formalized and standardized, but offers promising insights for answering a range of military questions (Tecott and Halterman 2021, p. 51-2). Further, campaign analysis's focus on creating simple models offers space for integrating other methodological approaches and performing multi-method research, allowing qualitative insights to guide quantitative modeling and vice versa. This research presents an application of campaign analysis for answering an important policy question: what level of military force, and what kinds of forces, are necessary for a given military operation? It also provides an example of how the method may be used for MOOTW, an important form of military operations which is understudied in the campaign analysis literature relative to its real-world importance. Further, the

[2] These new approaches include, among others, new methods of archival research (Darnton 2018), text analysis (Nielsen 2017; Min 2022), the intense historical study of individual events (Torigian 2021), wargaming (Pauly 2018; Lin-Greenberg et al. 2022), and applications of machine learning (Kikuta 2022).

method is theoretically generalizable to other operations: the difficulty of applying simple quantitative rules to MOOTW makes this method particularly useful for their analysis, but it could be expanded to other campaign analyses as well, or provide a useful complement to campaign analyses focused on conventional frontline combat.

This research offers civilians a new tool for thinking about questions of force planning or force sizing: how many and what kinds of troops are necessary to accomplish a given operation. For much of the twentieth century, this practice was mostly limited to specialists within militaries or governments operating with access to classified data and methods. Over the course of the Cold War, however, new work by civilian academics[3] broke open military analysis and provided new guidelines for force planning in conventional conflicts. These efforts also represented an attempt by civilians to provide transparent and replicable models to support their arguments, reducing complex battlefield problems to a level of simplicity where falsification became possible.[4] Simplified models offered by campaign analysis are also easier to convey to the public through writing or other presentations. However, these approaches have overwhelmingly been focused on conventional military operations, with some scholars expanding into analysis of nuclear warfare.[5] Fewer campaign analyses have focused on Military Operations Other Than War (MOOTW), despite the fact that such operations have become increasingly common and widespread within the international system and "are now a fixture in the modern security environment" (Lin-Greenberg 2018, p. 84).[6]

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[3] Mearsheimer (1982), Posen (1984), Epstein (1988).
[4] This achievement also allowed detractors of the method to argue against its efficacy and present challenges for further refinement. Indeed, recent attempts to standardize the method and incorporate uncertainty into modeling techniques can be seen as responses to some of the challenges raised in these early debates (see Cohen 1988).
[5] Riqiang (2020).
[6] For notable exceptions, see Greenhill (2001), Seibert (2007), and Bennett and Lind (2011).

The increased incidence of MOOTW, their importance for successful foreign policy, and the potential signaling value of the operations towards other militaries together make them deserving of closer study (Ibid; Pion-Berlin 2016). As campaign analysis is further developed and formalized as a methodology, then, it should also be applied to MOOTW and new tools should be developed to help researchers do so. These types of operations have been subject to other methods of operational research, including wargaming (O'Neal Jr 1999; Britt 2021), so there is reason to suspect that campaign analysis may also be useful for answering questions of political or operational importance related to MOOTW.

Past Approaches for Force Estimation in MOOTW

In particular, there is room to improve on existing techniques for estimating force sizes in MOOTW. Past attempts at force sizing have followed two methodologies, force ratios and operational design, both of which have serious drawbacks for civilian and academic analysts. Force ratio approaches like those pioneered by James Quinlivan (1995) make questionable assumptions, tend to be inaccurate, and say little about the composition of the force (Krause 2007). This last point in particular is a problem for force sizing because the composition of the force also affects the number of ground troops needed for the operation. Operational design approaches like those favored by US military planners, meanwhile, require a level of labor and iterative wargaming which is unlikely to be available to academic analysts. This is a problem because it means that realistic planning for these complex operations is limited to professionals working within military planning staffs. Taken together, the importance of these operations in the contemporary international system, the lack of planning methods among civilian analysts, and the interest within civilian agencies like humanitarian NGOs in MOOTW mean that civilian analysts require better methods. Debates do not just occur between civilians and militaries, moreover: as Alan Kuperman points out, debate was common between militaries, civilians, and

IGOs/NGOs following the Rwandan genocide as to what kind of force could have prevented the atrocities (2001). Settling debates like these requires a methodological approach which can use unclassified data to draw conclusions.

What is ultimately needed is a method which can combine the multivariate and qualitative approach of operational design with the clarity and replicability of the force ratio approach. This method would be useful not only for academic analysis but also for non-governmental organizations, intergovernmental organizations, think tanks, or individuals considering a proposed MOOTW deployment. Debate over the desirability, utility, and limits of the deployment could be better-guided by historical data. This research provides such a method by adapting campaign analysis for a new, case-based approach to force sizing.

Military Operations Other Than War

While the term has fallen out of common usage among military professionals and civilian analysts, Military Operations Other Than War was a term employed in the 1990s to describe military operations other than "large-scale, sustained combat operations" (JP 3-07, 1997). This broad category included a broad range of possible operations, including rescue operations, counterinsurgency or insurgency support deployments, domestic deployments, and peacekeeping missions, among others. MOOTW may involve operations at varying levels of violence and complexity, ranging from the use of no force to deployments which risk deadly combat.

Recent events in the Ukraine and increased tensions between the US and China have refocused attention on conventional conflict and great-power competition, so it may be argued that MOOTW are no longer a useful category of study. However, MOOTW, as broadly construed, remain the most common types of military deployments, and the types of conflicts they tend to address (intrastate conflicts) remain the most common form of conflict in the contemporary international system. MOOTW, furthermore, are a continued object of interest among major-power militaries, including (specifically) China's People's Liberation Army (Lei 2011) and EU militaries (Paris 2014; Fravel 2011). MOOTW are also likely to be involved in national and international responses to emerging challenges in the international system like climate change and new patterns of migration (Bayer and Struck 2019; Sahu and Mohan 2022). Finally, MOOTW can provide signaling information which affect state's attitudes about another state's military or foreign policy (Lin-Greenberg 2018), so their conduct remains relevant for great power competition as well.

Contributions

The contributions of this research are several. First, I provide a new method for estimating force requirements for military operations below the level of conventional warfare. Methods for force planning in conventional conflicts have been developed or adapted by other researchers and are available for determining the force requirements for such conflicts. Models of conventional conflict can be based on mathematical expressions like loss ratios or relative orders of battle on both sides,[7] but operations below the level of conventional warfare often have objectives which are harder to define, leading to more difficult problems in modeling force requirements. While scholarly focus on conventional conflict has increased along with a general increase in great-power competition in the international system, intrastate conflicts, peacekeeping and counterinsurgency missions, and humanitarian efforts remain the most common contexts in which military force is used today. Still, this method has applications outside of MOOTW, especially for tasks like logistics and ISR. As long as operations can be properly classified and a dataset of comparison operations can be identified, operational inference offers insight for its planning.

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[7] See, for example, Posen (1984) and Mearsheimer (1982).

Further, as evidenced by the Cold War, intense great-power competition does not necessarily mean that intrastate warfare or operations below the level of conventional warfare will become less common. Indeed, these kinds of operations may become more common as intense competition coupled with great risks from direct conflict leads to conflict below the threshold of conventional interstate war. Regardless, better tools for force planning in these operations can help reduce the risk of policy failure against any systemic backdrop. They can help analysts and policymakers get a better sense of the resources required for such operations and situate them within a state's overall grand strategic picture. Operations below the level of war run the dual risks of both committing scarce military resources to long-term projects as well as failing to intervene in cases of potentially destabilizing humanitarian disaster. Improving our ability to plan for such operations, and to critically assess government estimates of forces necessary, remains a key goal in improving the conduct of foreign policy, particularly in Western democracies (Yi 2018).

The second main contribution of the method is that it provides additional tools for civilians to engage in debates over humanitarian deployments. This is necessary for several reasons. Civilians in government or NGOs who focus on a particular area or issue may be more invested than military officers in deploying troops for MOOTW, so they should have better tools available to estimate the military requirements when they advocate for such deployments. Given the need for rapid response in many MOOTW situations, this method can improve the planning process. Even within organizations like the African Union which have a military function, permanent planning staffs like those which enable the operational design process may not be available. A method which can provide roughly accurate estimates quickly can speed the planning process, at least in terms of evaluating its feasibility.

Finally, I provide a method which extends the formalization of campaign analysis methods into new areas, further demonstrating its promise as a research method. The structured use of campaign analysis remains in its infancy despite the impressive efforts of past scholars to show the way forward both in applying the method and providing attempts to formalize it.[8] I advance this research agenda not only by applying the campaign analysis method to a novel problem, but also showing how campaign analysis may be combined with other methodological insights to develop new research techniques and answer new questions.[9] Specifically, I provide an example of how case selection by identifying most-similar cases may be employed as part of any campaign analysis which relies on the structured comparison of cases.[10]

The following chapter details the shortcomings in the previous literature on force sizing and lays out the steps required for the new method, *operational inference*. It also explains the theoretical and methodological connections between operational inference and other methodological approaches in the social sciences. The third chapter demonstrates the use of the method for determining the force size of a hypothetical humanitarian operation, while the fourth chapter demonstrates the method for noncombatant evacuation operations by showing its performance in estimating force sizes for a historical operation. Taken together, these chapters show how the method may be applied to a range of MOOTW scenarios and demonstrates its superior performance relative to force ratio approaches. The fifth chapter reviews the conclusions of the cases, suggests improvements to the method, and concludes.

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[8] Tecott and Halterman (2021).
[9] In doing so, I am answering Tecott and Halterman's call for this kind of methodological cross-pollination (2021, p. 58, 83).
[10] Nielsen (2016). This technique is particularly useful for campaign analysis because the method often deals with medium-N sets for comparison: conflicts or operations are relatively rare but occur often enough that a close qualitative comparison of all cases is infeasible.

Chapter 2: A New Method for Force Sizing in MOOTW

Operational inference, a new method for estimating force sizes in MOOTW, takes a case-based approach to force planning, selecting similar past operations as examples which can be used to guide the design of the force for the current operation. Case selection is intended to create a *most-similar* set of past operations. This set of similar operations are then used as cases to help determine the size and composition of the force necessary to complete the operation's goals. This chapter provides an overview of current approaches to force sizing and identifies their shortcomings. It proposes a new method, operational inference, which combines quantitative and qualitative inference to address these problems and provides a general overview of the method's steps. Finally, it suggests possible diagnostics to assess the method's performance against that of force-ratio methods.

Past Methods for Force Sizing

Force planning as a discipline is poorly-understood by civilian analysts of political science. Part of this, no doubt, is due to the specific and technical nature of the practice: since most political scientists have little exposure to force planning in a professional capacity, their input and insight into the process is limited. Even within the military, however, force planning and sizing remains an inexact science, and planners struggle to "articulat[e] and justify… force requirements to civilian decision makers" (Zanella 2012, p. 1). Within the academic literature (including within the campaign analysis literature) the standard practice remains the use of force ratios, or ratios of troops to population.[11] Outside of the academy, military planners tend to take a

[11] For example, Seybolt (2007) refers to Quinlivan's ratio several times in determining the size of the force in his analysis, while Bennett and Lind (2011) use McGrath (2006) as well as Quinlivan to determine the "tiered" force ratios in their proposed North Korean stability operations. Lin-Greenberg (2011) provides an exemplary scholarly treatment of force ratios outside of the campaign analysis literature, noting that force planning for humanitarian operations is often based on troop ratios.

more qualitative approach based on wargaming, classified information, and staff work, requiring a level of information and labor input which is unlikely to be available to the civilian analyst. These two main approaches, as well as their drawbacks, are described below.

Force Ratio Approaches

Force ratios were introduced by Quinlivan (1995) in a brief article for *Parameters*, the premier journal for the US Army, where he identified the key problems with force sizing as an exercise, particularly the unpredictability of the number of forces necessary to handle a quickly-evolving battlefield environment (1995, p. 59). To simplify analysis, Quinlivan started from the proposition that for "stability operations"[12], the object was to provide basic security for the civilian population, so the size of the force should be determined by the size of the civilian population of concern. Using a range of historical cases of varying degrees of operational intensity, Quinlivan determined that for forces to have "a plausible capability for coercion, control or protection" in the least permissive environments (Malaya and Northern Ireland), an appropriate ratio would be 20 soldiers and police per thousand civilians. This ratio was later adopted by the US Army in their official COIN doctrine, though its use has since been abandoned.[13] Quinlivan's ratio, however, was based primarily on the British decolonial experience, and there is a question of whether the operational realities of these campaigns translate into modern military contexts.[14] Additionally, the Northern Ireland case presents a

[12] As opposed to mobile warfare and frontline combat under the modern system (Biddle 2006), stability operations are "Operations in which security forces (combining military, paramilitary, and police forces) carry out operations for the restoration and maintenance of order and stability." (Quinlivan 1995, p. 59). This includes counterinsurgency operations as well as peacekeeping missions, humanitarian operations, and other operations other than war.

[13] From US Army Field Manual 3-24, *Counterinsurgency*: "A better force requirement gauge is troop density, the ratio of security forces (including the host nation's military and police forces as well as foreign counterinsurgents) to inhabitants. Most density recommendations fall within a range of 20 to 25 counterinsurgents for every 1,000 residents in an [area of operations]. Twenty counterinsurgents per 1,000 residents are often considered the minimum troop density required for effective [counterinsurgency] operations." David Yi (2018, pp. 2-3) claims that though the ratio was dropped from official US Army doctrine, its influence persists.

[14] Krause (2007).

scenario where the costs of deployment were relatively small in both financial and political terms (Moore 2013, p. 857), meaning that the ratio of 20:1000 may be too high to be practical in most scenarios, particularly if an operation is one of choice being conducted for humanitarian purposes, possibly over a long distance.

Quinlivan himself notes that his derived ratio is extremely costly in terms of manpower, resources, and political will: reviewing the empirical record from operations since 1995, his force ratio seems impractical for contemporary operations and has not been closely followed by military planners. Fewer forces are generally committed than his ratio would suggest, and when numbers are augmented by local troops or police forces, reliability and cooperation with Western military personnel has sometimes been strained. Furthermore, the technique treats soldiers as fundamentally interchangeable, ignoring that different types of units may be more useful for different types of operations, allowing for potential labor savings. A medical brigade, for example, is better-suited than a mechanized infantry brigade for providing humanitarian assistance in a peaceful scenario, while the mechanized infantry are better-suited for frontline combat.

Still, the idea of a "force ratio" which can be formulaically determined through econometric tools has remained strong within Western national security communities, particularly in the United States.[15] The political costs of ongoing counterinsurgency deployments seem to be driving this continued popularity to some degree: being able to turn to a quantitatively-determined force ratio may be useful for military planners reporting to civilian decisionmakers and in turn gives those same decisionmakers cover when dealing with the public at large. However, Quinlivan's finding has been broadly challenged by analysts following in his

[15] Krause (2007).

footsteps, both by those who accept the premise of a force-ratio approach but critique Quinlivan's data or model construction as well as those who identify deeper theoretical problems with the approach.

Because of the continued demand for force-sizing advice, the search for an improved method in calculating force ratios was picked up by several other researchers. Two studies accepted the idea of a monovariate force ratio but sought to improve on Quinlivan's data selection and methodological approach. John McGrath (2006) took an approach like Quinlivan's, collecting a range of cases of contingency deployments and police operations in Western cities to use as a basis for recommending a more accurate force ratio. His findings suggested a lower troop ratio of 13.26 soldiers per thousand inhabitants, leading to a force requirement of approximately two brigades (~11,000 troops) per million inhabitants. A team from RAND (Jones 2005), meanwhile, suggested that the appropriate ratio was closer to 13.5 per thousand. While these improved ratios were more in line with real-world force numbers, they remained motivated by the central theoretical assumption that increased numbers of troops were required and were unable to say anything about the specific military capabilities needed.

Goode (2010) went a bit further in attacking the theory which underlies the force ratio but did so to develop a more complex method of reaching the same basic type of measure. Claiming that the only significant predictor of operational success was the KIA rate among counterinsurgents, he developed a formula based on the death rate among counterinsurgents and the fraction of security forces which were local to the conflict area.[16] While his equation

[16] $F = 1.2 \times (\frac{K}{L})^{0.45} + 2.8$, where F is security forces per 1000 population, K is the KIA rate of counterinsurgents per million population, and L is the fraction of security forces local to the conflict area. Higher death rates increase the number of troops needed to quell increased violence, while greater fractions of local to outside counterinsurgents likewise reduces this number. Moore's methodology for developing this equation is not specified in the paper and cannot be replicated.

performed well within sample, he notes that it lacks the ability to respond to changing battlefield conditions, particularly when situations which previously demonstrated low levels of violence escalated (Goode 2010, p. 53-4).[17] The inability of Goode's model (along with Quinlivan's and the RAND model) to respond to escalatory situations illuminates several problems with force ratios as a planning tool in general.

First and most importantly, force ratios deal only with gross numbers of troops and thus say nothing about niche capabilities: a state may have enough manpower to consider a large contingency operation but may lack the ISR or Civil Affairs capability to fully support it. They also say little about what types of equipment the forces will need and cannot account for the fact that many operations require combined-domain forces incorporating air (Lin-Greenberg 2011) and sometimes naval (Wirtz and Larsen 2009) forces.[18] Second, anticipating escalations in violence is part of any realistic planning process for a military campaign: at the very least, a range of scenarios should be envisioned at various levels of the escalation ladder *during* the planning process, with distinct force planning implications across each scenario. Third, the fact that many of these ratios perform best in high-intensity, high-violence scenarios limits their applicability in situations which begin at levels of low or no violence. Since situations such as these are common in MOOTW, we should adapt our force planning tools accordingly. Finally, all force ratios assume some sort of monotonically positive relationship between troop deployments and victory, when the history of contingency operations illustrates that there are diminishing or even negative returns after a certain level of deployment.[19] Force sizing estimates

[17] The better performance of Goode's model at higher levels of violence is unsurprising. The closer contingency operations get to frontline, conventional warfare, the more the concrete mission of battlefield victory can be allowed to predominate over "softer" and less precisely defined policing and humanitarian missions (Goode 2010).
[18] As Lin-Greenberg points out, air forces, particularly through the use of UAVs, can provide ISR over broad areas, particularly in unfavorable geography.
[19] This dynamic should be abundantly familiar to American observers of the Vietnam, Iraq, and Afghanistan experiences, but it also exists in other contexts. The French deployed troops in Algeria at a rate higher than that

which ignore the political situation in troop-sending states as well as the ongoing military requirements of their armed forces, therefore, are not just inaccurate in specific cases but also potentially detrimental to overall foreign policy success.

Operational Design

Within the American military, an important tool for force sizing is "operational design", defined as "the conception and constriction of the framework that underpins a campaign or major operation plan and its subsequent execution".[20] Though several publications discussing operational design in the military context exist, the basic process of operational design consists of identifying the *current* state of the operational environment, the *desired* end state of the environment, as well as the *problem*, the factors in the environment which must be changed in order to reach a desired end state. Once this is done, an *operational approach* can be developed to address the problems.[21]

Operational design as practiced by military professionals, however, has its own problems for the purpose of civilian analysis, particularly by political scientists. The method, as might be expected for one which is intended for use by military professionals, involves identifying, testing (via wargaming), and simulation of various courses of action to arrive at the best possible plan: force sizing decisions are thus tied to choices between various courses of action (COAs). These courses of action require decisions to be made and testing to be performed at the strategic, operational, and tactical levels (Reilly 2012, p. 32). Civilian campaign analysis generally omits the tactical level: instead, it assumes a given course of action described by the analyst or uses a

suggested by Quinlivan, but ultimately were defeated, not least because of collapsing public support at home due to the size of French deployments (Moore 2013, p. 870).

[20] US Army 2009, *Planner's Handbook for Operational Design*, I-1.

[21] US Army (2009), Reilly (2012), JP 5-0 (2020).

publicly-debated and prior-defined course of action to make an analytical or theoretical point.[22] Further, few civilian analysts have the labor-hours available for extensive wargaming of alternative COAs. In campaign analyses scenarios are generally fixed to enable focused study: at most, individual variables important to the central model are allowed to vary in order to incorporate uncertainty into the analysis.[23] In neither case is the "dialectical" element of the planning process recommended by doctrine present. Where force ratio approaches do not go deep enough into the details of a potential operation, then, operational design approaches go too deep, requiring a level of iteration which is generally unavailable to most analysts. Further, since the selection of the final COA requires an iterative process involving wargaming and collaboration between officers and planners, its replicability is limited (if it is replicable at all).

Where do Past Approaches Fail?

It may be objected that while the force ratio literature has clear problems, it offers a "good enough" solution for civilian analysts. After all, military planning is always beset by friction and the fog of war, so elaborate planning methods are likely to offer little improvement over the broad guidelines proposed by troop ratio approaches. The argument that force ratios are "good enough" is based mainly on their ease of use. Regardless of their accuracy, they provide an easy method for analysts to set apparently reasonable bounds when discussing troop sizing decisions. The operative word in the above statement, however, is *apparently*. Even the most sophisticated models for determining force ratios are based on surprising and likely incorrect

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[22] See for example several prominent campaign analyses in the literature, most notably Talmadge (2008) and Cunningham (2020). In both analyses, the authors define a problem and analyze the likely consequences of a given course of action.

[23] Attempts to integrate Bayesian logic into these analyses which replace single values with distributions are one example of this: these allow the analyst to incorporate uncertainty with a minimum of additional effort (Tecott and Halterman 20210). The more general approach is that taken by Bennet and Lind (2011): though they identify a number of possible scenarios for North Korean regime collapse, they choose only one for careful study. Similarly, Cunningham (2020) identifies several possible strategies for maritime interdiction before choosing a blockade strategy for her analysis.

assumptions. Most concerning, especially given the lack of transparency in his methodology, is Goode's assertion (2010, pp. 48-51) that geographic, political, and other variables are ultimately insignificant for determining the relationship between force size and operational success. This is concerning because it ignores, on the one hand, the possibility for manpower savings due to advances in technology, and on the other, the possibility that it is not a single variable, but rather a *combination* of ignored variables, which can exert an effect on the intensity of the conflict and thus increase the need for additional forces. Operational inference, the method introduced here, takes this broader range of factors into account.

A New Method for Force Sizing: Operational Inference

In broad strokes, *operational inference* is a case-based approach to force sizing which takes advantage of both qualitative and quantitative analytical approaches. To determine the forces needed for a particular military action, it identifies a set of *most-similar* past operations (Gerring and Seawright 2008) and using qualitative analysis of the operation's performance, evaluates whether those operations achieved their goals given the force packages which were available. To do this, it takes advantage of news reports, unit histories, government publications, and secondary research. It then uses these reference operations as a guide for suggesting force packages for a hypothetical future operation, reasoning that if a force package performed well in a similar operation, it will likely do so in the operation under consideration. In doing so, it uses many of the same steps used in past studies which used campaign analysis as a method but adapts them for the specific purpose of force sizing.[24]

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[24] Using Tecott and Halterman's six-step method (2021, p. 55) as a framework, the first step (define a problem) is largely set: the problem is determining the appropriate size and composition of a force for the operation under consideration. Generally speaking, this is what Tecott and Halterman call a "sufficiency" question: what level of force will make success in a given campaign achievable? This can, of course, be used to answer a number of questions, as this research shows. In Chapter 3, for instance, the technique is used to approach the larger policy-relevant question of what kinds of military deployments the EU can reasonably undertake.

Step 1: Specify Problem, End State, and Tasks

The first step in operational inference is to identify the problem which the given operation is intended to address. MOOTW are undertaken for a variety of reasons, ranging from domestic disaster response and evacuation of civilians all the way up to air strikes and active counterinsurgency operations. The range of required tasks and possible operating environments means that force requirements vary as well. In order to estimate the forces necessary for a given operation, then, we must first specify what kind of operation we are thinking about: what problem is it trying to solve, and what is the desired end state? By answering these questions, we can think about the operation in terms of tasks to be accomplished and can more easily approximate the troop-to-task framework discussed earlier.[25]

The most important question, of course, is what the starting situation is: why is the military operation being conducted or what real-world problem is it trying to solve? Given the diversity of operations within MOOTW, this is an important step in narrowing the focus of the analysis and ensuring that a comparable set of cases can be identified. A disaster-relief operation, for example, is unlikely to provide many insights for force sizing in freedom-of-navigation operations. The problem to be solved should be roughly comparable between the operation of interest and the universe of operations against which it is being compared.[26]

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[25] As should be clear from the earlier exploration of the past force sizing literature, troop-to-task reasoning is an important tool for military planners (particularly in MOOTW where conventional-warfare attrition calculations like Lanchester's Laws are less applicable) and is able to match troops by their functional role instead of simply suggesting total numbers of troops.

[26] I suggest the following broad categories for MOOTW operations, listed roughly in order of operational intensity/expected level of violence: disaster relief, noncombatant evacuation, freedom of navigation, humanitarian intervention, insurgency/counterinsurgency support, strikes/raids. This is, notably, not an exhaustive list: combating terrorism, counterdrug operations, domestic support operations, and recovery of personnel are all examples of MOOTW, but are not included in the above categories. These are not included here because they tend to be operations of least concern to civilian analysts curious about military questions, but future work could expand to include these operations as well: there is no reason why the method as currently specified could not be adapted to new operational contexts.

Very closely related is the question of end state: once military force is applied, what is the desired result? The problem may itself imply the desired end state: in Chapter 3 of this study, for example, the problem is an influx of Libyan refugees into Europe, so the desired end state is to stop refugees and displaced persons from leaving Libyan soil. This is not necessarily the case, however: in the hypothetical Libyan operation, for example, force requirements would be different for an operation which focused solely on interdiction at sea and one which sought to address and contain refugee flows on land.[27] Furthermore, the selection of an end state should not be used to restrict the universe of potential comparison cases (see Step 3 below). This, instead, should be driven by an inclusion rule established either by a prior researcher who compiled a dataset or by a doctrinally-based inclusion rule established by the analyst.[28]

Through aligning the problem and the desired end state the analyst can arrive at some broad tasks for the forces to accomplish. These tasks distinguish the operation under consideration from other possibly similar operations and help to identify other operations which are similar in terms of their problem and desired end state.[29] For example, some humanitarian operations may seek to establish exclusion zones where their troops can operate freely but hostile forces are excluded. These exclusion zones require certain military capabilities, often including some level of airpower. Operations which require exclusion zones, then, are likely to require military capabilities that other operations do not. Similarly, operations which are not undertaken

[27] Indeed, the difference between these two scenarios is the basis for the divergence in forces required between the operation in Chapter 3 and real-world maritime enforcement operations by EU FRONTEX, Operations Triton, Sophia, and Mare Nostrum.

[28] For an example of coding rules which can be used to establish sets of comparison cases, see Chapters 3 and 4.

[29] Task-based designs are found not only in the military literature but have also been used in past academic campaign analyses. Alan Kuperman, for example, in his analysis of hypothetical interventions in Rwanda, differentiated the possible types of intervention not just by the types and number of forces committed, but also by the tasks which the forces would need to achieve (2001, pp. 64, 71, 74). Seybolt (2007) also used task-based classification of operations in his exploration of humanitarian intervention and application of coercion and deterrence to such operations.

with the permission of the government of the target state are likely to require a great deal more combat power than others. Tasks may be defined by the analyst, or they may be defined by past research (see Step 3 below). For example, the Frankfurt Peace Research Institute's dataset on humanitarian military deployments contains a set of variables related to the goals of the mission which are essentially tasks to be completed (Gromes and Dembinski 2019). The range of potential tasks will depend on the type of operation which is being considered, but if not defined by a past researcher (again, see Step 3), they should be defined here.[30]

This overall approach (problem-end state) is consistent both with established work using the campaign analysis methodology as well as the general approach of operational design. In Step 2 of Tecott and Halterman's generalization of the method, they advise that the analyst of a military operation should define the scenario, or "the political-military context within which the interaction of military forces occurs" (2021, p. 57). This requires specifying the political factors which will most directly shape the operation under consideration and either holding them constant (building them into the scenario) or varying them to study their effect on the conduct of military operations.

Step 2: Identify Key Environmental Factors

The second step of operational inference refines the framing from the first step. Once the operation has been described and its key tasks identified, key environmental factors influencing the success or failure of operations of this type should be specified as variables to be used in judging which operations are similar. This is likely to vary according to the type of operation being considered, but some basic guidelines can be established: these factors are likely to

[30] It is probably a good general practice for the analyst to define a range of possible tasks at this stage regardless of the availability of past definitions. This will allow her to check the work of past scholars for face validity as well as to potentially identify a more appropriate range of tasks for her analysis.

influence the difficulty of the operation or otherwise change the number and composition of forces required.

One key variable which should be included is the number of people the operation is intended to affect. This is the key insight behind the force ratio use of population as the main determinant of force size: the larger the population, the greater the challenge and the more resources must be committed to ensure success. It is easy to see how this same logic applies in the context of disaster recovery and other forms of humanitarian military operations as well. In the context of NEOs, meanwhile, scale is determined primarily by the number of evacuees to be rescued. Other variables may have to do with logistics: how accessible is the area and how difficult is it to operate throughout the entire area? Remote inland environments overland transport can be difficult and prone to interdiction, requiring forces to either commit additional resources to securing supply lines or using airlift as the primary means of logistical support.[31] The size of the area of operations is another possible variable. For humanitarian operations, more territory means more things to monitor, while for NEOs, the number of sites where evacuees must be collected determines how spread out the operation will be and how much the function of protecting evacuation routes and critical sites will need to be duplicated.

Finally, variables may be related to the level of expected violence. These may be already included in the allocation of tasks: as previously mentioned, operations which have the defeat of an opposing force as a task are likely to see most operations occurring at a higher level of violence. Otherwise, environmental variables like the estimated size of an opposing force or the death rate among populations of interest pre-intervention might be used. For natural-disaster

[31] The flexibility and range of airlift is its key strength in logistical operations: it can reach areas safely which would be much more difficult for forces relying on ground-based transportation. The key limitation for airlift, of course, is its lift capacity, which is much lower than other methods.

relief missions, the state capacity of the government pre-disaster or the pre-disaster level of violent crime might provide reasonable proxies for a baseline level of violence in the area.

The analyst, however, should be careful to consider only the most important environmental factors and avoid the temptation to include excessive numbers of variables in their matching criteria. Campaign analysis (and by extension, operational inference) requires the analyst to specify as simple and transparent a model as possible. Not only does this help avoid the "curse of dimensionality" which is common in all multivariate models, but in the specific case of campaign analysis, it allows other analysts to see the assumptions inherent in the model and to challenge them more easily. Important variables may be sourced from documents on military doctrine or may be theoretically motivated by other academic work: for example, JP 3-68 on Noncombatant Evacuation Operations lists a number of conditions which affect force planning (JP 3-68 2015). Additional case knowledge of the type of operation under consideration can also help suggest which variables are most important.

Step 3: Identify or Construct Comparison Set

As stated in Step 1, MOOTW range widely, and not all MOOTW can be used as reference operations for a given operation. Further, because of the breadth of operations which fall under MOOTW, no centralized dataset of operations is available to civilian analysts. It is up to the analyst to determine the universe of comparison operations, establishing principled rules for the inclusion or exclusion of operations from comparison or otherwise explaining why a given set of operations were chosen for comparison. The analyst should return to the conclusions reached in Step 1: what is the problem to be solved in the hypothetical operation, and what is the desired end state to be reached? Using these basic questions as guidelines, the analyst may classify the operation of interest according to a broad class of MOOTW and use that classification to identify possible comparisons.[32] In general, these sets should be complete as possible and should include as many operations as satisfy criteria for inclusion in the dataset. Cases which satisfy inclusion criteria should not be removed from the dataset unless there are strong theoretical motivations for doing so.

The research performed here provides an example of how this might be done. In the first case study (Chapter 3) it examines force requirements for a humanitarian military operation aimed at controlling refugee flows. Because this is a humanitarian deployment in another country, a dataset of humanitarian military deployments developed by the Peace Research Institute of Frankfurt is used as the universe of comparison cases. In the second case study (Chapter 4) it shows how to construct a universe of cases using data from National Evacuation Operations performed by the US military since World War II.

Importantly, the operations in the dataset do not all need to be "successful" in a political sense in order to provide useful information for a hypothetical operation. The idea of "success" in MOOTW, after all, is somewhat nebulous: Operation Unified Protector, the 2011 NATO intervention in Libya, was successful in providing civilian protection and ultimately in creating conditions which allowed for the overthrow of the Ghaddafi regime (its operational goals, according to various accounts)[33] but was unsuccessful in creating conditions through which a stable Libyan state could arise. Similarly, Operation Provide Comfort (1991, Northern Iraq) was successful in averting potential violence against the Kurds but was ultimately unsuccessful in settling the political conflict between Kurds and other Iraqis. This does not mean, however, that the forces used were insufficient to complete their assigned tasks. Operational inference does not

[32] Generally, cases should be included because they fit a set of criteria which qualify them for inclusion in the dataset. See Chapter 3, Stage Three below for an example of a set of inclusion criteria.
[33] See Kuperman (2013).

attempt to make larger claims about the capacity of intervening forces to solve underlying political problems, but rather their ability to fulfill a concretely-defined set of objectives. Thus, when constructing a dataset of comparison operations, the analyst does not generally need to consider whether an operation was "successful" in terms of its political goals.[34] What is important is that *operational* goals can be identified and the success of the intervening force in achieving these goals can be assessed. In terms of military doctrine, operational inference is concerned with measures of performance ("was the task completed to standard?") rather than measures of effectiveness ("are we doing the right things to create the effects of changes…that we desire?") (*JP-05* 2020, p. K-19; *Commander's Handbook* 2011, Ch. 3).

Focusing on measures of performance rather than measures of effectiveness has the advantage that it allows a more clear-cut assessment of success or failure. In particular, it is difficult to argue that an intervention which achieved its operational goals but not its long-term political goals failed to do so because of inadequate force size. Focusing on operational goals and measures of performance also allows the researcher to avoid the larger debate over whether MOOTW, particularly humanitarian interventions, actually succeed at achieving their political goals over the long term (Bell et al. 2019, Paris 2014, Pfundstein Chamberlain 2016, Jones 2017). For some classes of MOOTW of course, like NEOs, these questions are more cut-and-dried, but for others they can be quite difficult, and what the political goals even *are* may be an object of debate: once again, the case of the 2011 NATO intervention in Libya provides a case in point.

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[34] This division of political and operational success is also a suggested practice in campaign analysis research, where the political situation is largely held to be fixed in order to allow for tractable analysis.

Step 4: Identify Reference Operations

Once we have specified the operation under consideration and identified a universe of comparable operations, we can identify a smaller subset of the comparison set to use in our inference about force sizing. In order to avoid the potential problem of cherry picking, the analyst must have a principled rule for which cases in the comparison set will be used for qualitative comparison against the hypothetical operation under consideration.[35] In a loose sense, this smaller group of reference operations (hereafter referred to as the "reference set") is similar to a "matched set" in the causal inference literature. Operations within the reference set are more similar to one another than they are to operations outside of the set because they require similar tasks from deployed troops and are similar in terms of key environmental variables. In the context of this method, it means that the operations within the "matched set" are all similar in terms of important covariates, most importantly the tasks which troops will need to accomplish.[36] This is intended to maximize comparability between cases and minimize the influence of unobserved confounders.[37]

The analyst selects operations for the reference set by calculating a distance between the hypothetical operation (expressed as a vector of key variables) and each operation in the universe of comparison cases. A variety of different multivariate distance metrics may be used, and the matching literature suggests a number of possible metrics (see Imai et al. 2021). One common metric (and the one used in this research) is the Mahalanobis distance. A Mahalanobis distance is calculated between the hypothetical operation and each operation in the universe of comparison

[35] Goertz (2017, p. 6-7) suggests this as a general best practice for Medium-N research, which is a common setting for campaign analysis research.
[36] Note that this is similar to "optimal full matching", a process in matching which selects a set of most-similar untreated observations to match with each treated observation. See Ho et al. (2011).
[37] Nielsen (2016).

cases: the smaller the distance, the more similar the operation is to the hypothetical operation being considered.

The size of the final reference set can be determined in two ways. If the analyst is concerned that their hypothetical operation will not have many matches in the universe of comparison cases, they may arbitrarily define a desired number of operations within each set (for example, a minimum of 1). This may be a useful approach when considering a hypothetical operation which is highly unusual relative to the universe of comparison cases in terms of some key variable. This, however, does not guarantee that the operations in the reference set are empirically similar to the hypothetical operation. Alternatively, the analyst may select a p-value for a maximum distance threshold using the fact that Mahalanobis distance follows a chi-squared distribution with k-1 degrees of freedom, where k is the number of variables used to calculate the Mahalanobis distance. This ensures that the operations in the reference set will be at least somewhat similar to the hypothetical operation being considered. This second approach is used in the present research and is generally suggested as it is more likely to produce strong results.

Step 5: Analysis

Having specified the operation being considered and identified a useful reference set, the final qualitative analysis proceeds task-by-task, asking what level of troops and equipment were necessary for the reference operations to accomplish the tasks assigned them. Were troop levels actually sufficient, and what problems were encountered that could be fixed through the inclusion of additional troops or capabilities? What types of units were deployed that made a major impact, and how were they equipped?

The exact method of analysis will depend on the study: the questions the analyst brings to the exercise should guide her analysis and conclusions. For sufficiency questions (see Tecott and Halterman 2021), the analysis is fairly simple: what level of success did the reference operations have with the resources they deployed? Were they *sufficient* to the task? Did the operations accomplish those tasks with different force mixtures, and if so, why? Looking at the overall forces available to the state(s) which are being asked to supply the forces, how strenuous is the deployment in a *strategic* sense?[38] If a new capability (air defense system, modern antitank weaponry) were introduced to the conflict, how would the advice for force sizing change?

This technique is also useful for answering other questions related to operations other than war since the size of the force may be only part of another question. Seibert's work (2007) suggests one such application: once a force size is estimated for a hypothetical operation, it is then possible to ask whether it would be logistically feasible to for the force to arrive at a given area of operations within a specific timeframe. We might also imagine a scenario where a range of possible levels of violence are possible, leading to variation in the tasks required for intervening forces and thus force requirements between scenarios.[39] Using this technique allows the analyst to specify a range of scenarios at the outset, identify different reference sets of operations for each scenario, and make appropriate judgements about force requirements.

Step 6: Diagnostics

Finally, the overall findings from the analysis can be checked to ensure that the results are not driven by the selection of reference cases or the operation under consideration. It should also be noted that this step conforms with Tecott and Halterman's (2021) final step in campaign analysis: building uncertainty into the model. They suggest that this might be done in a Bayesian fashion by incorporating distributions rather than point estimates as inputs to the model: this allows single variables to be varied and to isolate their effect on the outcome of the analysis.

[38] That is, how much of a state's overall military power is the operation expected to occupy, and is this amount reasonable given other current or possible security concerns?
[39] For example, in Bennet and Lind's (2011) hypothetical operation aimed at securing nuclear materials following the collapse of the North Korean state, a number of possible scenarios are identified.

Here, since the analysis itself largely depends on qualitative examination of past battlefield behavior, it is difficult to provide a single diagnostic process which will fit all possible uses of the method. However, it is possible to identify metrics which can be used as a diagnostic, particularly in the context of the force-sizing problem. I implement one such metric in this research and show the improvement versus force ratios offered by operational inference in order to demonstrate how diagnostics may be incorporated into the analysis and to demonstrate the utility of operational inference in force planning relative to force ratios.

Past force ratio approaches aimed solely at estimating the number of ground troops necessary for a given operation. Therefore, for purposes of performance comparison, I use the total number of ground troops deployed in the operation as a benchmark. There are several reasons for this. First, "boots on the ground" hold an important political significance in Western domestic political debates surrounding the use of military force. The presence of ground troops as well as the size of the presence make a qualitative difference in terms of the stakes and visibility of the operation. A useful method for estimating force sizes, therefore, should offer some way of answering questions about how many ground troops are necessary for a given mission. Second, as discussed earlier, operational inference necessarily performs better than force-ratio approaches at identifying the overall composition of forces. However, this is a function of its qualitative nature and thus is not a direct improvement over the force-ratio approach. However, it is also my contention that by better modeling the overall force package, we can get a better and more accurate estimate of the total number of ground forces required, which is an important accomplishment on its own and is a "hard test" for the method. Operational inference (unlike the force-ratio approach) is not primarily focused on estimating this quantity, so if it still outperforms past work then it has strong validity, at least relative to past approaches. Similar performance, moreover, provides evidence that the method is *at least* as good as force ratio approaches and the question of which is superior will depend on the research question and the time/resources available to the analyst.

Diagnostic 1: Basic Set Diagnostics

Finally, we must account for the possibility that the findings from the study of the reference set are driven by a single case in the dataset: that is, there might be an operation or operations which are influential and are driving the results, most likely because they were incredibly atypical in terms of the size of forces required for the mission. For example, the 2003 intervention in the Democratic Republic of Congo required only 1000 ground troops, despite the fact that the population of the country was over five million people, a number that would have called for 100,000 troops under Quinlivan's model. Any hypothetical scenario which includes this case in its reference set will systematically have a lower predicted number of ground troops relative to the Quinlivan approach. To address this possible problem, I check whether the inclusion of each of the cases in the reference set for the given hypothetical operation causes a large change in the median number of ground troops among the set of reference operations selected via operational inference. If the change is small in terms of the spread (standard deviation) of ground troops in both the reference set and the dataset at large, then it seems unlikely that the findings from this analysis are being driven by the inclusion or exclusion of certain key cases from the reference set.

Diagnostic 2: Monte Carlo

First, it might be that the hypothetical case chosen for the analysis is a particularly favorable one: that is, that it has a profile of tasks which are particularly well-suited for a relatively small force or one which uses diversity of forces to make up for the small size of the deployment. Therefore, we should expect that the results for this type of operation will by systematically improved relative to other hypothetical operations. That is, if we had specified a different hypothetical operation, the results would have been better. I suggest that this concern can be addressed via Monte Carlo simulation: if the concern is that some combination of inputs is driving the results, then showing that the improved performance of the model persists under a variety of inputs should suggest additional explanatory power. Evidence of strong performance from this diagnostic test is given by the shape of the distribution of the differences between the number of troops estimated using operational inference and that estimated using force ratio approaches. If the distribution of the differences is unimodal and clustered about the mode, then variation in the input does not lead to changes in the relative performance of the methods.

Diagnostic 3: Comparing Errors

Second, we can use the fact that the dataset contains the true number of ground troops deployed for each operation in order to compute the error (*estimated # troops – true # troops*) under each method. In this robustness check I use leave-one-out cross-validation in order to assess the relative performance of the different techniques:[40] a random operation is removed from the dataset and used as the "hypothetical" operation whose force size remains to be estimated. A matching set is then constructed for the sampled observation using the Mahalanobis matching procedure and the median number of ground troops among the matching set is computed, which provides the number of ground troops estimated via operational inference. The estimated number of ground troops is also computed for the sampled operation using each of the force ratios. The error in the estimate produced by each method is then recorded and the distribution of errors generated by each of the five methods (operational inference and the four force ratios) can then be compared. Because we are directly computing errors in this diagnostic

[40] For more on Leave-One-Out Cross Validation and its use in model evaluation, see Vehtari et al. (2017).

and expect the errors of the force ratios to be positive, evidence of strong performance by a given method is given by an error distribution where the mean error is not significantly larger than zero.

Why A New Method?

As stated previously, operational inference is an attempt to approximate the operational design process performed within the military without the significant investment of labor in the analysis stage. Instead, it attempts to incorporate this process implicitly by using past forces as a model for future force-sizing decisions. One key advantage which this technique offers, therefore, is the ease and speed with which it can identify a set of comparable operations to be used as models for the operation being planned. By controlling for the "matched" variables which remain similar between the operations, variations in the number or type of forces deployed can be more plausibly attributed to variation in the "unmatched" variables, further aiding analysis and allowing the campaign analyst to transparently identify the assumptions in her force sizing process: what factors does she assume are important for determining the size of the force? If future researchers find fault in the variables used to select matching operations, for example, they can use their own set of variables to better approach the matching problem. The process of identifying the "matched set" is also automated and based on similarity in terms of operational characteristics as well as other environmental variables[41], so there is reduced likelihood of researcher bias motivating the choice of the reference operations (though significant freedom for the researcher remains in the selection of variables).

Another reason why I argue that this method offers better performance over past approaches is that it explicitly attempts to integrate quantitative and qualitative methods, which

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[41] These variables are left general here because the variables used will change according to the type of operation under consideration. For the analysis in Chapter 3 these include the size of the population in the area of operations, the size of the land area, and the time period, among others. See Chapters 3 and 4 for specific variables.

is increasingly necessary in the field of security studies. Most types of conflicts are (thankfully) relatively rare, and battlefield behavior is highly contingent on processes which are affected by the fog of war and friction (Clausewitz 1989). Campaign analyses tend to draw on a small universe of comparison cases, either operations which a state has recently carried out or prior operations in the area where the hypothetical analysis is expected to occur.[42] To use small collections of historical events as useful data for projecting future force needs, we need both the ability to qualitatively assess the operational narrative of past operations as well as a way to ensure that we are choosing comparison cases in a principled way.

Connections to Other Methodological Approaches

Operational inference draws on other methodological approaches in the social sciences: specifically, it is inspired by the process of "matching" practiced in quantitative social science, though it has key differences (Iacus et al. 2019; Rosenbaum and Silber 2001). Matching is a form of data preprocessing which attempts to isolate causal effects by restricting the sample ahead of analysis to a subsample. Untreated observations within this "matched" subsample correspond closely to the treated observations in terms of covariates, creating several "matched sets" of similar observations. Observations within each "matched set" in the subsample differ from each other mainly in their treatment assignment: this creates a quasi-experimental setup wherein it is easier to argue that changes in the dependent variable across the matched sample are due to variations in the key explanatory (or treatment) variable. While this technique is primarily deployed in quantitative research, the basic logic of the technique, if not the technique itself, may be applied in qualitative settings (Nielsen 2016; Yu et al. 2021). A key task in matching is to identify a range of relevant control variables and to use the observed values of those variables to

[42] For example, in planning a hypothetical US blockade of China, Cunningham (2021) draws primarily on US blockades of Iraq in the Persian Gulf, while in analyzing the ability of Iran to close the Strait of Hormuz, Talmadge (2008) analyzes US minesweeping and freedom-of-navigation operations during the Gulf War.

calculate a measure of distance between observations in the dataset. Those observations which are close to each other in terms of the distance metric are plausible cases for comparison. In the context of force sizing, this means that, rather than simply sizing the force based on population, we match our proposed military operation with other operations in the past which are similar in terms of key covariates.

The method used here, however, is distinct from most applications of matching in two important ways. First, unlike most research involving matching, it does not attempt to draw a *causal* inference about the success or failure of an operation (Stuart 2010). Rather, the operational success of the various operations is investigated in the more qualitative stages of analysis and is used to guide the final judgment about force size and composition. In line with this fact, the method also does not specify a *treatment* variable since the goal is not to estimate the causal effect of a given treatment. Second, in most matching designs the outcome of interest is explicitly *not* the same for observations which are deemed similar to one another: matching is between observations which are generally similar in terms of matched characteristics and randomly different on other background variables but are (ideally) systematically different in terms of both treatment and outcome. Here, by contrast, the selection of similar operations is done in the hopes that the outcome of interest (troop size and composition) *will also* be similar.

The method described here is also intended to mirror the decisionmaking process of military planners more closely than the force ratio method. Despite the guidelines which force ratios can provide, military planning ultimately involves a process which is like that described here, a process called “Troops-to-Task Assessment” (T2T). Planners identify key tasks which the force must accomplish and define the environment in which those tasks must be completed (United States Army 2011, B-16). Troop needs are thus based on the observed initial environment, the desired end state of the operation, and the difficulty of the notional tasks which bring the initial environment to said end state.[43] Critics of T2T, however, claim that, like force ratio approaches, it assumes that each "unit" (soldier, platoon, company, etc.) is assumed to be fungible and undifferentiated. Further, "the methodology articulated in doctrine to perform the analysis is lacking" (Zanella 2012, p. 47) and needs to be better formalized for use in academic analysis as well as future military planning. I argue that this method represents a significant step in this direction.

Possible Objections

It might be objected that the qualitative analysis in this method is not useful or is at best marginally useful relative to the effort expended once the preprocessing has been performed. One might imagine that once a matching reference set has been identified using the multivariate distance metric, the analyst could simply take the average of the number of the ground troops used for the operations in the reference set: after all, if the operations are similar in terms of their covariates, they should be similar in terms of their force size. Simply checking the reference sets, however, reveals that this is not necessarily the case. In the reference set for the hypothetical case in Chapter 3, for example, the total number of ground troops ranged from a low of 1000 to a high of 23,242. In fact, the number of ground troops committed varied much more widely than did the populations of the states which were undergoing interventions. This suggests that a qualitative examination of the actual operations themselves is necessary in order to determine what is actually driving the force-sizing decisions.

In this same example, the high end of the range (23,242 ground troops) came from Operation Provide Comfort in Northern Iraq: a large number of the troops deployed for the

[43] In this way the military response to the larger problem is determined by the specific requirements of the situation, as described by Posen (1997) in his discussion of military responses to refugee crises.

mission were already pre-deployed near the borders of Iraq thanks to Operation Desert Storm and many were held back as a strategic reserve against the potentially numerous and formerly well-armed Iraqi Army. Many of the most important operations were in fact executed by a much smaller force of between two and four thousand ground troops, including US, UK, and Danish Marines (Rudd 1991). Within-set qualitative analysis of the operations is able to capture this fact, where a crude quantitative metric misses it. Yu et al. (2021) make this point in their recent paper on "optimal matching." Using data from police reports involving the confiscation of firearms, they show that simply matching the sets can miss key details, particularly when there are contextual factors which may be driving conclusions in a meaningful way. In this case, contextual factors were largely responsible for variations in force sizing: in Northern Iraq, a relatively small force was necessary to perform many of the actual operations. The inclusion of the larger number of forces was motivated by the potential threat of the Iraqi military and the availability of troops near the area of operations. Using this method, therefore, can not only help us identify force sizes for particular scenarios, but it can also identify possible important determinants of force size or suggest possible alternative force structures under alternative parameters: greater levels of hostility, different opposing capabilities, different operating environments, etc.

Applying the Method

Past approaches to force sizing in MOOTW in the academic literature have relied primarily upon force ratios, which have a number of issues in their theoretical basis and empirical performance. One of their major limitations is that they are unable to account for contingent factors which are important for force size and composition, factors which are addressed in military methods for planning MOOTW. The method proposed here, operational inference, offers several improvements in performance over the force ratio approach without requiring an iterative wargaming process. Not only does it use insights from qualitative comparisons to provide additional information in terms of force composition (the inclusion of land, sea, and air forces and their equipment), but it also performs better than the most commonly-used force ratio approaches in terms of estimating the number of ground troops necessary for a given operation. Further, its performance relative to other approaches can be quantified. The following two chapters provide examples of how this method may be applied to two different forms of MOOTW.

Chapter 3: Applying the Method to Humanitarian Operations

Humanitarian military operations, or those which are undertaken by third parties to a conflict in order to protect a population from some sort of threat, may take on a variety of forms. The reasons for deployment of troops and the level of combat they expect to encounter may vary widely, with consequences for the types and number of troops necessary to fulfill a given mission. Recommendations from force ratio approaches to estimating force sizes are based on a different class of MOOTW, so-called "contingency" operations which often include colonial policing or counterinsurgency missions. While these missions have some things in common with humanitarian deployments, it is not always the case that humanitarian deployments will favor one side or another in a conflict, something which is generally expected in contingency operations, nor is it always true that a high level of violence against the outside troops is expected. Determining the force requirements for humanitarian military operations, therefore, can be done more accurately by using other humanitarian operations as comparison cases and leaving out other operations. In order to demonstrate the utility of the method proposed by this research I estimate the force requirements for a hypothetical humanitarian operation performed by the EU in Libya. This example also shows how the method may be applied to an existing dataset, specifically the Peace Research Institute of Frankfurt's dataset of humanitarian military operations (Gromes and Dembinski 2019).

Feasibility

The operation under consideration here may not in itself appear substantially likely given that the EU has not yet intervened in the Libyan Civil War and has new security concerns engendered by the recent conflict in Ukraine: the EU, it might be argued, has no interest in an optional deployment aimed at a secondary security threat at this time. There are, however, reasons to think that this is a feasible operation. First, it is in line with past deployments of EU forces: while it could be argued that population flows from North Africa do not constitute a threat to European Security in the same way that the Russian conventional threat does, the fact remains that the only time the EU decided to deploy troops under its Common Security and Defense Policy (CSDP) was during Operations Triton and Themis, maritime operations aimed at interdicting Mediterranean migrants. Thus, envisioning this type of deployment is within the realm of possibility. These kinds of operations were also common during the 1990s when conflict in Post-Soviet Eastern Europe raised fears in Europe about destabilization and refugee flows.

It seems likely that refugees will continue to be a serious issue in international and domestic politics in the near future. A new era of great power competition occurring alongside widespread climate change means that future conflicts and climate emergencies are likely to create increased refugee flows. For example, while the war in Ukraine has raised the valence of Russia as a threat to European security, it has also intensified the problem of refugees arriving in the EU (UNHCR 2022). Refugee flows like this, or like those generated by conflicts in North Africa, can be used as a tool for coercion by both sending states and other parties to conflicts by creating domestic political pressure and threatening broader regional instability, possibly leading to the increased desire among publics and policymakers for military deployments aimed at stopping them (Greenhill 2010). Further, if EU member states are serious about pursuing an integrated and more independent security policy, they should be prepared to plan for the possible use of EU forces in expeditionary humanitarian operations: the history of NATO shows that conglomerations of military force aimed at conventional threats can often be used for humanitarian missions or to address threats other than conventional warfare.

The Conflict

It may be helpful to provide a brief overview of the ongoing conflict in Libya before applying the method. The Libyan Civil War has been highly complex, with many warring parties and internal conflicts within them; a detailed review of its conduct is beyond the scope of this analysis.[44] At its core, however, the conflict stemmed from a split in the immediate aftermath of the Libyan revolution. Islamist and revolutionary leaders (mostly based in Tripoli and Western Libya), attempted to exclude former members of the Libyan military and Qaddafi regime (mostly based in Benghazi and Eastern Libya) from government, with strong opposition from the Libyan elite and nationalists. Following the expiration of the GNC's mandate to govern in February 2014, the split led to an attempted coup by forces loyal to nationalist General Haftar. Haftar demanded that the GNC be dissolved in favor of the establishment of a House of Representatives and with the expiration of its mandate the GNC came under intense public pressure to hold elections, the results of which were questioned.

Following the election, a new movement named Libya Dawn seized power in Tripoli and reinstated the former GNC, driving LNA forces and the House of Representatives government to retreat to the Eastern city of Tobruk. The body governing in Tripoli is broadly known as the Government of National Accord, or GNA, and is recognized by the United Nations as the government of Libya. Initially the GNA worked closely with Italy on issues related to migration and coastal access, though more recently France, Italy, and the rest of the EU have seemed to want to avoid picking sides, favoring instead a "common European agenda" aimed at enforcing the porous arms embargo and encouraging a negotiated settlement to the conflict (Poletti 2020).

[44] See, however, Chorin (2012), Cole and McQuinn (2015), Mollesworth (2015), Eriksson (2016), Strazzari and Tholens (2014), Lacher and al-Idrissi (2018), and Friend (2018).

From the point of the 2014 split onward, the LNA and GNA have fought a nationwide conflict between themselves while also fighting various regional, tribal, and Islamist forces operating throughout Libya. The LNA, bolstered by external support (including from Russia, France, the UAE, Egypt, and Saudi Arabia)[45], initially made considerable progress in this multilateral war and extended its control over most of Libya outside of the densely-populated Northwest Coast and the core areas of GNC support (Westcott 2019). In April of 2019, the LNA launched a final offensive to seize Tripoli. Bolstered by aid from outside partners, particularly Qatar and Turkey, the GNA was successful in repulsing this assault. Following the failure of the Tripoli offensive, the two sides agreed to preliminary discussions and the formation of a unified executive government under Prime Minister Abdel Hamid Ddeibeh in December of 2021.[46] Negotiations since then have focused on what government will follow Ddeibeh's caretaker regime have been contentious and marked by attempts by the Eastern factions to take greater control of the country as a whole, causing fears of a renewal of the civil war.[47]

Still, focusing on the conflict between the two largest factions obscures the fact that the overall security situation on the ground in Libya is highly fragmented. Security is often provided by locally-based tribal or neighborhood militias which have alliances with the main political players. This dynamic is particularly pronounced in Tripoli, where the capital is controlled by a patchwork of local forces, some supporting the GNA and others the Tobruk government (Iffat 2016, Lacher and Al-Idrissi 2018). The militias nationwide are often a *de facto* arm of the dominant state authority within their territory, drawing their pay from the government via factionally-disbursed oil revenues (Wehrey 2019). Militia groups also profit from the flourishing

[45] Feltman et al. 2021.
[46] Al-Jazeera, *Libya's Rivals*, 2022.
[47] Al-Jazeera, *What is Behind*, 2022.

smuggling trade in arms, drugs, and human lives, a dynamic which has deepened the conflict within Libya and helped feed the ongoing immigration flows across the Mediterranean (Altai Consulting 2017). The present conflict, then, is essentially intercommunal rather than ideological, with attendant high levels of violence and civilian displacement. This trend towards a higher level of violence is exacerbated in the Libyan case by the potential rewards for the victors. Libya's oil wealth was the foundation of the *Jamhiriya*, giving pre-revolutionary Libya the highest GDP per capita in Africa and producing $1.5 billion in revenues just in March of 2019 (Laessing 2019); this wealth, and control of the nominally independent Libyan Oil Company, is the ultimate prize of the conflict.[48]

Libya as a Migrant Hub

Even before the current civil war, Libya was a major center for migrants thanks to its favorable geography[49], the *Jamhiriya*'s dependence on low-paid African labor, and Gaddafi's personal connections to smuggling networks (Toaldo 2015). Migration control was one of the first issues negotiated between Libya and Italy during their rapprochement in the early 2000s: by keeping African migrants off Italian shores and within Libya's farms, factories, and jails, Gaddafi proved a valuable partner. With the fall of the Gaddafi regime in 2011 and the ensuing Libyan Civil War in 2014, the lack of a local interlocutor to manage migrant flows led to a spike in migrants and refugees along the Central route, 124,000 in 2014 (Ibid). Italy was the primary point of entry for migrants along the Mediterranean route, with nearly 300,000 entering during the peak of the crisis from 2015-16. During this time, thousands of migrants died at sea before reaching European shores, making headlines around the world. Even after the EU took proactive measures to save migrants at sea and attempt to enforce its sea borders, 119,000 migrants still

[48] Ibid.
[49] The Northwest coast of Libya sits only 350km from the islands of Malta and Lampedusa.

arrived by sea in 2017 (Lewis and Laessing 2018). It was only in 2018, following the funding, training, and equipping of the Libyan Coast Guard by EU member states, that the number of arrivals dropped. But could the EU go further in the future, approving the use of ground forces within Libya itself to help stanch the flow of immigrants?

I argue that this is a real possibility, particularly if flows of refugees from Libya again approach or exceed their previous high levels. States often respond to increased refugee flows as if they were a form of violent coercion: as Greenhill points out, increased migrant flows can increase nativist political agitation against the ruling regime even within developed democracies, while the hypocrisy costs of doing nothing in the face of humanitarian disaster can work to the same ends (Greenhill 2010, p. 38-9; Conley and Ruy 2018, p. 4-5). Faced with a double dilemma, some states choose to respond to this coercion by striking at the ability of the coercer to generate migrant flows or attempting to interdict the flows themselves. After rejecting the initial terms of the Rambouillet Accords for increased Kosovar autonomy in 1999, Milosevic threatened the countries of Western Europe with an exodus of Albanian refugees, a threat he maintained even as the NATO air campaign against Yugoslavian forces (Greenhill 2010, p. 133-34). Faced with increased migration from the Mediterranean driven by ongoing instability in the Middle East and weak state control of the borders in North Africa, the European Union responded in a similar way: it deployed naval and coast guard forces to the Central Mediterranean in a sequence of operations intended to interdict migrant vessels and disrupt the business model of the smuggling networks while attempting to alleviate the worst humanitarian disasters at sea.

Why did EU countries deploy naval forces in an effort to contain a humanitarian disaster? The EU's Common Security and Defense Policy (CDSP) has in the past been invoked to justify

EU intervention in third-party countries in the name of external security, in order to avoid state collapse or the flourishing of terrorist or criminal networks which can destabilize states outside of the EU. Operation Sophia represented the first time that the CDSP was invoked in terms of both internal and external security: not only was it supposed to contribute to the general stability of the Mediterranean (Sonnino 2015, p. 35), but it was also intended to prevent the flow of drugs, arms, and possible terrorists into the EU itself by attacking key vectors in the smuggling network, the boats of the smugglers themselves (Tardy 2015). The urgency of this mission, however, has receded with the slowing of migrant flows. The smuggling networks within Libya remain largely intact even as smuggling out migrants has become more difficult and the fighting intensifies. It is not outside of the realm of possibility, therefore, to envision a situation where an increased flow of migrants *despite* ongoing EU efforts leads to calls for a more direct interdiction of migrant flows onshore through the deployment of ground forces.

Applying the Method

This analysis presents a net assessment of the European Union's ability to launch an expeditionary force to the Northwest coast of Libya against the backdrop of LNA offensives against Tripoli and Misrata. It uses the new method for force estimation, operational inference, described in the previous chapters in order to generate not only superior estimates of ground troops relative to force ratio approaches, but also to provide richer detail on the composition of the force necessary. The scenario envisioned here is based on orders of battle for the Libyan combatants from early 2019; this is the last time reasonably reliable data on force sizes was available: estimates of fighters on both sides since then have largely used these numbers as a basis.[50]

[50] In the IIHS's annual *Armed Conflict Survey*, for instance, estimates of the number of troops on both sides remain unchanged from the 2019 to the 2021 editions. See Appendix A1, Sections I-III for estimated orders of battle.

Step 1: Specify Problem, End State, and Tasks

In order to apply operational inference we begin by specifying the problem: an offensive occurring which is generating large numbers of internally displaced Libyans, with African migrants currently in the combat zones displaced as well, and Central Mediterranean migrant crossings are increasing in volume to levels exceeding those observed in 2015-16.[51] The desired end state for the EU is to prevent these migrants from reaching their shores and to instead keep them onshore within Libya. The method for achieving this, and the desired operational end state to be reached, is to establish humanitarian safe havens within Libya so that internally displaced Libyans and African migrants can collect within the zones rather than try and make the crossing to Europe. It is important to note that these are safe *havens*, rather than safe *zones*: while intended to protect civilians who live inside the zones, they are also intended to be temporary areas of safety within the larger Libyan conflict which will be disbanded following a political solution to the conflict (Posen 1996, Seybolt 2007).

Having identified the problem and desired end state of the operation, we now identify tasks that must be performed in order to establish, maintain, and protect the safe havens ashore. These tasks will be used to identify other, similar operations (see Step 4 below) which can then be used as a guide to estimate the size and composition of the force needed for this operation (see Step 5 below). Here I introduce these tasks chronologically in three stages. Each of the operation's three stages is broken into several tasks which must be performed during the stage. By accomplishing these tasks, the EU can move from its starting "problem" state to its desired end state.

[51] Generally, we may think of this as a resumption of the civil war following a failed period of negotiation (Walter 1997).

First, the EU forces will establish a no-fly zone over the Northwest Coast of Libya. This initial stage of the operation will also involve the presence on the ground of Special Operations Forces (SOF) working with local civil and militia authorities as well as aid organizations[52] to coordinate the establishment of the safe havens and communicate the terms of the havens to local parties. During these initial actions, the EU force will assemble and board ships for transport to Libya. In the second stage the naval expeditionary force will arrive in theater to deploy EU troops into the safe havens. The troops will assemble, deploy, and secure the havens while elements of the marine force create a zone of interdiction off the Libyan coast. The third stage will be to maintain the safe havens, no-fly-zone, and naval interdiction zone while rotating troops into the theater for up to a year until a follow-on force can be formed or an end to the conflict can be negotiated.

Stage One: Preparing the Ground and Establishing a No-Fly Zone

Preparing the Ground

This task is the first in terms of both chronological order and importance. Before the EU force can enter Libya and begin establishing the safe havens, small teams of observers and special forces will deploy to Libya. The tasks of the forces in this role are *Special Reconnaissance* and *Military Information Support Operations* (*JP 3-05: Special Operations* 2016, pp. II-7 and II-16). In providing special reconnaissance these forces will gather key information about local terrain and force dispositions to assist the main force in planning its establishment of local headquarters and forward operating bases, as well as to indicate any potentially dangerous forces operating within the areas of exclusion. Special forces accomplish this task with a mixture of forces, including teams on the ground and manned and unmanned aerial assets. These operations are intended to complement other strategic-level ISR capabilities

[52] Aid organizations on the ground in Libya at present include the International Organization for Migration, UNHCR, and the World Food Programme as well as a range of NGOs.

such as satellite and high-altitude aerial reconnaissance and signals monitoring (*P 3-05: Special Operations* 2016, p. II-7).

One of the key responsibilities in preparing the ground will be communicating the terms of the safe havens as well as the weapons exclusion zones around them. Safe havens only work to protect civilians and provide a safe place of assembly if their terms and goals are clearly communicated with the belligerent parties and civilian population (Seybolt 2007, p. 188). Civilians must understand where the havens are, safe routes for access, what the havens offer, and what the conditions are for entry (e.g. no small arms, contraband searches, etc.). Belligerent parties to the conflict, meanwhile, must understand what actions they are required to take with regards to the zones (e.g. withdrawal of weapons and forces from zones of exclusion) as well as those which they are forbidden from taking. This will be both aimed at the belligerents who have consented as well as at other militia groups who may attempt to make unauthorized attacks on the havens. Furthermore, these rules must be backed by an explicit communication of consequences in order to serve as an effective deterrent against attacks on the zones (Ibid). Importantly, these consequences must be demonstrated if local belligerents test them. Special operations serve as an early show of force for interveners: their presence shows that the EU is able to put soldiers on the ground within the safe havens and the soldiers should be ready and willing to use force in order to defend themselves and so establish the deterrent potential of the intervening force (Seibert 2010, p. 22; Shurkin 2014, p. 13).

Establishing a No-Fly Zone

The next task for EU forces is to impose area interdiction throughout the area surrounding the havens by using European airpower to impose a no-fly zone. This is a common first step in humanitarian interventions and has been employed in cases from Iraq to Bosnia to Libya itself during its 2011 revolution (Kramlinger 2001, Mueller 2015). It deprives the combatants of an important tool for striking rear areas, particularly urban centers where attacks on military targets may cause civilian casualties. It also deprives both sides of their most mobile combat assets, allowing easier detection of and response to emergent threats to the safe havens. Air power and no-fly-zones are, in fact, *the* preferred method of intervention for Western powers in humanitarian conflicts due to their low costs in terms of casualties relative to ground deployments (Pashakhanlou 2018, p. 39; Pape 2012, p. 55). Arnaud Delalande, an analyst specializing in the Libyan Civil War, has noted that the current distribution of forces between the combatants is evenly matched on the ground and that the use of airpower has been a deciding factor in the conflict (AFP 2019). Grounding and defeating the two sides' air forces, then, can increase the expected costs of future conflict for both sides and may serve to bring the parties to the negotiating table, supporting the strategic goal of ending the conflict as a factor generating refugee flows.

The no-fly-zone itself will extend over most of the Northwest Libyan coast, creating an area free of aircraft stretching from Zuwara to Misrata (See Figure 1 in Appendix A2). Initial operations will be focused against violating aircraft and air-defense forces within the safe havens, though they will also subsequently involve conducting reconnaissance and surveillance of ground forces within the no-fly zone in order to alert inbound EU forces of the presence of massed forces which may threaten the safe havens. The aircraft participating in the no-fly zone should also take part in psychological and information warfare operations by dropping leaflets and emitting television and radio broadcasts which explain the purpose and regulations of the safe havens (Sewall et al. 2014, p. 124).

The proposed no-fly zone should be fairly low-cost for EU air forces. Both sides in the civil war possess small numbers of third-generation fighter aircraft inherited from the Qaddafi regime (See Tables 2 and 4 in Appendix A1, Delalande 2018, *Military Watch* 2019). These forces, however, proved unable to protect Libya airspace during NATO's 2011 intervention, and due to maintenance issues the most capable aircraft, the MiG-25 interceptor, was not used at all (Mueller 2015, p. 43; *Military Watch* 2019). Libya also lacks an integrated air defense system after the destruction of its obsolete equipment in 2011 (Mueller 2015, p. 46-7). In operational terms, then, imposing the no-fly-zone should consist of declaring it, imposing it, and then, if targets present themselves, striking ground-based air-search radar activated within the no-fly zone using naval cruise missiles or SEAD aircraft (Dunnigan 2003, p. 207) and destroying any violating aircraft using European fighters. Once the no-fly zone has been established the aircraft employed will also be tasked with monitoring possible threats to the havens from the ground and will have the responsibility of deterring and defeating attacks on the havens.

This is not to say that the no-fly-zone would be without any risks, nor that imposing it would be easy. European aircraft may be threatened by the widespread proliferation within Libya of man-portable SAMs (MANPADs), particularly the SA-7 "Grail" and SA-24 "Grinch" variants (Schroeder 2015, Binnie 2014). The Qaddafi regime stockpiled thousands of these weapons during the Cold War and following the Revolution they have entered black arms markets across the Middle East and Africa (Schroeder 2015). While individually a MANPAD (the antiquated SA-7 variant in particular) poses little threat to a modern fighter aircraft with advanced air-defense countermeasures, quantity has a quality all its own and the weapons have been successful in shooting down several Libyan aircraft during recent fighting. This could pose a threat to EU aircraft flying low, such as those attempting to strike targets in urban areas. There is also wide proliferation of anti-aircraft guns within Libya, which also threatens aircraft like helicopters or UAVs flying at low altitudes: these are often mounted on trucks and so are highly mobile. Finally, while the LNA largely fields Soviet-made SA-6 SAMs (see Table 2 in Appendix A1) which have proven singularly ineffective against modern air forces in a number of conflicts, more advanced air defense systems like the Pantsir S-1 have also been reported (Rondeaux 2021). The operational record of these systems in Libya, however, has been poor: Libyan forces with Turkish advisors have been successful in destroying such systems with drones and artillery (Ibid, Singh 2021). Further, if both sides including the LNA assent to the operation, these radars should not pose a threat to EU aircraft unless a larger political problem with the operation emerges or a militia group acting outside the authority of the LNA command structure takes control of the installation. Still, strong performance by drones in disabling or destroying such systems in recent conflicts like Libya and Nagorno-Karabakh suggests that a force which includes SEAD aircraft, drones and/or loitering munitions, and special forces capable of sabotage operations would have options for dealing with the danger posed by even these advanced air-defense systems (Singh 2021, Postma 2021).

Stage Two: Securing the Havens and Establishing Maritime Operations

Securing the Borders of the Havens

Securing the borders of the havens is not as simple as constructing a roadblock and parking an infantry fighting vehicle behind it. Experts in humanitarian intervention describe a three-layered conceptualization of the safe haven (Holt and Smith 2014, p. 27). First there is the haven itself, which must be kept safe and free of weapons in order to protect both the civilians within as well as the troops guarding them. Next there is a "patrol" area, which extends about 2 km around the borders of the safe haven. This area, which encompasses the approximate range of most direct-fire weapons (Dunnigan 2003), is to be patrolled by EU forces alert for the possibility of infiltrators attempting to attack the haven. Finally, outside of this zone is a 25-

kilometer exclusion zone within which no indirect-fire weaponry may enter.[53] This outermost zone should be patrolled occasionally by ground forces searching for evidence of indirect-fire weapons and should be monitored continuously by manned and unmanned aerial assets. Such an approach was applied at Sarajevo and other Bosnian safe areas; once these zones were credibly enforced by NATO airpower and artillery during Operation Deliberate Force, they proved effective in forcing Serbian forces to abandon their siege of the city (*CIA* 2002, p. 377-9). Similar approaches striking loyalist artillery during Operation Unified Protector also proved effective in forcing heavy weapons to retreat from attacks in cities (Mueller et al. 2015, p. 172). Libyan militias, of course, lack the firepower of the Serbian forces, but the principle still applies, particularly given the possibility of mortar or other indirect fire from the mountainous areas near Khoms.

Maritime Operations

Of all the tasks assigned to the European force, the maritime component is likely to be the most familiar. After all, the EU and its member countries have had a great deal of practice in recent years in attempting to interdict migrant flows in the Mediterranean. It is, however, the part of the operation which has the fewest precedents in past operations. Most humanitarian operations take place in inland areas away from major seaports (even when a state has a coastline). When naval units are deployed for humanitarian operations, however, they are often deployed in the manner described here, as a maritime method for stopping outflows of refugees and migrants.[54] Like the EU operations described previously in this analysis, the goal of the maritime force will primarily be area interdiction: naval forces are to stop smuggling vessels in

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[53] At present the only indirect-fire weapon with a longer than 20-km range in either of the major parties' inventories is the Grad MLRS, and that only in the case that it has new-model rockets (unlikely in the Libyan case).
[54] This was true not only in Operations Themis and Triton, but also during the 1997 Albanian Civil War, when Italian naval vessels patrolled offshore (leading to the tragic sinking of the *Otranto*), and in East Timor.

the water, destroy (empty) vessels operated by smugglers, and rescue any migrant vessels in danger of capsizing. The eventual status of the migrants once they are rescued is beyond the scope of this analysis: if migrants claim refugee status, for instance, they cannot simply be returned to Libya, and many are not Libyan in the first place, making their return to Libya, even to a safe area within it, a question of international law. For present purposes, then, the naval force will simply interdict and destroy vessels and rescue endangered migrants. Searches will be primarily conducted using patrol aircraft, including fixed-wing, rotary, and unmanned assets, while the Northwest coast of Libya is monitored via satellite (EEAS 2018, p. 19). Boarding and search operations may be carried out by any vessel within the force but will most likely be carried out by patrol vessels, particularly those associated with member state border authorities and police organizations.

It may be objected that the presence of EU troops on land and the establishment of the safe havens makes the maritime component of this mission unnecessary. This, however, fails to appreciate the reality of the situation on the ground in Libya. Even if the two sides of the conflict agree to the havens, they may not actively discourage migrants from departing in vessels: further, the militias which often control people-smuggling routes are even less likely to honor this agreement, particularly since it represents a direct attack on their economic interests. The long coastline of Libya also makes it unrealistic to assume that migrants will only flee to the havens when another option, escape via the sea, is already present nearby. A maritime component is necessary in order to provide a backstop for operations ashore, particularly if the mission described here is motivated by domestic political pressure to stop migrants from arriving onshore and/or dying in European coastal waters.

Of course, the presence of European troops on land means that the naval force has objectives beyond the humanitarian. As mentioned in the previous section regarding the no-fly-zone, the naval force will have a role to play in force protection, including possible operations aimed at suppressing air defenses within the no-fly zone. Standoff capabilities like cruise missiles, while rare among European navies, will contribute to the deterrent power of the force on the ground while the presence of an aircraft carrier allows for a quick-reaction strike force to augment the aircraft being used for the no-fly zone (Sewall et al. 2010, p. 57). The naval force, then, must be large enough to not only conduct humanitarian and interdiction operations over a large area of sea, but it must also be able to provide protection and support to onshore troops as well as the civilian populations within the safe havens (Siegel 2009, p. 101-2). This will be accomplished by a group of forward-deployed naval forces including a flagship aircraft carrier. While the aircraft carrier may seem an excessive commitment for this kind of operation, it should be noted that aircraft carriers were used in past EU FRONTEX missions and so this is very much in line with EU doctrine as revealed by past deployments.

Stage Three: Maintaining the Safe Havens

Once the safe havens have been established and the main EU force has landed, the mission shifts to maintaining stability and security for the civilians living within the havens. It is important to note that EU forces will likely be unable to maintain the complete safety of the populations within the havens: given Libya's recent status as a hub of terrorist networks and the inevitably high-profile nature of the deployment, these havens are likely to become targets of bombings, harassment raids, and occasional mortar fire. Moreover, the creation of the havens will attract an influx of civilians and migrants, causing damage to local civic life and institutions. What EU forces *can* do is prevent the havens from collapsing, either under attack from outside or from rising disorder inside, thereby preventing massive loss of life and likely a large flow of refugees.

Some measures of performance may be inferred from past operations. The first and most obvious is to prevent outside attackers from taking offensive actions against the havens. This involves actively engaging or communicating with outside and potentially hostile forces as occurred during Operation Provide Comfort (Rudd 2004). It also involves preventing the establishment of militia or terrorist camps nearby, as was done in Operation Artemis (Turke 2008, p. 31). Another measure of performance is the prevention and suppression of rioting within the safe havens. When this occurred within the city of Bunia during EU's 2003 Operation Artemis in the Democratic Republic of the Congo, for example, the use of force by EU troops beginning on June 13 was able to stop rioting and clear a violent militia from a sector of the city by June 21 and eventually prevent the open carrying of weapons within the haven by June 24 (Turke 2008, p. 29). Ultimately, maintenance of the havens will be considered operationally successful if the havens can be kept internally peaceful with no persistent areas of violence and rioting, no visible weaponry, and no penetration of the havens or their surrounding exclusion zones by outside militia forces. Occasional protests or limited unrest, harassing fire from mortars or rockets, or terrorist attacks within the havens may occur, but these incidents should be limited and should be followed by an active response to eliminate the source of the threat: again, in Operation Artemis EU forces responded to the formation of a nearby militia base by taking the base and disarming the local units (Turke 2008). A limited success can be attained if attacks are minimized and are not allowed to increase the overall level of violence within the safe havens.

Protecting the Havens from Without

The first and most important task in maintaining the safe havens is that EU troops be able to defend them against attack. This requires forces militarily powerful enough to provide deterrence against attacks on the havens, to defend the havens against attack should deterrence fail, and ultimately, to coerce attackers into ceasing their attempts. Part of this effort is to conduct external patrols of the direct-fire and heavy-weapons-exclusion zones surrounding the havens. The havens are small enough that dedicated ISR should be able to pick up any large concentrations of forces moving towards them but finding “shoot and scoot” artillery systems like rockets, self-propelled howitzers, or concealed mortars requires active patrol. Occasional patrols of the heavy weapons zone using helicopters for mobility should also be employed (Holt and Smith 2008).

All that being said, the need for ground forces is not expected to be prohibitively high. For one thing, the provision of air and naval assets in the overall operation helps offset the need for large elements on the ground dedicated to force protection. The fact that the safe havens are to be imposed with the consent of both parties is another reason why fewer ground forces are needed: the havens are unlikely to come under concentrated attack from massed forces equipped with heavy weaponry, so the main worry for EU troops is local, lightly-armed militias operating independently as well as terrorist groups who want to strike at the havens and those within them.

Protecting the Havens from Within

A key task in a humanitarian intervention is to provide a level of order and security within the areas established for civilians. Part of this involves patrols within the havens themselves. The object of these patrols is to show proof of European troops’ presence within the haven and to contribute to an overall atmosphere of stability. These internal patrols can be performed by foreign soldiers, although local police or European paramilitary or MP units are better suited to the task. Still, there are times when only soldiers will be able to stop violence within the havens. Experiences from the Kosovo peacekeeping forces illustrate this vividly. In one instance, 700 troops were able to stop a mob of thousands from destroying an Orthodox church (Friesendorf 2010, p. 103). Similarly, forces of 70 and 200 soldiers (in separate incidents) supported by tactical airpower and helicopters were able to successfully confront and defeat hostile militias of hundreds in Bunia during Operation Artemis in the DRC (Ulriksen et al. 2007). In a haven like Zuwara where two long-opposed ethnic groups (Arabs vs. Amazigh) shelter together, this kind of intercommunal violence is all too possible and must be proactively addressed by EU forces.

Patrols should be performed to show that European troops are actively committed to protecting the people inside as well as to monitor the status of weapons within the havens. One of the key concerns about maintaining a safe haven during an ongoing conflict is the possibility that one side or the other will use the safe havens as bases from which to launch attacks at their enemies. The case of Srebrenica, a former UN safe zone in Bosnia, is instructive in this regard. Bosnian partisans within the safe zone were able to launch attacks on Serbian civilians both inside and outside of the safe zone, leading to increased tensions with the Serbian forces outside of the zone. Accordingly, the EU troops within the havens will need to make sure that fighting forces do not form within the havens which can threaten the overall stability of the area. This, of course, is complicated by the ubiquity of local militias in the Libyan context. One possible solution to this problem is to offer an agreement that the militias give up all heavy weaponry, particularly explosives, leaving themselves only small arms for protection. Another is to disarm all militia within the havens except for a core group which can be seconded into local police forces since that is the role that many militias currently fill in many Libyan cities: this was done successfully during Operation Artemis after several shows of force were successful in coercing militias to flee the city and abandon weaponry (Ulriksen et al. 2007). Past working relationships between EU member states and local officials within the havens, such as the cooperation of Italy with local officials in Khoms, will be invaluable in moving the process forward.

Tasks as Variables

With the tasks identified through relating the beginning and desired end state of the operation, they can be used as a set of variables on which to select similar operations. For a full list of these variables, see Table 1. Without specifying these tasks, we would be left with a large number of operations for potential comparison to the hypothetical Libyan intervention and no guarantee that any of these operations would actually yield useful information for planning an operation such as that described in this step. Together with the environmental factors described in Step 2 below, these tasks can be used to narrow the universe of possible cases to those which are most directly comparable and thus provide the greatest analytical leverage for the problem at hand.

Step 2: Identify Key Environmental Factors

In the first step of operational inference, a set of tasks were identified which described the *tasks* required of EU troops to accomplish their mission. Simply knowing these tasks, however, does not tell us everything about the force needs of a specific mission: different environments affect both the number and type of troops needed. The next step in applying operational inference, therefore, is to identify key environmental variables which are important for determining the troop requirements for the mission at hand. Taken together, these environmental variables help provide a context which helps determine the overall difficulty of the operation at hand. These environmental factors, together with the tasks from the prior step, make up the full set of variables (see Table 1) which are used to select similar operations for comparison from the larger dataset.

The first important environmental factor used in this analysis is the population of the state: here I follow the theory advanced by force-ratio theorists and use the total population of the area of operations as a measure of scale. Humanitarian military operations often require working closely with local populations to ensure both community security and the flow of humanitarian supplies within the area of operations. Larger populations make both of these tasks more difficult. The next key environmental factor is the land area of the area of operations: large areas of operations require larger numbers of troops, more mobile troops, or both in order to provide adequate coverage of the entire area. Another important environmental factor is the temporal setting of the operation: because this operation is occurring in the post-Cold-War period, its conduct will differ from operations taking place during the Cold War both in terms of the pressures from the international system (Miller 1998; Pickering and Kisangani 2009) and in terms of the technology and types of forces available to the interveners (Lin-Greenberg 2011; Lohne and Sandvik 2014). See Table 1 for a full list of variables.

Other important environmental concerns are already included in the analysis through the inclusion of the task variables. Since humanitarian operations may or may not include an expectation of fighting against a given force, whether or not the host government agrees to the deployment provides a reasonable proxy for whether a high or low level of violence is expected.[55] Similarly, the fact that the intervention is not aimed at regime change or to aid in the defeat in one side or the other suggests that the overall level of violence expected will be lower. Specific data on pre-intervention fatalities is available for some operations in the universe of comparison cases but is not missing at random (unavailable for older operations) and is difficult

[55] For example, during Operation Provide Comfort in Northern Iraq, Saddam Hussein's government did not grant permission for the intervention, something which necessitated the maintenance of a strategic reserve of troops able to respond to any offensive operations by the Iraqi Army.

to find for the Libyan case, so I argue the use of these task variables as a measure for the overall expected level of violence is sufficient for the purposes of this analysis.

Step 3: Identify or Construct Comparison Set

It is imperative, given the diversity of possible operations which may fall into the category of Operations Other than War, to identify a truly comparable universe of operations from which to select our reference set. These operations should share some common characteristic in terms of the political purpose for the operation or the scenario to which it is intended to respond. This similarity in political purpose or scenario is the basis for the operations having potentially similar tasks and provides a way for us to exclude military operations from the analysis which are clearly unlike the operation under consideration. For example, we would want to include Operation Provide Comfort, the 1991 intervention to protect the Kurdish population in Northern Iraq (a humanitarian intervention), but we would not want to include Operation Desert Storm (a conventional war). The two operations, though occurring at around the same time and involving same countries, were completely dissimilar in their political goals and operational conduct.

Here, the operation falls into the category of humanitarian military deployments, those operations which are launched in order to enforce a peacekeeping mandate or to accomplish some kind of humanitarian goal. We therefore need to select a universe of comparison operations which have these same kinds of goals in mind. Data on past humanitarian interventions which includes the reference cases was taken from the PRIF Humanitarian Military Interventions dataset (Gromes and Dembinski 2019). These are operations which, by the coding rules of the dataset's authors:

"share a conceptual core of three elements in defining humanitarian military intervention: (1) the threat or use of force abroad by a state or group of states with (2) the purpose of "saving strangers", (3) from a violent emergency." (Ibid, p. 7).

The universe of comparison cases offered by the HMI dataset is reasonably representative of operations comparable to the hypothetical intervention in Libya. The data were collected according to a principled rule for inclusion and include interventions worldwide within a reasonable time period. Even looking at the interventions themselves, most were performed by advanced militaries from leading global powers (the US, USSR/Russia, and/or Western European states) and thus are useful comparison cases for a hypothetical intervention by EU troops. The HMI dataset contains data from 112 variables on 35 humanitarian military deployments since World War II, including data on operational goals and environmental variables which can be used to match the hypothetical operation in Libya with similar operations undertaken in the past.

Matching Criteria in the Dataset

The first important set of variables are the "operational" variables from Step 1: what must the intervening force do in order to accomplish their larger political goals? The PRIF dataset offers data on operational goals for each intervention covered. These include whether or not the intervention was aimed at interposing troops between two competing sides, whether intervening troops disarmed combatant parties, whether those forces were engaged in protecting civilians, whether intervening troops distributed humanitarian aid, whether they imposed a no-fly zone, whether set areas were set aside for intervening troops to protect, whether the mission was aimed at regime change, and whether or not the operation was approved by the government(s) of the host state. A full summary of the operational (and environmental) variables used to select the matching set can be found in Table 1 below.

The next important set of variables are the environmental variables discussed in Step 2, namely the geographic area of operations and the size of the population in the target state. Both of these variables are available in the PRIF dataset (see Step 3 below) as “POPULAT” (the population of the state targeted for intervention during the first year of the intervention) and “AREA” (the land area of the state where the intervention is to occur). A third, temporal variable, “COLDWAR”, was also included. The practice of humanitarian intervention underwent a qualitative shift with the end of the Cold War, with attendant consequences for the size and composition of forces deployed (Finnemore 2003). This also provides some level of control over the level of technological sophistication among the forces being deployed.

Step 4: Identify Reference Operations

With the environment and assumptions for the proposed operation set and a set of tasks identified to bring the problem to the desired end state, we can calculate the Mahalanobis distance between the hypothetical operation and those in the larger dataset in order to identify some similar cases of past humanitarian intervention.[56] Theoretically, the matches should be cases where intervening troops had to establish safe havens for civilians and provide humanitarian aid but were not intended to target one of the parties of the conflict or overthrow a government. Applying the method outlined in Chapter 2 identifies five operations which are significantly similar to the hypothetical Libyan intervention in terms of the key operational and environmental variables: Operation Provide Comfort (United States in Iraqi Kurdistan, 1991); Operation Artemis (European Union in the Democratic Republic of Congo, 2003); the 2007 UN

[56] Given that the number of parameters is likely to be high relative to the size of the dataset, it is possible that an appropriate covariance matrix cannot be computed because the data are computationally singular. In this case the Moore-Penrose Generalized Covariance may be substituted. The generalized covariance may also be used for calculating Mahalanobis distance for all observations with little impact on performance. See Pires and Branco (2019, p. 3). Ultimately, this was unnecessary for the analysis in this chapter.

intervention in Darfur, Sudan; NATO's Operation Deliberate Force (1995, Bosnia and Herzegovina); and EUFOR TCHAD/RCA (European Union in Chad and the Central African Republic, 2008-2009).

While we can draw useful insights from all of the operations in this matched set, the mixed qualitative-quantitative nature of operational inference means that we can also use qualitative judgment to narrow our choice of cases for comparison. Doing so allows us to exclude even operations within the matched set which are unlike the hypothetical operation in critical ways. In particular, I focus the comparison on the three operations which were closest in terms of the operational variables, reasoning that these are the ones which are closest to the hypothetical operation in terms of the tasks to be undertaken and thus the troops to be assigned: these were found to be Operation Provide Comfort, Operation Artemis, and EUFOR TCHAD/RCA (see Table 1 above for coding). In all three operations, relatively small forces were able, at least for a while, to protect large numbers of civilians in defined geographic areas while also aiding in the protection and distribution of humanitarian aid. In none of these operations was the priority of the intervening forces to destroy or defeat opposing forces, and force, when used, was mainly deterrent. The UN intervention in Darfur is excluded because it did not involve creating safe areas, a critically important part of this operation, and so it is not as comparable: instead, it focused on protecting aid distribution and enforcing possible peace agreements. This required more mobile forces than might be necessary for defending a fixed area as in the hypothetical Libyan operation. NATO's 1995 intervention in Bosnia, meanwhile, was mainly aimed at enforcing an agreement being violated by one side (the Serbs) and was essentially a one-sided operation aimed at coercing Serbian forces (Posen 1996; Lake 2009).

Again, the mixed-method nature of operational analysis allows us to make these nuanced comparisons where a simple quantitative test would miss them.

I further augment the analysis with useful insights from other operations. For air operations I draw some operational and logistical details from Operation Unified Protector (NATO in Libya, 2011): this operation was substantially different in terms of its goals but used roughly the same level of airpower technology and occurred in the same state.[57] Further, because all the reference cases took place in inland areas, they did not include maritime operations and so can tell us little about the size and composition of the naval forces required for this operation. To fix this shortcoming, I use past EU maritime interdiction missions in the Mediterranean as a guide: Operations Triton (2014-18), Sophia (2015-20), and Themis (2018-present), all of which were aimed at interdicting migrant and smuggling vessels in the Mediterranean. These operations were not included in the initial dataset of comparison cases constructed by PRIF researchers, most likely because they were understood in the European Union to be border control operations as much as attempts at humanitarian rescue.

Step 5: Analysis

Having identified a useful reference set of operations for comparison, we can finally move on to a case-based analysis of force requirements for the hypothetical Libya operation.

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[57] Insights from Operation Unified Protector are restricted to air operations and have little impact on the final recommendations for force size and composition beyond providing key logistical data (availability of airbases in the Mediterranean) and an exemplary strike for purposes of sortie calculations.

Table 1: Key Variables and Reference Operations

Variable	Variable Name (PRIF)	Coding (Libyan Operation)	Coding (Iraq 1991)	Coding (TCHAD)	Coding (DRC 2003)
Did intervening forces interpose themselves between parties to the conflict?	INTERPOS	No	No	No	No
Did intervening forces engage in disarming local forces?	DISARM	No	No	No	No
Did intervening forces engage in protecting civilians?	CIVILIAN	Yes	Yes	Yes	Yes
Did intervening forces engage in protecting the delivery of humanitarian aid?	HUMANAID	Yes	Yes	Yes	Yes
Did intervening troops enforce a no-fly zone?	NOFLY	Yes	Yes	No	No
Did intervening troops enforce a safe or protected area?	SAFEAREA	Yes	Yes	Yes	Yes
Did intervening troops help one party avoid its defeat?	LOST	No	No	No	No
Did the intervening troops bring about a regime change?	REGIME	No	No	No	No
Did the government of the target of the intervention give permission?	GOVTPERM	Yes; all interveners and activities (2)	No (0)	Yes; all interveners and activities (2)	Yes; all interveners and activities (2)
What is the population of the state targeted for intervention?	POPULAT	6,871,000	17,900,000	11,100,000	47,100,000
What is the land area (km^2) of the state targeted for intervention?	AREA	1,759,000	438,000	1,284,000	2,345,000
Did the intervention occur during the Cold War?	COLDWAR	No	No	No	No

Stage One: Preparing the Ground

Preparing the Ground: Force Requirements

European military interventions tend to open with the commitment of a large special operations force as the first troops on the ground. This has been true both in multinational EU as well as national French operations. The size of the leading force has also been consistent, ranging between a company and a battalion-sized force. The first joint EU military intervention, Operation Artemis in the Democratic Republic of Congo, deployed approximately 220 special forces troops (Tomolya 2015, p. 126; Government of Canada 2016). Initial Entry Forces (IEF) employed in EUFOR TCHAD/CAR numbered some 450 special forces troops and airmen (Seibert 2010, p. 22) while French involvement in Operation Serval in Mali began with an estimated contingent of 400 special forces soldiers, including airmen (Boerke & Schurrman 2015, p. 814; Shurkin 2014, p. 7). The difference in force sizes between these three missions reflects the range of tasks assigned to the special forces in each case. Special forces involved in Operation Serval were tasked with reconnoitering AQIM forces across Northern Mali and organizing local defenses with Malian forces (Shurkin 2014 Ibid). SOF in EUFOR TCHAD were tasked with reconnoitering and showing force (Seibert 2010, p. 21) across a large area (200,000 km^2; Seibert 2007, p. 18). Both forces required a high degree of mobility to cover the vast distances of their Areas of Operations and had significant helicopter support.

In contrast, the SOF detachment in Operation Artemis was tasked with securing a single city, the refugee center of Bunia, DRC. This is more in line with the requirements of the operation under consideration in this analysis: in terms of population Bunia is similar in size to each of the havens, having an estimated population of 40,000 within the city proper (Tomolya 2015, p. 128) and 300,000 within its larger province at the time of the intervention (Genocide Watch 2002, p. 1). While overall Operation Artemis's success was limited by its geographic and temporal mandates, the initial deployment into Bunia was quite successful in stabilizing the city itself and attracting refugees to return.

In terms of tasks SOF in Bunia had a similar list to that envisioned in this operation, including securing key locations (Bunia airfield), establishing a “weapons-invisible” zone within the town, and establishing a deterrent presence through the use of force in self-defense (Tomolya 2015, p. 126-7). Total force requirements, then, are one company of SOF per haven for a total of an SOF battalion. Overall, this amount is also in line with SOF requirements for other past EU and EU member state operations. The initial force should also have with it a Civil Affairs complement which can begin liaising with local leadership, particularly local government, port officials, and aid coordinators, as well as militia commanders to establish new policies for migrants stopped at sea. Operation Protective Force provides an example of how this can be done: early special forces teams dispatched to assess conditions in Kurdish refugee camps brought two CA officers per company of SOF (Rudd 2004, p. 68-9).

Establishing a No-Fly Zone: Force Requirements

The no-fly-zone envisioned in this operation spans across three land-based engagement zones which together form a continuous corridor from the outskirts of Misrata to the Western edge of Zuwara. One engagement zone is centered above each safe haven, with a third centered above Tripoli itself. The first French strike during Operation Harmattan, early in NATO’s intervention in the Libyan Revolution struck four armored vehicles, halting the Libyan Army’s advance on Benghazi (Mueller et al. 2015, p. 192). Taking this strike as exemplary, strike aircraft on-station should be able to destroy four emergent ground targets per sortie to demoralize forces attempting to advance on the safe havens. Each engagement zone has a radius of either 25 (Tripoli) or 30 (havens) nautical miles: if the strike aircraft fly at subsonic cruising speeds of 500 knots, they should be able to fly from the center to any point within their assigned engagement zone within 3-4 minutes and strike the required four targets within 15 minutes.[58] Aircraft employed in the no-fly-zone will also be armed with air-to-air munitions and will be searching for emergent helicopter or fixed-wing threats to the havens. Given that the havens are based on the consent of the warring parties within Libya, however, it is not expected that each sortie will actually have to strike a target, so a minimal number of aircraft necessary to establish deterrent force can be used.[59] Accordingly, each engagement zone will be patrolled by a flight of two strike aircraft at all times, for a total of 12 patrol sorties per day per engagement zone, or thirty-six patrol sorties a day total. Given an effective sortie rate of 1.6 sorties per day for land-based aircraft and assuming an average rate of airworthiness among strike aircraft, maintaining this rate of patrol sorties will require some 32 land-based strike aircraft at bases in Sicily.[60]

The EU force will have additional need for airborne assets besides the strike aircraft used for maintaining the engagement zones. It will need reconnaissance assets, airborne warning and control (AWACS) aircraft, and especially tanker support to maintain ongoing flight operations. The coastal locations of the havens make airborne support operations easier: AWACS and tankers can fly over the Mediterranean, out of range of ground-based MANPADs and SAM batteries, while strike craft can quickly fly to the edge of their orbits to rendezvous with tankers. UAVs of various types will also be necessary, mainly for ISR and suppression of air defenses: recent combat in Libya, Nagorno-Karabakh, and Ukraine has shown that even unsophisticated UAVs can be used to hunt, kill, or reveal advanced air-defense positions (Witt 2022).

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[58] Aircraft force requirements are based on formulae put forward by Haggerty (2014) as well as force composition estimates from Shlapak et al. (2002).

[59] Given the number of air-to-surface munitions each Rafale (max 12 250kg) or Mirage-2000 (max 18 250 kg) can carry, this number is quite low. Sortie counts in this operation are driven by the need for onsite aircraft, not ordnance or target availability. Payload information from Jackson et al. (2017).

[60] See Appendix A3: Airpower Calculations for detailed calculations using Haggerty's model.

Stage Two: Securing the Havens

Securing the Borders of the Havens: Force Requirements

Securing the outside of the havens should be done quickly and all at once to create maximum clarity about the boundaries of the safe havens. To do so provides the forces defending the havens with increased credibility by demonstrating a material capability to make the havens real (Posen 1996, p. 84). Failure to do so can lead to elements of combatant forces being present within the safe havens or the weapons exclusion zones surrounding them. Past interventions offer a model for how to secure the borders around a haven. During Operation Provide Comfort in Northern Iraq, forces from a Marine Expeditionary Unit crossed the border into Iraq from Turkey to seize the Kurdish city of Zakho and establish a safe haven around the city to allow the Kurdish population to return to their homes. The drive on the city began with an air assault of two companies of Marines plus a mortar platoon who took up positions on the outskirts of Zakho (Rudd 2004). A similar aerial assault was performed during Operation Serval in Mali during the effort to liberate Timbuktu: 250 French airborne infantry parachuted at night into positions around the outsides of the city in order to trap suspected Islamist forces in the event that they tried to escape (Shurkin 2014). It should be noted that a similar level of force was used in both situations despite differences in the mission as well as the operating environment. In both cases the surrounding force was just the leading echelon for a follow-on force: this would be the case in this operation as well, as the initial force in each haven would be joined by the remainder of the EU force coming ashore at the local ports.

This operation, then, will require six companies of airborne infantry as part of the initial air deployment establishing the boundaries of the havens. Two companies will be employed at Zuwara, while the larger geographic and population size of Khoms will require the presence of approximately a battalion (four companies). These troops will be supported by aircraft on-station in the no-fly zone while SOF already on the ground serve as a land-based quick reaction force and naval aircraft provide additional quick-reaction support. Half of these companies will eventually be relieved by a mechanized company assigned to their safe haven (See Table 9 in Appendix A1 for Force Composition).

Maritime Operations: Force Requirements

To determine the force requirements for the maritime interdiction operation we turn to the period in which naval humanitarian operations in the Mediterranean were most successful: the period from 2015 to 2018 when both Triton (and later, its sister operation Themis) and Sophia were in operation and Central Mediterranean migration was at its height.[61] The EU estimates that the operations together saved almost 300,000 lives during this period (EU 2019). The area of operations for the maritime mission will be largely similar to those of the former operations Sophia and Triton, two missions whose areas of operation in fact overlapped (see Figure 8 in Appendix A2 for a map of these past operational areas).

During the height of the deployment of both operations, the total area of operations covered stretched over 525 square nautical miles, including much of Libya's coastline and the Central Mediterranean (Roberts 2018, p. 221). The total force committed, meanwhile, was commensurate with this large area of responsibility, with Triton deploying 27 total ships, mostly coastal and open-water patrol vessels, alongside 17 aircraft (see Table 9 in Appendix A1 for exact force levels). At approximately the same time operation Sophia deployed eight total ships, including the Italian aircraft carrier *Garibaldi* and four frigates, along with nine aircraft. The naval force's area interdiction and SAR operations will need to cover the same geographic area as this force in order to avoid smugglers and migrants simply moving elsewhere along Libya's

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[61] Migrant arrivals via the Central Mediterranean were 153,895 in 2015, rising to 181,459 in 2016 before falling to 118,912 in 2017 and 23,762 in 2018. See FRONTEX (2019).

coast or into neighboring Tunisia to avoid EU patrols. The full list of ships required for naval operations can be found in Table 10 of Appendix A1.

The naval force envisioned in this operation differs in both total number of forces as well as in composition from that which was employed in Operations Triton and Sophia. The presence of ground troops onshore in Libya assisting the displaced as well as recent advances in performance by the Libyan Coast Guard should reduce the overall outflow of migrants and hence the need for a large patrol component near the European coast should be smaller. Accordingly, the total number of patrol vessels (similar to those used in Operations Triton/Themis) is reduced from 26 to 15, while the number of search aircraft remains the same in order to surveil the same area. Second, the mix of aircraft and ships provided is different since the aircraft wing of the carrier in this operation will be used as a quick-reaction force for EU troops based onshore, providing a deterrent for the safe havens. In total, naval operations will require a force of approximately 26 ships (including eight proper warships and at least one aircraft carrier) and 26 patrol aircraft.

The operation will have two components, each with a flagship. The first, containing all of the patrol vessels (3 offshore, 12 coastal) and flagged by an amphibious assault craft with SAR helicopters[62], will be based closer to Europe itself, interdicting and providing humanitarian assistance to vessels which are able to evade the forces closer in-theater. This rear component also receives the majority of patrol aircraft (12 fixed-wing, 5 rotary) for SAR operations. The second component is the forward naval force, flagged by an aircraft carrier[63], which provides interdiction of smuggling off the Western coast of Libya as well as force protection and precision-strike capabilities via sea-launched cruise missiles and the carrier air wing. This force

[62] The *Garibaldi*, as in Operation Triton.
[63] Here, the *Cavour*.

also includes a survey ship as well as nine patrol aircraft (3 fixed-wing, 6 rotary) based on Sicily. An attack submarine is included for sea-launched cruise missile capability. Each component of the naval force is accompanied by a supply ship.

Stage Three: Maintaining the Havens

Maintaining the Havens: Force Requirements

In a permissive environment where both sides of a conflict accept the presence of intervening forces the need for deterrent/compellent force is lower than it is in highly contested areas. This is particularly true when forces employing modern combined-arms tactics face opponents who have relatively small stocks of combat aircraft and heavy weapons, which over the course of the Libyan conflict have been concentrated in areas with the heaviest fighting, namely Tripoli. The addition of the no-fly-zone and offshore naval air and standoff strike capability means that these forces already have a strong capability to make any threats regarding the violation of the havens real.

In order to determine the ground force requirements for this operation, I turn again to past humanitarian interventions. For the Zuwara haven, the example of Operation Artemis is instructive. The EU’s mission in Bunia required maintaining control over and imposing stability upon a small city with an initial population of 40,000 that quickly ballooned to over 100,000 as displaced persons facing violence outside of the city flooded in (Homan 2007, p. 3). The force’s mandate was also limited to the area of the town and airport, much like the mandate of EU troops is limited by the accession of both sides of the conflict to its presence. Like in Zuwara, the mission required early insertion of an engineering team in order to improve the local airport so that it could be used for humanitarian aid and military logistics (Turke 2008, p. 27). Overall, the European force within Bunia numbered some 1100 troops including 100 engineers but not including approximately 2 companies of special forces. 1000 of the troops were members of a

French GTIAM, a battalion-level task group made up of three companies of light infantry, one company of mechanized infantry, and battalion-level HQ and support elements (Ibid).[64] Using this as the starting point, I propose the following force for the Zuwara haven.

The basic structure of the force will be a GTIAM-like (four-company) structure, plus additional HQ and combat support elements, totaling 1,000 troops. The GTIAM's combat element is composed of two companies of light infantry who will enter the haven via air assault (see previous section) as well as two companies of mechanized infantry. This force is supplemented by an already-in-place company of SOF as well as a company of engineers and a company of paramilitary police forces. Additionally, a dedicated logistics company is necessary within each haven to coordinate to coordinate distribution of critical supplies.[65] The HQ element of the force is supplemented with an additional section of CA officers. Medevac operations are to be fulfilled by two air ambulance companies, though medical services in-theater will be limited due to the lack of hospital ships among EU militaries.[66]

Turning to the Khoms haven the challenge for EU forces is greater. To begin, the haven has a population at the outset that is five times larger than that of Zuwara. It is also physically larger, and nearly the entire haven is made up of either urban or hilly terrain.[67] Further complicating matters is the fact that the Khoms haven is completely reliant on its port for supply: this means that port protection, already important in Zuwara, is a matter of life or death for

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[64] For a detailed discussion of GTIAM structure see Shurkin (2014).
[65] I am grateful to the participants of the MIT Security Studies Working Group for pointing out this requirement beyond units attached to HQ staffs.
[66] On MEDEVAC force requirements see Fulton et al. (2015). The lack of hospital ships can be observed in the most recent *Military Balance* (2022). Again, I am grateful to MIT SSWG for this suggestion.
[67] See Appendix A2 (Maps and Charts) for a detailed picture of the areas surrounding the safe havens. Figures 2 and 3 provide a detailed satellite view of the Khoms haven, while Figures 4 and 5 provide the same view of Zuwara. Figure 7 provides a topographical overview of the entire are: it is easy to see from this map that the area around Khoms (labeled al-Khums and in the eastern coastal portion of the map) is much hillier than that surrounding Zuwara.

everyone within the haven. Accordingly, the force requirements for the Khoms haven are larger, requiring forces in approximate brigade strength. This battalion is made up of two GTIAM-like forces, or eight companies, with four overall companies of mechanized infantry and four companies of light infantry plus battalion-level HQ and support units for both groupings. Again, an additional logistics company is also included. The overall brigade command is enhanced by an already-in-place SOF company as well as two companies of paramilitary police, one of which has the protection of the port as its sole mission. As before, mechanized companies guard the approaches to the havens and patrol within the direct fire zone while light infantry focus their efforts on local patrolling, foot patrols and searches of nearby urban areas for heavy weapons, and airmobile patrols of the hilly heavy weapons restriction zones. Brigade HQ is also enhanced by a CA platoon. All in all, the ground forces deployment calls for some 4180 troops, including already-deployed SOF (see Table 9 in Appendix A1).

Final Force Estimates

Taken together, the analysis here suggests that a force of 4180 ground troops would be sufficient to accomplish the mission under consideration. The size of the ground force was in line with the size of forces which were required to accomplish each of the operations in its reference set. This estimate can be compared to those provided by the force ratio approaches:

Table 2: Ground Force Estimates Using Various Methodologies

Estimation Method	Ratio	Troop Est.
Operational Inference	*N/A*	*4180*
Quinlivan	20/1000	137,420
RAND	13.5/1000	92,758
McGrath	13.26/1000	91,109
Goode	2.8/1000	19,238

As expected, all of the force ratio estimates of ground troop numbers were higher than the estimate reached via operational inference. This was generally in line with past analysts’ assertions that force ratio approaches systematically overestimate the number of troops needed for some operations (Krause 2007, Yi 2018).

While the question of operational inference's superior performance strictly in terms of ground troops remains subject to scrutiny in the additional robustness checks performed below, its performance in estimating the overall composition of the force package provides a qualitative improvement over force ratio approaches. Using past operations and secondary operations research as a guide, operational inference was able to estimate both the number and composition of forces in the air and naval components of the operation as well, something which force ratio approaches are definitionally incapable of doing.

Step 6: Diagnostics

Given the highly qualitative nature of the analysis employed in this method, it is difficult to truly compare the findings in Step 5 to a large number of hypothetical scenarios. Therefore, in order to establish the face plausibility of the method, I choose to use a metric which is readily available in the dataset used for comparison in this study, the number of ground troops employed for an operation. If operational inference performs well, then the number of troops needed for the operations within each reference set should be closer to the real number needed than that predicted by troop ratio approaches. Troop ratio approaches calculate their ratio using an entire dataset: by reducing the dataset to a set of most-similar operations, we should be able to achieve increased performance in terms of the number of ground troops. This, I feel, constitutes a hard test for the method: if better estimates for the basic quantity of interest in troop ratio approaches can be obtained using operational inference, then the method offers improvement over past approaches not just in its ability to estimate the full size and composition of the force but in estimating the size of ground forces as well.

Academic commentary notes that that troop ratio approaches tend to systematically overestimate the number of troops needed for a given operation.[68] Given this, we expect that the number of troops estimated for the hypothetical operation using a troop ratio approach should be higher than that suggested by simply taking the median number of ground forces in the reference set. This should be true for two reasons: first, because the troop ratio method does not consider labor savings from the use of air and sea forces, it should overestimate the number of troops necessary, and second, because force ratio approaches use the entire dataset, they are more likely to be affected by the presence of operations in the dataset which have unusually large troop contingents. Accordingly, I evaluate the statistical significance of the following diagnostics based on one-tailed tests unless otherwise noted.

Diagnostic 1: Basic Reference Set Diagnostics

First, it might be that the results we obtain from the matching phase are being driven by a particularly influential operation in the reference set. We might imagine, for example, that a reference set which has a single operation with an abnormally small (or large) number of ground troops relative to the other reference operations might systematically produce small (or large) troop estimates. In part this criticism is already addressed through the construction of the quantity of interest used for diagnostic comparison, the median number of ground forces across the reference operations: using the median (as opposed to the mean) reduces the ability of an extremely large or small operation to influence the estimated number of ground troops. I address this concern further by investigating the relative dispersion of the estimated median number of troops in the reference set after removing each element of the reference set. I then compare this

[68] See Krause (2007). Further calculations performed by the researcher showed that within the PRIF dataset, the Quinlivan method overestimated ground troop requirements for 100% of operations. The RAND method overestimated troop requirements in 97.1% of operations; McGrath's in 71.4% of cases; and Goode's in 62.9% of cases.

dispersion with the dispersion of the median number of troops in the entire dataset when a proportional number of operations are removed.

Table 3: Changes when reference set operations are removed

Operation Name	GROUNDNO	Median Troops When Removed	Std Dev. Set GROUNDNO When Removed	Change (Ref Set Std Devs)
All Humanitarian Interventions	**N/A**	**12,717**	**173,848**	**N/A**
Reference Set, No Operation Removed	**N/A**	**17,777**	**14,934**	**N/A**
Operation Artemis	1,000	20,510	13,978	0.18
EUFOR TCHAD/RCA	3,700	20,510	15,085	0.18
Operation Provide Comfort	23,242	10,739	16,710	0.47
Darfur 2007	17,777	13,471	17,229	0.29
Operation Deliberate Force	37,500	20,510	10,776	0.18

As can be seen from Table 3 above, removing individual operations from the set causes little change in the estimated number of ground troops except when those observations are themselves the median observation or used in the calculation of the median observation. Overall, this suggests that using the median as the quantity of interest for estimating ground force requirements prevents operations which are unusual in terms of the number of ground forces from exerting extreme influence on the quantity of interest. In terms of the standard deviation of the numbers of ground troops used in both the reference set (Table 3, Row 2) and the entire humanitarian intervention dataset, the changes produced are quite small, with the largest change being less than half a standard deviation. In practical terms, of course, these are large changes of thousands of troops, but relative to the spread of troop numbers in the entire dataset (or, for that matter, in the reference set), these changes are fairly small. All in all, it does not seem that any individual operation is driving the quantitative calculations underlying the diagnostics presented here, while in the qualitative portions of the analysis no one operation in the reference set predominated the comparisons once the operations most similar in terms of task had been selected. I believe that it is reasonable to claim that the results of operational analysis, at least for the analysis presented in this chapter, are not being driven by individual operations present in (or absent from) the reference set.

Diagnostic 2: Monte Carlo

Second, it might be that the hypothetical case chosen for the analysis is a particularly favorable one: that is, that it has a profile of tasks which are particularly well-suited for a relatively small force or one which uses diversity of forces to make up for the small size of the deployment. If this was true, we would expect that the results for this specific type of operation would be systematically improved (estimate lower numbers of troops) relative to other hypothetical operations. That is, if we had specified a different hypothetical operation, the results would not have led to suggesting a better or lower force estimate.

I addressed this concern via Monte Carlo simulation: if the specific hypothetical operation under consideration here (the EU intervention in Libya) is driving the results, then showing that the performance of the model persists under a variety of inputs should suggest additional explanatory power. For this diagnostic, therefore, I first created an artificial "hypothetical" operation using independent draws of random values for each of the operational variables from the dataset. A matching set was then identified for the hypothetical operation using the Mahalanobis technique from Step 4. If a matching set could not be identified for a given combination of randomly-drawn values k, the hypothetical operation k was dropped and a new operation was generated in its place.[69] This was repeated for 1000 simulations.

[69] The decision to drop these cases was theoretically motivated: after all, some combinations of mission characteristics are highly implausible and should not have *any* operations which are useful references. A regime change operation with the permission of the current regime, for example, is unlikely to have any real-world

Figure 9a in Appendix A4 shows the results from this diagnostic when the estimates yielded by selection of reference sets are compared to those from the troop-ratio methods. As can be seen in Figure 9a (top panel), the method easily outperforms Quinlivan's ratio: many estimates calculated using Quinlivan's ratio were so large they could not be displayed alongside estimates from the other methods using a common scale. The ratio from the RAND study produced lower estimates, but like those produced by Quinlivan's ratio, overall estimates were significantly higher than those estimated using operational inference (Figure 8, panel 2). McGrath's ratio exhibited similar performance (Figure 8, panel 3). However, the method did not estimate significantly lower force sizes relative to those estimated using the force to population ratios put forward by Goode under conditions of low violence (Figure 8, panel 4).

Across all force ratios, the direction of the difference in the estimates (force ratios tend to estimate higher number of troops than operational inference) was consistent with critiques of force ratio approaches in the literature. Further, the differences tended to be unimodal and clustered about the mode, both of which suggest that the choice of hypothetical operation was not driving the distribution of the differences. Taken together, these results suggest that the improvement in performance from operational inference relative to force ratio approaches observed in the analysis of the hypothetical Libya operation was not driven by the choice of hypothetical operation.

Diagnostic 3: Comparing Errors

Second, we can compare the results of the force estimation methods directly by calculating the error from each approach. Following a procedure similar to that in Diagnostic 1, individual operations were randomly sampled from the universe of comparison cases and

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analogues, but could be generated via a Monte Carlo process. Raising the number of simulations to 5,000 or 10,0000 did not significantly change the results of this diagnostic test.

removed from the dataset. Each sample operation was then used as the "hypothetical operation" and the five methods (median troops using operational inference and the four force ratios) were used to estimate the forces required for the real-world operation. The differences between these estimates and the true number of troops committed were computed to give the error. This process was repeated 1000 times to produce a distribution of errors.

Figure 9 in Appendix A4 shows the results from this diagnostic test. As can be seen in Figure 9 (top panel), operational inference alone among the methods produced a relatively symmetric error distribution centered around zero, though the spread of the errors from operational inference was the widest of the group. Quinlivan's ratio again had the worst performance in terms of error (Figure 9, second panel): all of the estimates generated with this method were too high by at least 5000 troops. The ratio from the RAND study significantly overestimated the number of troops required, with 95% of its errors greater than 0 (Figure 9, third panel). McGrath's force ratio also tended to significantly overestimate the number of troops required (Figure 9, fourth panel). Finally, Goode's ratio at a level of zero violence produced mostly overestimates but on average did not produce an error significantly greater than zero (Figure 9, fifth panel).

Policy Conclusions

While the above sections demonstrate the use and superior performance of operational inference in a methodological sense relative to the force ratio approach, I now turn to showing how the conclusions from operational inference can be applied to answer the types of policy-relevant questions often asked in more traditional campaign analyses. As explained at the beginning of this chapter, one of the purposes of using a hypothetical EU operation as an example for analysis was that EU member states, particularly France, have expressed a desire for a more autonomous security policy and for the EU to come into its own as a global provider of security. If this is truly the goal of the EU, it is important to understand what kinds of operations the EU is capable of undertaking, and under what conditions. The operation considered in this analysis is a relatively low bar to clear: it is nearby, and thanks to its low level of expected violence requires a relatively small commitment of forces (see Table 2) above. However, the expeditionary nature of the deployment means that key logistical, ISR, and force protection capabilities are necessary, capabilities which are not widely available among EU member militaries and the deployment of which must be balanced against security needs closer to home and elsewhere worldwide. Using the findings from the force estimation performed via operational inference, we can draw larger conclusions about the readiness of the EU to expand its role in global security.

EU Air Forces

To determine the overall composition of the ground-based aircraft used in the operation I use as a guideline a proposed composition for an American Air Expeditionary Task Force put forward by Shlapak et al. (2002), though the exact composition is changed to reflect the specific needs of the operation under consideration here. In particular, I remove bomber and stealth elements of the force along with most SEAD assets, replacing them with additional strike craft and UAV assets for strike and ISR sorties. The overall force sizes are comparable[70], and the overall force package for establishing the no-fly zone comprises some 71 aircraft, including 32 strike aircraft, 8 UAVs, and 10 tankers among others. Sufficient basing space is available for all of these aircraft at Italian air bases within 300 nm of Tripoli (see Mueller et al. 2015, p. 403-406 for NATO basing arrangements during Operation United Protector).

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[70] See Table 11 for a breakdown of the overall composition of the air forces package as well as Shlapak et al.'s "initial deployment" AEF used as a model.

In terms of strike aircraft, the force package proposed here is modest: France alone contributed 33 strike aircraft during Operation Unified Protector (Mueller et al. 2015). In other areas, however, this force begins to stretch the overall limits of the EU's air forces. Tanker capacity is one key area: the mission calls for 10 tanker aircraft, which exceeds the number of aircraft in the dedicated tanker fleet among (non-UK) European air forces that participated in Operation United Protector (*The Military Balance* 2022).[71] While this amount can be stretched with the use of more numerous tanker/transports like the KC-130 or A-400M, it still presents an area of vulnerability for EU forces, which as of the start of 2022 had only 34 tanker aircraft total (Ibid). In addition, the demand for 8 heavy UAVs is a stretch for the air forces of the EU, which had only 20 non-deployed such assets at the outset of 2022 (Ibid). In fact, deployment of 8 heavy UAVs would almost equal the number of current EU heavy UAV deployments worldwide (9). One possible bright spot in terms of UAV availability is that several UAVs, including 6 Reaper units, are already deployed as part of Operation Barkhane and are based in Niger. These UAVs could be re-tasked to the mission in Libya if necessary or could split their sorties between the two theaters.

A lack of tanker support and ISR assets was a prohibiting factor for EU operations during United Protector: except for Italy the European powers depended almost entirely on the United States for these capabilities (Quintana et al. 2014). While EU member states have made definite strides in these areas since OUP, they remain in a fragile state where even a midsize deployment like the one envisioned in this analysis represents a major strain on their forces; procurement and further development of these capabilities will need to continue over the short to medium term.

[71] These are Belgium, Denmark, France, Germany, Greece, Italy, the Netherlands, and Spain. Combined, these nations had a total of three dedicated tanker aircraft (all French).

EU Naval Forces

A key question for EU states considering contributing to the operation is whether or not this is an effective use of their naval power. Modern navies are expensive, and even deployment of small vessels for an extended period means that assets are being diverted from the defense of home waters as well as from other defense commitments in the Mediterranean and broader European littoral. This deployment requires the use of one of only two true aircraft carriers in the EU's naval forces as well as two of seven current EU naval vessels with sea-launched cruise missile capability (*Jane's Fighting Ships* 2021). To be sure, these assets are not far from home since Sicily lies a mere 300 nm away, but as with tanker and ISR capabilities in the realm of air forces, even a limited deployment is enough to stretch overall capabilities, particularly in the face of increased need for European security resources closer to home due to fears about Russia.

EU Ground Forces

The overall need for ground forces represents about the amount of a reinforced mechanized infantry brigade with three battalions of combat infantry. While the EU member states certainly have sufficient manpower to assemble such a force, the question remains of how exactly the force is to be composed. First, I consider the idea of using an EU Battlegroup as a foundation. Since EU member states have repeatedly rejected this idea, I instead review the contributions that certain prominent member states can make to the force.

EU battlegroups are small, battalion-sized self-contained units which in their original conception were intended to serve as a rapid-reaction force for the Union. The use of EU Battlegroups has been debated as part of a European response to several past crises, including local actions in Chad/CAR and Mali (Barcikowska 2013, Seibert 2010, Dijkstra 2013), but the battlegroups were turned down in favor of primarily French deployments. Further, analysts have questioned whether the battlegroups, whose budgets require their commanders to request additional funding for mission-critical tasks like intelligence, civil affairs, and captured ordnance storage/disposal are truly suited for rapid deployment into humanitarian intervention operations (Barcikowska 2013, p. 4). As such, while the battlegroups may seem like an ideal option for this operation due to their self-sufficient nature and standing readiness, it is unlikely that the EU will actually deploy one. Still, they provide a useful yardstick for considering the deployment of a modular infantry force.

If the battalions employed in this operation are not ready-made battlegroups, where will they come from? In terms of sheer capability, the most likely candidate is France. The French Army is the largest in Europe and has taken the lead in every EU humanitarian intervention in Africa. It is likely to provide a good portion of the strike aircraft used in the no-fly zone and its unique naval capabilities are the only reason the EU force can expect cruise missile support during their mission. The French Army has a long expeditionary tradition (Shurkin 2016) and has been continuously in action since 1978. Still, this constant operational tempo has worn on the force (Shurkin 2017, p. 6) and at present French units are deployed across Africa as well as on French soil. The Republic's most recent 2013 Defense White Paper specified that total troops involved in overseas temporary interventions should number only 6000-7000 (Le Drien 2013, p. 87), but at present France has 10,727 troops deployed worldwide, mostly as part of Operation Barkhane against AQIM (*The Military Balance* 2022)[72]; according to the stipulations of the white paper this would disqualify France from playing the leading role in such a mission. Still, even given its heavy deployments, France should contribute a battalion for the force as well as air and naval support. Of the EU member states, only Italy has been more involved in the Libyan conflict, and given France's past relations with Haftar, its participation may be able to help

[72] Note that this does not include troops stationed in overseas French departments as well as deployments as part of standing NATO forces in Europe.

assuage the LNA that the intervention is not an EU attempt to achieve a favorable outcome in the conflict, encouraging his buy-in to the creation of the havens. If both France and Italy participate, this operation will be an additional expression of their common policy of wanting to end the ongoing conflict in Libya via a negotiated settlement.[73]

As the nation most involved in (and most affected by) Libya's hosting of migrants, Italy is a natural second choice to contribute a battalion to the force and a strong choice to take the lead in the operation. Its forces have a great deal of experience in peacekeeping and humanitarian missions (Ignazi et al. 2012), particularly in contexts like Kosovo where organized crime is driving persistent insecurity. Like France's contribution, Italian participation in the mission would send a message that the intent of the intervention is truly focused on migration and not on forcing a political outcome through a show of force.

Germany, despite its economic power, is a poor candidate to provide a battalion. The latest *Bundeswehr* White Paper (Bundeswehr 2016, p. 88) seeks to reorient Germany's military strategy towards the borders of NATO while recent experiments with rotating equipment across different units has resulted in little but a force with lower readiness and poorly maintained equipment (Shurkin 2017, p. 8). Instead, Germany should participate by providing niche capabilities where it excels: its large fleet of A-400Ms, for example, could provide emergency airlift services if need be while its capabilities in light and medium UAVs could prove a boon to the Libyan mission (see below).

Rather than Germany, the last battalion should be committed by Spain. Besides France and Italy, Spain is perhaps the European state most affected by the flow of migrants through North Africa, though its migrant streams come through Morocco rather than Libya. With the

[73] Further, the French force should be based in Zuwara where their presence may help to de-escalate tensions between local Amazigh and nearby LNA forces.

coming of Brexit, Spain is also poised to become a major military and economic power within the EU, one of the four "core" Eurozone nations along with France, Italy, and Germany (Colomina 2018). Spain also has a fairly sizable army, larger than the German *Heer,* and has few ongoing overseas deployments (*The Military Balance* 2022). In terms of its present capabilities and interests, as well as its possible future as a leader within the EU, Spain has good reason to contribute a battalion.

Composition of Support Units

In addition to the normal combat troops and other detachments attached to the forces described above, some specialized units will be necessary. Some of these units have already been noted elsewhere in this analysis: they include the provision of paramilitary police forces to help maintain public order within the safe havens. Italian C*arabinieri* units should be used in this role for several reasons. First, the *Carabinieri* have a history of good performance in law-enforcement actions during humanitarian or peacekeeping missions, including on deployments to Kosovo and Lebanon (Ignazi et al. 2012, p. 153). Second, a good deal of the maritime patrol force is likely to be comprised of seaborne *Carabinieri* aboard coastal patrol vessels: this was the main part of the force in Mare Nostrum and continued to play such a role when the operation transitioned to Triton under EU auspices (Ministero Della Difesa 2019). Having elements of the same police unit working both onshore to disrupt smuggling and criminal networks and offshore to interdict them directly can lead to better outcomes. Finally, the *Carabinieri* have taken a leadership role in working with GNA officials and even run a field hospital in Misrata: they are used to working with local GNA leaders and may be seen as trustworthy figures within the havens, something which is invaluable when trying to maintain stability within a crowded haven (Ibid).

Another key element is Civil Affairs personnel. These officers are essential in coordinating aid operations with NGOs and IGOs as well as communicating between the intervening forces and local authorities. Bhatia, in assessing the changing role of Civil Affairs over time, suggests that "Civil Affairs officers have quickly become a prime determinant of success" (Bhatia 2003, p. 130). I have already mentioned that civil affairs personnel should be sent in with the initial companies of SOF in the early entry to the havens, but this should also be expanded further in the full force. Again, these units should be composed primarily of Italian officers or others who have worked with Libyans in recent years, drawing upon past national experience working with GNA authorities as well as past peacekeeping experiences (Mockaitis 2004, p. 21-2). Special forces companies should also be contributed by specific member states, namely Italy and France. These are the member states most involved in the Libya conflict and most in contact with local forces (Lapo 2019), so their special forces will be best able to liaise with local authorities and will need less time to get the lay of the land before the main force deploys.

Finally, infantry units in the havens should receive additional light UAV support. Small, unit-deployed UAVs extend the vision of infantry on the ground, allowing them to monitor long stretches of highway, desert terrain, or dense city blocks from their positions at a checkpoint or operating base. This provides an on-the-ground complement to higher-level ISR being conducted by other aerial and space-based assets. UAVs should prove particularly useful for troops based in the Khoms haven, who can use their UAVs to scout the rugged terrain to the south as well as to monitor the sprawl of the city itself. German forces are well-equipped with these assets (*The Military Balance* 2022): one platoon of German light UAV troops could be added to each battalion.[74] This does raise questions of interoperability, however, so these troops could also be replaced with French tactical Sperwer UAVs.

Conclusions of the Libya Analysis

The application of operational inference to a hypothetical EU intervention in the EU civil war yielded two sets of conclusions: one related to the usefulness of the methodology and another more policy-relevant set of conclusions related to the future of EU security policy. Taken together, these show the strong performance of operational inference as well as its utility for answering broader policy questions as part of a traditional campaign analysis.

On the methodological side, this analysis showed that operational inference does offer significant improvements in performance over the force-ratio method, particularly the older versions of the method put forward by James Quinlivan and John McGrath. Relative to these older force ratios, the operational inference approach offers a more accurate estimate of the number of ground troops and is able to model the reduction in the number of ground troops required for a given humanitarian operation made possible by combined-arms operations. While the newest force ratio approach, that put forward by Steven Goode, offered similar performance in terms of estimating ground troops, the extended qualitative analysis of operational inference offers insights for a greater number of research questions (including logistical and strategic feasibility), and suggests an overall force package which includes critical elements like air and naval support. Further, it should be noted that the performance of operational inference in the statistical diagnostics was based on a “hard test” related solely to the number of ground troops and which did not fully take advantage of the qualitative insights offered through the full mixed-

[74] This mirrors the brigade-level structure of the US Army Brigade Combat Team (US Army 2015).

methods analysis in operational inference. The improved performance noted in these tests was generated entirely through the pre-processing step of selecting reference operations. Given the qualitative improvement in performance offered by the method as well as its fairly strong performance in the "hard test" diagnostics, there is evidence that this approach has validity for the planning and research of humanitarian military operations.

While the results of this study do not overwhelmingly show that operational inference offers a significant improvement in all aspects of performance over all force ratio approaches, they still provide lessons for analysts, academic and otherwise, who are interested in estimating force sizes for humanitarian deployments or other military operations outside of conventional warfare. First, the widespread use of Quinlivan's force ratio in popular and academic writing on force sizing is incorrect: force ratios developed by other analysts, particularly Goode, offer better prescriptive performance. While Quinlivan's work is still deserving of mention for his pioneering attempt at tackling the problem of force sizing, further refinement of force ratios has made the 20/1000 ratio an obsolete tool whose use should be abandoned or at least reconsidered in light of more useful alternative force ratios in the literature. Second, force ratios generally overestimate the number of ground troops needed in this specific form of MOOTW because they assume higher rates of violence, more aggressive political goals, and greater troop availability than is true of a typical humanitarian intervention. These contextual variables have long been a problem for estimating force requirements outside of conventional warfare but the results of this study show that selecting a set of reference operations via operational inference can help control for contextual factors. This leads to superior performance in estimating force requirements, particularly when the full method is employed by including a cross-case qualitative analysis, as was shown in the analysis of the hypothetical Libya intervention in this chapter.

Substantively, the results from operational inference showed that calls for a united EU army are likely to run into significant problems in the event that the force is actually fielded, particularly if it is used for an expeditionary deployment outside of Europe. The operation envisioned here is happening in the EU's near abroad and would have logistical advantages which are rare in humanitarian military operations, particularly in terms of access to port facilities for transport of troops and key military and humanitarian supplies. Further, the political situation envisioned is quite permissive. Estimates of ground forces are in line with past EUFOR missions, while individually the maritime and airborne components of the operation are familiar and scaled-down versions of operations many EU member states have accomplished in the past.

Still, even given a fairly permissive environment and reduced scale of operations, each element of the force strains EU member states in some way. For the ground forces, Germany's refocusing towards conventional conflict on NATO's Eastern flank and its recent experiments with rotating equipment make it a poor contributor in many respects while France feels the weight of nearly four decades of nonstop expeditionary operations as well as turmoil at home. New nations like Spain or Hungary would need to contribute to the force in order to fill out its numbers. Among the air forces, even a relatively limited expeditionary force stretches some core capabilities like dedicated tanker aircraft and heavy-UAV-based ISR: the noted deficiency among European air forces in developing a "tail" to go with their "teeth" means that any independent expeditionary EU air campaign will demand a significant proportion of these states' logistical and ISR aircraft and personnel. Among the naval forces, the intervention highlights that EU states have done little since Operation United Protector to invest in naval standoff strike, preferring to rely on their air forces and the United States for this capability. To be sure, European states have made some significant gains, particularly in their acquisition of additional airlift capacity, but the EU's emergence as a true international power capable of expeditionary military operations is still hampered by past procurement decisions and reliance upon American power for specialized capabilities. This may change in the coming years as defense spending by EU member states increases, but the extent of the change will depend on the willingness of policymakers to prioritize these niche capabilities.

Chapter 4: Applying the Method to Noncombatant Evacuation Operations

Operational inference is primarily intended to provide insights for the planning of hypothetical operations. However, there may be questions about whether the method truly generates insights which comport with operational reality. In part, the diagnostics related to showing the true error are intended to demonstrate the method's notional performance, at least in terms of estimating ground troops. However, we can also demonstrate the method's utility and accuracy by comparing its predictions to real-world operations. This chapter does so by applying the method to a recent high-profile MOOTW, the evacuation of Afghanistan in August of 2021. It attempts to estimate the forces (primarily the ground forces) used in the operation and draws larger lessons about the conduct of NEOs from the study of the operation's reference set and the campaign analysis presented through operational inference. In doing so, it provides another demonstration of the method's utility by showing how closely its findings track with real-world military planning processes. This is an important verification of a central claim of operational inference, that it allows civilian analysts to get closer to military planning methods with just the use of publicly available data.

In addition to demonstrating its improved general and theoretical validity, this chapter also provides evidence that the method can be used to study a variety of MOOTW, and, I argue, other types of military operations as well. Operational inference performed very well in this real-world analysis. It produced estimates of total ground forces required which were nearly identical to those used in Operation Allies Refuge[75] and the close study of the operations in the reference set produced some invaluable insights into key parts of NEOs, including crowd control and the operation of Evacuation Control Centers. Altogether, the strong performance of operational

[75] As will be discussed later, these estimates were arrived at before the researcher investigated troop numbers during the Kabul evacuation.

inference in the analysis presented in this chapter gives additional confidence about its broad utility in studies of military operations.

Planning Noncombatant Evacuation Operations

As shown in the prior chapter, operational inference offers promising insights for the notional planning of humanitarian military operations. Its use, however, is not limited to this specific subset of MOOTW, nor are humanitarian military operations the only class of MOOTW which have continued relevance in the international system today. Noncombatant Evacuation Operations (often referred to as NEOs) are another important class. NEOs are defined under US military doctrine as "an operation whereby noncombatant evacuees are evacuated from a threatened area abroad, which includes areas facing actual or potential danger from natural or manmade disaster, civil unrest, imminent or actual terrorist activities, hostilities, and similar circumstances" (JP 3-68 2015, p. ix). They involve creating a force, at least part of which is intended to be inserted into another country in order to facilitate the extraction of a state's noncombatant nationals, whether that be diplomatic staff, NGO employees, or other citizens working and living locally.

While NEOs can seem like low-stakes operations, they can have serious implications for a state's foreign relations and domestic politics, particularly when things go wrong. Perhaps the most famous NEO conducted before 2021 was the 1975 US evacuation of its embassy in Saigon as the North Vietnamese Army approached the capital. A dramatic culmination of nearly 15 years of conflict, the NEO seemed to signal a shift in American power on the international stage which, taken together with the larger American defeat in the war, has been interpreted as beginning a period of US international malaise referred to by commentators and politicians as

"Vietnam Syndrome."[76] Nor is the importance of NEOs limited to the United States: other Western states like the United Kingdom and EU member states have conducted NEOs in the past[77] while rising powers like China and (especially) India have become increasingly active in attempting to evacuate their citizens and protect their property in conflict zones.[78] In the same ways that involvement in humanitarian operations provides information about military capabilities and foreign policy priorities to other states (Lin-Greenberg 2018), NEOs showcase the ability of a state to project power rapidly around the world and provide a signal that it is willing to use its military to protect its global economic and security interests (Fravel 2011). Nor are NEOs becoming rarer or less difficult: the globalization of capital and populations alike mean that states are both more exposed to the unique risks that lead to NEOs as well as less assured in their ability to respond (Bond 2016). The ability to plan for these operations and respond to emergent crises, then, represents a matter of concern for states worldwide, including the United States.

A recent NEO which illustrates all of these dynamics is the US evacuation of civilians from Afghanistan in 2021, officially named Operation Allies Refuge (hereafter referred to as the Kabul Airlift for the sake of brevity, as is the hypothetical operation). Like the 1975 Saigon evacuation, this event was an object of political criticism in the US media, which faulted the Biden administration for both the bare fact of a withdrawal from Afghanistan as well as the way in which the evacuation was conducted.[79] Some commentators claimed that the Airlift was a sign of collapsing US power (Sly 2021), while others faulted the response of the Biden administration for operational reasons like the early closing of Bagram Air Base or the sluggishness of the

[76] Buley (2007, p. 54-63).
[77] For the UK see Bond (2016). For the EU see Lindstrom (2003), Dossi (2015).
[78] For details on Chinese NEOs see Zerba (2014) and Fravel (2011).
[79] Shephard (2021).

operation (Thomsen 2021, Flatley 2021). But how fair were these criticisms, and could the operation have been improved? The analysis presented in this chapter seeks not only to expand the use of operational inference, but also to provide a point of comparison for Allies Refuge and to provide a hypothetical example against which it can be compared to see where the Biden Administration went wrong (if at all).

The analysis presented in this chapter thus makes three major contributions: first, it evaluates whether the method suggested here generates realistic suggestions for forces in NEO operations. While the evacuation of Afghanistan represents an outlier, its importance as a political event makes it especially worthy of study and a key case for evaluating the method's performance, particularly since a major goal for operational inference is to provide a tool which can be used to conduct public debates over military operations. Within the confines of this thesis, meanwhile, this chapter's analysis shows how an analyst may assemble her own universe of cases, define important operational variables, and then apply the method on the resulting dataset. While the previous chapter showed that this could be done with an existing dataset, this analysis shows how operational analysis may be applied to new datasets and new classes of military operations. Finally, it provides a preliminary dataset of US NEOs which can be used by other researchers: to my knowledge this is the first publicly available such dataset which attempts to gather data about US NEOs and code relevant operational data about them in a consistent way. It also provides a first cut (to my knowledge) in the security studies literature at seriously evaluating the conduct of the Afghanistan withdrawal: could it have been done better, and how?

The Conflict: Afghanistan Withdrawal in Context

The American withdrawal from Afghanistan was a watershed moment worldwide: searing images of Afghans crowding at the gates of the Kabul airport and clinging to the wheel wells of planes on takeoff were widely disseminated via traditional and social media channels, while leaders and former officials around the world weighed in on the wisdom of the US withdrawal and the War in Afghanistan in general. The withdrawal itself was rooted in negotiations between the Trump administration and the Taliban which concluded in February of 2020. Officials from the Afghan National Defense and Security Forces (ASDF) claimed that this agreement signaled to Afghan soldiers not just that US troops and political support for the government would be withdrawn, but so would one of the few actors in the country who could pressure the Afghan government to regularly pay and supply its forces (SIGAR *Collapse* 2022, p. 6). The agreement granted the central Taliban demand (withdrawal of US forces and contractors) in exchange for the Taliban not opposing the withdrawal and assurances of Taliban participation in intra-Afghan talks. Also included was a large prisoner exchange: many of the Taliban prisoners released as part of the agreement would reappear during the coming Taliban offensive as political and military leaders (Ibid, p. 7). The Biden administration repeatedly affirmed its desire to comply with the Doha Agreement, and as late as April 2021 was still dismissing suggestions that it retain an American force in the country past the deadline.

Militarily, the withdrawal from Afghanistan occurred against the backdrop of a major Taliban offensive across Afghanistan which began in May 2021 (Thomas 2021). The growing strength of the Taliban can be contrasted against shrinking numbers of US troops: by July of 2021 when the US left Bagram Air Base, around 1000 US troops remained in the country, mainly tasked with protecting the US Embassy.[80] The first US-sponsored evacuation flights began at the end of July. Meanwhile, the Taliban offensive continued picking up steam until a final offensive began in August of 2021, when provincial capitals began falling to the Taliban

[80] Shesgreen 2021, Thomas 2021.

with little to no resistance by Afghan security forces. The final collapse of the Ghani government was made total by August 15, when the first Taliban fighters entered Kabul, at which time the US evacuation of Kabul began in earnest with the closure of the US embassy and the beginnings of an airlift that, by the end, would evacuate around 124,000 people.

Applying the Method

This analysis presents an assessment of the forces required for the US to conduct the evacuation of Kabul at the end of the War in Afghanistan. It uses the newly developed method for force estimation, operational inference, in order to generate estimates of both logistical and security force needs, providing a holistic estimate of the military and civilian capabilities required for the successful completion of the mission. The scenario envisioned here is guided by the real-world parameters of the Kabul Airlift and as much as possible makes the same assumptions.[81] When it does not (for instance, the start date of the evacuation is allowed to vary) this is done in order to draw analytical conclusions.

For example, this analysis assumes the same sequence of events and the political behavior of the US government. The Taliban's offensive, culminating in the capture of Kabul on August 15th, 2021, is assumed to progress at the same pace and it is assumed that US forces do not interfere to stop it in any serious way. Further, it is assumed both that the Taliban accede to the evacuation and do little to stop evacuation activities going on at the airport itself: while there were reports of Taliban fighters harassing Afghans who attempted to get to the airport or seeking out Afghans in Kabul who had been friendly to NATO forces during the evacuation, the Taliban

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[81] Assessing the accuracy of the analysis requires checking the findings against real-world performance. In order for this to not bias the findings of the analysis, it is a suggested best practice for the analysis to be performed before deep research is done into the conduct of the real-world operation the analyst is attempting to model. This is the practice which is followed here: detailed research into the conduct of the Kabul Airlift was (as much as possible) left until the researcher reached Step 6 (Diagnostics).

did not attempt to stop the evacuations themselves by striking the runway at the airport despite their ability to do so had they chosen to violate the agreement.[82] Though this analysis discusses events which happened in the past, it is written from the perspective of a planner working before the airlift itself, which affects both its reasoning as well as the tense in which it is written ("the Taliban are" as opposed to "the Taliban were"). Accordingly, wherever possible the analysis has been performed without foreknowledge of the exact parameters of Allies Refuge, something which is a suggested best practice for future analysts applying operational inference to real-world operations.

Step 1: Specify Problem, End State, and Tasks

The ultimate problem facing the US in planning this NEO is how to evacuate not just US citizens and diplomatic employees, but also the many thousands of Afghans and other civilians who have provided services to NATO forces. Collecting estimates from a range of sources, some 128,079 people are eligible for evacuation.[83] The desired end state for the US is to evacuate this full complement of Afghan and US citizens. The method for achieving this will be to undertake an airlift from the Kabul International Airport. Evacuees from the airport will be flown to several locations, mostly in US and allied airbases in the Persian Gulf, where they will be processed,

[82] This was the strategy taken by North Vietnamese troops during the Fall of Saigon: artillery and airstrikes struck the Saigon airport. The motives for those strikes, however, suggest that such an action is unlikely in the Afghanistan case: US fixed-wing aircraft were being used for evacuation on their outbound flights but brought in artillery pieces, munitions, and other supplies for South Vietnamese forces on their inbound flights. Since we also assume that the ASDF will not put up an active resistance there is less reason to assume that the Taliban will be incentivized to violate their agreement and attempt to disrupt attempts to evacuate using fixed-wing aircraft. Further, contemporary reports from Frequent Wind suggested that the NVA was aware of the progress of the evacuation and only chose to strike once it was certain that the remainder of the operation could be completed with helicopters. (Tobin et al. 1985).

[83] This included 2,500 US personnel and dependents (*The White House* 2021); 3,529 Afghans with US citizenship or permanent resident status (DHS 2022); 4,050 Afghans with high-priority refugee referrals (Ibid); 81,000 Afghans with pending visa applications (Staffieri et al. 2022); and 37,000 Afghans who were previously enrolled in the Special Immigrant Visa (SIV) program but had not filed a visa application (DHS 2022).

assisted, and monitored for COVID-19 infection. Following a period at these Gulf bases, the evacuees will be sent to the United States for final resettlement.

Ultimately, the operation can be broken into three phases.[84] First, US troops will need to secure the Kabul International Airport (hereafter referred to as KBL), the single zone from which the evacuation flights will leave.[85] With the airport secured, a second stage of operations will see a detachment of troops travel into Kabul itself in order to extract US government personnel and dependents from the US embassy and escort them to KBL for evacuation. The third stage of operations is the airlift itself: fixed-wing aircraft will be used to evacuate Afghan and American citizens from Kabul. Finally, the fourth stage will be ongoing throughout the course of the operation: the initial evacuation sites at US airbases outside of Afghanistan must be prepared for the evacuees and must be of a size where they can actually hold evacuees for a brief period of time in order to finish processing evacuees and monitor them for symptoms of COVID-19. I address each of these stages in turn below, and then briefly discuss how they were coded as variables for Step 4 of the operational inference procedure.

Stage One: Securing the Airport

The first stage of the NEO will be securing the airport, the site where the evacuation will actually occur. Since the airport will, at the start of the operation at least, be under the control of ASDF troops, deployments made will be in a permissive environment and will not require additional operations to seize the airfield. These inserted troops will then take over the security of the airport and begin preparing to process evacuees for final airlift out of the country. This

[84] These phases are based loosely on the concept of operations at Tanh Son Nhut AB in Vietnam as well as the hypothetical plan to establish a beachhead ashore in South Vietnam, Talon Vise. Both of these were early alternatives to Frequent Wind that were eliminated by the NVA's advance.
[85] Because this analysis follows the real-world timeline of events in Afghanistan, the withdrawal of American troops from Bagram Air Base on July 3rd-4th, 2021 has already occurred, leaving only KBL as a viable evacuation site.

will require not just troops able to administer the airlift but also a substantial troop presence which can provide crowd control and force protection. It is likely that large crowds will gather or attempt to gather near evacuee processing sites, and the airport itself is not well engineered as a defensible site, so this starting phase will feature a number of challenges and will require sufficient troops to provide both protection to the base as well as the capacity to respond to emergent threats to the evacuation when and if they arise.

Providing Security at the Airport

Securing the airport is likely to be difficult for two reasons. First, the overall security situation in Afghanistan makes it difficult for US forces to accurately assess threats to their presence at the airport. Second, the layout of the airport itself is not conducive to defensive operations. Accordingly, the security situation of the evacuation is likely to be uncertain throughout. The Afghan National Security Forces have been largely ineffective and have historically relied on American support.[86] ANSF forces, therefore, are not included in the planning for evacuation laid out here. In the Doha Agreement the Taliban promised not to interfere with the evacuations and there is reason to suspect they will honor this commitment in order to make their transition to formal political power as smooth as possible.[87] However, the Taliban are not the only potentially hostile force operating in Afghanistan. Another prominent threat is the Islamic State Khorasan Province (ISKP), an organization which emerged following the defection of Afghan and Pakistani fighters within the Taliban and al Qaeda (Giustozzi 2018; Doxsee et al. 2021). The focus of the Kabul Airlift operation, therefore, is to minimize possible conflict with the Taliban while also providing security against possible standoff or terrorist

[86] It would, of course, become clear early on in the withdrawal that the ANSF would be completely unable to resist Taliban takeovers, with most garrisons giving up without fighting back.
[87] This assumption is made not just on the basis of Taliban self-interest but also on the fact that since the Doha Agreement the Taliban have largely refrained from attacking US forces in Afghanistan.

attacks by ISKP or other militant groups nominally outside the control of the Taliban on the process of the evacuation itself.

Further increasing the risks of this operation is the fact that the layout of the airport itself makes controlling access to the airfield difficult. Kabul airport is not surrounded by a wall and has several well-known entrances: it is quite possible for outside crowds of civilians to enter the airport area and run onto the runways, either in an attempt to prevent the evacuation or to evacuate themselves (Mizokami 2021). This lack of defensibility makes a multilayered approach to defense even more important even as it makes it more difficult. Most attacks on airbases and airfields of the type that might disrupt operations in this NEO involve using standoff attacks, whether that means using standoff weapons like mortars or rockets or non-conventional standoff weapons like car bombs or suicide attacks. These attacks are often limited in scope but can be devastating when delivered with accuracy, particularly in situations where large numbers of aircraft are grouped tightly on an airfield's apron (Briar 2004; Caudill 2014 *Vol. I*, p. 35). Another reason for extending defenses outside the immediate surroundings of the airfield is the risk from MANPADS or other surface to air missiles which could be used against planes on takeoff or on approach. A successful strike using such a weapon would be a highly visible failure with possible strategic consequences (Caudill 2014 *Vol. II*; pp. 125, 146).

Taken together, the situation in Kabul, the wide array of potential threats, and the poor defensive layout of the airport mean that US troops should prepare for the upper range of what is referred to as a "Level II" threat in joint security doctrine (*JP 3-10* 2019, p. I-2).[88] In responding to a threat of this nature, any US force package deployed should include an element dedicated to force protection. In the context of the NEO at large, this means that the total force package on the

[88] "Level II" threats go beyond standard security problems like terrorists, civil disturbances, and saboteurs and include small tactical units which may have standoff weapons capability. See *JP 3-10* (2019, p. I-2)

ground must be large enough to not only administer the airlift but also to defend the entire perimeter of the airport, monitor the area beyond the perimeter for indirect-fire weapons, and have an element in reserve for dealing with emergent threats to the evacuation.[89] In particular, the response element (called a "mobile security force", or MSF) should be well-resourced, with key capabilities including "armored mobility, larger-caliber direct-fire weapons, and organic indirect-fire capabilities" (paraphrase of *JP 3-10* 2019, p. III-7).

Defense of the airport itself will follow the basic plan for base security against a Level II threat laid out in *JP 3-10: Joint Security Operations* (2019, p. IV-5). Under this doctrine the base is defended not just along its perimeter but also within a larger area surrounding called a Joint Security Area (JSA; Ibid, p. vii).[90] The defending force should be able to escalate from warning to nonlethal to lethal force and be well equipped with nonlethal weapons, small arms, and other light weapons suitable to a range of threats (Frini and Stemate 2008). The defending force must be able to conduct reconnaissance to detect the nature and capabilities of any threats nearby, as well as to actively patrol areas outside the airport to monitor for likely indirect fire or MANPADS firing positions (Ibid, p. IV-5). Finally, the force should be able to secure access to the airport at the three gates (see Figure 11 for gate locations and the section below for discussion of gate access) as well as provide basic security within the base itself.

Securing the airport will be made easier with adequate air protection. Air power is an important part of the defense of key areas during NEOs in hostile or uncertain environments, both by providing fire support as well as ISR support for monitoring areas away from the airfield

[89] The concept of multi-layered airfield defense is a recently-developed one in US Air Force doctrine which is beginning to reach maturity. See Caudill (2014 *Vol. II*, p. 115-17) as well as *JP 3-10, Joint Security Operations in Theater* (2019, p. IV-3).
[90] See Figure 12 in Appendix C for a notional JSA surrounding the base. Using GIS software I drew a 1km and a 2km boundary: given the dense urban nature of Kabul as well as assumed cooperation by the Taliban, I believe it is more realistic for US troops to monitor and patrol the 1-km JSA and that doing so would not unduly compromise security for the operation.

perimeter (*FM 90-29* 1994, p.56; *JP 3-68* 2015, p. A-2). Capable air support allowed small US forces to successfully defend airbases in Vietnam, Iraq, and Afghanistan, while its relative absence during the Fall of Saigon is blamed by some commentators for the willingness of the NVA to attack the Than Son Nhut airport during fixed-wing air evacuation operations.[91] Beyond the force protection provided by aircraft, additional ISR provided by aircraft on station, UAVs, and reconnaissance aircraft can provide critical early warning for any developments which threaten to disrupt the evacuation (Caudill 2014 *Vol II*).

Measures of performance for securing the airport will be how successful the force deployed is at deterring or detecting/preventing attacks on the airfield, whatever form (ground, indirect, terrorist) they may take. Optimal performance, obviously, would be that no successful attacks or breaches of the airport perimeter occur. Experience in Vietnam, Afghanistan, and Iraq, however, suggests that this is unlikely (Ibid), so a better measure of performance will be that attacks or security breaches are kept at a level where they do not significantly disrupt the evacuation via airlift itself. If successful breaches or attacks can be addressed quickly, with only a few hours' delay in operations at maximum, and attacks which disrupt or destroy evacuation aircraft can be avoided, then the task of securing the airport can be considered to be fulfilled satisfactorily.

Crowd Control Outside the Airport

The size of the operation being considered here makes it a near-certainty that processing of evacuees will be difficult and there is a strong possibility of large crowds forming near the evacuation site at the airport. Securing the airport, then, means not just protecting it from outside

[91] Other commentators dismiss these criticisms, pointing out that the decision by the NVA to strike the airport appeared strategically motivated. Further evidence in favor of this analysis is that the *relative* amount of air power supporting the mission (measured in terms of fighter aircraft deployed) did not change between the fixed-wing and rotary-wing portions of the Saigon Airlift. See Johnston (1975) as well as Muir (2017) and Dunham (1990).

attack, but also preventing unauthorized entry which could delay the loading, unloading, processing, and evacuation procedures. In past NEOs, ground security has been important for managing the evacuation in an orderly manner. It is particularly true that in cases where the US is willing to evacuate individuals besides US government personnel, large crowds often form at the sites of evacuation. The Saigon evacuation of 1975 is perhaps the most searing example of this, but it also occurred in other past NEOs, including during Assured Response in Liberia, when thousands of potential evacuees from a range of different states took refuge in American buildings within Monrovia (*JP 3-68* 2015, Partin and Rhoden 1997). In both of these scenarios, however, US troops were able to maintain order without the need to kill civilians, though some attested that they were afraid they would have to do so.

Forces undergoing crowd control should be prepared to deal with an “agitated” crowd, one where strong emotions related to the fall of Kabul to the Taliban will tend to develop a sense of crowd unity and lead to the possibility of extreme behaviors and possibly sporadic violence.[92] These teams should be prepared to cooperate with local Afghan (and eventually, Taliban) officials in managing the ability of crowds to access the airport. Managing cooperation with Taliban officials is likely to be difficult and will likely require balancing the need for deconfliction and maintenance of the Doha Agreement with the desire to evacuate as many civilians as possible without the Taliban interfering.

This task can be considered satisfactorily performed if troops posted at gate locations (Figure 11) are successful in preventing an agitated crowd from breaching their gate location.

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[92] “Agitated” crowds are distinguished from the more dangerous “mob-like” crowd by their lower levels of violence, lack of “extreme” acts of violence, and lack of intense property damage. See *FM 3-19.15 Civil Disturbance Operations* (2005, pp. 1-6 & 1-7) for the doctrinal distinction. None of the most dangerous behaviors associated with mob-like crowds were present among South Vietnamese or Liberian civilians attempting to evacuate during the reference operations being considered here.

Additionally, it is preferred that the troops be able to do so with the absolute minimum of force, using only warnings or shows of force to disperse and limiting the use of nonlethal (or, in the worst case, lethal) force to emergency situations where the safety of evacuees inside the airport or the force itself is threatened. Like with preventing attacks, breaches may happen, but if they do, a successful crowd control force will be able to disperse them without undue delay to the ongoing evacuation.

Stage Two: Extracting Embassy Employees

With the airport secured, the next step will be for the US to recover its personnel from the nearby US embassy. It is common during NEOs for American diplomatic staff to be extracted from the host country to ensure their safety and to prevent high-profile embassy standoffs or occupations like that which occurred in Tehran, 1979. Extraction missions like this are actually somewhat uncommon during NEOs. It is more common to see all evacuees concentrated in a single place or for there to be sufficient warning that evacuees can congregate in a single location before the actual evacuation begins. When this is not the case, however, it can become necessary for intervening troops to leave the evacuation zone(s) in order to gather and extract evacuees. These troops may travel by land or via helicopter but their main goal is to gather evacuees in a central location with minimal risk of contact with hostile forces or loss of life. The extraction of US military and embassy personnel should be conducted as soon as sufficient troops are available to both ensure security at the airport and undertake the extraction mission.

The extraction operation considered here, it should be noted, will be strictly limited to embassy personnel. The US will not attempt to extract civilians beyond those who are employees of the US embassy or their dependents. In particular, the US government will not seek to extract evacuees from areas outside of Kabul or (eventually) within Kabul that the Taliban controls. This decision is both motivated by strategic motivations and is based on past experience: the lessons of Operation Frequent Wind in Vietnam show that it is best to avoid confrontational moves against a strong opponent during an NEO, as these opponents often have the standoff capabilities (mortars, rockets, other artillery) to seriously threaten aircraft on the ground.[93] A single rocket attack during Operation Frequent Wind posed sufficient risk to stop the fixed-wing airlift from Than Son Nhut airbase, forcing US troops to shift to the backup option of an evacuation entirely by helicopter (see Johnston 1975 as well as Lee and Haynsworth 1999, p. 128). Given the potential scale of the airlift and Afghanistan's distance from the Indian Ocean, however, there is no backup option for the Kabul airlift, so the evacuation will whenever possible attempt to avoid confrontation with possible Taliban fighters. Limiting the scale of the extraction side of the operation makes this more plausible.

The goal of keeping extraction limited, however, must be balanced against the overall success of the NEO: for example, if an attack makes it unsafe for large crowds to gather near the airport while awaiting processing, then additional extractions may be necessary to transport evacuees to the airport. Should extraction become necessary later on in the operation, extractions could be conducted at multiple sites throughout the city. Following past NEOs, this would most likely occur by having evacuees gather at predetermined points to be picked up by civilian buses escorted by US troops. If this is contemplated, additional troops should be added to the force in order to keep up with the increased demand for potentially dangerous action on the ground.

[93] Using the tiered threat classifications common in doctrinal writing about airbase defense, I classify the Taliban as a Type II threat, meaning they are less threatening in general than the NVA during the fall of Saigon (a Type III threat who operated advanced aircraft during the battle for Saigon itself).

Stage Three: Conducting the Evacuation

The third stage, once the airport is secured, is to process civilians who come to be evacuated and conduct the airlift from Kabul using military fixed-wing aircraft.[94] Processing will take place at a number of Evacuation Coordination Centers established on the grounds of the airfield: at these Centers evacuees are interviewed to gather basic information, entered into Department of Defense (DoD)/Department of State (DoS) NEO monitoring systems which allow their evacuation to be tracked, and given medical screenings before being moved on to their transportation.

The evacuation itself will be via fixed-wing military aircraft from Kabul International Airport. An evacuation from an airfield/airport is the sole option since the inland remoteness of Afghanistan severely limits the options available to military planners. It is common in NEOs which take place in more coastal areas for evacuees to be extracted via helicopter or ship, neither of which is possible in the Afghanistan case because of the long distances from any potential sea base in the Indian Ocean or Persian Gulf.[95] Overland travel is similarly restricted because of Afghanistan's borders: with Iran to the west and the tribal areas of Pakistan to the east, the lack of safe routes would require extensive escort forces of ground troops and in any case are not feasible on the short timeline required. The airlift from Kabul itself will be conducted entirely by military aircraft. Aircraft from the Civil Reserve Air Fleet (CRAF) will be used, but only for the second stage of operations wherein these aircraft will be tasked with transporting evacuees from

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[94] Civilian aircraft are also used in this operation, but their use is restricted to Stage 4 operations in order to airlift evacuees from intermediate staging sites back to the US. This is intended to reduce possible exposure of civilian aircraft to fire on the ground at KBL.

[95] Operation Frequent Wind in Vietnam, for example, had five possible operational plans, many of which involved a combination of fixed-wing airlift and sealift. Indeed, the final operation incorporated both fixed-wing airlift and helicopter airlift, but military pressure from North Vietnamese forces required the US abandon first its plans for sealift when ports were deemed unsafe, and then fixed-wing evacuation when the (Than Son Nhut) airfield was struck by rocket fire.

the overflow sites (see Stage Four below) back to the continental US or other US airbases. This minimizes potential exposure by civil aircraft to dangerous conditions on the ground in Kabul.

Further increasing the difficulty of the NEO is the relatively rapid timeline and the hard stop date of the Airlift. In the analysis presented here in Step 5 (see below), two alternative timelines are considered, both of which are based on battlefield results in the rapid progress of Taliban forces into Kabul. The first, more generous timeline, assumes that major evacuation operations begin overnight on August 7th, the day after the capture of Zaranj, the first provincial capital to fall to the Taliban. The second possible date is overnight on August 13th, the day after Pul-el-Alam and Ghazni, two major provincial capitals near Kabul, fell. Regardless of the start date, however, the Airlift will come to an end by the end of August 31st, the day by which the US was bound to withdraw from Afghanistan under the Doha Agreement.

Performance measures for the evacuation itself are straightforward: how close did the US come to evacuating all of its intended evacuees? In an evacuation of this scale, it is almost inevitable that terrible scenes of Afghans attempting to leave the country and clustered around the airport will occur: this, after all, was what happened in both Operations Frequent Wind and Assured Response once it became clear that US forces were willing to evacuate non-Americans. The best measure of success, then, is how close the US gets to achieving the goal it initially sets for itself.

Stage Four: Accommodating Evacuees

At the destination sites where flights from KBL arrive, intermediate staging areas will need to be set up in order to accommodate the Afghan evacuees. Accommodating the Afghan evacuees at the transshipment points requires accomplishing three basic goals. First, the sites must be prepared to hold the evacuees. Second, these sites must hold their evacuees for at least seven days in order to monitor the health of evacuees and prevent the spread of COVID-19 among evacuated Afghans. Finally, they must have sufficient capacity to allow evacuees to fly from the staging area to a final destination in the US. The operation as considered here ends when all evacuees have arrived on US soil, leaving the remainder of care for the evacuees to a follow-on integration operation like Operation New Life which followed the evacuation of South Vietnam.

Generally, it is not expected that this portion of the operation will be very difficult, especially compared to earlier stages of the operation. The air bases being used as transshipment points, especially al-Udeid, are active military airbases which are used by US troops (Wallin 2018). These facilities should have abundant stores of food and water as well as the ability to bring in additional food via overland and/or water transportation from their host countries, with the option of airlifting additional food, water and medical supplies should that become necessary. Dividing the large number of planned evacuees among three separate staging areas, moreover, should reduce the load on any one base to support the evacuees. Measures of performance for this stage are throughput at the intermediate staging areas: how quickly can evacuees arrive and be processed, can the sites support evacuees while at their peak numbers, and how quickly can evacuees be moved on to the final stage in their journey, arrival in the United States?

Tasks as Variables

With the tasks identified through relating the beginning and desired end state of the operation, they can be used as a set of variables on which to select similar operations. As with the prior analysis of the hypothetical Libyan analysis, doing so allows us to ensure that the operations we are using as our comparison set are empirically similar to the Kabul airlift. Together with the environmental factors described in Step 2 below, these tasks can be used to narrow the universe of possible cases to those which are most directly comparable and thus provide the greatest analytical leverage for the problem at hand. While a full list of the variables used to select the reference set can be found in Table 5, the task-related variables used to select comparable operations focus on differentiating what the forces used for each NEO were doing and what resources they employed to achieve their assigned tasks.

One important task variable which deserves closer scrutiny is number of evacuees for each operation: the size of the evacuation is a critical part of informing which tasks will be required as well as how difficult they will be and how long the force itself will need to be sustained in order to reach the desired end state. The dataset used here codes the number of evacuees as that which are actually rescued: an alternative approach would be to use the notional number of refugees which planners used as a target when designing their force. This alternative approach of using the "target" number of refugees does have the advantage of more closely corresponding to the planning process, but there are several reasons why I believe that the true number is the better approach.

First, the target number of refugees can change quickly as conditions on the ground shift: since NEOs are often launched in response to rapidly changing situations, there may be multiple stages of estimates which can vary widely. In the planning for the evacuation of Saigon, for example, estimates of the number of civilians to evacuate ranged from under 100,000 on the low end to over 2 million. The ultimate target number of refugees shifted as planning for the mission was underway and different operational avenues were foreclosed by the progress of North Vietnamese forces on the ground. Second, while a force may be planned for a given number of evacuees which is not met, I argue that it is more important for planning purposes to know what the force was *actually able to accomplish* than to know what was hoped or initially envisioned.[96] We might imagine a case where a force was planned for a 50,000 evacuees but was only successful in evacuating 20,000: using the high target estimate might lead us to conclude that the force which could only assist 20,000 would be a sufficient planning analogue for a larger planned evacuation when in reality it is a better model for a smaller evacuation closer in size to the real number of evacuees. Using the true number of evacuees, moreover, does not preclude the use of the planned number of evacuees as a data point in the analysis, it merely shifts it to the qualitative stage rather than the pre-processing stage.[97] Finally, and on a more practical note, information on the final number of evacuees is more readily available and comparable across cases than information on planned numbers of evacuees.

Step 2: Identify Key Environmental Factors

In the first step of operational inference, a set of tasks were identified which described the *tasks* required for a successful evacuation of Kabul. The conduct of NEOs, however, like all military operations, is not solely determined by the operational requirements. The operating environment is also critically important in terms of the size and composition of the force required (*JP 3-68* 2015, pp. I-4 to I-6). The next step in applying operational inference, therefore, is to identify key environmental variables which are important for determining the troop requirements for the mission at hand. These environmental factors, together with the tasks from the prior step, make up the full set of variables (see Table 5) which are used to select similar operations for comparison from the larger dataset.

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[96] For many NEOs, particularly those simpler NEOs which occur in a permissive environment for a small number of evacuees, planned and final evacuee numbers are likely to be substantially similar if not identical. For other NEOs, the planned number can be

[97] Indeed, for a sufficiency analysis like the ones presented in this paper, knowing the planning numbers in addition to the true numbers can tell the analyst whether or not the planned force was adequate to the challenge, as well as possibly what other force packages might have been considered under alternate scenarios.

In US doctrine related to NEOs, the "environment" is generally abstracted into a categorical measure: the operational environment for an NEO may be "permissive" [98], "uncertain"[99], or "hostile"[100]. These categories, however, are rather coarse and run the risk of subjective coding for the researcher in constructing a dataset: while some military documents related to NEOs do use this coding, it is not universally used and the lack of a publicly available database to check against raises questions of coding replicability. Furthermore, if the dataset used here were expanded into a cross-national dataset, there is no guarantee that other states would use the same doctrinal framework or would interpret and report operational environments in the same way. We can, however, think of the operational environment in more general terms: as one moves up the scale from permissive to hostile, the level of control exercised by local authorities decreases and the likelihood of US troops facing exposure to and use of lethal force increases.

As a solution, therefore, I decompose the "operational environment" into two separate and empirically observable variables which capture the level of local control and the probability/severity of violence. The first, "Troops Taking Fire", codes whether or not troops involved in the NEO were fired upon by hostile forces. This is an indicator of the level of violence present in the host nation at the time of the evacuation. Higher levels of violence require

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[98] "A permissive environment is an operational environment in which host country military and law enforcement agencies have control as well as the intent and capability to assist operations that a unit intends to conduct. Under this condition, no resistance to evacuation operations is expected, and thus the operation would require little or no assembly of combat forces in country" (*JP 3-68* 2015, p. IV-14).

[99] "An uncertain environment is an operational environment in which host government forces, whether opposed to or receptive to the NEO, do not have total effective control of the HN territory and population in the intended operational area. Because of the uncertainty, the JFC may elect to reinforce the evacuation force with additional security units or a reaction force" (*JP 3-68* 2015, p. IV-15).

[100] "Noncombatant evacuees and civilians may be evacuated under conditions ranging from civil disorder, to terrorist action, to full-scale combat. Under such conditions, the JTF must be prepared for a wide range of contingencies. The JFC may elect to deploy a sizable security element with the evacuation force or position a large reaction force, either with the evacuation force or at an ISB" (Ibid.)

additional forces deployed for security. The second environmental variable is "Host Nation Cooperation": did forces in the host nation accede to the operation and cooperate in its conduct, whether by providing active assistance or by refraining from interference? Taken together, these variables can be used to form a rough approximation of the categorical coding used in US doctrine. When troops come under fire and there is no host nation cooperation, the operating environment is hostile, while if troops are not fired upon and there is host nation cooperation, the operating environment is permissive. In mixed situations, the environment is uncertain. This coding is reproduced in Table 4 below.

Table 4: Coding Operational Environment Using Observable Variables

	Troops Taking Fire = 1	Troops Taking Fire = 0
Host Nation Cooperation = 1	*Uncertain*	*Permissive*
Host Nation Cooperation = 0	*Hostile*	*Uncertain*

It may be objected that the level of violence (troops taking fire) will be difficult to know beforehand.[101] This is true in a general sense: NEOs often take place in the context of rapidly-evolving situations on the ground. However, I argue that in this specific case, the long history of US troops in Afghanistan and the specific context makes the coding reasonable, if not prudent. Similarly, I believe that coding host nation cooperation as present is also reasonable given the pre-operation assurances given in the Doha Agreement. In the operation being planned here, therefore, the environment is coded as "uncertain". US troops will expect host nation cooperation

[101] Operational inference also allows the analyst to respond to this critique in a general sense: joint doctrine instructs planners to develop additional plans for different operational environments. Using operational inference, the analyst may more easily develop a set of comparison operations for an operation occurring in different operational environments. This would allow a researcher to vary the operational environment as a way of incorporating uncertainty (Tecott and Halterman 2021) into their analysis of an NEO and to easily identify points of comparison to aid their planning. In the analysis at hand, however, I feel confident leaving these codings as they are for the reasons elaborated below.

from both the Afghan National Government who will provide some additional assistance with local policing and planning, while the Taliban will be expected to hold to their side of the Doha Agreement and refrain from attacking the airport in the course of the evacuation. However, the unsettled situation in Afghanistan, the likely presence of groups like IS-K, and the possibility of fighting between Taliban and ANSF in the area surrounding Kabul all make it seem likely that US troops are likely to come under fire. As in the analysis of the Libya operation, some additional information about the operational environment is also implied by the task variables, most notably the inclusion of air power in the operation and the need for US forces to provide security: both of these variables, if present, speak to an expectation of a high level of violence and suggest a qualitatively different kind of NEO from that which occurs in a completely permissive environment.

Step 3: Identify or Construct Comparison Set

In the preceding chapter a prior dataset of humanitarian interventions compiled by the PRIF was used as a comparison set. No such dataset of NEOs, however, exists in the publicly available literature. In cases such as this, applying operational inference will require the analyst to compile her own comparison set using publicly available data. For the present analysis the operations used as a comparison set were those NEOs performed by the United States since 1974. Detailed rules for coding and constructing the dataset can be found in Appendix B, but the process can be briefly reviewed here.

Constructing the Dataset

The first step in performing the analysis for the Afghanistan NEO, before applying the method, was to construct a dataset of comparable NEOs from which to draw insights for the planning of the current operation. A full list of US NEOs 1974-2014 was compiled using several sources including the history archives of United States service branches and lists of named military operations and overseas deployments compiled by the Congressional Research Service.[102] The final list included 30 NEOs, each of which could be accurately described by the definition of NEO offered by *Joint Publication 3-68:*

"Noncombatant evacuation operations (NEOs) are conducted by the Department of Defense (DOD) to assist in evacuating US citizens and nationals, DOD civilian personnel, and designated persons (host nation [HN] and third country nationals [TCNs]) whose lives are in danger from locations in a foreign nation to an appropriate safe haven"

(*Joint Publication 3-68* 2015, I-1)

Key operational and environmental details for each of the NEOs in the dataset were then gathered using from news reports, military publications, and secondary academic research. These were used to code the variables used for selecting the reference set in Step 4 of operational inference following the coding rules laid out in Appendix B.

The dataset used here is (unlike the prior PRIF dataset) not cross-national in its coverage, nor does it cover the entire time period from World War II onwards. The state restriction (US operations) is made primarily because data is most publicly available for US operations. Through outlets like the Defense Technical Information Center (DTIC), the Marine Corps Gazette, and the Combined Arms Research Library, detailed after-action reports, military research, and operational planning documents can be used to assess the force needs and operational conduct of each operation. Outside of the United States, this data is less publicly available. For the analysis under consideration, furthermore, the experience of the United States is most applicable because the US has conducted the largest NEOs: even if the comparison dataset was expanded to include

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[102] USMC (2007), Salazar Torreon and Plagakis (2022), Warnock (1997), Antal and Berghe (2004).

NEOs from a number of states, it is unlikely given the potential scale of the Afghanistan evacuation that they would be selected to be part of the reference set. Further work could be done to expand the dataset into an international dataset and make it more equivalent to the PRIF humanitarian interventions data in its cross-national coverage. The time restriction, meanwhile, is made because this is the period in which noncombatant evacuations have been most often practiced by the US. In general, scholars of NEOs have noted their increasing prevalence in the last 30 years (Bond 2016), though it is worth noting that NEOs were performed from at least the 1920s[103] and many decolonization processes were also marked by operations which were similar to NEOs in their conduct.

Matching Criteria in the Dataset

Based on a survey of the operations used to construct the dataset as well as NEO planning guidance provided in doctrinal publications (most notably *Joint Publication 3-68*), a number of operational tasks for troops performing an NEO were identified. The full set of variables can be seen in Table 5 below but taken together they represent a set of tasks undertaken during NEOs, the assignment of which varies across different operations. The next important set of variables are the environmental variables discussed in Step 2, namely that host nation forces are allowing the operation to go forward as well as whether or not troops are expected to come under fire. Like many other kinds of MOOTW, NEOs are highly complex and contingent operations, and each is unique in some way. Using these basic task and environmental variables, however, we can establish a basis for comparison between NEOs which can help us in our analysis of the Kabul Airlift.

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[103] Interestingly, the United Kingdom undertook its own Kabul Airlift in 1928-29. See Baker and Ivelaw-Chapman (1975).

Table 5: Key Variables and Reference Operations

Variable	Variable Name	Operational or Environmental	Coding (Afghan NEO)	Coding (Vietnam 1975)	Coding (Liberia 1996)
How many people were evacuated?	Number of Evacuees	Operational	128,079	100,000	2,444
Did evacuees include citizens of the host nation?	Host Nation Evacuees	Operational	Yes	Yes	No
Did intervening forces provide security against external attack?	Provide Security	Operational	Yes	Yes	Yes
Were combat aircraft (fixed wing) used in providing security?	Combat Aircraft	Operational	Yes	Yes	Yes
Did a local government cooperate actively or tacitly in the evacuation?	Host Nation Cooperation	Environmental	Yes	Yes	No
Did the troops being used for the NEO take fire during the operation?	Troops Taking Fire	Environmental	Yes	Yes	Yes

Step 4: Identify Reference Operations

Using the variables identified in Steps 1 and 2 and elaborated upon in Step 3, we can find the Mahalanobis distance between the vector representing the Kabul Airlift and datapoints representing past US NEOs. These matches should be cases with large numbers of evacuees where US troops had to provide security and were operating in hostile or highly uncertain environments. The presorting step identifies two similar operations. The first is the 1975 evacuation of Saigon, Operation Frequent Wind. The second is the 1996 evacuation of Monrovia, the capital of Liberia, known as Operation Assured Response. These matches make sense in a general way: Frequent Wind was the largest NEO performed by US forces prior to the Kabul Airlift and like the Kabul Airlift was triggered a longtime enemy force taking over the capital of a state whose government was formerly supported by the US.[104] In both evacuations, moreover, US forces evacuated not just a small number of US citizens but also refugees from other states including the host nations, using US military resources to conduct the evacuation itself. Both took place against the backdrop of high levels of violence, requiring a ground security force of troops to provide protection throughout the evacuation, and US forces in both came under fire multiple times. Finally, like the operation under consideration here, both were protracted operations which took place over the span of more than a week and required US forces to remain in place under potentially hostile conditions.

Relative to the US experience in Operation Frequent Wind, the US forces in Afghanistan enjoy some significant advantages. First, US forces in Vietnam were restricted in number and US aircraft were not allowed to base in the country. No such statutory limits exist in the Doha Agreement, however, so the US will have greater latitude to plan the operation and provide

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[104] One military officer writing before the fact of the Kabul Airlift also considered Frequent Wind to be a reasonable reference for planning. See Hoke (2019).

troops for force protection, including bringing in large numbers of additional troops. Additionally, while the Taliban is a fighting force with some statelike capabilities, it is severely deficient in terms of manpower and equipment when compared to the North Vietnamese Army at the end of the Vietnam War.[105] Similarly, US forces in Afghanistan will also have some significant advantages over their counterparts who undertook Operation Assured Response: they will have access to a modern, well-appointed airport for evacuation operations and will not be constrained by the need to confine operations to the relatively small area of an embassy compound.

Of course, some differences between the Kabul Airlift and its reference operations make the operation more difficult. The most obvious is geographic: Liberia and Vietnam are both coastal states, and the United States in both cases was able to use US Navy vessels both for extracting noncombatants as well as serving as seabases for helicopters which could be used to continue the NEO after fixed-wing airlift became too difficult or dangerous (Partin and Rhoden 1997; Johnston 1975). Due to Afghanistan's inland location, however, it will be largely infeasible to use a seabase for any part of the operation outside of combat aircraft being used for overwatch. Furthermore, the remoteness of Afghanistan means that there is no backup option of using helicopters for evacuation should a fixed-wing evacuation fail.

Step 5: Analysis

Like in the prior chapter, the analysis to be performed here is a sufficiency analysis intended to determine the size and composition of a force package large enough to successfully complete the Kabul Airlift (see Tecott and Halterman 2021 for the definition of a sufficiency

[105] On the other side of the coin, ASDF troops are less likely than South Vietnamese troops to provide an active defense of Kabul in the face of a Taliban advance. From the perspective of NEO planning, however, this is not necessarily a negative: reduced levels of violence around Kabul as the Taliban moves in will make deconfliction easier, reduce the temptation of the Taliban to strike the evacuation, and increase the chances of a successful NEO.

analysis in the campaign analysis context). Using *operational inference*, it estimates how many troops will be needed to perform the set of tasks identified in Step 1 given the environmental conditions identified in Step 2. In order to do so, it draws on not only recent doctrinal publications to guide its force-sizing decisions, but also the experiences of US troops in the operations in the reference set from the prior Step 4 (see above). I augment this analysis with other insights from US military doctrine and the performance of US troops in other recent conflicts (particularly the war in Afghanistan itself) and NEOs/repatriation operations. Unlike the analysis in the previous chapter, however, I do not choose additional operations outside of the matching set for analysis because the tasks envisioned here are similar to those employed in the reference set operations and do not include operations (like the naval operations in Chapter 3) which are substantially different in terms of their domain-specific nature. The closest I come to this is in considering how COVID-19 might affect the operations, but this did not require selecting an entirely different set of comparison operations simply for that portion of the analysis.

Stage One: Securing the Airport

The first stage of the NEO will be securing the airport, the site where the evacuation will actually be occurring. In order to do so, the US will bring in forces intended to augment the capabilities of the 1000 troops present in Afghanistan prior to the start of this operation.[106] As discussed in Step 1, this first stage of the operation is more complex than simply placing troops at the airport. Protecting the airlift, to say nothing of civilians attempting to reach the airport, will require US forces to patrol, monitor, and possibly interdict threats within the radius of the Base Security Zone (Caudill 2014 *Vol II*, p. 97). From the discussion of the task in Step 1, we have the

[106] These soldiers are being employed in defense of the US Embassy as well as the airport. See Sink (2021).

general guidelines that the force used for this component of the operation will be composed of three basic units. First is a base defense force tasked with defending the airport itself, providing security along its perimeter as well as within the airport itself and in the areas surrounding. Second is a mobile reaction force which is able to provide additional security and crowd control at key points as well as striking power against any emergent threats to the airport. Finally, a package of strike, reconnaissance, and C2 aircraft will provide additional security to the evacuation as well as assistance in coordinating the local airspace.

Potential Threats

The security situation of the evacuation is likely to be uncertain throughout. The Afghan National Security Forces have been largely ineffective and have generally relied on American support.[107] The Taliban agreed in the Doha Agreement not to interfere with the evacuations and have reason not to in order to make their transition to formal political power as smooth as possible but may be unable or unwilling to completely control all fighters affiliated with their network, which could open up the possibility of an attack. Further, the Taliban are not the only potentially hostile force operating in Afghanistan. One prominent threat is the Islamic State Khorasan Province (ISKP), an organization which emerged following the defection of Afghan and Pakistani fighters within the Taliban and al Qaeda (Giustozzi 2018; Doxsee et al. 2021). ISKP is the primary threat envisioned in this operation: though other militant groups like the Haqqani Network and Al-Qaeda do operate in Afghanistan, these groups tend to cooperate more often than they conflict with the Taliban and all three groups (HQN, AQ, Taliban) are aligned against the more aggressive and actively- recruiting ISKP (Shah 2021).

[107] In the real world it would, of course, become clear early on in the withdrawal that the ANSF would be completely unable to resist Taliban takeovers, with most garrisons giving up without fighting back.

In terms of the level of threat to the airfield I consider ISKP, together with other potential Islamist groups and the low-probability but high-threat Taliban, to be about a “Level II” threat as determined in US military doctrine related to base defense. “Level II” threats go beyond standard security problems like terrorists, civil disturbances, and saboteurs and include small tactical units which may have standoff weapons capability (see *JP 3-10* 2019, p. I-2). They also demand a higher level of security than standard security threats, requiring the ability to detect and respond to potential threats in the area surrounding the base, including (in extreme cases) with indirect fires or forces using armored vehicles.

Airport Security

The Air Force, responding to the “nonlinear” battlefield of the post-Cold-Wra era, has developed a unit which is capable of accomplishing the task of providing security at the Kabul Airport. The 820th Base Defense Group (BDG), a unit of some 915 personnel, is a unit with organic base defense and security capabilities, able to patrol and defend a site as well as to provide the ISR support which enables base defense (Cook et al. 2003; Emery 2009). The 820th BDG is trained to provide security at a large airbase and has been at the forefront of developing airbase defense doctrine in the Cold War and post-Cold War periods (Caudill *Vol I* 2014, pp. 269-74) It is among the most capable units in the US Air Force at the kind of ground operations envisioned here, and one of the few units in all the US military specifically focused on airbase defense. The 820th BDG provided security at Camp Bucca (near Basra, Iraq) as well as Bagram Air Base near Kabul. In both deployments the 820th was successful at identifying threats to the airbase by conducting patrols as well as ISR operations using organic UAV capabilities, specifically with Raven and Scan Eagle drones (Emery 2009; Caudill *Vol II* 2014, pp. 99, 126-9).

The 820th BDG is also similar in size to the ground forces which were deployed to provide ground security during Operation Frequent Wind. A force of 865 US Marines (eight companies) was deployed to the Defense Attaché Office (DAO) compound at Than Son Nhut Airport (Johnston 1975). These marines were able to hold the DAO compound, process evacuees, and oversee evacuation in fixed and rotary-wing aircraft over five days (Johnston 1975, Baird 2017). Unlike the Frequent Wind Marines, however, the BDG will have responsibility for securing not just a compound of buildings but an entire airport. Not only is the area of responsibility larger, but forces involved in the Kabul Airlift will also be required to undertake actions which are beyond the remit of the Marines in Saigon: the BDG will be required to actively patrol an area outside the base and hold its position for an extended period of time rather than the single day Marines held the DAO compound in Saigon.[108] In Operation Assured Response, meanwhile, where US forces held a single building, a single company (140) was sufficient to hold the US embassy for nearly eight days while evacuations were completed (Clinton 1996).

Additional Ground Security

The second component of the force providing security at the airfield is a rapid reaction force. Because of the risks of breaches of airport security as well as potential terrorist and indirect fire attacks, joint doctrine for base security suggests that a force capable of reacting quickly to possible attacks on the airfield will be necessary, called a *mobile security force* in US doctrine (*JP 3-10* 2019, p. GL-5). Further, this MSF will need to come from sources besides the BDG because of the larger responsibilities faced by the force being used specifically for security on

[108] It is worth noting, however, that in plans for a fully fixed-wing evacuation of Saigon which were ultimately abandoned, the US planned to use the same-sized ground force, in combination with South Vietnamese forces, for defense of the entire airfield, which was to be the sole evacuation location. See *USSAG/7AF* (1975). Methodologically, operational inference allowed this insight by identifying Frequent Wind as an object of close study: Frequent Wind underwent a number of changes over the course of its planning, and the rejected Option II is remarkably similar to the Kabul Airlift in terms of the tasks assigned to US troops.

the base. While an additional, heavily armed force like this may appear unnecessary, there are reasons, both doctrinal and historical, to believe that this is not the case. Doctrinally, *JP-10* recommends that any body of troops whose primary purpose is force protection in the face of a Level II threat (the level of threat envisioned here), should have some form of armored component as well as heavy direct-fire and (at least) medium indirect-fire capabilities (*JP-10* 2019, p. III-7). Doctrine also notes that systems like these have additional utility outside of force protection as they can serve as intimidating deterrents at checkpoints or while out on patrol.

Historically, the past experiences of US troops also show the importance that shows of force using disproportionate firepower can have in NEOs: in operation Assured Response, for example, shows of force using aircraft and helicopters were successful in scattering hostile citizens at several points, while in Operation Frequent the lack of deterrent firepower made controlling crowds extremely difficult. In fact, the final evacuation from the Saigon Embassy was partially necessitated by the fact that a crowd of evacuees was able to get inside the Embassy compound (Muir 2017, pp. 23-7). While the ultimate evacuation of a portion of the embassy crowd was a humanitarian success, the fact that it happened at all suggests that lightly armed infantry are not enough to control agitated crowds in high-stress scenarios like major evacuations. Further, the problem of deterring evacuees from interfering with the helicopter evacuation once inside the compound was itself difficult: several Marines reported that they were afraid they would be forced to kill civilians in order to complete the evacuation safely (Ibid, pp. 26-7).

The size of the mobile security force is determined by “the priority of ongoing operations, the criticality of the base under attack, and the amount of time needed for friendly elements to consolidate” (*JP 3-10* 2019, p. IV-6). The priority of the ongoing operation is high due to its scale and visibility. KBL is a highly critical location: as previously discussed, given Afghanistan's geography and the lack of an alternative evacuation airfield, the airport must be held for the entire length of the operation to ensure continuous evacuation operations. Due to the poor past performance of the ANSF, moreover, we do not expect that "friendly elements" will be able to consolidate in defense of KBL, and that any combat force available to defend the airfield in case of emergencies will have to be either on the ground as part of the NEO or be available for rapid air deployment.[109] Taken together with the uncertain broader security situation in Afghanistan, all of this suggests that the mobile security force should be at the larger end of its size, closer to a Tactical Combat Force (TCF).[110] An appropriate Tactical Combat Force for this operation would be a Marine Expeditionary Unit (MEU). MEUs are often used in NEOs, especially those which take place in hostile or uncertain environments, and accordingly undergo proper training. The combination of combat power and NEO capability makes an MEU a natural choice for this mission, as does the presence of the 22nd MEU in the waters of the Persian Gulf at the start of this operation and thus is already available in theater for transshipment to one of the starting air bases in the Gulf and subsequent deployment to Afghanistan (*USNI News* 2021).

The size of the operation being considered here makes it a near-certainty that processing of evacuees will be difficult and there is a strong possibility of large crowds forming near the evacuation site at the airport. Securing the airport, then, means not just protecting it from outside attack, but also preventing unauthorized entry which could delay the loading, unloading, and evacuation procedures. In the NEOs in the reference set, this kind of ground security was

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[109] "Rapid" is also relative: the fastest possible deployment of heavily-armed combat forces from al-Udeid would require a 3-hour flight and 2.75 hours of loading and unloading time at either end of the flight. Performing this kind of deployment under fire is obviously quite dangerous and would consume airfield resources that would otherwise go towards continuing the evacuation, causing serious delays.

[110] A TCF is a "A rapidly deployable, air-ground, mobile combat unit with appropriate combat support and combat service support assets assigned to, and capable of, defeating Level III threats, including combined arms." (*JP 3-10* 2019, GL-5).

important for managing the evacuation in an orderly manner, whether provided by Marines who attempted to control entry to evacuation sites in Operation Frequent Wind or by Special Forces who helped control and protect crowds gathered outside the US embassy in Monrovia. In both cases, crowd control was possible without the use of lethal force against either civilians or potentially hostile forces: shows of force or warnings were sufficient to prevent the situation from devolving. To be sure, troops in Vietnam were ultimately not successful in keeping large crowds of potential evacuees out of the US embassy, but the force at the time of the breach was much smaller and less capable than that considered here, only around 50 lightly armed Marines (Kean 1975). This would later be augmented with a larger force which was at least successful at preventing the chaotic last hours of the Saigon Embassy from descending into a bloodbath.

An MEU is, in total, composed of around 2200 personnel divided between a Ground Combat Element, Aviation Combat Element, Logistics Combat Element, and HQ company.[111] The ground element consists of around 1200 troops equipped with light vehicles, armor, and artillery. The aviation element (400+) consists of a small fighter squadron (F-35B or AV-8B Harrier), light UAV capability (RQ-21A), and rotary-wing aircraft (AH-1Z, UH-1Y, CH-53E). The logistics element (~270), together with the HQ unit (~170) and offshore Amphibious Ready Group vessels, can provide a full range of logistical, medical, communications, and intelligence support. The light armor, rotary-wing, and artillery components of the MEU allow the force to make significant shows of force should that become necessary, while its internal logistics and ISR capabilities allow it to be self-sustaining while ashore and to integrate its intelligence collection and analysis with other units (in this case, the 820th BDG). In short, an MEU has the full complement of capabilities All of the MEU's equipment, save its tiltrotor V-22 Osprey

[111] All information on MEU composition in this paragraph comes from USMC (2007).

aircraft, is transportable via C-17, so this analysis assumes that same C-17s being assembled for the airlift will be used as a way to bring forces into Kabul.[112]

Fixed-Wing Air Support

The final element of the force tasked with defending the airport from outside attack is the air support element. Air support for this operation has three basic functions. First, to provide ISR support for troops on the ground near the airport, to warn them of potential threats developing outside the base area.[113] If a threat is detected which the ground forces cannot respond to or will not be able to respond to in time, the second function to provide a nonlethal show of force in order to deter the threat.[114] If that measure fails, or if the threat is of sufficient gravity, the third and final function is to strike the threat using lethal force.

As noted above, part of this force will be organically provided by the MEU being used as ground security, which has its own internal air wing, further augmented by aircraft from the MEB aircraft being held in reserve. Given the long distances involved in this operation and the premium that will be placed on runway availability at KBL, this analysis presumes that strike aircraft will launch from the Marine ARG (off the shore of Pakistan at about Midpoint 1, see Figure 13). For the strike profile I assume the use of the F-35B launched from the Marine ARG's offshore vessels.

In order to determine the need for strike aircraft, we use the same sortie generation formula used in the prior chapter (Haggerty 2014). I use many of the same parameters as well:

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[112] It is also possible, however, for the Marines to be deployed from al-Udeid via KC-130J aircraft from the USMC's own fleet. These aircraft have a range at maximum nromal payload of 2100 nm, which would allow them to deliver troops and light vehicles from al-udeid to Kabul without refueling on the ground in Kabul if a second portion of KC-130Js were reserved at Midpoint 1 for aerial refueling. To simplify analysis, I assume that C-17s can and will be used for all missions.

[113] Troops like the 820th BDG providing security at Bagram Airbase often depended on ISR reports from combat aircraft in addition to their own ISR capabilities. See Caudill *Vol II* (2014, p. 127).

[114] See Schanz (2007) for a description of this practice during the Afghan war.

each strike aircraft should be able to destroy four emergent ground targets per sortie, while the engagement zone is smaller, with a radius of 10 nm. In order to keep at least one aircraft on station 24 hours a day, 14 aircraft would be needed under average readiness (see Appendix C3). This is a greater number of aircraft than is included the native aviation element for the 22nd MEU, which generally has a complement of only six strike aircraft. Because the 22nd MEU is deployed as part of a larger MEB, however, we can assume that it will have access to at least 16 strike aircraft (USMC 2021). Overhead coverage could also be extended through the use of UAVs. An MQ-9 "Reaper", for example, can provide loitering ISR for up to 27 hours: two MQ-9s could provide constant cover for the airport. Any UAV used, however, would need to be based out of KBL itself due to the lack of air-to-air refueling capability among US UAVs. The full air package estimated by this analysis can be found in Table 13. As in Chapter 3, I use Shlapak's Air Expeditionary Force template scaled in half to reflect the number of strike aircraft.[115] I change Shlapak's recommendations to reflect the increased need for tankers given the long distances involved and the limited need for SEAD given the lack of integrated air defense systems among Taliban fighters. The increased number of tankers also provides an emergency reserve for potential refueling of C-17s carrying a large amount of weight.

Inserting Troops and Reserves

Inserting the troops for this initial stage will require an initial airlift using the same C-17s which will later be used to ferry evacuees away from KBL. Because the ECCs are not yet set up, however, the initial insertion flights will return to the Intermediate Staging Areas empty. As is shown in Appendix C2, KBL has a daily capacity of 29 C-17 sorties, assuming 85% queueing efficiency. This means that the initial insertion of ground security forces can be expected to last

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[115] Estimates of the number and types of aircraft used in Operation Allies Refuge are relatively hard to come by outside of the use of C-17s in general.

about a day and a half. If staged correctly, however, ECCs (see below) could be up and running by the end of the first day, so as the flights from the remaining half-day of the deployment arrive, they could be loaded with processed evacuees. Thus, I assume that one day of airlift operations with no evacuations will be necessary to insert the initial force.

It is possible that the number of troops currently envisioned for onshore operations will be insufficient, particularly if an emergency response is needed. An operational reserve should, therefore, be established. In keeping with the use of the 22nd MEU as the ground security force, I use it as the basis for constructing a larger force, a Marine Expeditionary Brigade (MEB). MEBs are intended to be a scalable unit built out of constituent MEUs which can respond to threats beyond those which can be handled by a single MEU (USMC 2021). The MEB I envision here is a combination of three MEUs, one of which is the 22nd.[116] Should the need arise, the ground, logistical, and HQ elements of one of the other two MEUs in the MEB could be deployed, adding around 1800 ground troops and creating a total force of 5,915. Taken altogether, the inclusion of the other two MEUs allows a surge capacity of an additional (estimated) 3600 Marines along with their equipment.[117] If fully deployed, the MEB, the 820th BDG, and the troops already present in Afghanistan would bring total forces to around 5500, only including combat and security forces. Including the logistics and air wings from the rest of the MEB would swell total forces to 7500.

[116] Again, this is in line with past operations: in the first round of planning for Frequent Wind when fixed-wing airlift and sealift were still seen as viable options (at this point named Talon Vise), a regimental combat team (called a regimental landing team at the time) of Marines was to provide the operational reserve (see *OPLAN 1-75 TALON VISE* 1975, p. 57). This is equivalent in size to the ground element of the standard MEB (~4400 including the ground, HQ, and logistics elements). The insights gained from studying Talon Vise were, again, made possible because of the focused study of Frequent Wind due to selection via operational inference.

[117] This number (3600) represents the ground combat element (1200 each) of both reserve MEUs, along with the 150 HQ and 450 logistical troops attached to both.

The problem with inserting additional reserves, however, is that they introduce delays at the end of the airlift. Each inserted MEB equivalent represents about 1800 ground troops (combat/HQ/logistics) plus their equipment, requiring 24 C-17 sorties with no evacuees on board in order to extract. In order to make up for this gap, 13 C-17 sorties which were previously carrying the standard number of NEO evacuees must be filled to the emergency capacity level (see *AFPAM* 2018). While in theory the C-17 sorties which carry in the reserves could also extract waiting evacuees, this assumes that processing of evacuees operates continuously: if this is not the case, then the time spent inserting the reserves will likely be lost entirely.

Stage Two: Extracting Embassy Employees

With the airport secured, the next step will be for the US to attempt to recover its personnel from the nearby embassy. There are several reasons why this should be a priority and should take place early in the evacuation. First, consolidating the number of evacuees in a single location will make it easier for the US to evacuate its own citizens and avoid having to respond to any attack on the embassy itself by dividing its forces and possibly exposing the area around the airport to further danger. Second, embassy personnel are often critical for managing the processing of evacuees and can be useful as part of the ongoing operations at the airport.[118]

Taken together, we might imagine the extraction occurring here being multi-staged and assisted by a small unit of ground troops: a company-strength force divided between escorting buses or other ground transportation from the embassy to the airport on the one hand and providing site security at the embassy on the other. If violence is high enough that ground

[118] On this latter point, US embassy staff in both Frequent Wind and Assured Response were used to augment military efforts in processing staff. Embassy staff, particularly those with consular experience, are already especially suited for this role. See Partin and Rhoden (1997, p. 27) as well as Johnson (1975, p. 14). Note that this ability to use already-present civilians to limit duplication of roles in the military deployment would be less apparent without the kind of focused qualitative study which operational inference enables.

operations are seen as too risky, evacuations from the embassy to the airfield could be completed fairly easily given that the flight between the two is so short. In either case, this task should be feasibly accomplished by a security force of company size detached from the larger ground security forces. Not only is this what is called for in doctrinal research related to NEOs (Perry et al. 2015, p. 59), it is also essentially what happened in past NEOs. During Operation Frequent Wind, for example, the ground security force divided itself between its core area of operations at the Defense Attaché Office compound and the US embassy itself, sending a smaller detachment of 130 Marines by helicopter in order to manage the crowd at the Embassy and provide security for the team inside (Johnston 1975; USSAG/7AF 1975). Further, during Operation Assured Response, a force of 140 troops was able to complete the entire NEO, which amounted operationally to extraction of evacuees and staff from the US embassy compound (Partin and Rhoden 1997).

In extraction operations like the one pictured here measures of performance are fairly simple: was the operation successful in transporting all personnel in need of extraction, with minimal loss of life among both the noncombatants being extracted as well as the assigned troops? Within the reference set, the number of troops assigned was sufficient for a high level of success in Assured Response; no evacuees were killed or injured in the course of the evacuation, nor did US troops suffer any casualties. During Operation Frequent Wind, extraction from the Saigon Embassy was less successful because hundreds of Vietnamese and South Korean evacuees were left behind, though American embassy employees and military personnel were all evacuated safely and with no casualties (Muir 2017, p. 27).[119] That some potential evacuees were left behind was due to three unusual limiting factors. First, the crowd at the embassy continued to

[119] US forces did suffer two casualties during Operation Frequent Wind but those casualties were suffered by forces at the DAO compound earlier in the day. The forces redeployed to the Saigon Embassy suffered no casualties.

grow throughout the evacuation. Second, planners and commanders were not fully aware of the size of the crowds at the embassy and could not adequately plan for extraction. Finally, this evacuation occurred during the very last stages of the NEO when extraction capacity was at its lowest and potential danger was at its highest. Since the extraction mission envisioned here is to take place early on in the NEO during a more permissive period, it should be able to avoid the problems which occurred during Frequent Wind, though it is worth noting that even in Frequent Wind, all American personnel were recovered, which is the ultimate goal of this phase of the NEO. The force estimated here of a company, therefore, should be able to complete this task in a satisfactory manner.

Stage Three: Conducting the Evacuation

The third stage, once the airport is secured, is to hold onto the airport, process civilians who come to be evacuated, and conduct the airlift using military fixed-wing aircraft (specifically C-17s, selected for reasons outlined below). An evacuation from an airfield is the sole option since the inland remoteness of Afghanistan severely limits the options available to military planners. It is common in NEOs which take place in more coastal areas for evacuees to be extracted via helicopter or ship, neither of which is possible in the Afghanistan case because of the long distances from any potential sea base in the Indian Ocean or Persian Gulf.[120] Overland travel is similarly restricted because of Afghanistan's borders: with Iran to the west and the tribal areas of Pakistan to the east, the lack of safe routes would require extensive escort forces of ground troops and in any case are not feasible on the short timeline required. The sole method of

[120] Operation Frequent Wind in Vietnam, for example, had five possible operational plans, many of which involved a combination of fixed-wing airlift and sealift. Indeed, the final operation incorporated both fixed-wing airlift and helicopter airlift, but military pressure from North Vietnamese forces required the US abandon first its plans for sealift when ports were deemed unsafe, and then fixed-wing evacuation when the Than Son Nhut airfield was struck by rocket fire.

evacuation from Kabul available will be military fixed-wing aircraft since civilian aircraft will not be sent to Kabul because of high levels of risk.

Further increasing the difficulty of the NEO is the relatively rapid timeline and the hard stop date of the Airlift. In the analysis presented here, two alternative timelines are offered, both of which are based on battlefield results in the rapid progress of Taliban forces into Kabul. The first, more generous timeline, assumes that major evacuation operations begin overnight on August 7th, the day after the capture of Zaranj, the first provincial capital to fall to the Taliban. This gives the US 25 days to complete the Airlift. The second possible date is overnight on August 13th, the day after Pul-el-Alam and Ghazni, two major provincial capitals near Kabul, fell; this gives the US 20 days to complete the Airlift. Regardless of the start date, however, the Airlift will come to an end and all US troops will be withdrawn by the end of August 31st, the day by which the US was bound to withdraw from Afghanistan under the Doha Agreement. This means that the NEO will have between 20 and 25 days to successfully evacuate all 128,079 noncombatants as well as all US forces.

Kabul Airport

Before discussing the operational details, we should note the environment in which they will be occurring since this is important for force planning and force sizing decisions. Kabul International Airport (hereafter, KBL) offers both advantages and disadvantages as an evacuation site for an NEO. It has the advantage of being a mixed civilian-military airport whose facilities are suited for the use of US logistical aircraft: its runway is paved and is long enough to host any aircraft in the US arsenal. It also has a great deal of parking space for helicopters as well as some (limited) local facilities for refueling and maintenance.

KBL is mainly limited in its usefulness as a base for an NEO by its single runway and limited space on the ground for wide-body aircraft like the C-17. The C-17 is coded as a "Category D" (IFATCEG 2022) aircraft and requires a square area of 175 ft in length by 220 feet in wingspan (without wing walkers, see *AFPAM 10-1403* 2018) to park. Using the standard parking availability at KBL, the airport's parking maximum on the ground (pMOG) for C-17s is eight aircraft.[121] However, we assume that not all of these spaces will be available for use by US forces. Commercial air service from Air India as well as Emirati and Qatari airlines continues at KBL[122], and other NATO states/US allies are also likely to be conducting their own evacuations using commercial and military aircraft. To provide a conservative estimate of pMOG we assume that all of the parking aprons near the civilian terminal which serve Category D aircraft (those on Aprons 3, 4, and 5, see Figure 11 and Table 1, Appendix C) will be reserved for civilian flights and the use of allied aircraft, leaving only one officially listed parking berth for Category D aircraft available to US forces (on Apron 1, see Figure 11).

This, however, is not the final limit of the pMOG at KBL. Additional spaces could be created: a number of parking aprons are scattered about the grounds of the airport whose size and capacity are unlisted. Estimating the size of these aprons using Google Earth, it seems as though several of the aprons could accommodate additional C-17 aircraft, particularly since there is no need for refueling on the ground (see footnote below). Leaving aside Aprons 3, 4, and 5, which are reserved for allied and commercial aircraft, the largest number of potential parking areas for

[121] When using MOG in planning air operations, there are several potential MOG which can be used besides pMOG. Others include fuel MOG (fMOG, how many aircraft can be fueled at once) and working MOG (wMOG, how many aircraft can be loaded/unloaded at once). See Brigantic and Merrill (2004). For this stage of the analysis we assume that parking MOG is the most important limiting factor. This is because C-17 flights from the staging areas have sufficient range to land in Kabul and return to their staging areas without refueling either in air or on the ground. Working MOG, meanwhile, is less likely to be the limiting factor since the "cargo" being loaded are passengers who can be assisted by elements of the US ground force.

[122] Kirk et al. (2021). These flights were momentarily canceled following the security breaches at the airport on August 16th but continued afterward in a limited capacity.

large aircraft like the C-17 are available on the military parking apron, Apron 8. This apron has a number of spaces available (parked wing-to-wing, each half of the apron could hold at least four aircraft), but to allow for maximum spacing as well as potentially some equipment storage around these areas, we reduce the number of aircraft parked here to 2 on both portions of the Apron (see Figure 11 for a representation of Apron 8). Though Apron 8 is technically intended for the use of the Afghan Air Force, in the scenario envisioned here the Afghan Air Force is not pursuing active operations against the Taliban and will be unable or unwilling to prevent the US from using this apron for its own operations once US forces take over security and air control operations at the airfield. Apron 2, located near the terminal, would also be a useful staging area and is capable of parking two C-17s, if only for the reason that it is near one of the gates and thus evacuees could be processed and moved onto planes quickly.[123] Other aprons could provide additional pMOG capacity but in this analysis are assumed to not be used because space will be at a premium inside the airport[124] and some space will need to be set aside for living and storage space for US forces.[125] Using this logic, we estimate two possible pMOG for KBL. The first is an "aggressive" pMOG of 7 which includes Aprons 1 (one C-17), 2 (two C-17s), and 8 (four C-

[123] This proximity to the perimeter of the airport does raise concerns about security: US troops will need to be particularly diligent about ensuring that nothing damages the aircraft parked on Apron 2. However, the proximity of the apron to the airport perimeter and entrance gates is shared with other potentially useful aprons like Apron 8, so this is not as disqualifying a feature as it first appears.

[124] I do not attempt to analyze space requirements for US troops posted at KBL except to note that storage and living space in and around KBL was apparently sufficient in the real-world Kabul Airlift and, to my knowledge, was not remarked upon as a limiting factor for US operations.

[125] In particular, I do not incorporate other aprons for the following reasons. Aprons 3, 4, and 5 are presumed to be left for the use of commercial and allied flights, removing a total of 7 officially listed parking berths which could fit a C-17. Apron 6 is not included because it is used for helicopter storage and is generally unsuitable, while Apron 7 is not included because it is the most distant Apron from all entrance gates. Allied aircraft or troops could use this as an overflow area. Apron 9 is not included because it is also used for helicopter storage and is near a number of storage buildings, both characteristics which could be put to good use by US troops. Finally, Apron 10 both far away (like Apron 7) and has a strange shape which means that despite its great length, it would only be able to accommodate two C-17s at a time.

17s). The second is a "conservative" pMOG of 4 which include only Apron 8 (four C-17s).[126] We use the "conservative" pMOG for most of the airlift calculations because if the operation is feasible under the conservative pMOG then it should also be feasible under the more aggressive accounting.[127]

Intermediate Staging Areas

A key part of this part of the operation will be acquiring overflight and access rights to each of the intermediate staging areas used as a transition point and airbase. Because Afghanistan is an inland country, any airlift will require crossing the territory of other states. Pakistan in particular will need to be used as a path for overflight. One area where the US is unlikely to be able to negotiate overflight rights is Iran. This is unfortunate because the most direct routes from Kabul to sites in the Gulf would cross Iranian airspace. For the actual flights, therefore, US aircraft will first fly over Pakistan in order to reach a point in the Persian Gulf, then turn to fly to other bases without entering Iranian airspace. Notional routes along with distances for each leg of the route can be found in Figure 13. For this operation, flights will be directed to al-Udeid AFB, RAFO Masirah, and RAFO al-Musannah on a 2:1:1 ratio, respectively. RAFO Masirah (2027 nm round-trip) and RAFO al-Musannah (2034 nm) are both close enough that a C-17 with an above-standard load can make the flight easily.[128]

Al-Udeid is far enough (1337 nm one-way, 2674 nm round-trip) from Kabul that fuel could become a problem if an aircraft is forced to circle for an extended period of time while waiting to

[126] The "conservative" pMOG scenario is essentially one where the US restricts its aircraft space to the official military parking aprons. This could allow more efficient security within the US area of operations, allowing a concentration of base security in the area around Aprons 8 and 9.

[127] Further, much of the contemporary reporting surrounding the Kabul Airlift remarked on its low capacity for accommodating aircraft on the ground: taking the lower of the two estimates thus seems appropriate.

[128] Again, see Figure 13 in Appendix C2.

land, but in general a C-17 should be able to make the round-trip flight without the need to refuel in the air or to stop for ground refueling.

Processing Evacuees

Before evacuees can actually be evacuated, they will need to be processed at a number of stations at the border of the airport. These stations, called Evacuation Control Centers (ECCs) will be located near the access gates evacuees will use to enter the airport (see Figure 10). At these stations initial identification will be checked and those who appear to qualify can be passed forward to assembly areas and then to a C-17 for evacuation. A key metric for success in this portion of the operation (given the large number of potential evacuees as well as the short timeline) is throughput for processing evacuees: how many evacuees can be admitted to the airport, processed so that there is accountability in tracking evacuees, and then move onto a waiting aircraft?

Accounts of recent NEOs as well as doctrine suggest that a standard pace for processing refugees at a single evacuation site equipped with a computerized NEO Tracking System is between 50-100 evacuees per hour (*JP 3-68* 2015, p. VI-8; Kennedy 2001, p. 11) in permissive scenarios. Given that the situation at the evacuation sites is likely to be chaotic and there will likely be a need for close examination of evacuee credentials, to say nothing of the difficulty imposed by conducting the evacuation in accordance with anti-COVID social distancing protocols, we will set the number of evacuees to be processed at the low end of the range, assuming that each processing site can process 50 refugees per hour, about half the rate claimed in permissive environments. Given the estimated total of evacuees (128,079) and the estimated rate of evacuee processing of 50 evacuees/site/hour, this means that over the course of the evacuation 2,562 site-hours will be required to process all evacuees.

For this operation six site teams will be required, and the ECCs will operate 24 hours a day. Under a 22.5-day timeline (begin August 6th, one day for deployment, 1.5 days for withdrawal) 113.9 site-hours must be invested each day across multiple sites at the airport (19 hours per ECC). Given a 17.5-day timeline (begin August 12th, one day for deployment, 1.5 days for withdrawal), this means 146.4 site-hours must be invested each day, meaning that an additional ECC will be required and all 7 ECCs will operate 21 hours per day. Given the around-the-clock schedule of these centers' operations under both the 20-day and 25-day scenarios, staff must be available for two 12-hour shifts at each of the 6-7 ECCs.

Based on past experiences of US forces, a force of 20 people (15 troops augmented by DoS personnel), is sufficient to run an ECC. This force assists with processing of evacuees and moving them through staging areas from intake to boarding the evacuation aircraft.[129] During Operation Assured Response, for example, a mixture of a Special Forces platoon (19 operators) and embassy employees were able to process and extract 1,540 evacuees in a three-day period, working about 12 hours a day (~ 42.8 evacuees per hour) in extremely cramped conditions and without the benefit of a contemporary computerized ECC (Partin and Rhoden 1997, pp. 29-32).[130] Given the throughput achieved by this small group of troops in an environment even more austere than the one imagined here, 50 evacuees processed per station per hour seems like a reasonably conservative assumption for throughput. Given the parameters assumed here, the ECCs established will be able to process 300-350 evacuees per hour, essentially the equivalent of a single C-17 transport sortie payload (or more) each hour.

[129] Forces needed for operating the ECCs can be sourced from the 820th BDG or from forces providing security at each gate. MEU troops may be especially well-suited for this role given their NEO-specific training.

[130] In an operational analysis of ECC throughput, Olsen (2011, p. 15) confirms this rough staffing level. Again, the utility of operational inference as a method is shown here: through focused comparison with Operation Assured Response, it was possible to establish a baseline assumption for ECC throughput and to get a real-world estimate of the numbers of troops necessary to operate one.

Aircraft Used

The US has a large number and wide variety of transport aircraft available for this type of operation. However, the workhorse aircraft which is used most often in NEOs is the C-17 and its variants. The C-17 has a number of advantages for the type of mission being considered here. Perhaps most importantly, C-17s are numerous: the US has a large number of C-17s and a robust infrastructure of trained crews, replacement parts, and other sundries needed to maintain a high-tempo operation. The C-17 also has a high enough transport capacity to support the given operation. Each C-17 can take a standard load of 101 passengers, or up to 300 passengers under emergency conditions (*AFPAM 10-1403* 2018). Either way, carrying this number of passengers plus some small personal luggage, the likely payload for each C-17 will be less than 100,000 lbs; with a payload of 100,000 lbs, a C-17 has a range of around 4,500 nm and can easily make the round trip flight from KBL to the intermediate staging areas (see Figure 13 for distance estimates). Under standard loads, it would take about 1269 C-17 sorties to complete the NEO, which is far too many to be achievable in either a 20 or 25-day timeframe (see Appendix C2 for more detail on this calculation). Accordingly, I do not use the standard load of evacuees in the analysis from this point onward.

I also analyze the scenario wherein the C-17s make "half and half" sorties, where half of the total sorties carry a standard load of passengers and the other half carry the emergency load, leading to an average number of evacuees per sortie of 200. The half-and-half passenger load models a more real-world scenario where the number of evacuees per flight increases over time, whether due to increased efficiency in the processing of evacuees over time or a conscious decision to add more evacuees to outgoing flights as a deadline looms. If planes are loaded according to Emergency guidelines, they should be able to transport 300 passengers plus some small luggage each trip. Using this loading schema, it would take 427 C-17 sorties to complete the evacuation, not counting sorites to withdraw the ground security force. Under half-and-half sorties, this would take 641 sorties (See Appendix C2 for more detail on airlift calculations). Both of these are achievable in the given time frame.

Aircraft required for this operation would most likely be sourced from the 379th Air Expeditionary Wing (AEW). Not only is the 379th AEW the largest air wing in the US Air Force, it is also based out of al-Udeid and so would not require shifting any resources beyond dividing up operations between al-Udeid and the two Omani staging areas. Further, the 379th has a full complement of tanker, C2ISR, and other necessary support aircraft available to support operations, as well as sizeable maintenance, logistical, and medical support elements.

Airlift Operations

The basic flight cycle for a C-17 aircraft participating in the Kabul Airlift described here begins at the aircraft's intermediate staging area in one of the states in the Persian Gulf. The staging areas chosen for this operation are nearby airfields, mostly located in states in the Persian Gulf.[131] The bases chosen for staging areas are those which already host large numbers of USAF personnel and which are thus likely to have sufficient facilities for hosting both US troops employed in this operation as well as evacuees. Flights will be distributed between the bases on a 2:1:1 ratio, with two parts going to al-Udeid AFB near Doha, Qatar. This was determined because al-Udeid is the major airbase in CENTCOM and is the home base of one of the units which would make the most sense to employ for the airlift portion of the operation (see below). In order to minimize the number of evacuees who will be on the base at any one time, however,

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[131] This was also the approach taken by the US in Operations Frequent Wind and Assured Response. In both cases US troops and aircraft were based out of nearby air bases in Thailand and Senegal, respectively, as well as offshore naval vessels providing seabasing support. See Johnston (1975) as well as Partin and Rhoden (1997).

and to prevent overcrowding, half of the evacuees will be evenly divided between two bases in nearby Oman: RAFO al-Mussanah and RAFO Masirah. Each of the intermediate staging areas has a higher MOG for C-17 aircraft than KBL as well as greater numbers of runways (two runways at each base), so the main limiting factor in the airlift operations will be the capacity for organizing the airlift on the Kabul end of the cycle (Wallin 2018).[132]

From the intermediate staging areas, the aircraft flies into Pakistani airspace and then on to Kabul, avoiding Iranian airspace as it does so (Figure 13). This inbound flight takes about 2-2.5 hours, depending on which intermediate staging area is used as a starting point. Landing in Kabul, the aircraft then spends approximately 2.75 hours loading on passengers, after which it departs again for another 2-2.5 hour flight to its intermediate staging area. Arriving, the C-17 unloads again this time also taking on fuel, which takes another 2.75 hours, while its crew enjoys a 16.5 hour rest period (*AFPAM 10-1403* 2018). At the end of the crew's rest period, the aircraft is ready to repeat its flight, with the whole cycle lasting around 37.25 hours (10.75 hours of flight and loading/unloading plus 16.5 hours of crew rest). If three crews are available to operate each C-17, it will be able to operate in a continuous cycle.[133] For the calculations performed here, I assume that three crews are available for each C-17 along with plentiful repair parts, allowing around-the-clock, continuous operations within the bounds of standard assumed levels of operational efficiency.[134] I believe this is a reasonable assumption given the large number of C-17s in the US inventory and the fact that additional C-17 crews could be surged to the areas if

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[132] Additional staging aeras were considered, particularly al-Dhafra AFB in the UAE. However, given that al-Dhafra is an extremely busy base and supports US operations across all of CENTCOM, it was not chosen as a site for keeping evacuees. US use of Omani bases has slackened off since 2002, but its bases, particularly the two chosen for this operation, were a key site for operations at the start of Enduring Freedom in 2001-2002 (see Wallin 2018). Given this history and the fact that both bases are actively used for military operations and pilot training, there is reason to believe that they have the facilities necessary to support evacuees for the required period of time.
[133] All crew and ground times for the C-17 are sourced from *AFPAM 10-1403* (2018).
[134] Specifically, I assume an 85% efficiency rate for ground operations, following the recommendations provided in *AFPAM 10-1403* (2018) and Brigantic and Merrill (2004).

needed through the use of the CRAF aircraft making return flights to the staging areas from the US and Ramstein AFB.

Extracting Forces

To extract forces, the same airlift from the first part of this stage will need to be repeated, plus additional flights to accommodate the approximately 1,000 US troops stationed in Afghanistan at the start of the airlift. Doing so will require the use of C-17 flights which cannot carry any evacuees. When evacuating, US forces have the option of evacuating only troops or both troops and equipment: the former option (troops only) will require 41 C-17 sorties (~1.5 days) while the latter will require 51 sorties (~1.75 days).[135] I assume that the small amount of equipment brought into Kabul will be recovered.

Stage Four: Accommodating Evacuees

At the destination sites where flights from KBL arrive, overflow sites will need to be set up. Most notably, these sites must be able to hold their evacuees for up to one week in order to monitor the health of evacuees and prevent the spread of COVID-19 among evacuated Afghans. This stage of the evacuation is technically outside of the planning process for the largest NEOs, where it is generally covered in a separate operation: for example, evacuees from South Vietnam were accommodated by "Operation New Life", which was separate from Frequent Wind (Anderson and Silano 1977). Accordingly, I do not go into great detail in the planning of this operation beyond laying out some basic guidelines, providing a simple model of evacuee flow through the transshipment points, and calculating requirements for airlift of evacuees back to the United States using civilian aircraft.

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[135] See Appendix C2.

Preparing Sites

The closest analogue to the operations being considered in this stage was Operation New Life, the follow-up to Operation Frequent Wind. During New Life, over 130,000 Vietnamese and Cambodian refugees were accommodated on Guam during a two-month period (April 24-June 25, 1975) while awaiting transfer to the US (Anderson and Silano 1977, p. xi). Their stay on the island coincided with the summer months and required managing populations of up to 40,000 at a given time. Orote Point, the main processing center in Guam, peaked at a settled population of 40,000 refugees, though this number fluctuated widely as nearly 100,000 people were processed through the site before transfer to other camps (Anderson and Solano 1977, p. I-B-5).[136] At the camp the Army (assisted by evacuee labor) constructed or operated all required amenities, including establishing the tent cities, operating aid stations and field hospitals, and providing mess areas as well as other temporary support facilities. This operation envisions a substantially similar camp being established at each of the three intermediate staging areas. At al-Udeid this should be fairly simple as the base is built to hold over 10,000 American servicemembers and prefab "trailer" dwellings are opening up as a result of ongoing construction of housing complexes and dormitories at the base by the Qatari government (al-Shafir 2021). Between the available trailer dwellings, other base buildings, and erection of tents, the US military should be able to accommodate a large number of evacuees at the site.[137]

Running the Orote Point site, which we will take as an exemplary site, required 2135 troops. Of these, however, 919 were combat troops providing security, with around 1200 troops

[136] Coincidentally, 40,000 is about the peak population expected at the intermediate staging areas for this operation. See "Modeling Evacuee Flows" below.
[137] Less is publicly available about the response made to accommodate the over 2000 evacuees from Operation Assured response. It is known that they were evacuated to an intermediate staging area in Freetown, Senegal before final transshipment to Dakar, Senegal. See Partin and Rhoden (1997, pp. 5 & 9).

directly filling support roles (Ibid V-B-1). The security function can, I argue, be largely filled by MP and other security units attached to the airlift units operating from the bases, a portion of the ground elements committed to the operational reserve, and host-nation (Qatari/Omani) forces already providing security at the bases. Thus, an additional battalion of support troops would likely be sufficient to support evacuees at each staging area. Units notionally similar to an Army Brigade Support Battalion would be able to fulfill this task.

Further Processing, Medical Evaluation, and Quarantine

While in the intermediate staging area evacuees undergo additional processing to confirm their immigration status and prepare for the next step of resettlement. Processes like background checks which are too time-consuming to do at an ECC can be performed here while evacuees are waiting in one place. One aspect of this NEO which makes it different from past operations is that it is taking place during the global COVID-19 pandemic. The risk of transmission among evacuees is high, particularly because the collapse of the Afghan government is likely to trigger large movements of evacuees into Kabul and evacuation operations necessarily put evacuees in close quarters both in flight and in processing areas on the ground.[138] Another risk factor in COVID transmission is vaccination rates, which in Afghanistan are very low compared to the United States.[139] The vaccination of unvaccinated evacuees should be undertaken after several days if evacuees test negative upon intake and arrival at their staging site. Evacuees, therefore, will be required to stay at their intermediate staging location for seven days while they await a negative COVID test and receive the first round of the vaccine. Second vaccinations may be administered after their arrival to an intake facility in the US.

[138] Afghanistan reports very low COVID case and death numbers (Johns Hopkins 2022), but it is unclear whether these are reflective of the true rate of COVID infection within the Afghan population or are a function of public health reporting (Essar et al. 2021).
[139] Only 1.2% of Afghans were vaccinated by July of 2021 (Ritchie et al. 2020).

Flights to US

Flights to the US from the transshipment points will be operated by the Civil Reserve Air Fleet (CRAF). The CRAF has been activated in the past to support US operations during the Gulf War and Operation Iraqi Freedom (Singh 2021) but this would be its first activation as a result of an NEO. These aircraft will be used to fly evacuees back to US soil, from which point they will be dispersed to a number of military bases capable of housing them until a larger evacuee reintegration program can find them a permanent place in the US or another state. During this period the evacuees will receive language and cultural training. Vietnamese and Cambodian evacuees following the Vietnam War underwent a process much like this one, and were dispersed across four military bases: Fort Chaffee, AR; Camp Pendleton, CA; Fort Indiantown Gap, PA; and Eglin AFB, FL (Thompson 2010, Anderson 1977).

I use 20 planes for this scenario, choosing the number because it is close to the number of C-17s needed and should help to maintain a smooth rate of flow without creating any bottlenecks. The planes used for this stage of the evacuation will be split between Boeing 747s and Boeing 777s.[140] There are several reasons for this. First, the two planes are the most commonly-used long-haul passenger aircraft in the inventories of major US airlines, who are the members of the CRAF. Second, it was confirmed by United Airlines that four of its 777s were used in the real-world Afghanistan operation (Singh 2021). The 747 has a range long enough to make an uninterrupted flight from all of the intermediate staging areas direct to the US, where McGuire-Dix Joint Base serves as the stopping point for the flights. From there, evacuees can be moved elsewhere in the US via additional commercial aircraft, military aircraft, or via commercial travel from airports in the New York, Philadelphia, or D.C. metro areas.

[140] Specifically, I use the Boeing 747 and the 777-200 for determining performance stats.

The NEOs in the reference set are mixed in their ability to provide guidance here. Operation Assured Response can tell us fairly little about the transfer of evacuees since there is little publicly-available information about accommodation of the evacuees in Freetown or Dakar. Another follow-on operation to Operation Frequent Wind, however, Operation New Arrivals, used a mixed civil-military airfleet to make around 600 flights ferrying evacuees from Pacific islands to the continental US (Haulman 2003, p. 115). This airlift took about four and a half months; superior ranges and capacities among the CRAF airfleet relative to Vietnam-era aircraft, together with the fact that the flights will not be transpacific, should make the airlift considered here both faster and easier, reducing the burden on the intermediate staging bases hosting the evacuees.

The operation analyzed here ends once the CRAF aircraft land at McGuire AFB. From there, additional aircraft or commercial flights from other airports may distribute evacuees to other bases around the US. Fort Dix (NJ), Travis AFB (CA), and Lackland AFB have been used in recent NEO and COVID repatriation/quarantine operations and could be suitable destinations for the evacuees. This is, of course, not the last phase of the operation for evacuees from Afghanistan. After evacuation during an NEO, host-country and third-country nationals admitted to the US or an allied state on a visa face a long and possibly difficult road to integration in their new country.

Modeling Evacuee Flows

I construct a basic model of evacuee flows to check the assertions of the prior sections and provide estimates of success and failure of the operation under a range of different scenarios. These scenarios vary in three important ways: the number of evacuees loaded onto each flight, whether the NEO has a 20-day or 25-day timeframe, and whether or not there was a delay which stopped evacuee flows from Afghanistan for a day. I do not model evacuee flows under the standard number of evacuees per aircraft as this number was inadequate to fulfill the NEO no matter what the circumstances (see Appendix C2 for more details on throughput under different loading assumptions). The first pair of analyses (Tables 2 and 3, Appendix C3) model the flow of evacuees between Afghanistan, the intermediate staging areas, and the US under conditions where there is no delay and the flights are loaded according to the "half and half" schema (200 evacuees per plane). I use them here as an example to assist the reader in understanding the flow tables.

As can be seen by comparing the two tables, Table 2 (Appendix C2) presents the NEO on a 25-day timeline, where the NEO begins on August 6th, while Table 3 (Appendix C2) presents the NEO on a 20-day timeline beginning August 12th. Each day the NEO is active (it is inactive on the first day when the NEO force is establishing itself), I reduce the number of evacuees remaining in Afghanistan by the maximum capacity of the airfield under the given loading conditions and assumed level of ground efficiency.[141] At the same time, I increase the number of evacuees in the intermediate staging areas ("total in havens") by an equivalent amount. This amount is split between the al-Udeid, Masirah, and al-Musannah staging areas on a 2:1:1 basis. The evacuees in the staging areas stay there for seven days undergoing further processing as well as COVID testing. At the end of the seven days' waiting period at the intermediate staging area (August 14th in Table 2, Appendix C2), the average payload across the CRAF aircraft is moved from the staging areas to the final point in the US. The red rows represent days which need to be held aside for transporting US troops and military equipment: if a scenario has a positive number

[141] This is done because the airport's throughput is the limiting factor in the operation.

of evacuees in the "Afghanistan" column once reaching these days, it has failed to evacuate the full complement of evacuees.

While a 25-day NEO under "half-and-half" loading conditions would likely be successful, when given only 20 days it falls short by over 20,000 evacuees. I then recreate the same tables, but this time changing only the number of evacuees loaded on each C-17, raising it to the emergency level used for NEOs (300 passengers/C-17, see Tables 4 & 5, Appendix C2). Raising the number of evacuees has a dramatic effect on the number of days required for a successful evacuation: in the 25-day NEO put forward in Table 5 (Appendix C2), the operation could theoretically be completed by August 20th. Even when the NEO is delayed 5 days, there is still considerable cushion for error, as shown in Table 5 (Appendix C2). Next, I recreate the same four tables from the above section, but this time I add a single day's delay. We might imagine this to be an attack on the evacuation which requires US forces to delay actions for 24 hours. No changes are made to loading decisions or any other factor affecting throughput. As can be seen from Tables 6 and 7 (Appendix C2), adding a single day's delay does not change the results under half and half loading: a 25-day NEO is still likely to be successful, while a 20-day NEO still fails. Adding a delay to the emergency loading scenarios in Tables 8 and 9 similarly has little effect. Overall, it seems that the most powerful factor driving overall throughput in this scenario is the number of evacuees per plane.

The evacuee flow tables have a secondary purpose: they allow us to see when and at what level evacuee populations peak at each of the staging areas. Emergency loading tends to lead to a backlog at the intermediate staging areas, with al-Udeid reaching over 40,000 evacuees for three consecutive days under non-delayed emergency loading scenarios (Tables 4 and 5, Appendix C2). A day's delay, however, can make a difference in the backlog at the staging areas since the staging area is able to offload evacuees without having them replenished by incoming flows from Kabul. Of course, this benefit only applies if the delay happens during a period where all current evacuees at a staging area are not being held for COVID observation (Tables 7 and 9, Appendix C2).

Total Force Estimates

Taken altogether, the operation as currently envisioned would require the commitment of over 11,000 ground troops, only 1,000 of which would be present in Afghanistan at the beginning of the operation. If all combat troops assigned to this mission were sent ashore, the total force in Kabul would peak at about 7,715 troops. If reserves were not committed, the force ashore would total around 4,415 troops. Including all troops along with the Army Support Battalions assigned to each of the intermediate staging areas brings the number up to 11,515. This number does not include the sailors on board the estimated six vessels of the MEB Amphibious task force (though it does include the pilots of the task force's strike aircraft since those are included in the MEU air combat element), nor does it include the airmen and pilots from the 379th AEW who will be attached to the mission. See Tables 12 and 13 in Appendix C3 for a summary of the estimated forces needed for this operation.

Step 6: Diagnostics

Given the highly qualitative nature of the analysis employed in this method, it is difficult to truly compare the findings in Step 5 to a large number of hypothetical scenarios. Therefore, in order to establish the face plausibility of the method, I choose to use a metric which is readily available in the dataset used for comparison in this study, the number of troops committed to an operation. In constructing the dataset used for this analysis this quantity was estimated from either after-action reports, news reports, military literature, or other secondary research.[142] This number can vary widely in NEOs. Many require no additional troops beyond what is already being used for embassy security: evacuees are able to leave before violence escalates to the point where additional security is necessary. At the other end of the spectrum, intense violence during an NEO can require large numbers of combat troops to provide security and ensure that the NEO is not disrupted by hostile forces.

If operational inference performs well then the number of troops needed for the operations within each reference set should be closer to the real number needed than that predicted by troop ratio approaches. Troop ratio approaches calculate their ratio using an entire dataset: by reducing the dataset to a set of most-similar operations, we should be able to achieve increased performance in terms of the number of ground troops. This, I feel, constitutes a hard test for the method: if better estimates for the basic quantity of interest in troop ratio approaches can be obtained using operational inference, then the method offers improvement over past approaches not just in its ability to estimate the full size and composition of the force but in estimating the size of ground forces as well. In the quantitative diagnostics below, I compare the median number of troops among operations in the reference set with estimates generated using troop ratio approaches by applying the troop ratio to the estimated population of the city where the operation is occurring.[143]

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[142] See Appendix B for more details on the construction of the dataset.

[143] I chose this metric because it seems to get closest to how we would apply the theoretical logic of troop ratio approaches to the NEO context: it represents the number of troops which are necessary to ensure security within the immediate area of operations (the city where the NEO is taking place). I rejected another possibility, applying the troop ratio to the number of evacuees expected, because the number of evacuees in NEOs is often quite small, in the dozens or hundreds, and would not even trigger the deployment of a single soldier according to troop ratios. This problem of measure selection is another argument in favor of the development of a new method: it is clear from the confusion of where the ratio should be applied that the troop ratio approach is unsuited for application to specialized operations like NEOs.

For the reasons discussed in the previous chapter, we expect that the number of troops estimated for the hypothetical NEO using a troop ratio approach should be higher than that suggested by simply taking the median number of ground forces in the reference set. This should be true for two reasons: first, because the troop ratio method does not consider labor savings from the use of air and sea forces, it should overestimate the number of troops necessary, and second, because force ratio approaches use the entire dataset, they are more likely to be affected by the presence of operations in the dataset which have unusually large troop contingents. Accordingly, I evaluate the statistical significance of the following diagnostics based on one-tailed tests unless otherwise noted.

Diagnostic 1: Basic Reference Set Diagnostics

First, it might be that the results we obtain from the matching phase are being driven by a particularly influential operation in the reference set. We might imagine, for example, that a reference set which has a single NEO with an abnormally small (or large) number of ground troops relative to the other reference operations might systematically produce small (or large) troop estimates. As before, I address this concern both by using the median number of troops as the quantity of interest in the quantitative diagnostics as well as by investigating the relative dispersion of the estimated median number of troops in the reference set after removing each element of the reference set. I then compare this dispersion with the dispersion of the median number of troops in the entire dataset when a proportional number of operations are removed.

Table 6: Changes when reference set operations are removed

Operation Name	GROUNDNO	Median Troops When Removed	Std Dev. Set GROUNDNO When Removed	Change (Ref Set Std Devs)
All NEOs	**N/A**	**12,717**	**173,848**	**N/A**
Reference Set, No Operation Removed	**N/A**	**3,500**	**3535**	**N/A**
Operation Frequent Wind	6,000	1,000	0	0.71
Operation Assured Response	1,000	6,000	0	0.71

As can be seen from Table 6 above, removing individual operations from the set causes change in the estimated number of ground forces required: this is mainly because the matching set for the hypothetical Afghanistan NEO is small (2 operations). However, even with a small reference set, when putting the changes in the estimated number of ground troops in terms of the standard deviation of the number of ground troops used in both the reference set (Table 6, Row 2) and the entire humanitarian intervention dataset, the changes produced still less than a standard deviation. Again, these are practically significant differences but are small in statistical terms. It does not seem that any individual operation is driving the quantitative calculations underlying the diagnostics presented here, while in the qualitative portions of the analysis no one operation in the reference set predominated, though Frequent Wind was referenced more often because of its greater level of similarity in terms of both tasks assigned and scale. I believe that it is reasonable to claim that the results of operational analysis, at least for the analysis presented in this chapter, are not being driven by individual operations present in (or absent from) the reference set.

Diagnostic 2: Monte Carlo

Second, it might be that the hypothetical case chosen for the analysis is a particularly favorable one: that is, that it has a profile of tasks which are particularly well-suited for a relatively small force or one which uses diversity of forces to make up for the small size of the deployment. If this was true, we would expect that the results for this specific type of operation would be systematically improved (estimate lower numbers of troops) relative to other hypothetical operations. That is, if we had specified a different hypothetical operation, the results would not have led to suggesting a better or lower force estimate.

I addressed this concern via Monte Carlo simulation: if the specific hypothetical operation under consideration here (the EU intervention in Libya) is driving the results, then showing that the performance of the model persists under a variety of inputs should suggest additional explanatory power. For this diagnostic, therefore, I first created an artificial "hypothetical" operation using independent draws of random values for each of the operational variables from the dataset. A matching set was then identified for the hypothetical operation using the Mahalanobis technique from Step 4. If a matching set could not be identified for a given combination of randomly-drawn values *k*, a matching set was instead generated by taking the *m* most similar operations in terms of distance.[144] For the purposes of this analysis, *m* was set at three.[145] This was repeated for 1000 simulations.

Figure 18 in Appendix C4 shows the results from this diagnostic when the estimates yielded by selection of reference sets are compared to those from the troop-ratio methods. As can be seen in Figure 18 (top panel), the method easily outperforms Quinlivan's ratio: many estimates calculated using Quinlivan's ratio were so large they could not be displayed alongside estimates from the other methods using a common scale. The ratio from the RAND study

[144] This technique, described earlier in Chapter Two (see above), was used here because wide variations in the qualitative nature of NEOs meant that randomly generating NEOs for comparison led to hypothetical operations which were unlikely in real world terms and thus generated high Mahalanobis distances across the board.
[145] Three was chosen as the number of the matching set because there was little appreciable difference in performance between a matching set size of 1 and 2. Increasing the size of the matching set yielded similar performance to 3 up to 6.

produced lower estimates, but like those produced by Quinlivan's ratio, overall estimates were significantly higher than those estimated using operational inference (Figure 18, panel 2). McGrath's ratio exhibited similar performance (Figure 18, panel 3). However, the method did not estimate significantly lower force sizes relative to those estimated using the force to population ratios put forward by Goode under conditions of low violence (Figure 18, panel 4). Across all force ratios, the direction of the difference in the estimates (force ratios tend to estimate higher number of troops than operational inference) was consistent with critiques of force ratio approaches in the literature. Taken together, these results suggest that the improvement in performance from operational inference relative to force ratio approaches observed in the analysis of the hypothetical Kabul Airlift was not driven by the choice of hypothetical operation.

Diagnostic 3: Comparing Errors

Finally, we can compare the results of the force estimation methods directly by calculating the error from each approach. Following a procedure similar to that in Diagnostic 2, individual operations were randomly sampled from the universe of comparison cases and removed from the dataset. Each sample operation was then used as the "hypothetical operation" and the five methods (median troops using operational inference and the four force ratios) were used to estimate the forces required for the real-world operation. The differences between these estimates and the true number of troops committed were computed to give the error. This process was repeated 1000 times to produce a distribution of errors.

Figure 19 shows the results from this diagnostic test. As can be seen in Figure 10 (top panel), operational inference alone among the methods produced a relatively symmetric error distribution centered around zero, though the spread of the errors from operational inference was the widest of the group. Quinlivan's ratio again had the worst performance in terms of error (Figure 19, second panel): all of the estimates generated with this method were too high by at least 5000 troops. The ratio from the RAND study also significantly overestimated the number of troops required, with all of its errors greater than 0 (Figure 19, third panel), as did McGrath's force ratio (Figure 19, fourth panel). Finally, Goode's ratio at a level of zero violence produced mostly overestimates but on average did not produce an error significantly greater than zero (Figure 19, fifth panel).

Qualitative Diagnostics: What Actually Happened?

A second diagnostic, and one which relies less on quantitative cross-national comparison, is to compare the force package arrived at using operational inference with that which was actually sent by the US to conduct the Kabul Airlift. Doing so provides additional assurance to the analyst that the basic task-based logic underlying operational inference is functioning as it is supposed to: given the same set of tasks and operational environment faced by the analyst, do real-world policy makers come to the same decisions?

The actual airlift began during the last week of July, 2021, though the number of flights at this time was relatively small and restricted only to those who had already begun the SIV application process (Thomas 2021). The first flights during this last weeks of July used commercial aircraft to extract "hundreds" of vulnerable Afghans, mostly children. By August 12th, however, provincial capitals were falling to the Taliban at an increasing rate and the full collapse of the Afghan state appeared inevitable: in a phone call on that day with then-President Ashraf Ghani, Secretary of Defense Austin announced that the SIV flights would begin to accelerate. From this point, the airlift began operating at a much higher pace, and by August 22, the US had evacuated 19,500 (Melimopolous and Chughtai 2021). Soon it would be evacuating more than that number every day.

Securing the Airport

KBL was initially protected by a portion of the 1000 US troops who remained in Afghanistan by the start of August. Initially, the Kabul Airlift involved the insertion of around 3,000 soldiers and Marines to support the 1000 US troops already on the ground, with the troop increase announced on August 12th and began arriving over the next 48 hours. An additional brigade of infantry was positioned in Kuwait at this time as an operational reserve (Macias and Kimball 2011). By August 15th, another 1000 troops had been sent to Kabul in order to complete the evacuation of the US Embassy, bringing the total to 5000 (Judd and Starr 2021). By August 24, the number of troops on the ground had peaked at around 6000, comprised of a total of 6 battalions.

The overall ground force component committed by the US in Kabul was largely in line with what was suggested by this research. A total of around 9000 ground troops were committed to the operation, whether actually deployed or held in Kuwait as an operational reserve (Lubold 2021), where this research predicted the use of 7,715 (see Table 12 in Appendix C3). The composition of the forces, which mainly came from the Army (particularly the 82nd Airborne, see Judd and Starr 2021), was somewhat different than that envisioned by this research, which drew more heavily on Marine units. Still, overall force estimates were fairly accurate. The analysis presented here predicted a ground element of 4,115 with two battalions held in reserve. Adding one of the reserve battalions to the total, as was done following the seizure of Kabul by the Taliban, produces almost identical ground force estimates (see Table 7 below) to the ground forces employed by the US during this operation. Compared with the other methods, operational inference had a much smaller error (1.4%), with its closest competitor, Goode's ratio, producing an error of greater than 100%.

In general, the forces securing the airport were fairly successful, suffering only two failures during the evacuation stage of Operation Allies Refuge. The first failure came on August 16th, the day following the Taliban's seizer of Kabul. Crowds of Afghans breached the perimeter of the airport, swarming onto the runways and forcing the US to pause the evacuation until the next day. In the chaos at the airport, eight Afghans were shot and killed by US Marines while other troops used low-flying helicopters, smoke grenades, and firing into the air in an attempt to disperse the crowds (Lubold 2021). Despite the scale of the chaos, US forces were able to resume flights the next day. The second security failure was the suicide bombing near the Abbey Gate on August 26th which left 170 civilians and 13 US troops dead. Following the bombing, flights were briefly interrupted but after US troops and Taliban fighters set up a tighter cordon around the airport, flights began again within 12 hours (Victor et al. 2021). The US retaliated with two drone strikes, one of which, in Kabul, killed ten members of a single family (BBC News 2021).

While these were both major failures of security, it is worth noting that after both incidents the evacuation was able to resume uninterrupted within 24 hours, which is a sign of a successful security force able to reimpose order.[146] Further, US forces were successful in detecting rumors of both incidents and warning civilians about them: on the 15th US officials warned US citizens not to go to the airport and to shelter in place waiting for instructions. A similar message was sent out before the bombing, telling civilians to avoid the airport (U.S. Embassy 2021). This suggests that US intelligence was somewhat successful at detecting and

[146] Compare this especially to the rocket attack on the runway of Tanh Son Nhut during Frequent Wind, which shut the airport down for the duration of the operation.

interpreting threats, even if its performance could have been significantly improved in terms of saving lives and completely preventing violence.

Table 7: Comparing Ground Troop Estimates Across Methods

Method (Kabul pop. of 4.43 million)	**Ground Troops**	**Error**
Reality (incl. 1000 reserves)	6,000	0
Operational Inference	4,115	-1,885
Operational Inference (Reserves)	5,915 (4115 + 1800 reserve)	-85
Quinlivan (20/1000)	88,700	82,700
McGrath (13.26/1000)	58,808	52,808
RAND (13.5/1000)	59,872	53,872
Goode (2.8/1000, no violence)	12,404	6,404
Goode (2.83/1000)[147]	12,516	6,516

Extracting Embassy Personnel

The process of leaving the US Embassy began on August 13th, when staff were told to begin destroying documents (AP 2021, *"Taliban Fighters*"). The evacuation of the embassy itself began on the 15th of August after the embassy began taking fire: Secretary of State Blinken announced on the night of the 14th (EST) that the embassy would relocate to the airport, now solidly under the control of US troops (Sullivan et al. 2021). The embassy evacuation finished by midday on the 16th. Operational details on the extraction of diplomatic personnel from the embassy are difficult to come by, though it does appear that multiple helicopters delivered troops to aid in securing the embassy, most likely delivering a force between platoon and company size to the embassy and removing other embassy staff (Atwood et al. 2021). Moreover, the evacuation appears to have been conducted through a mixture of ground transport and CH-47

[147] Here I use casualty data from 2019 to estimate Goode's ratio more accurately. As a reminder, Goode's formula is: $F = 1.2 \times (\frac{K}{L})^{0.45} + 2.8$, where F is security forces per 1000 population, K is the KIA rate of counterinsurgents per million population, and L is the fraction of security forces local to the conflict area. I set K at (7000/38.93million) and L at (16,600/272,500). Data for this calculation was drawn from Saif (2020) as well as Gollob and O'Hanlon (2020).

helicopters (AP 2021, *"Taliban*"). Finally, extraction missions via helicopter did go on later on in the evacuation as both Germany and the US sought to gather evacuees after the Taliban tightened their control of the area around the airport.

Conducting the Evacuation

While the evacuation technically began far before either of the start dates chosen in this analysis, it got off to a much slower start. The pace of the evacuation, however, steadily increased as the operation continued. Between the seizure of Kabul on August 14-5th and August 25th, more than 82,000 people had evacuated, with 21,600 people flying from KBL between the 23rd and 24th alone, a pace which far outstripped any estimated in the prior analysis (Cooper and Schmitt 2021).[148] In general, the evacuation was, given the strict timeline and late start, quite successful. 124,000 people, short of the initial goal but still an impressive sum, were evacuated by the August 30th end of the airlift (AP 2021, "*Explainer"*).

The biggest problems in terms of the throughput of the evacuation appear to not have been caused by the limited space at the airport, as was initially thought to be the major limiting factor, but rather by the processing stage of allowing Afghans into the airport itself (Machi 2021). The US and Germany both sought to address this by using helicopters to extract hundreds of citizens, but ultimately tight security around the airport (particularly following the breakthrough of August 16th) slowed entry (Ibid., AFP 2021). Stories appearing after the airlift about the "thousands" of SIV recipients and applicants left behind in Afghanistan suggest that this problem of throughput had real consequences, stopping many deserving evacuees from

[148] The reasons for this discrepancy remain unclear, particularly since US flights were said to be departing "every 45 minutes" at the height of the evacuation, a rate which would allow 32 C-17 flights per day, a pace that was similar to the calculated capacity of KBL under 100% queuing efficiency. One strong potential explanation is that the US was willing to go far beyond the normal "emergency" limits of NEO evacuees per flight. Passenger loads of 400 evacuees per C-17 were reported, and (as stated previously) other aircraft certainly exceeded this, with one C-17 carrying 640 total evacuees (Cooper and Schmitt 2021).

escaping during the course of the airlift. Still, the speed with which the airlift was ramped up was impressive, and the rate of evacuation at its highest point exceeded even the most optimistic models offered by this analysis.

Accommodating the Evacuees

This was the stage where the operation envisioned in this analysis diverged most widely from real events. To be sure, there were some similarities: both operations used CRAF aircraft as a transport back to the US and kept those aircraft away from Kabul. Further, the number of aircraft (20) chosen in this research as a way to maintain an even flow throughout the operation, was similar to that used by the real-world operation (18). From there, however, the two operations diverged significantly.

To begin, while in the operation considered in the analysis evacuees were divided between multiple staging areas before heading to a single point (done for ease of modeling), most evacuees from Allies Welcome were sent to al-Udeid and then sent on to a wide variety of sites. Another key difference was that, unlike in the planned evacuation wherein all evacuees were sent to the US, in Allies Refuge evacuees were reportedly sent to await resettlement in “at least eight” countries (AP 2021, “*Explainer*”). COVID precautions and testing were not a priority until the refugees reached their medium-term resettlement locations, such as in the US: unlike in the operation envisioned here, evacuees were not screened or vaccinated at the transshipment points, but rather further down the line of the evacuation. Accommodation at al-Udeid was not easy: assuring access to food, water, and hygiene products while keeping evacuees healthy in a Qatari August was a major problem, with many evacuees sleeping in hangars with no climate control (AFP 2021). Further, throughput at al-Udeid was slower than anticipated in this research’s model: by some reports, it could take up to twelve hours to check an evacuee against the National Counterterrorism Center watchlist (Ibid). Still, the US was able to take advantage of its networks of alliances and bases to temporarily house evacuees in a number of locations, including Germany, the UAE, and Kuwait. On the whole this stage of the evacuation was fairly successful: despite the problems, thousands of evacuees passed through Qatar on their way to other bases.

What Went Wrong in Kabul?

Though the Kabul airlift in reality was able to extract most of the desired evacuees, it left behind a good number and was widely criticized for its failures.[149] The exact number of Afghans working with ISAF left behind in Afghanistan remains unknown, but one report by the Association of Wartime allies claimed that at least 78,000 Afghans eligible and enrolled in the SIV program were left in Afghanistan following the withdrawal. Using the operation designed here, we can answer some questions about what went wrong with the Kabul airlift, what could have been done to improve performance during the operation, and advice to carry forward in the future.

The primary failure was the slow start of the evacuation. Members of the Biden administration claimed that they were unwilling to quickly escalate the evacuation because to do so would have hastened the collapse of the Afghan government. This may have been a reasonable fear based on what was known before the Taliban offensive when it was unclear to what degree the ASDF would fight the Taliban. However, given what happened, it is now clear that waiting to begin the evacuation in hopes that appearing confident would stiffen the spine of the Afghan government was a mistake. As the results of this analysis show, starting the evacuation in earnest the day the first provincial capital fell (the 6th) would have provided an

[149] See US Senate (2022) for a comprehensive review of criticisms of the withdrawal.

excellent chance for all applicants to evacuate. The fact that the Biden administration waited until the 13th-14th to begin the evacuation in earnest was a major missed opportunity. Looking at the flow tables, it is clear that 20-day evacuations (which begin on the same day as the first fallen provincial capital) were always pressed for time in evacuating and are fully successful only at the highest loading capacity (300 per flight) assumed in this analysis. Because US troops eventually exceeded even these numbers, they were able to make up for some of the lost time, but in a 25-day evacuation

Another criticism is that the Biden administration did not take seriously the need to expedite and update the SIV program in order to allow additional applicants to evacuate Kabul. Given what actually happened in Kabul, it is unclear whether or not this would have made a difference. Delays in throughput at the Kabul airport appear to have been caused by the size and desperation of the crowds rather than any kind of paperwork problems: indeed, lengthy problems with documents and paperwork processing tended to occur at transshipment points like al-Udeid rather than at the airport itself. Expanding and expediting SIV applications may have actually made the problem worse by increasing the numbers of Afghans gathered around the airport. However, choosing early on to prioritize the SIV application process could have had some important benefits. It could have directly benefited the operation by easing throughput at transshipment points by preclearing more applicants against terrorist watchlists: this would not have solved the problem of chaos at the airport but may have made the rest of the experience easier for evacuees. Indirectly, an earlier focus on the SIV program may have provided a better sense of the scope of the problem, encouraging the Biden administration to act sooner.

One criticism of the airlift which this analysis finds to be spurious is the assertion that Bagram AB should not have been closed (see the Wall Street Journal's editorial [2021] on the subject for an example; see also US Senate 2022). In reality, the airport at Kabul had the capacity to evacuate more than the number of evacuees required under the parameters of this study. Operating at Bagram as well as KBL would have increased the number of troops needed for ground security and might have opened up additional space for attacks on evacuees and US forces. The main advantage to Bagram, its defensibility, does not seem to be a great advantage in terms of throughput: the security breaches which did occur do not appear to have slowed the evacuation appreciably. Further, the defensibility of Bagram would likely have not done much to prevent a tragedy like the Abbey Gate bombing: there would likely have been crowds gathered at Bagram as well as the airport, with US troops in front providing crowd control. For a group like ISKP, this kind of target of opportunity would be hard to pass up, doubly so if the US was still using a former airbase and symbol of foreign occupation as an escape route. Instead, keeping the evacuation to one site allowed all evacuating nations to focus their forces at a single location and minimized the amount of traveling Western troops had to do outside of occasional flights in helicopters, which also contributed to force protection.

Could it Have Been Improved?

Whether or not the evacuation of Afghanistan could have been more successful if given more time depends on a number of contingent factors. A longer operation may have attracted more attacks or created greater crowd control problems. Whether or not the force committed for the operation had the capacity for a larger operation processing the evacuees is an open question. Still, if the operation had begun on August 6th and had maintained an emergency loading of 300 evacuees per C-17 almost the entire population intended to be evacuated in the operational inference exercise (128,079) as well as the 78,000 “left behind” SIV (206,709 total) could have been evacuated. Flow Table 10 (Appendix C2) shows that at emergency loading, almost the entire combined population could have been evacuated while maintaining a pace slower than the one the US military was able to maintain during much of its evacuation; the 21,600 evacuees in a day reported by Cooper and Schmitt (2021) is more than double the 8,901/day under emergency loading. If the US had maintained flights of 400 passengers, which was apparently a regular occurrence, it would have been possible to evacuate the entire population of 206,709 with double the amount of attacks with three days to spare (see Table 11, Appendix C2). By starting only a week earlier then, much more could have been done.

Conclusions of the Afghanistan Analysis

In order to demonstrate the utility of the method for analyzing a real-world military operation, operational analysis was applied to the Kabul Airlift (Operation Allies Refuge). Doing so allowed the chance to demonstrate and double-check the method's performance against real-world data while also providing another application of the method to a new class of MOOTW. Whereas in Chapter 3 operational inference was used to analyze a hypothetical scenario in order to answer policy-relevant questions, here it is used to analyze a real-world operation and can be used to evaluate and respond to policy criticisms. Taken together with its strong performance in the diagnostics in both this chapter and Chapter 3, this demonstrates both the improved accuracy of the method relative to force ratio methods as well as evidence for its broader validity across multiple classes of military operations.

On the methodological side, this analysis showed that operational inference does offer significant improvements in performance over the force-ratio method, particularly the older versions of the method put forward by James Quinlivan and John McGrath. Relative to these older force ratios, the operational inference approach offers a more accurate estimate of the number of ground troops. While the newest force ratio approach, that put forward by Steven

Goode, offered similar performance in terms of estimating ground troops, the extended qualitative analysis of operational inference offers insights for a greater number of research questions: the kind of logistical modeling which is done here would be more difficult and less accurate if the researcher was simply working from a force ratio estimate. Like in the previous chapter, the improved performance noted in the quantitative diagnostic tests was generated entirely through the pre-processing step of selecting reference operations. Given the qualitative improvement in performance offered by the method as well as its performance in the "hard test" diagnostics, there is evidence that this approach has validity for the planning and research of multiple categories of MOOTW and likely other classes of military operations as well.

The results from this chapter further confirm many of the findings from the previous chapter. Quinlivan's ratio performed poorly in the NEO context relative to operational inference and other force-ratio approaches, while Goode's ratio continued to exhibit the best performance among ratio approaches. Force ratio approaches continued to produce systematically higher estimates relative to operational inference approaches, and non-Goode force ratios produced errors which were *always* greater than zero, though the absolute magnitude of the errors was lower in the NEO context than the humanitarian intervention context. Generally, the ability to control for important contextual variables leads to superior performance in estimating force requirements, an insight which can now be applied to multiple types of MOOTW as well as (possibly) other types of military operations.

Substantively, this analysis showed that the Kabul airlift was generally successful at hitting the DHS target of 128,079, though it ultimately fell short of even this goal, allegedly left behind tens of thousands more, and was marred by a number of tragedies besides. Despite these failures, US forces were able to recover and maintain a high level of throughput, exceeding the expectations of this analysis. The tragedies which befell the operation were not unknown to US troops before they occurred, but in NEOs of this size and complexity, taking place in a collapsing state, there is always a chance of serious violence which threatens US lives and the execution of the operation. It is to the credit of US troops that they overcame the delays these tragic incidents forced on the operation and indeed were able to accelerate the evacuation, at least after the perimeter breach on August 16th. US performance during the NEO was, if not stellar, beyond what could reasonably be expected for an NEO which only operated at full capacity for about two weeks. Key to this performance was a willingness and ability to regularly overload C-17 flights: doing so in situations where airfield capacity is the main limitation on throughput creates significant gains in productivity, as the flow modeling tables in Appendix C2 show. Common criticisms of the operation, including that the US should not have abandoned Bagram or should have focused on accelerating the SIV process, appear unlikely to have made a difference in the conduct of the operation and may have created additional problems. The main change this analysis identifies which would have made a real difference in terms of the number of people evacuated would have been to start the NEO sooner: fears of causing the Afghan government to collapse by jumping the gun appear in hindsight to be overblown, if not wrongheaded. In future NEOs the US should begin the planning process as early as possible, and if destabilization of local governments is a concern, should develop the plan on the US side to the greatest extent it can before going public with the operation.

Chapter 5: Conclusions

The study of military operations in the security studies literature is in the midst of a period of intense methodological innovation. New technologies and crossover from other branches of political and social science enable researchers to ask new questions and use new sources of data to draw their conclusions. This methodological flowering, however, has largely ignored military operations outside of conventional warfare. This research represents an important correction to this trend in the literature and develops a new methodological approach to the study of military operations, particularly MOOTW. The new method, operational inference, uses a simple quantitative technique, calculating multivariate distance, to guide case selection. Theoretically, operational inference imitates the troop-to-task decisionmaking within the military itself. The method outperforms the most common tool used by civilian analysts in the past, force ratios, in estimating the number of ground forces needed for military operations, and additionally provides a tool for estimating the composition of forces, including air and naval assets required.

The success of operational inference as a method offers civilian researchers in the academy and NGO space the ability to estimate military needs for Military Operations Other Than War. It does so by using past operations similar to the operation being considered as a model and provides a method for justifying case selection. This conceptually simple but powerful technique goes beyond the heuristic approach of force ratios and offers civilian analysts a way to think seriously about military requirements, with hopefully positive consequences for public debate before and after military operations. It also offers a new extension of the method of campaign analysis and provides an example of how other methodological techniques can be used to extend its usage into new areas of study.

Superior Performance

The prior chapters demonstrated the superior performance of operational inference in predicting force size and composition relative to force ratio approaches. Not only does operational inference offer qualitative improvement in that it can make suggestions related to the composition of the force needed for an operation, but it also outperforms force ratio approaches at the central task of predicting the number of ground troops deployed for an operation. At the same time, the prior analyses showed the value that operational inference has relative to an unstructured case comparison. Case-based methods benefit from principled methods of case selection and operational inference provides a relatively simple way to justify case selection. The case analyses presented in the two prior chapters show how the close study of cases which are substantially similar to a hypothetical or real-world operation can yield important insights on key questions and help the researcher get a picture of what she is missing in her analysis.

This is not to say that operational inference will always be the preferred method for answering questions about MOOTW. A higher level of effort is required to code and select a reference set than is required to simply apply a ratio, particularly in cases like Chapter 4 where no dataset of relevant comparison operations exists: in such cases, applying operational inference requires a good deal of effort in order to identify comparison operations and code key operational and environmental variables. Researchers will have to balance their need for increased accuracy with the level of effort required[150]: if only a back-of-the-envelope estimate is needed, Goode's 2.8/1000 troop ratio may be acceptable. It is my contention, however, that generally the improved performance offered by operational inference makes it a preferable technique in most instances, particularly for campaign analyses and definitely for campaign

[150] In particular, the level of effort required for OI is higher if a comparable set of operations is not available and must be constructed by the researcher.

analyses aimed at answering sufficiency questions. If a database of operations comparable to the one the analyst is contemplating is available, the method is able to generate far superior estimates with only a few hours' or days' effort. If not, the assembly of a comparable database is the work of a few weeks for a single researcher and possibly less than a week for a small team. Further, the more effort future researchers put into compiling datasets of military operations, the greater the utility of operational inference will become.

Contributions from this Study

This study makes a number of contributions to the study of military operations using open-source data. This is an important contribution because there is a large and growing gap in knowledge of military affairs between civilians and military professionals, but civilians remain no less invested in the use of the military, particularly in highly visible deployments like NEOs or humanitarian deployments. In fact, civilians who may be most invested in humanitarian deployments generally lack accurate tools to think about the requirements of a military operation. Operational inference offers a framework through which a structured argument can be made, drawing on historical knowledge as a guide.

More generally, this research shows the utility of reducing the number of potential comparison cases in a medium-*n* dataset down to a smaller and more manageable number via a case selection method. While researcher freedom does persist in the choice of variables to include in the analysis, operational analysis offers a way to integrate quantitative and qualitative insights in an iterative way such that the one motivates and improves the contributions of the other. It is, therefore, an example of a truly mixed-methods approach to the study of military operations which other scholars of international security as well as analysts outside of academia may apply in their own work.

This research also extends the emerging research agenda of campaign analysis. Rather than simply apply the method of campaign analysis to a new problem, this research provides a method to help campaign analysts structure their thinking and guide their case selection for comparison. It is especially suited to answering what Tecott and Halterman (2021) call sufficiency questions*:* how much or how many of a given asset is necessary for accomplishing a given goal, and could the goal be accomplished with the resources available under prevailing conditions? Generally, the further away a military operation under analysis is from conventional frontline combat, the greater the analytical leverage operational inference will provide the researcher. This research is an example of the methodological cross-pollination to strengthen campaign analysis as a method which Tecott and Halterman call for in their paper and shows that campaign analysis can be used by civilian analysts with access to only open-source data to answer a wide variety of military questions. Last (but not least), it provides a new tool to assist (and hopefully some helpful examples to inspire) future campaign analyses focused on MOOTW.

Finally, this research contributes to the academic study of Noncombatant Evacuation Operations. While these military operations are becoming more widely studied in civilian research, the events in Afghanistan discussed in Chapter 4 show that they are not fully understood and that their conduct could be improved, particularly given the importance a highly visible NEO can have for perceptions of a state's capabilities. This study advances research on this topic by compiling the first publicly available dataset of US NEO operations, as well as by providing a critical assessment of the evacuation of Afghanistan.

New Applications

Operational inference is a useful tool for military analysis outside of the specific uses presented here. The basic logic of the technique, that simple quantitative preprocessing can be used to guide case selection for qualitative comparison, is not restrictive in the types of operations to which it can be applied. While operational inference is less useful for modeling conventional combat where more established estimation techniques exist, it can provide a useful complement to such analyses, particularly for supporting operations like logistics, ISR, or occupation duty. So far, many past campaign analyses have done a good job of modeling conventional frontline combat in a variety of domains, but fewer answer important questions about what it might take to sustain a force, or how force requirements might change through the introduction of a new technology: operational inference offers a way to answer these complementary questions, and to help guide the choice of comparison cases for the analysis. This new tool could generally improve operational-level studies of war, particularly when medium-n or even large-n data exists: while country-level datasets providing information about entire wars are common in security studies research (Izmirioglu 2017; Urlacher 2021) and the use of battle-level data is becoming more common (Cochran and Long 2017; Lehmann and Zhukov 2019), less attention is paid to the operational level of warfare. Operational inference offers researchers a new way to study warfare and troop requirements at this level of analysis.

Future Improvements

Future work in the same vein as this research could, as explained above, expand the application of operational inference to new kinds of operations, both MOOTW and conventional warfare. The technique could, for example, be used to determine similarities in airpower campaigns: many historical airpower campaigns exhibited more than one of Pape's (1995) airpower strategies, so operational analysis could be used to identify campaigns which were similar in aim and/or scope. Within MOOTW, other, less-studied types of missions like raids could be studied. Finally, so far, all the applications I have provided for the use of operational inference have been post-WWII operations. If future analysts use this technique to study more conventional warfare, they might do so with historical operations (pre-Cold War) which have a wealth of available data in reference texts rather than piecing together a narrative from disparate sources. The availability of such data would also make the construction of datasets like that from Chapter 4 easier, providing additional benefit to other researchers.

On the methodological side, future work could focus on the distance metric, incorporating other distance measures in order to test their relative efficacies. Mahalanobis distance was chosen in this study because of its use in the matching literature as well as its ease of calculation and interpretation, but it is not the only distance metric in the literature, nor does it have any special properties which make it inherently suited to this kind of analysis. Even within Mahalanobis, future work could experiment with weighting the variables differently. This was done qualitatively in Chapter 3 where two operations from the reference set were dropped for being too dissimilar, but it could also be done in the quantitative portion as well. Future researchers could also (resources permitting) take a more qualitative approach, surveying military experts to determine which variables should be weighted highly and which ignored. The strong performance of Operational Inference in this study suggests that future analyses which attempt to improve the method will also be likely to produce fruitful results.

Appendix A: Libya Analysis

Appendix A1: Combatant Forces and Equipment

Section I: Libyan National Army and Allied Militias

Personnel

Table 1: LNA Personnel

Force	**Type**	**Estimated Strength**
Libyan National Army	Army/Militia	7,000
Private Contractors	Private	2,000
Wagner Group	Private	3,000
Zintan Militias	Militia	2,500
Tribal Forces	Militia	18,000
TOTAL		~32,500

Sources: IISS Armed Conflict Database 2021, AFP 2019, Delalande 2018

Equipment

Table 2: LNA Equipment

Class of Weapon/Equipment	**Type of Equipment** (Quantities Unknown Unless Otherwise Noted)
Ground Forces	
Main Battle Tanks	T-55; T-72
Reconnaissance Vehicles	BRDM-2 ("Hundreds" modernized); EE-9 Cascavel; Civilian "Technicals" armed with machine guns or anti-air guns
Armored Personnel Carriers	M113; BTR-60PB; Nimr *Jais*; *Puma*; BMP-1; *Ratel*-20; 500 T-6 *Panthera*
Anti-Tank/Anti-Infrastructure Missile	10 9P157-2; 9K11 *Malyutka*; 9K11 *Fagot*; 9K111-1 *Konkurs; Milan*
Anti-Tank/Anti-Infrastructure Recoilless Rifle	106mm M40A1; 84mm *Carl Gustav*
Self-Propelled Artillery	122mm 2S1 *Gvodzika*
Towed Artillery	122mm D-30
Multiple Rocket Launchers	107mm Type-63; 122mm BM-21 *Grad*
Missiles	R-17 Elbrus (SCUD-B)
Mortar	M106
SAMs	SA-6 *Gainful*; SA-7A *Grail*; SA-24 *Grinch*
Anti-aircraft Cannon	SP 14.5mm ZPU-2; 23mm ZSU-23-4
Naval Forces	
Patrol and Coastal Combatants	1 *Burdi* w/ 23mm gun; 1 *Burdi* w/ 76mm gun; 1 *Burdi;* 2 FRA RPB20; 1 *Hamelin*; 1+ PV30 Patrol Boat
Air Force (15+^ combat capable*)	
Fixed-wing Aircraft	12 MiG-23^; 14 MiG-21bis^; 1 *Mirage* F-1ED; 2 Su-22UM-3K^; MiG-25^
Helicopters	Mi-24/35 *Hind*; Mi-8; Mi-17 *Hip;* 4 Mi-35Ps
AAM	R-3; R-60

Source: The Military Balance 2022, Beckhusen 2018, (*) *AFP 2019,* (^) *Military Watch 2019, Schroeder 2015, Global Security 2019*

Section II: Government of National Accord and Allied Militias

Personnel

Table 3: GNA Personnel

Force	**Type**	**Estimated Strength**
Misrata Militias	Militia	18,000
Private Contractors	Private	Unknown, mainly pilots
Turkish Officers	Army	100 (trainers, advisors)
Tripoli Special Deterrence Forces	Militia	1,800
Nawasi Militia (Tripoli)	Militia	1,800
Misc. Militias	Militia	800
TOTAL		~ 23,500

Sources: AFP 2019, IISS Armed Conflict Survey 2021

Equipment

Table 4: GNA Weapons and Equipment

Class of Weapon/Equipment	Type of Equipment (Quantity Unknown Unless Otherwise Noted)
Ground Forces	
Main Battle Tanks	T-55, T-72
Reconnaissance Vehicles	Civilian "Technicals", armed with machine guns or anti-air guns
Armored Personnel Carriers	BMP-2, 4K-7FA Steyr
Anti-Tank/Anti-Infrastructure Missile	9M123
Self-Propelled Artillery	155mm *Palmaria*
Towed Artillery	122mm D-30
SAMs	SA-7A *Grail*; SA-24 *Grinch* (Small Arms Survey)
Naval Forces	
Patrol and Coastal Combatants	1 *Sharaba*, 4 single launchers with *Otomat* Mk2 AshM, 1 76mm gun 2+ PV30 Patrol Boat
Landing Ships	1 *Ibn Harissa*, 3 twin 40mm DARDO CIWS (capacity 1 heli; 11MBT; 240 troops)
Air Force (10^-15*+ Combat Capable)	
Fixed-wing Aircraft	MiG-23BN; 1 MiG-25^; 1 J-21 *Jastreb*; 3 G-2 Galeb; 8 L-39ZO; SF-260 (unknown quantity);
Helicopters	Mi-24 *Hind*; Mi-17 *Hip*
AAM	R-3; R-60; R-24

Source: The Military Balance 2022, (^) Military Watch 2019, (*) AFP 2019, Schroeder 2015

Section III: IS and Other Islamist Forces

Personnel

Table 5: Islamist Manpower

Force	Type	Estimated Strength
Islamic State	Militia/Terrorist	800
AQIM	Militia/Terrorist	1,000 (not all in Libya)

Source: Wilson and Pack 2019, Department of State 2018

Equipment

Table 6: Islamist Weapons and Equipment

Class of Weapon/Equipment	Type of Equipment (Quantities Unknown)
Ground Forces	
Small Arms	Rifles, Explosives, Rocket-Propelled Grenades
SAMs	Various MANPADs (Likely SA-7A or SA-24)
Artillery	Rockets (Unknown Type), Mortars (Unknown Type)

Section IV: Haven Populations and Displacement Scenarios

Table 7: Displacement and IDP Population of Northwest Libya by Region

Region	Population (2006)	Migrants (Feb. 2019) ^	IDPs (Feb. 2019) *	Total Est. Pop
Zuwara	287,359	15,505	527	**303,391**
Azzawiya	290,637	37,890	7,937	**336,464**
Aljfara	451,175	34,390	7,030	**492,595**
Tripoli	1,063,571	143,838	16,227	**1,223,636**
Almargeb	427,886	20,865	6,741	**455,492**
Misrata	543,129	59,078	21,340	**623,547**

*Source: Statesman's Yearbook 2016, ^IOM 2019(1), *IOM 2019(2)*

Table 8: Estimated Haven Populations Post-Displacement

Haven	Population (est.)	Post-Displacement, 2011 Rates (Displaced)	Post-Displacement, 2011 Rates Switched
Zuwara	45,000	60,877 (15,887)	281,131 (236,131)
Khoms	200,000	365,544 (165,544)	282,765 (82,765)
TOTAL DISPLACED		181,431	318,896

Section V: Force Requirements

Table 9: Peak Force Requirements, Past EU Naval Operations

Ship/Asset Type	Operation Triton	Operation Sophia	**TOTAL**
Aircraft Carrier	0	0	0
Frigate/Destroyer	0	4	4
Corvette	0	1	1
Offshore Patrol Vessel	6	0	6
Coastal Patrol Vessel	17	0	17
Amphibious Assault Ship	1	1	2
Fixed-wing Patrol Aircraft	12	3	15
Rotary Aircraft	5	6	11
Hydrological Ship	0	1	1
Misc. Ship/Unspecified	3	1	4
TOTAL Ships	**27**	**8**	**35**
TOTAL Warships	**1**	**6**	**7**
TOTAL Patrol Vessels	**26**	**1**	**27**
TOTAL Aircraft	**17**	**9**	**26**

Sources: Amnesty International 2015, EEAS 2016, Sonnino 2015

Table 10: Naval Force Requirements, Present Operation

Ship/Asset Type	**TOTAL**	**Class (Ex.)**
Aircraft Carrier	1	*Cavour (IT)*
Frigate/Destroyer (ASW)	1	*Bremen (DE* *Aquitaine (FR, IT)*
Frigate/Destroyer (AA)	2	*Horizon (FR, IT)* *Aquitaine (FR, IT)* *Saschen (DE)*
Frigate/Destroyer (SLCM)	1	*Aquitaine (FR)*
Corvette	1	*Minerva (IT)* *Braunschweig (DE)*
Submarine (SSN, SLCM)	1	*Suffren (FR)*
Offshore Patrol Vessel	3	*Commandante (IT)* *Cassiopeia (IT)*
Coastal Patrol Vessel	12	*Various*
Amphibious Assault Ship	1	*Mistral (FR)* *Garibaldi (IT)* *Galicia (SP)*
Fixed-wing Patrol Aircraft	15	*Various*
Rotary Aircraft	11	*Various*
Hydrological Ship	1	*BHO (FR)* *Elettra (IT)*
Supply Ship	2	*Durance (FR)* *Etna (IT)*
TOTAL Ships	**26**	
TOTAL Warships	**8**	
TOTAL Patrol Vessels	**15**	
TOTAL Aircraft	**26**	

Source for Classes: I Jane's Fighting Ships 2021-22
Note: Does not include vessels for sealift: additional amphibious assault ships used in sealift.

Table 11: Force Requirements, No-Fly Zone

Role	Number (Shlapak 2002)	Number (Current Operation)	Aircraft Type (Ex.)
Air Superiority/Strike	28	32	*Rafale, Mirage 2000, Typhoon, F-15, F-35II*
SEAD	8	4	*Tornado ECR*
Surveillance/AWACs	3	3	*E-3*
CSAR	3	3	*Caracale, CH-53*
Airlift	8	8	*A310, A340*
Tanker	10	10	*A310, A330, C-135*
Transport	3	3	*A400M, C-130*
UAV	N/A	8*	*Reaper, Predator, Heron, Marfang*
TOTAL	63	71	

Note: Transport aircraft listed here does not include transports for ground forces.
*: *UAV requirements are based on force levels from Operation Unified Protector. Note that while these assets were insufficient during OUP, the required area of operations was over three times as large as that proposed in this analysis.*

Table 12: Force Requirements, Ground Forces

	Zuwara		Khoms		Total	
Unit Type	**Unit**	**Number (Approx.)**	**Unit**	**Number (Approx.)**	**Unit**	**Number (Approx.)**
Light Inf.	2x Cpy	400	4x Cpy	800	6x Cpy	1200
Mech Inf.	2x Cpy	400	4x Cpy	800	6x Cpy	1200
HQ + Support	1x Cpy	200	2x Cpy	400	3x Cpy	600
Engineers	1x Cpy	100	0	0	1x Cpy	100
Logistics	1x Cpy	100	1x Cpy	100	2x Cpy	200
Paramilitary Police	1x Cpy	100	2x Cpy	200	3x Cpy	300
CA	1x Sec	20	1x Plt	40	1x Plt (+)	60
Light UAV	1x Plt	40	2x Plt	80	3x Plt	120
SOF	1x Cpy	100	1x Cpy	100	2x Cpy	200
MEDEVAC					2x Cpy	200
TOTAL		**1460**		**2520**		**4180**

Appendix A2: Maps and Charts

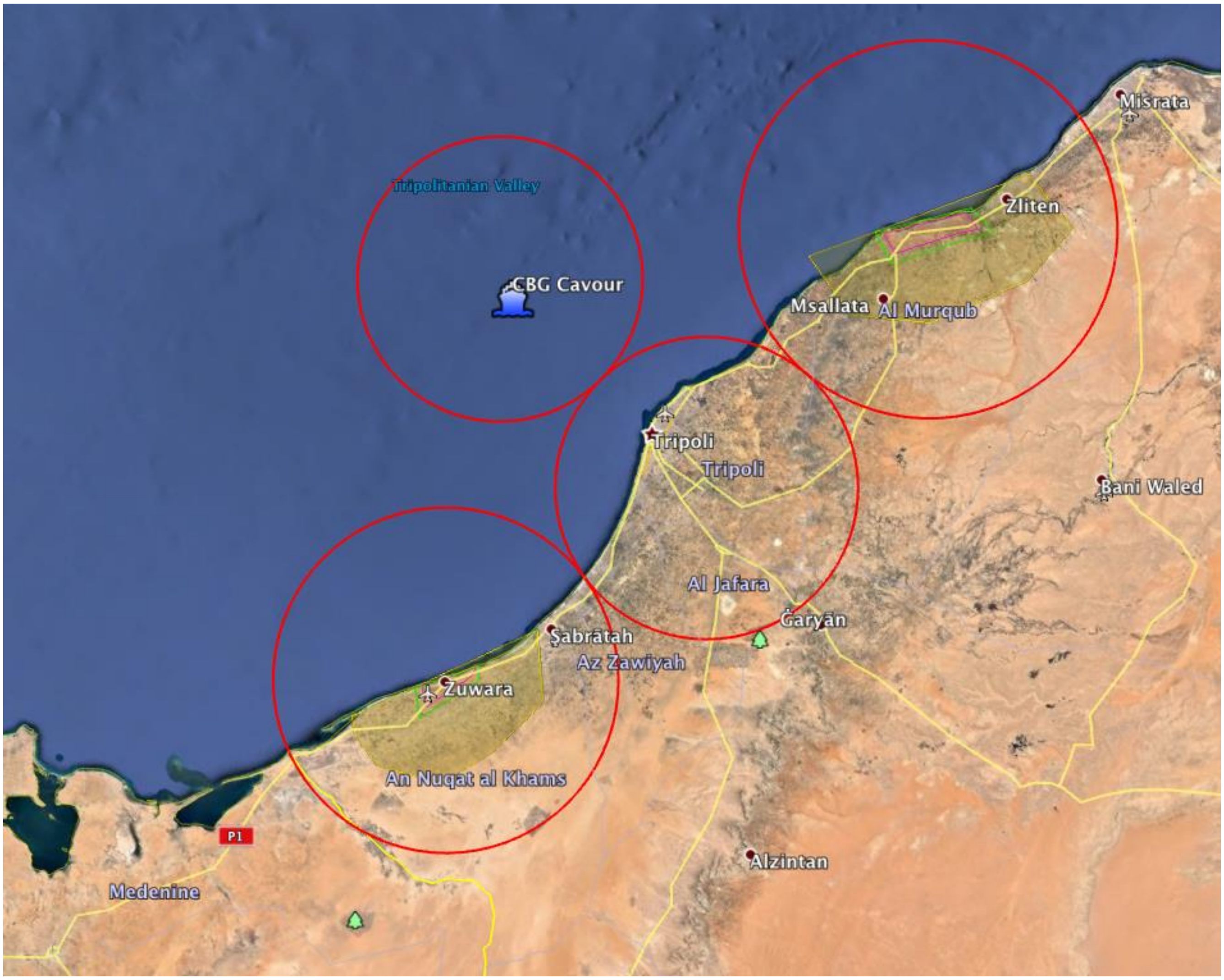


Fig 1: Satellite View of Area of Operations.
Pink regions are safe havens, yellow are heavy weapons exclusion zones, green lines are indirect fire zones, red are aircraft engagement zones.

Fig. 2: Khoms Safe Haven.
Pink regions are safe havens, yellow are heavy weapons exclusion zones, green lines are indirect fire zones, red are aircraft engagement zones.

Fig 3: Detail of Port of Khoms.
Pink regions are safe havens, yellow are heavy weapons exclusion zones, green lines are indirect fire zones, red are aircraft exclusion zones.

Fig 4: View of Zuwara

Pink regions are safe havens, yellow are heavy weapons exclusion zones, green lines are indirect fire zones, red are aircraft engagement zones.

Fig. 5: Detailed view of Zuwara Airfield and Port

Pink regions are safe havens, yellow are heavy weapons exclusion zones, green lines are indirect fire zones, red are aircraft engagement zones.

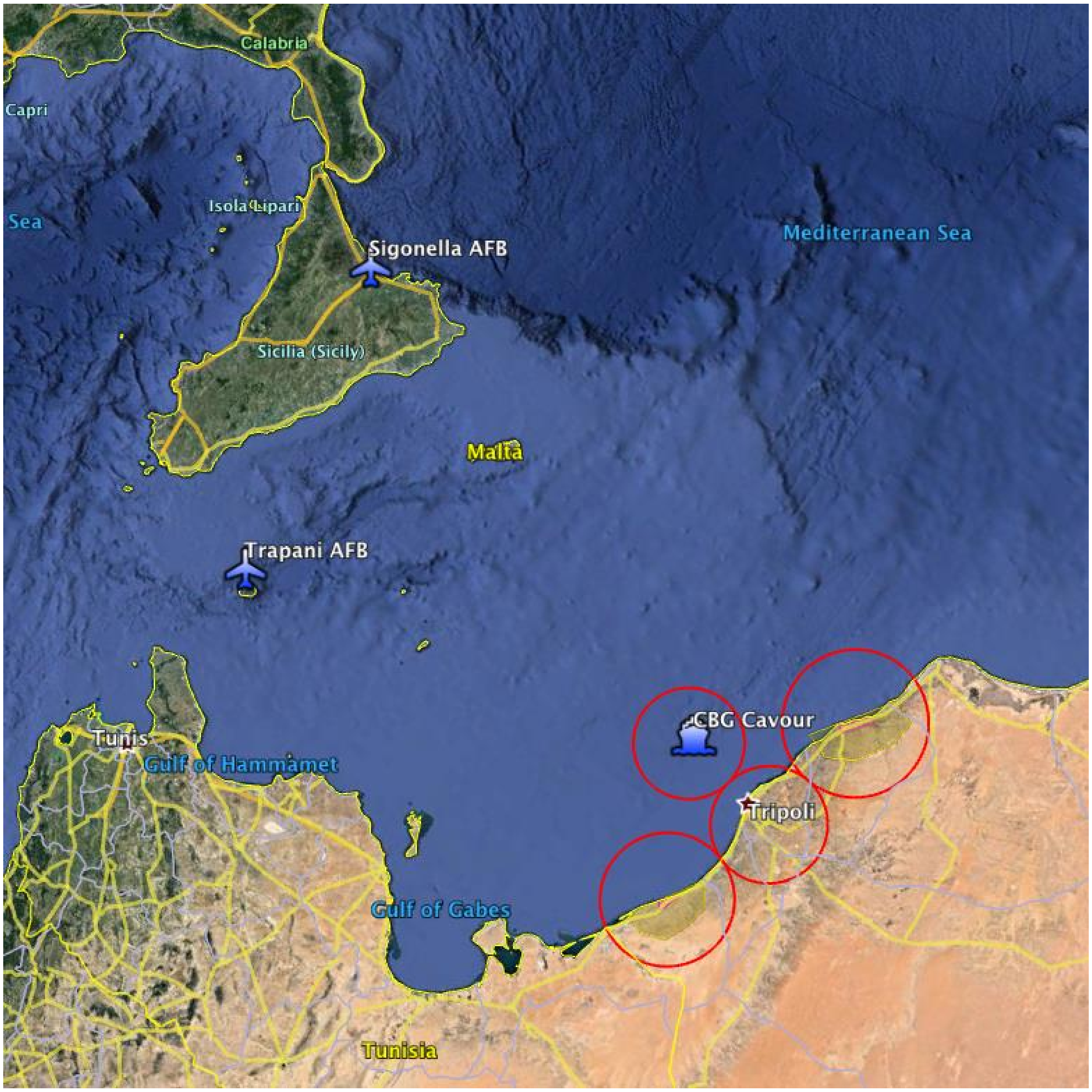
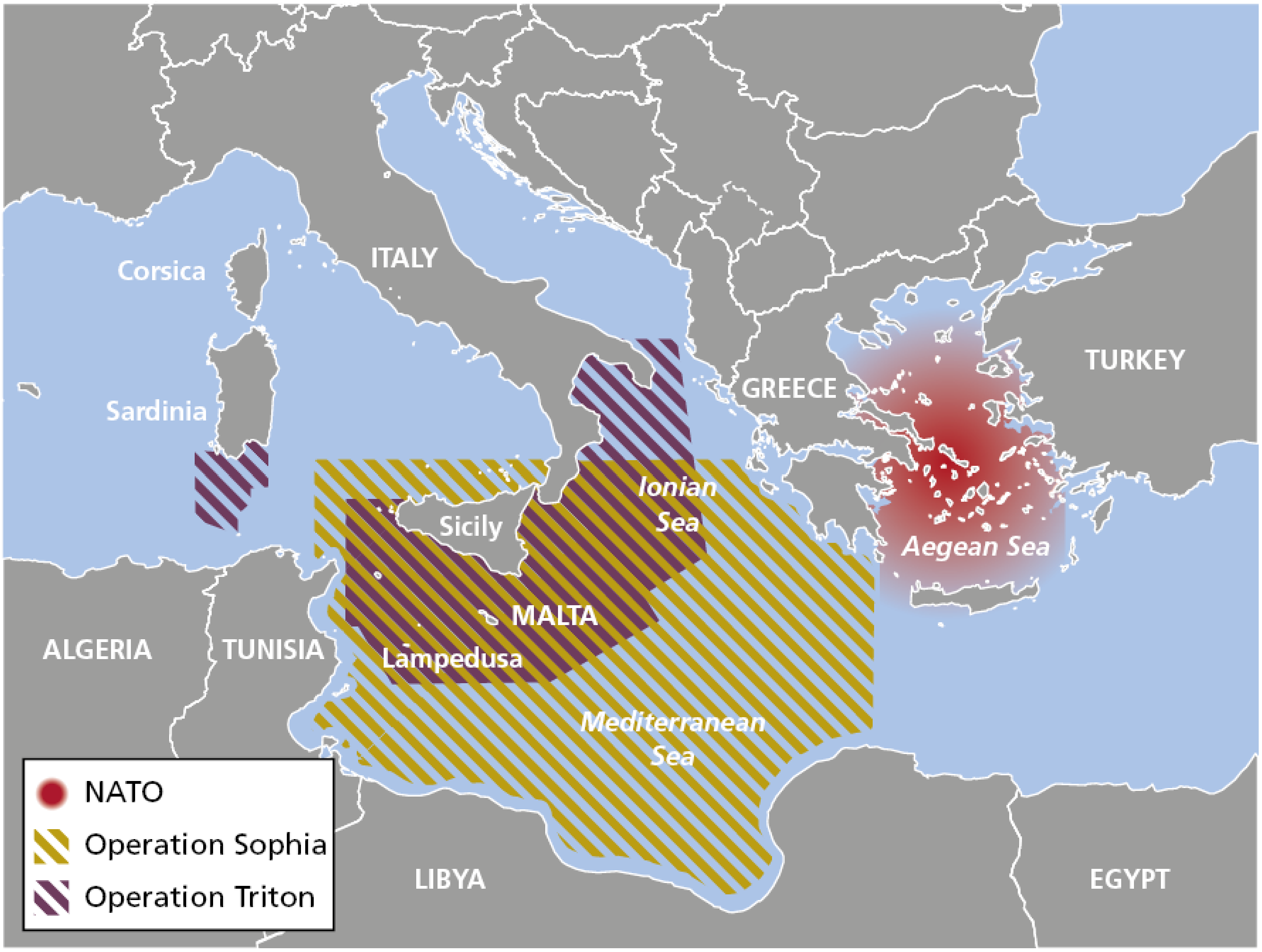


Fig 6: Satellite View of Area of Operations with Trapani and Sigonella Air Bases.
Pink regions are safe havens, yellow are heavy weapons exclusion zones, green are indirect fire zones.

Fig. 7: Topographic Map of Area of Operations



Fig, 8: Past Mediterranean Naval Operations
Source: UK House of Lords

Appendix A3: Airpower Calculations

Number of Strike Sorties Required Per Day

$$3\ Engagement\ Zones * \left(\left(\frac{8PGMs}{4targets}\right) Fighters * \left(\frac{24hrs}{4\ hrs\ on\ station}\right)\right) = 36\ Strike\ Sorties$$

Number of Daily Sorties Per Aircraft

$$Sortie\ Rate = \frac{24hrs}{Flight\ Time + Turnaround + MaintTime}$$

where $MaintTime = 3.4hr + 0.68hr * Flight\ Time$

Assuming an airspeed of 500 knots for all strike aircraft, as well as three hours of turnaround time, the flight time and sortie rate for air and carrier-based aircraft is:

Land-Based Aircraft

$$Flight\ Time = 2 * \left(\frac{300nm}{500\,nm/h}\right) + 4(hr\ on - station) = 5.25hrs$$

$$Sortie\ Rate = \frac{24\ hrs}{(5.25 + 3 + 3.4 + 0.68 * 5.25)\frac{hrs}{sortie}} = \frac{24\ hrs}{15.22\frac{hrs}{sortie}}$$
$$= 1.6\ sorties/day/aircraft$$

Carrier-Based Aircraft

$$Flight\ Time = 2 * \left(\frac{60\ nm}{500\,nm/h}\right) + 4\ hr\ on\ station = 4.33\ hrs$$

$$Sortie\ Rate = \frac{24\ hrs}{(4.33 + 3 + 3.4 + 0.68 * 4.33)\frac{hrs}{sortie}} = \frac{24\ hrs}{13.67\frac{hrs}{sortie}}$$
$$= 1.75\ sorties/day/aircraft$$

Number of Strike Aircraft Required

Under 100% Readiness

$$\frac{36\ sorties/day}{1.6\ sorties/day/aircraft} = 23\ aircraft$$

Under Average Readiness

$$\left(\frac{36\,sorties/day}{1.6\,sorties/day/aircraft}\right) * \left(\frac{1}{0.739}\right) = 32\ aircraft$$

Appendix A4: Diagnostics

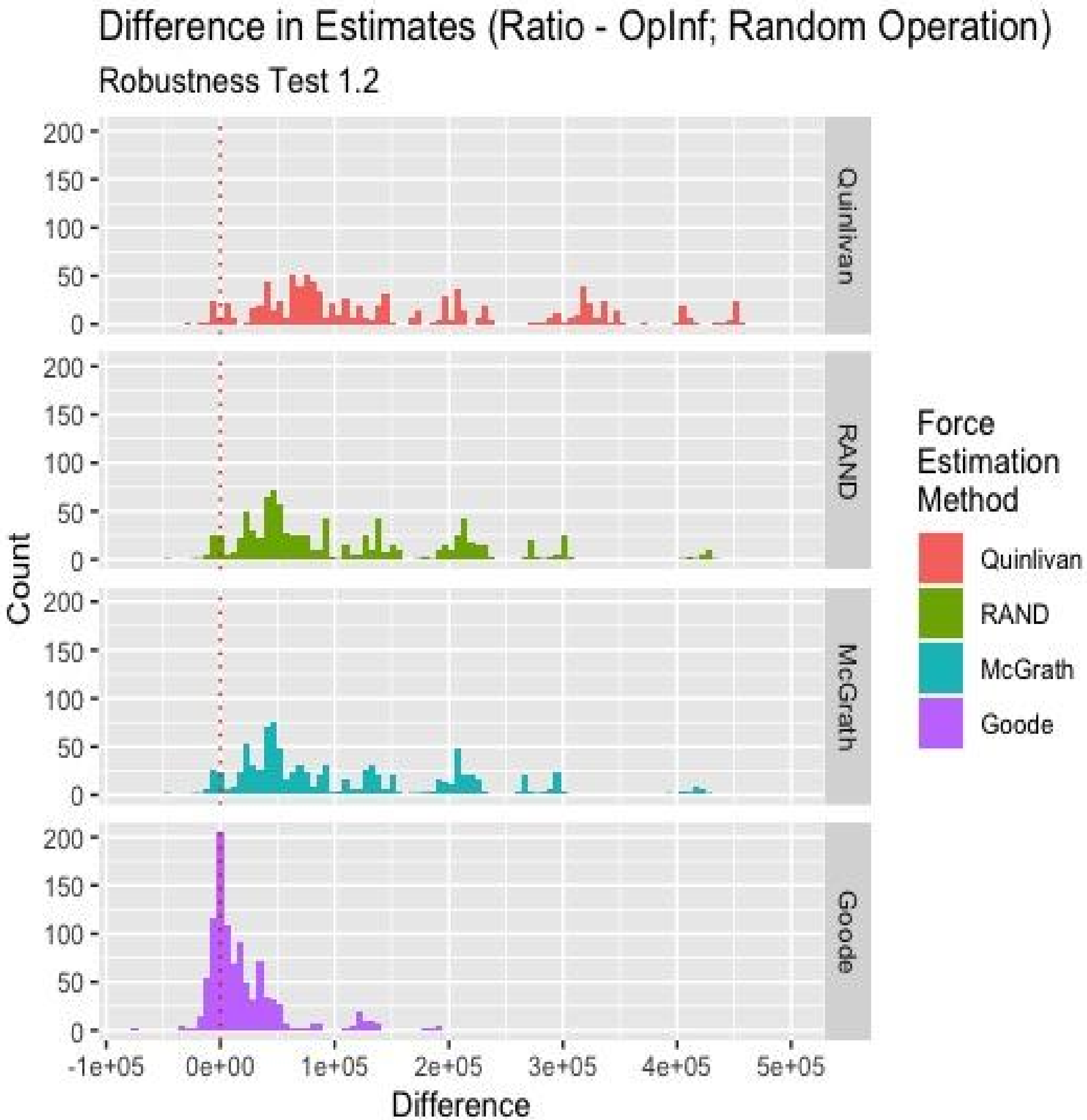


Fig. 8: Diagnostic Test 2, Monte Carlo

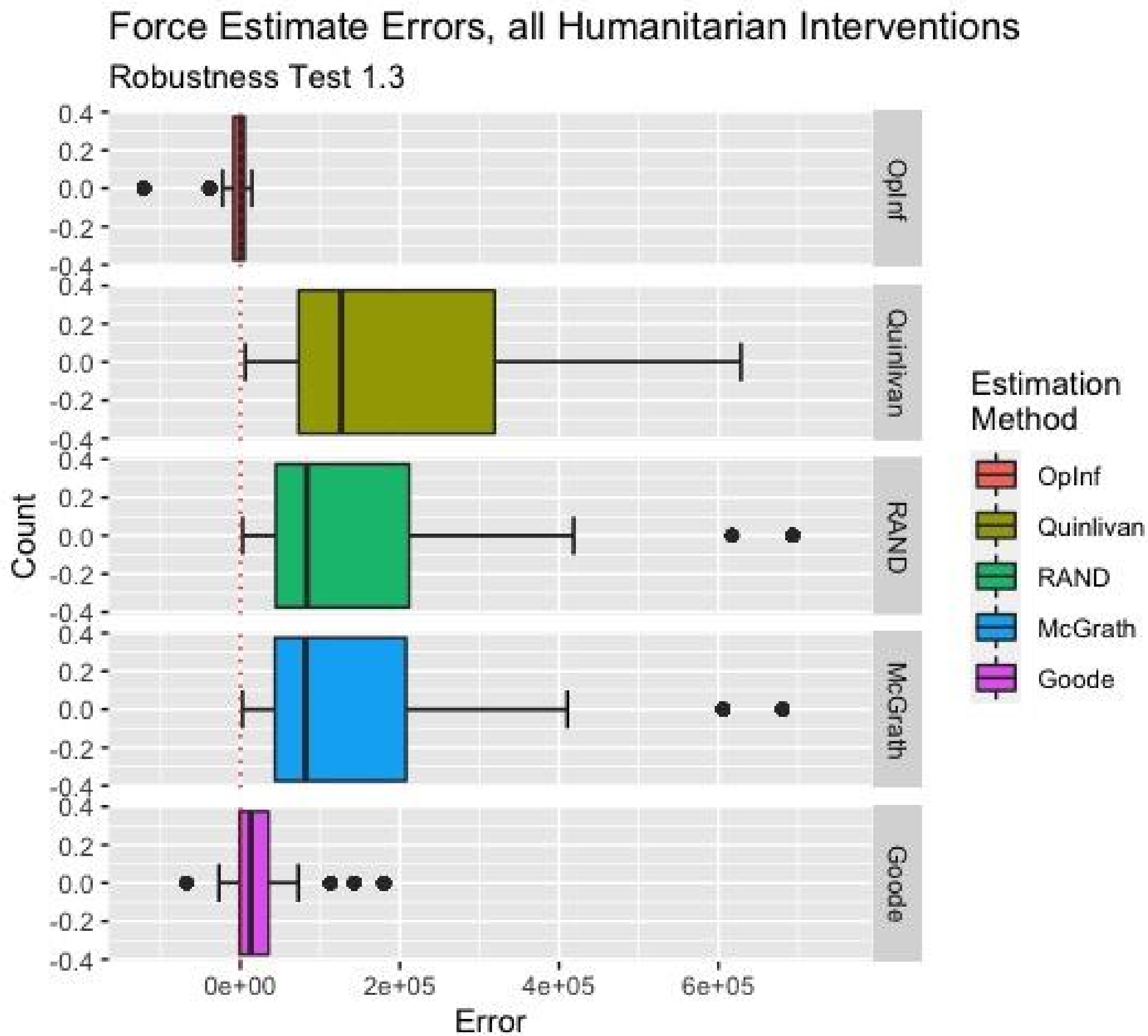


Fig. 9: Diagnostic Test 3, True Errors

Appendix B: NEO Dataset

Appendix B1: Identifying and Including NEOs

Major sources used for identifying NEOs were:

- Antal, James G, R. John Vanden Berghe, and United States. Marine Corps. History and Museums Division. On Mamba Station: U.S. Marines in West Africa, 1990-2003. Washington, D.C.: History and Museums Division, United States Marine Corps, 2004.
- Globalsecurity.org. "List of Non-Combatant Evacuation Operations." Global Security, 2017. https://www.globalsecurity.org/military/ops/neo-list.htm.
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- United States Marine Corps. "Selected Non-Combatant Evacuations (NEO): 1975-Present." Marine Corps University, 2007. https://www.usmcu.edu/Research/Marine-Corps-History-Division/Brief-Histories/Selected-Non-Combatant-Evacuations-NEO-1975-Present/.

All NEOs identified by these sources were included in the dataset unless they failed to meet the following criteria:[151]

- The primary purpose of the operation was to evacuate civilians, whether US citizens, citizens of the operation's host country, or citizens of third countries.
- The operation included military (Department of Defense) personnel in an active role.
- The evacuation was in response to some emergent source of danger which threatened the lives of the civilian evacuees. This danger is interpreted broadly and could include military violence, civil unrest, natural or manmade environmental catastrophe, or specific threats against American lives.
- The operation was not part of a larger military operation with separate objectives.
- Unclassified information about the operation is available.

As an example of the inclusion criteria in action, Operation Odyssey Dawn, the US code name for its 2011 operations in Libya not affiliated with NATO, was listed as an NEO by several sources but is not included in the dataset: though this operation began its lifecycle as a planned NEO, the evolving situation on the ground in the Libyan Civil War led to it transforming into a humanitarian or regime change operation. Another operation (and one which is referenced in terms of accommodating evacuees in Chapter 4), Operation New Life, was dropped from the dataset despite its inclusion in some larger lists of NEOs. Unlike the other operations in this dataset, New Life did not involve extraction of noncombatants from a potentially dangerous situation. Rather, its primary aim was to care for and transport evacuees from prior NEOs (Operations Frequent Wind and Eagle Pull). Operation Victor Squared (Haiti, 1991) met all of

[151] Inclusion criteria were based on the following definition of NEO: *"Noncombatant evacuation operations (NEOs) are conducted by the Department of Defense (DOD) to assist in evacuating US citizens and nationals, DOD civilian personnel, and designated persons (host nation [HN] and third country nationals [TCNs]) whose lives are in danger from locations in a foreign nation to an appropriate safe haven"* (*JP 3-68* 2015, I-1)

the first four criteria, but details of this operation remain classified and there is surprisingly little detail about the operation is available in the open-source literature.

Appendix B2: Dataset Construction and Coding Rules

Name (neo_id): The name of the operation. If possible, use the official DoD operation name. If not, use the following formula: [Year] [Country] Evacuation.
Year (year): The year when the operation began.
Host Country (evac_state): The state where the evacuation took place. Use the name at the time of the operation.
Host Country Evacuees (host_evac): Binary variable. Did the evacuees include citizens of the host country?
Number of Evacuees (evac_num): The number of evacuees (American or otherwise) evacuated. As described in Chapter 4, this is the real-world number of evacuees rather than a potential or planned number of evacuees. In the analysis presented here, this variable has been converted to a logarithmic scale.
Number of Ground Troops (GROUNDNO): The number of ground troops committed to the operation. When known, the number of troops in the regular security detachment for the evacuation sites (embassy guards, troops deployed prior to the operation, etc.) are not included.
Local Cooperation (local_coop): Binary variable. Did local authorities actively cooperate in or aid the evacuation?
Troops Taking Fire (troops_fire): Binary variable. Were US troops fired upon during the evacuation?
Gather Evacuees (gather_evac): Binary variable. Did US troops go to areas outside of the evacuation sites to gather evacuees?
Provide Security (provide_security): Binary variable. Did an additional force come ashore to the host country in order to provide security for the mission? This is coded as 0 if the only troops used were embassy guards or were already deployed to the host nation for other reasons before the evacuation.
Local Population (POPULAT): What was the population of the city where the evacuation took place at the time of the operation? Data sourced from the UN's Population Data Portal.
Combat Aircraft (combat_air): Binary variable. Were fixed-wing combat aircraft (fighters, bombers) used as part of the intervening force?

Appendix B3: NEO Dataset Sources

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Appendix C: Afghanistan Analysis

Appendix C1: Kabul Airport Information

- Runways: 1
  - Runway 1: 11,482 ft x 164 ft

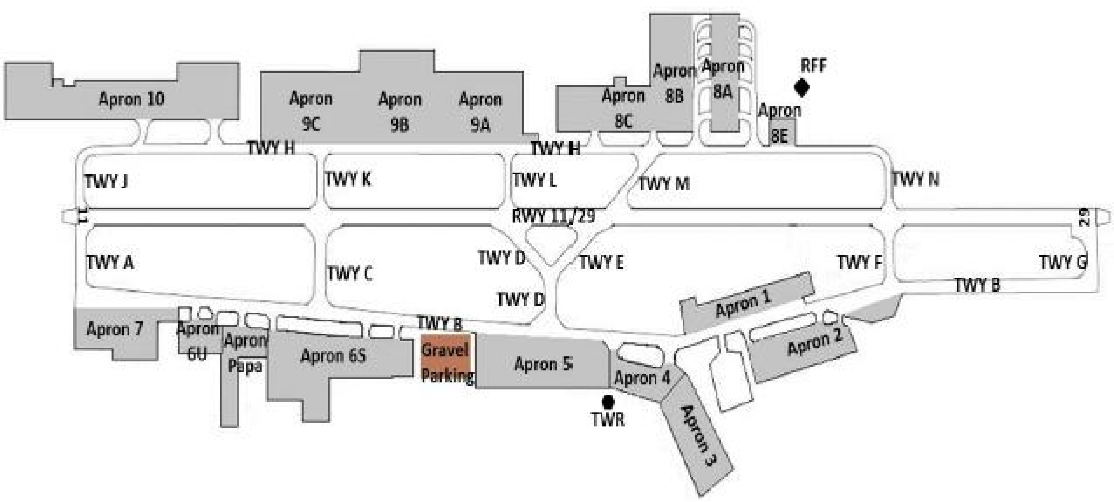
Table 1: Apron Measurements and Ground Capacity at KBL

Apron	Official Cat. D Capacity	Area	Add'l Cat. D Capacity for US	Conservative pMOG	Aggressive pMOG	Notes
Apron 1	1	1250 x 200 ft^2	0	0	1	Only one Cat. D possible
Apron 2	0	875 x 300 ft^2	2	0	2	Aircraft can taxi in and back out onto taxiway.
Apron 3	0	350 x 700 ft^2	0	0	0	Reserved for other traffic.
Apron 4	1	700 x 400 ft^2	0	0	0	Reserved for other traffic.
Apron 5	6	1400 x 375 ft^2	0	0	0	Reserved for other traffic.
Apron 6	N/A	Not estimated	0	0	0	Helicopter storage, unsuitable for parking use
Apron 7	N/A	900 x 400 ft^2	0	0	0	Far from gates: could be used as overflow for allied aircraft.
Apron 8	N/A	(375 x 1050) + (325 x 1050) ft^2	4	4	4	Two parking areas, each can be partially used.
Apron 9	N/A	1700 x 500 ft^2	3	0	0	In theory this could hold up to 7, but I reduce that for additional space for helicopter parking & other equipment.
Apron 10	N/A	2400 x 275 ft^2	2	0	0	Strange shape; planes could pull in and back out from the taxiway ramps.
TOTAL	**8**		**11**	**4**	**7**	

Note: All apron area figures come from researcher estimates using Google Earth and are deliberate underestimations.

Figure 10: Map of Kabul International Airport (KBL) Access Gates

Figure 11: Parking Aprons at the Kabul Airport



Source: Republic of Afghanistan (2020)

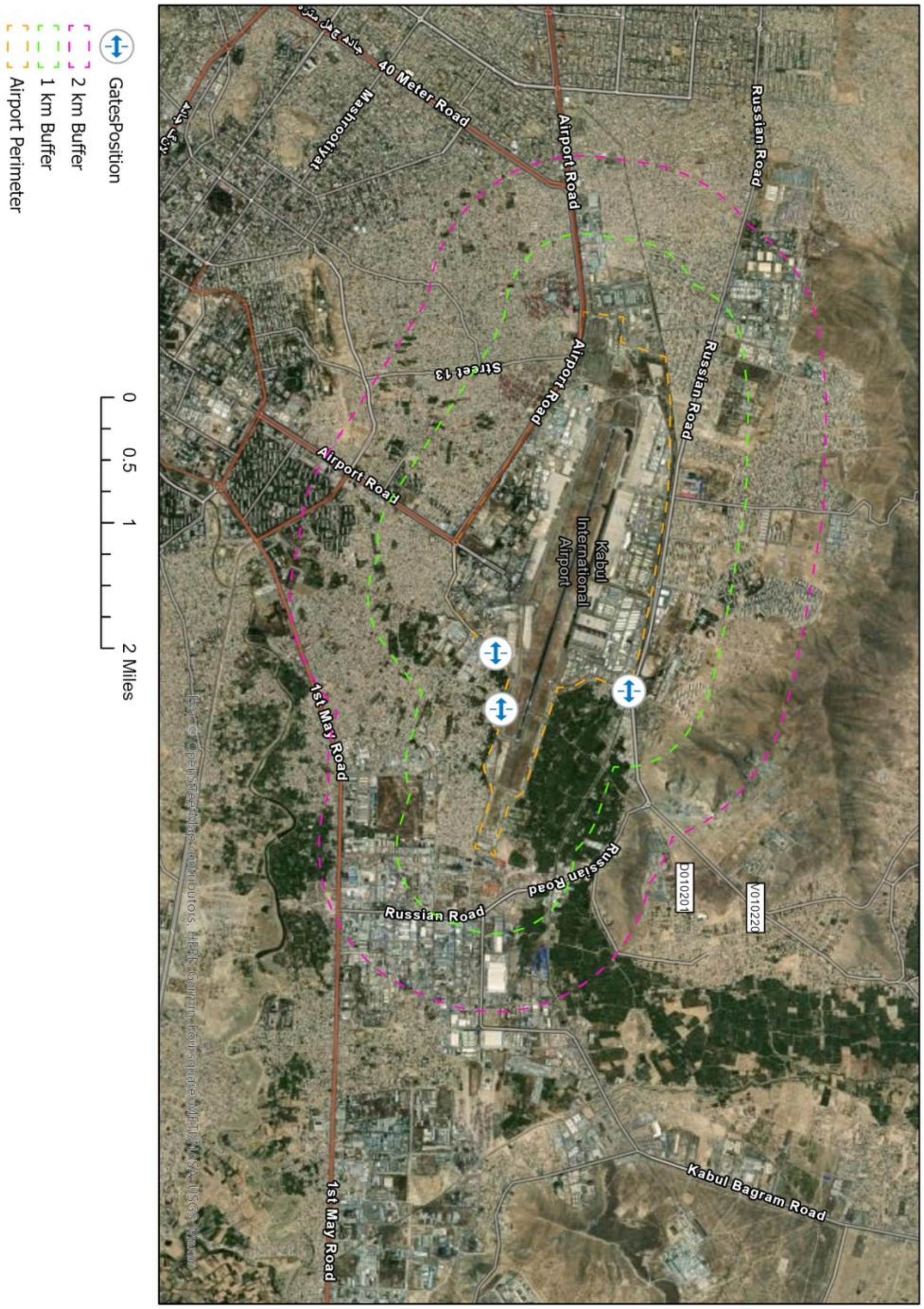
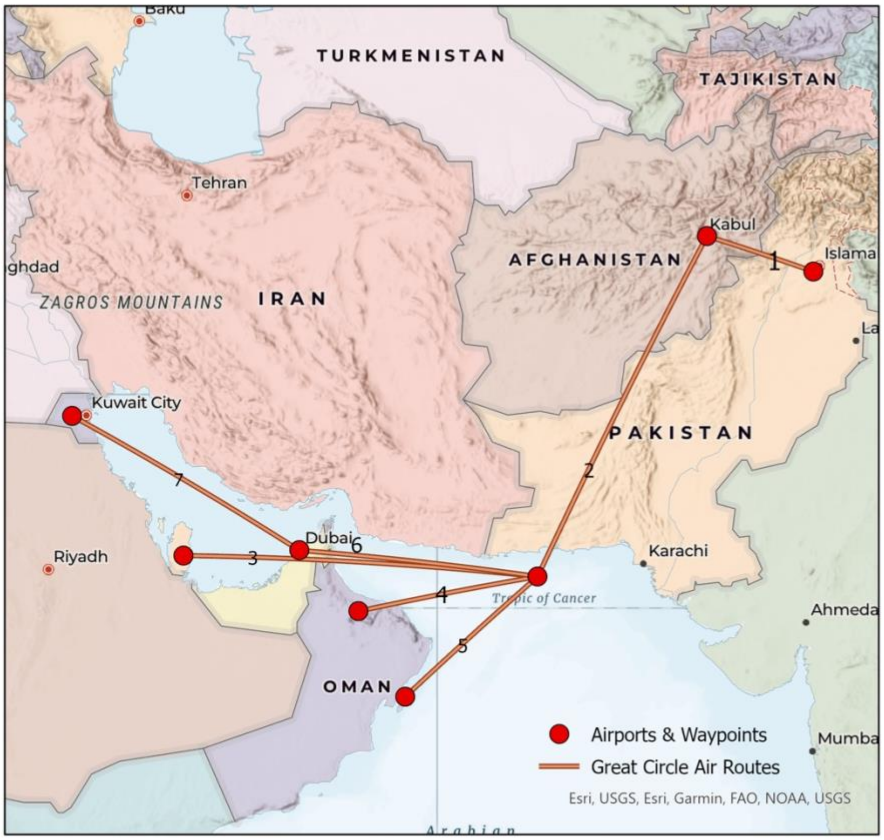


Figure 12: Satellite Photo of Kabul international Airport. Shown are the locations of entrance gates as well as notional 1-km (green) and 2-km (pink) Base Security Zones.

Appendix C2: Airlift and Airpower Calculations

Airlift Maps and Data



Label	Route	Length (nm)
1	Kabul to Islamabad	191.03766
2	Kabul to Midpoint 1	675.152195
3	Midpoint 1 to al-Udeid AFB	661.486537
4	Midpoint 1 to RAFO Masirah	338.345321
5	Midpoint 1 to RAFO al-Musannah	342.825422
6	Midpoint 1 to Midpoint 2	447.196545
7	Midpoint 2 to Ali Al Salem AB	480.531939

Figure 13: Map and Great Circle Distances between intermediate staging areas, flight midpoints, Kabul, and other bases. Map and distances generated with ArcGIS.

Figure 14: Satellite photo of al-Udeid AFB, Qatar.

Figure 15: Satellite photo of Royal Omani Air Force Base Masirah, Oman

Figure 16: Satellite Photo of Royal Omani Air Force Base al-Mussanah, Oman.

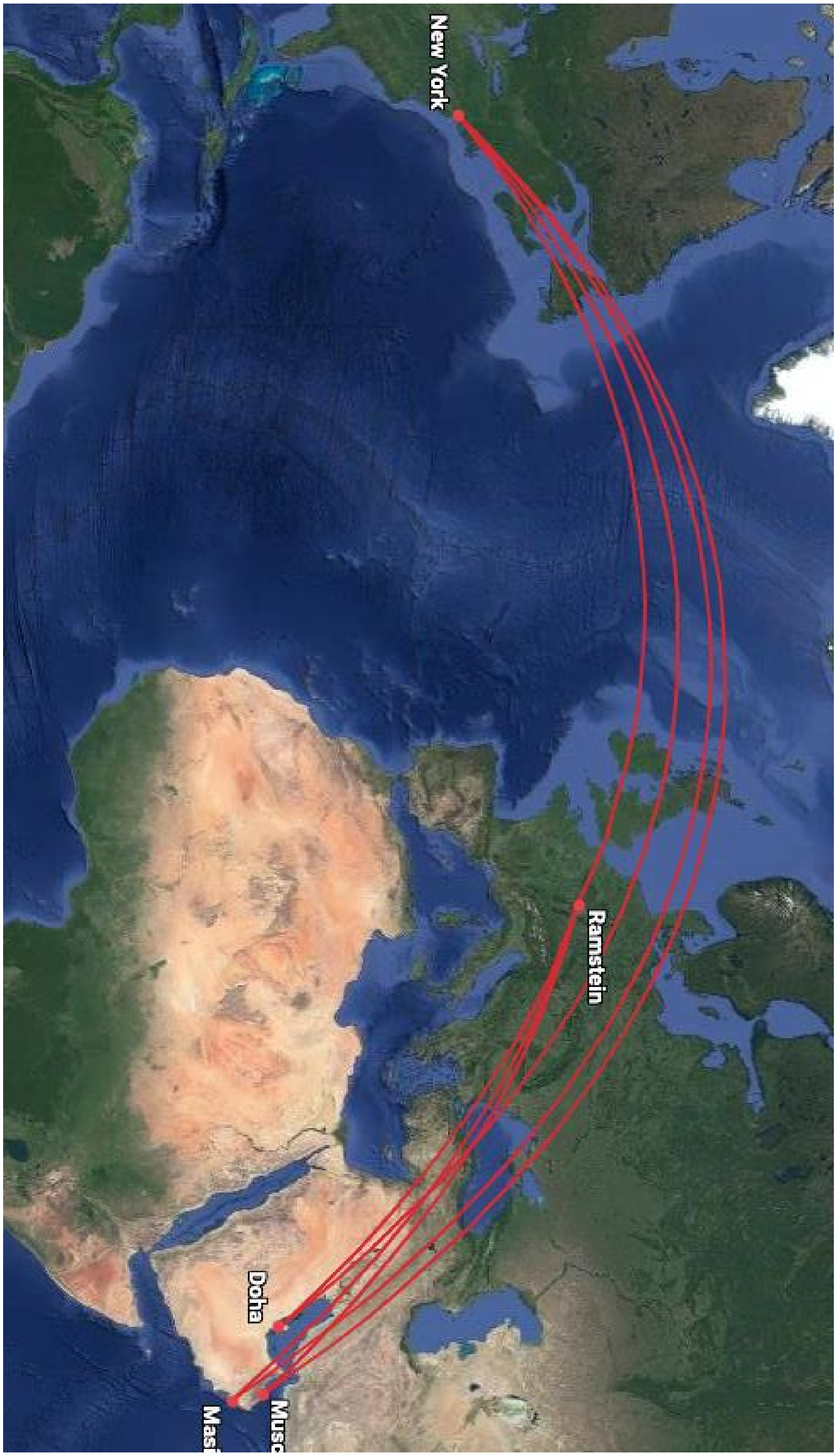


Figure 17: Great Circle Air Routes from Staging Areas to Ramstein AFB and McGuire/Dix Joint Base.

Note: for some of the calculations performed in this section, quantities are rounded or truncated. Generally, this rounding/truncation is intended to be conservative. That is, quantities which represent capability or capacity (throughput, passengers on an aircraft, etc.) are truncated or rounded down, while those which represent requirements (missions required, aircraft required, etc.) are rounded up.

Airlift Calculations, Troop Deployment to and Withdrawal from Kabul

For the initial force we have two units deploying to the airfield at Kabul. Taken together, these units represent 915 airmen (820th) and 2200 Marines. Included with the USMC forces are a small selection of vehicles and helicopters intended to provide extra intimidation factor, force protection, and operational flexibility.[152] I do not include flying in any logistics equipment or supplies beyond what is included in the ground company's standard equipment, assuming that such equipment is either already present at the airport or can be flown in later on a C-17 coming to pick up evacuees. Further, I assume that any logistics equipment or supplies flown in on these extra flights are either consumed or abandoned and are not flown out.

$$Missions\ Required = \frac{\#\ Troops}{troops\ per\ aircraft} + \frac{\#\ LAV}{LAV\ per\ aircraft} + \frac{\#\ HMMV}{HMMV\ per\ aircraft} + \frac{\#\ AH1Z\ Helicopters}{Helos\ per\ aircraft} + \frac{\#\ CH53\ Helicopters}{Helos\ per\ aircraft}$$

$$= \frac{2200 + 915}{102} + \frac{7}{3} + \frac{40}{10} + \frac{4}{2} + \frac{2}{1} = 40.8 = 41^{153}$$

We can generally think of each term in the "missions required" equation above as representing a certain number of deployment loads. Using this general unit, we calculate throughput capacity for the airport:

$$ATC = \frac{MOG * (\#\ deployment\ load) * Operating\ Hours}{Ground\ Time}$$

$$= \frac{4 * (1\ deployment\ load) * (24\ hrs)}{(2.75\ hrs)} = 34.9 = 34\ deployment\ loads$$

This, however, assumes perfect efficiency. Applying the 85% efficiency rule of thumb for queuing efficiency yields:

$$34.9\ deployment\ loads * 0.85 = 29.7 = 29\ deployment\ loads$$

Because KBL has a daily capacity of only 29 C-17 deployment loads, it will take around a day and a half ($\frac{41}{29} * 24\ hrs$) to fully offload the initial ground security force and its equipment, which require 41 C-17 sorties. Similarly, it will take the same amount of time and aircraft (day and a half, 41 sorties) to extract this force package at the end of the operation, though this number could be reduced substantially (by 11 sorties) if the initial force's vehicles are all abandoned.

Required Aircraft

[152] The CH-53 helicopter complement, for example, could be used for extraction missions if that becomes necessary.
[153] Amounts based on outlines in and Marty (2022). C-17 data from *Aeroweb* (2022).

Since I assume that the airlift of ground security forces will be performed by the same C-17s which are assigned to the evacuation, I calculate the required aircraft in the below section.

Adding Reinforcements

If the initial ground security force is not sufficient, the option exists to add reinforcements. However, as noted in Chapter 4, this comes with a cost, as it shortens the window of time available for the evacuation. Below I present an airlift estimate for the number of sorties required to deploy each of the two additional MEUs less their aviation components:

$$Missions\ Required = \frac{\#\ Troops}{troops\ per\ aircraft} + \frac{\#\ LAV}{LAV\ per\ aircraft} + \frac{\#\ HMMV}{HMMV\ per\ aircraft}$$

$$= \frac{1800}{102} + \frac{7}{3} + \frac{40}{10} = 23.9 = 24$$ [154]

It will thus take about 20 hours to deploy, and more importantly, to *withdraw*, each additional MEU. The 24 flights out of Kabul at the end of the operation required by the insertion of each additional MEU represent a tradeoff: they are 24 flights that are not carrying Afghan evacuees. This can be made up by adding evacuees to C-17 flights until they hit the emergency threshold for NEO evacuation (300 evacuees) (*AFPAM* 2018). In the scenario where all flights carry the standard number of evacuees (100):

$$evacuee\ shortfall = (\#\ of\ flights\ for\ MEU\ insertion) * (\#\ evacuees\ per\ flight)$$

$$evacuee\ shortfall = 24 * 101 = 2424$$

$$Flights\ Packed = \frac{evacuee\ shortfall}{evacuee\ gain\ from\ packing}$$

$$Flights\ Packed = \frac{2424}{300 - 101} = 12.18 = 13$$

For each MEU beyond the initial security force inserted, therefore, 13 flights will need to shift from a standard number of NEO evacuees to the emergency load of 300.

Extraction

At the end of the operation all US troops, including those in Afghanisatn at the start of the mission, must be extracted.

$$Missions\ Required = \frac{\#\ Troops}{troops\ per\ aircraft} + \frac{\#\ LAV}{LAV\ per\ aircraft} + \frac{\#\ HMMV}{HMMV\ per\ aircraft} + \frac{\#\ AH1Z\ Helicopters}{Helos\ per\ aircraft} + \frac{\#\ CH53\ Helicopters}{Helos\ per\ aircraft}$$

$$= \frac{2200 + 915 + 1000}{102} + \frac{7}{3} + \frac{40}{10} + \frac{4}{2} + \frac{2}{1} = 50.7 = 51$$ [155]

If only troops are extracted, not vehicles:

$$Missions\ Required = \frac{\#\ Troops}{troops\ per\ aircraft}$$

$$= \frac{2200 + 915 + 1000}{102} = 40.3 = 41$$ [156]

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[154] Amounts based on outlines in and Marty (2022). C-17 data from *Aeroweb* (2022).

[155] Amounts based on outlines in and Marty (2022). C-17 data from *Aeroweb* (2022).

[156] Amounts based on outlines in and Marty (2022). C-17 data from *Aeroweb* (2022).

It will take either 1.75 days to extract all troops and equipment (including vehicles) or 1.5 days to extract troops only. The remainder of the calculations which follow assume that troops abandon their vehicles when leaving.

Airlift Calculations, Evacuation from Kabul

First, some key quantities to keep in mind:

$$Standard\ \#\ of\ NEO\ evacuees\ (C17) = 101$$

$$Emergency\ \#\ of\ NEO\ evacuees\ (C17) = 300$$

$$Half\ and\ Half\ \#\ of\ NEO\ evacuees\ (C17) = 200$$

$$Cruising\ Speed\ (C17) = 450\frac{nm}{hr}$$

First, we'll want to know how many missions must be flown from the staging points to Kabul in order to evacuate all of the expected evacuees.

$$Missions\ Required = \frac{\#\ evacuees}{passengers\ per\ aircraft} = \frac{128{,}079}{101} = 1{,}268.1 = 1{,}269$$

$$Missions\ Required\ per\ Day = \frac{Missions\ Required}{\#\ of\ Days}$$

$$MRD = \frac{1269}{25 - 2.75} = 57.0 = 57$$

$$OR$$

$$MRD = \frac{1269}{20 - 2.75} = 72.5 = 73$$

We can recalculate the above quantity for the number of NEO evacuees which can be carried in an emergency situation, as well as a "half and half" mixture of the two. For max load:

$$Missions\ Required = \frac{\#\ evacuees}{passengers\ per\ aircraft} = \frac{128{,}079}{300} = 426.93 = 427$$

$$Missions\ Required\ per\ Day = \frac{Missions\ Required}{\#\ of\ Days}$$

$$MRD = \frac{427}{25 - 2.75} = 19.19 = 20$$

$$OR$$

$$MRD = \frac{427}{20 - 2.75} = 24.75 = 25$$

For the "half and half":

$$Missions\ Required = \frac{\#\ evacuees}{passengers\ per\ aircraft} = \frac{128{,}079}{200} = 640.4 = 641$$

$$Missions\ Required\ per\ Day = \frac{Missions\ Required}{\#\ of\ Days}$$

$$MRD = \frac{641}{25 - 2.75} = 28.8 = 29$$

$$OR$$

$$MRD = \frac{641}{20 - 2.5} = 37.15 = 38$$

Now we need to calculate the average real total flight time for a C-17 flying from each of the three intermediate staging areas in the Persian Gulf. The formula for round trip flight time:

$$RTFT = \frac{leg\ dist_1}{block\ speed_1} + \frac{leg\ dist_2}{block\ speed_2} + \cdots + \frac{leg\ dist_n}{block\ speed_n}$$

So for the C-17 aircraft, using the distances from Figure 13, we can calculate the RTFT separately for each of the three staging areas. First, al-Udeid AFP, Qatar:

$$RTFT_{UD} = \frac{leg\ dist_1}{block\ speed_1} + \frac{leg\ dist_2}{block\ speed_2} + \frac{leg\ dist_2}{block\ speed_2} + \frac{leg\ dist_1}{block\ speed_1}$$

$$RTFT_{UD} = \frac{675.15\ nm}{450\frac{nm}{hr}} + \frac{661.49\ nm}{450\frac{nm}{hr}} + \frac{661.49\ nm}{450\frac{nm}{hr}} + \frac{675.15\ nm}{450\frac{nm}{hr}} = 5.94\ hr$$

Next, the RTFT for RAFO al-Mussanah, Oman:

$$RTFT_{MN} = \frac{leg\ dist_1}{block\ speed_1} + \frac{leg\ dist_2}{block\ speed_2} + \frac{leg\ dist_2}{block\ speed_2} + \frac{leg\ dist_1}{block\ speed_1}$$

$$RTFT_{MN} = \frac{675.15\ nm}{450\frac{nm}{hr}} + \frac{342.83\ nm}{450\frac{nm}{hr}} + \frac{342.83\ nm}{450\frac{nm}{hr}} + \frac{675.15\ nm}{450\frac{nm}{hr}} = 4.52\ hr$$

Finally, the RTFT for RAFO al-Masirah, Oman:

$$RTFT_{MS} = \frac{leg\ dist_1}{block\ speed_1} + \frac{leg\ dist_2}{block\ speed_2} + \frac{leg\ dist_2}{block\ speed_2} + \frac{leg\ dist_1}{block\ speed_1}$$

$$RTFT_{MS} = \frac{675.15\ nm}{450\frac{nm}{hr}} + \frac{338.35\ nm}{450\frac{nm}{hr}} + \frac{338.35\ nm}{450\frac{nm}{hr}} + \frac{675.15\ nm}{450\frac{nm}{hr}} = 4.50\ hr$$

Since the C-17s and evacuees will be allocated to the three staging areas on a 2:1:1 basis, the weighted average flight time is:

$$RTFT_{AVG} = 0.5 * RTFT_{UD} + 0.25 * RTFT_{MN} + 0.25 * RTFT_{MS} = 5.23\ hr$$

The next step in calculating the total flight time is the ground time: how long each plane spends on the ground. This includes loading evacuees in Kabul as well as unloading them at an intermediate staging area. Total ground time can be expressed as:

$$TGT = onload\ time + (en\ route\ time * number\ of\ stops) + offload\ time$$

Because the range of a C-17 is 4500 nm with a cargo of 100,000 lbs or lower, it can complete the flight without needing to make an additional stop or needing to refuel in the air. Thus, Total Ground Time for each aircraft is:

$$TGT = onload\ time + offload\ time$$

$$TGT = 2.75\ hrs + 2.75\ hrs = 5.5\ hrs$$

Now that we know the flight and ground times, we can calculate the cycle time: how long it takes an aircraft to complete the inbound-load-outbound-unload cycle.

$$cycle\ time = RTFT + TGT$$

$$cycle\ time = 5.23\ hrs + 5.5\ hrs = 10.73\ hrs$$

Now that we know the ground, flight, and cycle times, we can calculate the other main limiting factor: how many flights can be made from KBL each day. To do this we will need to first calculate the airfield throughput capability. This relies on knowing the MOG, which is discussed in Step 5, Stage 3. Here, we use the "conservative" MOG estimate discussed in that section:

$$ATC = \frac{MOG * Avg\ Payload * Operating\ Hours}{Ground\ Time}$$

$$= \frac{4 * (101\ passengers) * (24\ hrs)}{(2.75\ hrs)} = \ 3{,}525.81 = 3{,}525$$

This, however, assumes perfect efficiency. Applying the 85% efficiency rule of thumb for queuing efficiency yields:

$$3525.81\ passengers * 0.85 = 2996.9 = 2996\ passengers$$

With this in mind, at the standard payload for NEOs, across the entire duration of the operation (less 2.5 days for deployment and withdrawal, see above) KBL has capacity for:

$$KBL\ Capacity = \ 2996\frac{passengers}{day} * (25 - 2.75\ days) = \ 66{,}661\ \ passengers$$

OR

$$KBL\ Capacity = \ 2996\frac{passengers}{day} * (20 - 2.75\ days) = 51{,}681\ Passengers$$

Clearly, this falls far short of the required 128,079 evacuees which is our goal. There are two ways this number can be increased: raising the MOG by occupying additional apron space or increasing the number of passengers per aircraft.

A variety of MOG scenarios are discussed in Chapter 4, Step 5, Stage 3. If US forces were to clear additional space on parking aprons for C-17s, I estimate they could create a MOG of up to seven C-17s, leading to an airport capacity of:

$$ATC = \frac{MOG * Avg\ Payload * Operating\ Hours}{Ground\ Time}$$

$$= \frac{7 * (101\ passengers) * (24\ hrs)}{(2.75\ hrs)} = \ 6{,}170.18 = 6{,}170\ passengers$$

Applying the 85% efficiency rule of thumb for queuing efficiency:

$$6170.18\ passengers * 0.85 = 5244.7 = 5244\ passengers$$

At the higher MOG, KBL has capacity for:

$$KBL\ Capacity = \ 5244\frac{passengers}{day} * (25 - 2.75\ days) = \ 116{,}679\ \ passengers$$

OR

$$KBL\ Capacity = \ 5244\frac{passengers}{day} * (20 - 2.75\ days) = 90{,}459\ Passengers$$

As we can see from the above calculations, increasing MOG is insufficient for evacuating all persons of interest on either schedule without also increasing the number of evacuees per flight, as is done in the calculations below.

Now we consider raising the number of passengers per aircraft. We have already considered one scenario: the standard number of passengers for NEOs. A higher number, however, could be substituted. The C-17 has an emergency NEO capacity of 300: the C-17s could either take this emergency passenger capacity for the entire time, or, more likely, a mixture of capacities could be taken. We start with emergency capacity and recalculate the KBL Capacity:

$$ATC = \frac{MOG * Avg\ Payload * Operating\ Hours}{Ground\ Time}$$

$$= \frac{4 * (300\ passengers) * (24\ hrs/day)}{(2.75\ hrs)} = \ 10{,}472.72 = 10{,}472\ passengers/day$$

Applying the 85% efficiency rule of thumb for queuing efficiency:

$$10472.72\ passengers * 0.85 = 8901.8 = 8901\ passengers$$

Therefore, KBL's capacity across the entire operation using emergency loading for all flights:

$$KBL\ Capacity = 8901 \frac{passengers}{day} * (25 - 2.75\ days) = 198{,}047\ Passengers$$

OR

$$KBL\ Capacity = \ 8901 \frac{passengers}{day} * (20 - 2.75\ days) = 153{,}542\ Passengers$$

As can be seen, if flights can be run at full capacity from the beginning of the evacuation, either schedule (20-day or 25-day) will work.

We can also recalculate this quantity for the "half and half" payload scenario where we assume that 50% of flights take the standard number of evacuees and 50% take the emergency payload.

$$ATC = \frac{MOG * Avg\ Payload * Operating\ Hours}{Ground\ Time}$$

$$= \frac{4 * (200\ passengers) * (24\ hrs/day)}{(2.75\ hrs)} = \ 6{,}981.8 = 6{,}981\ passengers/day$$

Applying the 85% efficiency rule of thumb for queuing efficiency:

$$6981.8\ passengers * 0.85 = 5934.5 = 5934\ passengers$$

Therefore, KBL's capacity across the entire operation using "half and half" loading for all flights:

$$KBL\ Capacity = \ 5934 \frac{passengers}{day} * (25 - 2.75\ days) = 132{,}032\ Passengers$$

OR

$$KBL\ Capacity = \ 5934 \frac{passengers}{day} * (20 - 2.75\ days) = 102{,}361\ Passengers$$

As can be seen at "half and half" loading only the 25-day evacuation will be successful.

Aircraft Required

We can now calculate the number of C-17s required to undertake this airlift. For this, we must first calculate the flow interval, which is the interval at which we can expect an aircraft to begin the cycle from the intermediate staging area to KBL and back (see Brigantic and Merrill 2004).[157] This then allows us to calculate the number of aircraft required:

$$flow\ interval = \frac{(Closure\ period) * 24\ hrs - (oneway\ flight\ time)}{\#\ of\ Missions\ Reqd - 1}$$

$$req'd\ aircraft = \frac{cycle\ time}{flow\ interval}$$

Since the flow interval depends on the closure period and the number of missions required, we can calculate it separately for each of our closure periods (25-2.5 and 20-2.5 days) as well as the different number of missions under each loading scheme. First, for standard loading:

$$flow\ interval_{25\_std} = \frac{(25 - 2.5) * 24\ hrs - (2.165)}{1269 - 1} = 0.424$$

$$req'd\ aircraft_{25\_std} = \frac{10.73\ hrs}{0.424} = 25.3 = 26$$

Given that the required flow interval is unrealistically low, suggesting that the mission cannot be fulfilled at this combination of required missions and closure period, I do not calculate the required aircraft for the 20-day airlift.

We repeat the above calculations for the scenario where all flights have the emergency level of evacuees (300):

$$flow\ interval_{25\_emr} = \frac{(25 - 2.5) * 24\ hrs - (2.165)}{427 - 1} = 1.26$$

$$req'd\ aircraft_{25\_emr} = \frac{10.73\ hrs}{1.26} = 8.5 = 9$$

$$flow\ interval_{20\_emr} = \frac{(20 - 2.5) * 24\ hrs - (2.165)}{427 - 1} = 0.98$$

$$req'd\ aircraft_{25\_emr} = \frac{10.73\ hrs}{0.98} = 10.95 = 11$$

Finally, we repeat the above calculations for the scenario where all flights have the "half and half" level of evacuees (200):

$$flow\ interval_{25\_emr} = \frac{(25 - 2.5) * 24\ hrs - (2.165)}{641 - 1} = 0.84$$

$$req'd\ aircraft_{25\_emr} = \frac{10.73\ hrs}{0.84} = 12.8 = 13$$

$$flow\ interval_{20\_emr} = \frac{(20 - 2.5) * 24\ hrs - (2.165)}{641 - 1} = 0.65$$

$$req'd\ aircraft_{25\_emr} = \frac{10.73\ hrs}{0.65} = 16.4 = 17$$

Taken together, the airlift will require somewhere between 9 and 17 aircraft. Given a mission capable rate of 82.23% (Everstine 2020), this means that the airlift will require between 11 and 21 C-17s, depending on how many evacuees are on each flight and the number of days available

[157] Note: the minimum flow interval possible given the capacity at KBL is:

$$flowintKBL = \frac{groundtime}{MOG} = \frac{2.75}{4} = 0.6875$$

Any flow interval calculated in the above manner which is less than 0.6875 indicates that the mission is not achievable given the closure period and number of required missions.

for the airlift. Three crews will be required for each aircraft in order to allow continuous flight operations given the C-17's required 16.5-hour crew rest period.

Airlift Calculations, Transport to the United States

Now we calculate the airlift from the intermediate staging areas to the US. This will use civilian aircraft from the Civil Aerial Reserve Fleet (CRAF). For this analysis we will assume that these aircraft are divided between Boeing 747s and Boeing 777-200 aircraft. Flights will go from the staging areas back to the US, ending at Joint Base McGuire-Dix-Lakehurst. Some key quantities to keep in mind:

$$Standard\ \#\ of\ Passengers\ (747) = 374$$

$$Standard\ \#\ of\ Passengers\ (777) = 301$$

$$Avg\ \#\ of\ Passengers\ (CRAF) = 337.5 = 337$$

$$Cruise\ Speed\ (747) = 492\ \frac{nm}{hr}$$

$$Cruise\ Speed\ (777) = 490\ \frac{nm}{hr}$$

$$Avg\ Cruise\ Speed\ (CRAF) = 491\ \frac{nm}{hr}$$

As before we can estimate the round trip flight time for a CRAF aircraft flying from each of the three intermediate staging areas in the Persian Gulf. The formula for round trip flight time:

$$RTFT = \frac{leg\ dist_1}{block\ speed_1} + \frac{leg\ dist_2}{block\ speed_2} + \cdots + \frac{leg\ dist_n}{block\ speed_n}$$

In order to calculate round trip flight time, we will need to calculate it twice. This is because Boeing 747s and 777-200s have different ranges (7285 nm and 5240 nm, respectively) and 777-200 flights will have to stop at an American base in Europe to refuel on the way back to US soil. For the 747 (direct) flights, we calculate the RTFT separately for each of the three staging areas. All distances from greatcircle.com. For al-Udeid:

$$RTFT_{UD747} = \frac{leg\ dist_1}{block\ speed_1} + \frac{leg\ dist_1}{block\ speed_1}$$

$$RTFT_{UD747} = \frac{5834\ nm}{492\ \frac{nm}{hr}} + \frac{5834\ nm}{492\ \frac{nm}{hr}} = 23.7\ hrs$$

For RAFO al-Massanah:

$$RTFT_{MN747} = \frac{leg\ dist_1}{block\ speed_1} + \frac{leg\ dist_1}{block\ speed_1}$$

$$RTFT_{MN747} = \frac{6135\ nm}{492\ \frac{nm}{hr}} + \frac{6135\ nm}{492\ \frac{nm}{hr}} = 24.9\ hrs$$

For RAFO al-Masirah:

$$RTFT_{MS747} = \frac{leg\ dist_1}{block\ speed_1} + \frac{leg\ dist_1}{block\ speed_1}$$

$$RTFT_{MS747} = \frac{6298\ nm}{492\ \frac{nm}{hr}} + \frac{6298\ nm}{492\ \frac{nm}{hr}} = 25.6\ hrs$$

For the 777-200 flights, we assume that they will fly to and stop at Ramstein AFB in Germany. Given this stop, the RTFT for al-Udeid is:

$$RTFT_{UD777} = \frac{leg\ dist_1}{block\ speed_1} + \frac{leg\ dist_2}{block\ speed_2} + \frac{leg\ dist_2}{block\ speed_2} + \frac{leg\ dist_1}{block\ speed_1}$$

$$RTFT_{UD777} = \frac{2499\ nm}{490\ \frac{nm}{hr}} + \frac{3343\ nm}{490\ \frac{nm}{hr}} + \frac{3343\ nm}{490\ \frac{nm}{hr}} + \frac{2499\ nm}{490\ \frac{nm}{hr}} = 23.84\ hr$$

For RAFO al-Massanah:

$$RTFT_{MN777} = \frac{leg\ dist_1}{block\ speed_1} + \frac{leg\ dist_2}{block\ speed_2} + \frac{leg\ dist_2}{block\ speed_2} + \frac{leg\ dist_1}{block\ speed_1}$$

$$RTFT_{MN777} = \frac{2826\ nm}{490\ \frac{nm}{hr}} + \frac{3343\ nm}{490\ \frac{nm}{hr}} + \frac{3343\ nm}{490\ \frac{nm}{hr}} + \frac{2826\ nm}{490\ \frac{nm}{hr}} = 25.18\ hr$$

For RAFO al-Masirah:

$$RTFT_{MS777} = \frac{leg\ dist_1}{block\ speed_1} + \frac{leg\ dist_2}{block\ speed_2} + \frac{leg\ dist_2}{block\ speed_2} + \frac{leg\ dist_1}{block\ speed_1}$$

$$RTFT_{MS777} = \frac{2977\ nm}{490\ \frac{nm}{hr}} + \frac{3343\ nm}{490\ \frac{nm}{hr}} + \frac{3343\ nm}{490\ \frac{nm}{hr}} + \frac{2977\ nm}{490\ \frac{nm}{hr}} = 25.80\ hr$$

Since the evacuees will be allocated to the three staging areas on a 2:1:1 basis, the weighted average flight time is:

$$RTFT_{AVG} = 0.5 * (0.5 * RTFT_{UD} + 0.5 * RTFT_{UD}) + 0.25 * (0.5 * RTFT_{MN} + 0.5 * RTFT_{MN}) + 0.25 * (0.5 * RTFT_{MS} + 0.5 * RTFT_{MS})$$

$$RTFT_{AVG} = 0.5 * (0.5 * 23.7 + 0.5 * 23.84) + 0.25 * (0.5 * 24.9 + 0.5 * 25.18) + 0.25 * (0.5 * 25.6 + 0.5 * 25.8)$$

$$RTFT_{AVG} = 0.5 * (23.77) + 0.25 * (25.04) + 0.25 * (25.7) = 24.57\ hr$$

The next step in calculating the total flight time is the ground time: how long each plane spends on the ground. This includes loading evacuees at the intermediate staging area as well as unloading them in the US. Total ground time with the mixture of flights (half of which can fly direct) can be expressed as:

$$TGT = \frac{1}{2}(onload\ time + (en\ route\ ground\ time * number\ of\ stops) + offload\ time) + \frac{1}{2}(onload\ time + offload\ time)$$

$$TGT = \frac{1}{2}\left(1\ hr + \left(1\frac{hr}{stop} * 1\ stop\right) + 1\ hr\right) + \frac{1}{2}(1\ hr + 1\ hr)$$

$$TGT = \frac{3}{2}\ hr + \frac{2}{2}\ hr = 2.5\ hr$$

Now that we know the flight and ground times, we can calculate the cycle time: how long it takes an aircraft to complete the inbound-load-outbound-unload cycle.

$$cycle\ time = RTFT + TGT$$

$$cycle\ time = 24.57\ hrs + 2.5\ hrs = 27.07\ hrs$$

Flow Tables

Date	Afghanistan	Al-Udeid	RAFO Masirah	RAFO al-Musannah	Total in Havens	Total in US
8/6/21	128079	0	0	0	0	0
8/7/21	122145	2967	1484	1484	5934	0
8/8/21	116211	5934	2967	2967	11868	0
8/9/21	110277	8901	4451	4451	17802	0
8/10/21	104343	11868	5934	5934	23736	0
8/11/21	98409	14835	7418	7418	29670	0
8/12/21	92475	17802	8901	8901	35604	0
8/13/21	86541	20769	10385	10385	41538	0
8/14/21	80607	20746	10373	10373	41491	5981
8/15/21	74673	20722	10361	10361	41444	11962
8/16/21	68739	20699	10349	10349	41397	17943
8/17/21	62805	20675	10338	10338	41350	23924
8/18/21	56871	20652	10326	10326	41303	29905
8/19/21	50937	20628	10314	10314	41256	35886
8/20/21	45003	20605	10302	10302	41209	41867
8/21/21	39069	20581	10291	10291	41162	47848
8/22/21	33135	20558	10279	10279	41115	53829
8/23/21	27201	20534	10267	10267	41068	59810
8/24/21	21267	20511	10255	10255	41021	65791
8/25/21	15333	20487	10244	10244	40974	71772
8/26/21	9399	20464	10232	10232	40927	77753
8/27/21	3465	20440	10220	10220	40880	83734
8/28/21	0	19182	9591	9591	38364	89715
8/29/21	0	16192	8096	8096	32383	95696
8/30/21	0	13201	6601	6601	26402	101677
8/31/21	0	10211	5105	5105	20421	107658
9/1/21	0	7220	3610	3610	14440	113639
9/2/21	0	4230	2115	2115	8459	119620
9/3/21	0	1239	620	620	2478	125601
9/4/21	0	0	0	0	0	128079
9/5/21	0	0	0	0	0	128079
9/6/21	0	0	0	0	0	128079
9/7/21	0	0	0	0	0	128079
9/8/21	0	0	0	0	0	128079

9/9/21	0	0	0	0	0	128079
9/10/21	0	0	0	0	0	128079

Table 2: Evacuee Flow Table, 25-Day NEO, Half and Half Loading, No Delays

Date	Afghanistan	Al-Udeid	RAFO Masirah	RAFO al-Musannah	Total in Havens	Total in US
8/6/21	128079	0	0	0	0	0
8/7/21	128079	0	0	0	0	0
8/8/21	128079	0	0	0	0	0
8/9/21	128079	0	0	0	0	0
8/10/21	128079	0	0	0	0	0
8/11/21	128079	0	0	0	0	0
8/12/21	128079	0	0	0	0	0
8/13/21	122145	2967	1484	1484	5934	0
8/14/21	116211	5934	2967	2967	11868	0
8/15/21	110277	8901	4451	4451	17802	0
8/16/21	104343	11868	5934	5934	23736	0
8/17/21	98409	14835	7418	7418	29670	0
8/18/21	92475	17802	8901	8901	35604	0
8/19/21	86541	20769	10385	10385	41538	0
8/20/21	80607	20361	10181	10181	40722	6750
8/21/21	74673	19953	9977	9977	39906	13500
8/22/21	68739	19545	9773	9773	39090	20250
8/23/21	62805	19137	9569	9569	38274	27000
8/24/21	56871	18729	9365	9365	37458	33750
8/25/21	50937	18321	9161	9161	36642	40500
8/26/21	45003	17913	8957	8957	35826	47250
8/27/21	39069	17505	8753	8753	35010	54000
8/28/21	33135	17097	8549	8549	34194	60750
8/29/21	27201	16689	8345	8345	33378	67500
8/30/21	21267	16281	8141	8141	32562	74250
8/31/21	15333	15873	7937	7937	31746	81000
9/1/21	9399	15465	7733	7733	30930	87750
9/2/21	3465	15057	7529	7529	30114	94500
9/3/21	0	13415	6707	6707	26829	101250
9/4/21	0	10040	5020	5020	20079	108000
9/5/21	0	6665	3332	3332	13329	114750
9/6/21	0	3290	1645	1645	6579	121500
9/7/21	0	0	0	0	0	128079
9/8/21	0	0	0	0	0	128079
9/9/21	0	0	0	0	0	128079

9/10/21	0	0	0	0	0	128079

Table 3: Evacuee Flow Table, 20-Day NEO, Half and Half Loading, No Delays

Date	Afghanistan	Al-Udeid	RAFO Masirah	RAFO al-Musannah	Total in Havens
8/6/21	128079	0	0	0	0
8/7/21	119178	4451	2225	2225	8901
8/8/21	110277	8901	4451	4451	17802
8/9/21	101376	13352	6676	6676	26703
8/10/21	92475	17802	8901	8901	35604
8/11/21	83574	22253	11126	11126	44505
8/12/21	74673	26703	13352	13352	53406
8/13/21	65772	31154	15577	15577	62307
8/14/21	56871	32614	16307	16307	65227
8/15/21	47970	34074	17037	17037	68147
8/16/21	39069	35534	17767	17767	71067
8/17/21	30168	36994	18497	18497	73987
8/18/21	21267	38454	19227	19227	76907
8/19/21	12366	39914	19957	19957	79827
8/20/21	3465	41374	20687	20687	82747
8/21/21	0	40116	20058	20058	80231
8/22/21	0	37125	18563	18563	74250
8/23/21	0	34135	17067	17067	68269
8/24/21	0	31144	15572	15572	62288
8/25/21	0	28154	14077	14077	56307
8/26/21	0	25163	12582	12582	50326
8/27/21	0	22173	11086	11086	44345
8/28/21	0	19182	9591	9591	38364
8/29/21	0	16192	8096	8096	32383
8/30/21	0	13201	6601	6601	26402
8/31/21	0	10211	5105	5105	20421
9/1/21	0	7220	3610	3610	14440
9/2/21	0	4230	2115	2115	8459
9/3/21	0	1239	620	620	2478
9/4/21	0	0	0	0	0
9/5/21	0	0	0	0	0
9/6/21	0	0	0	0	0
9/7/21	0	0	0	0	0
9/8/21	0	0	0	0	0
9/9/21	0	0	0	0	0

9/10/21	0	0	0	0	0

Table 4: Evacuee Flow Table, 25-Day NEO, Emergency Loading, No Delays

Date	Afghanistan	Al-Udeid	RAFO Masirah	RAFO al-Musannah	Total in Havens	Total in US
8/6/21	128079	0	0	0	0	0
8/7/21	128079	0	0	0	0	0
8/8/21	128079	0	0	0	0	0
8/9/21	128079	0	0	0	0	0
8/10/21	128079	0	0	0	0	0
8/11/21	128079	0	0	0	0	0
8/12/21	128079	0	0	0	0	0
8/13/21	119,178	4451	2225	2225	8901	0
8/14/21	110,277	8901	4451	4451	17802	0
8/15/21	101,376	13352	6676	6676	26703	0
8/16/21	92,475	17802	8901	8901	35604	0
8/17/21	83,574	22253	11126	11126	44505	0
8/18/21	74,673	26703	13352	13352	53406	0
8/19/21	65,772	31154	15577	15577	62307	0
8/20/21	56,871	32614	16307	16307	65227	5981
8/21/21	47,970	34074	17037	17037	68147	11962
8/22/21	39,069	35534	17767	17767	71067	17943
8/23/21	30,168	36994	18497	18497	73987	23924
8/24/21	21,267	38454	19227	19227	76907	29905
8/25/21	12,366	39914	19957	19957	79827	35886
8/26/21	3,465	41374	20687	20687	82747	41867
8/27/21	0	40116	20058	20058	80231	47848
8/28/21	0	37125	18563	18563	74250	53829
8/29/21	0	34135	17067	17067	68269	59810
8/30/21	0	31144	15572	15572	62288	65791
8/31/21	0	28154	14077	14077	56307	71772
9/1/21	0	25163	12582	12582	50326	77753
9/2/21	0	22173	11086	11086	44345	83734
9/3/21	0	19182	9591	9591	38364	89715
9/4/21	0	16192	8096	8096	32383	95696
9/5/21	0	13201	6601	6601	26402	101677
9/6/21	0	10211	5105	5105	20421	107658
9/7/21	0	7220	3610	3610	14440	113639
9/8/21	0	4230	2115	2115	8459	119620
9/9/21	0	1239	620	620	2478	125601
9/10/21	0	0	0	0	0	128079

Table 5: Evacuee Flow Table, 20-Day NEO, Emergency Loading, No Delays

Date	Afghanistan	Al-Udeid	RAFO Masirah	RAFO al-Musannah	Total in Havens	Total in US
8/6/21	128079	0	0	0	0	0
8/7/21	122145	2967	1484	1484	5934	0
8/8/21	116211	5934	2967	2967	11868	0
8/9/21	110277	8901	4451	4451	17802	0
8/10/21	104343	11868	5934	5934	23736	0
8/11/21	98409	14835	7418	7418	29670	0
8/12/21	92475	17802	8901	8901	35604	0
8/13/21	86541	20769	10385	10385	41538	0
8/14/21	80607	20746	10373	10373	41491	5981
8/15/21	80607	17755	8878	8878	35510	11962
8/16/21	74673	17732	8866	8866	35463	17943
8/17/21	68739	17708	8854	8854	35416	23924
8/18/21	62805	17685	8842	8842	35369	29905
8/19/21	56871	17661	8831	8831	35322	35886
8/20/21	50937	17638	8819	8819	35275	41867
8/21/21	45003	17614	8807	8807	35228	47848
8/22/21	39069	17591	8795	8795	35181	53829
8/23/21	33135	17567	8784	8784	35134	59810
8/24/21	27201	17544	8772	8772	35087	65791
8/25/21	21267	17520	8760	8760	35040	71772
8/26/21	15333	17497	8748	8748	34993	77753
8/27/21	9399	17473	8737	8737	34946	83734
8/28/21	3465	17450	8725	8725	34899	89715
8/29/21	0	16192	8096	8096	32383	95696
8/30/21	0	13201	6601	6601	26402	101677
8/31/21	0	10211	5105	5105	20421	107658
9/1/21	0	7220	3610	3610	14440	113639
9/2/21	0	4230	2115	2115	8459	119620
9/3/21	0	1239	620	620	2478	128079
9/4/21	0	0	0	0	0	128079
9/5/21	1	0	0	0	0	128079
9/6/21	2	0	0	0	0	128079
9/7/21	3	0	0	0	0	128079
9/8/21	4	0	0	0	0	128079
9/9/21	5	0	0	0	0	128079
9/10/21	6	0	0	0	0	128079

Table 6: Evacuee Flow Table, 25-Day NEO, Half and Half Loading, 24-hr Delay

Date	Afghanistan	Al-Udeid	RAFO Masirah	RAFO al-Musannah	Total in Havens	Total in US
8/6/21	128079	0	0	0	0	0
8/7/21	128079	0	0	0	0	0
8/8/21	128079	0	0	0	0	0
8/9/21	128079	0	0	0	0	0
8/10/21	128079	0	0	0	0	0
8/11/21	128079	0	0	0	0	0
8/12/21	128079	0	0	0	0	0
8/13/21	122145	2967	1484	1484	5934	0
8/14/21	116211	5934	2967	2967	11868	0
8/15/21	116211	5934	2967	2967	11868	0
8/16/21	110277	8901	4451	4451	17802	0
8/17/21	104343	11868	5934	5934	23736	0
8/18/21	98409	14835	7418	7418	29670	0
8/19/21	92475	17802	8901	8901	35604	0
8/20/21	86541	17394	8697	8697	34788	6750
8/21/21	80607	16986	8493	8493	33972	13500
8/22/21	74673	16578	8289	8289	33156	20250
8/23/21	68739	16170	8085	8085	32340	27000
8/24/21	62805	15762	7881	7881	31524	33750
8/25/21	56871	15354	7677	7677	30708	40500
8/26/21	50937	14946	7473	7473	29892	47250
8/27/21	45003	14538	7269	7269	29076	54000
8/28/21	39069	14130	7065	7065	28260	60750
8/29/21	33135	13722	6861	6861	27444	67500
8/30/21	27201	13314	6657	6657	26628	74250
8/31/21	21267	12906	6453	6453	25812	81000
9/1/21	15333	12498	6249	6249	24996	87750
9/2/21	9399	12090	6045	6045	24180	94500
9/3/21	3465	11682	5841	5841	23364	101250
9/4/21	0	10040	5020	5020	20079	108000
9/5/21	0	6665	3332	3332	13329	114750
9/6/21	0	3290	1645	1645	6579	121500
9/7/21	0	0	0	0	0	128079
9/8/21	0	0	0	0	0	128079
9/9/21	0	0	0	0	0	128079
9/10/21	0	0	0	0	0	128079

Table 7: Evacuee Flow Table, 20-Day NEO, Half and Half Loading, 24-hr Delay

Date	Afghanistan	Al-Udeid	RAFO Masirah	RAFO al-Musannah	Total in Havens	Total in US

8/6/21	128079	0	0	0	0	0
8/7/21	119,178	4451	2225	2225	8901	0
8/8/21	110,277	8901	4451	4451	17802	0
8/9/21	101,376	13352	6676	6676	26703	0
8/10/21	92,475	17802	8901	8901	35604	0
8/11/21	83,574	22253	11126	11126	44505	0
8/12/21	74,673	26703	13352	13352	53406	0
8/13/21	65,772	31154	15577	15577	62307	0
8/14/21	56,871	32614	16307	16307	65227	5981
8/15/21	56,871	29623	14812	14812	59246	11962
8/16/21	47,970	31083	15542	15542	62166	17943
8/17/21	39,069	32543	16272	16272	65086	23924
8/18/21	30,168	34003	17002	17002	68006	29905
8/19/21	21,267	35463	17732	17732	70926	35886
8/20/21	12,366	36923	18462	18462	73846	41867
8/21/21	3,465	38383	19192	19192	76766	47848
8/22/21	0	37125	18563	18563	74250	53829
8/23/21	0	34135	17067	17067	68269	59810
8/24/21	0	31144	15572	15572	62288	65791
8/25/21	0	28154	14077	14077	56307	71772
8/26/21	0	25163	12582	12582	50326	77753
8/27/21	0	22173	11086	11086	44345	83734
8/28/21	0	19182	9591	9591	38364	89715
8/29/21	0	16192	8096	8096	32383	95696
8/30/21	0	13201	6601	6601	26402	101677
8/31/21	0	10211	5105	5105	20421	107658
9/1/21	0	7220	3610	3610	14440	113639
9/2/21	0	4230	2115	2115	8459	119620
9/3/21	0	1239	620	620	2478	125601
9/4/21	0	0	0	0	0	128079
9/5/21	0	0	0	0	0	128079
9/6/21	0	0	0	0	0	128079
9/7/21	0	0	0	0	0	128079
9/8/21	0	0	0	0	0	128079
9/9/21	0	0	0	0	0	128079
9/10/21	0	0	0	0	0	128079

Table 8: Evacuee Flow Table, 25-Day NEO, Emergency Loading, 24-hr Delay

Date	Afghanistan	Al-Udeid	RAFO Masirah	RAFO al-Musannah	Total in Havens	Total in US
8/6/21	128079	0	0	0	0	0

8/7/21	128079	0	0	0	0	0
8/8/21	128079	0	0	0	0	0
8/9/21	128079	0	0	0	0	0
8/10/21	128079	0	0	0	0	0
8/11/21	128079	0	0	0	0	0
8/12/21	128079	0	0	0	0	0
8/13/21	119,178	4451	2225	2225	8901	0
8/14/21	110,277	8901	4451	4451	17802	0
8/15/21	110,277	8901	4451	4451	17802	0
8/16/21	101,376	13352	6676	6676	26703	0
8/17/21	92,475	17802	8901	8901	35604	0
8/18/21	83,574	22253	11126	11126	44505	0
8/19/21	74,673	26703	13352	13352	53406	0
8/20/21	65,772	28163	14082	14082	56326	5981
8/21/21	56,871	29623	14812	14812	59246	11962
8/22/21	47,970	31083	15542	15542	62166	17943
8/23/21	39,069	32543	16272	16272	65086	23924
8/24/21	30,168	34003	17002	17002	68006	29905
8/25/21	21,267	35463	17732	17732	70926	35886
8/26/21	12,366	36923	18462	18462	73846	41867
8/27/21	3,465	38383	19192	19192	76766	47848
8/28/21	0	37125	18563	18563	74250	53829
8/29/21	0	34135	17067	17067	68269	59810
8/30/21	0	31144	15572	15572	62288	65791
8/31/21	0	28154	14077	14077	56307	71772
9/1/21	0	25163	12582	12582	50326	77753
9/2/21	0	22173	11086	11086	44345	83734
9/3/21	0	19182	9591	9591	38364	89715
9/4/21	0	16192	8096	8096	32383	95696
9/5/21	0	13201	6601	6601	26402	101677
9/6/21	0	10211	5105	5105	20421	107658
9/7/21	0	7220	3610	3610	14440	113639
9/8/21	0	4230	2115	2115	8459	119620
9/9/21	0	1239	620	620	2478	125601
9/10/21	0	0	0	0	0	128079

Table 9: Evacuee Flow Table, 20-Day NEO, Emergency Loading, 24-hr Delay

Date	Afghanistan
8/6/21	206079
8/7/21	197178
8/8/21	188277
8/9/21	179376
8/10/21	170475
8/11/21	161574
8/12/21	152673
8/13/21	143772
8/14/21	134871
8/15/21	134871
8/16/21	125970
8/17/21	117069
8/18/21	108168
8/19/21	99267
8/20/21	90366
8/21/21	81465
8/22/21	72564
8/23/21	63663
8/24/21	54762
8/25/21	54762
8/26/21	45861
8/27/21	36960
8/28/21	28059
8/29/21	19158
8/30/21	10257
8/31/21	1356
9/1/21	0
9/2/21	0
9/3/21	0
9/4/21	0
9/5/21	0
9/6/21	0
9/7/21	0
9/8/21	0
9/9/21	0
9/10/21	0

Table 10: Evacuee Flow Table, 25-Day NEO, Emergency Loading, 48-hr Delay

Date	Afghanistan

8/6/21	206079
8/7/21	192,116
8/8/21	183,215
8/9/21	183,215
8/10/21	174,314
8/11/21	165,413
8/12/21	156,512
8/13/21	147,611
8/14/21	138,710
8/15/21	138,710
8/16/21	124,747
8/17/21	110,784
8/18/21	96,821
8/19/21	82,858
8/20/21	82,858
8/21/21	68,895
8/22/21	54,932
8/23/21	40,969
8/24/21	27,006
8/25/21	27,006
8/26/21	13,043
8/27/21	0
8/28/21	0
8/29/21	0
8/30/21	0
8/31/21	0
9/1/21	0
9/2/21	0
9/3/21	0
9/4/21	0
9/5/21	0
9/6/21	0
9/7/21	0
9/8/21	0
9/9/21	0
9/10/21	0

Table 11: Evacuee Flow Table, 25-Day NEO, 400-passenger loading, 96-hr delay

Appendix C3: Force Suggestions

Airpower Calculations

Number of Strike Sorties Required Per Day

$$1\ Engagement\ Zone * \left(\left(\frac{4\ PGMs}{2\ targets}\right) Fighters * \left(\frac{24\ hrs}{4\ hrs\ on\ station}\right)\right) = 12\ Strike\ Sorties$$

Number of Daily Sorties Per Aircraft

The premium on runway availability at KBL as well as the danger of operations there means that long-range operations are more viable, so aircraft will need to fly into Kabul airspace in order to provide protection and ISR to the airlift operations. Due to the long distances involved, strike aircraft will need to refuel using tanker aircraft: the combat radius of the F-35B in a strike profile is 505nm. This means that to make the flight from the "midpoint" (notional location of the ARG off the coast of Pakistan), each strike aircraft will have to refuel over Pakistan. I allocate 15 minutes for each fueling stop: one on the way in, one during the sorite, and one on the way out. Loiter times for the F-35B are not available, so I assume that to stay aloft for the full four hours required on-station, each F-35 will need to fuel at least once during its sortie. I assume that all aircraft are F-35B STOL variants based on the Marine ARG.

$$Sortie\ Rate = \frac{24hrs}{Flight\ Time + Turnaround + MaintTime}$$

where $MaintTime = 3.4hr + 0.68hr * Flight\ Time$

Assuming an airspeed of 1042 knots for all strike aircraft as well as three hours of turnaround time, the flight time and sortie rate for carrier-based aircraft is:

Carrier-Based Aircraft

$$Flight\ Time = 2 * \left(\frac{675.15\ nm}{1042\ nm/h}\right) + 4\ hr\ on\ station + 3\ (0.25\ hr) = 6.04\ hrs$$

$$Sortie\ Rate = \frac{24\ hrs}{(6.04 + 3 + 3.4 + 0.68 * 6.04)\frac{hrs}{sortie}} = \frac{24\ hrs}{16.55\frac{hrs}{sortie}}$$
$$= 1.45\ sorties/day/aircraft$$

Number of Strike Aircraft Required

Under 100% Readiness

$$\frac{12\ sorties/day}{1.45\ sorties/day/aircraft} = 8\ aircraft$$

Under F-35A Avg. Readiness

$$\left(\frac{12\,sorties/day}{1.45\,sorties/day/aircraft}\right) * \left(\frac{1}{0.616}\right) = 13.4 = 14\,aircraft$$

Force Tables

Table 12: Notional Ground Troops-to-Task Assignment

Task	Required Unit	Required Troops	Separate Force Needed to Fill?	Where do They Come From?	# of Troops (Added to Running Total)	# in KBL
Stage 1: Secure Airport						
Airport Security	1 btn	800	Y	820th	915	915
Quick Reaction Force (QRF)	1 btn	1000	Y	22nd MEU	2200	2200
Gate Security (3 Gates)	1 coy	3 x 150	N	QRF	0	0
Operational Reserve	2 btn	2000+	Y	2nd MEB	4400	0-3600
Prepositioned Troops	1 btn	1000	N	Pre-deployed	1000	1000
Stage 2: Extraction						
Extraction Operations	1 coy	100-150	N	QRF	0	0
Stage 3: Evacuation						
ECC Operation (6 ECCs, 2 shifts)	2 coy	240	N	Gate Security	0	0
Stage 4: Accommodation						
Support Staff (Medical, Eng., PSY, CA, misc). x3 Sites	1 btn x 3	3000	Y	3 Army	3000	0
TOTAL					**11,515**	**4,115-7,715**

Data sourced from USMC (2007)

Table 13: Operational Reserves and Intermediate Staging Areas

	Total	
Unit Type	**Unit**	**Number (Approx.)**
II Marine Expeditionary Force		
24th MEU	2 x btn	2200
26th MEU	2 x btn	2200
Army Support Battalions		
Misc.	3x btn	3000
TOTAL		**7400**

Note: the 24th and 26th MEUs also have their own organic aviation combat elements

Table 14: Notional Air Package

Role	**Number (Shlapak 2002)**	**Number (Current Operation)**	**Aircraft Type (Ex.)**
Air Superiority/Strike	28	14	*F-35B*
SEAD	8	0	*F-16*
Surveillance/AWACs	3	2	*E-8C Joint STARS*
CSAR	3	2	*CH-53*
Airlift	8	21	*C-17*
Tanker	10	6	*KC-135, KC-130*
UAV	N/A	2	*MQ-9 Reaper*

Appendix C4: Diagnostics

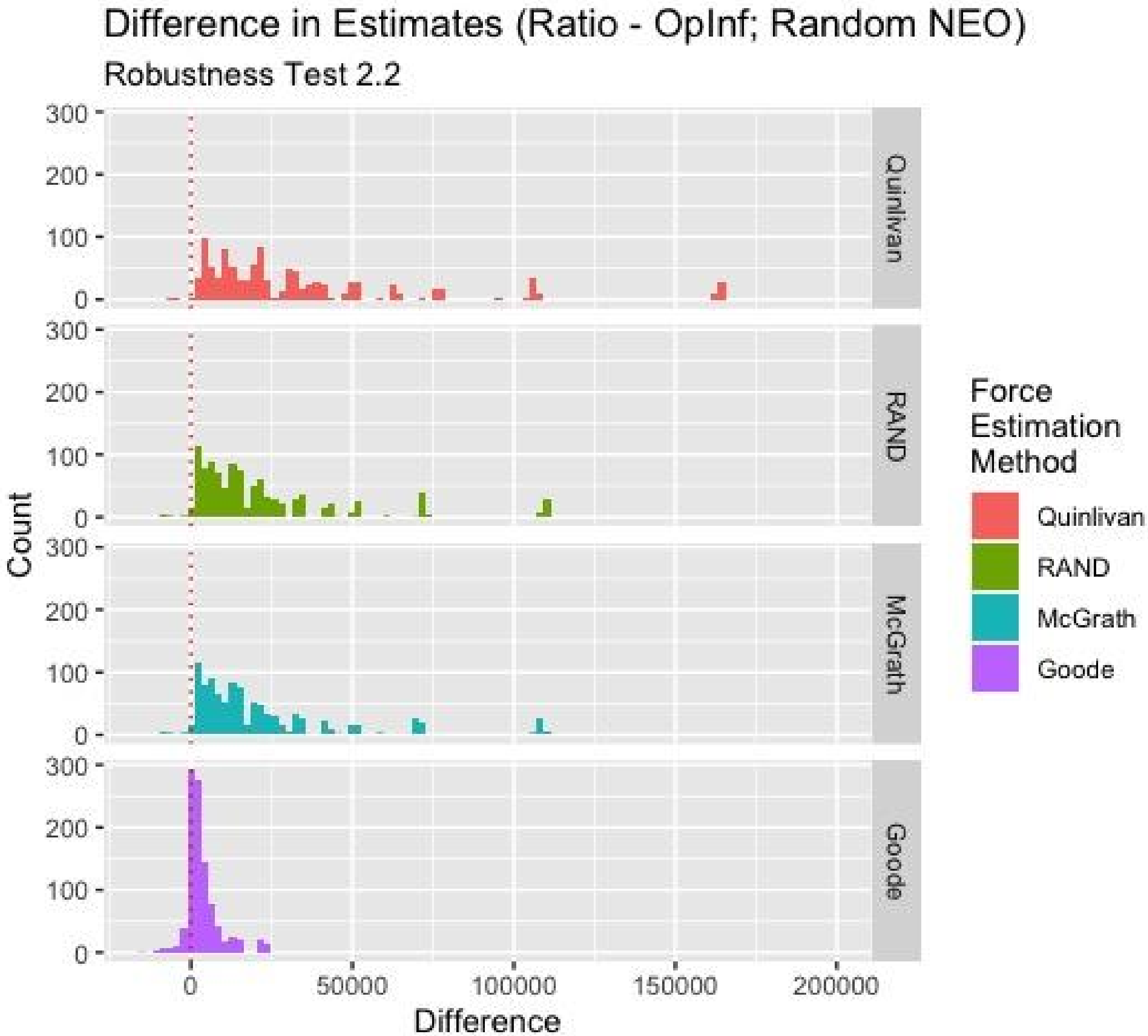

Figure 18: Diagnostic Test 2: Monte Carlo

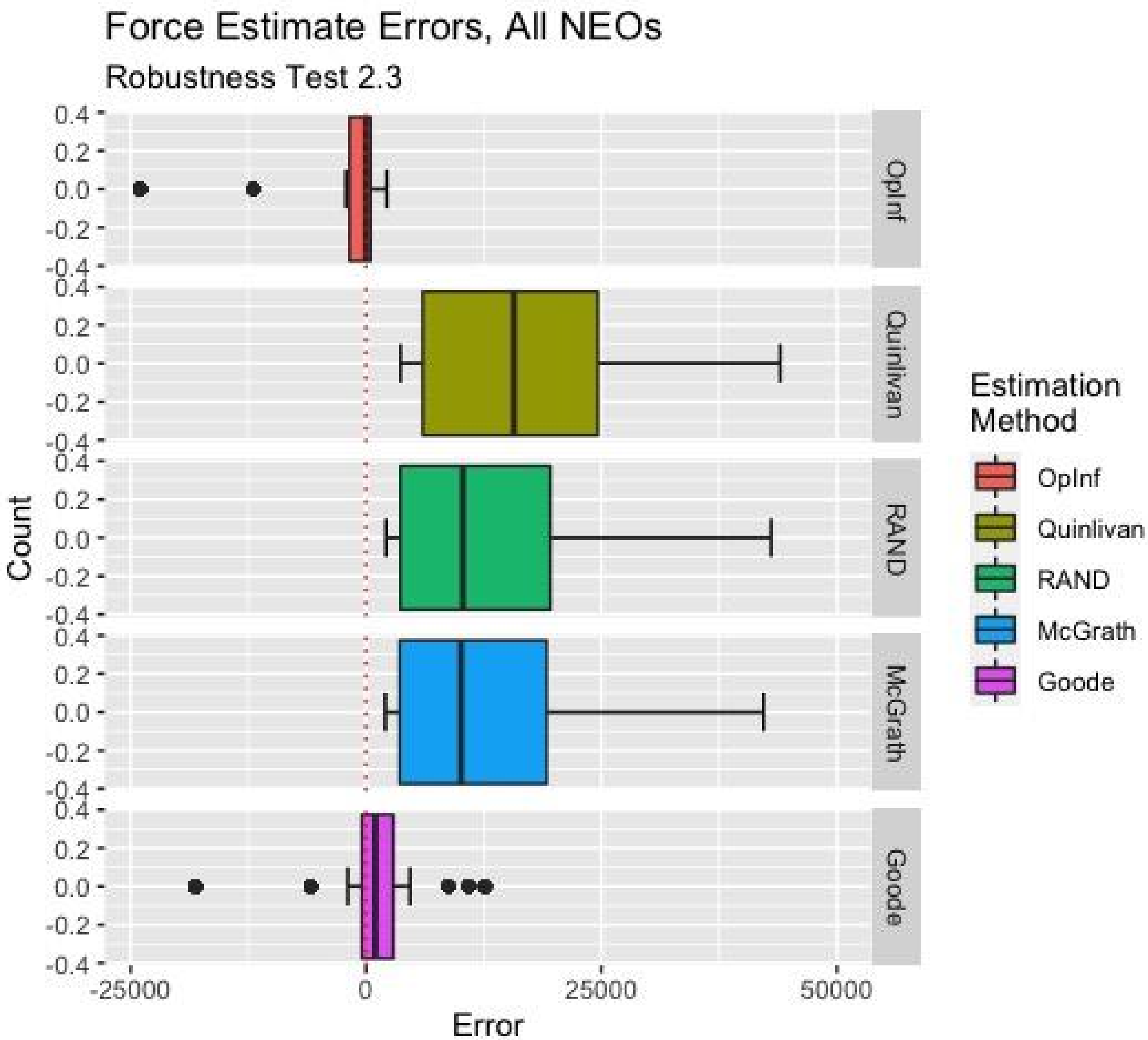

Figure 19: Diagnostic Test 3, True Errors

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