Allocating Marine Expeditionary Unit Equipment to Minimize Shortfalls

Third Edition

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Preface

For various reasons explored in this report, including the commander's priorities and expected mission requirements, the Marine Corps' amphibious lift requirements—that is, the space that Marine Corps units need to transport the equipment they expect to use to complete tasks associated with a given mission—may exceed the lift capacity of an Amphibious Ready Group. For this reason, Marine Expeditionary Units (MEUs) afloat generally do not embark all of the equipment assigned to their subordinate units. What is the impact of this shortfall on the MEU's ability to complete the tasks associated with the mission—especially when the mission includes reconstruction and stabilization operations? In general, MEUs do not fail because of the equipment shortfalls; Marine Corps commanders are able to make use of the equipment they have in innovative and creative ways to complete the tasks at hand. However, equipment shortfalls do force shortcuts and sometimes sacrifice the quality and speed of task completion. This report describes the development of an automated tool aimed at allocating equipment to achieve the various tasks associated with MEU missions. The purpose is to highlight the equipment implications associated with completing these tasks.

This report is the third edition of a previously published report. Additional missions were added and the tool was modified to improve its performance and accuracy.

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Summary

As a rapidly deployable force with air, ground, naval, and amphibious components, a Marine Expeditionary Unit (MEU) is tasked with a variety of missions and must have both the right personnel and the right equipment to accomplish them. A critical component of mission accomplishment is the MEU's ability to access equipment deemed necessary to accomplish all tasks associated with the mission. However, in many cases, the Navy's lift capacity falls short. As a result, when the MEU departs, some equipment is left behind.

There are several factors that may affect what equipment ultimately ends up aboard the ship and what equipment remains behind: (1) the risk preferences of the commander; (2) expectations about the nature of the deployment; (3) guidance or direction from combatant commanders to be supported; and (4) equipment readiness and repair schedules. What is the impact of this shortfall on the MEU's ability to complete all the tasks associated with the mission? Even if the shortfalls do not prevent the MEU from accomplishing its mission, and even if the MEU may receive supplemental support from other sources, equipment shortfalls do affect mission performance and efficiency.

Research Objective

The objective of this work is to assess the overall impact of equipment shortfalls on selected mission performance for MEUs afloat—leading to the following research questions:

- **What is the mission set?** The sponsor, the Marine Corps Combat Development Command (MCCDC), provided a set of 15 kinetic and nonkinetic missions to be assessed. In the two previous edition of this report, we were focused on just four of these missions: humanitarian assistance (HA) operations; noncombatant evacuation operations (NEOs); tactical recovery of aircraft and personnel (TRAP); and airfield and port seizure operations. In this report, we focus on an additional two of the 15 missions: amphibious raid and stability operations.
- **What tasks and subtasks comprise each of the 15 missions?** This required a thorough deconstruction of all 15 missions, with particular emphasis on the missions included in the first two phases of this study and the two additional missions included in this phase of the study.
- **What equipment is available to the MEU to accomplish mission tasks and subtasks?** A diverse set of factors affect the types of equipment aboard a MEU, including not only space available but also risk trade-offs made by commanders and expectations about the nature of the deployment. Since there is no standardized table of equipment (T/E) for a MEU, the study team obtained a list of equipment assigned to a recent MEU, which included information on what was embarked and what was left behind.
- **What measures and metrics should be used to assess the capability of selected equipment?** The loading list provided the set of available equipment. We then used equipment manuals and sponsor input to define the capabilities of each piece of equipment in performing designated tasks. This information is displayed to the user when a piece of equipment is selected.
- **What tasks cannot be accomplished immediately because of lack of equipment?** This includes equipment not necessarily designed to accomplish the task, but which might do in an emergency. This then ends the shortfall impact assessment question.

Approach

This study drew on work that RAND completed in support of MCCDC's Operational Analysis Division. RAND developed a computer-based system to allocate U.S. Marine Corps units to stabilization and reconstruction tasks that could account for changing situational factors. The finished system was called the Stabilization and Reconstruction Force Allocator (SRFA). Central to the work presented here was the development of a software system, the Marine Air-Ground Task Force (MAGTF) Equipment Structural Assessment (MESA), which was loosely based on the SRFA previously developed. Inputs to the system consist of a MEU equipment list, the tasks identified through the mission deconstruction process, the measures and metrics used to define equipment capabilities, and the set of linkages between tasks and equipment.

The research answered the research questions in three phases. First, we conducted a thorough review and deconstruction of the 15 missions, focusing in particular on the four missions included in the phase 1 and phase 2 work and the two missions added during this phase. Second, we identified the equipment needed to accomplish the tasks for all six missions that MESA currently supports. Third, we identified the measures and metrics, or "planning factors," needed to assess the capability of each piece of equipment in the loading list. Equipment selection is up to the user of the MESA. The software upgrades proceeded in parallel with these activities.

We explored current operational planning processes, first through literature review and next through interaction with personnel familiar with current MEU operations. Members from our study team attended a MEU Operational Advisory Group meeting in December 2013, and they also visited the staffs of East and West Coast–based MEUs, to ensure that the MESA incorporated current practices and that the final product would reflect reality.

Mission Deconstruction

Mission deconstruction is the process of breaking down the MEU missions into their constituent tasks and subtasks. This allows the planner to identify when, where, and how the task is to be accomplished in the context of the larger mission. In addition, it helps identify those tasks that are common across several missions. This is extremely important in those cases where the MEU is given multiple missions to perform.

Deconstructing missions in this way suggests some interesting observations and themes:

- **Common tasks:** First, deconstructing missions highlights the significant role that common tasks play in mission development and execution. Because they rely on common tasks, the initial phases of the missions are extremely similar.
- **Mission specific tasks:** The deconstruction process also makes it clear that the mission-specific tasks are the ones that really define the mission and that determine the equipment most essential to mission completion.
- **Primacy of context:** Deconstruction also highlights the importance of context. The specific operational environment, threat level, terrain, and contributions of other organizations will all significantly affect the activities the MEU is expected to complete and the associated equipment requirements.

What Mission Set?

As a rapidly deployable force, a single MEU may be involved in several diverse missions. The question then is: "What equipment is needed to support all of these missions, and what are the effects of shortfalls on mission accomplishment?" First, however, the appropriate missions must be identified. Fifteen MEU missions are addressed in this report, divided into two categories:

1. Amphibious operations missions

2. Missions consisting of expeditionary support to other operations/crises and limited contingency operations-operating across the range of military operations.

What Tasks?

One way to identify the pieces of equipment and numbers of units needed for a given MEU mission is to deconstruct that mission into its component tasks and subtasks and then determine the equipment needed to complete each. The first step in this approach is to deconstruct the 15 missions into tasks, subtasks, and activities and to identify some of the characteristics of each mission that may affect equipment requirements.

In addition to the HA mission used as the prototype for the MESA in the first edition of this report, we added an additional three missions to the application in the second edition: NEO, TRAP, and airfield and port seizure operations. In this edition, we add two more missions: stability operations and amphibious raid. In addition, we discuss the treatment of "fenced forces," such as the Quick Reaction Force (QRF). By "fenced," we mean that equipment needed to support these forces cannot be used for any other purpose.

Missions generally share many common tasks and activities, such as planning, establishing the command center, and area and road clearance. Because the implementation of even common tasks will vary depending on the mission they support, we offer generic descriptions of the common tasks and then highlight some of the specific operational and environmental characteristics that are most likely to affect their execution.

In many cases, a MEU is asked to complete not a single mission from the mission set, but a more complex operation that involves several overlapping missions that must be completed sequentially or nearly simultaneously. We refer to this as *mission nesting*.

Deconstruction reveals how the boundaries between missions are often blurred. Nesting has implications for planning in that it can be exploited to streamline the process. For example, planners may be able

to supplement the HA mission plan with a NEO "module" based on past experience, rather than starting from scratch.

What Equipment?

The equipment available to perform the tasks associated with the missions consists of the equipment onboard the MEU and possibly additional, remotely located equipment. For this study, the equipment list was provided by one of the MEUs we visited. This has the advantage of providing a realistic equipment set. However, as we explain later, the MESA application we have developed can accommodate equipment lists that are significantly different, larger, and smaller than what we use as a baseline. For example, if certain equipment is not available to support a given plan, the quantities can be set to zero.

Equipment Characteristics

Equipment characteristics are critical to the planning process: the capability, capacity, and operating constraints associated with MEU equipment comprise the planning factors that link tasks or military activity to the equipment. In the MESA application, equipment characteristics are displayed to the user when a piece of equipment is selected. The characteristics then determine the planning factors, consisting of (1) whether the equipment is adequate to accomplish the task; (2) the number needed and for how long; and (3) modifications to plans to accomplish the task due to equipment constraints. If the desired equipment is not available, either temporarily, because it is currently planned for other tasks, or simply not onboard or readily accessible, substitutions or compromises are then made.

The process of developing planning factors is left to the user and requires completing several steps: (1) mission deconstruction, including the identification of key tasks and specific subtasks and activities; (2) linking military tasks with specific pieces of equipment; (3) defining relevant metrics; and (4) prioritizing pieces of equipment and unit types based on their relative capabilities. The first step was discussed

earlier and is included in the MESA application. Below we describe the subsequent steps.

- **Linking tasks to equipment:** To accomplish each task and military activity, suitable equipment must be identified that has the requisite capabilities and is not otherwise operationally constrained.
- **Developing metrics:** A metric as used in this work represents the capability of a piece of equipment as applied to a specified task or military activity. Examples are the range of a vehicle on a single tank of gas or the carrying capacity of a vehicle in terms of the number of personnel.
- **Priority equipment:** Prioritization focuses on the best piece of equipment to accomplish the task. After specifying the appropriate metrics for each task, the user's next step is to assign each military activity all the relevant pieces of equipment that could be used to complete the task. Depending on the availability of the best piece of equipment, the user may have to prioritize less than ideal equipment that could be used instead.

Fungibility

Once planning factors have been developed, it is easy for users to substitute between pieces of equipment with similar capabilities. A set of trucks for example, may be more or less fungible. Fungibility allows commanders to complete missions even when optimal equipment is not available. The prioritization of equipment ensures that the concept of fungibility is also incorporated into the MESA application.

The MAGTF Equipment Structural Assessment (MESA) Application

The MESA application is a software tool that allocates equipment from a predetermined and potentially limited inventory to a set of missions and tasks selected by the user. The application incorporates the deconstructed missions developed as part of this research effort and produces

as an output a notional set of equipment that could be used to complete a specific user-defined mission.

The MESA software consists of a series of tabs (depicted in Figure S.1 and listed in Table S.1) containing input fields that define a scenario. The user navigates through the tabs, filling in the fields as appropriate to define the mission, its constituent tasks, subtasks, and other characteristics. Once the user is satisfied with the mission parameters, the program will allocate equipment from the selected inventory and assign it to the individual tasks. If the user decides that the results are worth saving for future reference and planning purposes, they can be exported to an Excel spreadsheet. If insufficient equipment is available to complete a task, the application will display the percentage of each task completed.

The MESA application assesses the equipment requirements of a given mission based on a number of user-defined inputs. The current version allows for either a single mission or multiple missions. Multiple mission configurations accommodate situations in which a primary mission might be a combat mission with a humanitarian mission

Figure S.1
Main Screen of the MESA Application

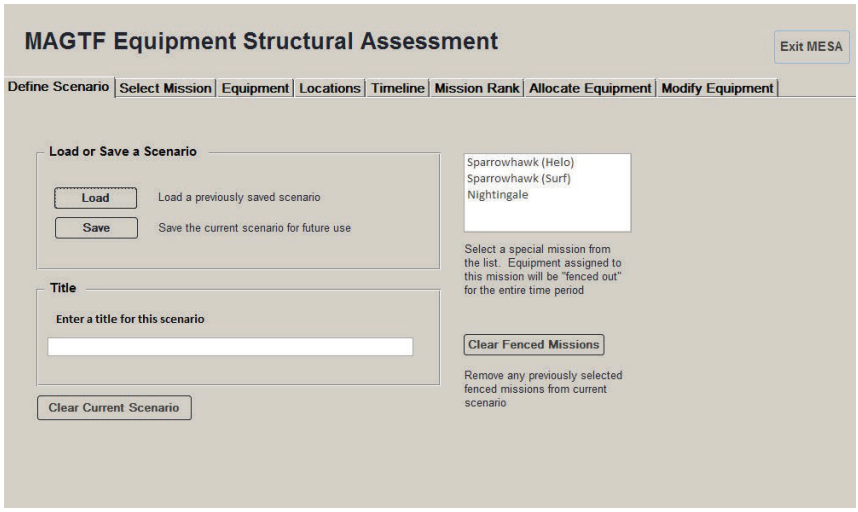

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Table S.1
MESA Main Interface Tabs

Tab	Function
Define scenario	The user is presented with 15 missions. He or she can select one or more of them (in this version, only six missions are fully operational).
Select mission	For each mission selected, the user is offered a series of tasks and subtasks that he or she may select as being critical to the scenario.
Equipment	The equipment available to the MEU is displayed at this tab.
Locations	The user selects from a list of locations or inventories that will be available to the mission.
Timeline	The user can specify the start and finish date for each task.
Mission rank	The user is offered the opportunity to rank missions by priority when assigning equipment.
Allocate equipment	The results of the equipment allocation are displayed at this tab.
Modify equipment	Interface for adding new equipment items or altering the descriptions of existing items.

combined. The result would be a nested mission set in this case. The following describes the inputs required:

- **Missions and Tasks:** The user first determines the mission and the specific tasks required to accomplish the mission. At present, six missions are fully operational. An example of a typical set of mission tasks might be planning, establishing a command post, securing routes, providing perimeter defense, and establishing locations for providing assistance.
- **Prioritization:** When multiple missions are chosen, the user may prioritize these missions based on their importance. Missions ranked higher receive first pick when allocating equipment to their tasks and subtasks.
- **Timelines:** MESA needs to know the start and end of each mission task and subtask selected. The user can select from two different time intervals: hours and days. The default scenario time

interval is hours, and the default start and end for the scenario is hour 1 and hour 48, respectively.

- **Roster of Available Equipment:** The MESA application allocates equipment to missions from a predetermined list of USMC equipment. The equipment roster currently includes approximately 147 items of combat and noncombat equipment available to the application. Each item of equipment includes several metrics describing capabilities. These metrics are used to determine the number of an item required to perform each task. The definition of appropriate metrics is determined by the user and is central to the development of planning factors.
- **Locations/Equipment Inventories:** Conceptually, the MESA application is intended to evaluate mission success given limited inventories of equipment. To do this, the application requires a *count* or inventory of each item of available equipment. The application contains a predetermined set of inventories of equipment (termed locations in MESA) potentially available to the mission. These locations can represent ships, prepositioned dumps, cargo left on pier, fixed base locations, or any other location.

Application Outputs

The MESA application output consists of four elements: (1) a summary of the tasks and requested equipment specified by the user, (2) a task completion and equipment usage display, including any shortfalls, (3) an Excel spreadsheet with tabs displaying the task-specific completion percentages, detailed inventories, and scenario parameters, and (4) an Excel spreadsheet containing a detailed breakdown of equipment item usage over time. These outputs are generated by clicking the "Review Scenario," "Score Scenario," "Score Equipment," and "Save to Excel" buttons from the "Allocate Equipment" tab, respectively.

- The "Review Scenario" button produces a summary of the missions and tasks selected by the user, the amount of equipment requested for each task, and the task-specific start and end periods. In practice, this display is very helpful for reviewing the components of a scenario under development.

- The "Score Equipment" button displays the task completion percentage and shortfalls. Successfully completed tasks can be identified by a completion percent of 100; any shortfalls are represented by a value less than 100 percent, including 0 percent, which indicates that none of the requested equipment was available for a specific task.
- The "Save to Excel" button generates an Excel spreadsheet that includes all the information displayed by the "Review Scenario" and "Score Equipment" buttons. In addition, it includes details of the available inventories and a summary of other scenario parameters, such as time period, start and end period, and the scenario title.

Once the user is satisfied with the scenario definition and the resulting equipment allocation determined by the MESA application, he can elect to save the output to an Excel spreadsheet for further manipulation.

Capabilities

Output from MESA informs planners and commanders about the types of equipment essential to mission completion, identifies likely equipment shortfalls, and can assist the commander in an assessment of the implications of equipment shortfalls. Planners and commanders can use this information to adjust mission plans or to adjust the equipment traditionally assigned to the MEU.

The application is extremely flexible: Not only does the user define the tasks involved and the operational conditions, but the user can also reconfigure equipment inventories and rankings as necessary or desired.

Limitations

The MESA application as currently configured is strictly a planning tool, and it models only generic MEU missions. An application of this nature cannot capture the full range of complexities and alternatives associated with a given MEU mission. As a result, the application produces useful approximations and guidelines, but requires additional

human input and vetting to translate output into a viable operational plan.

The Stress Test

In an effort to test the how well the MESA application can support mission planning, we developed a scenario designed to *stress* its ability to assess equipment shortfalls. Instead of simply executing a single textbook doctrinal operation, we explored the increasingly prominent split–Amphibious Ready Group (ARG) operating concept, as well as the more complex challenge of multiple simultaneous operations. We used the traditional combined ARG as our control group, and we also examined individual missions in order to be able to compare their impact on equipment availability with multiple simultaneous missions.

Lessons Learned

The processes of defining planning factors and developing the MESA application suggest several observations:

- **Common Tasks:** There is considerable overlap in the types of tasks and activities involved in the mission set. These commonalities are important to mission planning because they imply that similarities in the equipment requirements may also exist.
- **Constrained Allocations:** The MESA application allows the equipment set to be constrained, facilitating planning under suboptimal conditions.
- **Situation-Dependent Allocations:** The MESA application allows the user to specify operational conditions that can have an effect on the equipment requirements.
- **Task Sequencing and Timing:** If tasks occur sequentially, equipment used in one task may be available in the next. However, if tasks overlap, then equipment required by multiple tasks may

only be available for one activity, again forcing substitution and reallocation.

- **Relative Task Importance:** For any mission, some tasks may be more important than others. Prioritizing tasks is one way that commanders can ensure that the most effective pieces of equipment are available to complete the most important tasks.
- **Mission Nesting:** In some cases, a MEU is asked to complete not a single mission from the mission set, but a more complex operation that involves several overlapping missions that must be completed sequentially or nearly simultaneously.

Challenges

The MESA application described in this third edition expands the previous versions of MESA, which considered only the HA, NEO, TRAP, and airfield and port seizure missions. Although two additional missions were added, future work should expand the MESA application to include the rest of the nine required missions.

The value of the MESA application and its contribution to mission planning could also be significantly advanced by developing more rigorous and accurate planning factors for the military tasks and activities listed on the Marine Corps Task List. To be useful, these planning factors would need to link tasks from the task list to specific pieces of equipment that can be used to complete them.

Similarly, a more sophisticated model of equipment performance would be helpful. For example, time and distance parameters are crucial to estimating the demand for transportation resource, yet at present the MESA application does not address this fully.

Finally, better documentation of the specific tasks involved in specific missions and better ways of capturing the experiences of past MEU commanders will also provide better data on unexpected equipment substitutions and collecting additional performance data from real-world situations.

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CHAPTER ONE

Introduction

As a rapidly deployable force with capabilities for ground, naval, and amphibious operations, the Marine Corps' set of missions are diverse and numerous. A single Marine Expeditionary Unit (MEU) may be involved in a range of missions, from expeditionary support to contingencies such as humanitarian operations to amphibious assault operations. In many cases, MEUs afloat are the first responders to disasters and post-conflict operations. Consequently, they are often called on to initiate the stabilization missions in the absence of civilian leadership and direct support. Facing this diverse set of missions, MEUs must have the resources, skills, and leadership to deal with this challenge. Critical among the resources required is the right types of equipment to successfully accomplish their objectives. Creating a stable environment requires the use of security forces, whereas reconstruction requires skills quite different from combat. The lack of such skills and equipment onboard can result in forgoing the completion of some tasks—or it can result in considerable delay in getting the task done.

Nevertheless, the MEU is often forced to operate without its ideal or optimal set of equipment. In most cases, the Navy's lift capacity, or the space available on the ships that make up the MEU, falls short of that needed to transport the MEU's full set of equipment. As a result, when the MEU departs, some equipment is left behind, considered cargo left on pier (CLOP), leaving the MEU less-than-ideally equipped to complete certain missions. This is especially true when the MEU must be prepared for stabilization, humanitarian, and contin-

gency operations.[1] There are several factors that may affect what equipment ultimately ends up aboard the ship and what equipment remains behind. The risk preferences of the commander, expectations about the nature of the deployment or previous MEU experience, and equipment readiness and repair schedules all play a role in equipment selection. The fact that the MEU commander must make choices between pieces of equipment and is not able to deploy with an ideal equipment set raises the question: "What is the impact of this shortfall on mission accomplishment—especially when the mission includes stability operations?"

Research Objective

This report and the Marine Air-Ground Task Force (MAGTF) Equipment Structural Assessment (MESA) application that accompanies it are intended to provide a systematic framework and approach that can be used to evaluate the effect of equipment shortfalls on the performance of specific missions. The approach used in this report is for the user to (1) use the MESA application to facilitate the development of planning factors by the user and (2) use the MESA application to assign equipment to tasks. This process provides a framework that MEU commanders can use to develop mission plans and understand where equipment shortfalls are likely. The process consists of simple steps that translate mission requirements into tasks, subtasks, and military activities, each of which is linked directly to the types of equipment needed for completion. It also highlights key parameters that may affect the types of equipment needed or the execution of key tasks, including terrain, threat-level, infrastructure quality, or host-nation support. The

[1] A critical component of mission accomplishment is the MEU's ability to access equipment deemed necessary to accomplish all tasks associated with the mission. In this report, the term *mission accomplishment* refers strictly to delivering the equipment needed to complete all tasks associated with the mission. It does not refer to how well the tasks are performed or, in the case of combat missions, degrees of combat effectiveness. The term *requirement* also has a narrower meaning in the context of this report; it refers to the equipment Marine Corps planners feel is needed to complete all tasks associated with the mission.

MESA tool supports this objective by asking the user to define mission-specific characteristics and allowing the user to tailor equipment lists, equipment priority, and task priority as appropriate.

The approach described in the report and the MESA tool have significant value because they provide an analytic method that can be used to estimate equipment requirements and shortfalls. This approach also highlights the importance of task sequencing and prioritization and equipment sequencing, both to mission planning and as ways to address and overcome equipment shortfalls when they arise. The report is not intended to address either the broader set of factors affecting the choices of what equipment deploys and what remains behind (such as mission priorities and where commanders choose to accept risk) or the specific impact of equipment shortfalls across missions.

The report addresses several more specific research questions:

- **What is the mission set?** The sponsor provided a set of 15 kinetic and nonkinetic missions to be assessed. In the two previous editions of this report, we were focused on four of these missions: humanitarian assistance (HA) operations, noncombatant evacuation operations (NEOs), tactical recovery of aircraft and personnel (TRAP); and airfield and port seizure operations. This report adds two more categories of missions: amphibious raid and stability operations.
- **What tasks and subtasks make up each of the 15 missions?** This required a thorough deconstruction of all 15 missions, with particular emphasis on the missions included in the first two phases of this study and the two additional categories of missions included in this phase of the study.
- **What equipment is available to the MEU to accomplish mission tasks and subtasks?** A diverse set of factors affect the types of equipment aboard a MEU, including not only space available, but also risk trade-offs made by commanders and expectations about the nature of the deployment. Since there is no standardized table of equipment (T/E) for a MEU, the study team obtained a list of equipment assigned to a recent MEU, which included information on what was embarked and what was left behind.

- **What measures and metrics should be used to assess the capability of selected equipment?** The loading list provided the set of available equipment. We then used equipment manuals and sponsor input to define the capabilities of each piece of equipment in performing designated tasks. This information is displayed to the user when a piece of equipment is selected.
- **What tasks cannot be accomplished immediately because of lack of equipment?** This includes equipment not necessarily designed to accomplish the task, but which might do in an emergency. This then ends the shortfall impact assessment question.

Approach

This study drew on work RAND completed in support of the Marine Corps Combat Development Command's (MCCDC's) Operational Analysis Division. RAND developed a computer-based system to allocate U.S. Marine Corps (USMC) units to stabilization and reconstruction tasks that could account for changing situational factors. The finished system was called the Stabilization and Reconstruction Force Allocator (SRFA). It includes an index scoring system that reflects the capabilities of USMC units with respect to stabilization and reconstruction operations. The index focuses on a narrow set of missions persistent in post-conflict operations. These include security missions (enabling kinetic activities) and stability and reconstruction missions (nonkinetic activities). The index scoring system measures a unit's capabilities in each of the missions selected, and it is used to allocate units to mission tasks. In this work, instead of allocating units to tasks and assuming that equipment organic to the units was available, we assigned equipment to tasks and assumed that the personnel to operate the equipment were available.

Central to this work was the development of a software system—loosely based on the SRFA previously developed. Inputs to the system consist of a MEU equipment list, the tasks identified through the mission deconstruction process, the measures and metrics used to define

equipment capabilities, and the set of linkages between tasks and equipment.

The research answered the research questions in three phases. First, we conducted a thorough review and deconstruction of the 15 missions, focusing in particular on the four missions included in the phase 1 and phase 2 work and the two missions added during this phase. Second, we identified the equipment needed to accomplish the tasks for all six missions. Finally, we identified the measures and metrics, or "planning factors," needed to assess the capability of each piece of equipment in the loading list. In our initial construction of the MESA, we identified which alternative equipment might accomplish a task, albeit not as effectively. We found that this severely limited users, in that they generally concluded that either we had it wrong or that other equipment might do just as well or better than what we selected. Consequently, equipment selection is now up to the user of the MESA. The software upgrades proceeded in parallel with these activities.

We explored current operational planning processes, first through literature review and next through interaction with personnel familiar with current MEU operations. Members from our study team attended a MEU Operational Advisory Group meeting in December 2013, and they also visited the staffs of East and West Coast–based MEUs, to ensure that the MESA incorporated current practices and that the final product would reflect reality.

The Complete Mission Set

The central topic of this report is the accomplishment of MEU missions. Consequently, we include in Table 1.1 a list of the complete set of MEU missions discussed in this report. Although the set of missions is diverse, they can be categorized into a smaller set of mission types, based on the primary, unique activities involved. This framework may be useful for planners who can exploit similarities between missions within each category to estimate and project personnel and equipment requirements. For example, there are "evacuation" missions that involve evacuation of noncombatants or isolated individuals, such as the NEO

or the TRAP. There are "assistance" missions, such as HA, foreign internal defense (FID), theater security cooperation, and even stability operations. Another category of missions includes short-duration missions with limited objectives, such as direct action, advance force, or special reconnaissance. Finally, there are amphibious missions, including amphibious raids and assaults, and there are maritime missions and aviation operations.

The Marine Corps has categorizes what it calls "mission-essential tasks" into two classes: *amphibious operations* and *expeditionary support to other operations/crises and limited contingency operations—operating across the range of military operations*. The mission-essential tasks are what we are referring to as MEU missions. Table 1.1 is organized along these two classes of missions.[2] Three of the missions we were tasked with including in the MESA are not included in mission-essential task list. These are direct action, special reconnaissance, and FID. However, we continue to include them in our set of missions.

Mission Deconstruction

Mission deconstruction is the process of breaking down the missions listed in Table 1.1 into their constituent tasks and subtasks. This allows the planner to identify when, where, and how the task is to be accomplished in the context of the larger mission. In addition, it helps identify those tasks that are common across several missions. This is extremely important in those cases where the MEU is given multiple missions to perform.

Deconstructing missions in this way suggests some interesting observations and themes. First, it highlights the significant role that common tasks play in mission development and execution. Because they rely on common tasks, the initial phases of the missions are extremely similar. However, the deconstruction also makes it clear that the mission-specific tasks are the ones that really define the mission and

[2] Marine Corps Order 3502.3B, *Marine Expeditionary Unit (MEU) and MEU (Special Operations Capable) (SOC) Pre-Deployment Training Program (PTP)*, April 30, 2012.

Table 1.1
MEU Missions

Mission Name	Description
Amphibious operations	
Amphibious raid	Short-duration, small-scale deliberate attacks, from the sea, involving a swift penetration of hostile or denied battlespace.
Amphibious assault	Attack launched from the sea by naval and landing forces embarked in ships or craft involving a landing on a hostile shore.
Maritime interdiction operations (MIOs)	Operations to intercept commercial, private, or other nonmilitary vessels and conduct visit, board, search, and seizure procedures.
Advance force operations	Operations to shape the battlespace in preparation for the main assault by conducting such operations as reconnaissance, seizure of supporting positions, minesweeping, underwater demolitions, and air support.
Expeditionary support to other operations/crisis response and limited contingency operations	
Noncombatant evacuation operations (NEOs)	Evacuation of noncombatants from countries when their lives are endangered by civil unrest or natural disaster to safe havens or to the United States.
Stability operations	An overarching term encompassing various military missions, tasks, and activities conducted outside the United States in coordination with other instruments of national power to maintain or reestablish a safe and secure environment and provide essential governmental services, emergency infrastructure reconstruction, and humanitarian relief.
Humanitarian assistance (HA) operations	Operations that respond to manmade and natural disasters and include tasks such as providing personnel and supplies and a mobile, flexible, rapidly responsive medical capability for acute medical care.
Tactical recovery of aircraft and personnel (TRAP)	An operation conducted to locate and extract distressed personnel and sensitive equipment from an enemy-controlled area during wartime, or contingency operations to prevent capture.
Joint and combined operations	Joint operations incorporate two or more military departments and are commanded by a joint force commander with a joint staff. Combined operations incorporate military forces from two or more nations.

Table 1.1—Continued

Mission Name	Description
Aviation operations from expeditionary shore-based sites	Marine aviation units operating from expeditionary shore-based sites (in line with unit/platform capabilities), including forward operating bases, expeditionary airfields, forward arming and refueling points, austere forward operating sites, tactical landing zones, and helicopter landing zones.
Support for theater security cooperation (TSC)	Bilateral and multilateral military noncombat activities conducted with allies and other potential partners to build partner capacity and support interoperability and cooperation with U.S. forces.
Airfield/port seizure operations	Offensive operations to occupy or defend airfields or ports for use by friendly forces.
Special operations (conducted when associated Marine Special Operations Forces element is present)	
Direct action (DA) operations	Strikes and small-scale offensive actions conducted as special operations in hostile, denied, or politically sensitive areas, using specialized military capabilities.
Special reconnaissance (SR)	Reconnaissance and surveillance actions conducted as a special operation in hostile, denied, or politically sensitive areas to collect information of strategic or operational value.
Foreign internal defense (FID)	Participation by civilian and military agencies of the government in any of the action programs taken by another government or other designated organization to free and protect society from subversion lawlessness and insurgency.

SOURCES: Definitions from OPNAVINST 3500.38B/MCO 3500.26B/USCG COMDTINST 3500.1B, *MCTL 2.0*, September 1, 2010; Joint Publication 1-02, *DoD Dictionary of Military and Associated Terms*, November 2010, as amended through December 15, 2014c; JP 3-0, *Stability Operations,* 2011.

that determine the equipment most essential to mission completion. Deconstruction also highlights the importance of context. The specific operational environment, the threat level, terrain, and contributions of other organizations will all significantly affect the activities the MEU is expected to complete and the associated equipment requirements.

In addition to the HA mission used as the prototype for the MESA in the first edition of this report, we added an additional three missions to the application in the second edition: NEO, TRAP, and airfield and port seizure operations. In this edition, we add two more missions: stability operations and amphibious raid. In addition, we dis-

cuss the treatment of "fenced forces" such as the Quick Reaction Force (QRF). By "fenced," we mean that equipment needed to support these forces cannot be used for any other purpose. The complete set of fully deconstructed missions is in Appendix A.

Challenges

Several methodological challenges affected the research approach and placed some constraints on the MESA application and its outputs. First, there is ambiguity associated with the definition of subtasks within each mission. Although it is possible to provide some general description of the military activities involved in a generic MEU mission, the specific requirements are highly variable and difficult to predict. The report and the MESA application attempt to provide as much detail about the activities involved in each subtask and the environmental or situational factors that may affect these activities as possible.

One of our first steps was to deconstruct the six missions currently supported by the MESA application into their component tasks and subtasks, using USMC documents as guidance, as well as Joint Publications and other relevant information—including visits to two operational MEUs. The MESA application similarly attempts to capture requirements at the subtask level by providing screens for each subtask and allowing the user to tailor the predefined scenario as necessary. However, the mission tasks and subtask discussions remain relatively general and at a level of detail too high to support detailed mission planning. However, this ambiguity does not affect the value or generalizability of the approach used in this report to develop inputs for the planning tool. Mission deconstruction, prioritization of tasks and equipment, and task sequencing are still the relevant steps that planners must use to develop mission plans and to estimate equipment requirements, even if, in reality, deconstruction must occur at a more granular level.

A second challenge and limitation of the method is associated with the planning factors used for the study. Planning factors link equipment to military tasks and activities, defining in relevant units

what a given piece of equipment can do in a set period of time if properly used. MEU commanders and marines involved in MEU operations typically have relatively clear ideas about the planning factors for specific pieces of equipment. However, the MEU does not have a written set of planning factors that it uses to develop mission plans or to guide what it brings aboard its ships. This lack of written planning factors led us to rely more heavily on the users of the MESA. We consulted equipment manuals that provided details on the capabilities of pieces of equipment, such as payload, maximum speed, or lift capacity, and the application makes this information available to the user as he or she selects equipment to accomplish required tasks.

Limitations

In deconstructing the missions and developing the MESA application, we considered only the tasks and equipment involved in operational activities. This includes the movement of personnel and equipment to the area of operations, but not the sustainment of these personnel and equipment or the tasks involved in reception, staging, onward movement, and integration (RSO&I).

Sustainment of personnel and equipment may include everyday logistics, routine maintenance and repair to equipment, and basic personnel support activities. RSO&I is similarly focused on logistics and organization of personnel. Specifically, it describes the process through which personnel, materiel, and equipment are received and cleared through the point of debarkation (reception); assembled and organized into units and forces (staging); and moved from reception and staging areas to the area of operations (onward movement).

Although sustainment and RSO&I tasks fall outside the scope of our research effort, these activities are centrally important to the successful completion of MEU missions. They often also have additional resource implications, requiring specialized repair or communication equipment, additional personnel, and basic commodities, such as food, water, and fuel. Users of the MESA application must keep these addi-

tional requirements in mind when translating the MESA application's output from hypothetical into real operational plans.[3]

About This Report

This document records the tasks associated with the set of 15 missions defined in the Marine Corps Task List, the specific pieces of equipment that may be necessary to complete these tasks and their capabilities, and the software system developed to assess the impact of shortfalls in equipment. Chapter Two describes the organization and operations of a MEU. Chapter Three discusses the tasks common to multiple missions. Chapter Four discusses the development and use of the planning factors. Chapter Five describes the MESA application developed to assess equipment shortfalls and their impacts. Chapter Six reports on a "stress test" administered to the MESA tool, and this chapter serves as a tutorial for the application's use. Chapter Seven lists some conclusions concerning this process and possible extensions. Three appendixes are also included. Appendix A records all of the 15 MEU missions. Six of these are fully deconstructed, whereas only summary deconstructions are recorded for the remaining nine. Appendix B is a User's Guide for the MESA application. Appendix C records the operational details of the stress test described in Chapter Six.

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[3] U.S. Joint Chiefs of Staff, *Joint Tactics, Techniques, and Procedures for Joint Reception, Staging, Onward Movement, and Integration*, Joint Publication 4-01.8, Washington, D.C., June 2000.

CHAPTER TWO

MEU Organization and Operations

Central to this discussion is the MEU itself. It will be tasked with carrying out the missions, subtasks, and activities described in this report. For this reason, we include a general discussion of its organization and general operations. Figure 2.1 illustrates the organization of the MEU as described in Marine Corps Reference Publication 5-12.[1]

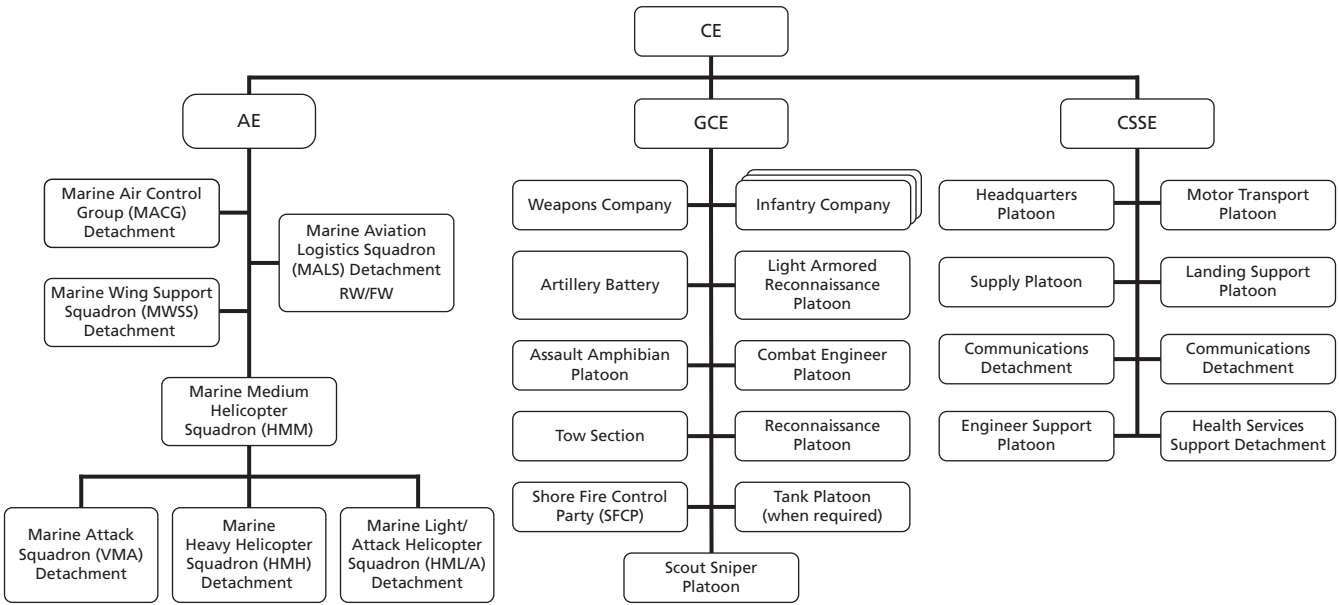
The Marine Air-Ground Task Force (MAGTF)

A MEU is structured along the task-organized concept of the Marine Air-Ground Task Force (MAGTF). As a MAGTF, each MEU is composed of four core elements: a command element, a ground combat element, an aviation combat element, and a logistics combat element, formerly referred to as a *combat service support element*. A MEU may be task organized for specific missions. The composition and functions of each of the MEU's core elements is as follows:

- A command element is the MEU headquarters and is commanded by a colonel. It may include additional assets, such as command and control, a force reconnaissance company, and signals intelligence capabilities provided by the radio battalion. The command element provides the command, control, communications, computers, and intelligence (C4I) necessary for effective planning,

[1] Headquarters, U.S. Marine Corps, *Organization of Marine Corps Forces*, Marine Corps Reference Publication 5-12D, Washington, D.C., October 13, 1998.

Figure 2.1
MEU Organizational Structure



SOURCE: MCRP 5-12D, p. 2-4.
NOTES: CE = command element; AE = aviation element; GCE = ground control element; CSSE = command service support element. The CSSE is now referred to as the logistics combat element.

RAND *TL167-2.1*

direction, and execution of operations in a joint/combined environment.

- A ground command element consists of an infantry battalion reinforced with artillery, reconnaissance, engineer, tanks, light armored reconnaissance units, assault amphibian units, and other attachments as required. In a MEU, this element is also referred to as a *battalion landing team*; it consists of approximately 1,200 personnel. It is task organized to conduct combined arms, ground operations in support of the MEU's mission.
- An aviation combat element consists of a combat assault transport helicopter squadron reinforced with utility and attack helicopters, vertical/short takeoff and landing fixed-wing attack aircraft, air refuelers/transport aircraft, and other detachments as required. The aviation combat element conducts offensive and defensive air operations and is task organized to perform the six functions of USMC aviation required to support the MAGTF mission: assault support, anti-aircraft warfare, offensive air support, electronic warfare, control of aircraft and missiles, and aerial reconnaissance.
- A logistics combat element is task-organized around a combat logistics battalion, formerly called a *service support group*. This element has engineering, supply, transportation, landing support, medical, and maintenance capabilities.[2] The logistics command element provides a full range of combat service support functions necessary to accomplish assigned missions and provides 15 days of sustainability through its supply detachment.

The approximately 2,200 personnel and equipment of each MEU are typically embarked aboard three Navy ships comprising an Amphibious Ready Group (ARG) (See Figure 2.2).[3] This combination of forces allows a MEU to maintain the desired characteristics of a for-

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[2] Headquarters, U.S. Marine Corps, *Marine Corps Operations*, Marine Corps Doctrinal Publication 1-0, Washington, D.C., September 27, 2001.

[3] Marine Corps Order 3120.9C, *Policy for Marine Expeditionary Units (MEU) and Marine Expeditionary Units (Special Operations Capable) MEU(SOC)*, August 4, 2009.

Figure 2.2
Ships of the ARG

SOURCE: U.S. Navy photo by Chief Mass Communications Specialist John Lill.
NOTE: The photo shows the Makin Island Amphibious Ready Group, composed of the USS *Pearl Harbor* (LSD 52), USS *Makin Island* (LHD 8), and USS *New Orleans* (LPD 18), underway off the coast of California in 2011. The USS *Pearl Harbor* is one of the newest *San Antonio*–class dock landing ships.
RAND *TL167-2.2*

ward presence with operational flexibility, rapid response capability, a task organization for multiple missions, and a sea-based, strategic reach with organic force protection.[4]

Efforts from the four elements are coordinated by the command element, which can exercise operational command and control either from ship or ashore. The MEU elements participate in an intensive training program before the MEU is certified for deployment. Leaders in each element coordinate their activities along the six warfighting

[4] MCO 3120.9C, 2009.

functions of command and control, maneuver, fires, intelligence, logistics, and force protection.[5]

ARG Composition and Simultaneous Missions

Each ARG/MEU is designed to operate as a single task force capable of conducting a wide array of individual missions. However, at times, conditions and the needs of geographic combatant commanders may require that multiple missions be conducted simultaneously, which each MEU is prepared to do. Further, it is possible that the ships and marines constituting an ARG/MEU may be required or requested to operate in a distributed fashion.[6] By distributing the assets of the MEU geographically, parts of the MEU may be more responsive to some areas of an area of responsibility, but these disaggregated operations (referred to in this report as *split-ARG operations*) also face limitations with regard to capacity, command and control, and logistical support. The MESA application is also capable of testing the effects of these dynamics on equipment shortfalls as is discussed further in following chapters.

MEU Operational Planning

MEUs use the Marine Corps Planning Process (MCPP) as the basis for all operational planning. MCPP is similar to the other services' and the Joint Operational Planning Process. It consists of six steps: problem framing, course of action (COA) development, COA wargaming, COA comparison and decision, orders development, and transition. Since planning can be a time-intensive process, MEU staffs typically rely on an accelerated version of MCPP known as the Rapid Response Planning Process (R2P2). MEU planners prepare to execute R2P2 by

[5] MCDP 1-0, 2001.

[6] Headquarters, U.S. Marine Corps, *Amphibious Ready Group and Marine Expeditionary Unit: Overview*, Washington, D.C., undated.

having well-established and rehearsed standard operating procedures for both task organized operational units as well as planning teams. Even with solid procedures in place, information management remains challenging.[7] The MESA is intended to help with this information management challenge by accounting for equipment employment and assessing the resulting equipment shortfalls.

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[7] Headquarters, U.S. Marine Corps, *Marine Corps Planning Process*, Marine Corps Warfighting Publication 5-1, Washington, D.C., August 24, 2010, p. H-2.

CHAPTER THREE

Common Tasks

As a rapidly deployable force, the missions a single MEU is expected to complete vary in complexity, length, and risk and often have very different equipment requirements. Each mission also involves distinct tasks that are shaped by the mission's unique goals and operating conditions. However, many MEU missions also share many common tasks and activities, such as planning, establishing the command center, area and road clearance, and surveillance and reconnaissance. This chapter provides a discussion of the common tasks and subtasks that are involved in many different MEU missions. It is important to bear in mind, however, that even if missions share common tasks, it is the unique tasks and subtasks that are likely to have the most direct effects on equipment needs and to be most severely affected by equipment shortfalls.

The common tasks are listed in Table 3.1. Because the implementation of even common tasks will vary depending on the mission they support, we offer generic descriptions and then highlight some of the specific operational and environmental characteristics that are most likely to affect execution; for example, external threat or host-nation support.

Table 3.1
Common Tasks

Task	Description
Plan the mission	Define objectives and mission phases. Relies on intelligence, surveillance and reconnaissance (ISR) activities to identify threats, characteristics of the operating environment, and status of infrastructure.
Establish command center(s)	Insert or designate command center facility and command element, establish connectivity (communication and data processing facilities), and develop and implement intelligence and logistics plans.
Clear roads and areas	Prepare air or beach landing sites, create transport routes for supply or personnel, create sites for evacuation, equipment repair, or medical care, demine existing roadways.
Conduct reconnaissance	Ground or air operations to gain intelligence.
Control the population	Enforce ceasefire; eliminate remaining insurgents; provide security; ensure freedom of movement; and conduct information operations, public affairs, psychological operations, and civil military operations.
Assemble and transport evacuees	Transport personnel to evacuation point, process evacuees. In extreme cases, provide critical medical or humanitarian aid.
Conduct force protection operations	Use of weapons against hostile forces, erection of barriers or checkpoint. Neutralize external threats presented by the adversary and from the environment, including hazardous materials (HAZMAT).
Transition to host-nation control	Shift provision of emergency services, governances, security operations to host nation. Initial transition may be from the USMC to nongovernmental organizations (NGOs) rather than directly to the host nation.
Conduct withdrawal	Withdrawal of personnel and equipment involves (1) equipment maintenance, (2) provision of medical care to the wounded, (3) planning withdrawal, (4) maneuver to extraction or departure site, and (5) force protection operations if required.

Plan the Mission[1]

Mission planning is the first step of most Marine Corps missions. It involves defining mission objectives and outlining the mission's distinct phases. Mission planning relies heavily on reconnaissance and surveillance activities used to define the level of the external threat, the physical characteristics of the operating environment (terrain, weather), and the status of existing infrastructure. A completed mission plan should define the number and types of personnel needed, potential transit routes and landing sites, primary sources of threat, the pieces of equipment that will be used, the tasks that must be accomplished, and the lines of operational control. Chapter Four will describe one method that can be used to match equipment and personnel with tasks.

Establish Command Center(s)[2]

Establishing the command center from which mission operations are controlled, monitored, and directed, is a second core task of most Marine Corps missions. The command center may take many forms and range in size from a single combat operations center to a more established facility depending on the level of external threat, the complexity of the specific mission, the expected duration of the mission, the status of existing infrastructure, and the level of support provided by host-nation, partner, or joint forces. Importantly, certain missions may have multiple command centers, some operated jointly with allies or partner forces. In more hostile environments, the command center may consist of only a single armored vehicle in a remote location. Regardless of its

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[1] Headquarters, U.S. Marine Corps, *Infantry Training and Readiness Manual*, Navy/Marine Corps Manual 3500.44, Washington, D.C., September 16, 2008b; OPNAV Instruction 3500.38B/Marine Corps Order 3500.26B/U.S. Coast Guard Commandant Instruction 3500.1B, *MCTL 2.0*, September 1, 2010; and Marine Corps Order 3502.3B, *Marine Expeditionary Unit (MEU) and MEU (Special Operations Capable) (SOC) Pre-Deployment Training Program (PTP)*, April 30, 2012.

[2] NAVMC 3500.44, 2008b; OPNAVINST 3500.38B/MCO 3500.26B/ USCG COMDTINST 3500.1B, 2010.

form, the establishment of the command center(s) involves establishing communication lines and data processing facilities, and using these facilities to implement intelligence and logistics plans.

Clear Roads and Areas[3]

Because most missions require USMC units to be able move through the operating environment or set up sites for evacuation, assembly, or provision of humanitarian assistance, area and road clearance are also tasks that span across missions. Area and road clearance may be used to prepare air or beach landing sites, create transport routes for supply convoys or personnel, or create sites for evacuation, equipment repair, or medical care. Clearance activities involve removing obstacles such as trees, rocks, or other debris from roadways or other areas, defusing improvised explosive devices (IEDs) and other potential threats, repairing roadways where necessary, and then securing roadways or assembly areas using force protection measures, such as establishing a perimeter or barriers. Importantly, road security and repair provided by marines are intended primarily to allow USMC personnel safe passage, and do not involve permanent rebuilding. The clearance activities required will depend on the level of threat, the status of existing infrastructure, and the road-miles or area to be cleared.

Conduct Reconnaissance[4]

Many missions also rely heavily on reconnaissance and intelligence gathering, either to supplement mission planning or to support the ongoing mission. Much reconnaissance uses ground-based assets, gath-

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[3] NAVMC 3500.44, 2008b; OPNAVINST 3500.38B/MCO 3500.26B/ USCG COMDTINST 3500.1B, 2010.

[4] NAVMC 3500.44, 2008b; OPNAVINST 3500.38B/MCO 3500.26B/ USCG COMDTINST 3500.1B, 2010; U.S. Joint Chiefs of Staff, *DoD Dictionary of Military and Associated Terms*, Joint Publication 1-02, Washington, D.C., November 2010, as amended through December 15, 2014d; MCO 3120.9C, 2009.

ered and processed by teams of marines in the field. As a result, reconnaissance requires transport of personnel to and through the area of operations. The appropriate mode of transport depends on the level of external threat and status of existing infrastructure. Air reconnaissance may also be important, since aircraft can often cover more territory, more quickly, and with less risk than ground assets. However, ground vehicles may still be used for close reconnaissance and surveillance. Both types of reconnaissance operations may be armed, especially in hostile areas. The level of threat, the status of local infrastructure, and the types of intelligence information being collected will shape reconnaissance missions by determining the likely need for weapons, force protection operations, and armored vehicles.

Control the Population[5]

Many USMC missions also involve civil control operations conducted to prevent riots or public disturbances and to neutralize the local population as a threat to mission completion or the security of the force. Civil control may involve any number of specific activities, depending on the environment (urban or rural), the level of external threat, the size of the population, and the extent of local security support. For example, it may include simply neighborhood patrols or it may involve provision of security at key buildings and the administration of checkpoints on important roadways. If local police are cooperative and strong, civil control responsibilities may fall to them alone. Civil control may involve enforcing a ceasefire, eliminating insurgents, providing security at key buildings and businesses, ensuring freedom of movement, and conducting information operations.

[5] NAVMC 3500.44, 2008b; OPNAVINST 3500.38B/MCO 3500.26B/ USCG COMDTINST 3500.1B, 2010; U.S. Joint Chiefs of Staff, *Interorganizational Coordination During Joint Operations*, Joint Publication 3-08, Washington, D.C., June 24, 2011.

Assemble and Transport Evacuees[6]

Evacuation is another task that appears in several USMC missions. Evacuation of noncombatants is the primary objective of the NEO, while recovery and evacuation of isolated individuals is the key activity of the TRAP (see Chapter Four). Evacuations will be influenced by factors such as the level of the operational threat, the number of individuals to evacuate, the number and types of injuries, and the mode of evacuation (air, ground, or amphibious transport). A typical evacuation involves the transport of personnel to the evacuation point, processing of evacuees if necessary, and, in extreme cases, the provision of critical medical or humanitarian aid, including food and water. When included, the provision of food, water, and emergency medical care to the local population is important from a planning perspective because such aid has significant implications for the types and amount of equipment needed to complete the evacuation. Force protection may be needed in especially hostile environments.

Conduct Force Protection Operations[7]

The MEU always prepares for force protection, even when the threat appears low. Force protection operations may include the use of weapons to repel enemy forces, the erection of barriers or fences to secure a perimeter, the use of checkpoints to monitor entry and exit of personnel, and HAZMAT responses to nuclear, biological, or chemical weapons. The types of operations conducted in a given mission depend on the operational environment, the level of the external threat, the area that must be secured or defended, and the size of the force. Force pro-

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[6] NAVMC 3500.44, 2008b; OPNAVINST 3500.38B/MCO 3500.26B/USCG COMDTINST 3500.1B, 2010; U.S. Joint Chiefs of Staff, *Noncombatant Evacuation Operations*, Joint Publication 3-68, Washington, D.C., January 22, 2007.

[7] NAVMC 3500.44, 2008b; OPNAVINST 3500.38B/MCO 3500.26B/USCG COMDTINST 3500.1B, 2010; Joint Publication 1-02, November 2010, as amended through December 15, 2014c; Headquarters, U.S. Department of the Army, *Operations*, Field Manual 3-0, Washington, D.C., 2011.

tection operations will be extensive when the threat is high and when the MEU is required to hold territory for long periods of time. However, other than vehicles and weapons, the equipment requirements of force protection activities may be relatively minimal.

Transition to Host-Nation Control[8]

The transition from USMC to host-nation control varies depending on the specific mission. In humanitarian operations, it will involve a shift to host-nation provision of emergency services, such as electricity and water. In other cases, it involves the return of operational control to the host nation following a raid, port/airfield seizure, or assault on an adversary target. The initial transition may be from the USMC to NGOs rather than directly to the host nation. Transition may also involve training of host-nation security forces and will conclude with the withdrawal or extraction of USMC forces, often through an amphibious withdrawal. The level of the external threat, the status of local infrastructure, and the capacity of the host nation will shape the transition stage and, importantly, the duration and nature of the MEU mission.

Conduct Withdrawal[9]

The final cross-mission task is the withdrawal of personnel and equipment. Preparation for withdrawal requires the completion of necessary equipment maintenance and repairs along with the provision of necessary medical care to wounded personnel and reconnaissance operations to plan the withdrawal route. The extraction of personnel and equipment may occur by air or by amphibious operation, depending

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[8] NAVMC 3500.44, 2008b; OPNAVINST 3500.38B/MCO 3500.26B/USCG COMDTINST 3500.1B, 2010; U.S. Joint Chiefs of Staff, *Counterinsurgency*, Joint Publication 3-24, Washington, D.C., November 22, 2013.

[9] NAVMC 3500.44, 2008b; OPNAVINST 3500.38B/MCO 3500.26B/USCG COMDTINST 3500.1B, 2010; FM 3-0, 2011.

on the operational environment or the location. The withdrawal will be shaped by the external threat, the status of existing infrastructure, and the number of personnel and pieces of equipment to extract. Withdrawals that are conducted where the infrastructure is weak or destroyed are likely to involve route and area clearance or to rely on vehicles that can handle difficult terrain. Withdrawals also become more difficult when the force is large, when there are injured personnel, or when there are many pieces of damaged equipment.

CHAPTER FOUR

Linkages: Equipment, Tasks, Metrics, and Planning Factors

Planning factors link tasks or military activities to the pieces of equipment needed to complete the task. For example, a planning factor for the task "clear six miles of two-lane roadway" might specify that three military personnel can clear 1 mile of roadway per hour using a truck able to tow or haul at least 1 ton of material. A military planner could use this planning factor to determine that the task will take three military personnel six hours to complete or can be accomplished in three hours using six military personnel and two trucks operating side-by-side.

Planning factors form the backbone and foundation of any effort at mission planning, including the MESA application, because they link the activities the MEU will be required to complete with necessary equipment. Once planning factors are defined, they can be combined with the mission task list to generate a list of required equipment. This list can be compared against equipment available onboard or at remote locations and provide commanders with clear information on which tasks can be accomplished with the available equipment and which will require substitutions or compromises.

The process of defining planning factors that can be used for operational planning requires several steps, including mission deconstruction, linking military tasks with specific pieces of equipment that have the required capabilities, defining relevant metrics, and then prioritizing pieces of equipment and unit types based on their relative capabilities. The first step, the deconstruction of missions into their component

tasks and activities, is discussed in Chapter One and Appendix A. This chapter will describe in more detail the process used to define planning factors and use the humanitarian assistance task as a specific example.

As noted in the introduction, we faced some significant methodological challenges in our attempts to define meaningful planning factors that could be used to project equipment requirements. Regardless of the specific planning factors used, the approach for defining and applying them described here provides a systematic framework that planners can use to assess and estimate the equipment requirements associated with specific missions. At the same time, it identifies many of the essential challenges inherent in the process that must be incorporated into mission plans and commander assessments.

From Missions to Tasks, Subtasks, and Military Activities

We relied on several key sources as we deconstructed missions into their component tasks and activities. First, we used USMC doctrinal publications and Joint Publications to identify the tasks and activities likely to span missions, as well as the specific tasks and phases involved in each of the 15 missions.

Next, we used the NAVMC 3500.44 publication and the Marine Corps Task List as well as Joint Publications and the U.S. Agency for International Development's *Field Operations Guide for Disaster Assessment and Response* to identify more specific subtasks and activities involved in each phase of relevant missions. The Joint Publications are especially valuable because they outline the specific tasks involved in most missions included in the mission set and are often explicit about the role played by military and civilian organizations.

The Detailed Tasks and Subtasks

We start from the mission deconstructions and identify subtasks and activities that need to be accomplished to support those tasks. Table 4.1 records the results of our analysis of the deconstruction supported by the various documents discussed above. The specific tasks, subtasks, and activities listed in the tables are used by the MESA application.

Table 4.1
Tasks, Subtasks, and Activities

Task	Subtasks and Activities
Humanitarian assistance operations	
Plan the mission	• Reconnaissance • Surveillance
Establish command center(s)	• Insert JTF and secure command center(s) • Establish and secure communication lines • Planning and direct intelligence and logistics
Clear roads and areas	• Clear transport routes of debris, IEDs • Conduct essential infrastructure repairs
Establish and secure evacuation, assembly, and other sites	• Clear areas for HA provision • Assist in construction/repair of local facilities • Transport supplies for USMC operations
Provide assistance at central sites or with mobile units	• Transport and distribute emergency food and other aid • Provide critical medical care • Transport of supplies for USMC operations • Personnel transport for search-and-rescue (SAR) operations or force protection
Restore critical services	• Assist in restoration of local utilities and services • Assist in local infrastructure repair • Transport of supplies for USMC operations
Transition to host-nation control	• Transfer of security functions and provision of basic services to local police • Training of local personnel
Noncombatant evacuation operations	
Plan the mission	• Coordinate with combatant commander and Department of State • Publish warning order • Conduct reconnaissance of objective and locate personnel to be evacuated • Assess the status of personnel to be evacuated • Conduct assessment of enemy disposition, capabilities, and courses of action • Conduct assessment of terrain and weather using OCOKA-W • Evaluate potential land/air/sea avenues of approach • Conduct reconnaissance of landing zones • Assess maneuver, communications, force protection, fire support, intelligence, and logistical considerations • Complete the plan • Publish the order

Table 4.1—Continued

Task	Subtasks and Activities
Establish command center(s)	• Insert a forward command element • Establish and secure communication lines • Plan and direct intelligence and information operations • Plan and direct logistics operations • Conduct defensive and force protection operations
Establish and secure evacuation, assembly, and other sites	• Move forces to assembly and evacuation site(s) • Establish communications • Secure sensitive information and property • Establish defensive positions and force protection measures • Secure routes to and between assembly and evacuation sites • Prepare assembly and evacuation sites for evacuees • Establish medical locations • Establish food and water locations • Establish hygiene and sleeping areas • Control civilian population
Deploy JTF main body	• Move forces to assembly and evacuation sites • Conduct defensive and force protection operations
Transport and assemble evacuees	• Move evacuees to assembly and evacuation sites • Communicate with evacuees • Provide transportation • Provide medical care • Provide food and water • Provide hygiene and sleeping facilities • Control civilian population • Transport and process evacuees • Screening and cataloguing with NEO-Tracking System • Conduct information operations among evacuees
Evacuate noncombatants and extract military personnel	• Transportation of evacuees by air, land, and/or sea • Provide security during the evacuation process • Integrate air support and maneuver • Extract remaining military personnel
Tactical recovery of aircraft and personnel	
Plan the mission	• Publish warning order • Conduct reconnaissance of objective and locate personnel and/or aircraft to recover • Assess the status of personnel and aircraft • Conduct assessment of enemy disposition, capabilities, and courses of action • Conduct assessment of terrain and weather using OCOKA-W • Evaluate potential land/air/sea avenues of approach • Conduct reconnaissance of landing zones • Assess maneuver, communications, force protection, fire support, intelligence, and logistical considerations • Complete the plan • Publish the order

Table 4.1—Continued

Task	Subtasks and Activities
Establish command center(s)	• Insert a forward command element and a JTF • Establish and secure communication lines • Plan and direct intelligence and information operations • Plan and direct logistics operations • Conduct defensive and force protection operations
Establish and secure evacuation, assembly, and other sites	• Movement to entry point • Secure beach/aircraft landing site(s) • Establish defensive positions • Clear and secure evacuation route(s) • Remove obstacles and neutralize threats • Control local population
Reach and secure recovery site(s)	• Occupy recovery site(s) • Clear immediate area of threats • Neutralize or secure hazardous and sensitive materials • Control local population • Conduct defensive operations
Recover personnel and aircraft	• Recover personnel • Provide medical care • Provide food and water • Prepare personnel for transport • Recover aircraft • Repair, destroy, and/or secure aircraft • Secure or destroy hazardous and sensitive materials • Maintain security • Control local population • Conduct defensive operations
Evacuate noncombatants and extract military personnel	• Evacuate recovered personnel by ground/air/sea • Remove or destroy damaged aircraft • Extract USMC units and equipment
Airfield and port seizure operations	
Plan the mission	• Publish warning order • Conduct reconnaissance of objective • Conduct assessment of enemy disposition, capabilities, and courses of action • Conduct assessment of terrain and weather using OCOKA-W • Evaluate potential land/air/sea avenues of approach • Conduct reconnaissance of landing zones • Assess maneuver, communications, force protection, fire support, intelligence, and logistical considerations • Complete the plan • Publish the order

Table 4.1—Continued

Task	Subtasks and Activities
Seize and secure airfield or port	• Move to target/area of operation • Conduct ground, air, and naval maneuvers as appropriate • Conduct fires as appropriate • Seize and secure selected areas/facilities • Conduct defensive and force protection operations
Establish command center(s)	• Establish command center(s) • Establish and secure communication lines • Establish defensive positions and force protection measures • Plan and direct intelligence • Conduct route and area reconnaissance and surveillance • Plan and direct logistics
Conduct follow-on operations	• Conduct medical aid and evacuations • Conduct civilian control • Conduct resupply • Conduct information operations • Improve airfield/port for future use • Transfer control of airfield/port to other forces or host-nation control • Move forces off of objective
Stability Operations	
Plan the mission	• Coordinate with combatant commander and Department of State • Publish warning order • Conduct reconnaissance of objective • Conduct assessment of enemy disposition, capabilities, and courses of action • Conduct assessment of terrain and weather using OCOKA-W • Evaluate potential land/air/sea avenues of approach • Conduct reconnaissance of landing zones • Assess maneuver, communications, force protection, fire support, intelligence, and logistical considerations • Complete the plan • Publish the order
Establish command center(s)	• Insert a forward command element • Establish and secure communication lines • Plan and direct intelligence and information operations • Plan and direct logistics operations • Conduct defensive and force protection operations
Conduct marine resupply	• Deliver water • Deliver fuel • Deliver food • Deliver ammunition

Table 4.1—Continued

Task	Subtasks and Activities
Restore and maintain civil society	• Enforce cessation of hostilities • Eliminate remaining threats • Ensure security and freedom of movement • Protect key personnel and facilities • Conduct intelligence and psychological operations • Conduct civil-military operations
Provide assistance at central sites or with mobile units	• Secure aid provision sites • Provide food, water, medical care, and shelter • Provide power, water, and sanitation • Restore civil security • Rebuild local infrastructure • Restore local provision of services
Transition to host-nation control	• Restore local provision of essential services • Train local security forces for new responsibilities • Support new elections and return to local governance • Continue civil-military operations
Support economic stabilization	• Establish transportation and communication networks • Ensure provision of basic services • Rebuild and secure financial and business infrastructure • Maintain political stability and rule of law
Plan for transition of operations to follow-on military unit or civilian authority	• Conduct security force assistance • Build host-nation capacity to protect military infrastructure • Establish/bolster/reform defense institutions • Establish disarmament/demobilization/reintegration program
Amphibious raid	
Plan the mission	• Coordinate with combatant commander and Department of State • Publish warning order • Conduct reconnaissance of objective • Conduct assessment of enemy disposition, capabilities, and courses of action • Conduct assessment of terrain and weather using OCOKA-W • Evaluate potential land/air/sea avenues of approach • Conduct reconnaissance of landing zones • Assess maneuver, communications, force protection, fire support, intelligence, and logistical considerations • Complete the plan • Publish the order

Table 4.1—Continued

Task	Subtasks and Activities
Establish command center(s)	• Insert a forward command element • Establish and secure communication lines • Plan and direct intelligence and information operations • Plan and direct logistics operations • Conduct defensive and force protection operations
Embark the force	• Prepare vehicles, boats, aircraft • Load vehicles, boats, aircraft • Establish and secure communication lines • Conduct intelligence and information operations • Plan and direct logistics operations
Move to objective	• Ship to shore movement • Shore to objective movement • Ship to objective movement • Maintain communication lines • Conduct intelligence and information operations • Conduct logistics operations • Conduct defensive and force protection operations • Provide supporting fires
Conduct raid actions	• Destroy targets • Harass enemy • Capture/kill key personnel • Conduct attack • Obtain information on terrain and/or enemy • Evacuate individuals or materiel • Maintain communication lines • Conduct intelligence and information operations • Conduct logistics operations • Conduct defensive and force protection operations • Provide supporting fires
Conduct withdrawal	• Movement from objective to withdrawal point • Movement from withdrawal point to ships • Re-embarkation on ships • Maintain communication lines • Conduct intelligence and information operations • Conduct logistics operations • Conduct defensive and force protection operations • Provide supporting fires

NOTES: JTF = joint task force; OCOKA-W = observation, cover and concealment, obstacles, key terrain, avenues of approach, weather.

Challenge

A challenge was specifying the subtasks and activities involved in operations to a level of detail that supports a close match between task and equipment. This was critical for the user to define the specific planning factors for the tasks under the anticipated operating conditions. Drilling down to higher levels of specificity was difficult if not impossible. For example, we can state with some certainty that the HA mission will involve cargo transport, but we cannot specify precisely what type of cargo or the distance it is to be transported. We can guess that road clearance may be necessary for all six missions, but we do not know what types of obstacles must be cleared.

Because of these essentially contextual details, we met this challenge by choosing to let the user develop the planning factors to be used. To assist in that process, the MESA tool displays all the characteristics of a piece of equipment selected to include operational limitations, its ability to operate in all terrain under varying weather conditions, and its vulnerability to attack.

Linking Equipment to Tasks, Subtasks, and Activities

Once the military tasks and activities are defined, the user has to link each activity to the appropriate metrics and pieces of equipment with required capabilities. In this section, we discuss the methods used to accomplish this, and we highlight the difficulties associated with trying to link equipment to subtasks and activities.

Identifying the Appropriate Metrics

The first task is for the user to identify the appropriate metrics for the equipment designated to support a given task. For example, to define planning factors for the task "transport X personnel Y miles in Z hours," the user would need to define the relevant metrics for the personnel transport task (in this case personnel transported some distance per hour), identify all available vehicles capable of personnel transport, and review the display of specific capabilities of all relevant pieces of equipment. These pieces of information together allow for

matching of tasks to suitable equipment, the development of planning factors, and the choice between pieces of equipment to select the most effective alternative.

In the case of personnel transport, the metrics are fairly straightforward—the number of persons transported and the distance traveled per time period. For other tasks, the selection of proper metrics and the selection of relevant equipment and units may be more challenging. For example, it may be difficult to define the appropriate metrics for road clearance as a task, since the metrics may depend on whether clearance involves removing IEDs, fallen trees, water, or large rocks. These challenges affect the metrics that we use and ultimately our planning factors, because it may be difficult to match equipment to tasks with broadly defined metrics. While passenger capacity and speed are common metrics used to define truck capabilities, area cleared per hour or trees removed per hour are not commonly listed as technical specifications. These are challenges facing the MESA user.

Equipment Selection

After specifying the appropriate metrics for each task, the user next matches the tasks with the equipment required from the list provided in the MESA application. Equipment manuals were consulted to develop the equipment specification displays used by the user to evaluate the suitability of a selected piece of equipment. Information such as equipment weight, its speed, towing or hauling capacity, range, frequencies transmitted, as well as other details relevant to the use of the equipment, are included in the display for each item in the MEU loading list.

The final step involves using the metrics and equipment capabilities developed, to define the planning factors. Unfortunately, the USMC does not maintain a set of rigorous planning factors that link equipment to subtasks, so this places the burden on the user. Measures of equipment capability are not traditional planning factors, but they do provide insight into the types of tasks a given piece of equipment may be able to complete and how its capabilities compare with others. This information is available to the user to help with matching equipment to tasks. Ideally, we would like to know exactly how many of

each type of vehicle are required to clear a roadway of a specific type of debris or which sets of engineering equipment are used to assist in construction or drilling activities, based on past MEU experience. We would like to have the capabilities of trucks defined not only in miles per hour and payload, but also in their contribution to road clearance or infrastructure repair tasks. In its absence, users must rely on their past experience in developing appropriate metrics, selecting the appropriate equipment using the metrics and considering the equipment's capability and the context in which it will be used.

Once the tables linking task, subtask, and activities to equipment were created, the RAND research team hosted a workshop held at the RAND offices in Arlington, Va. Marine Corps officers who had been involved in HA operations were invited to attend. They were asked to use their expertise to assess whether we had properly defined HA mission tasks and had assigned the right pieces of equipment to each task. Their comments allowed us to define tasks more precisely and refined our assignment of equipment. For example, they alerted us to several pieces of equipment that were always allocated together (e.g., the unmanned aerial vehicle [UAV] system) as well as to the fact that tanks and armored vehicles were often considered too threatening to be used on an HA mission.

No workshop was held for the three additional missions. The reason is that several of the tasks identified for the HA mission were the same or sufficiently similar to the tasks and subtasks associated with the three added missions. Where questions arose concerning the proper assignment of equipment to complete tasks and whether we had the tasks and subtasks correctly identified, we consulted with the sponsor.

Prioritizing Equipment Based on Contribution

Linking equipment to tasks and subtasks requires that we know which pieces of equipment *can* complete a given task, but not that we know which pieces of equipment *will be best* at accomplishing the task. Equipment prioritization is important especially when considering potential resource constraints.

The creation of a prioritized list of equipment based on how effectively it completes a given task, and that identifies potential second and third substitutions between pieces of equipment as required by availability, is not possible because of the number of variables associated with mission context. Consequently, this is also a task left to the experienced user. With metrics in mind and knowing the capabilities and limitations of the equipment available and considering the operational context, the user selects the equipment to be used to accomplish the task. There is no guarantee that the equipment selected will be optimal, even if all the relevant equipment is available. In most cases, this is not an issue, and where it is, the best equipment to accomplish the task is generally known.

Many factors may affect the prioritization of equipment. For example, security concerns may make certain pieces of equipment more effective than others in a given situation. In HA missions, for example, heavily armed vehicles may be perceived as threatening to the local population, ranking them below Humvees or Medium Tactical Vehicle Replacement (MTVRs). The terrain or weather may also affect vehicle prioritization as will mission objectives and concerns. The choice of vehicle for personnel transport when speed is the top concern may be distinct from that chosen when remaining undetected is of highest importance.

Relative Task Importance

Prioritization focuses on the best piece of equipment to accomplish a task. In addition to this feature, the MESA application is also able to respond to a user's assessment of the relative importance of the tasks that need to be accomplished. The more important tasks are usually the ones that get accomplished first.

In the first edition of the MESA, relative importance was set by the user when executing the tool. The method used to calculate relative importance was the Analytic Hierarchy Process. This process involves building a hierarchy (ranking) of decision elements and then making comparisons between each possible pair in each cluster (as a matrix).

This gives a weighting for each element within a cluster (or level of the hierarchy) and also a consistency ratio (useful for checking the consistency of the data).[1] Although effective, this method of assessing relative importance was found to be too complicated—especially when several tasks were included. Consequently, in the current version of MESA, this feature has been eliminated. We rely instead on the sequencing of tasks to establish relative importance. This was more acceptable and understandable by the users.

Fungibility

Unfortunately, the seemingly simple and straightforward linking of mission tasks and subtasks to equipment gets a bit more complex based on the linkages among the equipment, including the ability to substitute one piece of equipment with another. We refer to these two complementary issues as "packaging" and "fungibility."

The use of planning factors to substitute between pieces of equipment with similar capabilities raises the issue of fungibility. A set of trucks may be more or less fungible: They may not always transport the same weight or number of personnel, but they can accomplish similar objectives and can replace one another in a pinch or in the case of heightened demand. However, trucks and radios are not fungible. If the MEU needs to send a radio communication for help, a truck is of no use. If the unit needs to transport personnel, the radio clearly cannot fill the requirement.

Where it exists, fungibility is useful because it allows commanders to complete missions and meet their responsibilities even when optimal equipment is not available. Clearly, not performing a critical task because the ideal equipment is not available is generally not an option for commanders.

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[1] The Analytical Hierarchy Process Model was designed by Thomas L. Saaty as a decision-making aid. See Thomas L. Saaty, *The Analytic Hierarchy Process*, New York: McGraw Hill, 1980.

Limitations

In its early configuration, the MESA application was able to account for only one mission at a time. However, in practice, a MEU may be faced with more than one mission. Consequently, with the addition of five new missions, the application was modified to overcome this limitation. MESA can now deal with multiple missions and therefore can accommodate relative mission ranking as well as relative task ranking within a mission.

Finally, the MESA does not produce an optimum solution for allocating equipment to tasks. The SRFA is able to optimally allocate units to missions and it is also able to handle multiple missions. The MESA allows the user to allocate equipment to tasks based on any number of criteria, such as when the task must be completed and the priority the user assigns to the equipment capable of accomplishing the given task.

CHAPTER FIVE

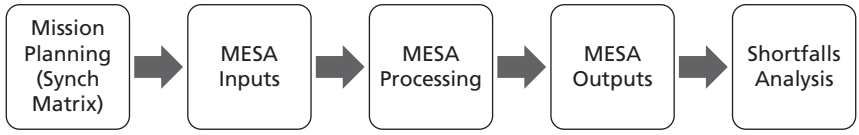
The MAGTF Equipment Structural Assessment (MESA) Application

The MAGTF Equipment Structural Assessment (MESA) application is a software tool that allocates equipment from a predetermined and potentially limited inventory to a set of missions and tasks selected by the user. The MESA application incorporates the deconstructed missions developed as part of this research effort and produces as an output a notional set of equipment that could be used to complete a specific user-defined mission. This chapter provides a general description of the application. A detailed user's guide for the application can be found in Appendix B.

The MESA Process

The process for identifying shortfalls, depicted in Figure 5.1, begins prior to entering information into the MESA application. Mission planning is required to allocate equipment to the mission, its tasks, and its subtasks over the operational period. These data are then entered

Figure 5.1
The MESA Process



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into MESA, which identifies equipment availability, equipment operating hours required, and any resulting shortfalls. The application then provides outputs that help the user to analyze equipment shortfalls for the mission. The MESA process is as follows:

1. **Mission Planning.** This involves allocating equipment over time to tasks and subtasks of the assigned mission. A synchronization matrix (described in Chapter Six) was used. See Appendix C for an example.
2. **MESA Inputs.** Once the user has determined how to allocate equipment, this information can be entered into the MESA application.
3. **MESA Processing.** The MESA application considers what equipment is available, when and for how long it is needed, and the prioritization of concurrent missions.
4. **MESA Outputs.** With all the inputs entered, the user "scores" the scenario, which will provide the user with a variety of information on availability and shortfalls of equipment.[1]
5. **Shortfall Analysis.** With the MESA application outputs, the user analyzes the shortfalls for the assigned missions, given the equipment available.

Application Overview

The MESA software consists of a series of tabs (depicted in Figure 5.2 and listed in Table 5.1) containing input fields that define a scenario. The user navigates through the tabs, filling in the fields as appropriate to define the mission and its constituent tasks, subtasks, and other characteristics. Once the user is satisfied with the mission parameters, the program will allocate equipment from the selected inventory and assign it to the individual tasks. If the user decides that the results are worth saving for future reference and planning purposes, they can be

[1] The term *score* is used to execute the MESA application. Examples are provided later in this chapter.

Figure 5.2
Main Screen of MESA Application

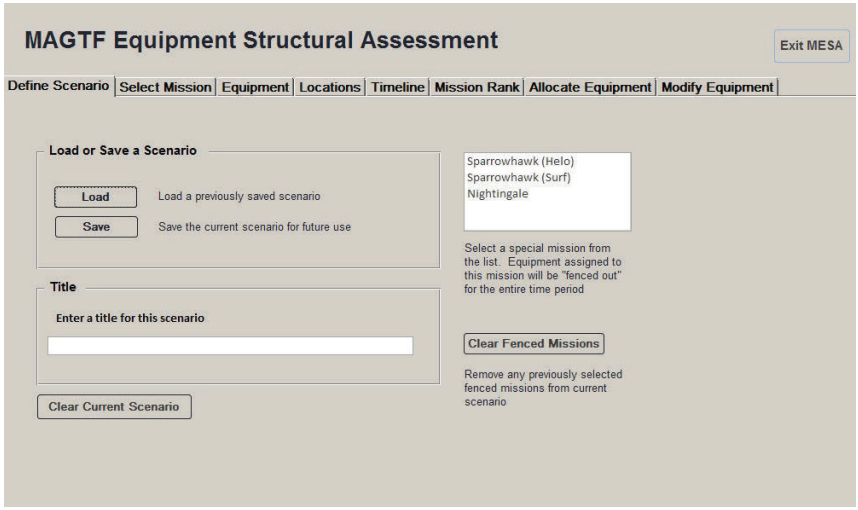

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Table 5.1
MESA Main Interface Tabs

Tab	Function
Define scenario	The user is presented with 15 missions. He or she can select one or more of them (in this version, only the six missions discussed in Chapter Four are fully operational).
Select mission	For each mission selected, the user is offered a series of tasks and subtasks which he or she may select as being critical to the scenario.
Equipment	The equipment available to the MEU is displayed at this tab.
Locations	The user selects from a list of locations or inventories that will be available to the mission.
Timeline	The user can specify the start and finish date for each task.
Mission rank	The user is offered the opportunity to rank missions by priority when assigning equipment.
Allocate equipment	The results of the equipment allocation are displayed at this tab.
Modify equipment	Interface for adding new equipment items or altering the descriptions of existing items.

exported to an Excel spreadsheet. If insufficient equipment is available to complete a task, the application will display the percentage of each task completed.

The MESA application rests on an underlying structure of linked Standard Query Language (SQL) tables implemented in Microsoft Access 2010. The table structure was designed to reflect as closely as possible the real-world relationships of elements. Thus a table of missions links to a table of tasks, which in turn links to a table of equipment items. A relational table structure provides significantly greater flexibility for future development and expansion of the MESA application than the previous spreadsheet-driven model. The individual SQL tables will be will be described in more detail in the user's guide in Appendix B.

Application Inputs

The MESA application assesses the equipment requirements of a given mission based on a number of user-defined inputs. The current version allows for either a single mission or multiple missions. Multiple mission configurations accommodate situations in which a primary mission might be a combat mission with a humanitarian mission combined. The result would be a nested mission set in this case. The sections below describe the inputs required. Appendix B illustrates entering these inputs through examples.

Mission and Task Selection

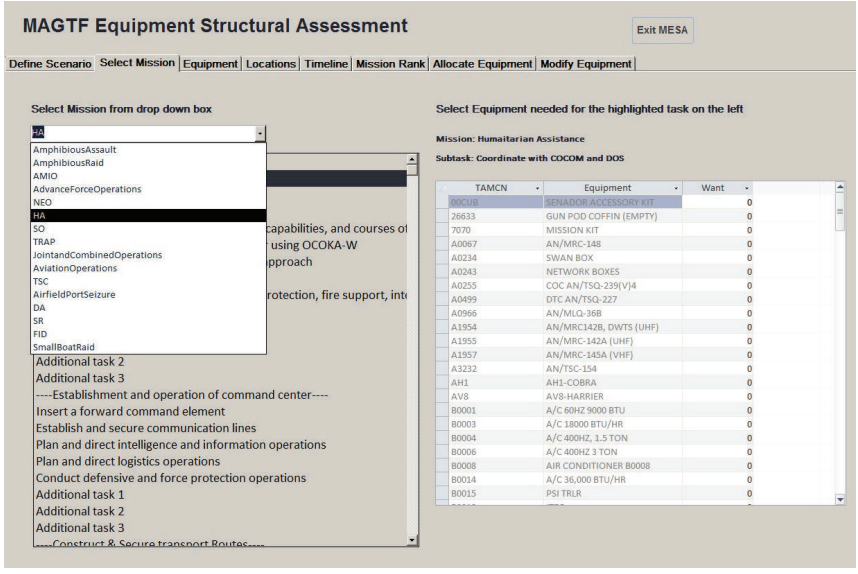
The user first determines the mission and the specific tasks required to accomplish the mission. At present, six missions are available, although there are stubs for those remaining. An example of typical set of mission tasks might be planning, establishing a command post, securing routes, providing perimeter defense, and establishing locations for providing assistance. The tasks included in the MESA application match those identified in the mission deconstructions, described in Appendix A.

Available missions are displayed in a drop-down menu on the "Select Mission" tab (Figure 5.3). When the user selects a mission, the tasks associated with that mission are displayed in a window immediately below. As the user highlights each task, a list of all available equipment is displayed. The user may select equipment items that are deemed appropriate for each highlighted task by entering the desired quantity in the "Want" column of the list of equipment.

Prioritization

When multiple missions are chosen for a specific scenario, the user may prioritize these missions based on their importance. The default is to rank each mission in the order in which they are defined within the MESA application as displayed on the "Select Mission" tab drop-down menu. Missions ranked higher receive first pick when allocating equipment to their tasks and subtasks. However, the user may wish to alter this ranking, and allow a mission lower on the list to receive first prior-

Figure 5.3
Mission and Task Selection Screen



RAND *TL167-5.3*

ity. The user can specify this on the "Mission Rank" tab (Figure 5.2). When a mission is prioritized higher than another, its equipment needs will be filled first, before equipment is allocated to other missions. This will be especially important in multiple-mission scenarios where several missions require the same equipment at nearly the same time.

Timelines

The MESA application also needs to know the start and end of each mission task and subtask selected. The user can select from two different time intervals: hours and days. The default scenario time interval is hours, and the default start and end for the scenario is hour 1 and hour 48, respectively. If the user is satisfied with this timeline, nothing more need be done. However, if one task needs to start before another—for example, if mission planning needs to start before establishment of a command post—or if the user wishes the time interval to be specified in days instead of hours, this can be changed on the "Timeline" tab (Figure 5.2).

When the time sequence is defined, tasks that are necessary first steps are resourced prior to subsequent ones. The implications of sequencing on equipment requirements depend on whether tasks are overlapping or occur in sequence, as well as on whether pieces of equipment can be used more than once. If a piece of equipment can be used several times, then sequencing may have minimal effects. However, if tasks overlap or if each piece of equipment can be used only once, then tasks that occur early in the mission (or that are highest priority) may be fully resourced, while those at the end lack needed equipment or rely on substitutions.

Roster of Available Equipment

The MESA application allocates equipment to missions from a predetermined list of USMC equipment. The equipment roster appears on the "Equipment" tab (Figure 5.2), which currently includes approximately 147 items of combat and noncombat equipment available to the application. These include surveillance assets, transportation equip-

ment, communications equipment, mobile command posts, etc.[2] Each item of equipment includes several metrics describing capabilities such as range, speed, load capacity, etc. These metrics are used to determine how many of a specific item of equipment is required to perform each task within a mission. The definition of appropriate metrics is determined by the user and is central to the development of planning factors.

Locations of Equipment Inventories

Conceptually, the MESA application is intended to evaluate mission success given limited inventories of equipment. To do this, the application requires a *count*, or inventory, of each item of available equipment. The application contains a predetermined set of inventories of equipment (termed *locations* in MESA) potentially available to the mission. These locations can represent ships (e.g., USS *Boxer*), prepositioned dumps, cargo left on pier (CLOP), fixed base locations (Diego Garcia), and any other location.

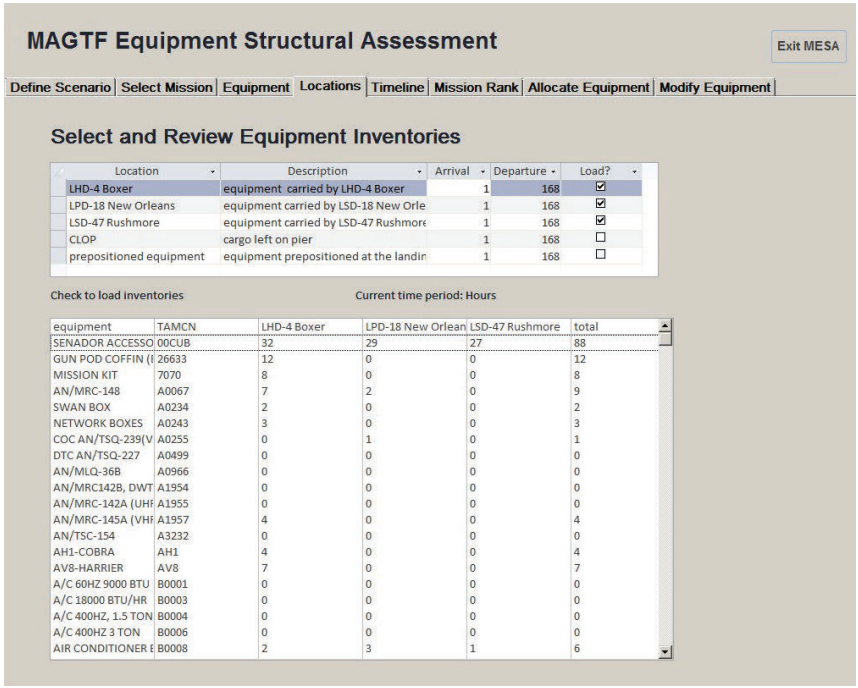
The user selects locations by clicking on the check boxes displayed on the "Locations" tab (Figure 5.4). By default, each location or inventory is available throughout the mission timeline. However, on the "Locations" tab, the user can specify an arrival and departure time for each inventory item. This feature could be used, for example, to simulate the late arrival or early departure of a transport vessel. In addition to the locations provided with the MESA application, the user can add locations as desired.

Equipment Allocation Process

The day-by-day equipment allocation is created by cycling through the list of tasks and assigning equipment to that task from the inventory(s) selected by the user for the specific scenario. Equipment is allocated on a "first come, first served" basis and remains assigned to each task until

[2] See Appendix B for a complete list to include the capability of each item of equipment where applicable.

Figure 5.4
Selecting Location of Equipment Inventories



RAND *TL167-5.4*

the task is completed. For example, if the user has specified that two UAV units are required throughout the entire mission timeline, then MESA will allocate two UAV units—if they are available. Thus, it is important that the user identify the task-specific start and end periods carefully.

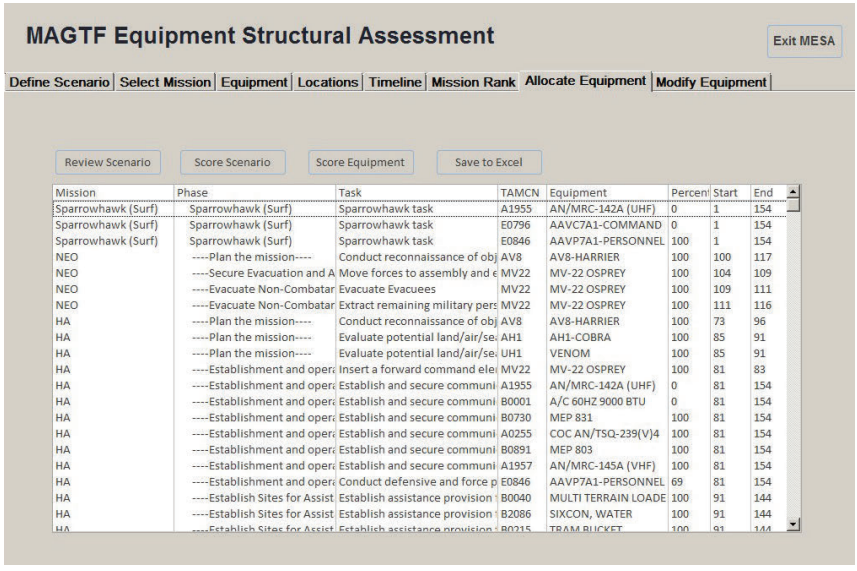
The MESA application determines the task specific completion percentage in terms of the total equipment unit-time periods units requested for the entire task. For example, if the user requests two UAVs for a 24-hour reconnaissance task, the denominator for determining the completion percentage is 48 (2 UAVs x 24 hours). If only one UAV were available during this period, the completion percentage would be 50 percent (24 unit-hours available/48 unit-hours requested).

Application Outputs

The MESA application output consists of four elements: (1) a summary of the tasks and requested equipment specified by the user, (2) a task completion and equipment usage display, including any shortfalls, (3) a summary of shortfalls collapsed to the level of each equipment item, and (4) an Excel spreadsheet with tabs displaying the task-specific completion percentages, detailed inventories, scenario parameters, and a detailed breakdown of equipment item usage over time. These outputs are generated by clicking the "Review Scenario," "Score Scenario," "Score Equipment," and "Save to Excel" buttons, respectively (Figures 5.5 through 5.9).

Clicking the "Review Scenario" button produces a summary of the missions and tasks selected by the user, the amount of equipment requested for each task, and the task-specific start and end periods. In practice, this display is very helpful for reviewing the components of a scenario under development.

Figure 5.5
Review Scenario Display



Mission	Phase	Task	TAMCN	Equipment	Percent	Start	End
Sparrowhawk (Surf)	Sparrowhawk (Surf)	Sparrowhawk task	A1955	AN/MRC-142A (UHF)	0	1	154
Sparrowhawk (Surf)	Sparrowhawk (Surf)	Sparrowhawk task	E0796	AAVC7A1-COMMAND	0	1	154
Sparrowhawk (Surf)	Sparrowhawk (Surf)	Sparrowhawk task	E0846	AAVP7A1-PERSONNEL	100	1	154
NEO	----Plan the mission----	Conduct reconnaissance of obj	AV8	AV8-HARRIER	100	100	117
NEO	----Secure Evacuation and A	Move forces to assembly and e	MV22	MV-22 OSPREY	100	104	109
NEO	----Evacuate Non-Combatar	Evacuate Evacuees	MV22	MV-22 OSPREY	100	109	111
NEO	----Evacuate Non-Combatar	Extract remaining military pers	MV22	MV-22 OSPREY	100	111	116
HA	----Plan the mission----	Conduct reconnaissance of obj	AV8	AV8-HARRIER	100	73	96
HA	----Plan the mission----	Evaluate potential land/air/se	AH1	AH1-COBRA	100	85	91
HA	----Plan the mission----	Evaluate potential land/air/se	UH1	VENOM	100	85	91
HA	----Establishment and oper	Insert a forward command ele	MV22	MV-22 OSPREY	100	81	83
HA	----Establishment and oper	Establish and secure communi	A1955	AN/MRC-142A (UHF)	0	81	154
HA	----Establishment and oper	Establish and secure communi	B0001	A/C 60HZ 9000 BTU	0	81	154
HA	----Establishment and oper	Establish and secure communi	B0730	MEP 831	100	81	154
HA	----Establishment and oper	Establish and secure communi	A0255	COC AN/TSQ-239(V)4	100	81	154
HA	----Establishment and oper	Establish and secure communi	B0891	MEP 803	100	81	154
HA	----Establishment and oper	Establish and secure communi	A1957	AN/MRC-145A (VHF)	100	81	154
HA	----Establishment and oper	Conduct defensive and force p	E0846	AAVP7A1-PERSONNEL	69	81	154
HA	----Establish Sites for Assist	Establish assistance provision	B0040	MULTI TERRAIN LOADE	100	91	144
HA	----Establish Sites for Assist	Establish assistance provision	B2086	SIXCON, WATER	100	91	144
HA	----Establish Sites for Assist	Establish assistance provision	B0215	TRAM BUCKET	100	91	144

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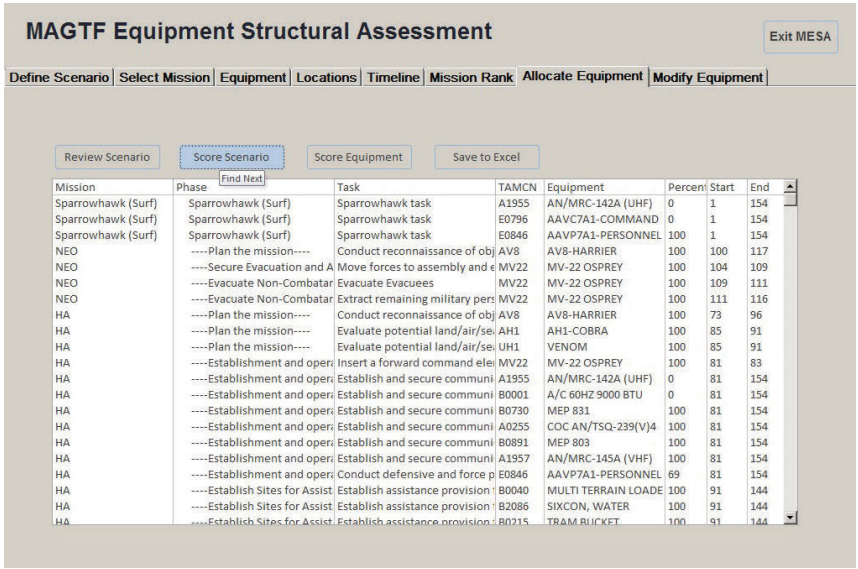
Figure 5.6
Score Scenario Display



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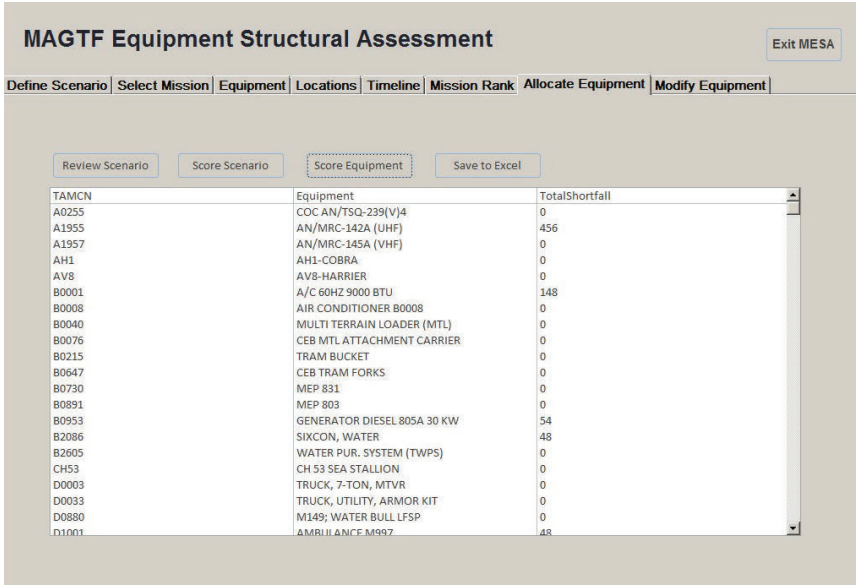
Clicking the "Score Scenario" button produces a display very similar to the "Review Scenario" display, except that it includes the task completion percentage and shortfalls. Successfully completed tasks can be identified by a completion percent of 100; any shortfalls are represented by a value less than 100 percent, including 0 percent, indicating that none of the requested equipment was available for a specific task.

Figure 5.7
Score Equipment Display



TAMCN	Equipment	TotalShortfall
A0255	COC AN/TSQ-239(V)4	0
A1955	AN/MRC-142A (UHF)	456
A1957	AN/MRC-145A (VHF)	0
AH1	AH1-COBRA	0
AV8	AV8-HARRIER	0
B0001	A/C 60HZ 9000 BTU	148
B0008	AIR CONDITIONER B0008	0
B0040	MULTI TERRAIN LOADER (MTL)	0
B0076	CEB MTL ATTACHMENT CARRIER	0
B0215	TRAM BUCKET	0
B0647	CEB TRAM FORKS	0
B0730	MEP 831	0
B0891	MEP 803	0
B0953	GENERATOR DIESEL 805A 30 KW	54
B2086	SIXCON, WATER	48
B2605	WATER PUR. SYSTEM (TWPS)	0
CH53	CH 53 SEA STALLION	0
D0003	TRUCK, 7-TON, MTVR	0
D0033	TRUCK, UTILITY, ARMOR KIT	0
D0880	M149; WATER BULL LFSP	0
D1001	AMBULANCE M997	48

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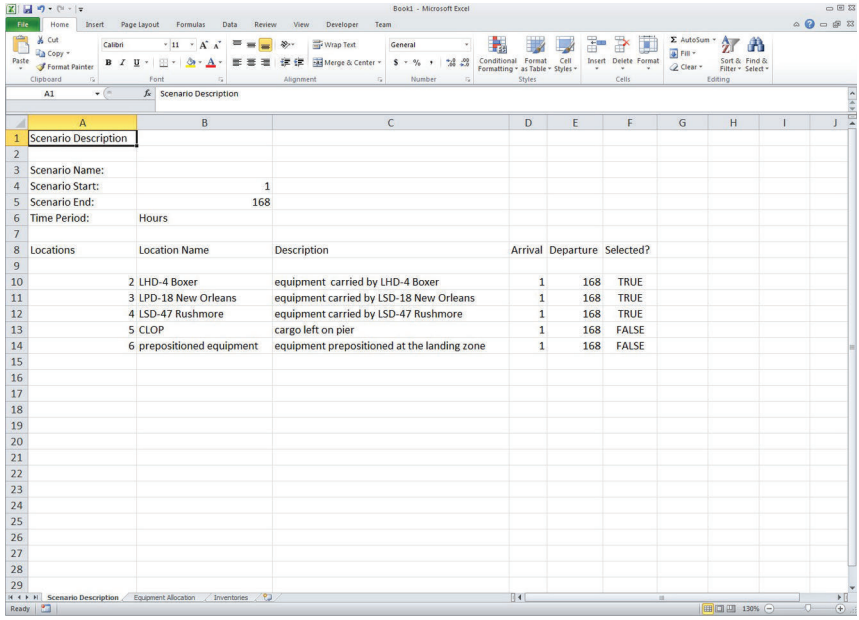
Clicking the "Score Equipment" button produces a three-column display collapsed to the equipment level. Any shortfall is expressed as the total equipment operating hours. A shortfall of zero means that all equipment requested was available from the inventories.

Figure 5.8
Save to Excel Output



	A	B	C	D	E	F	G	H	I	J
1	Scenario Description									
2										
3	Scenario Name:									
4	Scenario Start:	1								
5	Scenario End:	168								
6	Time Period:	Hours								
7										
8	Locations	Location Name	Description	Arrival	Departure	Selected?				
9										
10	2	LHD-4 Boxer	equipment carried by LHD-4 Boxer	1	168	TRUE				
11	3	LPD-18 New Orleans	equipment carried by LSD-18 New Orleans	1	168	TRUE				
12	4	LSD-47 Rushmore	equipment carried by LSD-47 Rushmore	1	168	TRUE				
13	5	CLOP	cargo left on pier	1	168	FALSE				
14	6	prepositioned equipment	equipment prepositioned at the landing zone	1	168	FALSE				

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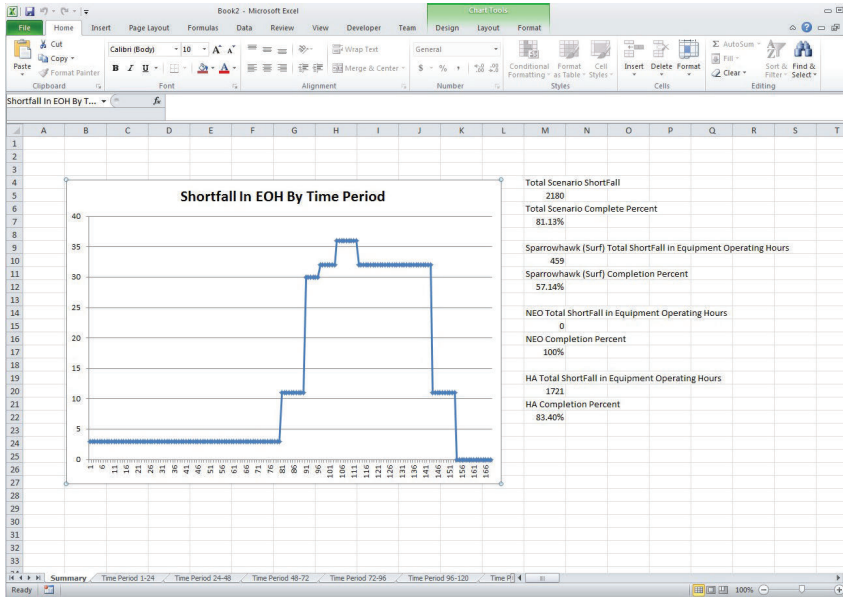
Clicking the "Save to Excel" button (Figure 5.8) generates an Excel spreadsheet that combines all the information displayed by the "Review Scenario," "Score Scenario," and "Score Equipment" buttons. It includes details of the available inventories and a summary of other scenario parameters, such as time period, start and end period, and the scenario title.

Also included on the spreadsheet are graphs of task and equipment-specific shortfalls broken down by time (Figure 5.9).

The information provided by these displays is of value to commanders and mission planners because it allows them to understand how insufficient equipment will affect mission performance and how they may need to adjust mission goals, priority, or scope. Importantly, in some cases the estimated "percent complete" may understate the amount of the task a USMC unit will manage to complete. While

Figure 5.9
Save to Excel Graphical Output



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marines can think creatively and adapt equipment to meet their needs, there are limits to how many substitutions they will be able to make on their own.[3]

Once the user is satisfied with the scenario definition and the resulting equipment allocation determined by the MESA application, he or she can elect to save the output to an Excel spreadsheet for further manipulation.

[3] In addition to assessing the fraction of each task the MEU is able to complete with available equipment, it would be useful to also assess the fraction (percentage) of the overall mission that can be completed. This feature is not yet included in the application. In addition, such a calculation might prove to be problematic, in that not all tasks are equal in importance.

Conclusion

The MESA application described in this chapter uses tasks from mission deconstruction, planning factors, and prioritized equipment rankings based on equipment manuals and USMC officer input, and user-defined parameters to estimate the equipment requirements of a given USMC mission and to compare these requirements with available equipment inventories. The tool is still in prototype and will require further refinement. We next summarize its capabilities and current limitations.

Capabilities

Output from MESA informs planners and commanders about the types of equipment that are essential to mission completion, identifies likely equipment shortfalls, and can assist the commander in an assessment of the implications of equipment shortfalls on task completion and timeline. Planners and commanders can use this information to adjust mission plans or to adjust the equipment traditionally assigned to the MEU.

The application is extremely flexible: Not only does the user define the tasks involved and the operational conditions, but the user can also reconfigure equipment inventories and rankings as necessary or desired. This allows planners and commanders to experiment with different task and equipment specifications.

Limitations

The MESA application as currently configured is strictly a planning tool, and it models only generic MEU missions. An application like this cannot capture the full range of complexities and alternatives associated with a given MEU mission. It is not fully automated, and therefore its outputs focus directly on equipment shortfalls based on the equipment available. The interpretation of the results in the form of operational costs and planning still requires human input.

CHAPTER SIX

Stress Test

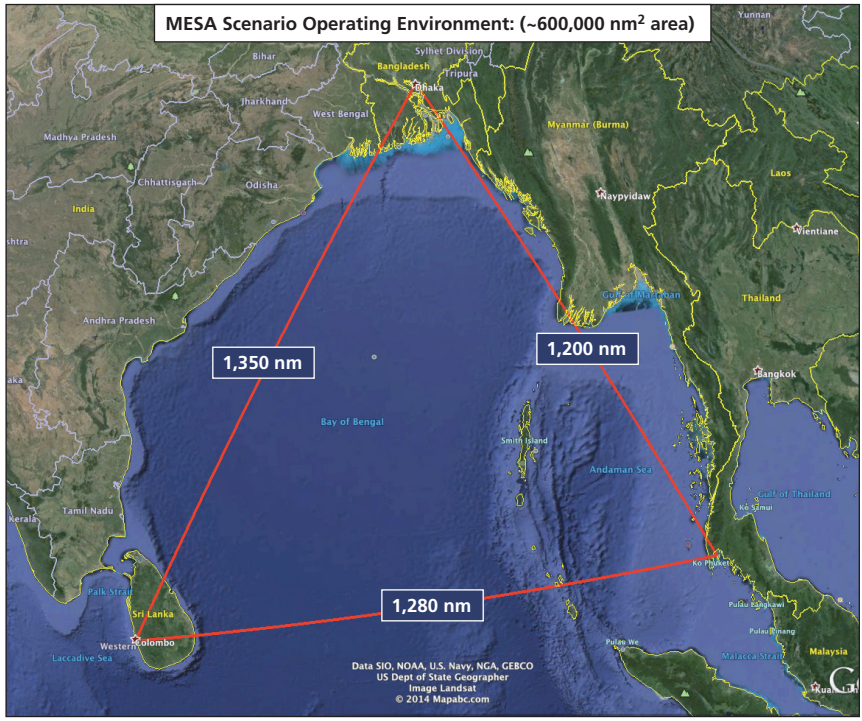
In an effort to test how well the MESA application can support mission planning, we developed a scenario that would stress the program's ability to assess equipment shortfalls. Instead of simply executing a single textbook doctrinal operation, we explored the increasingly prominent split-ARG operating concept as well as the more complex challenge of multiple simultaneous operations. We used the traditional combined ARG as our control group, and we also examined individual missions in order to be able to compare their impact on equipment availability with multiple simultaneous missions. This approach has the dual benefit of testing the effectiveness of the application and, more importantly, providing us with some preliminary findings by illustrating shortfalls under varying conditions. This chapter describes how we used the stress test as a means of evaluating the MESA application's ability to calculate equipment shortfalls. Appendix C is a more detailed description of the analytic process in tutorial form.

Situation

The following describes a fictional geopolitical and environmental situation in the U.S. Pacific Command area of responsibility that necessitates a notional MEU to conduct various combinations of missions, given different ARG configurations and MEU equipment inventories. The main features include a natural disaster in Dhaka, Bangladesh, that prompts the Bangladeshi government to request humanitarian assistance from the United States and political unrest in Sri Lanka

that prompts the U.S. Ambassador to Sri Lanka to request an evacuation of the U.S. Embassy in Colombo. As a result, the Secretary of Defense, with presidential authorization, tasks a MEU that is in the area to conduct an HA and NEO mission, as depicted in Figure 6.1. The operating environment covers approximately 600,000 square nautical miles, includes the Andaman Sea and Bay of Bengal, and is bounded by Dhaka, Colombo, and Phuket, Thailand. The operating environment will be described in the "Description of Cases" section in this chapter (and in Appendix C). The cases include the initial location for the MEU (or parts of the split-ARG MEU) for all of the cases.

Figure 6.1
Stress Test Operational Environment



SOURCE: Google Earth image, obtained early June 2014, with author overlay.

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HA and NEO Mission Requirements

The MEU ground command element, aviation control element, and logistics control element representatives begin by conducting mission-specific planning to identify tasks and subtasks necessary to accomplish the assigned missions. In the case of the HA mission, the MEU is tasked with providing humanitarian assistance for flooding in the vicinity of Dhaka that wiped out residential areas and destroyed transportation, communications, medical, and food and water distribution infrastructure. The flooding of the Meghma and Padma Rivers near Dhaka also destroyed port facilities downstream of Dhaka, which, combined with the 150 nm distance from Dhaka to the mouth of the Bay of Bengal, necessitated an airborne-delivered humanitarian assistance package. Thus, MEU planners identified four tasks and 15 subtasks (that exist in the MESA tool and the mission deconstruction data base in Appendix A) that were critical to accomplishing the mission. These tasks are depicted in Table 6.1.

The MEU is also tasked with evacuating 24 U.S. citizens at the U.S. Embassy in Colombo due to political unrest in and around Colombo. This political unrest poses an elevated threat to the Embassy, which necessitates the need for on-call close air support (CAS). The NEO mission MEU planners determine that the mission can be accomplished with two AV-8Bs providing ISR and CAS, two MV-22s providing insert and extract transport capability, and a platoon-sized force to provide security and conduct the extraction. Thus, MEU planners identified three tasks and four subtasks (that also exist in the MESA tool and the mission deconstruction data base in Appendix A) that were critical to accomplishing the mission. These tasks are depicted in Table 6.2.

Equipment Sets

MEUs have immediate access to the equipment embarked on the ARG, but they also maintain the ability to access pre-staged equipment from other locations. According to interviews with MEU staff members, this practice is becoming increasingly common. The abil-

Table 6.1
Selected Mission Tasks and Subtasks for HA Mission

Task	Subtask	Details
Plan the mission	• Conduct reconnaissance of objective • Evaluate potential land/air/sea avenues of approach • Establish and secure communication lines • Conduct defensive and force protection operations	• Mission planning conducted from ARG • ISR conducted by airborne assets • Establishing secure communications lines and force protection operations conducted by airborne delivered security forces
Establish and operate command center	• Insert a forward command element • Establish and secure communication lines	• Command center established at the Dhaka International Airport by airborne delivery of security and headquarters group
Establish sites for assistance provision	• Establish assistance provision facilities • Transport needed supplies • Secure provision site	• Assistance-provision facilities established at three sites around Dhaka airport • Supplies will be provided primarily by airborne insertion
Provide assistance	• Transport and process evacuees • Provide medical care • Provide food and water • Conduct NEO • Conduct SAR operation	• Transport of evacuees done by aircraft and airborne-inserted vehicles • Medical care, food, water provided by marines at assistance sites • NEO and SAR operations conducted by platoon on standby alert

ity to draw on equipment from alternative locations can significantly enhance the capability of the MEU, but there is a cost associated with the additional time and coordination needed to secure items in this way. This complicates the process of defining the equipment set to be used for the MESA application, in that there are alternatives to just using the equipment onboard the MEU. To simplify things, we have created three possible equipment set lists as depicted in Table 6.3: the universal set, the complete set, and the embarked set.

Table 6.2
Select Mission Tasks and Subtasks for NEO Mission

Task	Subtask	Details
Plan the mission	• Conduct reconnaissance of objective	• Mission planning conducted on ship • ISR conducted by airborne assets
Secure evacuation and assembly sites	• Move forces to assembly and evacuation site(s)	• Evacuation site established by airborne-inserted security platoon
Evacuate noncombatants and military personnel	• Evacuate evacuees • Extract remaining military personnel	• Evacuation and extraction conducted by airborne-transport platform and airborne-inserted security platoon

Table 6.3
Possible Equipment Set Lists

Equipment Set	MEU Table of Equipment	Cargo Left on Pier (CLOP)		Prepositioned Assets
		Flown In	Not Flown In	
Universal	X	X		X
Complete	X	X		
Embarked	X		X	

NOTE: Prepositioned assets may be flown in from remote locations or they may be part of an acquisition and cross-servicing agreement.

Description of Cases[1]

Each unique set of variables entered into MESA for the purpose of this test was considered an independent case.

Three variables were selected to be tested: shipping capacity, ARG composition, and simultaneous mission requirement. The test then answered the following questions:

[1] For a detailed description of the notional scenarios and planning assumptions applied to develop each case, see Appendix C.

- How does shipping capacity affect MEU capabilities?
- How does ARG composition affect MEU capabilities?
- How does conducting a simultaneous mission affect MEU capabilities?

Two instantiations of each variable were considered to produce a total of eight test cases. The variable settings are listed below, and the cases are described in Table 6.4. These cases were tested with the MESA application, and the results were compared. Table 6.5 organizes the cases as treatments of each of the variable instantiations.

- Shipping capacity (equipment inventory in MESA)
  - Embarked equipment[2]
  - Complete set
- The mission
  - HA only
  - HA and NEO
- ARG configuration
  - Combined ARG (LHD, LPD, and LSD operating together)
  - Split ARG (LSD operating separately from LHD and LPD)

Testing the Cases

Testing consisted of five phases: planning the mission, developing inputs to the MESA application, observing MESA calculations, producing outputs, and a shortfall analysis. These steps are discussed in detail in the tutorial at Appendix C. Here, we focus on the results and the analysis of the outputs from the MESA application.

[2] For the stress test, we examined the complete set designated. Equipment lists were drawn from the MAGTF Deployment Support System II (MDSS II) by the 26th MEU. The data they provided included allocation of all equipment by ship, as well as a list of all CLOP from their 2013 deployment.

Table 6.4
Stress Test Cases

Case	ARG Configuration	Mission	Equipment Inventory
1	Combined	HA only	Complete Set
2	Combined	HA only	Embarked Set
3	Combined	HA and NEO	Complete Set
4	Combined	HA and NEO	Embarked Set
5	Split	HA only	Complete Set
6	Split	HA only	Embarked Set
7	Split	HA and NEO	Complete Set
8	Split	HA and NEO	Embarked Set

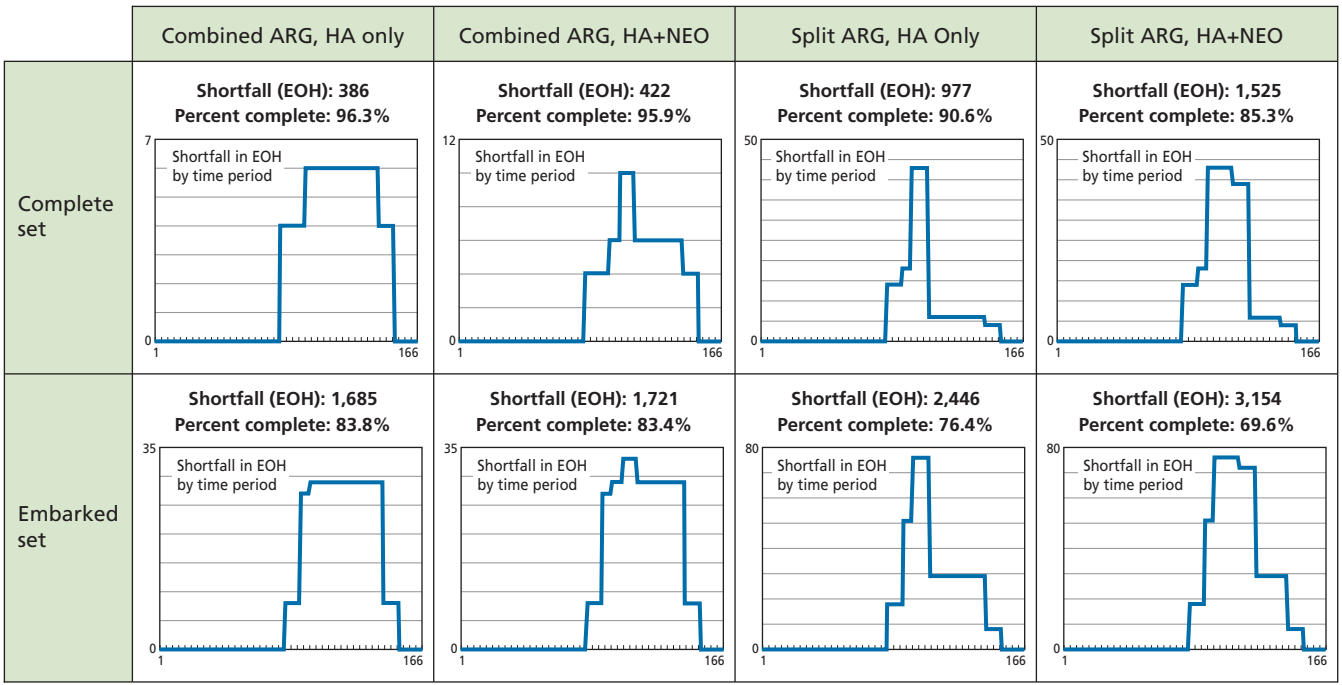
Table 6.5
Eight Case Testing Template

	Combined ARG, HA Only	Combined ARG, HA and NEO	Split ARG, HA	Split ARG, HA, and NEO
Complete set	Case 1	Case 3	Case 5	Case 7
Embarked set	Case 2	Case 4	Case 6	Case 8

Shortfall Analysis

The final stage of the identifying equipment shortfalls process is to conduct analysis of MESA results. Figure 6.2 depicts the equipment operating hour shortfall profiles for each of the eight cases tested. The results illustrate somewhat similar profiles for each case. In all cases, shortfalls begin only after the initial phases of the operation. In each column, the percentage of overall mission completion decreases with the more limited embarked equipment set. Similar comparisons can be made by comparing ARG composition and the number of missions, and we see that those conditions in the top left of the testing template result in a much greater mission completion rate than those toward the lower-right corner. The figures also suggest that the ability to complete the HA mission is affected more by a limited equipment set, or ship-

Figure 6.2
Shortfall Results



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ping capacity, than either having to conduct multiple missions or ARG configurations.

By isolating each variable, it is possible to visualize the degree to which that variable affects mission shortfalls. Figure 6.3, for example, illustrates that adding a small second mission like the NEO made very little difference in the MEU's ability to perform the HA mission when the ARG was combined, because while some equipment (MV-22s) had to be dedicated to the NEO, the rest of the equipment aboard the LSD was available for HA tasks. However, under split-ARG conditions, adding a second mission does have an effect, since it takes longer for the LSD to join with the other ships, as it is conducting NEO tasks and thus those other items aboard remain unavailable longer than they would if the LSD could sail directly to the HA operation.

Figure 6.4 illustrates that ARG composition has an effect on mission capability under all conditions but has a significantly greater impact when the second mission (the NEO) is added. However, what is not captured is that the tradeoff for being less mission-capable under conditions of split-ARG with two missions is an increased responsiveness to the NEO mission. In these scenarios, the NEO was completed

Figure 6.3
Effect of a Second Mission on Mission Capability

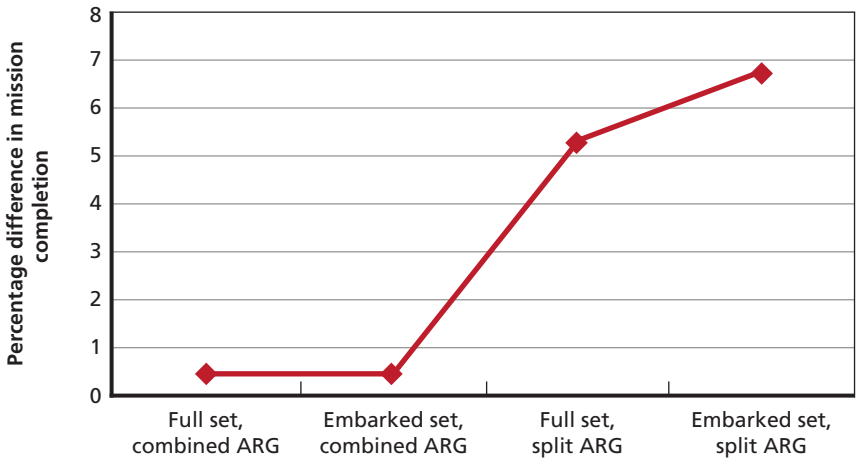

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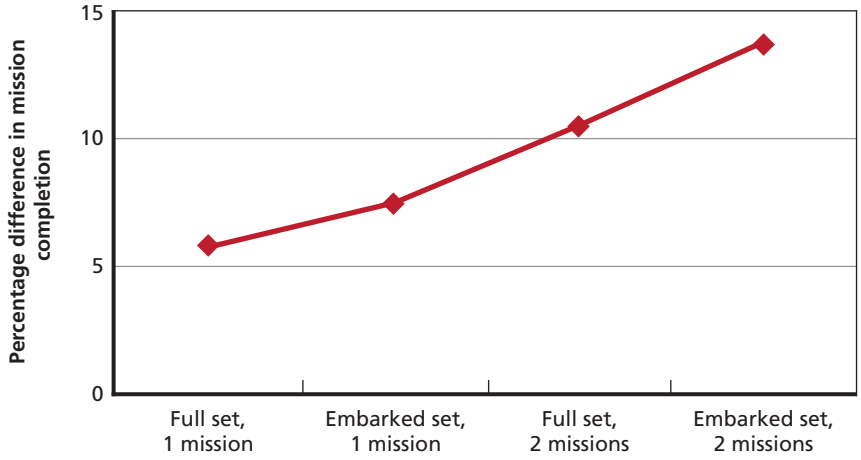
Figure 6.4
Effect of ARG Composition on Mission Capability



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eight hours quicker with the split-ARG configuration than with the combined ARG configuration. This is an example of why contextualizing such results is important, as the tradeoff in increased NEO reaction time for slightly reduced HA capability may be desired, depending on the operational situation.

However, regardless of other conditions, the effects of not having access to CLOP was the most consistent and generally greatest of all factors tested, as depicted in Figure 6.5. Note that even in split-ARG conditions it was assumed that CLOP in a Complete Set scenario would be available the entire time (beginning with hour 1), which suggests that all of the CLOP could have fit on the LHD and LPD, with none positioned on the LSD.

The average effects of each isolated variable, presented in Figure 6.6, clearly identify and quantify the largest drivers of equipment shortfalls that affect mission capability. Given the scenario parameters tested, shipping capacity (equipment set), or availability of CLOP, was the largest driver, followed by ARG composition, with the requirement to conduct a second mission being the least impactful.

Figure 6.5
Effect of Equipment Set on Mission Capability

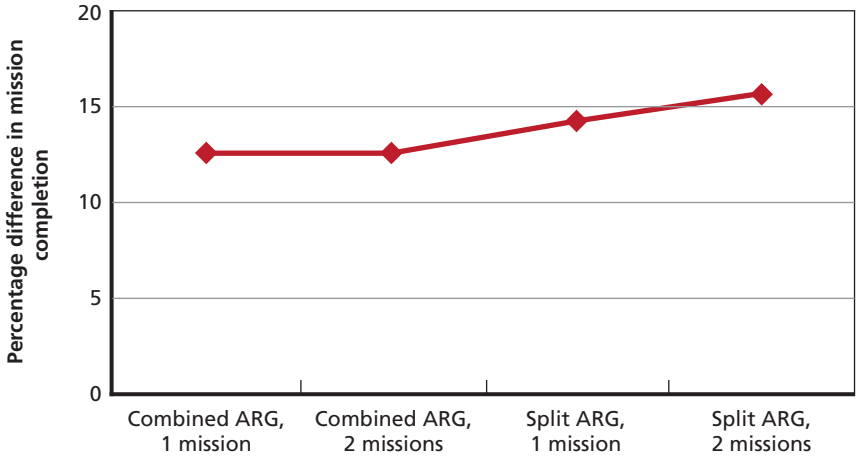

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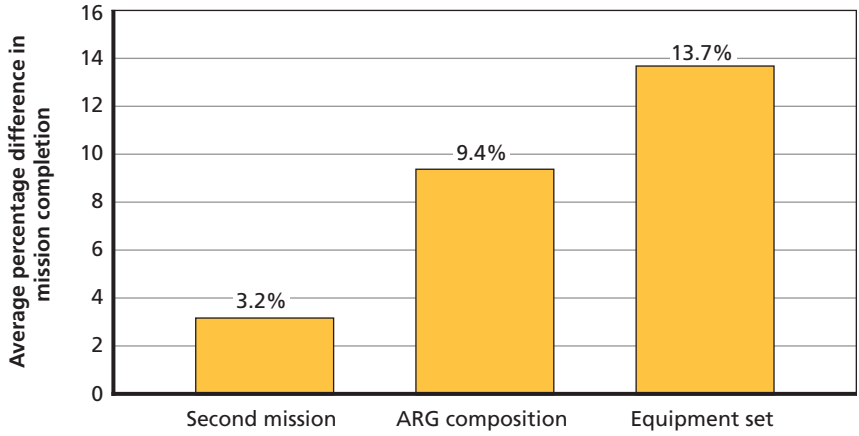
Figure 6.6
Average Effect on Mission Capability Across All Cases



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Figures 6.3 through 6.5 represent the percentage of mission completion calculated by treating every task and every equipment item equally. Therefore, one hour of one tent not satisfied is considered equal to one hour of one MV-22 not satisfied. MESA provides the cumulative calculations taken across all equipment items and tasks. However, the export-to-Excel function allows the user to narrow analysis down to particular equipment items or tasks of particular interest, such as aircraft, or tasks associated with being required to accomplish the mission, or tasks required to protect the force, that can be individually assessed.

Table 6.1 shows the results for each case tested when isolating specific items or tasks of interest. The five aircraft available were MV-22, AV-8, CH-53, AH-1, and UH-1. We see that aircraft, when isolated, are not affected by shipping capacity (equipment sets), because no aircraft are positioned in the CLOP inventory. However, mission capability is slightly impacted as missions are added and the ARG is split.

A total of 23 mission-dependent subtasks were identified as things that must occur to have a successful HA mission, such as transport/process evacuees, establish provision facilities, provide food, water, and

Table 6.1
Analyzing Specific Equipment Items and Tasks

Set	Combined ARG, HA Only	Combined ARG, HA+NEO	Split ARG, HA Only	Split ARG, HA+NEO
Complete set	Aircraft: 100% Mission Dependent Tasks: 98.9% Security/Force Pro Tasks: 92.3%	Aircraft: 99.2% Mission Dependent Tasks: 96.9% Security/Force Pro Tasks: 92.3%	Aircraft: 99.0% Mission Dependent Tasks: 89.2% Security/Force Pro Tasks: 86.0%	Aircraft: 98.6% Mission Dependent Tasks: 86.4% Security/Force Pro Tasks: 82.0%
Embarked set	Aircraft: 100% Mission Dependent Tasks: 92.3% Security/Force Pro Tasks: 92.3%	Aircraft: 99.2% Mission Dependent Tasks: 90.3% Security/Force Pro Tasks: 92.3%	Aircraft: 99.0% Mission Dependent Tasks: 82.0% Security/Force Pro Tasks: 86.0%	Aircraft: 98.6% Mission Dependent Tasks: 75.7% Security/Force Pro Tasks: 82.0%

medical care, and conduct search and recovery. Mission-dependent tasks are degraded by losing CLOP, because it includes items such as generators, engineering equipment, tents, and vehicles needed for those tasks that, if not done, degrade mission success.

Finally, four subtasks required for force protection or security were identified. These include initial defensive operations and securing the provision site. These subtasks experienced effects similar to aircraft because M1162 (PM), M1161 (ITV-LSV) trucks, utilities, armor kits, or amphibious assault vehicles (AAVs) were not in the CLOP inventory. Therefore, the equipment set limitation does not affect task completion percentages. Also, when the ARG is combined at the HA site, vehicles from all three ships are present and accessible, so there was no change when a second mission was added, which only required aviation assets. However, the AAVs on the LSD are not available when the ARG is split. As in the other cases, the LSD arrives at the humanitarian assistance/disaster response (HADR) site sooner if it does not have to stop to conduct the NEO, so the split-ARG, single-mission case is less affected than the split-ARG, two-mission case.

CHAPTER SEVEN

Conclusions

The MESA application described in this report provides Marine Corps planners and commanders with a means to estimate the equipment needed to complete a given set of tasks in support of one or more missions and to evaluate the sufficiency of available equipment to support mission completion. The tool can also be used to identify likely equipment shortfalls and assist in understanding the effects on these shortfalls on mission completion, and the tool allows the user to utilize equipment substitutions. Equipment shortfalls are unlikely to lead to mission failure, as MEU commanders will instead devise ways to use what they have to accomplish necessary tasks and activities. At times, the MEU will be able to rely on supplemental forces and equipment from nearby Navy ships, pre-positioned reserves, or other MEUs. However, equipment shortfalls may still slow mission completion, compromise efficiency, or expose the MEU to additional risks.

The initial iteration of the MESA application focused only on the HA mission, but the approach was easily extended to other mission types in the second and this, the third, edition. In its current configuration, the MESA application incorporates a good deal of flexibility, allowing the user to identify the equipment he or she feels can do the job required. In making equipment decisions, equipment specifications in the form of usage restrictions (terrain, weather, etc.) and technical characteristics are displayed to assist the user.

This report provides a systematic framework that can be used to deconstruct missions into their constituent tasks; identify environmental factors that may affect equipment requirements for specific tasks

and activities; define relevant planning factors using task metrics and equipment capability; and allocate equipment to tasks based on these planning factors, as well as equipment and task prioritization. Task sequencing allows the user to specify relative ranking among the tasks. The MESA application implements this method or framework with significant room for user-driven modification that enhances the value of the tool to military planners and commanders.

The value of the MESA application is also clear within the broader analytic context described in the introduction. Marine Corps planners face a large number of challenges and choices when determining which pieces of equipment should go aboard a MEU and which should stay behind. The MESA application focuses on one specific piece of this challenge—ensuring that the equipment selected allows the MEU to complete a wide set of possible tasks in support of multiple missions. The application, with the appropriate data, can also provide commanders with some insight into the implications of shortfalls and allow them to conduct risk assessments that can be compared across several different possible equipment allocations. Despite certain methodological limitations that place some constraints on the MESA output, the approach presented in the report and the MESA application together serve as planning and diagnostic tools that support and inform MEU commander decisions.

Lessons Learned

The processes of identifying planning factors and developing a MESA application has led to several observations about mission requirements, and it has highlighted several issues that commanders and military planners may consider in preparing for future operations.

Common Tasks

The deconstruction of missions into their component tasks shows the significant overlap in the specific tasks and activities involved in the MEU's diverse mission set. Tasks such as creating a mission plan, road and area clearance, and setting up a command center occur in most

missions, including those focused on stabilization and those that are combat-oriented. Subtasks and activities including reconnaissance and surveillance, establishing communication lines, and force protection are also common to many missions described in Table 1.1 and Appendix A.

These commonalities are important to mission planning because they imply that similarities in the equipment requirements of the diverse mission responsibilities the MEU faces may also exist. In other words, marines may be able to use similar sets of equipment to complete assaults, raids, HA, and SAR operations. The MESA application assists commanders by providing equipment characteristics, thereby providing the user information on possible substitutions. Commanders and military planners should exploit the substitutability of equipment and overlap in equipment requirements to maximize the readiness and flexibility of the deployed MEU.

Constrained Allocations

As in reality, the MESA application allows the set of equipment available to be constrained, facilitating planning under suboptimal conditions. The tool allows planners to assess which pieces of available equipment may support task completion if absolutely necessary and to define the mission implications of equipment shortfalls. Prior to a deployment, expected equipment shortfalls can be used to scale back mission objectives or to justify additional equipment allocations. During a deployment, however, commanders may be forced to rely more heavily on substitutions and nontraditional uses of pieces of equipment in order to accomplish high-priority tasks and activities. Importantly, even when alternate, suboptimal equipment allocations allow for task completion, equipment shortfalls may still have implications for the time, resources, and manpower required to accomplish a specific objective.

Situation-Dependent Allocations

The process of defining planning factors also underscores the important effect that operational conditions have on the equipment requirements of any MEU mission. The level of operational threat, the specific tasks involved, the weather, and the terrain may all affect the types of

equipment best suited to accomplish a given mission. Military planners and commanders are well aware of the significant effect played by external variables and the fact that no two operations are alike. The MESA application addresses this variation by allowing the user to prioritize specific tasks over others within a single mission (see below) and across missions. Equipment requirements are defined by the user and are informed by equipment descriptions, including externals such as weather, terrain, and other constraints on equipment operation.

Equipment Prioritization

In the original version of the MESA application, equipment prioritization was an automatic process included in the tool. It was based on a workshop held with USMC officers and their assessments of which pieces of equipment they would use to complete certain tasks. The MESA application made use of this prioritization when allocating equipment. The highest-ranked piece of equipment was allocated first; when this first choice was not available, the application made substitutions suggested by the overall ranking of similar pieces of equipment able to complete the task. Unfortunately, the widely varying mission set made this process too complex. For example, wheeled vehicles were the highest priority for moving personnel, and as long as there were vehicles available, the tool selected them. However, if transportation was needed to move personnel from ship to shore, wheeled vehicles were of little help. Consequently, that feature has been removed, and the user now selects the equipment he or she feels is most appropriate and which is available.

This simulates a commander's decisionmaking process and underscores the point that when operating in a constrained environment, the ability to flexibly compare and substitute equipment based on availability is a significant advantage. This observation suggests that planners and commanders would benefit from developing at least an informal ranking or understanding of how different pieces of equipment perform on various common tasks, both in absolute and relative terms.

Task Sequencing and Prioritization

Another lesson that emerged from the development of the MESA application is the importance of task sequencing to achieve task prioritization. Task sequencing is important because it affects the order in which equipment is allocated and used, and potentially which pieces of equipment are available at each point during mission execution. If tasks occur sequentially, equipment used in one task may be available in the next. However, if tasks overlap, then equipment required by multiple tasks may only be available for one activity, again forcing substitution and reallocation. Military planners and commanders may be able to maximize readiness and overcome equipment shortfalls by manipulating the timing and sequencing of the tasks and subtasks involved in a given military operation. This could involve reordering certain tasks over others or staggering tasks rather than attempting to execute them concurrently. The MESA application allows users to define task sequencing and therefore also to compare the effects of alternative task order. Of course, in certain situations, commanders and planners may lack the flexibility to make these kinds of revisions.

Relative Task Importance

Within any mission, especially those that are complex, certain tasks may be more important than others. For example, within the HA mission, distribution of essential food and water may take priority over road and infrastructure repairs. Where the two tasks rely on similar equipment, commanders may choose to allocate that equipment to the provision of assistance first and conduct infrastructure repairs using whatever equipment remains, even if this means only partial task completion. Especially in constrained environments, prioritizing key tasks is one way that commanders can ensure that the most effective pieces of equipment are available to complete the most important mission objectives. The MESA application allows users to rank specific tasks within a given mission and to explore how reprioritizing tasks and activities may affect overall mission completion or address the effects of equipment shortfalls.

Users can specify which tasks within a mission are more important than others through the sequencing process. Clearly, relative

importance is situation-dependent, and therefore users are prompted to establish relative importance when executing MESA by thinking through the sequencing process.

Mission Nesting

A final lesson suggested by the MESA application and the process of deconstructing missions relates to the concept of mission nesting. In some cases, a MEU is asked to complete not a single mission from the mission set, but a more complex operation that involves several overlapping missions that must be completed sequentially or nearly simultaneously, such as the two missions discussed in Chapter Six. We refer to this as *mission nesting*.

Mission nesting has implications for planners, for two reasons. First, it complicates the allocation of equipment and increases the potential for equipment shortfalls, because it means that equipment must be spread across the tasks of several different missions. At the same time, however, it allows planners to exploit common tasks that may apply to all missions. For example, road and area clearance and the establishment of a communications infrastructure are tasks that may only need to occur once in a given operational area, regardless of the number of separate missions being executed.

The HA mission is one that may be affected by nesting. HA missions sometimes involve NEOs and SAR operations. Both NEOs and SAR are more than "tasks" and have their own mission plans, even when they occur in the context of a larger HA operation. As a result, the NEO and SAR missions could be described as nested within the HA mission. Although the three missions would have to share equipment, they could all make use of cleared roads, command center communications, and general stability and security established in the early phases of the HA effort.

Mission nesting also requires prioritization, similar to task prioritization. In a constrained environment with several ongoing missions, commanders may be forced to determine which missions are highest priority and should be allocated top ranked equipment, and which could be accomplished with a more limited commitment. Continuing the example above, if a NEO and HA mission do overlap, they will

compete for vehicles—the NEO uses vehicles to transport personnel and the HA mission to transport supplies. Commanders would need to determine the relative importance of the two tasks, and this importance would then guide equipment allocation and task sequencing if required.

Stress Test and Tutorial

By choosing a notional scenario and creating eight cases by varying three variables (shipping capacity, ARG composition, and number of missions), it was possible to highlight the greatest cause of shortfalls. Given the scenario and the values assigned to each variable, shipping capacity appears to be the largest driver of equipment shortfalls. This demonstrates the ability of the MESA application to be employed in the manner intended, providing the user the ability to adjust multiple variables.

However, the five stages of the overall shortfall process and the multiple steps required within the MESA process itself could be improved. Through adapted interface modifications, additional automation, and new output options, the tasks of MESA inputs and final analysis could produce quicker results. Further, a user-friendly interface for inputting and adjusting variables internal to the MESA applications, such as equipment inventories and ARG configurations, could also improve the ease of use.

Next Steps and Challenges

The MESA application described in this report currently considers six missions and their associated tasks. However, adding additional missions is not difficult. As the number of missions continues to grow, we face two significant challenges:

- The first is how to deal with common tasks. We have addressed this challenge with six missions, but whether this scales linearly remains to be seen. It may be the case that a single command center is all that is needed to accommodate two missions, but

what about five or ten? Is it even realistic to assume that a MEU will be confronted with that many missions at once? In any event, equipment needed to support each mission may differ in some way. This will mean that although the task is "common," there may be unique, mission-specific requirements to accomplish it.

- A second challenge deals with sequencing the tasks to achieve relative importance at the task level versus at the mission level. We have addressed this issue for the six tasks in the current version of the application, but as above, the question is, "Will this scale up?"

Although we recognize that the MESA application is not designed to support operational planning, additional functionality can be added that would strengthen it as a planning tool.

Finally, better documentation of the specific tasks involved in specific missions and better ways of capturing the experiences of past MEU commanders can also provide better data on unexpected equipment substitutions, as can collecting additional performance data from real-world situations.

APPENDIX A

Mission Deconstructions

Although USMC missions share common tasks, it is often their mission-specific activities which have the greatest effect on their equipment and personnel needs and that are most immediately and severely affected by equipment shortfalls. In this appendix, we move from the discussion of specific tasks to a more careful deconstruction of the six missions developed for this project: HA, TRAP, NEO, port and airfield seizure operations, amphibious assault, and stability operations. The focus is on the tasks and characteristics that make the missions distinct and that most directly affect the planning required for completion. We also record summary deconstructions for the remaining nine missions.

We relied on several key sources as we deconstructed missions into their component tasks. Table A.1 summarizes the deconstructions of all 15 missions by including a brief mission description and then listing the tasks required to accomplish the mission.

Table A.1
Deconstructed Missions

Mission Name	Description	Tasks
Amphibious raid	Short-duration, small-scale deliberate attacks, from the sea, involving a swift penetration of hostile or denied battlespace.	• Plan the mission • Establish command center(s) • Embark the force • Move to objective • Conduct raid actions • Conduct withdrawal
Amphibious assault	Attack launched from the sea by naval and landing forces, embarked in ships or craft involving a landing on a hostile shore.	• Plan the mission • Embarkation • Movement to operational area • Assault
Maritime interdiction operations (MIOs)	Operations to intercept commercial, private or other nonmilitary vessels and conduct visit, board, search, and seizure procedures.	• Plan the mission • Establish command position • Secure area of operations • Secure, board, search ship • Escort ship to port
Advance force operations	Operations to shape the battlespace in preparation for the main assault by conducting such operations as reconnaissance, seizure of supporting positions, minesweeping, underwater demolitions, and air support.	• Plan the mission • Establish command center • Advance ISR • Preparation of battlespace • Neutralize high value targets
Noncombatant evacuation operations (NEOs)	Evacuation of noncombatants from countries when their lives are endangered by civil unrest or natural disaster to safe havens or to the United States.	• Plan the mission • Establish command center(s) • Clear roads and areas • Establish and secure evacuation, assembly, and other sites • Provide assistance at central sites or with mobile unit • Deploy JTF main body • Transport and assemble evacuees • Evacuate noncombatants and extract military personnel

Table A.1—Continued

Mission Name	Description	Tasks
Stability operations	Operations that encompass various military missions, tasks, and activities conducted outside the United States in coordination with other instruments of national power to maintain or reestablish a safe and secure environment, provide essential governmental services, emergency infrastructure reconstruction, and humanitarian relief.	• Plan the mission • Establish command center(s) • Conduct marine resupply • Restore and maintain civil society • Provide assistance at central sites or with mobile unit • Transition to host-nation control • Support economic stabilization • Plan for transition of operations to follow-on military units or civilian authority
Humanitarian assistance (HA) operations	Operations that respond to manmade and natural disasters and include tasks such as providing personnel and supplies and providing a mobile, flexible, rapidly responsive medical capability for acute medical care.	• Plan the mission • Establish command center(s) • Clear and roads and areas • Establish and secure assembly and other sites • Provide assistance at central sites or with mobile unit • Restore essential services • Transition to host-nation control
Tactical recovery of aircraft and personnel (TRAP)	An operation conducted to locate and extract distressed personnel and sensitive equipment from an enemy-controlled area during wartime, or contingency operations to prevent capture.	• Plan the mission • Establish command center(s) • Clear roads and areas • Establish and secure evacuation, assembly, and other sites • Provide assistance at central sites or with mobile unit • Reach and secure recovery site • Recover personnel, aircraft • Extract noncombatants and extract military personnel
Joint and combined operations	Joint operations incorporate two or more military departments and are commanded by a joint force commander with a joint staff. Combined operations incorporate military forces from two or more nations.	• Command and control • Intelligence • Fires • Movement and maneuver • Protection • Sustainment

Table A.1—Continued

Mission Name	Description	Tasks
Aviation operations from expeditionary shore-based sites	Marine aviation units operate from expeditionary shore-based sites (in line with unit/platform capabilities), including forward operating bases, expeditionary airfields, forward arming and refueling points, austere forward operating sites, tactical landing zones, helicopter landing zones, etc.	• Plan the mission • Establish command center • Preparation and coordination • Air reconnaissance • Air support operations • Assault support
Support for theater security cooperation (TSC)	Bilateral and multilateral military noncombat activities conducted with allies and other potential partners to build partner capacity and support interoperability and cooperation with U.S. forces.	• Plan the mission • Establish command center(s) • Counter-narcotics operations • Counter-proliferation operations • Provide emergency HA • Joint training • Security force assistance • Armaments and intelligence • Cooperation • International Military Education and Training (IMET), mil-to-mil contacts • Arms transfers
Airfield/ port seizure operations	Offensive operations to occupy or defend airfields or ports for use by friendly forces.	• Plan the mission • Establish command center(s) • Establish and secure evacuation, assembly, and other sites • Provide assistance at central sites or with mobile unit • Seize and secure airfield or port • Conduct follow-on operations
Direct action (DA) operations	Strikes and small-scale offensive actions conducted as special operations in hostile, denied, or politically sensitive areas, using specialized military capabilities.	• Plan the mission • Establish command center • Raid, ambush infiltration • Withdrawal
Special reconnaissance (SR)	Reconnaissance and surveillance actions conducted as a special operation in hostile, denied, or politically sensitive areas to collect information of strategic or operational value.	• Plan the mission • Establish command center • Covert movement to target • Collection of intelligence • Force protection • Extraction

Table A.1—Continued

Mission Name	Description	Tasks
Foreign internal defense (FID)	Participation by civilian and military agencies of the government in any of the action programs taken by another government or other designated organization to free and protect society from subversion, lawlessness, and insurgency.	• Plan the mission • Establish command center • Provision of security assistance • Civil-military activities • Restore local control

Humanitarian Assistance[1]

Humanitarian assistance is defined in Joint Publications and Army Field Manuals as:

> Programs conducted to relieve or reduce the results of natural or man-made disasters or other endemic conditions such as human pain, disease, hunger, or privation that might present a serious threat to life or that can result in great damage to or loss of property. Humanitarian assistance provided by US forces is limited in scope and duration. The assistance provided is designed to supplement efforts of civilian authorities or agencies that may have primary responsibility for providing humanitarian assistance.[2]

In recent years, U.S. military personnel have found themselves taking on significant humanitarian responsibilities. All HA operations share certain common tasks, but the nature of an HA mission also depends fundamentally on the nature of the precipitating crisis, the type of aid provided, and the operational environment. For example, although the HA mission following a major earthquake and one that occurs during an ongoing low-intensity civil war both are likely to involve the transport and distribution of emergency food and water

[1] NAVMC 3500.44, 2008b; OPNAVINST 3500.38B/MCO 3500.26B/ USCG COMDTINST 3500.1B, 2010; FM 3-0, 2011; U.S. Joint Chiefs of Staff, *Foreign Humanitarian Assistance*, Joint Publication 3-29, Washington, D.C., January 3, 2014a.

[2] JP 1-02, 2014c.

and road clearance, HA following an earthquake is likely to include significantly more rebuilding, whereas the civil war HA maintains a security focus.

The basic approach the Marine Corps takes toward HA operations and the role it defines for its personnel and equipment will affect the equipment requirements. USMC officers that we spoke to were clear that marines typically do not participate in the actual provision of humanitarian aid, such as the distribution of food, the building of shelters for refugees, or the provision of non-emergency medical care, leaving these tasks to local organizations and NGOs. However, sometimes necessity requires that they become more involved in certain aspects of humanitarian assistance, participating directly in the distribution of food and potable water or assisting in local construction and engineering activities.

The HA mission served as the prototype for the MESA application reported in the first edition of this report. The HA mission is a fairly common mission, but also one that can be complex, with many different tasks and subtasks, and one that depends on the number of people requiring assistance and the availability of partner, NGO, or joint force support. It may also occur alongside many other MEU missions, including FID, NEO, TRAP, stability operations, and even direct action or special reconnaissance on occasion, adding to the complexity of its resource requirements and raising issues such as task, mission, equipment prioritization, and sequencing. Table A.2 contains summaries of the major HA tasks.

Mission Planning and Command Centers

A typical HA mission consists of the tasks listed in Table A.2. It begins with mission planning and the establishment of a command center that oversees its execution. In the case of an HA mission, the plan will be shaped by a basic assessment of the disaster or crisis that considers the nature of the disaster or crisis; the effect of the disaster on local infrastructure, governance, and population; the status of food and water supplies; the medical care demands; the existence of host-nation or ally support; the level of security threat; and duration of assistance needed. The plan may also consider or project the likely operational demands;

Table A.2
Humanitarian Assistance Tasks

Task	Description
Plan the mission	The mission plan defines the objectives and operational plan for the mission, including the key tasks and associated requirements, using surveillance and reconnaissance. Factors considered in the mission plan will include the threat level, terrain, nature and severity of disaster, presence of local support, likely scope and duration of the mission, numbers of people requiring assistance, and status of infrastructure.
Establish command center(s)	The command center(s) serve as the operational center for the missions, including setting up communication lines and planning logistics and intelligence operations.
Clear roads and areas	Transportation routes must be cleared of obstacles and hazards to facilitate the movement of personnel and essential cargo. Obstacles may include debris from man-made or natural disaster, IEDs, or other emplaced munitions.
Establish and secure evacuation, assembly, and other sites	HA provision sites are used to supply emergency medical care, food, and water. The sites must be cleared of debris and secured. USMC units may take a lead in security-related tasks and assist NGOs in essential repairs of facilities for aid provision.
Provide assistance at central sites or with mobile units	The MEU may provide emergency HA assistance or support NGOs in this activity. MEU involvement is likely to include primarily transport and distribution of foreign aid, including food, water, and other supplies. They may also assist in SAR operations or evacuations as necessary.
Restore essential services	The MEU may assist in the restoration of critical services, such as power, water, and rule of law, and the repair of essential infrastructure until the host nation or NGOs are able to assume control.
Transition to host-nation control	The transition to host-nation (or NGO) control signals the end of the mission. It may include the transfer of service provision, the training of security personnel, and in some cases support for new elections.

for example, whether roads will need to be cleared, emergency assistance provided (and to how many people), or evacuations or search operations conducted. The size and nature of the HA mission will also affect the establishment of the command center(s), by determining the

number of sites requiring command centers and the command capabilities needed at each site.[3]

Road and Area Clearance

Once the command center and mission plan are in place, the next step in many HA missions will be accessing the areas in need of assistance. This may require extensive road and area clearance as well as critical road and infrastructure repairs, ranging from removing debris or IEDs to repairing bridges to dealing with flooded roads. For an HA mission, route clearance will be necessary to facilitate the transport of supplies to support the assistance provision mission, including food and other aid received from external donors for local populations and radios and other materials marines need to carry out their more specific responsibilities. The difficulty and extent of clearance activities will depend on the initial status of key roadways, the length of roadways, the types and number of obstacles that must be clear, and the level of security required. Area clearance may also be part of an HA mission, used to clear sites for the provision of assistance.

Establishing and Securing Sites for Assistance Provision

Before assistance can be provided, sites for aid provision must be established. The MEU is likely to work alongside NGOs and partner forces to establish sites for emergency or critical HA provisioning, and is unlikely to undertake extensive new construction. The demands of this task depend on the number of persons requiring assistance and the number of sites that must be established. The task may involve repairing existing buildings and facilities or using temporary shelters to house refugees and provide critical medical care, setting-up communication lines, and ensuring access to running water. It may also involve force protection and area security.

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[3] JP 3-29, 2014a; U.S. Agency for International Development, *Field Operations Guide for Disaster Assessment and Response*, Version 4, September 2005.

Providing Assistance and Restoring Critical Services

HA provisioning sites cannot function without medical supplies, food, water, and other essentials. Our interviews indicate that these supplies come from external sources (foreign donors and aid organizations), but that the marines are often involved in distribution of foreign food aid, bottled water, or medical supplies. As a result, cargo transport of these supplies is an important HA task, perhaps one of the most important during the HA mission. The demands associated with this task will depend on the weight that must be carried, the distance, the number of sites, and the time available. Importantly, MEU commanders do not consider the food and water provided to local populations as part of their planning considerations when preparing for an HA mission, as they are not taken out of the MEU's own supplies. The same is true of medical care. However, commanders may still be interested in the amount of food and water that will be required to assist local populations, since these amounts will directly affect the transport demands associated with the HA mission.

Although in extreme situations marines may carry out the assistance provision on their own, it is more likely that, as above, the MEU will support and work alongside NGOs, host-nation organizations, and partner forces. The defining characteristics of the HA mission will be the number of individuals requiring assistance, the types and extent of assistance that they require, and the time over which assistance must be provided. Assistance may be provided only in central locations or may be deployed to more remote sites. Types of emergency assistance that may be provided during an HA mission include medical care, food, water, shelter, and SAR operations. The MEU's central function in this phase of the mission will likely be transporting and distributing supplies, assisting in security operations, and providing emergency medical and other types of assistance. Vehicles for cargo transport and basic security operations, radios and other communication equipment, some medical equipment, and equipment able to produce potable water will be most important to these tasks. The cargo transported will include primarily foreign aid as well as the supplies marines need to assist in essential emergency rebuilding activities.

Assistance provision may also involve related SAR or evacuation operations, depending on the nature of the mission and disaster. For SAR operations, communication and personnel transport may be the most important types of equipment. In rare cases, NEOs may be required to remove U.S. citizens or citizens of allied nations from a dangerous or unstable situation. SAR operations and NEOs may overlap with the HA mission, but likely require their own mission plans. Although these overlapping missions may not always be involved in HA operations, where they are, they can have important resource implications. As a result, a planning tool, such as the MESA application, should incorporate and account for them.

A MEU involved in an HA mission may also assist in essential emergency reconstruction activities, including the restoration of essential services, such as water, electricity, and rule of law, until local institutions and forces are able to assume responsibility. The nature of the mission, the size of the population, and the duration of the operation will determine the equipment and personnel requirements as well as the demand for force protection and information operations. This phase of the HA mission is likely to be dominated by engineering activities, including well drilling, provision of potable water, clearing debris, and reestablishing basic utilities and public facilities. It may also involve training of local personnel to complete these tasks independently. However, while the marines may assist in the restoration of basic services, they are unlikely to use their own generators and other equipment intended for personnel sustainment to permanently restore power and water to local populations.[4]

Transition to Host-Nation Support

The final stage of the HA task is the transition to host-nation control. As described above, the goal of this phase in the HA mission is to restore local provision of key services, including not only electricity and water, but also law enforcement and governance.

[4] JP 3-29, 2014a; U.S. Agency for International Development, 2005.

Noncombatant Evacuation Operations

Joint Publication 3-68 describes a NEO as a mission "conducted to assist the Department of State (DoS) in evacuating U.S. citizens, Department of Defense (DoD) civilian personnel, and designated host nation (HN) and third country nationals whose lives are in danger from locations in a foreign nation to an appropriate safe haven."[5] Although normally considered in connection with hostile action, evacuation may also be conducted in anticipation of, or in response to, any natural or manmade disaster.[6]

The NEO mission begins with the development of a mission plan that incorporates the number of persons to evacuate, the medical and other critical needs of these individuals, the level of operational threat, the status of the existing infrastructure, and the presence of host-nation support. These same factors may also affect the establishment of the NEO command center(s). The first step in the NEO is to secure transport routes and evacuation sites, with a level of security that matches the external threat. The core of the NEO operation is the transport, processing, and evacuation of noncombatant personnel. NEO evacuations may include some emergency provision of food, water, shelter, and other comforts to evacuees while they await extraction. In hostile situations, force protection operations may be necessary. Table A.3 provides a brief description of the NEO mission tasks.

Mission Planning and Command Centers

A generic NEO mission begins with mission planning and the establishment of a command center that oversees its execution. The plan is shaped by a variety of factors, including the number of personnel to be evacuated, the geographic location, and the threat environment. A NEO mission will likely be shaped by political and diplomatic factors as well because the overall authority for a NEO rests with the senior U.S. government official, typically the U.S. Ambassador. In this context, it is essential for NEO mission planners to be familiar

[5] JP 3-68, 2007.

[6] JP 3-68, 2007, p. I-1.

Table A.3
NEO Tasks

Task	Description
Plan the mission	The mission plan defines the objectives and operational plan for the mission, including the key tasks and associated requirements, using surveillance and reconnaissance. Factors considered in the mission plan will include the threat level, terrain, nature and severity of disaster, presence of local support, likely scope and duration of the mission, numbers of people requiring assistance, and status of infrastructure.
Establish command center(s)	The command center(s) serve as the operational center for the missions, including setting up communication lines and planning logistics and intelligence operations.
Clear roads and areas	Prepare air or beach landing sites, create transport routes for supply or personnel, create sites for evacuation, equipment repair, or medical care, demine existing roadways, if needed.
Establish and secure evacuation, assembly, and other sites	This task involves moving security and evacuation forces to the assembly and evacuation site(s), establishing communications with the command center(s), securing sensitive or classified information or equipment, establishing force protection measures, securing routes to and between evacuation and assembly sites, and preparing these sites for evacuees.
Provide assistance at central sites or with mobile units	Depending on the scale and duration of the NEO mission, security and evacuation forces may have to establish locations to provide medical treatment, food and water, and/or hygiene and sleeping areas to evacuees or to other personnel involved in the NEO.
Deploy JTF main body	The JTF main body will initiate on-scene evacuation processes that may include moving forces to assembly and evacuation sites, conducting force protection operations, and processing noncombatants.
Transport and assemble evacuees	Evacuation forces move evacuees to the assembly and evacuation sites. In doing so, they account for and provide security for all personnel to be evacuated.
Evacuate noncombatants and extract military personnel	Evacuation forces provide security to noncombatants during the evacuation process as well as preparation of noncombatants for follow-on processing.

with embassy emergency action plans (EAPs) that outline the scope of specific evacuation operations, as well as available host-nation support capabilities.[7] U.S. forces conducting NEOs should also be familiar with the Department of State's Emergency Planning Handbook, which outlines procedures dealing with emergency contingencies, and the "F-77 Report," which identifies the numbers of potential evacuees at each embassy.[8]

Large NEO operations, such as Operation Frequent Wind—conducted in 1975 over the course of two days to evacuate nearly 7,000 American and Vietnamese citizens from Saigon—can be chaotic and may require extensive communication with nonmilitary personnel.[9] Other types of NEO operations may be long in duration, such as Operation Assured Response—conducted in Monrovia in 1996 over the span of eight days to evacuate nearly 2,500 noncombatants—and may involve numerous fixed and rotary wing aviation platforms.[10] The size, nature, and duration of the NEO mission therefore, affects the size, number, and capabilities of command centers and the command and control decisions relating to the establishment of intermediate staging bases or temporary safe havens.[11]

Specific subtasks during this stage of NEO missions can include conducting reconnaissance of the objective, assessing enemy disposition, inserting a forward command element, establishing lines of communication, and conducting force protection operations. In some situations, it may be necessary to insert a forward command element ahead of the main body evacuation force; however, in time-critical situations, the main body evacuation force may have to be inserted simultaneously with the forward command element.

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7 JP 3-68, 2007, pp. x–xi.

8 JP 3-68, 2007, pp. IV-1 and IV-6.

9 See George R. Dunham, *U.S. Marines in Vietnam: The Bitter End, 1973–1975 (Marine Corps Vietnam Operational Historical Series)*, Marine Corps Association, 1990.

10 See GlobalSecurity.org, "Operation Assured Response," undated.

11 JP 3-68, 2007, p. x.

Road and Area Clearance Operations

The evacuation of personnel from embassies and other locations requires that units move through the operating environment to set up sites for evacuation, assembly, or provision of humanitarian assistance. Area and road clearance facilitates the preparation of air or beach landing sites. It also creates transport routes for supply convoys or personnel (evacuees and marines), and facilitates the creation of evacuation sites, equipment repair facilities, and medical care sites. Clearance activities involve removing obstacles such as trees, rocks, or other debris from roadways or other areas, defusing IEDs and other potential threats, repairing roadways where necessary, and then securing roadways or assembly areas using force protection measures, such as establishing a perimeter or barriers. The clearance activities required will depend on the level of threat, the status of existing infrastructure, and the road-miles or area to be cleared.

Establish and Secure Assembly and Evacuation Sites

During this stage of a NEO operation, the security and evacuation forces move to the evacuation and assembly site(s); establish communications with the command center(s); secure sensitive information and property; establish defensive positions if required; secure routes to and between evacuation and assembly sites; and prepare these sites for evacuees. The latter may include the establishment of an evacuation control center.

Provide Assistance

Depending on the scale and duration of the NEO mission, security and evacuation forces may have to establish locations to provide medical treatment, food and water, and/or hygiene and sleeping areas to evacuees or to other personnel involved in the NEO. This task will likely be conducted by an evacuation site party but may also be conducted by the JTF main body depending on the threat environment.

Deploy JTF Main Body

For this task, the JTF main body initiates on-scene evacuation processes that may include moving forces to assembly an evacuation sites,

conducting force protection operations, and processing noncombatants. Depending on the size of the NEO operation, the JTF main body may consist of a headquarters element, a marshaling element, a security element, and possibly a special operations force.[12]

Assemble and Transport Evacuees

Prior to evacuating noncombatants by ground or by air transports, evacuation forces move evacuees to the assembly and evacuation sites. Although Department of State personnel are in charge of processing and screening noncombatants, the JTF main body can perform these functions if required. During this phase of a NEO mission, evacuation forces account for and provide security for all personnel to be evacuated. Situation permitting, all evacuees are screened for identification in preparation for movement to the United States or to another safe haven, such as a U.S. Navy ship or an intermediate staging base on foreign soil.[13]

Evacuate Noncombatants and Extract Military Personnel

The final stage of the NEO is to evacuate noncombatants and military personnel. Whether by air, ground, or sea transport, evacuation forces provide security to noncombatants during the evacuation process. They also integrate air support if necessary. Whether to an intermediate staging base, a temporary safe haven, a U.S. Navy ship, or U.S. soil, evacuation forces, in conjunction with Department of State personnel, also prepare noncombatants for follow-on processing.

Tactical Recovery of Aircraft and Personnel[14]

A Tactical Recovery of Aircraft and Personnel (TRAP) is performed for the specific purpose of the recovery of personnel, equipment, and/or

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[12] JP 3-68, 2007, p. xiii.

[13] JP 3-68, 2007, p. xiv.

[14] NAVMC 3500.44, 2008b; OPNAVINST 3500.38B/MCO 3500.26B/USCG COMDTINST 3500.1B, 2010; FM 3-0, 2011.

aircraft. A TRAP is conducted to locate and extract distressed personnel and sensitive equipment from enemy controlled area during wartime or contingency operations to prevent capture."[15]

The TRAP mission begins with planning and the creation of the command center. The mission plan defines the level of external threat, the number of personnel or pieces of equipment to recover, and environmental factors, such as the status of existing infrastructure, the terrain, and support from local forces that may affect mission execution. The TRAP command center is likely remotely located. The primary task of the TRAP is to recover and extract personnel or equipment onboard or apart from fallen aircraft. The insertion or the TRAP team may involve air, ground, or sea operations. Clearance operations to eliminate mines and other threats, similar to those already defined, may be required once the team is on the ground and as it moves toward isolated personnel and equipment. Once the TRAP team reaches the rescue site, it performs force protection and civil control operations, performs maintenance or disassembly operations on equipment, and provides medical care to personnel. The TRAP is completed with the extraction of personnel and equipment, an operation described above. The TRAP is supported by intelligence and surveillance, information operations, and force protection.[16] Table A.4 records descriptions of the major tasks supporting the TRAP mission.

Mission Planning and Command Centers

A typical TRAP mission begins with mission planning and the establishment of a command center that oversees its execution. According to the Universal Naval Task List, a TRAP mission "is a subcomponent of combat search and rescue (CSAR) and/or joint combat search and rescue (JCSAR) missions."[17] Thus, the TRAP mission planning is likely to be conducted in accordance with ongoing SAR principles. Given

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[15] MCO 3120.9C, 2009.

[16] NAVMC 3500.44, 2008b; OPNAVINST 3500.38B/MCO 3500.26B/USCG COMDTINST 3500.1B, 2010; FM 3-0, 2011; JP 3-68, 2007.

[17] OPNAV Instruction 3500.38B/Marine Corps Order 3500.26A/U.S. Coast Guard Commandant Instruction 3500.1B, *Universal Naval Task List Version 3.0*, January 2007;

Table A.4
TRAP Tasks

Task	Description
Plan the mission	The mission plan defines the objectives and operational plan for the mission, including the key tasks and associated requirements, using surveillance and reconnaissance. The location of survivors is required and will be a key component of intelligence operations during the planning phase.
Establish command center(s)	The command center(s) serve as the operational center for the missions, including setting up communication lines and planning logistics and intelligence operations.
Clear roads and areas	Moving from the ARG to aerial or beach landing sites initiates the execution phase of a TRAP operation. A TRAP task force provides sufficient security for landing sites and routes to and from the recovery site.
Establish and secure evacuation, assembly, and other sites	This task involves moving security and recovery forces to the assembly and evacuation site(s), establishing communications with the command center(s), securing sensitive or classified information or equipment, establishing force protection measures, securing routes to and between evacuation and assembly sites, and preparing these sites for evacuees.
Provide assistance at central sites or with mobile units.	Depending on the scale and duration of the TRAP mission and the threat environment, the TRAP task force may have to establish locations to provide medical treatment, food and water, and/or hygiene and sleeping areas to evacuees or to other personnel involved in the TRAP.
Reach and secure recovery site	If the terrain or threat environment does not allow the TRAP task force to move directly to the recovery site, the ground combat element will occupy and defend the recovery site before recovery operations can start.
Recover personnel and aircraft	This task is highly dependent on the characteristics of the personnel and aircraft to be recovered, but could include providing medical assistance, and this task is a major driver of what equipment is required for a successful mission.
Evacuate noncombatants and extract military personnel	Physically move personnel and equipment from the recovery site to a safe location where follow-on transportation, medical aid, and debriefing can be provided.

Marine Corps Task 6.2.1, *Conduct Assault Support [Tactical Recovery of Aircraft and Personnel (TRAP)] Operations*, January 30, 2007.

the time-sensitive nature of recovering downed aircraft and personnel, the Rapid Response Planning Process (R2P2) is utilized to ensure that MEU components begin executing the mission as soon as possible. In addition to the SAR inputs and typical R2P2 planning considerations, such as enemy capabilities and terrain, TRAP mission planning will also take into account some unique planning factors. For example, the number of personnel to be recovered, known or suspected casualties, ability to communicate with downed personnel, the training and capabilities of downed personnel, and whether or not personnel are on the move or in place at the crash site all affect what scheme of maneuver and units are chosen to execute the mission. Aircraft personnel would have likely briefed evasion and rescue plans prior to their flight, which would also be an important input for TRAP planning, particularly in cases in which there are no communications with downed personnel.

The size and nature of the TRAP mission also affects the establishment of the command center(s) and whether they will be forward-deployed or remain onboard the ARG ships, by determining the number of sites requiring command centers and the command capabilities needed at each site. A forward command element requires appropriate levels of force protection given the threat environment. In either case, the command element coordinates a number of ISR assets in order to further develop the situation and provide updates as the planning is completed and the mission is executed.

Establish and Secure Evacuation, Assembly, and Other Sites

The execution phase of a TRAP mission begins with the initial movement of forces from the ships of the ARG to a position near or at the recovery site. Helicopter landing zones, beach landing sites, and overland routes are monitored by ISR assets and supported through the use of indirect, aerial, and naval fires. If transportation over land is a part of the scheme of maneuver, removing or avoiding obstacles and clearing threats is planned for as well. Large civilian populations are avoided whenever possible. However, if this is not an option due to the geographic location of personnel and equipment to be recovered, the ground combat element task force conducting the TRAP mission

should be prepared to interact with and, where necessary, control civilian populations.

Provide Assistance

Depending on the scale and duration of the TRAP mission and the threat environment, the TRAP task force may have to establish locations to provide medical treatment, food and water, and/or hygiene and sleeping areas to evacuees or to other personnel involved in the TRAP.

Reach and Secure Recovery Site

The composition of the ground combat element and the method of moving to the recovery site(s) is dependent on the level of threat in the objective area. A sophisticated enemy with adept anti-air capabilities can drive the need for a ground mobile, clandestine approach, whereas a relatively low-threat environment and amiable terrain may allow helicopters to land directly at the recovery site(s). Regardless of the equipment and techniques used to move there, the recovery team must eventually occupy the recovery site(s) and provide local security. The strength of the needed defense is dependent on enemy capabilities and disposition in the area, and the length of time required will ultimately be driven by the amount of personnel and equipment to be recovered and methods of extraction.

Recover Personnel and Aircraft

If the ability exists, communications with personnel to be recovered during mission planning will assist in preparing the appropriate recovery methods and capabilities to bring to the recovery site. Sensitive materials, equipment, and aircraft can create additional transportation and lift requirements. While MCWP 3-24, *Assault Support*, states that "TRAP missions are conducted only when survivors and their locations are confirmed," it is possible that locations of all sensitive materials/equipment will not be known.[18] The TRAP task force is prepared to search for materials/equipment that was geographically distributed

[18] Headquarters, U.S. Marine Corps, *Assault Support*, Marine Corps Warfighting Publication 3-24, May 2004.

from personnel, particularly if the personnel were required to move away from the aircraft. Additionally, time and available forces and equipment may require the TRAP task force to destroy sensitive items that they are not able to physically extract.

Extract Personnel and Equipment

Finally, the TRAP task force extracts personnel and equipment, including the ground combat element component of the task force that carried out the mission. The movement can be conducted by any combination of air, sea, and land methods. Recovered personnel and equipment may be taken to nearby friendly positions, to the ships of the ARG, or other facilities where follow-on transportation of the recovered assets can be coordinated. The mission is considered completed upon return of the TRAP task force to the MEU.

Airfield and Port Seizure Operations[19]

The airfield/port seizure mission is described in Marine Corps Order 3120.9C as:

> Secure an airfield, port or other key facilities in order to support Marine Air Ground Task Force (MAGTF) missions, receive follow-on forces or enable the introduction of follow-on forces.[20]

Like other missions, the airfield/port seizure begins with mission planning and the establishment of a command center. The mission plan for this operation defines the specific objective and end states, the mode of transport, local conditions, operational environment, weather, terrain, and the threat level. The command center may remain on the ARG or be forward-deployed, depending on the commander's assessment of the situation.

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[19] NAVMC 3500.44, 2008b; MCO 3120.9C, 2009; OPNAVINST 3500.38B/MCO 3500.26B/USCG COMDTINST 3500.1B, 2010.

[20] MCO 3120.9C, 2009.

The core task is the actual seizure of the key facility (i.e., airfield or port). The execution phase of the mission begins with a covert movement of a deployed unit to the site either by air, land, or sea. An overt movement in a hostile environment would likely require maneuver to be supported by a variety of land, air, and naval fires. The seizure requires offensive operations to eliminate adversary targets, gain control of key assets, and secure key access points. The seizure operation itself, along with the level of required force protection immediately afterward, is affected by the area or number of facilities that must be secured, the size of the local population, the need for civil control operations, and the number of insurgents or adversary forces. Once seized, the airfield or port can be used for additional operations until control is turned over to other forces or the host nation and USMC forces retrograde from the objective area. Table A.5 records descriptions of the tasks associated with the airfield and ports seizure operations.

Mission Planning and Command Centers

A typical airfield/port seizure mission begins with mission planning and the establishment of a command center that oversees its execution. Mission planning follows the Marine Corps Planning Process and the Rapid Response Planning Process (R2P2) in cases that involve short timelines from receipt of mission to execution. In the case of an airfield/port seizure mission, the plan will be shaped by mission specific factors. These include the size and composition of the airfield/port facilities and what commercial and noncombatant presence and activity is in the area. Another important consideration is the level of facility capacity that will be required after the seizure. For example, an airfield that is seized in order to facilitate its use by friendly forces soon afterward requires more disciplined use of supporting fires than if the end state was simply to deny an enemy from using the facility. Each of these factors, in addition to enemy capabilities and disposition, the terrain, and time available, shape the operational scheme of maneuver and equipment needed.

The size and nature of the airfield/port seizure mission affects the establishment of the command center(s), by determining the number of sites requiring command centers and the command capabilities

Table A.5
Airfield and Port Seizure Operations Tasks

Task	Description
Plan the mission	The mission plan defines the objectives and operational plan for the mission including the key tasks and coordinating instructions for elements of the MEU that will execute the operation. Mission planning consists of the standard Marine Corps Planning Process, while additional considerations are made specific to the seizure mission.
Establish command center(s)	The command center(s) serve as the operational center for the missions, including setting up communication lines and planning logistics and intelligence operations. It may be necessary for a command center to transfer between units and locations depending on the phase of the seizure operation.
Establish and secure evacuation, assembly, and other sites	This task involves moving forces to different sites that may be needed to establish communications with the command center(s), secure sensitive or classified information or equipment, establish force protection measures, and secure routes.
Provide assistance at central sites or with mobile units	Depending on the scale and duration of the airfield/port seizure mission and the threat environment, marines may have to establish locations to provide medical treatment, food and water, hygiene and sleeping areas, and ammunition resupply to personnel involved in the airfield/port seizure and to potential noncombatants affected by the mission.
Seize and secure airfield or port	This task includes the actions of moving forces to the facility, seizing and occupying the objective area, and establishing defensive positions. This task generates the most requirements for offensive operations, supporting fires, and continuous force protection measures.
Conduct follow-on operations	Follow-on tasks can include a variety of actions but consist primarily of evacuating casualties, conducting resupply operations, and improving facilities for future use. If the operation's end state is to facilitate friendly use of airfield/port infrastructure, these improvements or preparations are planned for at the outset of the seizure operation.

needed at each site. It is also possible to transfer the location and unit in command after the airfield/port is seized.

Establish and Secure Evacuation, Assembly, and Other Sites

This task involves moving forces to different sites that may be needed to establish communications with the command center(s), secure sensi-

tive or classified information or equipment, establish force protection measures, and secure routes.

Provide Assistance

Depending on the scale and duration of the airfield/port seizure mission and the threat environment, marines may have to establish locations to provide medical treatment, food and water, hygiene and sleeping areas, and ammunition resupply to personnel involved in the airfield/port seizure and to noncombatants affected by the mission. This could happen at various sites depending on the scope of the mission.

Seize and Secure Airfield or Port

Successful accomplishment of this task depends on the actual seizure of the identified airfield or port. The Universal Naval Task List defines the Marine Corps task of conducting airfield seizure operations as "[the] conduct [of] offensive operations to seize, occupy and defend an airfield for use by friendly forces as an APOD [Aerial Port Of Debarkation]."[21] During this task, USMC forces are required to move from the ships of the ARG or another assault position to the objective area. This movement may be conducted via air, land, sea, or some combination and could be accompanied by supporting fires as required. It is specified within the definition that once at the objective, marines will occupy the facility, and this may require offensive operations.

Inherent to the seizure of an area is the requirement to defend the area and friendly forces once it is captured. An airfield or port may present unique challenges to providing force protection, as facilities may be distributed and/or near population centers. Airfields and ports are also likely to have well-established avenues of approach, such as waterways and developed roads, that allow quick reaction by enemy reinforcements and facilitate the movement of larger, more capable mobile platforms, such as armored vehicles and tanks. If an airfield/port is identified by the MEU or other authority as being tactically or operationally significant enough to seize, it is assumed that adversary

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[21] OPNAVINST 3500.38B/MCO 3500.26A/USCG COMDTINST 3500.1B, 2007; Marine Corps Task 1.6.5.6, *Conduct Airfield Seizure Operations,* January 30, 2007.

commanders have also identified the facility as key terrain. As such, adversary forces would likely have plans not only to defend the area but also to reinforce, attack, or simply harass through preplanned fires if and when the facility is seized by marines.

Conduct Follow-On Operations

Upon the initial seizure of an airfield or port and the establishment of force protection and defensive measures, there are a number of potential follow-on tasks that may be required. One of the first requirements is to identify, assist, and potentially evacuate casualties. Casualties from friendly, enemy, and civilian groups are planned for, so medical treatment and casualty evacuations can begin as soon as possible during the seizure operation. Unless the airfield/port is a purely military facility, it is likely that there will be at least some civilian presence. If controlling civilian populations is anticipated, facilities on the ground need to be augmented with personnel and equipment brought by the MEU forces. Information operations may also be a part of marine interactions with civilians that could create unique equipment requirements.

If the airfield/port is to be utilized by friendly forces as military ports of debarkation, it is possible that improvements would be required following any offensive actions taken to seize and occupy the area. Such improvements span a wide range of engineering tasks, from the removal of debris from landing strips to repairing fueling infrastructure to underwater construction. Depending on the complexity of the engineering requirements, other forces and supplies need to be transported to the airfield/port once it is occupied and controlled by initial friendly forces. Once the airfield/port is operational or other more limited objectives have been achieved (such as the denial of use by adversary forces), the USMC will have to either turn over facility operations to other forces or host-nation control. The movement of personnel and equipment off of the objective and back to the ARG or other positions for future missions marks the end of the airfield/port seizure operation.

Stability Operations[22]

> Stability Operations encompass various military missions, tasks, and activities conducted outside the United States in coordination with other instruments of national power to maintain or reestablish a safe and secure environment, provide essential governmental services, emergency infrastructure reconstruction, and humanitarian relief.[23]

Stability operations involve mission planning and establishing a command center, both shaped by the level of external threat, its location, types of activities required, the presence of local support or coalition forces, the status of current economic and political systems, and the weather and terrain associated with the area of operation. There may be multiple large or small command centers. The existence of several command centers is especially likely if the mission involves many different activities and covers a large area. The main tasks of the stability operation mission will be to establish and maintain basic law and order and to provide physical security for the local population. This may involve enforcing a ceasefire, assisting in disarmament or demobilization, aiding local security forces, and supporting border security. Intelligence, psychological, and information operations are often part of stability operations. Stability operations may occur alongside many other missions, such as HA, FID, and NEOs. Table A.6 records descriptions of the tasks associated with the stability operations mission.

Mission Planning and Command Centers

No two stability operations missions may be alike, but as with all MEU missions, a generic stability operations mission begins with mission planning and the establishment of a command center that oversees its execution. Mission planning follows the Marine Corps Planning Process and the Rapid Response Planning Process (R2P2) in

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[22] U.S. Joint Chiefs of Staff, *Stability Operations*, Joint Publication 3-0, Washington, D.C., August 11, 2011; JP 3-24, 2009; NAVMC 3500.44, 2008b; MCO 3120.9C, 2009; OPNAVINST 3500.38B/MCO 3500.26B/USCG COMDTINST 3500.1B, 2010.

[23] JP 3-0, 2011.

Table A.6
Stability Operations Tasks

Task	Description
Plan the mission	The mission plan defines the objectives and operational plan for the mission, including the key tasks and associated requirements, using surveillance and reconnaissance. Factors considered in the mission plan will include the threat level, terrain, nature and severity of disaster, presence of local support, likely scope and duration of the mission, numbers of people requiring assistance, and status of infrastructure.
Establish command center(s)	The command center(s) serve as the operational center for the missions, including setting up communication lines and planning logistics and intelligence operations.
Conduct marine resupply	This task can be broken down into four subtasks: delivering water, fuel, food, and ammunition to marines conducting stability operations.
Restore and maintain civil society	This task can be broken down into six subtasks: enforcing cessation of hostilities, eliminating remaining threats, ensuring security and freedom of movement, protecting key personnel and facilities, conducting intelligence and psychological ops, and conducting civil-military operations.
Provide assistance at central sites or with mobile units	This task can be broken down into six subtasks: securing aid provision sites; providing food, water, medical care, and shelter; providing power, water, and sanitation; restoring civil security; rebuilding local infrastructure; and restoring local provision of services.
Transition to host-nation control	This task includes four subtasks: restoring local provision of essential services; training local security forces for new responsibilities; supporting new elections and returning to local governance; and continuing civil-military operations.
Support economic stabilization	This task includes four subtasks: establishing transportation and communication networks; ensuring provision of basic services; rebuilding and securing financial and business infrastructure; and maintaining political stability and rule of law.
Plan for transition of operations to follow-on military unit or civilian authority	This task includes four subtasks: conducting security force assistance; building host-nation capacity to protect military infrastructure; establishing, bolstering, or reforming defense institutions; and establishing disarmament, demobilization, and/or reintegration programs

cases that involve short timelines from receipt of mission to execution. In the case of a stability operations mission, the plan will be shaped by mission specific factors. These include the threat environment; the degree of reconstruction efforts needed; the capabilities and capacities of host-nation security forces; the capabilities and capacities of host-nation security institutions; the perceived legitimacy of the host-nation national, regional, and local governments; the capabilities and capacities of U.S. civilian agencies to conduct reconstruction or stabilization operations; and the capabilities and capacities of other U.S. military services to conduct reconstruction or stabilization operations.

Conduct Ongoing Resupply Operations for Marines

Unlike other MEU missions that are likely to be discrete and shorter in duration, stability operations missions tend to longer in duration. A MEU operating by itself in an area of responsibility for longer than 15 days will require external logistical support. Nonetheless, resupply operations for marines during these missions will likely be continuous, which is why for this mission, it is a dedicated task.

Restore and Maintain Civil Society

A MEU involved in a stability operations mission may be required to restore and maintain civil society. This could necessitate that marines enforce cessation of hostilities; eliminate remaining threats; ensure security and freedom of movement; protect key personnel and facilities; conduct intelligence and psychological operations; and conduct other civil-military operations.

Provide Humanitarian Assistance

Stability operations may necessitate that marines secure aid provision sites, provide food, water, medical care, and shelter; provide power, water, and sanitation; restore civil security; rebuild local infrastructure; and restore local provision of services. During this phase of a stability operation, marines may be called to perform these humanitarian assistance and reconstruction activities until local institutions and forces are able to assume responsibility. The nature of the mission, the size of the population, and the duration of the operation will determine the

equipment and personnel requirements as well as the demand for force protection and information operations.

Reestablish Civil Control and Local Governance

This task may include restoring essential services; training local security forces for new responsibilities; supporting new elections and returning to local governance; and continuing civil-military operations.

Encourage Economic Stabilization

This task may require marines to establish transportation and communication networks; ensure provision of basic services; rebuild and secure financial and business infrastructure; and maintain political stability and rule of law. This phase of the stability operations mission could be dominated by engineering activities, including well drilling, provision of potable water, clearing debris, and reestablishing basic utilities and public facilities. Like other stability operations tasks, it may also involve training of local personnel to complete these tasks independently.

Plan for Transition of Operations to Follow-On Military Unit or Civilian Authority

The final stage of the stability operation is the transition of security, economic, and governance responsibilities to a follow-on military unit or the appropriate civilian authority, whether it be a U.S. civilian agency, an international organization, or the host nation. This task could include conducting security force assistance; building host-nation capacity to protect military infrastructure; establishing, bolstering, or reforming defense institutions; and establishing disarmament, demobilization, and/or reintegration programs.

Amphibious Raid

> Raids are operations to temporarily seize an area, usually through forcible entry, in order to secure information, confuse an adversary, capture personnel or equipment, or destroy an objective or

> capability (e.g., Operation URGENT FURY, Grenada 1983, to protect US citizens and restore the lawful government). Raids end with a planned withdrawal upon completion of the assigned mission.[24]

An amphibious raid may share many similar aspects with a NEO that is conducted in uncertain or hostile environments such as a "swift insertion of a force, temporary occupation of physical objectives, and [ending] with a planned withdrawal."[25] Further, the inclusion of a planned withdrawal is the prime characteristic that distinguishes a raid from an amphibious assault, which could also include similar tasks. Table A.7 records descriptions of the tasks associated with the amphibious raid mission.

Mission Planning and Command Centers

As with all MEU missions, an amphibious raid mission begins with mission planning and the establishment of a command center that oversees its execution. Mission planning follows the Marine Corps Planning Process and the Rapid Response Planning Process (R2P2) in cases that involve short timelines from receipt of mission to execution. In the case of raid missions, the plan will be shaped by mission specific factors, such as threat environment and the role the raid may play in a larger set of operations. It is possible that given the short duration of any given raid it may not prove practical to establish a temporary command center outside of the ARG, but the task is kept as a part of the raid mission as it may be necessary in some circumstances.

Embark the Force

A raid force may travel through a combination of ground vehicles, aircraft, and surface connectors. Preparing and loading these methods of transportation must be conducted in a deliberate and well-planned method in order to be capable of conducting the quick actions on the objective that are often required of a raid mission. The subtask of con-

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[24] JP 3-0, 2011.

[25] JP 3-0, 2011.

Table A.7
Amphibious Raid Tasks

Task	Description
Plan the mission	The mission plan defines the objectives and operational plan for the mission, including the key tasks and associated requirements, using surveillance and reconnaissance. Factors considered in the mission plan will include the threat level, terrain, nature and severity of disaster, presence of local support, likely scope and duration of the mission, numbers of people requiring assistance, and status of infrastructure.
Establish command center(s)	The command center(s) serve as the operational center for the missions, including setting up communication lines and planning logistics and intelligence operations.
Embark the force	The embarkation task includes subtasks such as preparing and loading vehicles, boats, and aircraft.
Move to objective	The movement to objective task includes all required transportation and associated logistics, force protection, and coordination subtasks required to arrive at the stated objective.
Conduct raid actions	Within this task are any subtasks that primarily define the raid mission itself. These could be to capture or kill enemy combatants, conduct harassing activities, collect information, or a number of other possible objectives.
Conduct withdrawal	This final task includes the consolidation of forces and movement back to the ships of the ARG.

ducting intelligence and information operations is also included during this period, as other MEU assets may be employed during this period just prior to the raid force moving to its objective.

Move to Objective

The primary subtasks within this task include the options of moving from ship to shore, from shore to objective, and from ship to objective. Depending on the terrain, enemy situation, and available equipment, a raid force may move directly to the objective via aircraft instead of establishing a beach landing site. The provision of providing fires is also included as an option during this movement task. While it may not always be necessary, some conditions may warrant the use of ground,

air, and/or naval fire support to provide protection for the raid force as it moves to its objective.

Conduct Raid Actions

The specific actions of any given raid include a diverse list of possible activities. An amphibious raid could be charged with destroying targets, killing enemy combatants, collecting information for intelligence purposes, evacuating personnel, or conducting harassment or feint activities. Regardless of what the specific actions are on the objective, this period may include a large commitment of equipment items for the purposes of force protection, logistical sustainment, and maintaining communications. Thus these are each included as separate subtasks of the conducting raid actions task.

Conduct Withdrawal

The planned withdrawal is a distinguishing characteristic of any raid. As with the movement to the objective, the raid force may choose to consolidate at a designated space prior to moving back to the ARG or move directly back to the ships. This option will be largely constrained by available equipment, such as aircraft and surface connectors, as well as the threat environment. Again, the potential for employing air, ground, and naval fire support is present during this period and is included as a subtask.

Quick Reaction Forces

MEUs commonly maintain several types of Quick Reaction Forces (QRF) to provide a rapid means of providing additional support during mission execution. These forces exist in several preplanned "packages" in order to allow them to train together prior to deployment and to ensure their effectiveness if called upon, once deployed. Packages are designed to respond by helicopter or via surface craft and come in company/bald eagle- or platoon/sparrowhawk-sized elements.[26] The

[26] These code names refer to varying sizes of QRF packages.

personnel and equipment allocated to these QRFs are up to the discretion of the commander. Both personnel and equipment allocated to the QRF is "fenced off" or taken out of the list of equipment available for supporting other missions. For example, if a MEU is planning an amphibious raid, the commander may choose to designate a surface sparrowhawk package as the QRF. The sparrowhawk package may be allocated four AAVs. Consequently, those four AAVs would no longer be available to the raid force. The MESA application allows for developing and entering QRF packages, and it automatically fences them off before moving into planning the primary mission.

Deconstruction Summaries

The following nine missions are discussed briefly. The tasks associated with each appear in Table A.1. These tasks are also included in the MESA application, though the missions are not yet fully operational.

Foreign Internal Defense

FID is defined by the Marine Corps Order 3120.9C as the following:

> Participation by civilian and military agencies of a government in any of the action programs taken by another government or other designated organization to free and protect its society from subversion, lawlessness and insurgency.

The FID operation begins with mission planning and the creation of a command center (or centers), activities shaped by the operational environment, the extent and type of assistance needed, the contribution of partner nations, and the capabilities of the host nation. Activities such as communications, intelligence, and logistics support will operate through the command center. Many FID operations and their command centers are joint or have support from partner nations. The core of the FID mission is the provision of security assistance to the local nation; for example, training provided to local security and law enforcement organizations or more direct involvement in security operations at key local assets (i.e., government buildings, police stations).

The extent of security assistance needed will depend on the external threat and the baseline capabilities of the host-nation security forces. FID operations promote rule of law and often require civil control, force protection, and law enforcement operations such as arrests and detentions. FID missions may also include civil-military operations, such as humanitarian assistance, repairing local infrastructure, public affairs, and psychological operations.

Special Reconnaissance

Special reconnaissance (SR) is defined by Marine Corps Order 3120.9C as follows:

> Reconnaissance and surveillance conducted as a special operation in hostile, denied, or politically sensitive environments to collect or verify information of strategic or operational significance, employing military capabilities not normally found in conventional forces. These actions provide an additive capability for [the] commander and supplement other conventional reconnaissance and surveillance actions.

Special reconnaissance is used primarily to gather detailed intelligence on a specific target area in the lead up to a raid, assault, or targeted strike. The special reconnaissance mission begins with a planning phase that is informed by the mission objective, the conditions on the ground, the operational environment, and the threat level. Since special reconnaissance missions typically involve short-term deployments, often into hostile areas, the command center will most likely be remotely based and involved in intelligence operations and secure communications.

The core of the special reconnaissance mission involves reconnaissance collection. However, the special reconnaissance mission involves unconventional tactics in hostile environments, and short-term deployment of covert teams with specific intelligence-collection objectives.

Advance Force Operations[27]

Advance force operations prepare an operational area for more substantial force maneuvers.[28] Advance force operations involve reconnaissance, seizure of supporting positions, mine countermeasures, preliminary bombardment, underwater demolitions, and air support.

The advance force operations mission begins with planning and the creation of a command center, both shaped by the nature and objective of follow-on operations, the level of external threat, and environmental factors. The command center is likely to be small and established by reconnaissance teams as a hub or rendezvous point. The primary task of the advance force operation is to prepare for the main assault or landing through the collection of specific intelligence and the elimination of adversary threats. Advance force operations will also involve more specific activities to prepare the landing areas and transport routes, such as eliminating IEDs, removing obstacles and clearing assembly areas, and neutralizing adversary resistance, in the form of weapons or personnel. Finally, shaping operations, including the development of fire support, evacuation, and tactical deception plans and psychological operations, may be used to create a local context that supports operational goals.

Direct Action Operations[29]

Direct action operations include short-duration strikes and other small-scale offensive actions conducted using special operations tactics, often in hostile, denied, or politically sensitive environments. Direct action operations employ specialized military capabilities to seize, destroy, capture, exploit, recover, or damage designated targets.

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[27] NAVMC 3500.44, 2008b; MCO 3120.9C, 2009; OPNAVINST 3500.38B/MCO 3500.26B/USCG COMDTINST 3500.1B, 2010; U.S. Joint Chiefs of Staff, *Joint Tactics, Techniques, and Procedures for Landing Force*, Joint Publication 3-02.1, Washington, D.C., May 11, 2004.

[28] U.S. Joint Chiefs of Staff, *Amphibious Embarkation and Debarkation*, Joint Publication 3-02.1, Washington, D.C., November 30, 2010.

[29] Headquarters, U.S. Marine Corps, *Reconnaissance (Recon) Training and Readiness (T&R) Manual*, Navy/Marine Corps (NAVMC) 3500.55B, Washington, D.C., May 20, 2013.

Direct action operations, like other missions, involve planning and setting up a command center. The mission plan of the direct action operation will define the specific mission objective and incorporate the environmental conditions, the level of threat, status of internal infrastructure, presence of local support, and type of missions the operations supported. Since most of these types of operations involve short-term deployments, the command center is likely to be small and located remotely. Direct action operations include recovery of personnel or material, emplacing mines or munitions, direct raids, and strikes on adversary target. Direct action operations are likely to be covert and involve some risk of hostile interaction with adversary forces. Preparatory fires; neutralizing chemical, biological, radiological, nuclear and high-yield explosives (CBRNE); and force protection may be required during a direct action mission.

Aviation Operations from Expeditionary Shore-Based Sites[30]

Marine aviation units maintain the capability to operate from expeditionary shore-based sites (in line with unit/platform capabilities), including forward operating bases, expeditionary airfields, forward arming and refueling points, austere forward operating sites, tactical landing zones, and helicopter landing zones.[31]

Aviation operations begin with mission planning and establishing the command center. The mission plan must incorporate the level of operational threat, the types of aviation operations required, and other associated missions that aviation operations may support. The command center is likely to support both the aviation operations and the larger missions with which the aviation mission is associated. Aviation operations are used mainly to conduct air reconnaissance; to offer logistical support to ground forces; to transport equipment, supplies, and personnel; and to evacuate deployed forces, injured personnel,

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[30] NAVMC 3500.44, 2008b; MCO 3120.9C, 2009; OPNAVINST 3500.38B/MCO 3500.26B/USCG COMDTINST 3500.1B, 2010; Headquarters, U.S. Marine Corps, *Aviation Operations*, Marine Corps Warfighting Publication 3-2, Washington, D.C., May 9, 2000.

[31] Marine Corps Task 1.3.3.3.2, *Conduct Aviation Operations from Expeditionary Shore-Based Sites*, December 1, 2014.

and noncombatants. In addition to support functions, aviation operations also include anti-air and interdiction operations used to protect air space and enforce no-fly zones. They may also involve active and passive defense, and offensive operations or strikes against adversary targets. Finally, aviation operations often provide support for assault operations, either for battlefield illumination or transport, delivery, and evacuation of deployed forces, personnel, injured, noncombatants, and equipment.

Maritime Interdiction[32]

Maritime interdiction operations are defined as "naval conducted operations that aim to delay, disrupt, or destroy enemy forces or supplies en route to the battle area before they do any harm against friendly forces."[33] They may include counternarcotics or countersmuggling activities as well as efforts to stop piracy or sea-borne terrorist attacks.

The maritime interdiction operation begins with mission planning. The mission plan in this case may identify target ships to be stopped and searched, the expected level of threat, areas to be covered in a blockade, or specific types of cargo that are of high interest. The command center for the maritime interdiction is likely to be located remotely, on a USMC vessel or amphibious craft.

The interdiction will involve three key tasks. First, the area of operations needs to be secured. In the case of a blockade, securing the area of operations amounts to setting the boundary for the operation, the line at which advancing ships will be stopped. In the case of a board-and-search operation, securing the area of operations means establishing positions from which the target ship can be boarded. Maritime interdiction operations next involve securing, boarding, and searching ships, both to seize smuggled or illegal goods and to prevent prohibited items from passing through a blockade. During this phase, USMC personnel inspect and document the cargo on the ship, seize contraband, make necessary arrests or detentions (alien migration),

[32] NAVMC 3500.44, 2008b; MCO 3120.9C, 2009; OPNAVINST 3500.38B/MCO 3500.26B/USCG COMDTINST 3500.1B, 2010.

[33] JP 1-02, 2014c.

and interview important crewmembers. The interdiction operation may conclude with marines escorting the target vessel to the nearest port, especially if the ship is found to have contraband or to be involved in illegal transport. Once the ship reaches port, however, the operation is most likely turned over to the local police or law enforcement. Factors such as the type of cargo, level of threat from target vessel, and the number of ships to be secured will very much affect how the interdiction operation unfolds.

Security Cooperation[34]

The DoD dictionary of military and related terms defines security cooperation as including

> [All] Department of Defense interactions with foreign defense establishments to build defense relationships that promote specific U.S. security interests, develop allied and friendly military capabilities for self-defense and multinational operations, and provide US forces with peacetime and contingency access to a host nation.[35]

Security cooperation missions can include a range of activities, from humanitarian assistance to joint training exercises to counternarcotics operations to military exchanges for officers of foreign nations. Security cooperation missions begin with a mission plan that outlines the key goals of the mission and the types of activities involved; identifies the level of external threat, the level of support provided by local forces, and the status of existing infrastructure. The command center for a security cooperation is likely to be a combined one with members of the host nation integrated into the U.S. team. Depending on the

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[34] NAVMC 3500.44, 2008b; MCO 3120.9C, 2009; OPNAVINST 3500.38B/MCO 3500.26B/USCG COMDTINST 3500.1B, 2010; Headquarters, U.S. Department of the Army, *Multiservice Tactics, Techniques, and Procedures for NBC Protection*, Field Manual 3-11.4, Washington, D.C., June 2003; U.S. Joint Chiefs of Staff, *Public Affairs*, Joint Publication 3-61, Washington, D.C., August 25, 2010c; U.S. Joint Chiefs of Staff, *Peace Operations*, Joint Publication 3-07.3, Washington, D.C., August 1, 2010a.

[35] JP 1-02, 2014c.

number of activities involved and their locations, there may be multiple command centers.

Security cooperation operations include many tasks and activities, the common thread being that they involve U.S. military personnel working alongside, assisting, and training personnel from the host nation or nations. The most straightforward forms of theater security cooperation include joint military training and exercises in which U.S. and foreign militaries train together to improve interoperability and prepare for potential or future international security challenges. International Military Education and Training (IMET), in which foreign military officers travel to the United States to attend education and training programs, as well as financial assistance provided to support training in partner nations and to finance weapons purchases, are also considered a type of security cooperation.[36] Other theater security cooperation activities focus on improving interoperability for future operations. These include armaments cooperation and intelligence sharing. Security cooperation can also involve direct interaction between U.S. forces and the local population, including operations such as humanitarian assistance and public affairs.

Finally, there are security cooperation activities in which U.S. personnel work with foreign militaries to address an international security challenge. Counternarcotic or counterdrug operations include activities to detect, interdict, or eliminate the cultivation, processing, transport, or sale of illegal drugs. Counter- and nonproliferation activities include interdiction; offensive operations to eliminate WMD threats or disrupt the transfer of WMD technologies; active and passive defensive operations to neutralize WMD threats and minimize their effects; security operations to ensure safety of exiting CBRNE facilities; and consequence management to conduct decontamination and provide medical care when needed.[37]

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[36] See Defense Security Cooperation Agency, *Guidelines for Foreign Military Financing of Direct Commercial Contracts*, August 2009, for additional information about financial assistance programs.

[37] FM 3-11.4, 2003.

Joint and Combined Operations[38]

Joint operations are completed in conjunction with other U.S. military services (the Army, Navy, and Air Force); combined operations are completed in conjunction with partner countries. Joint and combined operations are involved in many of the missions already described here, including HA, FID, NEO, security cooperation, and stability operations.

Joint and combined operations involve some unique challenges and have a fairly specific set of tasks laid out in Joint Publications. Joint and combined command and control involves establishing a joint or multinational command center able to support the operation; preparing plans and orders that define lines of responsibility; assessing the external threat; integrating forces from each service or nation; and identifying the procedures for the sharing of information. Joint and combined intelligence operations involve collecting, analyzing, and disseminating ground intelligence, human intelligence, and aerial intelligence by UAVs and satellites from multiple sources and partner nations into a single product that informs ongoing operations. Joint and combined fires operations include aerial, ground, or naval activities and involve selecting targets, providing oversight and logistics support, destroying enemy aircraft and missiles, interdicting enemy capability, executing information operations and other strategic effects, and conducting post-operation assessment.

Joint and combined movement and maneuver operations involve deploying or moving joint and combined forces by land, air, or sea; eliminating obstacles such as IEDs and other threats; conducting defensive operations necessary to delay the movement of enemy forces; holding strategically important territory; and conducting direct action and special reconnaissance missions to support ongoing operations.

Joint and combined protection operations focus on conserving the joint/combined force's fighting potential, with active and passive defensive measures that protect both personnel and information, and on establishing systems needed to respond to emergencies and recover

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[38] JP 3-0, 2011; NAVMC 3500.44, 2008b; MCO 3120.9C, 2009; OPNAVINST 3500.38B/MCO 3500.26B/USCG COMDTINST 3500.1B, 2010.

personnel if necessary. Finally, joint and combined sustainment operations involve activities executed to ensure the health, safety, and sustainment of joint and combined forces, including human resource support, religious and ministry operations, financial management, legal support, provision of food, water, medical supplies, arms and equipment, and establishing and maintaining sustainment bases.

APPENDIX B

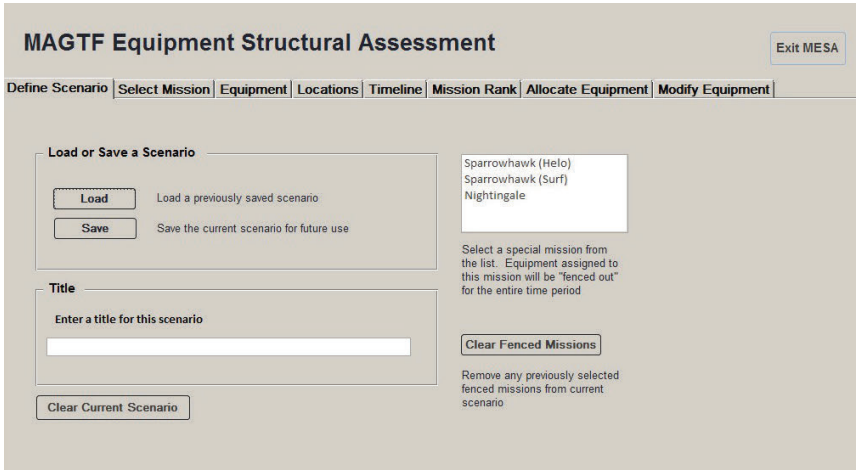
MESA User's Guide

This User's Guide is designed to assist the user in developing scenarios supported by the MAGTF Equipment Structural Assessment (MESA) application. These missions include noncombatant evacuation operations (NEOs), humanitarian assistance (HA), tactical recovery of aircraft and personnel (TRAP), airfield/port seizure, stability operations, and amphibious raid. In addition, a Quick Response Force (QRF) has been implemented in the same format as the other missions. The mission may be tailored to accommodate the specific requirements of the proposed scenario. Moreover, the application will support multiple missions, allowing the user to mix and match tasks from different missions as desired. The sequencing of tasks is specified if applicable, and the MESA software allocates equipment onboard the MEU to accomplish the specified tasks. The application software is available for download at www.rand.org/t/TL167.

Overview

The MESA interface consists of a series of tabs (depicted in Figure B.1 and listed in Table B.1) containing input fields that define a scenario. The user navigates through the tabs, filling in the fields as appropriate to define the mission, its component tasks, subtasks, and other characteristics. Once the user is satisfied with the mission parameters, the program will allocate equipment from the selected inventory and assign to the individual tasks. If the user decides the results are worth saving

Figure B.1
Main Screen of the MESA Application



RAND *TL167-B.1*

Table B.1.
MESA Main Interface Tabs

Tab	Function
Define Scenario	The user is presented with 15 missions. He or she can select one or more of them (in this version, only six missions are fully operational).
Select Mission	For each mission selected, the user is offered a series of tasks and subtasks which he or she may select as being critical to the scenario.
Equipment	The equipment available to the MEU is displayed at this tab.
Locations	The user selects from a list of locations or inventories that will be available to the mission.
Timeline	The user can specify the start and finish date for each task.
Mission Rank	The user is can rank missions by priority when assigning equipment.
Allocate Equipment	The results of the equipment allocation are displayed at this tab.
Modify Equipment	Interface for adding new equipment items or altering the descriptions of existing items.

for future reference and planning purposes, they can be exported to an Excel spreadsheet.

Installation and Operation

The MESA application is implemented as a Microsoft Access 2010 database. Modifications to the application—adding or modifying equipment items, restructuring missions and tasks, and adding new equipment inventories—can be accomplished by modifying the underlying SQL tables. However, there are some aspects of the functionality that cannot be modified without making changes to the underlying Visual Basic (VB) code. These are noted below where they occur.

Prerequisites

The MESA application was developed using Microsoft Access 2010. Access 2010 must be licensed and installed on any computer intended to run MESA.

Installation

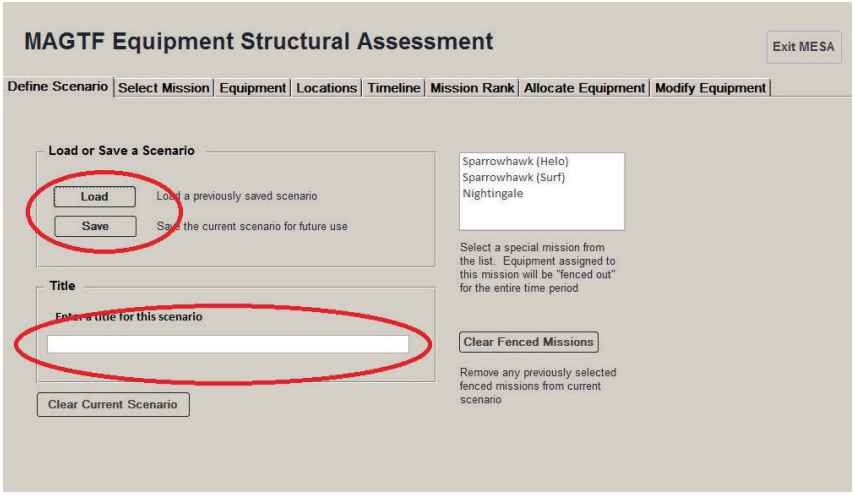
To install and run the MESA software, follow the directions below:

1. Drag and unzip MESA.zip onto desktop.
2. Open the resulting folder and double click on MESA2014.accdb. The MESA application should start up with the main screen displayed as in Figure B.1.
3. From this point the user can define a scenario, allocate equipment, and save the results as described below.

"Define Scenario" Screen

The "Define Scenario" screen (Figure B.2) is the initial tab seen by the user when the application is started. From here, scenarios can be loaded and saved after they have been defined. There is also an option to add a scenario title.

Figure B.2
The Define Scenario Screen



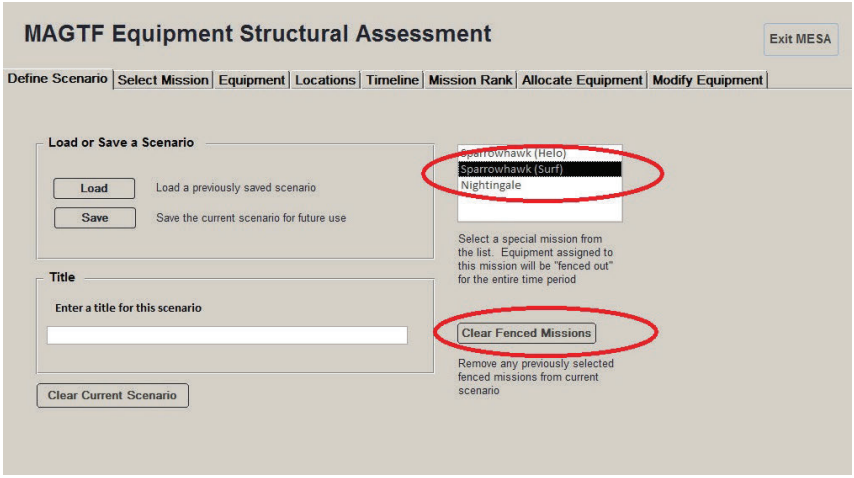
NOTE: Users can load and save scenarios and add an optional title.
RAND *TL167-B.2*

The "Define Scenario" screen also allows the user to select from among a list of "fenced missions," such as sparrowhawk or nightingale QRFs (Figure B.3). Clicking on one or more of the listed missions will add that mission to the current scenario. Fenced missions request a predetermined set of equipment and retain that equipment for the duration of the scenario. Fenced missions always receive top priority during equipment allocation. Because they do not appear as one of the list of 15 "normal" missions appearing in the drop-down box on the "Select Missions" tab, the button "Clear Fenced Missions" allows the user to delete any previously selected fenced mission from the current scenario.

"Select Mission" Screen

From the "Select Mission" tab (Figure B.4), the user can choose from a list of potential missions and request equipment to be assigned to tasks related to that mission. The HA mission is depicted; however, the underlying structure of the application supports multiple additional missions.

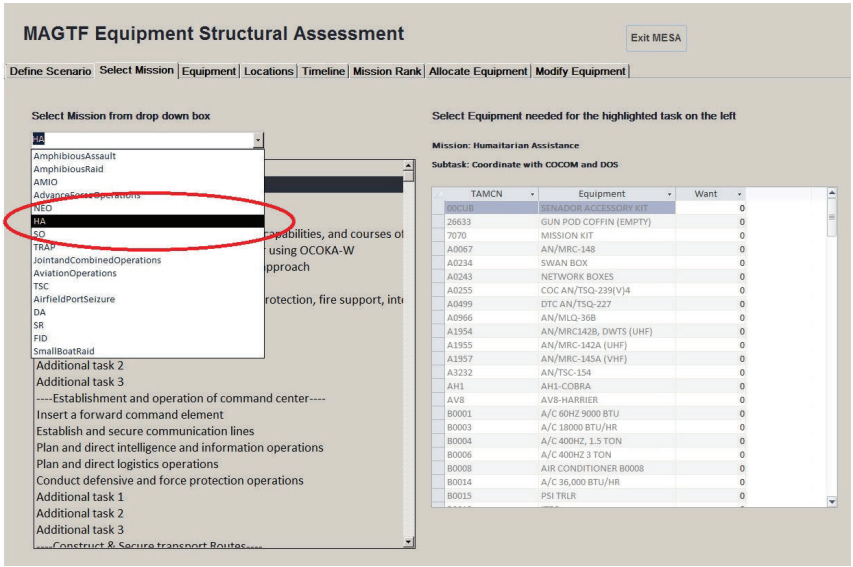
Figure B.3
Selecting a Fenced Mission from the Define Scenario Tab



NOTE: The user has selected the sparrowhawk (helicopter) fenced mission. The "Clear Fenced Missions" button removes it from the current scenario.

RAND *TL167-B.3*

Figure B.4
The Select Mission Screen

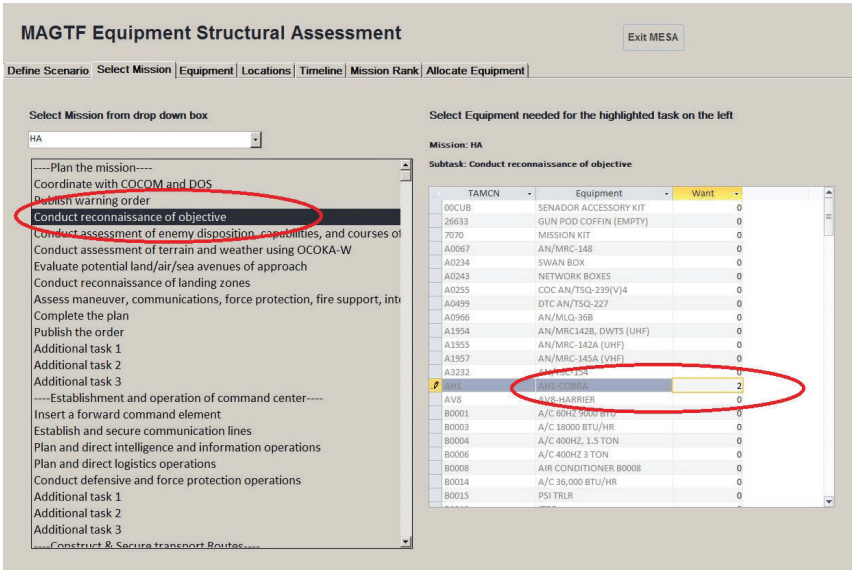


NOTE: The user has selected the HA mission.

RAND *TL167-B.4*

After selecting a mission from the drop-down menu, the left-hand panel will display the list of tasks and subtasks associated with that mission (Figure B.5). When the user clicks on a task in the left-hand panel, the right-hand panel will be updated with the list of available equipment and the requested amount (if any) of specific equipment items. Modifying the "Want" column allows the user to request more or fewer equipment items for assignment to the highlighted task.

Figure B.5
Requesting Equipment for Specific Tasks



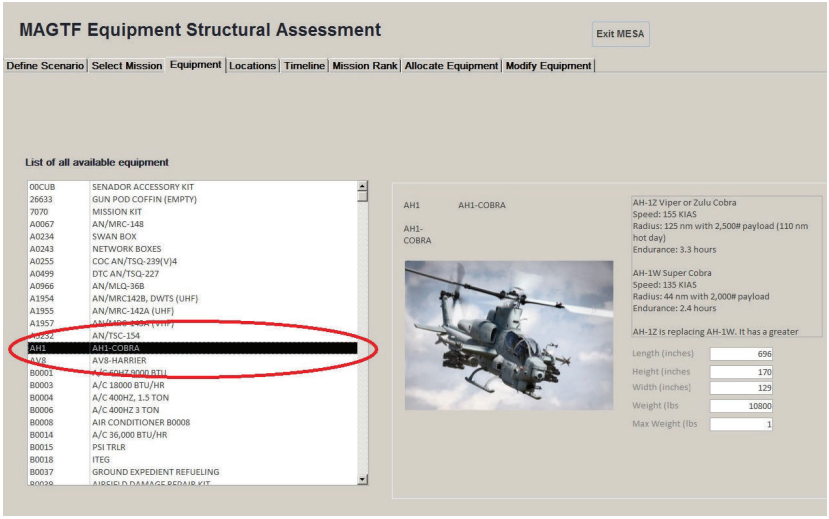
NOTE: The user has selected two AH1 Cobra helicopters for the task "conduct reconnaissance of objective."

RAND *TL167-B.5*

"Equipment" Screen

From the "Equipment" screen (Figure B.6), the user can select and review all equipment potentially available for use. Highlighting an item in the left-hand panel will display an image of the selected equipment in the right, along with a short text description and selected characteristics such as operational capabilities, limitations, and physical

Figure B.6
The Equipment Screen



NOTE: The user has selected the AH1 Cobra in the left-hand panel. Information about the Cobra appears in the right-hand panel.

RAND *TL167-B.6*

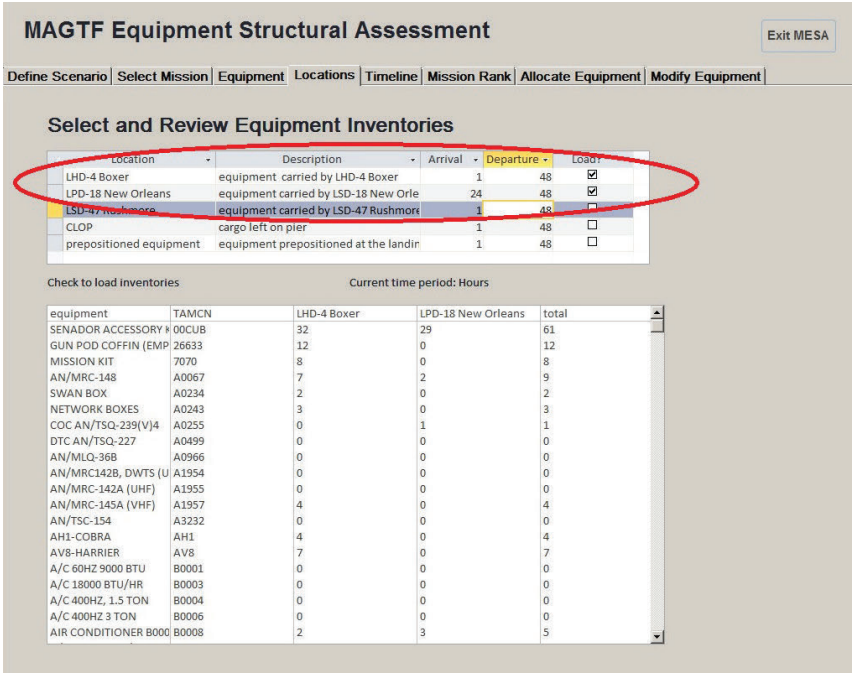
dimensions such as height and weight. Note that this screen displays *all* equipment, whether available to the current mission or not. The actual availability of equipment for a specific scenario is a function of the inventories selected from the "Locations" screen.

The "Equipment" screen does not support data entry or modification. It is simply an interface to the equipment table in the underlying database. Modifications and additions to the list of equipment can be made from the "Modify Equipment" screen described below.

"Locations" Screen

From the "Locations" screen (Figure B.7), the user can select from among the available inventories and decide on equipment arrival and departure dates. In the upper panel, the five MESA default inventories appear—the USS *Boxer*, USS *New Orleans*, USS *Rushmore*, CLOP (cargo left on pier), and a generic "pre-positioned equipment" inventory. Checking the checkboxes in the "Load" column makes the equipment

Figure B.7
The Locations Screen



NOTE: The user has selected the Boxer and the New Orleans to be available for this scenario. However, the New Orleans will not arrive until 24 hours into the scenario timeline.

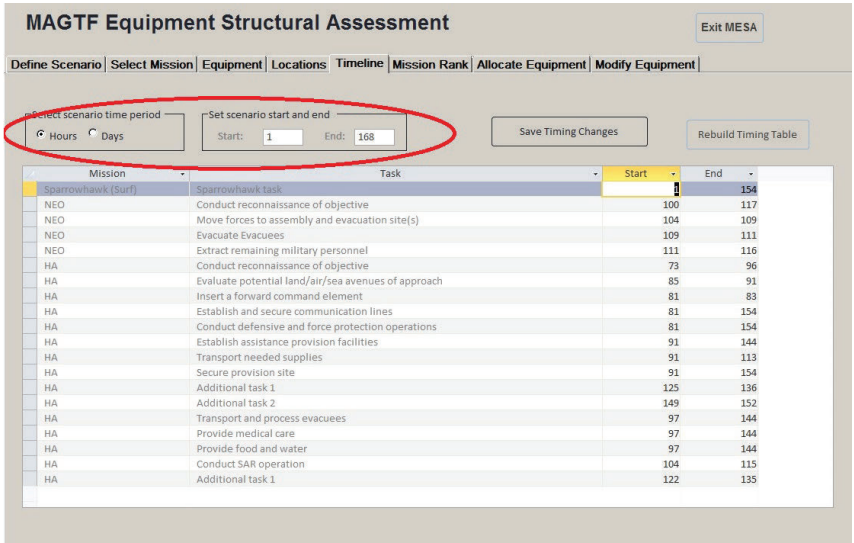
RAND *TL167-B.7*

in that inventory available to the scenario, and dynamically updates the lower panel of the screen. By default, inventories are available throughout the entire scenario unless the user alters their arrival and departure dates in the "Arrival" and "Departure" columns.

"Timeline" Screen

Once the scenario is defined and the tasks have been selected, the user may specify the start and finish time for any task or subtask using the "Timeline" screen, as illustrated in Figure B.8. The "Timeline" screen presents the user with a list of each of the tasks on the "Select Missions" screen for which equipment has been requested. By specifying start and

Figure B.8
The Timeline Screen



NOTE: The user has specified the start and end of the scenario tasks and the end period as 168 hours.

RAND *TL167-B.8*

end dates, tasks can be sequenced. For example, when conducting an HA mission, it may be appropriate to first "conduct reconnaissance of the objective" before "rebuilding local infrastructure."

From the "Timeline" screen, the user can select the scenario time period as either hours or days, and the overall scenario start and end period. The start and end period are expressed in terms of the scenario time period. The default time period is hours, and the default start and end are 1 and 48, respectively.

After making changes to the start and end of specific tasks (in the "Start" and "End" columns of the main panel), the user should click on the "Save Timing Changes" button to ensure that any changes are properly saved to the database.

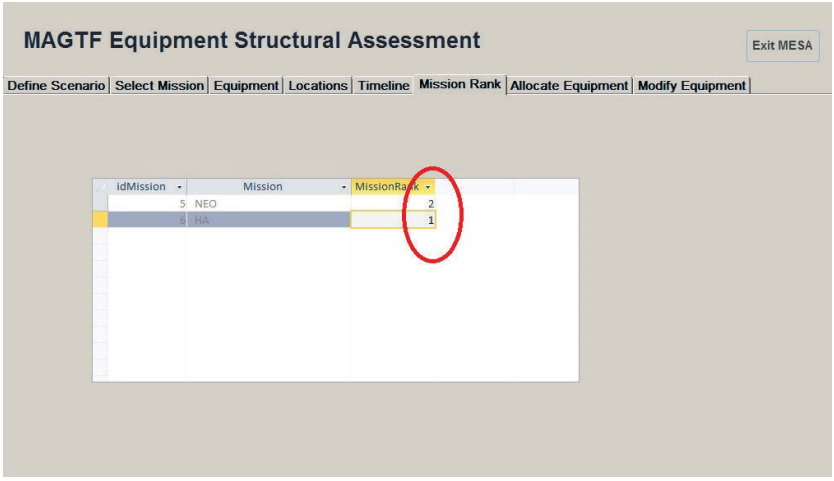
Note that the MESA application supports multiple missions, which can occur within the same timeframe. In Figure B.8, the user

has selected tasks from both a NEO and HA mission. The "Timeline" screen will allow tasks to be sequenced across the multiple missions.

Mission Rank

By default, MESA assigns equipment to multi-mission scenarios in the order in which they appear on the "Select Mission" drop-down menu. If a scenario includes tasks from both the NEO and HA missions, all NEO tasks will get first pick of equipment, since it is ordered earlier on the mission drop-down menu. However, there may be situations where it is preferable that the HA mission receive priority is selecting equipment. From the "Mission Rank" screen, the user can alter the rank order of missions by change the ordinal value in the "Mission Rank" column (Figure B.9). This applies only to multi-mission scenarios, and only at the mission level.

Figure B.9
The Mission Rank Screen



NOTE: The user has ranked HA tasks higher than NEO tasks, meaning that the former gets priority in selecting equipment.

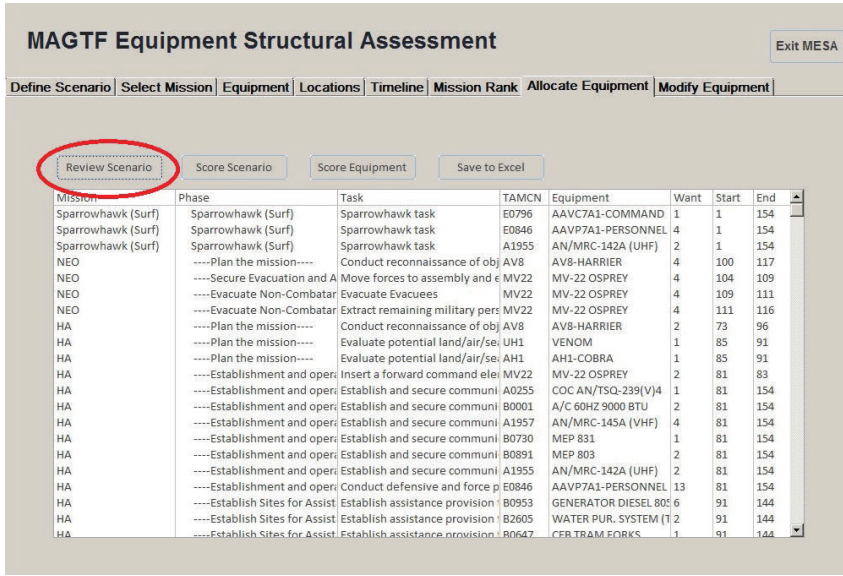
RAND *TL167-B.9*

Allocate Equipment Screen

Once satisfied with the mission and task selection, the equipment inventory, and the timeline, the user can proceed to the "Allocate Equipment" screen, which provides displays for examining the results of assigning equipment to the selected mission tasks. The MESA application output consists of four elements: (1) a summary of the tasks and requested equipment specified by the user, (2) a task completion and equipment usage display, including any shortfalls, (3) a summary of shortfalls collapsed to the level of each equipment item, and (4) an Excel spreadsheet with tabs displaying the task-specific completion percentages, detailed inventories, scenario parameters, and a detailed breakdown of equipment item usage over time. These outputs are generated by clicking the "Review Scenario," "Score Scenario," "Score Equipment," and "Save to Excel" buttons, respectively. Figures B.10 through B.14 illustrate the location of these buttons and the output produced by clicking them.[1]

[1] Table B.3 at the end of this appendix lists the complete 147 equipment items currently included in the MESA.

Figure B.10
Review Scenario Display

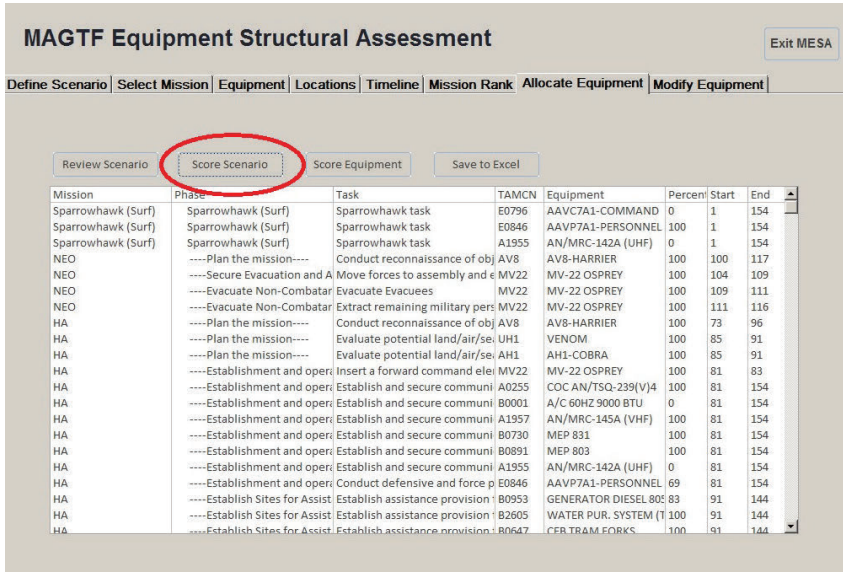


Mission	Phase	Task	TAMCN	Equipment	Want	Start	End
Sparrowhawk (Surf)	Sparrowhawk (Surf)	Sparrowhawk task	E0796	AAVC7A1-COMMAND	1	1	154
Sparrowhawk (Surf)	Sparrowhawk (Surf)	Sparrowhawk task	E0846	AAVP7A1-PERSONNEL	4	1	154
Sparrowhawk (Surf)	Sparrowhawk (Surf)	Sparrowhawk task	A1955	AN/MRC-142A (UHF)	2	1	154
NEO	----Plan the mission----	Conduct reconnaissance of obj	AV8	AV8-HARRIER	4	100	117
NEO	----Secure Evacuation and A	Move forces to assembly and e	MV22	MV-22 OSPREY	4	104	109
NEO	----Evacuate Non-Combatar	Evacuate Evacuees	MV22	MV-22 OSPREY	4	109	111
NEO	----Evacuate Non-Combatar	Extract remaining military pers	MV22	MV-22 OSPREY	4	111	116
HA	----Plan the mission----	Conduct reconnaissance of obj	AV8	AV8-HARRIER	2	73	96
HA	----Plan the mission----	Evaluate potential land/air/se	UH1	VENOM	1	85	91
HA	----Plan the mission----	Evaluate potential land/air/se	AH1	AH1-COBRA	1	85	91
HA	----Establishment and opera	Insert a forward command ele	MV22	MV-22 OSPREY	2	81	83
HA	----Establishment and opera	Establish and secure communi	A0255	COC AN/TSQ-239(V)4	1	81	154
HA	----Establishment and opera	Establish and secure communi	B0001	A/C 60HZ 9000 BTU	2	81	154
HA	----Establishment and opera	Establish and secure communi	A1957	AN/MRC-145A (VHF)	4	81	154
HA	----Establishment and opera	Establish and secure communi	B0730	MEP 831	1	81	154
HA	----Establishment and opera	Establish and secure communi	B0891	MEP 803	2	81	154
HA	----Establishment and opera	Establish and secure communi	A1955	AN/MRC-142A (UHF)	2	81	154
HA	----Establishment and opera	Conduct defensive and force p	E0846	AAVP7A1-PERSONNEL	13	81	154
HA	----Establish Sites for Assist	Establish assistance provision	B0953	GENERATOR DIESEL 805	6	91	144
HA	----Establish Sites for Assist	Establish assistance provision	B2605	WATER PUR. SYSTEM (T	2	91	144
HA	----Establish Sites for Assist	Establish assistance provision	B0647	CER TRAM FORKS	1	91	144

RAND *TL167-B.10*

Clicking the "Review Scenario" button produces a summary of the missions and tasks selected by the user, the amount of equipment requested for each task, and the task-specific start and end periods. In practice, this display is very helpful for reviewing the components of a scenario under development.

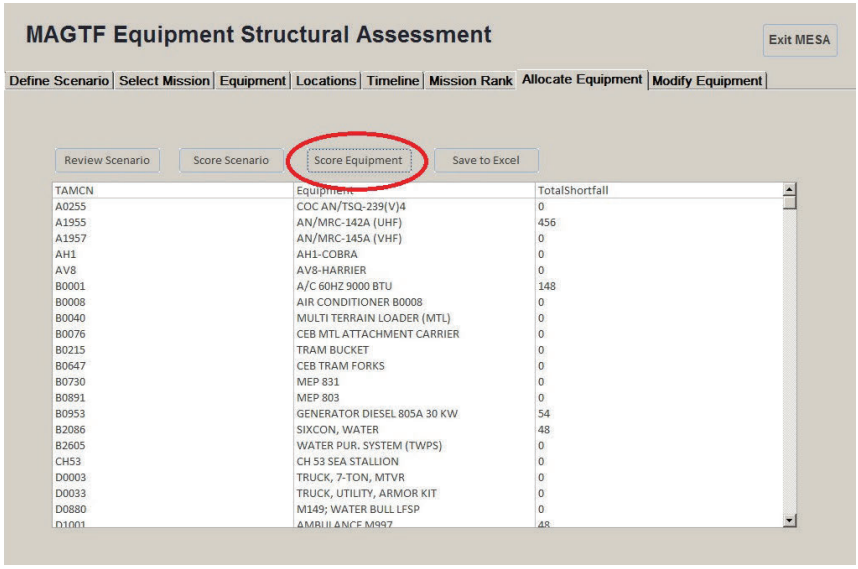
Figure B.11
Score Scenario Display



RAND *TL167-B.11*

Clicking the "Score Scenario" button produces a display very similar to the "Review Scenario" display, except that it includes the task completion percentage and shortfalls. Successfully completed tasks can be identified by a completion percentage of 100; any shortfalls are represented by a value less than 100 percent, including 0 percent, indicating that none of the requested equipment was available for a specific task.

Figure B.12
Score Equipment Display



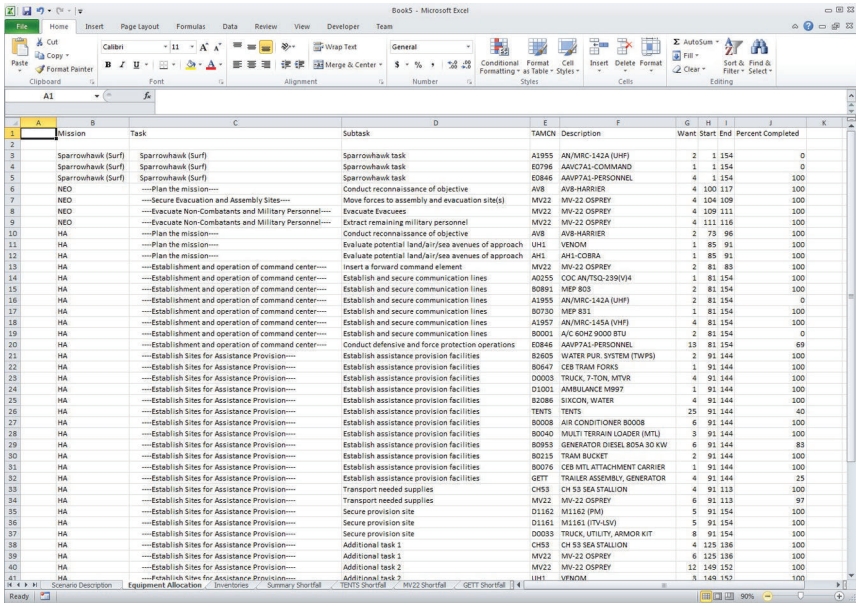
RAND *TL167-B.12*

Clicking the "Score Equipment" produces a three-column display collapsed to the equipment level. Any shortfall is expressed as the total equipment operating hours. A shortfall of zero means that all equipment requested was available from the inventories. See Figure B.12.

Once the scenario construction and summary output screens are deemed satisfactory, clicking on the "Save to Excel" button (Figure B.13) generates an Excel spreadsheet that combines all the information displayed by the "Review Scenario," "Score Scenario," and "Score Equipment" buttons. It includes details of the available inventories and a summary of other scenario parameters such as time period, start and end period, and the scenario title. This Excel file can be saved in the usual fashion, and the user can modify it and develop additional statistical and reporting functionality as with any spreadsheet.

Also included on the spreadsheet are graphs of overall and equipment-specific shortfalls recorded by scenario time (Figure B.14).

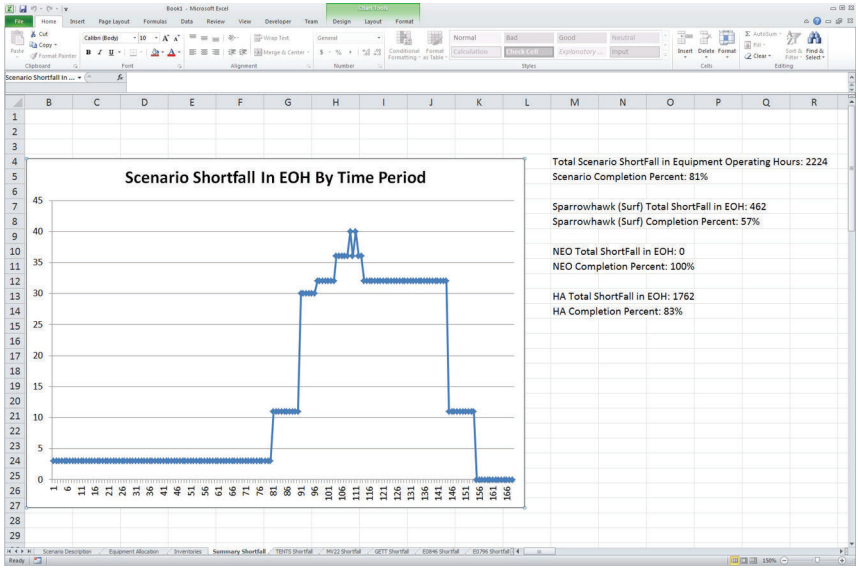
Figure B.13
Save to Excel Output



Mission	Task	Subtask	TAMCN	Description	Want	Start	End	Percent Completed
Sparrowhawk (Surf)	Sparrowhawk (Surf)	Sparrowhawk task	A1955	AN/MRC-142A (UHF)	2	1	154	0
Sparrowhawk (Surf)	Sparrowhawk (Surf)	Sparrowhawk task	E0796	AAVC7A1-COMMAND	1	1	154	0
Sparrowhawk (Surf)	Sparrowhawk (Surf)	Sparrowhawk task	E0846	AAVP7A1-PERSONNEL	4	1	154	100
NEO	----Plan the mission----	Conduct reconnaissance of objective	AV8	AV8-HARRIER	4	100	117	100
NEO	----Secure Evacuation and Assembly Sites----	Move forces to assembly and evacuation site(s)	MV22	MV-22 OSPREY	4	104	109	100
NEO	----Evacuate Non-Combatants and Military Personnel----	Evacuate Evacuees	MV22	MV-22 OSPREY	4	109	111	100
NEO	----Evacuate Non-Combatants and Military Personnel----	Extract remaining military personnel	MV22	MV-22 OSPREY	4	111	116	100
HA	----Plan the mission----	Conduct reconnaissance of objective	AV8	AV8-HARRIER	2	73	96	100
HA	----Plan the mission----	Evaluate potential land/air/sea avenues of approach	UH1	VENOM	1	85	91	100
HA	----Plan the mission----	Evaluate potential land/air/sea avenues of approach	AH1	AH1-COBRA	1	85	91	100
HA	----Establishment and operation of command center----	Insert a forward command element	MV22	MV-22 OSPREY	2	81	83	100
HA	----Establishment and operation of command center----	Establish and secure communication lines	A0255	COC AN/TSQ-239(V)4	1	81	154	100
HA	----Establishment and operation of command center----	Establish and secure communication lines	B0891	MEP 803	2	81	154	100
HA	----Establishment and operation of command center----	Establish and secure communication lines	A1955	AN/MRC-142A (UHF)	2	81	154	0
HA	----Establishment and operation of command center----	Establish and secure communication lines	B0730	MEP 831	1	81	154	100
HA	----Establishment and operation of command center----	Establish and secure communication lines	A1957	AN/MRC-145A (VHF)	4	81	154	100
HA	----Establishment and operation of command center----	Establish and secure communication lines	B0001	A/C 60HZ 9000 BTU	2	81	154	0
HA	----Establishment and operation of command center----	Conduct defensive and force protection operations	E0846	AAVP7A1-PERSONNEL	13	81	154	69
HA	----Establish Sites for Assistance Provision----	Establish assistance provision facilities	B2605	WATER PUR. SYSTEM (TWPS)	2	91	144	100
HA	----Establish Sites for Assistance Provision----	Establish assistance provision facilities	B0647	CEB TRAM FORKS	1	91	144	100
HA	----Establish Sites for Assistance Provision----	Establish assistance provision facilities	D0003	TRUCK, 7-TON, MTVR	4	91	144	100
HA	----Establish Sites for Assistance Provision----	Establish assistance provision facilities	D1001	AMBULANCE M997	1	91	144	100
HA	----Establish Sites for Assistance Provision----	Establish assistance provision facilities	B2086	SIXCON, WATER	4	91	144	100
HA	----Establish Sites for Assistance Provision----	Establish assistance provision facilities	TENTS	TENTS	25	91	144	40
HA	----Establish Sites for Assistance Provision----	Establish assistance provision facilities	B0008	AIR CONDITIONER B0008	6	91	144	100
HA	----Establish Sites for Assistance Provision----	Establish assistance provision facilities	B0040	MULTI TERRAIN LOADER (MTL)	3	91	144	100
HA	----Establish Sites for Assistance Provision----	Establish assistance provision facilities	B0953	GENERATOR DIESEL 80SA 30 KW	6	91	144	83
HA	----Establish Sites for Assistance Provision----	Establish assistance provision facilities	B0215	TRAM BUCKET	2	91	144	100
HA	----Establish Sites for Assistance Provision----	Establish assistance provision facilities	B0076	CEB MTL ATTACHMENT CARRIER	1	91	144	100
HA	----Establish Sites for Assistance Provision----	Establish assistance provision facilities	GETT	TRAILER ASSEMBLY, GENERATOR	4	91	144	25
HA	----Establish Sites for Assistance Provision----	Transport needed supplies	CH53	CH 53 SEA STALLION	4	91	113	100
HA	----Establish Sites for Assistance Provision----	Transport needed supplies	MV22	MV-22 OSPREY	6	91	113	97
HA	----Establish Sites for Assistance Provision----	Secure provision site	D1162	M1162 (PM)	5	91	154	100
HA	----Establish Sites for Assistance Provision----	Secure provision site	D1161	M1161 (ITV-LSV)	5	91	154	100
HA	----Establish Sites for Assistance Provision----	Secure provision site	D0033	TRUCK, UTILITY, ARMOR KIT	8	91	154	100
HA	----Establish Sites for Assistance Provision----	Additional task 1	CH53	CH 53 SEA STALLION	4	125	136	100
HA	----Establish Sites for Assistance Provision----	Additional task 1	MV22	MV-22 OSPREY	6	125	136	100
HA	----Establish Sites for Assistance Provision----	Additional task 2	MV22	MV-22 OSPREY	12	149	152	100
HA	----Establish Sites for Assistance Provision----	Additional task 2	UH1	VENOM	3	149	152	100

RAND *TL167-B.13*

Figure B.14
Save to Excel Graphical Output



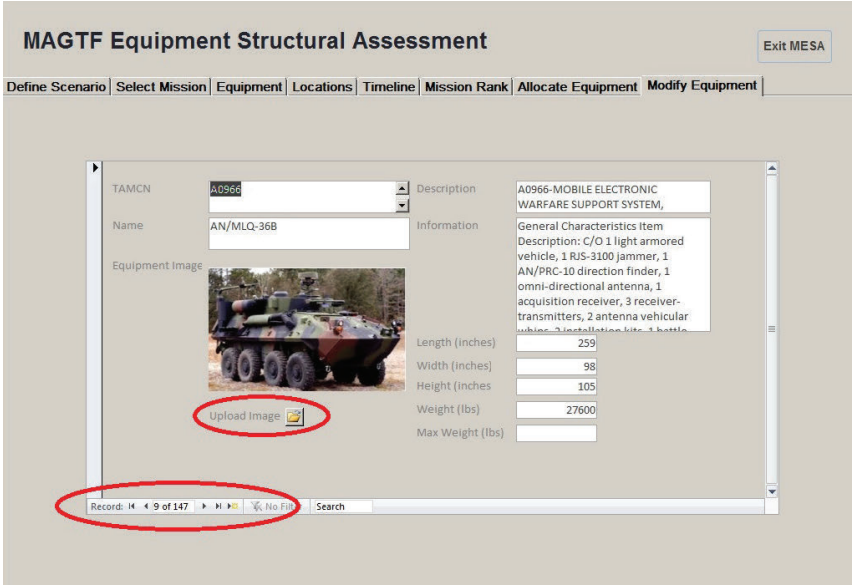
RAND *TL167-B.14*

"Modify Equipment" Screen

The final tab on the MESA main input screen is the "Modify Equipment" tab, which provides the user with an interface for adding new equipment items or modifying the descriptions of existing items. This tab can be thought of as a window on the equipment table that is part of the underlying Access database. The user can navigate through the equipment table using the navigation controls in the lower left of Figure B.15. Changes made on the "Modify Equipment" tab are saved directly into the equipment table, so there is no need for the user to save updates explicitly.

New equipment images in JPEG or BMP format can be uploaded by clicking the "Upload image" button and browsing to a directory location containing the image. In theory, images can linked from any location on the user's local network; however, this would have a poten-

Figure B.15
The Modify Equipment Screen



NOTE: Navigation controls appear in the lower left. The "Upload image" button permits the user to attach images to equipment items.

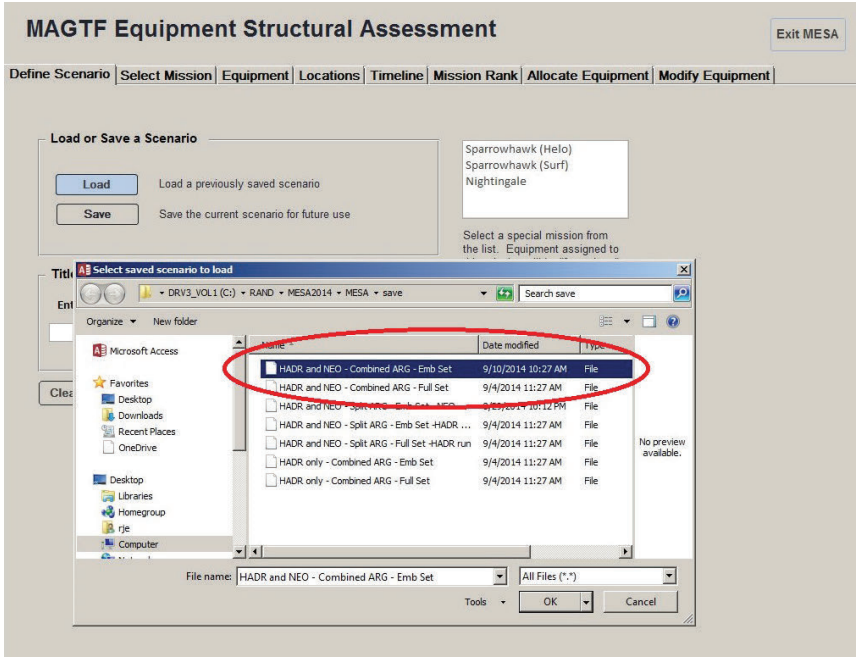
RAND *TL167-B.15*

tially severe impact on the portability of the MESA application. In practice, it is advisable to first copy the equipment image to the images folder (located below the MESA main directory) and only then link to the equipment table using the "Upload image" button.

Stepping Through a Simple Scenario

The following section steps through a simple scenario—running an allocation based on a previously saved scenario. We begin by loading a previously saved scenario from the "Define Scenario" tab as depicted in Figure B.16. In this example, the user has selected the first saved scenario from the file load dialog, which represents two missions, HADR and NEO, and a combined ARG.

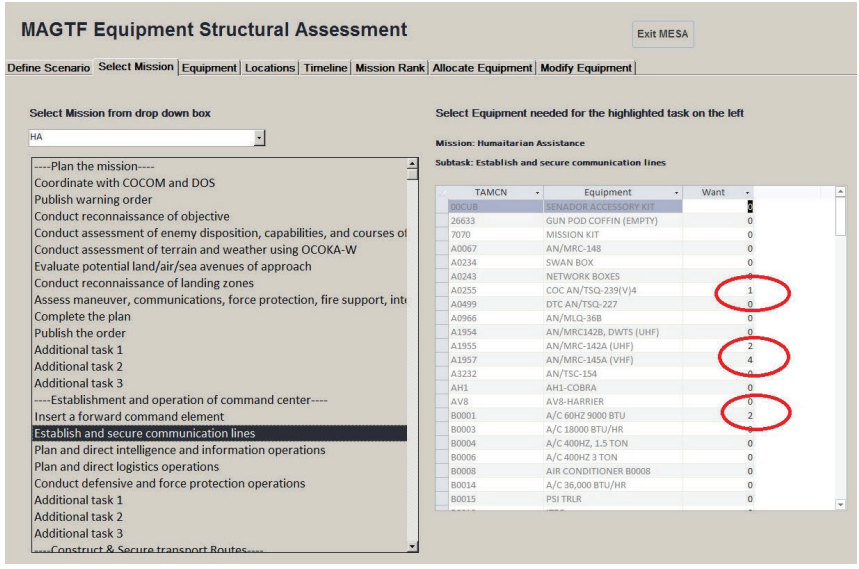
Figure B.16
Loading a Previously Saved Scenario



RAND *TL167-B.16*

Next, we review the task selection on the "Select Missions" tab, as depicted in Figure B.17. The red circled items highlight the stored settings. Among other items, the scenario requires a Combat Operations Center Tactical Command System and an AN/MRC-142A UHF Radio Terminal Set. The user may choose to modify the requested amount.

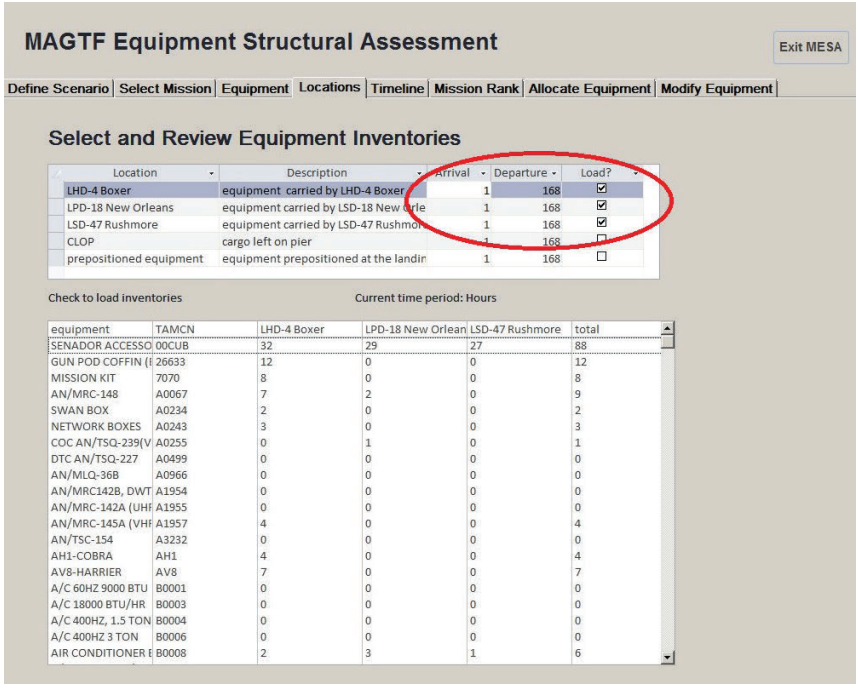
Figure B.17
The Saved Select Mission Screen



RAND *TL167-B.17*

Next the user determines which locations or inventories will be available for the mission. In this example, the user has selected the USS *Boxer*, USS *New Orleans*, and USS *Rushmore*. All three ships are available for the duration of the scenario, hours 1 through 168 (Figure B.18).

Figure B.18
The Saved Locations Screen

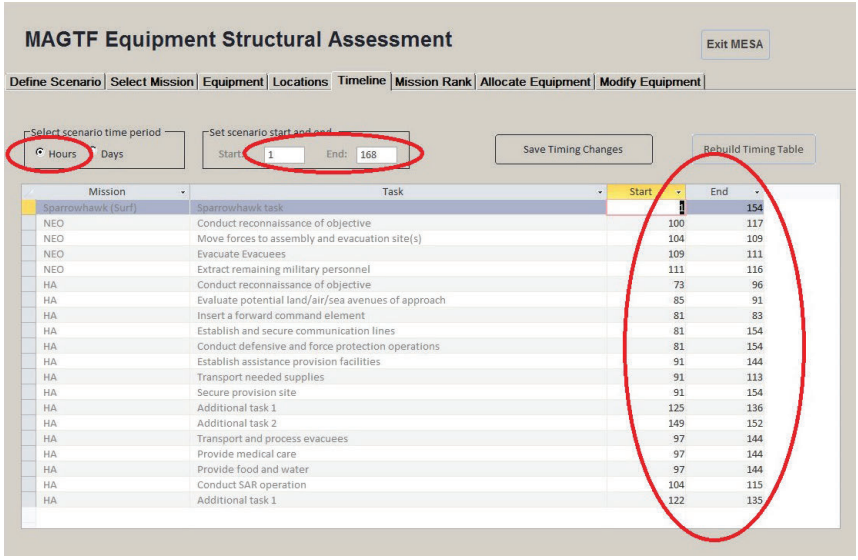


RAND *TL167-B.18*

The user can now set the timeline for each of the tasks on the "Timeline" tab, as depicted in Figure B.19. Notice that the user has selected a scenario time increment in hours, and that the scenario starts at hour 1 and ends at hour 168. The user has specified several different start and end periods for the individual tasks.

Once satisfied with the tasks selected and the timelines chosen, the user can review the new scenario and allocate equipment to tasks by clicking on the "Review Scenario," "Score Scenario," and "Score Equipment" buttons on the "Allocate Equipment" screen. Because there is relatively little overhead in setting up and running scenarios, the user can iterate as much as desired. It is recommended that once a scenario is defined that it be permanently saved for future use by clicking the "Save to Excel" button on the "Define Scenario" tab. Examples of the MESA allocation output display and generated spreadsheet appear in Figures B.10 through B.14.

Figure B.19
The Saved Timeline Screen



RAND *TL167-B.19*

Some Things Cannot Be Changed Without Modifying the Visual Basic Code

The user can change many aspects of the MESA application by modifying the linked SQL tables that comprise the Access database. However, there are some modifications that can only be accomplished by editing the underlying VBA code. One example is equipment allocation. Currently the MESA application assigns equipment to tasks based on a "first come, first served" basis. Tasks are allocated equipment in the order in which they appear on the "Define Mission" tab for a given mission. This may not be the ideal method for allocating equipment, and it might be that an algorithm that allows prioritization at the task level would be superior. This functionality, however, cannot be changed without modification of the underlying VBA code.

The MESA Database

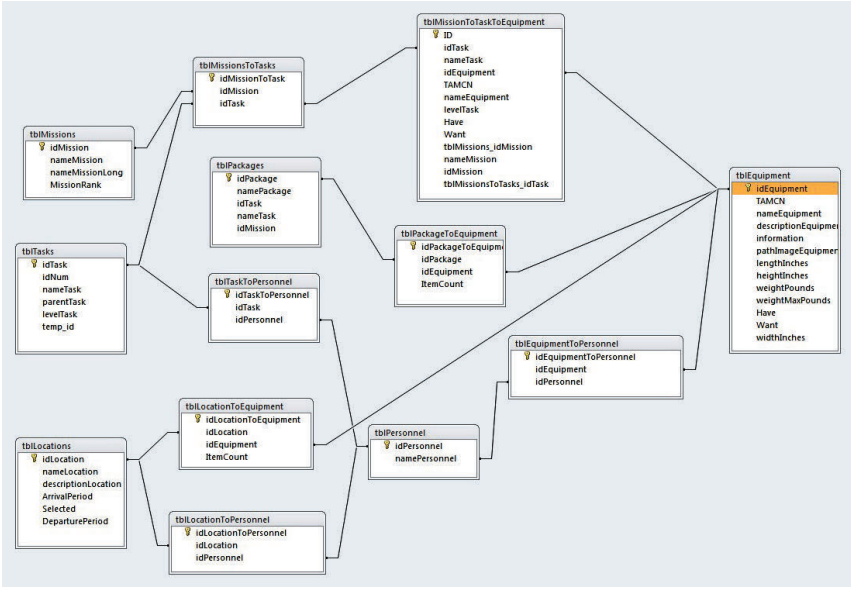
As described previously, the MESA application is implemented as a Microsoft Access 2010 database. The database consists of 16 discrete tables and the relationships linking them together. We next describe each of the MESA tables, followed by a discussion of the steps necessary to modify them.

MESA Table Structure

Figure B.20 is a graphical representation of some of the most important MESA tables and their relationships to one another. Not all tables are linked to all other tables. Tables are linked according to their actual relationship. Thus, for example, the missions table (tblMissions) is linked to the tasks table (tblTasks) because tasks are a logical part of a mission.

Each rectangle represents a discrete MESA table, with a list of the data fields contained in each table. The connecting lines represent the links or relationships between the tables. Note that some tables do not appear in Figure B.20 because they are standalone and therefore do not link to other tables.

Figure B.20
Relationship Between Key MESA Tables



RAND *TL167-B.20*

Table B.2 is a comprehensive list of all 16 MESA tables. Each table is identified by its name within the database, a short description of the table contents, and the other tables to which it is linked.

Table B.2
Description of All MESA Database Tables

Table Name	Function	Other Linked Tables
tblMissions	A list of 15 individual missions available to the MESA application.	tblMissionsToTasks
tblTasks	A list of the 181 specific tasks defined in MESA.	tblMissionsToTasks tblTaskToPersonnel
tblEquipment	A list of the 147 individual equipment items defined in MESA.	tblMissionToTaskToEquipment tblPackageToEquipment tblLocationToEquipment tblEquipmentToPersonnel
tblMissionsToTasks	This table lists the individual tasks associated with each of the 15 MESA missions.	tblMissions tblTasks
tblMissionToTaskToEquipment	This table is the master list of all missions, tasks, and requested equipment defined for the current scenario. It is updated dynamically as the user builds a scenario.	tblMissions tblTasks tblEquipment
tblPackages	This table contains the three packages or "fenced missions" currently defined within MESA.	tblPackageToEquipment
tblPackageToEquipment	This table defines the specific equipment items associated with each package or "fenced mission."	tblPackages tblEquipment
tblLocations	This table defines the five locations or inventories currently defined within MESA.	tblEquipment tblPersonnel
tblLocationToEquipment	This table defines the specific equipment items located at each location.	tblLocations tblEquipment

Table B.2—Continued

Table Name	Function	Other Linked Tables
tblCurrentScenario	This table is dynamically updated to reflect the current scenario as it is defined by the user.	Not linked to any other tables
tblMissionRank	This table is used to establish mission priority when allocating equipment. By default, missions are ranked according to the order in which they appear in tblMissions.	tblMissions
tblTiming	This table contains the start and end time period for all tasks defined in the current scenario.	Not linked to any other tables
tblPersonnel	A list of all available personnel. Not currently used by MESA but provides a structure for future expansion.	tblTaskToPersonnel tblLocationToPersonnel tblEquipmentToPersonnel
tblTaskToPersonnel	A table defining the specific personnel associated with each task. Not currently used by MESA but provides a structure for future expansion.	tblPersonnel tblTasks
tblLocationToPersonnel	A table defining the specific personnel associated with each location or inventory. Not currently used by MESA but provides a structure for future expansion.	tblPersonnel tblLocations
tblEquipmentToPersonnel	A table defining the specific personnel associated with each equipment item. Not currently used by MESA but provides a structure for future expansion.	tblPersonnel tblEquipment

Modifying the MESA Database Tables

We have seen how the equipment table can be expanded and modified via the "Modify Equipment" screen on the MESA interface. The equipment table is the only table for which a formal modification interface exists. Other tables can be modified by opening and editing them while MESA is running. The next section provides an example of how to add an additional fenced mission to the MESA application.

Example: Adding a New Package to tblPackages

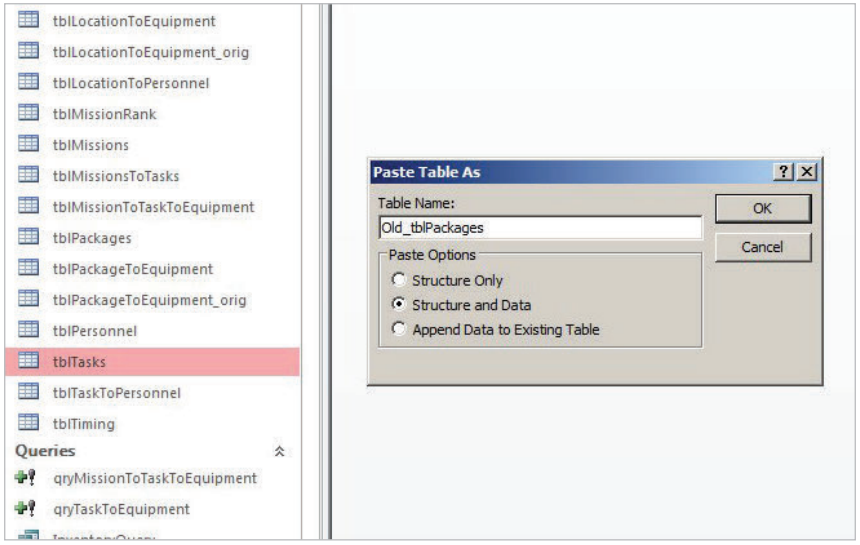
Currently, tblPackages defines three fenced missions—sparrowhawk (helo), sparrowhawk (surf), and nightingale. In this example, we will add a new fenced mission to MESA. To do this, the user must modify tblPackages (which identifies each package) and tblPackageToEquipment (which identifies the equipment required by each package). We know that these are the two tables that need to be modified by looking at Figure B.20 and Table B.2, which define the purpose of each table and their interrelationships. The steps to follow are:

1. Make a copy of the exiting tblPackages and save it with a meaningful name, such as old_tblPackages.
2. Open tblPackages and add a new line representing the new package.
3. Make a copy of the existing tblPackageToEquipment and save it with a meaningful name, such as old_tblPackageToEquipment
4. Open tblPackageToEquipment and add a new line for each equipment item associated with the new package.
5. Save the modified tables. The new package should appear on the "Define Scenario" screen the next time the MESA application is started.

NOTE: It is strongly recommended that users save a copy of the entire database—"MESA2014.accdb"—before modifying the underlying table structure. This will ensure the ability to recover from catastrophic errors.

The five steps are illustrated in Figures B.21 through B.26.

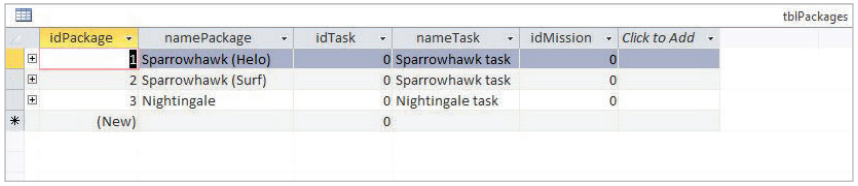
Figure B.21
Saving a Copy of tblPackages



RAND *TL167-B.21*

In Figure B.21, The user first saves the original tblPackages as Old_tblPackages.

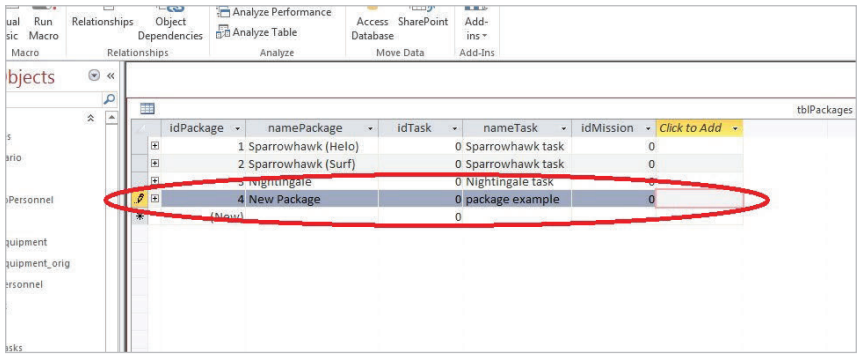
Figure B.22
Opening the Unmodified tblPackages



RAND *TL167-B.22*

In Figure B.22, the original tblPackages defines three fenced missions.

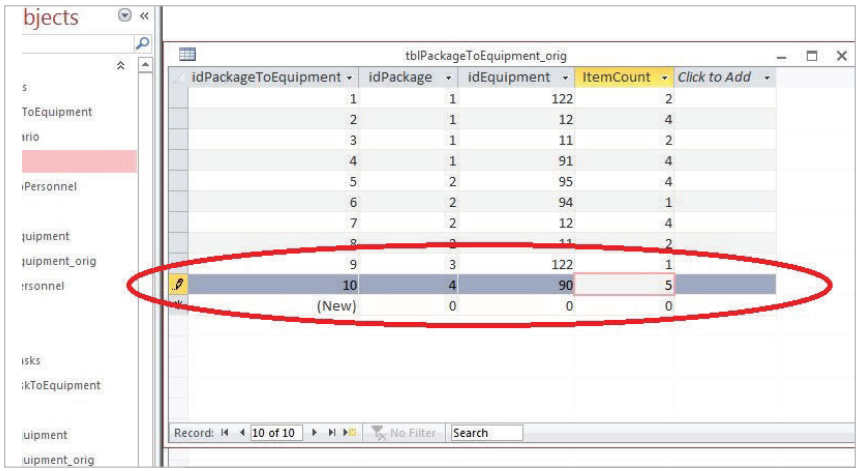
Figure B.23
Adding a New Fenced Mission to tblPackages



RAND *TL167-B.23*

In Figure B.23, the new fenced mission has been added. The user will provide a name ("New Package" in the namePackage column) and a short description ("package example" in the nameTask column). The idTask and idMission columns should be filled in with zero. The idPackage value (in this case 4) will be automatically generated.

Figure B.24
Adding Equipment to tblPackageToEquipment



RAND *TL167-B.24*

In Figure B.24, the user has added a single equipment item for the new package. Note that idPackage has a value of four, which is the same as the idPackage value on the modified tblPackages. The equipment item is a Humvee (TAMCN=D1158). The value of idEquipment is 90, which identifies the Humvee on tblEquipment. We know that the value is 90 by opening and examining tblEquipment (Figure B.25). The value 5 appears in the itemCount column (Figure B.24), indicating that the new package requires five Humvees for the duration of the mission.

Figure B.25
Identifying a HUMVEE on tblEquipment

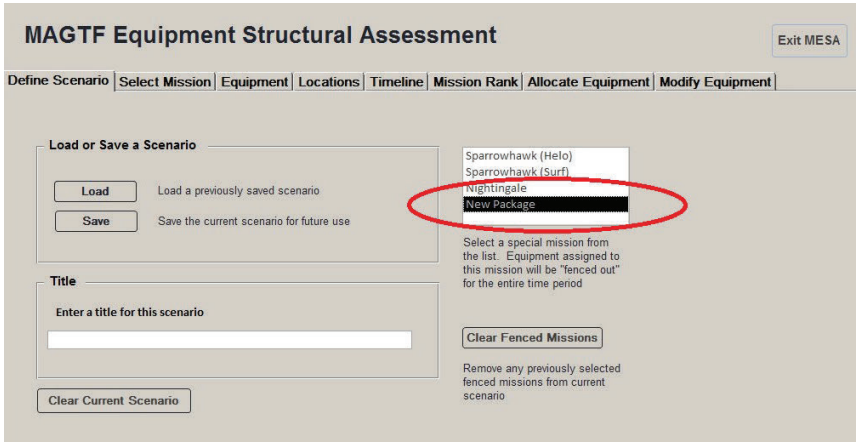
tblEquipment

idEquipmer	TAMCN	nameEquipment	descriptionEquipment
85	D0882	TRLR WATER MK149	D0882-TRLR, MTVR, WATER, MK149
86	D0886	TRUCK 22.5 TON LVSR	D0886-TRUCK, CARGO 22.5 TON, 10X10, (LVSR)
87	D1001	AMBULANCE M997	D1001-TRUCK, AMBULANCE, 4-LITTER, M997
88	D1002	AMBULANCE M1035	D1002-TRUCK, AMBULANCE, 2-LITTER, SOFT TOP, M1035
89	D1063	MTFR/MK37	D1063-MTVR,MK37(MK27W/CRANE)
90	D1158	HUMVEE	D1158-TRUCK, UTILITY, CARGO/TROOP CARRIER, M998 (HUMVEE)
91	D1161	M1161 (ITV-LSV)	D1161-M1161 INTERNALLY TRANSPORTABLE VEHICLE, LIGHT STRIKE VARIA
92	D1162	M1162 (ITV)	D1162-M1162 INTERNALLY TRANSPORTABLE VEHICLE, PRIME MOVER-WEA
93	E0076	TANK DOZER BLADE	
94	E0796	AAVC7A1-COMMAND	E0796-ASSAULT AMPHIBIOUS VEHICLE, COMMAND, AAVC7A1
95	E0846	AAVP7A1-PERSONNEL	E0846-ASSAULT AMPHIBIAN VEHICLE, PERSONNEL CARRIER (AAVP7A1)

RAND *TL167-B.25*

In Figure B.26, the user has saved the new version of tblPackages and tblPackageToEquipment and restarted the MESA application. The new package now appears in the left-hand panel of the "Define Scenario" screen.

Figure B.26
MESA Successfully Displays the New Package



RAND *TL167-B.26*

Modifications to other tables are equally straightforward, once the user understands the relationships between the tables. The key

principle to keep in mind is that all related or linked tables have to be modified consistently, or the MESA output will be unreliable or the application may fail to run.

Table B.3 lists all the equipment items included in the MESA application. The Equipment ID is used to identify equipment in the application for the Microsoft Access database manager. The TAMCN is the Table of Authorized Material Control Number.

Table B.3
MESA Equipment List

Equipment ID	TAMCN	Equipment Name	Description
1	00CUB	SENADOR ACCESSORY KIT	
2	26633	GUN POD COFFIN (EMPTY)	
3	7070	MISSION KIT	
4	A0067	AN/MRC-148	A0067-AN/MRC-148 (HF/VHF)
5	A0234	SWAN BOX	
6	A0243	NETWORK BOXES	
7	A0255	COC AN/TSQ-239(V)4	A0255-COMBAT OPERATIONS CENTER (COC), TACTICAL COMMAND SYSTEM, AN/TSQ-239(V)4 (BN/SQDN)
8	A0499	DTC AN/TSQ-227	A0499-DIGITAL TECHNICAL CONTROL (DTC) FACILITY, AN/TSQ-227
9	A0966	AN/MLQ-36B	A0966-MOBILE ELECTRONIC WARFARE SUPPORT SYSTEM, AN/MLQ-36B
10	A1954	AN/MRC142B, DWTS (UHF)	A1954-RADIO TERMINAL SET, AN/MRC142B, DWTS (UHF)
11	A1955	AN/MRC-142A (UHF)	A1955-RADIO TERMINAL SET, AN/MRC-142A (UHF)
12	A1957	AN/MRC-145A (VHF)	A1957-RADIO SET, AN/MRC-145A (VHF)

Table B.3—Continued

Equipment ID	TAMCN	Equipment Name	Description
13	A3232	AN/TSC-154	A3232-TRANSPORTABLE TACSATCOM (SMART-T), AN/TSC-154
14	AH1	AH1-COBRA	AH1-COBRA
15	AV8	AV8-HARRIER	AV8-HARRIER
16	B0001	A/C 60HZ 9000 BTU	B0001-AIR CONDITIONER MCS HORIZONTAL 60HZ 9000 BTU
17	B0003	A/C 18000 BTU/HR	B0003-AIR CONDITIONER, 1.5 TON, 18,000 BTU/HR
18	B0004	A/C 400HZ, 1.5 TON	B0004-AIR CONDITIONER, MCS, HORIZONTAL, 400HZ, 1.5 TON
19	B0006	A/C 400HZ 3 TON	B0006-AIR CONDITIONER MCS VERTICAL 400HZ 3 TON
20	B0008	AIR CONDITIONER B0008	
21	B0014	A/C 36,000 BTU/HR	B0014-AIR CONDITIONER, 3 TON, 36,000 BTU/HR
22	B0015	PSI TRLR	
23	B0018	ITEG	B0018-INTEGRATED TRAILER-ECU-GENERATOR (ITEG)
24	B0037	GROUND EXPEDIENT REFUELING	
25	B0039	AIRFIELD DAMAGE REPAIR KIT	B0039-AIRFIELD DAMAGE REPAIR (ADR) KIT
26	B0040	MULTI TERRAIN LOADER (MTL)	
27	B0060	MEDIUM CRAWLER TRACTOR	B0060-MEDIUM CRAWLER TRACTOR (MCT)
28	B0063	TRACTOR, MULTI-PURPOSE	B0063-TRACTOR, RUBBER-TIRED, ARTICULATED STEERING, MULTI-PURPOSE (TRAM)

Table B.3—Continued

Equipment ID	TAMCN	Equipment Name	Description
29	B0076	CEB MTL ATTACHMENT CARRIER	
30	B0215	TRAM BUCKET	
31	B0589	M9 ACE	B0589-M9 ARMORED COMBAT EARTHMOVER
32	B0640	FLOODLIGHT SET	
33	B0647	CEB TRAM FORKS	
34	B0730	MEP 831	
35	B0891	MEP 803	
36	B0953	GENERATOR DIESEL 805A 30 KW	B0953-GENERATOR SET, DIESEL ENGINE MEP 805A 30 KW
37	B0980	GENERATOR DIESEL	B0980-GENERATOR SET, DIESEL ENGINE
38	B1021	MEP 806	
39	B1045	MEP 807	
40	B1298	MINE CLEARANCE SYSTEM	B1298-MINE CLEARANCE SYSTEM, TRAILER-MOUNTED, MK 2 MOD 0
41	B1570	FUEL PUMP	Expedient Refueling System (ERS) (includes 500-gal fabric drum B0570)
42	B1620	WATER PUMP	
43	B2085	SIXCON, FUEL	B2085-SIXCON, FUEL STORAGE TANK MODULE
44	B2086	SIXCON, WATER	B2086-WATER SIX CONTAINER (SIXCON) STORAGE TANK MODULE
45	B2464	TRACTOR, FULL TRACKED	B2464-TRACTOR, FULL TRACKED W/MULTI-PURPOSE BUCKET
46	B2482	TRACTOR, ALL WHEEL DRIVE	B2482-TRACTOR, ALL WHEEL DRIVE W/ATTACHMENTS

Table B.3—Continued

Equipment ID	TAMCN	Equipment Name	Description
47	B2483	LOADER,BACKHOE	
48	B2561	EXTENDABLE BOOM FORKLIFT	B2561-EXTENDABLE BOOM FORKLIFT TRUCK (EBFL)
49	B2565	ENGINEER EQUIPMENT TRAILER	
50	B2605	WATER PUR. SYSTEM (TWPS)	B2605-TACTICAL WATER PURIFICATION SYSTEM (TWPS)
51	B2685	WELDING MACHINE	B2685-WELDING MACHINE, ARC, TRL-MTD
52	BL001	RGR KIT	
53	BL618	MULTI PURPOSE CONTAINER	
54	C0077	SUPPLY JMIC	
55	C4431	PALCON (AVI)	
56	C4433	TANKS QUADCON	
57	C7007	BLT MAIN # 2 ALOC TRK	
58	C7033	SHOP EQUIPMENT	C7033-SHOP EQUIPMENT, CONTACT MAINTENANCE, COMMON #20
59	C7905	WELDINGTRLR	
60	C7908	LUPO	
61	CH46	CH 46 SEA KNIGHT	CH46-SEA KNIGHT
62	CH53	CH 53 SEA STALLION	CH53-SEA STALLION
63	CMOC	BN CAP SET 1	CMOC-CMOC- BN CAP SET 1
64	D0003	TRUCK, 7-TON, MTVR	D0003-TRUCK, 7-TON, ARMORED, MTVR
65	D0004	MTVR AMK 25	
66	D0005	MTVR MK 27	
67	D0007	TRUCK AMK29/AMK29A1	D0007-TRUCK, DUMP, 7 TON, ARMORED, W/O WINCH, AMK29/AMK29A1

Table B.3—Continued

Equipment ID	TAMCN	Equipment Name	Description
68	D0015	TRUCK AMK36	D0015-TRUCK, WRECKER, 7 TON, ARMORED, AMK36
69	D0016	TRAILER, CARGO	D0016-TRAILER, CARGO (LTT-H)
70	D0017	LTT-MCC	D0017-LIGHT TACTICAL TRAILER, MARINE CORPS CHASSIS (LTT-MCC)
71	D0030	TRUCK M1151A1,W/B1	D0030-TRUCK, UTILITY, EXPANDED CAPACITY, ARMAMENT CARRIER, M1151A1,W/B1 ARMOR KIT
72	D0031	MRC 145 (COMM)	
73	D0032	TRUCK M1167	D0032-TRUCK, UTILITY, EXPANDED CAPACITY, TOW CARRIER, ARMORED, M1167
74	D0033	TRUCK, UTILITY, ARMOR KIT	D0033-TRUCK, UTILITY, EXPANDED CAPACITY, ENHANCED, IAP/ARMOR READY,M1152A1 W/B2 ARMOR KIT
75	D0034	M1165/ CO S VIC	
76	D0081	TRAILER 4 TON, MK353	D0081-TRAILER, GENERAL PURPOSE, 4 TON, MK353
77	D0085	M116 TRLR	
78	D0195	LVSR FLAT RACK	
79	D0198	ARTY MTVR	
80	D0840	TRAILER, ITV-AT	D0840-TRAILER, ITV AMMUNITION (ITV-AT)
81	D0850	101 TRLR	
82	D0860	ARTY M105 TRLR	
83	D0862	TRLR CARGO MK105	D0862-TRLR, MTVR, CARGO, MK105
84	D0880	M149; WATER BULL LFSP	

Table B.3—Continued

Equipment ID	TAMCN	Equipment Name	Description
85	D0882	TRLR WATER MK149	D0882-TRLR, MTVR, WATER, MK149
86	D0886	TRUCK 22.5 TON LVSR	D0886-TRUCK, CARGO 22.5 TON, 10X10, (LVSR)
87	D1001	AMBULANCE M997	D1001-TRUCK, AMBULANCE, 4-LITTER, M997
88	D1002	AMBULANCE M1035	D1002-TRUCK, AMBULANCE, 2-LITTER, SOFT TOP, M1035
89	D1063	MTFR/MK37	D1063-MTVR,MK37(MK27W/ CRANE)
90	D1158	HUMVEE	D1158-TRUCK, UTILITY, CARGO/TROOP CARRIER, M998 (HUMVEE)
91	D1161	M1161 (ITV-LSV)	D1161-M1161 INTERNALLY TRANSPORTABLE VEHICLE, LIGHT STRIKE VARIANT (ITV-LSV)
92	D1162	M1162 (PM)	D1162-M1162 INTERNALLY TRANSPORTABLE VEHICLE, PRIME MOVER-WEAPON (PM)
93	E0076	TANK DOZER BLADE	
94	E0796	AAVC7A1-COMMAND	E0796-ASSAULT AMPHIBIOUS VEHICLE, COMMAND, AAVC7A1
95	E0846	AAVP7A1-PERSONNEL	E0846-ASSAULT AMPHIBIAN VEHICLE, PERSONNEL CARRIER (AAVP7A1)
96	E0856	AAVR7A1-RECOVERY	E0856-ASSAULT AMPHIBIAN VEHICLE, RECOVERY (AAVR7A1)
97	E0857	EFV (PERS)	E0857-EXPEDITIONARY FIGHTING VEHICLE (PERS)
98	E0858	EFV (CMND)	E0858-EXPEDITIONARY FIGHTING VEHICLE (CMND)
99	E0915	LAU 117	

Table B.3—Continued

Equipment ID	TAMCN	Equipment Name	Description
100	E0946	LAV-C2A1 C&C	E0946-LIGHT ARMORED VEHICLE (LAV) - COMMAND AND CONTROL (LAV-C2A1)
101	E0947	LAV-25A1 LIGHT ASSAULT	E0947-LIGHT ARMORED VEHICLE (LAV) - LIGHT ASSAULT (LAV-25A1)
102	E0948	LAV-L LOGISTICS	E0948-LIGHT ARMORED VEHICLE (LAV) - LOGISTICS (LAV-L)
103	E0950	LAV-RA1 MAINT	E0950-LIGHT ARMORED VEHICLE (LAV) - MAINTENANCE/RECOVERY (LAV-RA1)
104	E0951	LAV-MEWSS	E0951-LIGHT ARMORED VEHICLE - MOBILE ELECTRONC WARFARE SUPPORT SYSTEM (LAV-MEWSS)
105	E0996	M1A1 MINE CLEARING	E0996-BLADE, MINE CLEARING, TRACK WIDTH MINE PLOW, MAIN BATTLE TANK, M1A1
106	E1070	120MM EFSS	
107	E1378	RECOVERY VEHICLE M88A2	E1378-RECOVERY VEHICLE, HEAVY, FULL-TRACKED, M88A2
108	E1713	SAMS VAN	
109	E1714	COMM VAN	
110	E1888	TANK M1A1	E1888-TANK, COMBAT, FULL-TRACKED, 120 MM GUN, M1A1
111	GETT	TRAILER ASSEMBLY, GENERATOR	
112	HL246	OX CART	
113	JDHPX	JOHN DEERE HPX GATOR 4 WHEE	
114	JTFE	JTF-E	JTFE-JTF-E
115	L7261	TIRE PALLET	

Table B.3—Continued

Equipment ID	TAMCN	Equipment Name	Description
116	LM223	WOODEN B0X SA	
117	LP101	LPOD	
118	LR326	TRANSPORTER, MUNITIONS/ DRAW	
119	MK38	JUMP CP MK-38/48	MK38-JUMP CP MK-38/48
120	MPC3	MANPORTABLE C-3	MPC3-MAN PORTABLE C-3
121	MV03M	SUPPORT, WING COMPONENT REM	
122	MV22	MV-22 OSPREY	MV22-OSPREY
123	NB011	CONVERSION ACTUATOR	
124	PC60	AIM 9 COFFIN	
125	RGRKS	TBFDS	
126	RIB	RIB BOATS	RIB-RIB BOATS
127	S0030	MRE S	
128	SEE	SEE TRACTOR	SEE TRACTOR
129	SWAN	SWAN/SWEDISH	SWAN-SWAN/SWEDISH
130	TENTS	TENTS	TENTS-GP- TENTS
131	UH1	VENOM	UH1-VENOM
132	Y2052	MAT, FUEL TANK	
133	Y8760	TRAILER ADAPTER, SWASHPLATE	
134	Z0096	GEAR BOX TRAILER	
135	Z0116	TRANSMISSION ADAPTER ASSY	
136	Z0296	TRAILER ADAPTER, APU	
137	Z0299	ADAPTER,TRAILER,TILTAXIS GE	
138	Z0315	ADAPTER,TRAILER,MIDWING GEA	
139	Z0324	HANDLING ADAPTER,MAIN LANDI	

Table B.3—Continued

Equipment ID	TAMCN	Equipment Name	Description
140	Z0340	ADAPTER SET, BLADE TRAILER	
141	Z0932	ADAPTER, HUB & BLADE ASSEMB	
142	Z1156	STAND, SHIPBOARD	
143	Z1279	TAIL ROTOR BLADE CART	
144	Z1728	LAU 7	
145	ZUAVC	UAV GCS GROUND STATION	ZUAVC-UAV GCS GROUND CONTROL STATION
146	ZUAVD	UAV GROUND DATA TERMINAL	ZUAVD-UAV GROUND DATA TERMINAL
147	ZUAVT	UAV TRLR	ZUAVT-UAV TRLR

NOTE: CMOC = civilian-military operations center.

Summary

This guide described the functionality of each of the MESA interface screens, documented the purpose and relationship of the SQL tables comprising the underlying Access database, and provided an example of how to modify the tables to expand the capabilities of the application. By understanding and modifying the database structure, the user is able to expand the mission list, enhance existing missions, modify inventories, and add new equipment items. The easiest way for the user to become familiar with the structure and characteristics of the MESA SQL table structure is to simply double-click on the table name in the left-hand panel of the application. This will open the table in a spreadsheet format. Another extremely useful tool is the Relationship Manager, which is accessed from the toolbar by clicking on "Database Tools" and then "Relationships." MESA is intended to be a flexible piece of software, and users are encouraged to explore its underlying components.

APPENDIX C

Stress Test Tutorial

This appendix describes in detail the sequencing of the stress test cases and the specific assumptions made about the nature of the missions and about certain joint assets that the MEU might need to accomplish those missions. It also includes a detailed walkthrough of how to develop inputs and produce outputs in the MESA application using actual examples from the stress test.

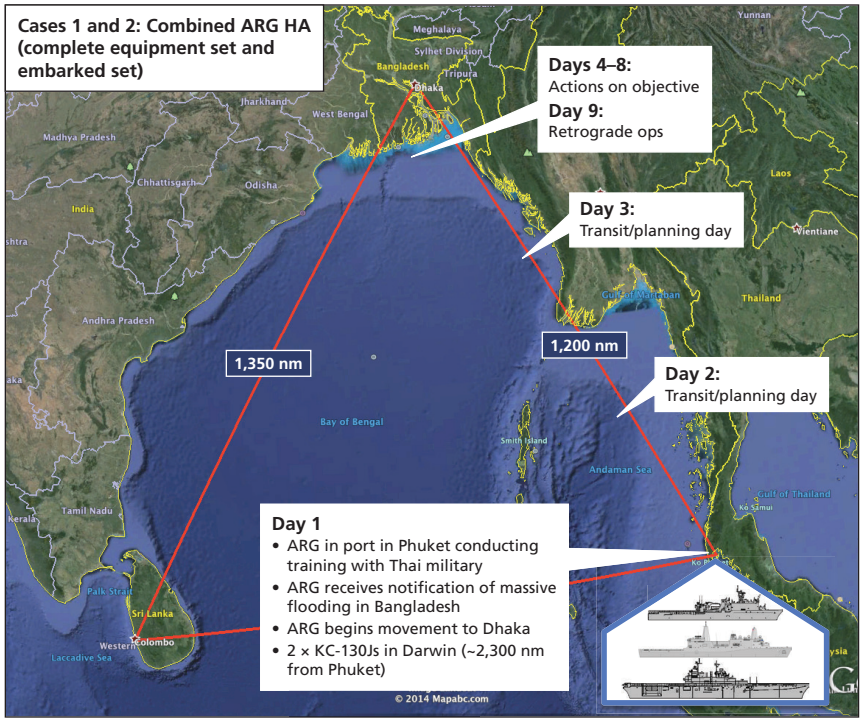
The Stress Test Cases

In this section, we detail the sequencing of the eight cases discussed in Chapter Six. The objective is to illustrate a realistic set of scenarios to use both as a stress test for the MESA application and as the basis of the tutorial that follows.

Sequencing of Stress Test Cases 1 and 2

As illustrated in Figure C.1, the mission flow for cases 1 and 2 starts on Day 1 with the full ARG in Phuket, Thailand. The MEU is there to conduct training with the Thai military, and while there it receives notification of massive flooding in Bangladesh. After receiving a warning order to conduct HA operations in and around Dhaka, the MEU starts planning for the mission and departs Phuket. The MEU KC-130Js are in Darwin, Australia (which is approximately 2,300 nm southeast of Phuket), undergoing maintenance. Day 2 is a transit and planning day for the ARG, during which the MEU finalizes HA mission planning. By the end of this day, the ARG has moved approxi-

Figure C.1
Cases 1 and 2: Combined ARG HA Mission (Complete Equipment Set and Embarked Set)



SOURCE: Google Earth image, obtained early June 2014, with author overlay.
RAND *TL167-C.1*

mately 480 nm closer to Dhaka. Day 3 is the second transit and planning day for the ARG/MEU. By the end of the day, the ARG is within 300 nm of Dhaka, so actions on the objective take place in the early morning hours of Day 4. Days 4–8 are steady-state HA operations in Dhaka. Day 9 features retrograde operations.

Mission assumptions:

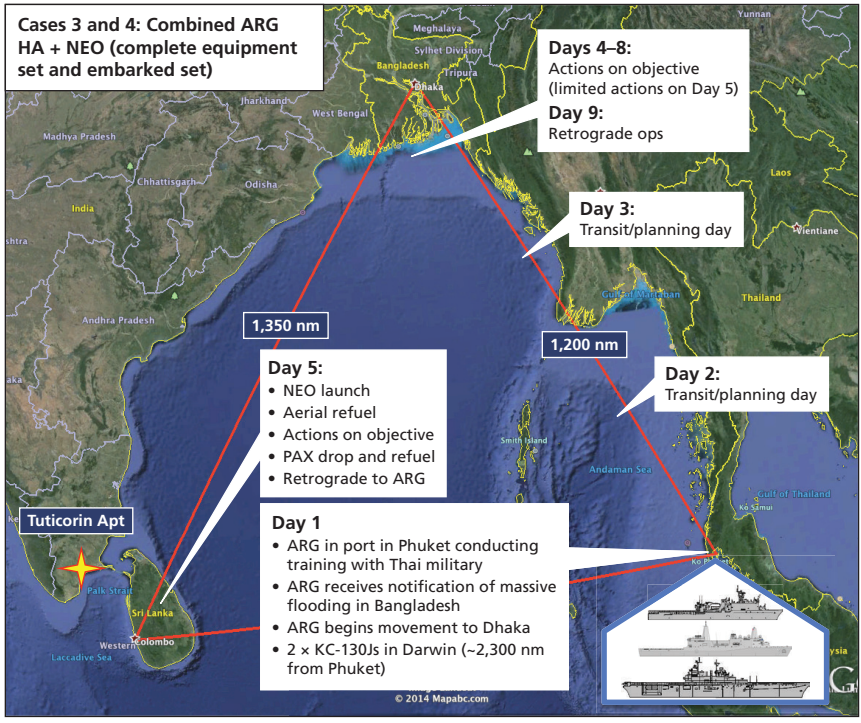
- The ARG moves at a speed of at 20 kts and covers 480 nm in 24 hours.
- The combat radius of the MV-22 is 325 nm.

- The combat radius of the CH-53E is 225 nm.
- The ARG is established in an off shore holding pattern 150 nm from Dhaka and is unable to offload at a port.
- Two KC-130Js arrive at Dhaka International Airport on Day 4.

Sequencing of Stress Test Cases 3 and 4

The mission flow for cases 3 and 4 is illustrated in Figure C.2. As in the previous two cases, the mission begins on Day 1 with the full ARG in Phuket, Thailand. The events from Day 2 through Day 4 are the same as in the previous two cases, ending with HA operations taking

Figure C.2
Cases 3 and 4: Combined ARG HA and NEO Mission (Complete Equipment Set and Embarked Set)



SOURCE: Google Earth image, obtained early June 2014, with author overlay.
RAND *TL167-C.2*

place during Days 4–8. However, for these two cases, the MEU also conducts NEO mission in Colombo, Sri Lanka, on Day 5. As in the previous cases, Day 9 features retrograde operations.

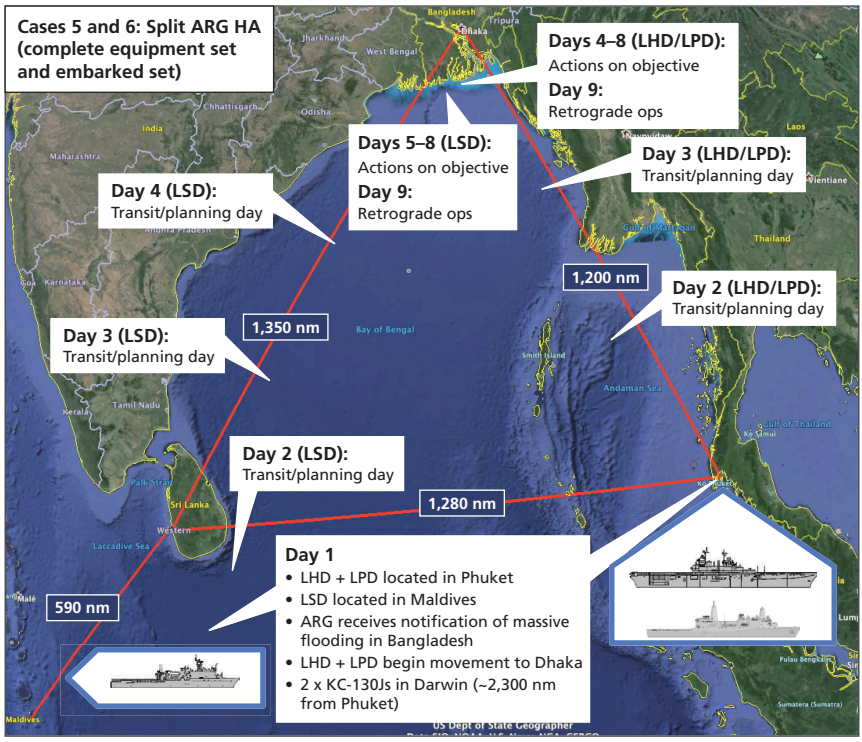
Mission assumptions are the same as in cases 2 and 3, with the addition of the following:

- Two KC-130s are reconfigured at the end of Day 4 to provide aerial refueling capability for MV-22 movement to Colombo, Sri Lanka on Day 5.
- The United States initiates talks with India to use Tuticorin Airport (150 nm from Colombo) as a staging base before movement to Maldives via AF KC-135s from Diego Garcia.
- AV-8Bs conduct aerial refueling at altitude with AF KC-135s launched from Diego Garcia.
- For the NEO mission on Day 5, MV-22s need to aerial refuel one time at the 700 nm mark and again at Tuticorin airport after dropping passengers.
- The NEO mission duration to the passenger drop at Tuticorin is 7 hours.
- The total NEO mission duration is 12 hours.

Sequencing of Stress Test Cases 5 and 6

Figure C.3 depicts cases 5 and 6. On Day 1, the LHD and LPD is in Phuket, Thailand, while the LSD is located in the Maldives and the KC-130Js are located in Darwin, Australia. As with Cases 1 through 4, the MEU receives a warning order to conduct HA operations in response to massive flooding in Bangladesh. As a result, the LSD and the LHD/LPD task forces depart the Maldives and Thailand, respectively, and start heading for Bangladesh. Day 2 is a transit and planning day for the split ARG. By the end of this day, both task forces of the ARG have moved approximately 480 nm closer to Dhaka; however, they are still approximately 1,000 nm apart. Day 3 is another transit and planning day for the split ARG. By the end of this day, both task forces of the ARG have moved approximately 480 nm closer to Dhaka; however, they are still approximately 750 nm apart. Day 4 is the first full day of the HA operation being conducted by the LHD/LPD task

Figure C.3
Cases 5 and 6: Split ARG HA Mission (Complete Equipment Set and Embarked Set)



SOURCE: Google Earth image, obtained early June 2014, with author overlay.
RAND *TL167-C.3*

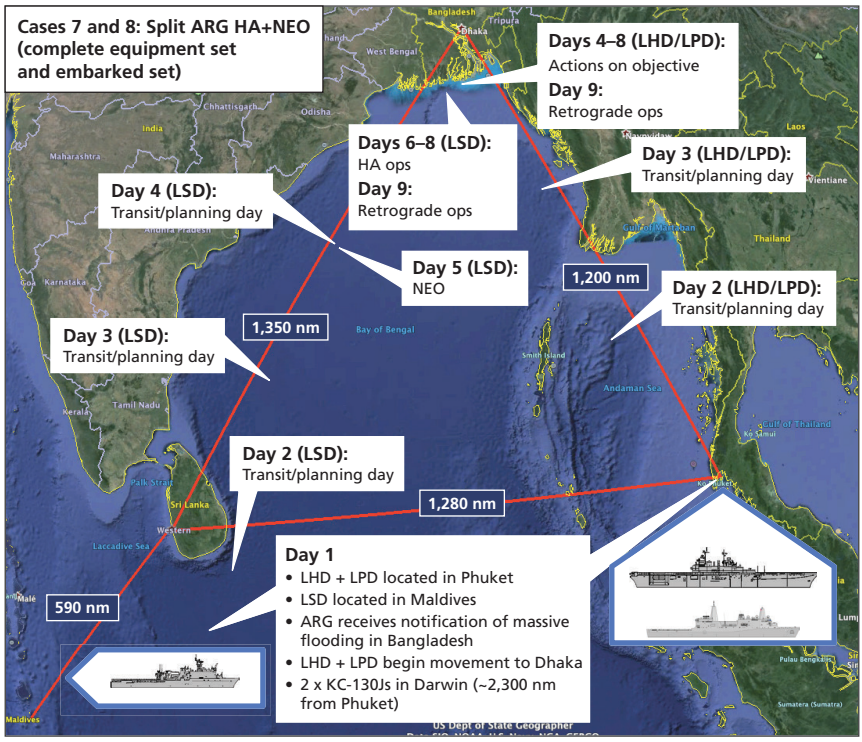
force. The LSD is still approximately 450 nm to the southeast, so it is still unable to support the HA mission. During Days 5–8, a reunited ARG positioned off the coast of Bangladesh conducts the HA mission. Day 9 features retrograde operations, where the LSD heads back toward the Maldives and the LHD/LPD head back toward Thailand.

Mission assumptions are the same as those listed for cases 1 and 2.

Sequencing of Stress Test Cases 7 and 8

Cases 7 and 8 are depicted in Figure C.4. Both cases parallel the events described in cases 6 and 7 until Day 4. By the end of Day 4, the LSD

Figure C.4
Cases 7 and 8: Split ARG HA and NEO Missions (Complete Equipment Set and Embarked Set)



SOURCE: Google Earth image, obtained early June 2014, with author overlay.
RAND *TL167-C.4*

task force receives the warning order to conduct the NEO. This is due to its closer position to Sri Lanka and available MV-22s. During Day 5, the LHD/LPD task force conducts HA operations and the LSD task force conducts the NEO operation, the priority mission at the time. As in cases 6 and 7, a reunited ARG positioned off the coast of Bangladesh conducts the HA mission during Days 5–8. Day 9 features retrograde operations, where the LSD heads back toward the Maldives and the LHD/LPD head back toward Thailand.

Mission assumptions are the same as for cases 3 and 4.

A MESA Tutorial

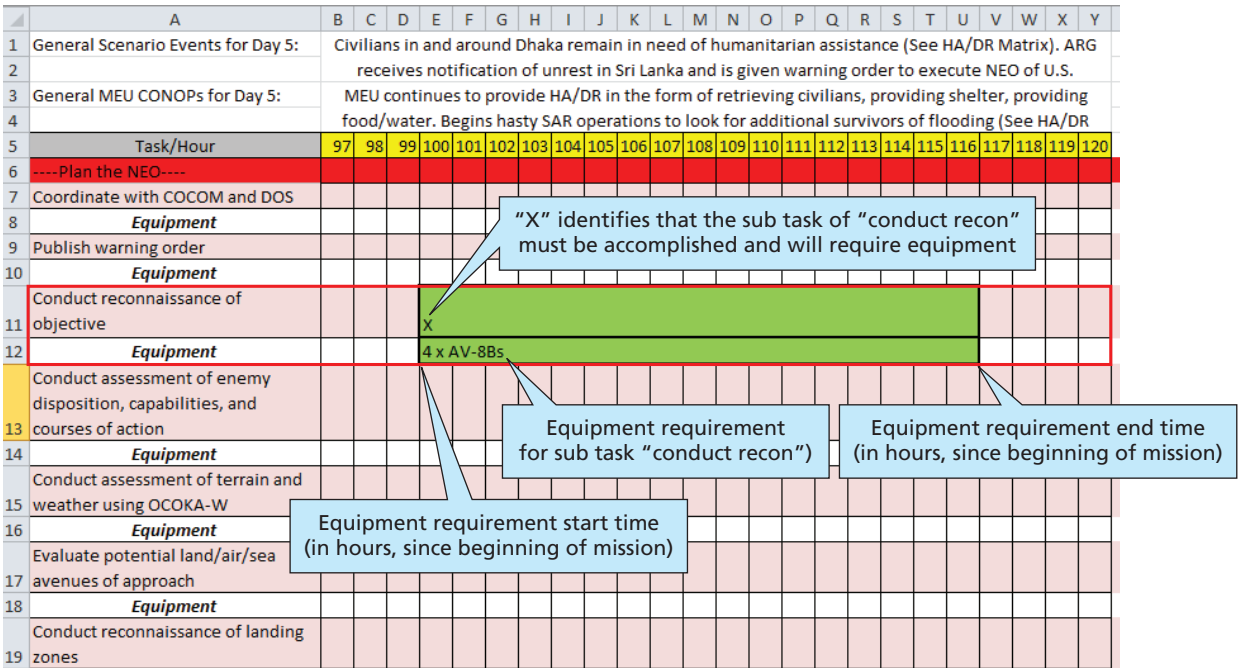
The following section provides a detailed walkthrough of how to develop inputs, observe MESA calculations, and produce outputs with the MESA tool, which in turn facilitates the shortfall analysis. Chapter Six provides an overview of the stress test and its findings. Appendix B details use of the application. The following is intended to be complementary to Chapter Six and Appendix B, with its illustration of some of the actual inputs used during the stress test.

Planning the Mission

Mission planning identifies mission requirements that are to be applied to each case. A Synch Matrix tool is used for mission planning, as depicted in Figure C.5. Equipment tasks, equipment items, and task times (beginning and duration) are initially catalogued in order to facilitate next phase: producing and entering requirements for the MESA application. Once all requirements were entered, the application conducts a series of calculations that are displayed through various outputs described in Chapter Five. These outputs are then compared with other similar tests, contextualized for the conditions and inputs selected, and generally analyzed prior to drawing any final shortfall related conclusions.

Figure C.5 is an example of a Synch Matrix for a NEO, which occurs on Day 5 in this scenario, hours 97–120. The entries at the top of the page provide a brief synopsis of scenario events to help orient the user. The first column lists the tasks and subtasks. It shows that the sub task of "conduct reconnaissance of objective" will require equipment, as shown by the "X." In this case, the user decided to allocate four AV-8B Harriers to accomplish this sub task, starting at the beginning of hour 100 and concluding at the end of hour 116. For both HA and NEO missions, Synch Matrices such as this were created to satisfy the mission requirements derived from the notional scenario and used to facilitate the MESA inputs process.

Figure C.5
Synch Matrix Example



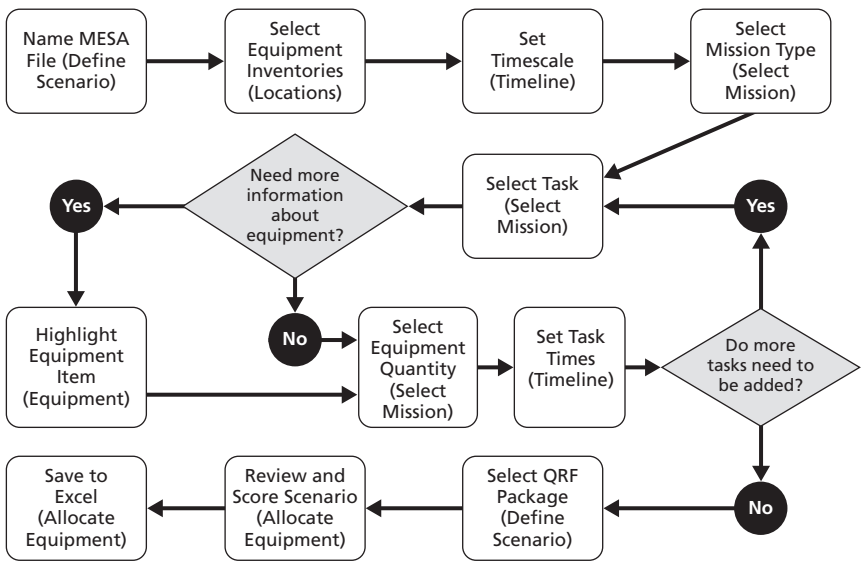
NOTE: OCOKA-W = observation, cover and concealment, obstacles, key terrain, avenues of approach, weather.

RAND *TL167-C.5*

Developing Inputs and Producing Outputs

Following the mission planning stage (in this case enabled through the use of multiple Synch Matrices), the required inputs are completed and entered into the MESA application. The inputs are scored (see Chapter Five) and outputs are produced. In most cases, this is an iterative process. The MESA application uses a flexible interface of multiple tabs for the user to easily navigate the various input and subsequent scoring screens. The steps beyond the planning stage are depicted in the process diagram at Figure C.6. The three phases (developing inputs, observing calculations, and producing outputs) can be described through discrete steps in the diagram. The parenthetical items in the rectangular process boxes are the tabs to be selected to enter commands (see the user's guide in Appendix B).

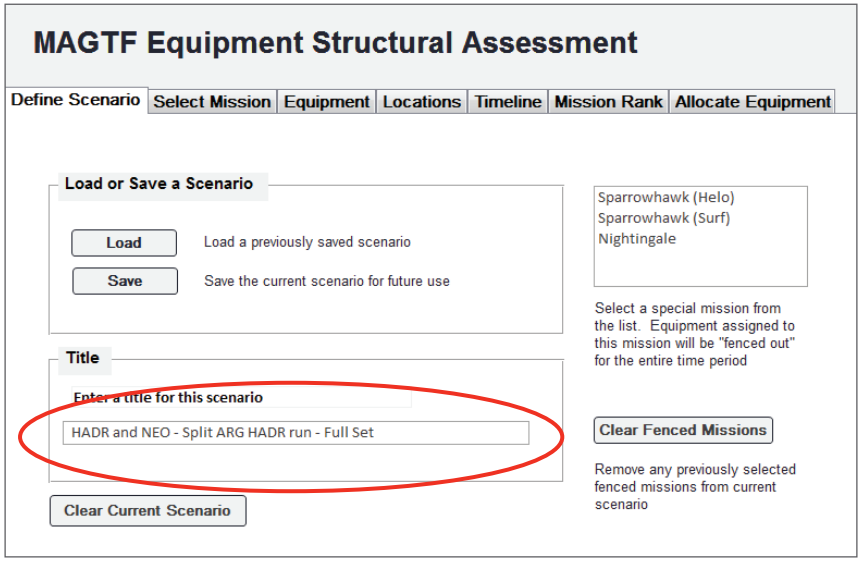
Figure C.6
MESA Application Process Diagram



RAND *TL167-C.6*

Figures C.7 through C.20 are MESA application screen shots depicting the actions taken at each of the process boxes in Figure C.6. These actions include the three phases: developing inputs, observing calculations, and producing outputs associated with the stress test. The first step is conducted on the "Define Scenario" tab and gives the user the option to either load a previously saved file or to name and save a new file (Figure C.7). In this case, we chose to create a new scenario and name it "HADR and NEO—Split ARG HADR run—Full Set."

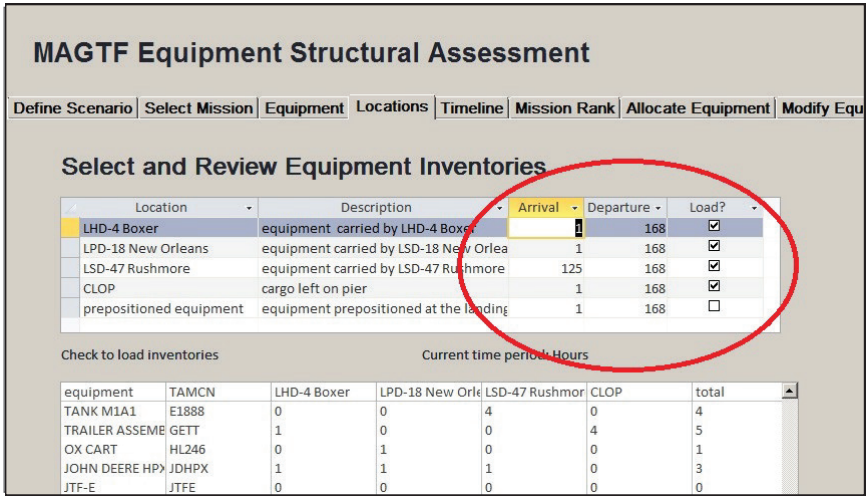
Figure C.7
Select Mission and Name Scenarios



RAND *TL167-C.7*

The second step, select equipment inventories, is depicted in Figure C.8. The user selects which *location* of equipment will be available and sets what time that equipment list will be available to complete tasks.[1] The display below the open fields shows what equipment inventories are available at each location. In this case, the complete set of equipment (MEU embarked set plus CLOP) is available, but because of the split ARG, the LSD-47 *Rushmore* equipment inventory is not accessible for the HA mission until hour 125.

Figure C.8
Select Equipment Inventories

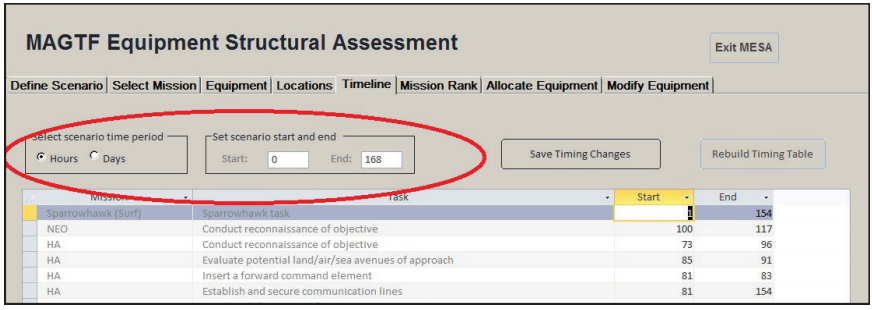


RAND *TL167-C.8*

[1] The application contains a predetermined set of inventories of equipment (termed *locations*) potentially available to the mission. These locations can represent ships (e.g., USS *Boxer*), prepositioned dumps, CLOP, fixed base locations, and anything else deemed appropriate. See Chapter Five and Appendix B for details.

Once equipment inventories are selected the user sets the timescale to be applied throughout the mission. On the "Timeline" tab depicted in Figure C.9, the time unit selected can be hours or days. The beginning and end of the mission is set on this tab as well. The scenario start and end times also define any fenced mission sets such as QRFs, which will automatically be given a task timeline for the duration of the mission. Recall that the equipment associated with the QRF is fenced, in this case for the entire mission; equipment allocated to this force is no longer available for other tasks. The scenario defined in this case lasts 168 hours.

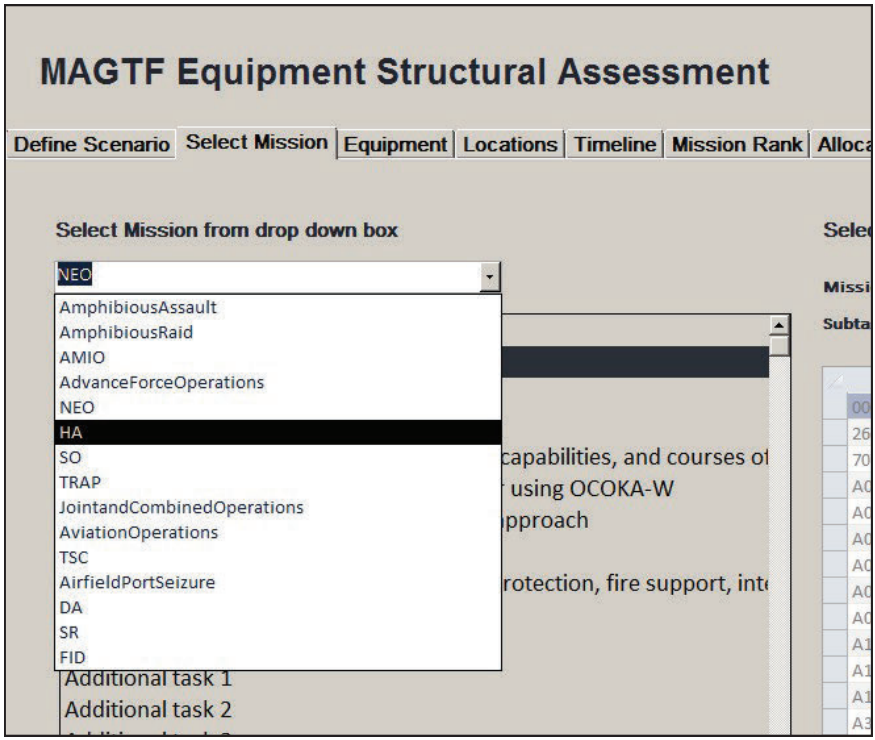
Figure C.9
Set Timescale



RAND *TL167-C.9*

Next, the user must select the mission to be executed. Figure C.10 depicts the "Select Mission" tab. The user selects the mission (NEO in this case) from the drop-down menu on the left side of the screen.

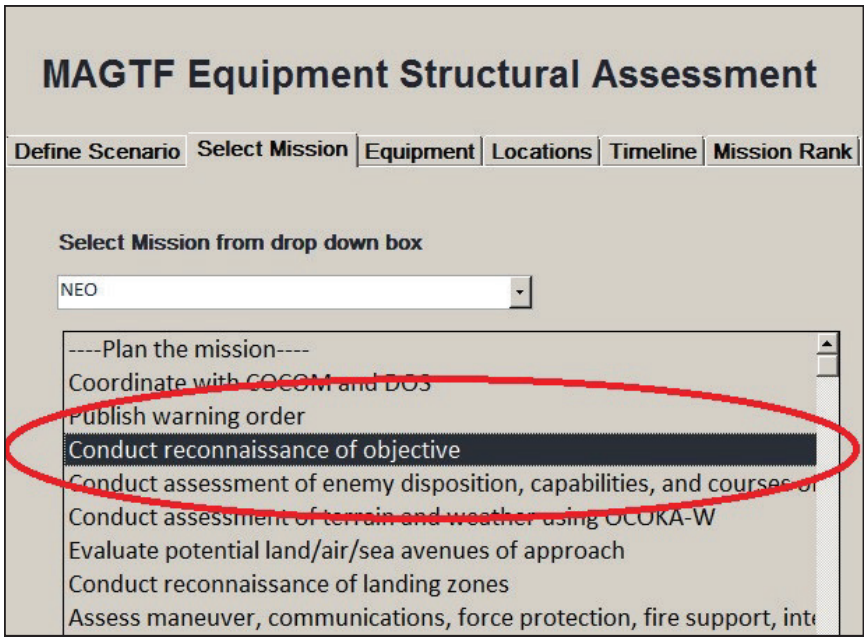
Figure C.10
Select Mission



RAND *TL167-C.10*

With the mission selected, user can begin selecting tasks and subtasks. In Figure C.11, the subtask, "Conduct reconnaissance of objective," under the general task of "Plan the mission," is selected. When highlighted, this task can now be assigned equipment and defined by a start and stop time period.

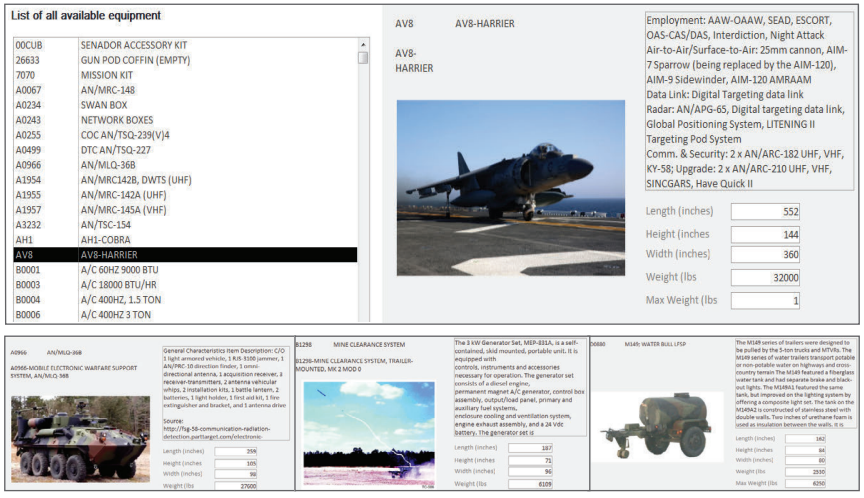
Figure C.11
Select Task



RAND *TL167-C.11*

There may be times when the user is not certain what equipment item is most appropriate or how many will be needed for a given task. This is the first question junction within the MESA Process Map in Figure C.6. If more information is needed, the user navigates to the "Equipment" tab to learn more about equipment items in the collective inventory. In Figure C.12, multiple items were selected and screened for their descriptions, operating capacities, and dimensions. It was determined that the AV-8 Harrier would be most appropriate for the reconnaissance task selected.

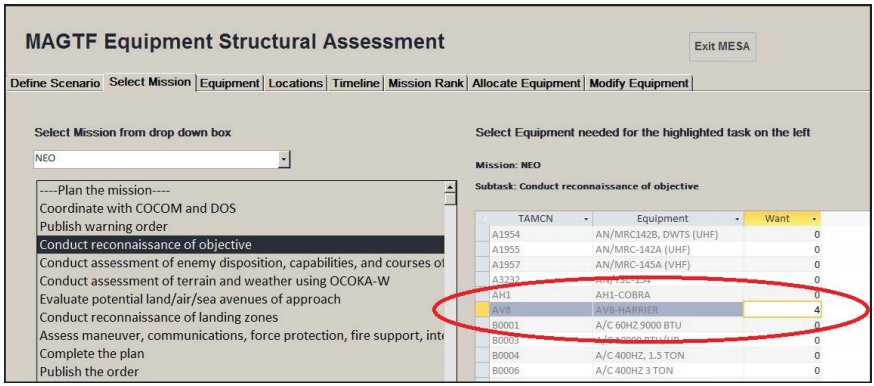
Figure C.12
Get Information About Equipment Items



RAND *TL167-C.12*

By returning to the "Select Mission" tab, the user can now assign the proper equipment item to the selected task and record the quantity required. As demonstrated in Figure C.13, four AV-8 Harriers are selected for the subtask of "Conduct reconnaissance of objective" under the task of "Plan the mission." The "Have" column to the left of the entry field lists the current available inventory as a reference.

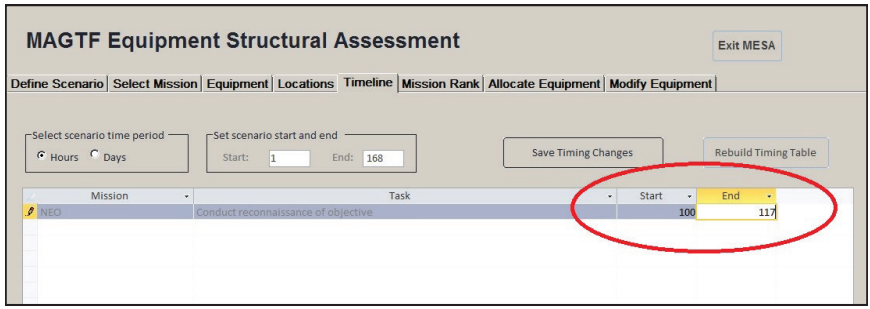
Figure C.13
Select Equipment Quantity Required



RAND *TL167-C.13*

Once the task and equipment items for that task have been selected, the user navigates to the "Timeline" tab to enter the beginning and end time period in hours for the task, which now appears in the first row of the "Timeline" screen. Figure C.14 indicates that reconnaissance in support of planning the NEO mission is scheduled to occur from hour 100 to hour 117.

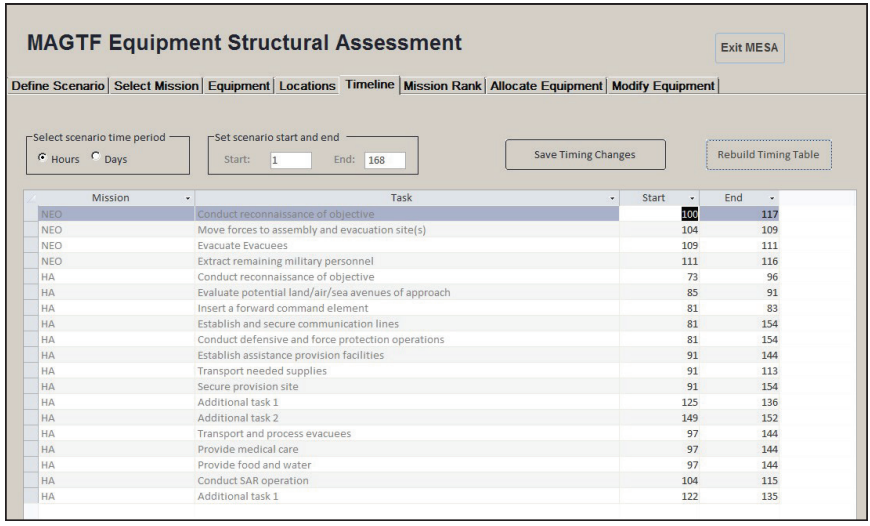
Figure C.14
Set Times for Task



RAND *TL167-C.14*

The previous step completes the inputs required for the first task, which is now saved in the MESA application. At the second question junction of the MESA Process Map (Figure C.6), additional tasks are loaded repeating the previous four steps. Once all tasks with respective equipment items and times have been loaded into the MESA application, they can be viewed by mission type in the "Timeline" tab, as depicted in Figure C.15. The NEO and HA mission tasks and subtasks are depicted in the figure.

Figure C.15
Repeat Task and Equipment Selection Tasks

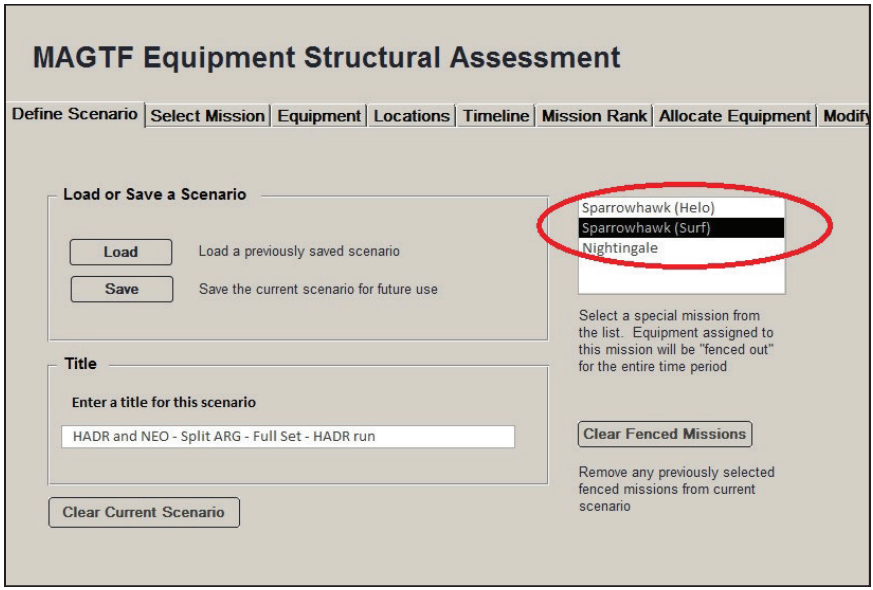


Mission	Task	Start	End
NEO	Conduct reconnaissance of objective	100	117
NEO	Move forces to assembly and evacuation site(s)	104	109
NEO	Evacuate Evacuees	109	111
NEO	Extract remaining military personnel	111	116
HA	Conduct reconnaissance of objective	73	96
HA	Evaluate potential land/air/sea avenues of approach	85	91
HA	Insert a forward command element	81	83
HA	Establish and secure communication lines	81	154
HA	Conduct defensive and force protection operations	81	154
HA	Establish assistance provision facilities	91	144
HA	Transport needed supplies	91	113
HA	Secure provision site	91	154
HA	Additional task 1	125	136
HA	Additional task 2	149	152
HA	Transport and process evacuees	97	144
HA	Provide medical care	97	144
HA	Provide food and water	97	144
HA	Conduct SAR operation	104	115
HA	Additional task 1	122	135

RAND *TL167-C.15*

The final input step is to select what, if any, QRF is desired for the mission. The QRF options are found on the "Define Scenario" tab and are considered to be fenced, because whatever equipment items associated with those fenced missions will be given first priority for the duration of the mission and not made available for use in any other task. In Figure C.16, the sparrowhawk (Surf) package is selected, which represents a platoon of AAVs.[2]

Figure C.16
Select QRF Package(s) Desired

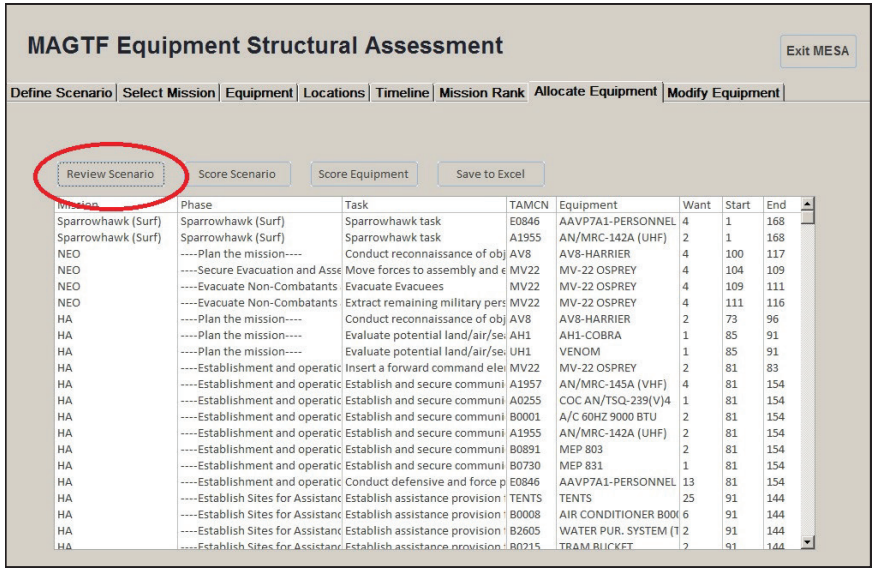


RAND *TL167-C.16*

[2] It is always good to save the inputs into MESA by selecting the "Save" button on the "Define Scenario" tab regularly. However, the QRF package selection step is listed as the last in the inputs here as a reminder to save the file prior to conducting the next stage of the process, which includes MESA calculations.

Now that all of the inputs have been loaded, the MESA calculations can be conducted by navigating to the "Allocate Equipment" tab and selecting the "Review Scenario" button. This function uses all of the inputs to calculate shortfalls—if there are any. When "Review Scenario" is selected in Figure C.17, an overview of all missions, tasks, subtasks, equipment items, quantities, and start and end time periods is displayed. This is a helpful screen to confirm that all inputs have been recorded correctly.

Figure C.17
Review Scenario

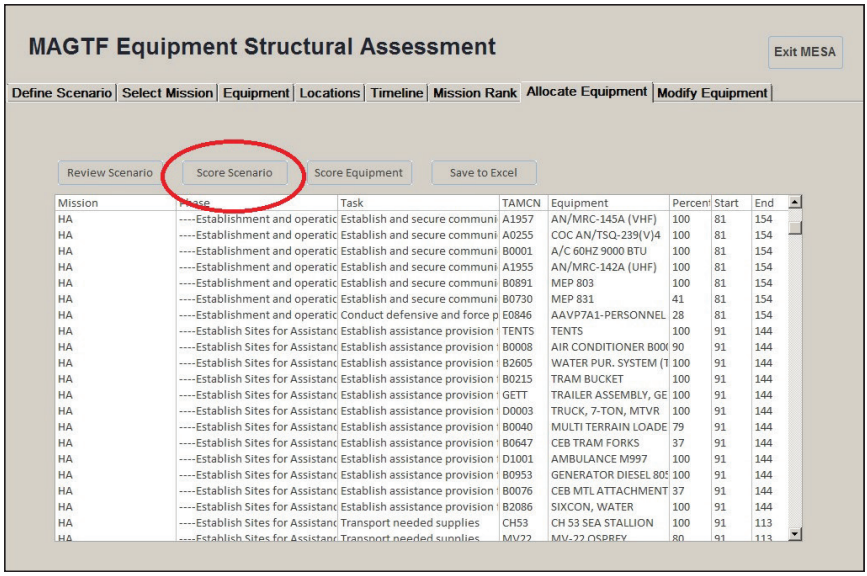


Mission	Phase	Task	TAMCN	Equipment	Want	Start	End
Sparrowhawk (Surf)	Sparrowhawk (Surf)	Sparrowhawk task	E0846	AAVP7A1-PERSONNEL	4	1	168
Sparrowhawk (Surf)	Sparrowhawk (Surf)	Sparrowhawk task	A1955	AN/MRC-142A (UHF)	2	1	168
NEO	----Plan the mission----	Conduct reconnaissance of obj	AV8	AV8-HARRIER	4	100	117
NEO	----Secure Evacuation and Asse	Move forces to assembly and e	MV22	MV-22 OSPREY	4	104	109
NEO	----Evacuate Non-Combatants	Evacuate Evacuees	MV22	MV-22 OSPREY	4	109	111
NEO	----Evacuate Non-Combatants	Extract remaining military pers	MV22	MV-22 OSPREY	4	111	116
HA	----Plan the mission----	Conduct reconnaissance of obj	AV8	AV8-HARRIER	2	73	96
HA	----Plan the mission----	Evaluate potential land/air/se	AH1	AH1-COBRA	1	85	91
HA	----Plan the mission----	Evaluate potential land/air/se	UH1	VENOM	1	85	91
HA	----Establishment and operatic	Insert a forward command ele	MV22	MV-22 OSPREY	2	81	83
HA	----Establishment and operatic	Establish and secure communi	A1957	AN/MRC-145A (VHF)	4	81	154
HA	----Establishment and operatic	Establish and secure communi	A0255	COC AN/TSQ-239(V)4	1	81	154
HA	----Establishment and operatic	Establish and secure communi	B0001	A/C 60HZ 9000 BTU	2	81	154
HA	----Establishment and operatic	Establish and secure communi	A1955	AN/MRC-142A (UHF)	2	81	154
HA	----Establishment and operatic	Establish and secure communi	B0891	MEP 803	2	81	154
HA	----Establishment and operatic	Establish and secure communi	B0730	MEP 831	1	81	154
HA	----Establishment and operatic	Conduct defensive and force p	E0846	AAVP7A1-PERSONNEL	13	81	154
HA	----Establish Sites for Assistanc	Establish assistance provision	TENTS	TENTS	25	91	144
HA	----Establish Sites for Assistanc	Establish assistance provision	B0008	AIR CONDITIONER B00(	6	91	144
HA	----Establish Sites for Assistanc	Establish assistance provision	B2605	WATER PUR. SYSTEM (T	2	91	144
HA	----Establish Sites for Assistanc	Establish assistance provision	B0215	TRAM BUCKET	2	91	144

RAND *TL167-C.17*

The next button on the "Allocate Equipment" tab is the "Score Scenario" button. When this is selected, MESA displays the shortfall percentages it calculated for each mission, task, subtask, and equipment item along with the time period in question. This view, displayed in Figure C.18, is helpful to quickly identify what equipment items and tasks are not fully satisfied with available equipment and to what degree.

Figure C.18
Score Scenario

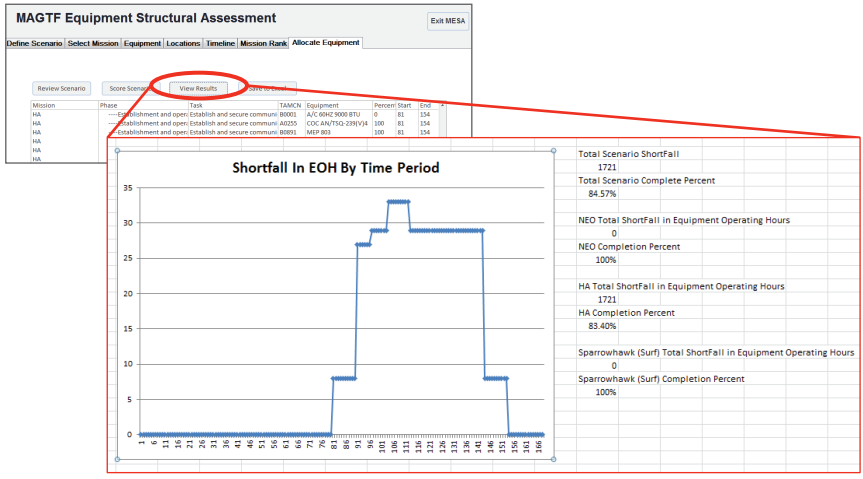


RAND *TL167-C.18*

If the user selects the "Score Equipment" button on the same tab, MESA populates the overall scenario shortfalls results in a separate Excel file. This file includes separate tabs for each time period section of the mission (in this case, 24-hour periods). The final tab includes the image displayed in Figure C.19, which lists the total equipment operating hours that are not satisfied for the mission. This is referred to as the *absolute shortfall*.

Also included in this tab is a graph of the equipment operating hour shortfalls total count for each time period. This chart describes where along the mission the most shortfalls are experienced. The metric used is equipment operation hours, or EOH. In the case highlighted in Figure C.19, there are no shortfalls for the initial stages of the operation, shortfalls increase as activity increases and peaks during the period in which both the HA and NEO missions are being conducted simultaneously, and then drops again during the retrograde phases of the scenario.

Figure C.19
Score Equipment

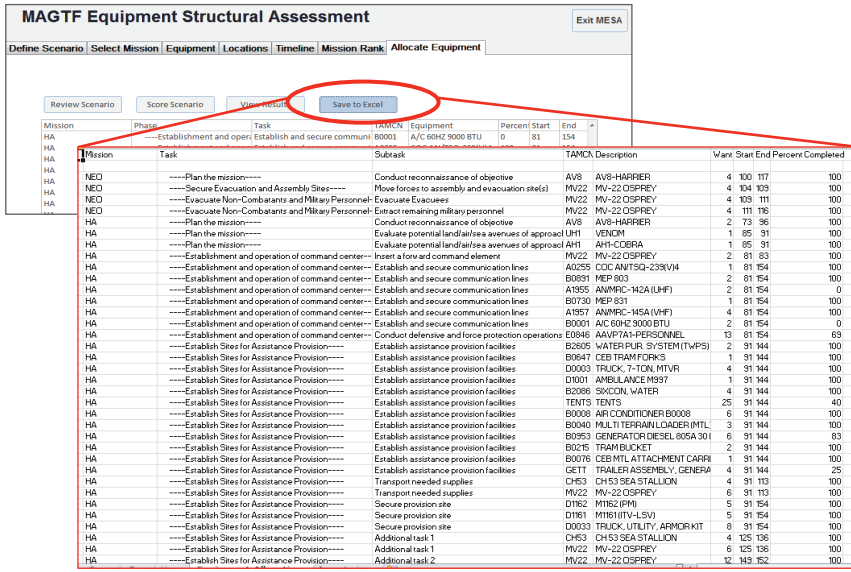


NOTES: This screenshot shows an older version of MESA in which the "Score Equipment" tab was labeled "View Results." EOH = equipment operating hours.

RAND *TL167-C.19*

If the user returns to the "Allocate Equipment" tab and selects the "Save to Excel" button, MESA produces a separate Excel file that contains the detailed scenario results. This file, pictured in Figure C.20, is useful for isolating key tasks and equipment items for more in-depth analysis.

Figure C.20
Save to Excel



Mission	Task	Subtask	TAMCN	Description	Want	Start	End	Percent Completed
NEO	----Plan the mission----	Conduct reconnaissance of objective	AV8	AV8-HARRIER	4	100	117	100
NEO	----Secure Evacuation and Assembly Sites----	Move forces to assembly and evacuation site(s)	MV22	MV-22 OSPREY	4	104	109	100
NEO	----Evacuate Non-Combatants and Military Personnel-	Evacuate Evacuees	MV22	MV-22 OSPREY	4	109	111	100
NEO	----Evacuate Non-Combatants and Military Personnel-	Extract remaining military personnel	MV22	MV-22 OSPREY	4	111	116	100
HA	----Plan the mission----	Conduct reconnaissance of objective	AV8	AV8-HARRIER	2	73	96	100
HA	----Plan the mission----	Evaluate potential landfair/sea avenues of approacl	UH1	VENOM	1	85	91	100
HA	----Plan the mission----	Evaluate potential landfair/sea avenues of approacl	AH1	AH1-COBRA	1	85	91	100
HA	----Establishment and operation of command center--	Insert a forward command element	MV22	MV-22 OSPREY	2	81	83	100
HA	----Establishment and operation of command center--	Establish and secure communication lines	A0255	COC AN/TSQ-239(V)4	1	81	154	100
HA	----Establishment and operation of command center--	Establish and secure communication lines	B0891	MEP 803	2	81	154	100
HA	----Establishment and operation of command center--	Establish and secure communication lines	A1955	AN/MRC-142A (UHF)	2	81	154	0
HA	----Establishment and operation of command center--	Establish and secure communication lines	B0730	MEP 831	1	81	154	100
HA	----Establishment and operation of command center--	Establish and secure communication lines	A1957	AN/MRC-145A (VHF)	4	81	154	100
HA	----Establishment and operation of command center--	Establish and secure communication lines	B0001	A/C 60HZ 9000 BTU	2	81	154	0
HA	----Establishment and operation of command center--	Conduct defensive and force protection operations	E0846	AAVP7A1-PERSONNEL	13	81	154	69
HA	----Establish Sites for Assistance Provision-----	Establish assistance provision facilities	B2605	WATER PUR. SYSTEM (TWPS)	2	91	144	100
HA	----Establish Sites for Assistance Provision-----	Establish assistance provision facilities	B0647	CEB TRAM FORKS	1	91	144	100
HA	----Establish Sites for Assistance Provision-----	Establish assistance provision facilities	D0003	TRUCK, 7-TON, MTVR	4	91	144	100
HA	----Establish Sites for Assistance Provision-----	Establish assistance provision facilities	D1001	AMBULANCE M997	1	91	144	100
HA	----Establish Sites for Assistance Provision-----	Establish assistance provision facilities	B2086	SIXCON, WATER	4	91	144	100
HA	----Establish Sites for Assistance Provision-----	Establish assistance provision facilities	TENTS	TENTS	25	91	144	40
HA	----Establish Sites for Assistance Provision-----	Establish assistance provision facilities	B0008	AIR CONDITIONER,B0008	6	91	144	100
HA	----Establish Sites for Assistance Provision-----	Establish assistance provision facilities	B0040	MULTI TERRAIN LOADER (MTL	3	91	144	100
HA	----Establish Sites for Assistance Provision-----	Establish assistance provision facilities	B0953	GENERATOR DIESEL 60SA 30 I	6	91	144	83
HA	----Establish Sites for Assistance Provision-----	Establish assistance provision facilities	B0215	TRAM BUCKET	2	91	144	100
HA	----Establish Sites for Assistance Provision-----	Establish assistance provision facilities	B0076	CEB MTL ATTACHMENT CARRI	1	91	144	100
HA	----Establish Sites for Assistance Provision-----	Establish assistance provision facilities	GETT	TRAILER ASSEMBLY, GENERA	4	91	144	25
HA	----Establish Sites for Assistance Provision-----	Transport needed supplies	CH53	CH 53 SEA STALLION	4	91	113	100
HA	----Establish Sites for Assistance Provision-----	Transport needed supplies	MV22	MV-22 OSPREY	6	91	113	100
HA	----Establish Sites for Assistance Provision-----	Secure provision site	D1162	M1162 (PM)	5	91	154	100
HA	----Establish Sites for Assistance Provision-----	Secure provision site	D1161	M1161(ITV-LSV)	5	91	154	100
HA	----Establish Sites for Assistance Provision-----	Secure provision site	D0033	TRUCK, UTILITY, ARMOR KIT	8	91	154	100
HA	----Establish Sites for Assistance Provision-----	Additional task 1	CH53	CH 53 SEA STALLION	4	125	136	100
HA	----Establish Sites for Assistance Provision-----	Additional task 1	MV22	MV-22 OSPREY	6	125	136	100
HA	----Establish Sites for Assistance Provision-----	Additional task 2	MV22	MV-22 OSPREY	12	149	152	100

RAND *TL167-C.20*

With these results, one can then proceed into shortfall analysis, which is covered in detail for the stress test in Chapter Six.

Abbreviations

AAV	amphibious assault vehicle
ACE	aviation combat element
ARG	Amphibious Ready Group
C4I	command, control, communications, computers, and intelligence
CAS	close air support
CBRNE	chemical, biological, radiological, nuclear and high-yield explosives
CE	command element
CLOP	cargo left on pier
CMOC	Civil Military Operations Center
COCOM	combatant commander
CSSE	combat service support element
DA	direct action
DoD	U.S. Department of Defense
EAF	expeditionary airfield
EOH	equipment operating hours
FARP	forward arming and refueling point

FID	foreign internal defense
FM	Field Manual
FOB	forward operating base
GCC	geographic combatant commander
GCE	ground combat element
HA	humanitarian assistance
HADR	humanitarian assistance/disaster response
HLZ	helicopter landing zone
HMH	Marine Heavy Helicopter Squadron
HML/A	Marine Light Attack Helicopter Squadron
HMM	Marine Medium Helicopter Squadron
IED	improvised explosive device
IMET	International Military Education and Training
ISR	intelligence, surveillance, and reconnaissance
JFC	joint force commander
JP	Joint Publication
JTF	joint task force
LAAD	low altitude air defense
LCAC	landing craft air cushioned
LCE	logistics combat element
LHD	landing helicopter deck (amphibious assault ship)
LPD	landing platform deck (amphibious transport dock)
LSD	landing ship dock

MACG	Marine Air Control Group
MAGTF	Marine Air-Ground Task Force
MALS	Marine Aviation Logistics Squadron
MASS	Marine Air Support Squadron
MCCDC	Marine Corps Combat Development Command
MCO	Marine Corps Order
MDSS-II	MAGTF Deployment Support System II
MESA	MAGTF Equipment Structural Assessment
MEU	Marine Expeditionary Unit
MIO	maritime interdiction operation
MTVR	Medium Tactical Vehicle Replacement
MWSS	Marine Wing Support Squadron
OPNAVINST	Chief of Naval Operations Instruction
NEO	noncombatant evacuation operation
NGO	nongovernmental organization
NTS	NEO Tracking System
OCOKA-W	observation, cover and concealment, obstacles, key terrain, avenues of approach, weather
QRF	Quick Reaction Force
RSO&I	reception, staging, onward movement, and integration
SAR	search and rescue
SFCP	Shore Fire Control Party
SOC	special operations capable

SQL	Standard Query Language
SR	special reconnaissance
SRFA	Stabilization and Reconstruction Force Allocator
TAMCN	Table of Authorized Material Control Number
T/E	table of equipment
TLZ	tactical landing zones
TOW	Tube-launched Optically-tracked Wire Command Link Guided Missile
TRAP	tactical recovery of aircraft and personnel
TSC	theater security cooperation
UAV	unmanned aerial vehicle
USCG COMDTINST	U.S. Coast Guard Commandant Instruction
VBSS	visit, board, search and seizure
VMA	Marine Attack Squadron
WMD	weapon of mass destruction

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To successfully accomplish their missions, Marine Expeditionary Units (MEUs) must have both the right personnel and the right equipment, as well as access to the personnel and equipment. However, in many cases, the available space on an MEU's ships falls far short of what is needed to transport the full set of required equipment. Thus, the MEU commander and mission planners must determine which equipment to take and which to leave behind. To assist commanders in making these difficult decisions in the context of limited equipment inventories, a RAND team developed a software tool, the Marine Air-Ground Task Force (MAGTF) Equipment Structural Assessment (MESA) application. The tool guides users through the decisionmaking process by comparing mission task needs to available equipment and allowing full customization of the mission timeline, component tasks and subtasks, sequencing, available equipment, and equipment and activity prioritization preferences. The application, still in development, currently features full functionality for six MEU mission types: humanitarian assistance, noncombatant evacuation operations, tactical recovery of aircraft and personnel, airfield and port seizure operations, amphibious raid, and stability operations. Future versions will include a set of 15 missions. This report includes a user's guide for the MESA application with step-by-step instructions for populating and modifying the tool to support mission needs.

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