A Wargame Method for Assessing Risk and Resilience of Military Command-and-Control Organizations

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Preface

Many recent wargames conducted by the joint community have examined alternative organizational structures for operational-level command and control (C2) in a scenario.\(^1\) However, wargames typically role-play and exercise the roles, responsibilities, and authorities of a prescribed C2 organizational structure in the scenario rather than compare and contrast the alternative structures themselves in a rigorous manner. This report provides a “how-to” guide for conducting a C2 risk and resilience tabletop exercise (TTX). The C2 risk and resilience TTX is a wargaming method developed by RAND Corporation researchers that can be used to compare and contrast alternative organizational structures for operational-level C2 in terms of associated risks to operational outcomes and of the organizational structures’ resilience to those risks. The method is an adaptation of the assumption-based planning methodology developed for the U.S. Army in the 1990s but conducted in a TTX format and using a retrospective futurology approach to elicit consensus from subject-matter experts. The steps involve preparing the materials, conducting a preparation session, evaluating risk and resilience metrics in a one- or two-day event involving 12 to 24 participants, and summarizing the results. This could be suitable for a multiday workshop conducted in parallel with and as part of a larger wargaming effort.

The research reported here was commissioned by Brig Gen Dirk D. Smith, Director of Air and Cyberspace Operations, Headquarters Pacific Air Forces and conducted within the Force Modernization and Employment Program of RAND Project AIR FORCE as part of a broader, fiscal year 2016 project, “The Future of Command and Control of Joint Air Operations in the Pacific.”\(^2\) The research was conducted between October 2015 and August 2016 as a core-funded project. The report should be of interest to the wargaming community, personnel in the operations and plans division of Pacific Air Force and other major commands, personnel in the Air and Space Operations Center, and personnel involved in operational-level control of joint military operations.

RAND Project AIR FORCE

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\(^1\) We define *command and control* as “the means by which a JFC [joint force commander] synchronizes and/or integrates joint force activities” (Joint Publication 1, 2013, pp. xxi–xxiii). The C2 organizational structure at the operational level is defined as the geographic combatant commander, the components, and joint task force commanders, as well as their staffs. This organizational structure interacts with the national command authority and tactical-level units, but those entities are considered external to the organizational structure.

\(^2\) The broader effort is described in Alkire et al., 2018.
provides the Air Force with independent analyses of policy alternatives affecting the
development, employment, combat readiness, and support of current and future air, space, and
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Summary

Recent wargames conducted by the joint community have experimented with new concepts for command and control (C2) in one or more scenarios. Many of these have focused on C2 at the operational level and include experiments with alternative C2 organizational structures. However, these wargames typically have other objectives besides experimentation with C2, and, as a result, the experimentation is usually limited to role-playing and exercising operational planning with a designated or prescribed C2 organizational structure in a given scenario. More-rigorous methods are needed in order to compare and contrast alternative C2 organizational structures in a given scenario.

RAND Corporation analysts recently developed a new method for comparing and contrasting alternative organizational structures for operational-level C2 in a project sponsored by Pacific Air Forces. As part of that broader effort, a RAND team developed a new wargaming approach for comparing and contrasting two or more alternative organizational structures in a given scenario in terms of risk and resilience. The objective of this report is to provide a practical “how-to” guide for conducting this type of wargame.

Command-and-Control Risk and Resilience

The National Institute of Standards and Technology defines risk thusly:

Risk is a measure of the extent to which an entity is threatened by a potential circumstance or event, and is typically a function of the adverse impacts that would arise if the circumstance or event occurs; and the likelihood of occurrence.

We define C2 risk as the likelihood of adverse conditions and their impact on operational outcomes. Obversely, resilience is defined as the inherent impact resistance, flexibility, adaptability, and recoverability of the C2 organizational structure.

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3 We define command and control as “the means by which a JFC [joint force commander] synchronizes and/or integrates joint force activities” (Joint Publication 1, 2013, pp. xxii–xxiii).

4 The C2 organizational structure at the operational level is defined as the geographic combatant commander, the components, and joint task force commanders, as well as their staffs. This organizational structure interacts with the national command authority and tactical-level units, but those entities are considered external to the organizational structure.

5 The purpose of these exercises is to train and practice the C2 relationships and processes rather than to examine risks and resilience actions.

6 The broader effort is described in Alkire et al., 2018.

How the Method Works

The method is an adaptation of the assumption-based planning methodology developed for the U.S. Army in the 1990s. However, it is conducted in the format of a tabletop exercise (TTX) and uses a retrospective futurological approach to develop consensus among subject-matter experts.

In most TTX wargames, participants are divided into opposing teams and provided a description of an evolving scenario. Participants then plan operations in distinct “moves.” The plans of the opposing sides are compared, and the results of their operations and interactions are adjudicated. Then players are briefed on the outcome, and the process repeats over the course of a few moves. Observations are tabulated during the game, and there is usually a structured discussion held at the conclusion that becomes an important source of information for developing findings.

In contrast, the RAND TTX methodology for comparing and contrasting C2 risk and resilience differs in many ways. First, we describe the scenario entirely in the past tense, as if all of the individual missions had already occurred, and in terms that are agnostic to the C2 organizational structure that might have been employed. In this sense, the performance of forces in achieving operational outcomes is held fixed. Second, players do not plan moves at all. Instead, we provide descriptions of two alternative C2 concepts and walk them through a structured process to identify key C2-related assumptions that must have held in order for the operational objectives to have been met. The players evaluate each assumption for potential impact. That is, if the assumption should fail to hold—regardless of the likelihood of failure—what impact would it have on operational outcomes? As a concrete example, consider the assumption that the joint force air component commander can effectively communicate with the forward forces he or she must control. In some scenarios, failure of that assumption could lead to a failure in meeting operational outcomes. Next, we guide the participants through a process to assess each assumption’s likelihood of failure. In our communication example, this might entail a discussion or review of evolving adversary capabilities and strategies to deny communications. Those assumptions that participants judge to have high impact on failure and to have plausible likelihood of failure are deemed “risks.” This is consistent with the National Institute of Standards and Technology definition of risk in terms of impact and likelihood of adverse conditions.

Next, we guide the participants through a structured process to identify actions to increase resilience and mitigate the identified risks. These are of two types: shaping actions, which can help to prevent an assumption from failing, and hedging actions, which can be taken should an

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8 See Dewar, 2002.
9 Note that describing the scenario in the past tense might also help lessen participants’ tendency to fight the scenario.
assumption fail. Fielding an aerial layer network to provide a new communication means between the joint force air component commander and forces forward would be an example of a hedging action. As a final step in the TTX, participants use an online tool to develop a consensus rank order of importance of the risks in the context of the scenario.\textsuperscript{10} The basis for the rank order is the law of comparative judgment and was first outlined by L. L. Thurstone.\textsuperscript{11}

Upon conclusion of the TTX, participants can compare, side by side, the risk and resilience of the two alternative C2 structures for the given scenario. In terms of quantitative metrics, we can report the total number of risks identified for each structure, including a breakdown of the number of risks that they had in common, as well as the number of risks that were unique to each. Similarly, we can report the number of resilience actions categorized by type and highlight any risks that lack resilience measures. For qualitative metrics, we list the textual descriptions of each risk, in order of importance, along with their associated resilience actions.

How We Conduct the Tabletop Exercise

\textbf{Step 1: Prepare Materials and Identify Participants}

We must identify and develop the scenario and two or more alternative C2 organizational structures. It is useful to describe the scenario in terms of individual missions. Those missions might roughly correlate to a “move” in a typical wargame. It is important that the scenario be described in terms that are as agnostic to the C2 used as possible and in the past tense. Also, although we want the scenario to stress forces, we also want to compare and contrast C2 concepts that resulted in meeting operational objectives rather than having failed to meet objectives.

The C2 concepts can be described in fairly broad terms. The description needs to state who is leading the operation; what components and joint task force elements are involved; key supported and supporting relationships; operational- and tactical-level control of assets; key roles, rules, responsibilities, and authorities; and where the C2 personnel are located.

We must identify participants. Ideally, the TTX will involve 12 to 24 participants representing the joint force and elements of nonmilitary organizations (this will be scenario dependent). They should have broad experience across functions that are important to the scenario.

\textbf{Step 2: Hold a Preparation Session for Participants}

We recommend holding a two- to three-hour preparatory session with the participants. Participants can attend remotely if necessary. This session should describe the objective, how the

\textsuperscript{10} The online tool is No More Marking, undated.
\textsuperscript{11} Thurstone, 1927.
TTX works, and what will be expected of participants. Time permitting, it might also be useful to describe the scenario and C2 structures in broad terms so that participants can begin to think about them in advance of the primary event.

**Step 3: Have the Capstone Tabletop-Exercise Event**

The capstone TTX event to evaluate the risk and resilience of two alternative C2 structures in one scenario occurs over the course of one or two days. We recommend that one facilitator serve as a full-time recorder during the event to capture inputs in real time. We also recommend that those inputs be projected so that participants can see how they are recorded and help with the wording. A second facilitator will be needed to lead the discussions. This includes describing the discrete events of the scenario and leading the discussion to identify risks and resilience actions. Additional facilitators should be made available to answer questions, to serve as subject-matter experts as needed, and to address participants’ questions.

**Step 4: Summarize Results**

Within a couple of days after the event, facilitators should be able to summarize the prioritized list of risks and associated resilience actions using the recorded results from the TTX.
We would like to thank the project sponsor, Brig Gen Dirk Smith, Headquarters (HQ) Pacific Air Forces (PACAF) Director of Air and Cyberspace Operations (A3/6), for the opportunity to conduct this research. We would also like to thank the project cosponsor, Mark (Tap) Tapper, defense intelligence senior leader and special adviser to the Deputy Chief of Staff for Intelligence, Surveillance and Reconnaissance, HQ U.S. Air Force. The project benefited from the help of many people across the Air Force, but we would like to specifically acknowledge the help we received from Col Max M. Marosko III, HQ PACAF/A3/6D; Col David Moeller, then-commander, 613 Air and Space Operations Center; Col David Kirkendall, then–vice commander, 613 Air and Space Operations Center; Lt Col Christopher Hoskins, lead, Command and Control Working Group, HQ PACAF/A3/6; and Steven Diamond, command historian, HQ PACAF. We thank our colleagues who contributed to the development of the methodology, including James A. Dewar, who was instrumental in the development of assumption-based planning; Christopher M. Carson and Christine Chen, who developed the sample scenario described in this report; and Caroline Baxter, Gary J. Briggs, David Gordon, Ryan Henry, Lance Menthe, and Daniel M. Romano, who all made intellectual contributions to the development of the methodology. We thank Daniel Gonzales and Michael Spirtas for their peer reviews of the draft version of this report. It is much improved as a result of their reviews. However, any errors or shortcomings are our responsibility.
## Abbreviations

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<thead>
<tr>
<th>Abbreviation</th>
<th>Description</th>
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<tr>
<td>374 AEW</td>
<td>374th Air Expeditionary Wing</td>
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<tr>
<td>ABP</td>
<td>assumption-based planning</td>
</tr>
<tr>
<td>AFP</td>
<td>Armed Forces of the Philippines</td>
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<tr>
<td>C2</td>
<td>command and control</td>
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<tr>
<td>C2R2</td>
<td>command-and-control risk and resilience</td>
</tr>
<tr>
<td>C-day</td>
<td>the day on which forces deploy</td>
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<tr>
<td>D-day</td>
<td>the day on which an operation commences</td>
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<td>GCC</td>
<td>geographic combatant commander</td>
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<td>HA/DR</td>
<td>humanitarian assistance and disaster relief</td>
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<td>JACCE</td>
<td>joint air component coordination element</td>
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<td>JAOC</td>
<td>joint air operations center</td>
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<td>JFACC</td>
<td>joint force air component commander</td>
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<td>JFC</td>
<td>joint force commander</td>
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<td>JFLCC</td>
<td>joint force land component commander</td>
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<td>JFMCC</td>
<td>joint force maritime component commander</td>
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<td>JFSOCC</td>
<td>joint force special operations component commander</td>
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<tr>
<td>JOA</td>
<td>joint operations area</td>
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<tr>
<td>JP</td>
<td>joint publication</td>
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<tr>
<td>JTF</td>
<td>joint task force</td>
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<tr>
<td>NDRRMC</td>
<td>National Disaster Risk Reduction and Management Council</td>
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<tr>
<td>NGO</td>
<td>nongovernmental organization</td>
</tr>
<tr>
<td>PACAF</td>
<td>Pacific Air Forces</td>
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<tr>
<td>SAR</td>
<td>search and rescue</td>
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<tr>
<td>TJFACC</td>
<td>theater joint force air component commander</td>
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<tr>
<td>TTX</td>
<td>tabletop exercise</td>
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<td>UN</td>
<td>United Nations</td>
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Chapter One. Background

Command and control (C2) in a military context has been defined as “the means by which a JFC [Joint Force Commander] synchronizes and/or integrates joint force activities.” \(^{12}\) We define C2 concept as an organizational structure for C2, along with the associated roles, rules, responsibilities, and authorities. We focus attention on C2 at the operational level. The C2 organizational structure at the operational level is defined as the geographic combatant commander (GCC), the components, and joint task force (JTF) commanders, as well as their staffs. This organizational structure interacts with the national command authority and tactical-level units, but those entities are considered external to the organizational structure.

Appendix A describes two examples of C2 organizational structures. In the first example, the GCC is designated as the JFC for a named operation. In the second example, a JTF is established, and the JTF commander is designated as the JFC for the named operation.

Objective

The objective of this report is to provide a practical guide for implementing the C2 risk and resilience (C2R2) tabletop exercise (TTX), which is a wargame that RAND analysts designed to compare and contrast alternative C2 concepts in a given scenario. In particular, the C2R2 TTX methodology provides a method to compare and contrast alternative C2 organizational structures in terms of risk and resilience, which we define in the next section. We developed this methodology as part of a broader C2 project sponsored by Headquarters, Pacific Air Forces (PACAF). \(^{13}\)

Command-and-Control Risk and Resilience

The National Institute of Standards and Technology defines risk thusly:

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\text{Risk is a measure of the extent to which an entity is threatened by a potential circumstance or event, and is typically a function of the adverse impacts that would arise if the circumstance or event occurs; and the likelihood of occurrence.}^{14}\]

We define C2 risk as the likelihood of adverse conditions and their impact on operational outcomes.


\(^{13}\) See Alkire et al., 2018.

In contrast, we define *C2 resilience* as the inherent impact resistance, flexibility, adaptability, and recoverability of the C2 concept.

**Origins of the Methodology and How It Works**

The C2R2 TTX methodology is an adaptation of assumption-based planning (ABP), which RAND analysts originally developed for the U.S. Army in the 1990s. ABP provides a means to identify weaknesses in an existing strategic plan so that the plan can be made more robust. Since its original development, ABP has been applied to a wide range of plans in the military, commercial, and civilian sectors. In order to adapt ABP to assessing risk and resilience associated with C2 organizations, RAND researchers treated C2 organizational structures as “plans” for operational-level C2 in a given scenario. Researchers adapted steps of the ABP process to a TTX format.15

The C2R2 TTX keeps performance of forces in reaching operational goals within the scenario fixed so we can compare and contrast the risk and resilience associated with each C2 organizational structure for the same scenario. For this reason, we developed a retrospective futurology. Specifically, we describe the scenario to TTX participants in the past tense—that is, as if the individual missions of the scenario had already occurred. We initially describe the scenario in terms that are as agnostic as possible to the C2 organizational structure used. This allows the TTX to focus on the C2 organization’s risk and resilience in enabling forces to achieve their objectives.

The steps of ABP and the C2R2 TTX methodology have much in common with the risk identification and mitigation steps of the joint planning process described in JP 5-0, wherein assumptions are periodically reviewed.16 Similarly, we guide TTX participants through individual missions or “events” of the scenario and ask them to identify what C2-related assumptions must have held to enable those missions. Once the participants have developed a list of the assumptions for the entire scenario, they review the list and are asked to judge whether failure of each assumption would adversely affect the mission outcome, regardless of the likelihood of failure. That is, we ask them to judge the potential impact of failure. (In Chapter Two, we provide recommendations on how to elicit these judgments).

We ask participants to judge the likelihood of failure under each organizational structure. Ideally, the participants judge whether the likelihood of failure is plausible or not under each C2 structure, but another option is to ask participants to rate the relative likelihood of failure under each C2 structure. We discuss this more in Chapter Two.

The result is a list of C2-related assumptions that could adversely affect operational outcomes in the scenario and have a plausible likelihood of failure under at least one of the

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15 For details about ABP, see Dewar, 2002.
alternative C2 structures. That is, the result is a list of C2-related risks. We also recommend that participants help identify signposts that can be monitored to know whether an assumption might be failing.17

In the joint planning process of JP 5-0, planners develop branches, sequels, or new courses of action in response to identification of a weak assumption. Similarly, we ask participants in the C2R2 TTX to develop resilience actions in response to identification of a risky assumption. There are two types of resilience actions: a shaping action, which is an action that can be taken to help prevent the failure of an assumption, and a hedging action, which can be taken in the event that an assumption fails. We guide participants through the list of risks and ask them to develop or recommend resilience actions that could be taken.

We ask participants to make pairwise choices between which of the identified risks is more important within the context of the scenario. The results are processed to produce an overall rank ordering of the importance of the identified risks.

The outputs of the TTX include the number of risks unique to each C2 organizational structure, the number of risks in common to all C2 organizational structures, the total number of risks identified, and textual descriptions of the risks of highest importance (both unique and in common) and their associated resilience measures. Appendix D provides a sample summary of TTX results.

**Limitations of the Methodology**

A limitation of the methodology is that it does not directly evaluate C2’s contributions to forces’ performance in meeting operational objectives. Instead, the methodology holds forces’ performance in meeting operational objectives fixed and evaluates C2-related risks that could adversely affect that performance. This could lead to faulty conclusions in a scenario in which C2-related factors are the primary drivers of operational performance.

Another limitation of the methodology is that it assumes that the C2 concept is static. In real-world operations, the C2 concepts tend to be very dynamic and can change in response to a variety of factors, including unforeseen changes in the objectives of the operation and issues relating to the nonmilitary instruments of power (e.g., diplomacy). Keeping the C2 concept fixed in an evaluation of an operation that would likely adapt the C2 over time could lead to invalid conclusions. In Chapter Three, we briefly discuss some potential ways to evolve the methodology to handle dynamic changes to C2.

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17 “A signpost is an event or threshold that indicates an important change in the validity or vulnerability of an assumption” (Dewar, 2002, p. 92).
Report Outline

Chapter Two describes how to conduct a C2R2 TTX to compare and contrast the risk and resilience of two alternative C2 structures in one scenario. Chapter Three describes how to assess the results. The appendixes provide example game materials. Appendix A provides graphical descriptions of two alternative C2 organizational structures. Appendix B describes a humanitarian assistance and disaster relief (HA/DR) scenario. Appendix C provides a sample agenda for a TTX designed to assess the C2 organizational structures described in Appendix A in the scenario described in Appendix B. Appendix D provides a sample summary of results from a TTX.
Chapter Two. How to Conduct a Command-and-Control Tabletop Exercise

Selection of Scenarios, Command-and-Control Concepts, and Participants

If the C2R2 TTX is to be conducted as a workshop associated with a larger wargaming effort, the scenario might have been already selected for the larger effort. Otherwise, the TTX planners might want to consider a range of C2-related stressors in their selection of a scenario. Here are a few examples to consider:

- **center of gravity**: Is the center of gravity an opposing military force, an irregular force, or a population?
- **force composition and size**: Is it a joint or combined force operation? Does it involve a large interagency force? How about nongovernmental organizations (NGOs)?
- **geographic dispersion**: Are operations conducted over a large area or more confined?
- **reaction time**: How much reaction time is needed?
- **force similarity**: Is the preponderance of forces from one service or operations largely isolated to one domain, or are the forces required dissimilar from one another?
- **permissive environment**: Is the operating environment permissive?
- **missions and phases of war**: Is there a possibility of major combat operations? Is it primarily a crisis response?18

It might be important to describe other security concerns that are going on within the theater, besides the scenario presented. These can stress resources available and the attention of C2 decisionmakers.

The C2R2 TTX has been applied to compare and contrast two alternative organizational structures for the same scenario. There were sharp differences between the structures that we compared and contrasted. Those structures were associated with C2 at the joint, operational level, as opposed to the tactical or strategic level or to bilateral C2. It should be possible to apply the TTX to an evaluation of more than two alternative structures, but we would not recommend

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18 *Phases of war* refers to the Joint Chiefs’ concept of joint operations having six phases:

Phases are distinct in time, space, and/or purpose from one another, but must be planned in support of each other and should represent a natural progression and subdivision of the campaign or operation. Each phase should have a set of starting conditions (that define the start of the phase) and ending conditions (that define the end of the phase). The ending conditions of one phase are the starting conditions for the next phase. (JP 5-0, 2011, p. xxiii)

The phases are shape (phase 0), deter (phase I), seize initiative (phase II), dominate (phase III), stabilize (phase IV), and enable civil authority (phase V) (JP 5-0, 2011, pp. xxiii–xxiv).
more than three because of the complexity involved. Further, we recommend keeping the participation level to 12 to 24 people.\textsuperscript{19}

Those participants should be chosen to represent a broad range of perspectives, depending on the scenario and organizational structures selected. For instance, ensuring adequate joint representation is very important for evaluating risk and resilience in joint operations. Also, participants should consider that they might want to assess C2 risks associated with military-to-political engagements, interactions between the military organizations and NGOs, and warfighter and combat support elements. These factors should be taken into consideration in the selection of participants. It is also important to think about the functional experience of the participants. For instance, having participants with experience in logistics, intelligence, plans, and operations can be important.

In addition to the participants, there will need to be facilitators to plan and run the TTX. We recommend one facilitator being dedicated to recording the assumptions and the risks and resilience actions that participants identify. A spreadsheet is adequate for capturing these inputs, and there should be a method available to display the spreadsheet to the participants as inputs are gathered in real time. The recorder should also work to capture key discussion points that are associated with the identification of the risks and resilience actions, to add context that might be valuable in interpreting the results. A facilitator will need to be dedicated to describing the scenario and structures and to leading the steps of the TTX. A few additional facilitators can help to share in these responsibilities, to serve as subject-matter experts on certain aspects of C2, to adjudicate unforeseen questions or issues that arise, and to help participants in execution of their responsibilities.

**Developing Game Materials**

Appendix A provides samples of C2 organizational structures that can serve as models for what needs to be developed. In addition to these graphical descriptions, TTX planners will need to describe the rules, roles, responsibilities, and authorities. For instance, if a JTF commander is given responsibility for a joint operations area (JOA), what tactical control does he or she have over the forces in that JOA? What about operational control? What authorities are withheld at the theater level? Who is the supported commander for operations that span multiple JOAs? Some of these details might best be described along with the scenario. But, where feasible, we suggest keeping the scenario description as agnostic as possible to the C2 structure.

Appendix B provides a sample scenario for a fictional HA/DR operation. The operation described lasts for around 30 days. The description is broken into three separate events, which might be associated with distinct “moves” in other wargaming contexts.

\textsuperscript{19} We recommend that the same group of participants evaluate all of the alternatives, rather than assigning different groups to evaluate different alternatives. Otherwise, the comparison of risks and resilience actions across C2 concepts would be subject to an additional variable.
Appendix C provides a sample agenda for assessing the two C2 structures described in Appendix A in the scenario described in Appendix B. As shown in the agenda, we recommend 1.5 days for this TTX. Note that, if the same two C2 structures are to be compared and contrasted in a second scenario, it might be possible to compress the timeline to just one day for each additional scenario.

**Conducting a Preparation Session**

We recommend conducting a two- to three-hour preparation session for participants before beginning the TTX. This can be conducted via teleconference if needed. The purpose of the preparation session is to describe the objectives of the TTX; describe the methodology and how it differs from other types of TTXs; share the agenda; and, time permitting, begin to introduce the C2 organizational structures and scenario that will be evaluated. The preparation session provides the TTX facilitators with a warm-up session and can help to highlight revisions that need to be made to the materials in advance of the TTX capstone event.

**Conducting the Capstone Wargame Event**

We recommend presenting the same materials that were presented during the preparation session to describe the objectives of the TTX and describe the methodology and how it differs from other types of TTXs. A short description of the C2 structures should be provided. Appendix C provides an example agenda.

Figure 2.1 shows the overall process flow for the capstone wargame event.
Describing the Scenario

First, the facilitators should narrate the entire scenario and describe that scenario as if the operations had already occurred. See Appendix B for a sample. This sample divides the activities of the scenario into discrete events. Note that it might be necessary to talk about the C2 structures. For instance, if the area of operations is divided into distinct JOAs under one but not both of the C2 structures, this detail might need to be described along with the scenario. But, as much as possible, we recommend keeping the description of the scenario agnostic to the specifics of any C2 structure. The reason is that the participants will be evaluating alternative C2 concepts for the same scenario.

Describing the Command-and-Control Concepts

Following the narration of the scenario, the lead facilitator should describe the two alternative C2 structures to the participants. See the samples provided in Appendix A. If there were changes to the C2 during the course of the scenario, they should be described. Participants will likely have questions about rules, roles, authorities, and responsibilities of the different C2 elements, and those questions will need to be addressed. As needed, designated facilitators can be excused to research and adjudicate answers to participants’ questions.
Identifying the Command-and-Control Assumptions

Next begins the important phase of identifying C2-related assumptions. We recommend that the facilitator repeat the description of the first event in the scenario and ask participants to suggest what important C2-related assumptions must have held in order for the missions in that event to have been successful. The recorder should capture the inputs in real time. Avoid discussions of whether or not the assumptions identified would have impact, whether there is likelihood of failure, or the applicability to specific C2 structures. Just capture the assumptions. We recommend displaying details of the event and the recorded inputs side by side so that all participants and facilitators can view them in real time. Try to get participants to help with the wording of the assumptions. We suggest that the TTX planners develop a few example assumptions in advance of the capstone event; these can be suggested if necessary to help stimulate participation. After assumptions for the first scenario event have been identified, repeat the process for all the remaining scenario events. As a rule of thumb, the aim should be to identify ten to 30 assumptions. As an example, participants might identify the assumption that the joint force air component commander (JFACC) has a robust means of communicating with forces forward.

Assessing Command-and-Control Assumption Impact

Once the list of C2-related assumptions for the scenario has been developed, the next step is to assess impact. That is, go through the entire list of assumptions, and assess which of them would adversely affect operational outcomes if it failed, regardless of the likelihood. (In our experience, impact is independent of the C2 structure, but likelihood is not. However, it is unclear whether this will always be the case.) To achieve this, the facilitators should display the list of assumptions, go through them one by one, and lead an interactive discussion of each one’s impact within the scenario. Ideally, there will be consensus among participants. In the event that there is not consensus, we recommend a vote after a period of discussion (we also recommend recording the details of the vote). For example, participants might judge that the assumption that the JFACC has robust means of communicating with forces forward would have impact because failure of that assumption could result in an inability to task those forces for a specific mission.

Assessing Likelihood of Assumption Failure

The result of the previous step will be a subset of C2-related assumptions that could adversely affect operational outcomes upon failure. The next step is to identify which of those assumptions has plausible likelihood of failure under each of the alternative C2 structures. Before beginning this step, it might be useful to quickly review those C2 structures again. Each assumption on the list should be reviewed one by one. Participants should engage in an interactive discussion of potential failure mechanisms. Ideally, there will be consensus on an absolute yes or no answer as to the plausibility of failure of a given assumption for each of the
alternative C2 concepts. If there is not, an option is to ask participants to rate the relative likelihood of failure under each C2 concept. The recorder should capture which (absolute or relative) conclusion is reached. Again, a vote might be needed, but, ideally, the discussions will lead to consensus. The result of this step is a list of C2-related risks for each C2 structure—that is, a list of which assumptions would adversely affect operational outcomes and have plausibility of failure. Note that there might be some risks that the alternative C2 structures have in common and some that are unique. As an example, participants might judge that the assumption that the JFACC has robust means of communicating with forces forward could plausibly fail in a C2 structure in which the JFACC is geographically far from those forces. This might be due to the adversary’s capability to deny communications through cyber or electronic warfare means.

It is useful to have participants identify signposts for each risk. A signpost is something that joint forces can monitor to determine whether an assumption is about to fail. Examples might be monitoring cyber probing in communication networks or monitoring the deployment status of electronic warfare forces of the opposing force. Signpost identification can happen in parallel with or after the assessment of likelihood. Typically, there will be fewer than a dozen risks at the conclusion of this step.

**Identifying Resilience Measures**

Once risks have been identified, the facilitator should review each one and ask participants to suggest resilience actions: shaping actions that can prevent failure or hedging actions that can be taken if failure occurs. Employing a cyber protection team to protect the primary communication system from attack is an example of a shaping action; deploying an aerial layer network to provide an alternative communication path is an example of a hedging action.

**Assessing Relative Importance**

The relative importance of risks can be assessed using the law of comparative judgment, which is described in detail by L. L. Thurstone. As distinct from identifying differences among physical measurements of such things as the relative loudness of sound from several sources measured in decibels, the law of comparative judgment is a model that is used for comparing perceptions of abstract concepts. For example, among a set of identified moral values, what is the ordering of their relative importance for guiding human behavior? In this case, we wish to identify the relative importance of risks associated with a selection of C2 concepts in a selection of scenarios.

An online comparative judgment tool can be used for this task. Participants are asked to log in to the online tool. The tool presents the participant with two risk statements (that is, a pair of

20 Thurstone, 1927.
21 See No More Marking, undated.
risks), and the participant is asked to judge which of the two is more important in the context of the scenario. The tool continues to present pairs of risks to the participants until each pair has been judged at least one time, and the results are used to provide consensus rank ordering of importance. (Note that the number of pairs grows rapidly with the number of risks. For example, with 14 risks, there are 91 pairs to judge. The tool reduces the burden of judging pairs by dividing it among the participants so that each pair of risks is judged by at least one participant.)

The final step of the capstone event is to present the results to the participants and invite interactive discussion. Topics might include the following: What assumptions, if any, did we miss? Are there any indications that our results are biased? Did we have the right representation of participants?

Other Recommendations for the Tabletop Exercise Facilitators

It is often the case that certain participants will tend to dominate the discussions. The facilitators should monitor this carefully and actively call on those attendees who have had less input. If possible, they should provide some discussion based on their background. They should explicitly tell the attendees that a wide range of inputs is desired. The facilitators should confer during breaks and share their observations on participation.

It is also important to watch for signs of bias in the identification of risks. For instance, without adequate joint representation at the TTX, there might be potential for the results to reflect the parochial biases of a particular service. Dewar provides some guidance for bias mitigation. Another good source is Krizan. Biases and bias mitigation techniques could be discussed with participants during the preparation session or on an as-needed basis during the TTX. The facilitators might wish to identify materials with opposing viewpoints of key aspects of C2 in advance of the TTX and be prepared to discuss those topics if they are concerned about confirmation bias during the TTX.

\[
\frac{n!}{k!(n-k)!} = \frac{14 \times 13}{2} = 91 \text{ pairs.}
\]

22 If there are \( n = 14 \) risks, the number of \( k = 2 \) is


Chapter Three. How to Assess the Results of a Command-and-Control Risk and Resilience Tabletop Exercise

Assessing and Summarizing the Tabletop Exercise Results

We recommend creating separate tables that list the risks and resilience actions that are unique to each C2 structure, as well as a list for those risks that the structures have in common. Each row of the table should list a different risk, its rank order of importance that was evaluated using comparative judgment, and the associated shaping or hedging resilience action. Table 3.1 shows an example list of risks in common for the two C2 structures from Appendix A (in the scenario described in Appendix B). (We provide this information to serve as an illustration of how to tabulate the results. We refer the reader to a separate report for an interpretation of these specific results.\textsuperscript{25}) Similar tables would be created for the unique risks.

Table 3.1. Risks and Resilience Actions in Common

<table>
<thead>
<tr>
<th>Risk Assumption</th>
<th>Rank Order</th>
<th>Resilience Action</th>
</tr>
</thead>
<tbody>
<tr>
<td>Deployable communication packages exist and are available when needed.</td>
<td>1</td>
<td>Continue to build out unit type code requirements for deployable communication packages and incorporate them into command-post exercise and field training exercise events.</td>
</tr>
<tr>
<td>Taskable mobility assets are available to transport critical materiel.</td>
<td>2</td>
<td>GCC requests support from commander, U.S. Transportation Command.</td>
</tr>
<tr>
<td>The host government provides permission for the JFLCC to conduct force protection.</td>
<td>3</td>
<td>Request force protection from the host nation.</td>
</tr>
<tr>
<td>Releasability protocols are in place.</td>
<td>4</td>
<td>Establish and practice the protocols.</td>
</tr>
</tbody>
</table>

Note: JFLCC = joint force land component commander.

We also recommend creating a side-by-side listing of the risk and resilience metrics for the two alternative C2 structures in the scenario. Metrics should include the number of unique risks for each and the number of risks in common, along with the total number of risks. We also recommend listing the text description of the risks of highest importance in each category, along with the associated resilience actions. Refer to Appendix D for an example.

\textsuperscript{25} Alkire et al., 2018.
Opportunities for Improvement

One opportunity for improvement is to evolve the methodology to evaluate risk and resilience for C2 concepts that adapt and change over time. This could be achieved by scripting specific changes to the C2 concept over the timeline of the scenario. An alternative is to provide participants with options for changing the C2 concept in response to potential risks and documenting the C2 options they chose to implement and the rationale (including risks) for change as outputs of the TTX.

A second opportunity for improvement is to develop methods for directly evaluating C2’s contributions to performance in achieving operational objectives, possibly through a combination of social science methods and modeling and simulation. This appears to be an open area of research. A key challenge is that many factors can contribute to the performance of achieving operational objectives, and C2’s contributions might be masked by other contributing factors.

A third opportunity for improvement is to develop methods for transforming the output of the TTX to adjudication aids for wargames and exercises that allow participants to role-play and practice C2 in an operational-level campaign. This could enhance learning of participants and lead to improvements in the design of C2.
Appendix A. Sample Game Materials: Organizational Structures

Figure A.1 depicts an example C2 organizational structure. In this example, the National Command Authority designates the GCC as the JFC for a joint operation. The JFC will have his or her traditional components: JFACC, JFLCC, joint force maritime component commander (JFMCC), and joint force special operations component commander (JFSOCC). Here, we depict the joint air operations center (JAOC), which is the primary weapon system for operational-level C2 of air component operations. Also depicted are joint air component coordination element (JACCE) staffs who might reside with the JFLCC, JFMCC, and JFSOCC for the purpose of coordinating joint air operations with the JFACC.26

Figure A.1. Geographic Combatant Commander as Joint Force Commander

![Diagram of C2 organizational structure]

SOURCE: RAND research based on JP 3-0, 2011, Chapter IV.

NOTE: TJFACC = theater JFACC.

Figure A.2 shows an alternative C2 concept in which the GCC establishes a JTF and designates the JTF commander as the JFC for the operation.

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26 The sample game materials provided in the appendixes come from a specific application that placed emphasis on joint air operations. Other applications might require emphasizing different elements of the organizational structure for operational-level C2.
Many additional elements are not depicted in Figure A.1. For instance, U.S. Strategic Command might designate the joint functional component command for space to support the JFC for the operation and similarly for U.S. Cyber Command support. The director of the National Security Agency could delegate signals intelligence operational tasking authority for the operation to the JFC. The JFC can designate any one of the individual component commanders as supported commander for a particular mission. Also, the figure does not depict C2 elements at the tactical level of war, which would include battle management elements, such as the Joint Surveillance Target Attack Radar System.
Appendix B. Sample Game Materials: Scenario Description

Overview of Humanitarian Assistance and Disaster Relief Scenario

In this fictional account, a magnitude 9.0 earthquake struck the Philippines on May 31, 2020. A tsunami resulted from the earthquake. Figure B.1 depicts the epicenter and the extent of the damage.

Figure B.1. Epicenter of a (Fictional) Earthquake and the Extent of Tsunami Damage

The U.S. Pacific Command (USPACOM) commander, in coordination with the U.S. ambassador, was directed to conduct foreign humanitarian assistance operations in support of the

27 In developing this scenario, we used an online tsunami damage estimation and mapping tool. See Tsunami Mapper, undated.
U.S. Agency for International Development (USAID) Office of U.S. Foreign Disaster Assistance. The commander’s intent was to enable relief operations in order to mitigate further loss of life and additional suffering and reduce the scope of the disaster. As required, the command would also provide military-to-military support to Armed Forces of the Philippines (AFP).

The U.S. military was asked to help with situation assessment, search and rescue (SAR), transportation of personnel and supplies, medical care, water purification, the reestablishment of communications, and repair and reconstruction of roads and bridges.

The operation can be described in terms of three events: an initial response, an effort to sustain relief, and a transition and redeployment. Refer to Table B.1.

<table>
<thead>
<tr>
<th>Event</th>
<th>Description</th>
<th>Start Date</th>
<th>C-Day and D-Day</th>
<th>Phase</th>
</tr>
</thead>
<tbody>
<tr>
<td>Initial response</td>
<td>Earthquake struck. U.S. forces were deployed and aid began to arrive. SAR efforts concluded, and the focus shifted to rebuilding and relief.</td>
<td>May 31</td>
<td>C – 2, D + 0</td>
<td>IV (Stabilization)</td>
</tr>
<tr>
<td>Sustain relief</td>
<td>Relief cargo was airlifted. U.S. forces were selectively redeployed.</td>
<td>June 11</td>
<td>C + 9, D + 11</td>
<td>IV (Stabilization)</td>
</tr>
<tr>
<td>Transition and redeploy</td>
<td>AFP and the UN continued relief operations without U.S. military support. The operation stood down.</td>
<td>June 23</td>
<td>D + 21, D + 23</td>
<td>V (Enable civil authority)</td>
</tr>
</tbody>
</table>

NOTE: C-day = commencement day, the day on which deployment for an operation commences. D-day = the day on which an operation commences. UN = United Nations.

The operation required the U.S. military to coordinate with many actors. They are summarized in Table B.2.
Table B.2. Actors with Which the U.S. Military Had to Coordinate for the Humanitarian Assistance and Disaster Relief Operation

<table>
<thead>
<tr>
<th>Type</th>
<th>Agency</th>
<th>Actor</th>
</tr>
</thead>
<tbody>
<tr>
<td>U.S. actor</td>
<td>U.S. Department of Defense</td>
<td>Humanitarian assistance survey team, humanitarian assistance rapid response team</td>
</tr>
<tr>
<td></td>
<td>U.S. Department of State</td>
<td>USAID disaster assistance response team, U.S. embassy</td>
</tr>
<tr>
<td></td>
<td>USPACOM</td>
<td>JFACC, director of mobility forces</td>
</tr>
<tr>
<td></td>
<td>U.S. Transportation Command</td>
<td>Intertheater airlift, contingency response group, tanker airlift control element</td>
</tr>
<tr>
<td>Host nation (Philippines)</td>
<td>NDRRMC</td>
<td>Office of Civil Defense, member agencies (by cluster) (AFP, Department of Health, Philippine Red Cross)</td>
</tr>
<tr>
<td></td>
<td>Local disaster risk reduction and management offices</td>
<td>Regional, provincial, city, municipal, barangay</td>
</tr>
<tr>
<td></td>
<td>Local NGOs</td>
<td>National Secretariat for Social Action</td>
</tr>
<tr>
<td>International or regional actor</td>
<td>UN agencies</td>
<td>World Food Programme (logistics), World Health Organization (health), UN Children’s Fund (water, sanitation, and hygiene), UN High Commissioner for Refugees, UN Population Fund</td>
</tr>
<tr>
<td></td>
<td>Other international organizations</td>
<td>World Bank, International Organization for Migration</td>
</tr>
<tr>
<td></td>
<td>Association of Southeast Asian Nations</td>
<td>Association of Southeast Asian Nations Coordinating Centre for Humanitarian Assistance on disaster management (Brunei Darussalam, Cambodia, Indonesia, Lao People’s Democratic Republic, Malaysia, Myanmar, Philippines, Singapore, Thailand, and Vietnam)</td>
</tr>
<tr>
<td>International or regional actor in another country (Japan, China, the United Kingdom, Canada, Australia)</td>
<td>Civilian</td>
<td>International Committee of the Red Cross, International Federation of Red Cross and Red Crescent Societies</td>
</tr>
</tbody>
</table>

NOTE: NDRRMC = National Disaster Risk Reduction and Management Council.

Key humanitarian aid centers included Manila Ninoy Aquino International Airport and are depicted in Figure B.2.
Event 1: Initial Response

The earthquake struck on May 31. One day later, on June 1, the government of Philippines established the NDRRMC in metro Manila. AFP began SAR operations across the affected islands. The same day, USPACOM issued planning and warning orders to provide C2 of intratheater airlift and reconnaissance in support of regional HA/DR operations in the Philippines. The same order directed commander, U.S. Marine Corps Forces, Pacific, to prepare to deploy disaster assistance response teams.

On June 2, the TJFACC at the 613 JAOC made a request from Air Mobility Command for tanker airlift control element and the associated support personnel to be deployed and for operational control for relief efforts. PACAF activated the Pacific Air Expeditionary Task Force Manila as a provision unit attached to PACAF for administrative control. A Chairman of the Joint Chiefs of Staff warning order directed USPACOM to provide a commander estimate, alternative courses of action, and a contingency plan by June 4 that would outline options for providing HA/DR to Southeast Asia.
On June 3, USPACOM established priorities: (1) perform damage assessment and (2) posture all available theater airlift assets to provide support. Development of a logistics concept of operations was also in progress to ensure expeditious movement of relief supplies as they arrived in theater. Australian sources indicated that Ninoy Aquino International Airport was fully operational, with military and civilian flights operating from separate sides of the airstrip. Legazpi and Southern Luzon Airports were closed. Mactan Cebu International and Roxas Airports were crowded but serviceable. The government of the Philippines authorized overflight of Philippine airspace for two weeks in support of HA/DR operations. The authorization included the possibility of further extensions upon coordination with the U.S. embassy and Indonesian government. Furthermore, a status-of-forces agreement was also coordinated. A civil–military operations center was established in Manila. The UN activated health, logistic, shelter, water, sanitation, hygiene, and telecommunication clusters to coordinate relief activities. Another three humanitarian coordination centers were being established in Roxas, Cebu, and Tacloban cities.

On June 4, international aid continued to arrive. A medical team from the Singapore Armed Forces was operating near Legazpi City, Albay. Military resources from Japan and Australia were on the way. Disaster relief assessment teams deployed to the Philippines to determine the extent of the damage, level of support, and the command’s capacity to support tsunami relief. PACAF deployed contracting officers to support HA/DR. The JFACC assigned tactical control of all military fixed- and rotary-wing aircraft associated with HA/DR for the purpose of establishing a unified and integrated air relief distribution system. This arrangement—cognizant of joint doctrine—was intended to facilitate seamless interfacing between intertheater and intratheater fixed-wing airlift and rotary-wing aircraft by placing all scheduling and tasking authority under one functional joint air commander to ensure full integration of air operations effort.

On June 5, the JFACC for the operation requested USPACOM assistance in obtaining additional forces needed to augment the Pacific Air Expeditionary Task Force. U.S. C-130s and C-17s airlifted supplies; these operations were complemented by C-130 and helicopter sorties by Australia, Singapore, Malaysia, Tunisia, and the Czech Republic.

On June 6, the Joint Staff approved activating crisis management reconnaissance operations in support of tsunami disaster relief operations utilizing P-3s.

On June 7, the aircraft carrier USS *Abraham Lincoln* took up station off the east coast of the Philippines, commenced helicopter operations, picked up supplies and personnel, and shuttled them to the hardest-hit parts of the countries. PACAF activated the 374th Air Expeditionary Wing (374 AEW) as a provisional unit assigned to the Pacific Air Expeditionary Task Force. The Philippine government agreed to allow the international airport as the U.S. military hub for humanitarian relief supplies.

By June 8, 1 million pounds of relief cargo had been moved by airlift since the start of the operation.
On June 9, the Pacific Rescue Coordination Center assumed responsibility for all personnel recovery–related coordination. (This would be different for the JFC or JTF because the JTF would have its own joint reception coordination center. USPACOM established the boundaries of the command’s relief operations area for Operation Unified Assistance, encompassing the area in and around the Philippines.

On June 10, AFP completed SAR. The estimated death toll reached 158,990, while more than 1 million residents were displaced. Meanwhile, 61 percent of medical clinics in the affected regions were damaged.

Event 2: Sustain Relief

By June 13, 5 million pounds of relief cargo had been moved by airlift since the start of the operation. One week later, that total had increased to 10 million pounds of relief cargo moved by airlift since the start of the operation.

By June 21, the World Food Programme, USAID, and UN logistics representatives concluded that U.S. military forces no longer needed to requisition HA/DR supplies. Delivery of items already purchased or en route continued until on-hand supplies were exhausted. USPACOM issued an order canceling future HA/DR requisitions.

By June 22, USPACOM reported that a planning order finalization was under way that would allow formal transition planning and enable the selective redeployment of U.S. forces.

Event 3: Transition and Redeploy

By June 24, the UN scaled down immediate relief efforts and transitioned to the buildup of food, water, and medical stocks.

On June 25, USPACOM issued a warning order to transition and redeploy.

On June 27, the Philippine country team declared the mission complete and stated that the embassy would coordinate remaining relief efforts.

By June 28, 15 million pounds of relief cargo had been moved by airlift since the start of the operation.

On June 29, USPACOM reported that the UN would most likely assume responsibility for fixed-wing and helicopter operations in the Philippines not later than the first week of July. The World Health Organization finalized the death toll at 289,754 and estimated the number of internally displaced people at 1.5 million.

On June 30, the 374 AEW reported mission complete and was ready to redeploy.

On July 2, the 374 AEW reported that all Air Force personnel had left the operational area. AFP and the UN were ready to continue relief operations without U.S. military support.

On July 3, military HA/DR operations stood down. Over the duration of the operation, 25 million pounds of relief cargo had been moved by airlift.
Appendix C. Sample Game Materials: Recommended Agenda for Command-and-Control Risk and Resilience Tabletop Exercise Capstone Event

In this appendix is the recommended agenda for a TTX to assess risk and resilience metrics of two alternative C2 organizational structures in one scenario. This schedule could be compressed into one day if the participants and facilitators have experience with the methodology.

Day 1

0730 Check in
0800 Overview of TTX and scenario
0900 Overview of two alternative C2 organizational structures
1000 Break
1015 Identification of C2 assumptions by scenario event
1215 Lunch break
1330 Assessment of impact (assumption impact)
1500 Break
1515 Identification of risks (assumption impact and likelihood)
1700 Adjourn

Day 2

0730 Check in
0800 Review of identified risks
0830 Identification of signposts
0945 Break
1000 Identification of resilience actions (hedging and shaping actions)
1145 Assessing relative importance of risks
1215 Lunch break
1330 Discussion
1430 Adjourn
Appendix D. Sample Game Materials: Summary of Game Results

In this appendix is a summary, side-by-side comparison of C2 risk and resilience metrics for the two alternative C2 organizational structures described in Appendix A in the scenario described in Appendix B.

Table D.1. Summary of Game Results

<table>
<thead>
<tr>
<th>Metric</th>
<th>GCC Led</th>
<th>JTF Led</th>
</tr>
</thead>
<tbody>
<tr>
<td>Number of unique risks</td>
<td>6</td>
<td>6</td>
</tr>
<tr>
<td>Number of common risks</td>
<td>4</td>
<td></td>
</tr>
<tr>
<td>Total number of risks</td>
<td>10</td>
<td>10</td>
</tr>
<tr>
<td>Unique risk of highest importance</td>
<td>Air operations were responsive to JOA needs.</td>
<td>Commander, JTF, had authorities established and was able to conduct operations in a timely manner.</td>
</tr>
<tr>
<td>Resilience actions for the unique risk of highest importance</td>
<td>Have the JAOC run separate air tasking order cycles for the HA/DR operation and other theater operations (shaping).</td>
<td>Develop a checklist of the authorities needed and update the associated concept plan (shaping).</td>
</tr>
<tr>
<td>Common risk of highest importance</td>
<td>Deployable communication packages existed and were available.</td>
<td></td>
</tr>
<tr>
<td>Resilience actions for the common risk of highest importance</td>
<td>• Continue to build out and unit type code the requirements for deployable communication packages, and incorporate them into command-post exercises (shaping).</td>
<td></td>
</tr>
<tr>
<td></td>
<td>• Leverage host-nation infrastructure, if available (hedging).</td>
<td></td>
</tr>
</tbody>
</table>

NOTE: The results depicted in this table are for sample purposes only.


http://www.dtic.mil/doctrine/new_pubs/jp3_0_20170117.pdf


http://www.dtic.mil/doctrine/new_pubs/jp5_0.pdf


JP 3-0—See Joint Publication 3-0.

JP 5-0—See Joint Publication 5-0.


Many recent wargames conducted by the joint community have examined alternative organizational structures for operational-level command and control (C2) in a scenario. However, wargames typically role-play and exercise the roles, responsibilities, and authorities of a prescribed C2 organizational structure in the scenario rather than compare and contrast alternative structures in a rigorous manner. This report provides a “how-to” guide for conducting a C2 risk and resilience (C2R2) tabletop exercise (TTX). The C2R2 TTX is a wargaming method that RAND researchers developed and can be used to compare and contrast alternative organizational structures for operational-level C2 in terms of associated risks to operational outcomes and the organizational structures’ resilience to those risks. The method is an adaptation of the assumption-based planning methodology developed for the U.S. Army in the 1990s but conducted in a TTX format and using a retrospective futurology approach to elicit consensus from subject-matter experts. The steps involve preparing the materials, conducting a preparation session, evaluating risk and resilience metrics in a one- or two-day event involving 12 to 24 participants, and summarizing the results. This could be suitable for a multiday workshop conducted in parallel with and as part of a larger wargaming effort.