16 Enabling operational users to fully exploit the tools, data, and analytics to shape potential futures[1]

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1. Overview

Human, social, cultural, and behavioral (HSCB) modeling with forecasting and mitigation-option capabilities improves operators' ability to understand and shape the operational environment. Sociocultural data and analysis assist in the identification of crises further "left of bang," allowing consideration of more mitigation options and more time to assess possible ramifications (Flynn, Sisco, & Ellis, 2012). As a greater number of HSCB-driven mitigation technologies improve and are deployed, more operational users will require training on these tools, data, and analytics to mitigate and shape potential futures.

Limited time, tools, and capacity currently constrain the number of prospective courses of action (COAs) that operational planners can generate and assess as they try to mitigate or avert potential crises. Processes implemented today are highly manually intensive and seldom integrated (computationally) with HSCB knowledge. As HSCB-driven mitigation technologies continue to evolve at a rapid pace, the quality and kind of information made available to users and the potential utility of this content will begin to blur the traditional "lanes" between current career fields such as intelligence, operations research, and operational planning. This, in turn, will require innovations in training to prepare users to effectively recognize and leverage content relevant to analyzing COAs for mitigation. For example, training on model interpretation, typically concentrated in particular career fields such as operations research, must be expanded to ensure that more operational users can effectively apply emerging mitigation options.

As the proliferation of HSCB knowledge makes COA mitigation capabilities more accessible, innovative training for the skills and knowledge needed to perform COA mitigation tasks becomes imperative. This chapter focuses primarily on the mitigation tasks related to COA development, COA analysis, and COA assessment. For each key mitigation task, trainers must consider user skill (ability necessary to perform the task) and knowledge (facts, concepts, and principles required to perform the task), as defined in the Military Handbook 29612-2A (MIL-HDBK-29612-2A, 2001). An initial analysis of the functional tasks involved in mitigation highlights several considerations, such as key training objectives and ideal training formats (e.g., computer based training, classroom, or exercise).

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This chapter begins with an overview of the HSCB knowledge and skills necessary to perform mitigation. We present a use case detailing the processes involved in development, analysis, and assessment of COAs. From the context generated by the use case, we describe training for mitigation by addressing training for each of those processes. We present each of the processes in terms of the knowledge and skills needed, the implications for training, and the state of the practice.

1.1. Knowledge and Skills for Mitigation

In general, HSCB knowledge and the skills for acquiring, understanding, applying and maintaining it can facilitate each mitigation task. HSCB knowledge spans general sociocultural information, such as current and historical characteristics of a geographic region (country, city, village, etc.), groups, and even individuals. This information builds context for and supports computational social science and other analytical capabilities designed to anticipate the effects (including n^{th}-order effects) of particular COAs and assess their impact. It also provides greater context to enable mitigation of a forecasted event (e.g., understand the rationale behind the forecast and the significance and potential impact of the event to mitigate). Aspects of HSCB knowledge include the PMESII (political, military, economic, social, informational, infrastructure) conditions in a region, as well as the goals, standards, preferences, and beliefs of groups and key influential individuals (e.g., leaders) in the region, and other key regional players and their objectives. Training for mitigation cultivates the special knowledge and skills that planners need to thoroughly understand applicable U.S. objectives and priorities when considering diplomatic, information, military, and economic (DIME) options for COAs, resources available to execute them, the effects of the COAs, and measures of effectiveness and performance.

Operators need many skills for mitigation and must be trained to acquire them, but we focus here on those skills most influenced by recent improvements in HSCB capabilities. All planners and analysts considering mitigation options must learn to rapidly ingest available information about the operational environment. To properly harness emerging HSCB capabilities, they must know how to use the tools, understand the quantitative and qualitative aspects of social science modeling, and recognize the benefits and limitations of the data sources used by HSCB tools.

To more clearly identify requirements for mitigation training, we consider the mitigation process from two perspectives: (1) the kinds of HSCB knowledge needed to perform mitigation analysis, and (2) the skills needed to incorporate the HSCB dimensions of a geospatial region into the planning process. We categorize these in terms of the development, analysis, and assessment phases.

The next section of this chapter presents a mitigation use case that offers a notional background for describing the knowledge and skills needed for each of the phases of mitigation. It discusses the three phases of constructing a Theater Campaign Plan (TCP), and highlights some emerging HSCB technologies beginning to have an impact on this process. Subsequent sections summarize the HSCB knowledge and skills required for each phase of mitigation. Finally, we discuss the objectives for training to support planners and analysts in developing the capabilities required to perform mitigation effectively.

2. Mitigation Use Case: Theater Campaign Plan

As an example of the skills and knowledge required from operators to perform mitigation, we describe the TCP**:** a strategic plan designed to mitigate instability and to achieve other desired end states in a Combatant Command's (CCMD's) area of responsibility (AOR). An AOR includes a number of countries that may exhibit considerable diversity. For example, U.S. Pacific Command (PACOM) spans 36 countries around the Pacific Rim, including Australia, China, and Fiji. Planning in the PACOM AOR is therefore a challenging problem that calls for considerable HSCB knowledge, skills, and tools (see Figure 1). U.S. goals in a geographic AOR include the prevention and mitigation of regional instability. For peacetime operations, the TCP and country plans represent longer range, multi-year allocations of resources to appropriate DIME actions.

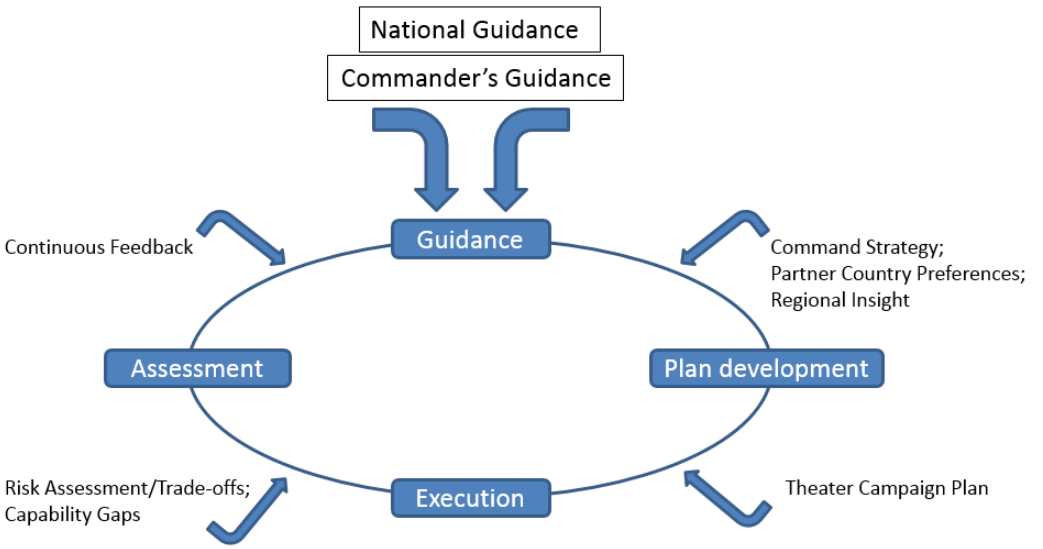

Figure 1. National Defense University model of the strategic planning process.

The TCP process not only reveals opportunities and requirements for additional automation[2], but also helps illustrate additional requirements for human competencies (knowledge and skills) that must be conveyed through training. The following description of the TCP is based on official planning guidance (Theater campaign planning, 2012) and on relevant discussions with CCMDs that

[2] DARPA Integrated Crisis Early Warning System (ICEWS) effort (O'Brien, 2010; Kettler & Hoffman, 2012) was initially targeted to aid CCMDs to develop and assess the Theater Security Cooperation Plan (TSCP), a key part of the TCP that focuses on bilateral DIME actions such as joint training exercises between the U.S. and another country.

took place as part of the Defense Advanced Research Projects Agency (DARPA) Integrated Crisis Early Warning System (ICEWS) program.

Inputs to the TCP include global U.S. priorities as articulated in the Guidance for the Employment of the Force (GEF) and Joint Strategic Capabilities Plan (JSCP). The GEF specifies broad strategic theater end states, looking out 5 to 10 years. TCPs have a strategic focus on the longer term, rather than on a specific operation (e.g., a combat operation, relief for a particular disaster, etc.). They also emphasize planning for the "steady state" by describing DIME actions and resources required to make progress on longer term objectives, including keeping the peace by mitigating potential instability. TCPs are not static and must be updated if the situation in the AOR changes, for instance if resources become unavailable or a natural disaster occurs. For example, the 2005 tsunami in Indonesia required considerable attention and resources from PACOM, given the scale of devastation and the longer term potential for adverse impact on regional stability. TCPs require coordination across the DoD (e.g., individual services supporting the CCMDs), non-DoD U.S. Government agencies (e.g., the State Department, U.S. Agency for International Development), the individual countries in the AOR, allies, and nongovernmental organizations (NGOs). Many of those entities are involved in the actual execution of the TCP – for example, providing resources – with the CCMDs responsible for overall planning, execution, and assessment of the TCP.

An early task in TCP planning is COA development, which focuses on mission analysis and on assimilating high-level guidance from documents such as the GEF and JSCP, and includes identifying desired theater strategic end states projected 5 to 10 years in the future. The planners integrate guidance and supporting information into (a) intermediate military objectives (IMOs)[3] leading toward end states, (b) key planning assumptions, and (c) available resources. Intelligence support to TCP planners identify and describe threats and opportunities associated with desired end states, including regional PMESII factors, the potential COAs of countries outside the AOR and hostile countries inside the AOR, and transnational actors that may have their own interests and objectives in the AOR.

ICEWS forecasts of country instability, which provide early warning of potential hot spots where the TCP planners may need to consider COAs for mitigation efforts, represent one example of recent HSCB-enabled technology that can have an impact in the area of mitigation. Recent work on supplementing ICEWS forecasts with details automatically mined from ongoing monitoring of open media (newsfeeds, social media, etc.) and classified sources may provide additional guidance for refining TCP development by elaborating and verifying the actionable details of a potential instability event of interest (EOI). For example, understanding which groups in a country might be fomenting unrest and why they are doing so could help avoid an event by suggesting more specific and effective COAs that the TCP may identify with respect to a peacekeeping IMO.

[3] Examples of IMOs include building partner (country) capacities, gaining access, maintaining relationships, conducting security force assistance, supporting ongoing operations, etc. Like all military objectives, IMOs are ideally outcome- vs. process-oriented, time-bound, and measurable.

Mindful of the threats and opportunities in the AOR, the CCMD next develops a TCP around IMOs that contribute to the desired end states. Initially the ICEWS forecasting capabilities (iCAST) were intended to help CCMDs determine where to focus their TCP portfolios, given their objectives, repertoire of potential DIME actions,[4] and available resources.

COA development centers on assimilating guidance into the identification of a desired end state and a strategic plan for realizing that end state. Training for COA development must advance students' knowledge and skills in identifying a desired end state consistent with guidance, relevant objectives, and possible actions (i.e., potential COAs) to accomplish the objectives based on awareness of the current state and the expected impact of possible COAs. While most planning courses currently teach these fundamentals to some degree, they must be extended to incorporate emerging HSCB capabilities. For example, TCP planners should learn to better incorporate social science knowledge about the populations affected to increase the number of potential COAs that might achieve key objectives.

Determining the best COAs corresponding to TCP objectives requires analysis of potential COAs to project and assess the likely impact. Ideally, this includes modeling the actions to provide a deeper understanding of potential impact. Such modeling can be difficult, since the actions themselves may be ill specified. Their effects may be conditional (i.e., differ depending on the situation), extended in time, subject to interaction with the effects of other actions that overlap in time, or dependent on unknown factors. Some contemporaneous actions may be unknown (e.g., the DIME actions by other world powers with potentially competing agendas). Actions may have n^{th}-order effects that are neither well known nor easy to mine from incomplete or noisy historical data.

To analyze COAs for DIME objectives, planners must understand the impact an action may have on the operational environment (see Figure 2). The ICEWS project built Bayesian models based on the input of subject matter experts (SMEs), such as social scientists, country analysts, etc., to explore the impact of DIME actions. The key SME tasks included defining DIME actions (e.g., what constitutes an economic action such as "Provide Financial Aid"), eliciting contextual variables that determine the conditional effects of a given action (e.g., Action *X* can have one set of effects in Country *X* and different effects in Country *Y*), and "linking" variables that capture the effects of DIME actions (e.g., the change in rate of violent events in a country). For example, SMEs associated an economic action such as "Provide Financial Aid" with context variables such as the capacity of government, influence of trading partners, distribution/delivery mechanisms, etc. The SMEs correlated these context variables with effect variables, such as impact on Cooperation (e.g., level of cooperative events) and Discord (e.g., level of violent events).

[4] Possible DIME actions include activities such as visits by high-level personnel, bilateral conferences, bilateral training exercises, port visits (for diplomatic, show-of-force, and economic impact), medical assistance, engineering project assistance, etc.

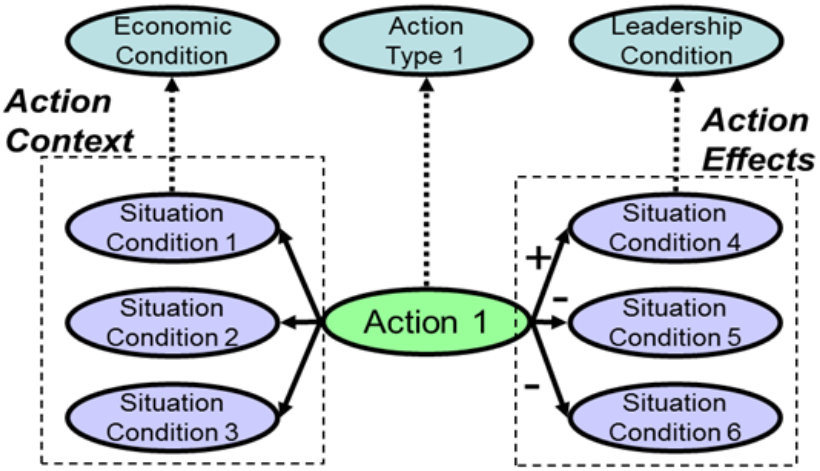

Figure 2. SMEs defined (a) the DIME action ("Action 1"), (b) relevant contextual variables ("Action Context"), and (c) effects of DIME actions ("Action Effects).

COA analysis assumes that the development phase has generated one or more potential COAs; the analysis then focuses on projecting and assessing the future impact of the actions defined in those COAs. Training for COA analysis must emphasize acquisition of knowledge and skills for identifying context variables relevant to the action and effect variables influenced by the action, understanding the relationship between the context and effect variables, and increasing awareness of sensitivities such as conditional or interaction effects. Advances in HSCB technologies, including "what-if" forecasting and variable identification, have built on some of the lessons learned from the intensive modeling exercises with SMEs, making the information more operationally accessible. To take advantage of these technologies, TCP planners need to be trained on HSCB models and other relevant tools.

COA assessment for TCPs often occurs in parallel with COA development, as different parts of the TCP may be in different stages of planning and ongoing execution. Assessment may be triggered by regular review timetables, commanders' questions or directives, developing world events, emergent threats or opportunities, the completion (or failure) of DIME actions, execution of the TCP, etc. Assessment includes applying various measures to evaluate the performance of planned tasks/actions (i.e., did the action take place as planned?). For example, did a port visit occur or was it prevented by weather or other factors? Was the action only partially completed? If an action executed as planned, did it have the desired diplomatic, military, political, or economic impact, contributing to a higher level desired end state? For example, perhaps the port visit was designed to improve public support for the United States, but actually spawned anti-U.S. protests. Finally, the assessment must cover the cost of performance versus the effectiveness of the action: was the resource investment worthwhile compared to alternative actions?

Assessments require significant resources to capture the relevant information, analyze it, assimilate it, and archive it for future use. Assessments demand manpower, tools, and data, and should be performed in a timely fashion while information is fresh. Tools have typically lagged behind the need and have been limited to databases, spreadsheets, and other ad hoc methods that impeded information integration, sharing, and reuse. Typically it is easier to collect information pertaining to measuring performance (what was done) vs. measuring effectiveness (what was achieved in terms of actual vs. desired effects).

Operational deployment of capabilities such as those offered by ICEWS allows the user to leverage open media (e.g., news reports, social media,[5] and other sources such as financial market indicators) to augment information gathered by CCMD assessment staff (Sanchack, 2012). For many countries, these sources provide a wealth of indicators relative to the issues that concern the population of a country or city and their sentiment about those issues. News reports can provide useful indications regarding the effects of a DIME action. For example, while a port visit is ongoing, analysts can inexpensively detect protests or other reactions among the populace by examining news reports from multiple sources. This helps define metrics for assessing effectiveness of the current TCP and for building computational models of DIME actions in the future.

Training for COA assessment should enable students to gain knowledge and skills for evaluating COA execution; measuring COA impact based on indicators in HSCB knowledge, including analysis of open media; and assessing COA suitability in terms of resource availability and consumption, cost, and other measures.

3. Knowledge and Skills Requirements for Functional Mitigation Tasks

This section presents an initial analysis of the knowledge and skills needed to perform the functional mitigation tasks of COA development, COA analysis, and COA assessment. The discussion will guide training considerations by identifying the learning objectives that foster the requisite human competencies. In this section, we describe the knowledge that informs all areas of mitigation tasking and then decompose each mitigation task to identify the particular skills needed to perform them.

3.1. Knowledge for COA Development, Analysis, and Assessment

COA development, analysis, and assessment require similar kinds of knowledge, although each uses that knowledge in a unique manner. To perform mitigation tasks analysts need (a) social science knowledge resulting from integration of information sources such as population-centric information and sociocultural information, and (b) knowledge of modeling (including underlying theories and data) and model results.

Social science knowledge generated from population-centric information and sociocultural information describes the HSCB dimensions of the operational environment that are essential for

[5] Via the newer iSENT social media (Twitter, blog, etc.) ingest and analytic capabilities, which include sentiment and influence analysis.

mitigation tasks. Population-centric information details the demographics of the population, while sociocultural information characterizes the relationships among contextual factors and individuals or populations. This includes such information as where people are located in a geographical space, group associations, political or religious affiliations, economic conditions, social and cultural expectations regarding how people interact with their environment and each other, and how deviations from social norms (e.g., improper discarding of holy items, inappropriate interactions with respected or authority individuals) may affect social responses such as sentiment or mood. These data are critical for developing high-quality and effective COA alternatives. The alternatives built upon this HSCB perspective reflect an understanding of the commander's intent within the sociocultural context of the local population, which results in an accurate and effective design for realizing essential tasks and, ultimately, in mission success. The integration of these kinds of information produces social science knowledge that enables useful understanding of the correlations among contextual factors and their impact on the operational environment to support the execution of necessary actions for mitigation.

To effectively plan tasks to be performed within a geographic region, the deployed resources must understand demographic characteristics of the local population. For example, if the United States intends to provide food as aid to a particular region, planners must understand the relevant tenets of the population's religion (e.g., dietary or handling implications).

Social and cultural behaviors can indicate group norms, where these norms encompass the actions or interactions that individuals of a particular social or cultural group would expect from their environment. These kinds of interactions can be as simple as shaking hands when meeting someone or as complicated as understanding an inherent social hierarchy and sitting lower (i.e., closer to the floor) than a perceived superior. Understanding this type of information facilitates the use of other relevant data sources such as social media in order to extract supporting content that provides deeper awareness and understanding. Mitigation training needed to support the processing of HSCB knowledge during COA development must be based on access to both population-centric and sociocultural information. For example, geolocated blog posts that reveal the political perspectives of the people in an area can add depth to population-centric information describing the political demographics of that area. Social media offer a fertile platform for acquiring population-centric and sociocultural information supporting various kinds of HSCB knowledge. These media can be a valuable source of data for sentiment analysis – assessing the attitudes, emotions, sentiments, and opinions of a population – and mood shift analysis, which specifically considers the trends in sentiment or mood. Social media also aid in trust assessment of open source data. Trust is a key element in the effective functioning of groups.

To generate alternative COAs in response to a mission statement and a strategic approach, planners need the ability to understand what the data convey about the characteristics and configuration of a population, and what the models indicate with respect to the theoretical significance of data trends. Models that depict how particular factors influence the human, social, cultural and/or behavioral dimensions of a population help analysts to project an expected consequence based on an initial configuration of such factors and DIME actions. These types of modeling tools provide the knowledge necessary for better understanding the relationships among

contextual factors within the HSCB space and the impact those factors have on the stability of the operational environment. Exploring models and manipulating the factors they encapsulate allow analysts to (a) investigate and identify threats and opportunities and their effects on the desired end state, (b) recognize high-level objectives of parties external to the AOR that may contend or otherwise affect the strategic agenda of the CCMD, (c) project and evaluate future impact of changes in contextual factors, and (d) contribute to defining measures for assessment and prioritization of COAs.

HSCB models enable users to apply the massive and complex data in the HSCB space in order to present analysts with tractable content and enable them to easily and quickly identify relevant information. However, all models present a simplified view of the actual world. To effectively leverage a model, users must translate the model's representation of the world to fit the user's perspective. Understanding a model's output requires knowledge of the purpose and performance of the model and awareness of sociocultural elements of the environment such as population distribution and composition, cultural norms, or religious affiliations. Users' trust in the ability of a tool to help generate COAs will depend on substantiated evidence that the model enables a *valid* representation of the operational environment. Thus, intelligence and operational planning experts must be trained on how HSCB models represent the operational environment, and how to translate and leverage this content for COA development. This will aid users to interpret the model results, build trust in the model, and gain awareness of factors in the real world (based on model analysis) that are relevant to COAs.

Because HSCB models rely on sociocultural knowledge and theories, users must also learn that some models are more heuristic based (Moss & Edmonds, 2005) than the models currently applied to operations, which typically provide detailed representations of potential kinetic force-on-force outcomes. Nevertheless, these heuristic models still provide valuable operational insight.

Clear visualizations and model transparency are critical to training in COA development. Interpreting visual representations of model performance, forecasts, analysis, etc., must become second nature to the HSCB model user/COA developer in order to make the results optimally effective in assessing relevant HSCB content and model forecasts quickly. Training must take into account that many potential users will be qualitative vs. quantitative thinkers; good visualization tools must support a range of users with varied job functions and modeling and social science expertise (OSD, 2009).

3.2. Skills for COA Development

To mitigate or avert a potential crisis or event, planners must first develop COAs that counter the undesirable action and promote achievement of the desired end state. Once planners have analyzed the mission and generated high-level guidance to achieve desired theater strategic end states, the TCP identifies objectives (i.e., IMOs) that contribute to these end states and ultimately designates COAs intended to realize the TCP objectives. COA developers such as TCP planners must have the knowledge and skills to identify contextual factors relevant to realizing the desired end state; understand the potential COAs of friendly, neutral, and adversary nations and transnational groups both inside and outside the AOR; assimilate guidance into the identification and description

of a desired end state; and generate COAs with the expectation of realizing the desired end state. This should include the ability to describe threats and opportunities associated with that end state, identify relevant regional PMESII factors in the AOR, define objectives (i.e., IMOs) leading toward the desired end state, recognize key planning assumptions, and, finally, for each objective, generate COA(s) designed to realize the objective and determine the available resources for performing the COA(s).

COA development requires awareness and understanding of the desired or projected future. The following subsections identify the knowledge and skills required to perform each of the four high-level tasks comprising COA development. They then describe how these knowledge and skills translate into training implications for developing the awareness and understanding necessary to perform these tasks effectively.

3.2.1. Skills to identify contextual factors of consequence

Once the commander has set a high-level strategic agenda and characterized it in terms of a desired end state and objectives, a COA developer must extrapolate and identify aspects of the operational environment relevant to the agenda. These aspects consist of contextual factors that will aid in assessing the current state, forecasting the future state, and interpreting the impact of actions on the future state.

While the intelligence career field has built some expertise in these skills, the planning community (though supported by intelligence) typically consists of operators (e.g., Air Force pilots). Training for these individuals must cover emerging HSCB-enhanced mitigation tools (such as social science forecasting models). The ability to understand models includes the ability to observe and learn the relationships and factors presented by a model of an HSCB phenomenon. Planners can leverage this understanding to interpret and understand the model's results. For example, the iCAST component of ICEWS contains agent-based models (ABMs) of specific countries for specified EOIs. iCAST calibrates these ABMs to the current state of the modeled country and then executes them to produce multiple trajectories of potential future states of that country. The actions and interactions of the agents in the ABM that lead to each future state are based on rules and environmental conditions that describe the country and the sociopolitical theory guiding the ABM. For example, all of the ABMs developed for ICEWS stem from a generic political model that captures rules based on political theory for actions such as protest, rebellious activity, and religious violence. As planners recognize and comprehend the political theory at play in the ABMs and the country's environmental conditions framing the initial state of the ABM, the model output enables them to understand the variety of potential future states that the model generates and hence potential futures for the country in question.

Within the possible futures, analysts may identify threats or opportunities that may manifest themselves, as well as specific contextual factors that could result from underlying operational factors. For example, the model might predict high levels of protest that may indicate depleted resources or insurgent propaganda. Those operational factors could suggest a potential COA for mitigation. Planners also benefit from the ability to experiment with model input parameters, manipulating the model in order to determine how changes in input affect potential futures.

3.2.2. Skills to understand COAs of other countries

Concurrently, COA developers must consider what activities other countries are engaged in or are planning to leverage, exploit, or contend with that may affect progress toward achieving the desired end state. Potential COAs of transnational actors or influential countries both inside and outside the AOR will favor distinct, though possibly overlapping or competing, interests and objectives. Identifying and understanding potential COAs of influential countries or groups may require the type of knowledge described above for identifying relevant contextual factors, and definitely requires unique skills for identifying possible high-level strategic agendas of other parties that may have an impact on the strategic agenda of the CCMD.

Once an analyst has characterized the interests of external parties, distinguishing COAs for transnational actors or for countries inside/outside the AOR calls for the recognition of high-level objectives that may conflict with or otherwise affect the strategic agenda of the CCMD. The process for recognizing relevant factors is similar to the process for identifying contextual factors described in section 3.2.1, the process for mapping contextual factors to high-level objectives described in section 3.2.3, and the process of translating objectives to COAs described in section 3.2.4.

Once analysts have noted the contextual factors relevant to the CCMD's strategic agenda, they need the skill to leverage the model's capability to explore external factors that may have an impact on the contextual factors associated with the strategic agenda. After identifying these external factors, analysts must consider the interests of other parties in these external factors. Scenarios illustrating how the interests of transnational actors or other countries can affect external factors result in identification of third party agendas that could threaten or present opportunities for the CCMD's strategic agenda.

3.2.3 Skills to identify objectives

Planners must decompose high-level strategic guidance into tractable objectives that can be aggregated to realize the desired end state. Identifying these objectives and the assumptions that may underlie them is critical for developing valid COAs. HSCB-relevant skills must enable planners to translate strategic guidance into clear operational objectives and articulate the key planning assumptions within the context of the unique sociocultural elements of the particular target country/region.

HSCB modeling and model results have become increasingly useful in understanding the relationship between a desired end state and its relationship to the operational environment. For example, the desired end state of effective cooperation between the United States and Country X may be achieved through COAs that support various objectives, including developing pro-American sentiment within the population.

3.2.4. Skills to generate candidate COAs

Having accomplished the previous steps, COA developers must consider how to relate specific objectives to the possible COAs, identify the resources required for each COA, and prioritize the COAs. Consider the operational objective of eliminating the support base of a particular adversary. Planners might consider multiple COAs, such as military information support operations (MISO),

increased security in certain areas, kinetic attacks on known adversary command and control elements, and non-kinetic attacks on adversary propaganda sites. Current kinetic models, based on the principles of physics and on extensive information on how systems operate (e.g., integrated air defense systems), can give users confidence in the accuracy of their estimates. By contrast, HSCB systems use theories from areas of study such as sociology, anthropology, and psychology that are much less (if at all) grounded in physical principles, yet are still capable of providing valuable and relevant insights. While most operational planners are very familiar with kinetic principles, their understanding of social sciences is often anecdotal at best. As such, operational planners must learn when it is appropriate to apply HSCB models, and how to interpret the model results with respect to the degree of confidence the model merits within the context it is being applied.

3.3. Skills for COA Analysis

In the TCP use case, planners must model the actions involved in a proposed COA to determine how implementing those actions might affect the operational environment. Exploring how DIME actions may affect the variables input to a forecast model supports COA analysis. If a DIME action can be associated with a change in a model's input variables, the model will reveal how those changes affect the forecast probability.

Planners should assess the feasibility of a COA to determine whether the proposed action can accomplish the mission objective within the allocated time, space, and resources. To support COA feasibility assessments planners need the information and tools that enable them to model and assess resource requirements and the impacts of DIME actions and others.

During the COA analysis phase planners must also evaluate the acceptability of a COA. This analysis considers whether the benefits of the COA outweigh the expected costs in terms of such factors as losses of friendly forces, time, position, and opportunity. Acceptability analysis also ensures that the COA accommodates constraints such as rules of engagement for specific operating environments.

Wargaming offers an effective preliminary means of performing feasibility and acceptability assessments. Wargaming provides a context to identify the advantages and disadvantages of a COA, ultimately allowing for a comparison among COAs. The wargame iterates a process of action, reaction, and counteraction that fosters ideas and insights that inform preliminary validity assessments of potential COAs.

Wargaming for COA analysis may be entirely manual or computer assisted. Both forms require similar training regarding the development of tactical judgment and operational experience, but computer-assisted wargaming incurs the additional overhead of loading scenarios into the system and training users on the system. However, the versatility of computer simulations for supporting multiple scenarios mitigates this cost.

To perform COA analysis, the operator must investigate the impact that a particular action may have in a given environment. Models that facilitate "what-if" investigation—also known as hypothesis testing— of the scenario of interest in the operational area can assist this impact

assessment. For example, a model could help operators to answer questions such as "If we increased forces in this area, how would the adversary or friendly/neutral actor respond?" or "If the adversary took a particular action, what would be the most effective counteraction?"

3.4. Skills for COA Assessment

COA assessment includes Measures of Effectiveness (MOEs) for evaluating the accomplishment of the mission objectives and achievement of the desired end state (CJCSI-3170.01E, 2005). MOEs may consist of more detailed measures, specifically Measures of Performance (MOPs) and Measures of Suitability (MOSs). MOPs detail in quantitative terms how well a particular activity was executed; for example, whether a port visit occurred or was prevented by weather or other factors. MOSs relate to the feasibility of the COA within the operational environment, reflecting operational readiness or availability with respect to the intended action; for example, whether the available resources could support a port visit, or whether elements of the logistical infrastructure could not meet the resource requirements. For example, a MOP assesses the performance of a port visit, an MOS assesses the operational capability to support a port visit, and the MOE assesses the impact of a port visit on the overall mission objective in terms of diplomatic, show-of-force, and economic effects.

4. Implications for Training for Mitigation

Training for mitigation must lead to the development of HSCB-related expertise. As technology capabilities emerge that support the management of HSCB content for application to mitigation scenarios, the training community will learn more about what training specific to this context requires. One concern is that in order to train individuals for a specific mitigation task using HSCB data, it must be assumed that the individual has been provided with a degree of education. There is no clear documentation of what education is required for training in mitigation. Having preliminary knowledge and understanding of the HSCB context of the deployment environment provides each trainee with better, deeper awareness of the human-related forces at play in that environment so as to be able to better perform the task being trained. This section distinguishes between education and training expectations and describes recommended learning objectives for both with respect to mitigation. We also describe emerging technologies that support such education and training or technological gaps related to each learning objective.

4.1. Description of the Mitigation Training Space

> Cultural understanding doesn't just help you achieve your objectives—it helps you discover what your objectives should be.
>
> — General Anthony Zinni (Rasmussen & Seick, 2012, p. 1)

While many breakthroughs in HSCB technology have the promise of fundamentally changing the military planning community's approach to mitigation, military members will need to be trained on how to use the rapidly growing amount of information and new tools before the promise of better mitigation can be reached. Historically, formal U.S. military training for crisis mitigation based on cultural factors has focused on potential nation-state level reactions to blue courses of action.

More recently, mitigation training has taken a strong tactical focus involving individual soldier training in face-to-face cross-cultural contact. The tools and cultural information/understanding did not exist in the military to conduct operational-level mitigation training. Training articles are beginning to discuss an expanded view of the cultural training, to include such concepts as "culture-general capabilities" and "cross-cultural competence" (3C), but these ideas still focus primarily on mitigating tactical level activity that might cause unanticipated strategic consequences. (Rasmussen, Sieck, & Osland, 2010; Wisecarver, Ferro, Foldes, Adis, Hope, & Hill, 2012)

Even with a tactical training view, work remains to be done on defining the best approaches to improving the military's cultural understanding, and applying that understanding to mitigate undesirable outcomes. "Current efforts towards defining and scoping culture-general capabilities, or Cross-Cultural Competence (3C) include high level cognitive skills such as sensemaking and perspective taking (Abbe, Gulick, & Herman, 2007)—however, the field has yet to effectively characterize the cognitive processes that these skills entail." (Rasmussen, Sieck, & Osland, 2010, p. 2)

Though training objectives don't currently exist for the new portfolio of HSCB tools, each of the services has developed training for individual cultural understanding. For example, the Marine Corps Operational Culture And Language Training And Readiness (T&R) Manual (p. 21), training objectives include:

- Assess the attitudes among a foreign populace
- Assess the behaviors among a foreign populace
- Assess cultural considerations that affect the population's attitudes/behaviors
- Incorporate cultural considerations into plans and operations
- Develop TTPs
- Implement plans to target the desired attitudes/behaviors
- Monitor the effectiveness of plans targeting attitudes/behaviors
- Reassess the population's attitudes/behaviors
- Adjust operations

These training objectives are representative of how the services are training their planners and operators to consider sociocultural factors. These objectives are often taught as thought exercises, and rarely extend past an initial understanding of potential first order effects. Some more complex capabilities, such as red teaming, are taught to limited groups and begin to train military personnel on how adversaries are likely to respond to blue courses of action. The objective of red teaming is to "avoid groupthink, mirror imaging, cultural missteps, and tunnel vision in plans and operations" (University of Foreign Military and Cultural Studies, 2011, p. 1). These techniques provide great value to operational planning, but seldom extend beyond considering the stated adversary into considering the reaction of the surrounding population.

Innovations such as those described here are designed to support operational level tasks such as course of action generation, etc. Today's HSCB tools bring the capability of not only considering the

adversary, but of multiple facets of the local population. This will radically increase the number of elements of mitigation that can be considered by planners, if the tools are made more widely available and properly trained. Training will need to include not only formal courses, but also integration into exercises and Master Scenario Event Lists (MSELs) and exercises.

4.2. Mitigation Education and Training: Bridging the Gap

Before we can expect a trainee to be able to perform a mitigation task which in the real world must be performed in the face of uncertainty, we must first educate the trainee to better understand and act in an uncertain space. As a result, training for mitigation must be preceded by education. To develop education curricula to support mitigation training, "we must cultivate an environment in which we teach our soldiers how to think and adapt, not what to think." (Burton, Nance, & Walton, 2011, p. 1) In other words, mitigation education must build "a culture of flexibility" in thinking to support the training of specific mitigation tasks (Burton, Nance, & Walton, 2011).

For example, in order to effectively mitigate scenarios dealing with information about events or actions taking place in a foreign environment, the user of the system must have received education previously. In particular, the kind of education relevant to such a context may be education in the norms and traditions of the associated culture, as well as education in the understanding and awareness of cognitive biases. This education background prepares the user to be able to mitigate uncertainties that may arise from being informed of events or actions contrary to what the user is accustomed to in his/her personal cultural experiences.

In this section, we will identify learning objectives for education for mitigation. Strategies that have been employed for achieving such objectives are identified. As tools to support mitigation have been developed, the question of how much education is needed to support use of the systems is an open question. If too much education is required, then the system requires over-specialization of its users, and cannot be sustained. For example, if a user needs to have a PhD in statistics to be able to interpret results presented by these systems or to understand the significance of events in a data set, then the system will not be able to be effectively employed by the target users. If the user is unable to understand what the system is doing or how it works, then the lack of confidence in the results will undermine the significance of the content. For example, if a mitigation support system is indicating the decreased likelihood of a violent event, but the system is not able to communicate to a layperson user what factors are leading to the assessment, then the user is less likely to trust the analysis and hence less likely to feel comfortable leveraging the information for building COA. Ongoing work is attempting to exploit visualization and automation techniques to support verification and validation of models and data to lower the education threshold for using these systems. For example, the Model Evaluation Selection and Assessment (MESA) project under the Office of Naval Research is investigating innovative verification and validation techniques for HSCB models to support the transparent and accessible understanding of how HSCB models work, the data they use and produce, and the theoretical principles that drive the model (Ruvinsky, Wedgwood, & Welsh, 2012).

This section describes recommended objectives for education and training for mitigation, as well as emerging technologies that support such training or technological gaps related to each learning objective.

4.2.1. Education learning objective #1: Understanding human dynamics

Sociocultural sensemaking for mitigation requires understanding "human dynamics," defined as "the actions and interactions of personal, interpersonal, and social/contextual factors and their effects on behavioral outcomes" (Defense Science Board, 2009, p. vii). In the HSCB domain, human dynamics propel change over time. Factors that influence human dynamics include economics, religion, politics, and culture. Developing skills in understanding human dynamics entails acquisition of two distinct, yet complementary, perspectives: a culture-general perspective on human behavioral tendencies, and a culture-specific perspective in which knowledge of these general behavioral tendencies is applied to a specific cultural context to develop an understanding of a particular culture.

Human Behavior Models (HBM) are used within simulations for training in which the task being trained requires understanding of other people, either individually (e.g., human psychology) or in a population (e.g., sociology), for decision making. They provide variations in human behavior in order to produce a more realistic experience for the trainee (Wray & Laird; 2003).

The use of HBM to establish the background context to training simulations makes it clear that education of the dynamics of human behavior is a pre-requisite to such training scenarios including scenarios relevant to mitigation where decisions are being made that impact populations.

4.2.1.1. Education for human behavior awareness

Education to foster awareness regarding human behavior must familiarize the trainee with the cultural factors that influence decision making at the micro level, as well as the kind of macro-level behaviors that emerge from these micro-factors. For example, ethnic diversity is the property of a geographical region and is described by having a population in which wide variety of races are found. In this example, the racial status of the individual contributes to the ethnic diversity of an area, which in turn impacts aspects of the environment which influences an individual's experience. According to Kanbur, Rajaram, & Varshney (2011, p. 149), "The daily life of families, neighborhoods, regions and countries is influenced by ethnic diversity." Various research projects hypothesize a positive association between ethno-linguistic fractionalization index (ELF; a measure of ethnic diversity) and the probability of civil war (Collier, Elliott, Hegre, Hoeffler, Reynal-Querol, & Sambanis, 2003). Education for human behavior awareness must leverage various disciplines, including psychology, sociology and anthropology, to name just a few.

Computational social science (CSS) models and HSCB data work to support an understanding of culture-general processes of human dynamics. Worldwide ICEWS (W-ICEWS) has a modeling and forecasting component called iCAST that leverages CSS models and HSCB data to predict events of interest. Though shown to be useful and produce interesting and relevant content, a significant challenge to this forecasting capability is the presentation of the sophisticated computational models and analyses to laypeople. To promote confidence in the iCAST models and forecasts, the

development team built a transparency capability that allows the user to explore the factors considered by the models and the relationships between the factors and the forecasted results. The transparency capability not only contributes to the user's awareness and understanding of how the model works by exposing the variables used by the models and allowing the user to change the values of variables to explore "what-if" scenarios, but also provides insight into the sociological implications of the model. Recent versions of iCAST leverage elements of the MESA program capabilities (Ruvinsky, Wedgwood, & Welsh, 2012), which provide techniques and tools to support the verification and validation of HSCB models.

4.2.1.2. Education for cultural awareness

Cultural Awareness as Cross-Cultural Competency (3C) is defined by Selmeski (2007, p. 12) as "the ability to quickly and accurately comprehend, then appropriately and effectively engage individuals from distinct cultural backgrounds to achieve the desired effect, despite not having an in-depth knowledge of the other culture." This competency goes beyond developing verbal communication skills for interacting with a particular culture, and toward developing culture-general knowledge as a framework for interacting with many different cultures. Understanding how culture influences human behavior is a first step toward understanding aspects of human dynamics in general, but real-world contexts are always culture specific. For example, the culture-general recognition that norms, beliefs, and customs influence the behaviors and interactions of individuals, groups, and societies helps analysts to identify or instantiate the norms, beliefs, and customs that prevail in a particular culture of interest. Analysts can then begin to reason about the impact of these instantiations on the behaviors and interactions of the individuals, groups, and societies in that culture.

Various technologies are being developed to support training in culture-specific awareness. For example, simulation environments for cultural training such as the Virtual Cultural Awareness Trainer (VCAT) have been shown to improve cultural-specific awareness (Johnson, Friedland, Schrider, Valente, & Sheridan, 2011). In fact, U.S. Southern Command has designated the VCAT as "Mandatory Training" for various culture-specific exercises (Alelo - Evidence of Effectiveness, 2013).

4.2.2. Education learning objective #2: Awareness and diminishing of cognitive bias

The term "cognitive bias" refers to subconscious errors that humans make in processing information. Such bias can lead to irrational or illogical actions. Trainees must learn to recognize cognitive bias in two contexts: (1) how cognitive biases affect the interaction of populations within the AOR, and (2) the trainee's own susceptibility to such biases as they evaluate potential COAs. Becoming aware of these cognitive vulnerabilities is a first step toward mitigating them.

4.2.2.1. Education to recognize evaluation biases

Understanding the benefits and limitations of data sources used by HSCB tools helps planners to evaluate the evidence presented by these tools. People are susceptible to a variety of extraneous influences when determining the evidence to rely on and how to interpret that evidence. Significant cognitive biases that can arise when evaluating evidence include confirmation bias, in which people place disproportionately great reliance on information that supports their own

beliefs or conclusions. HSCB data often describes aspects of human existence about which all people have ideas, opinions, and guiding principles or hypotheses. Analysts must be very careful to weigh the data objectively, and not to succumb to "the natural tendency of human beings to see what they expect to see" (Reese, 2012, p. 1261).

People are also subject to vividness bias, in which compelling, concrete, and personal information has a greater impact on the evaluation of a situation than more relevant, but abstract, information such as statistics. Vividness bias plays a role in assessing HSCB data because information garnered from HSCB sources such as social media often communicates memorable personal experiences in emotionally charged language (Heuer, 1999). Another form of bias, the anchoring effect, means that "focusing attention on a single option may lead the decision maker to neglect potentially valuable alternatives" (Missier, Ferrante, & Costantini, 2007). Planners must give consideration to all relevant and viable alternatives in the context of a decision problem.

As Keren (1990) posits, there are "cognitive pills for cognitive ills." The term "debiasing" describes any technique used to prevent or mitigate cognitive biases. These techniques include evidence lineup, which may mitigate the anchoring effect by specifying a "lineup" of possible alternatives to consider, and competitive self-regulation, in which analysts compete with each other to produce analytical products free from cognitive biases. An emerging technology designed to identify and mitigate cognitive biases in analysts comes from the Intelligence Advanced Research Projects Activity's (IARPA's) SIRIUS program, which uses Serious Games techniques and technologies to train participants to recognize and mitigate various cognitive biases.

4.2.2.2. Training to recognize cause and effect biases

When using HSCB data and models to perform COA mitigation, analysts must make judgments about cause and effect as they identify possible COAs that would lead to the desired end state, analyze COAs to understand how causal factors impact the current state, and assess the utility, viability, and affordability of each COA. Perceptions about cause and effect can be influenced by centralized direction bias, which leads people to attribute effects to coordinated actions or conspiracies rather than to accidents, mistakes, or coincidence. In addition, analysts may assume that causes and effects are proportional to each other. In other words, large effects must have large causes. The training debiasing techniques described in section 4.2.1, such as using lineups, can help trainees to counter cause and effect biases.

4.2.3. Training learning objective #1: Develop assessments of HSCB dimensions of foreign populace

The first training learning objective one needs to achieve in order to perform mitigation is to explore the data describing the foreign populace in question. As an example of the kind of training that supports this objective, we will present the iTRACE and iCAST components of the W-ICEWS suite, and describe the training initiatives conducted for these components. ICEWS was designed to forecast instability events for countries in an AOR. ICEWS consists of various components designed to support the visualization and understanding of data and forecasts generated by the ICEWS system. ICEWS is composed of three modules: iTRACE, iCAST and iSENT. Both iTRACE (ICEWS

Trending, Recognition & Assessment of Current Events) and iCAST (ICEWS Forecasting) have been demonstrated and trained to operational users.

4.2.3.1. Task 1: Identify, explore and analyze data relevant aspects of HSCB perspectives of a foreign populace to be investigated with respect to a mission objective.

The primary goal of iTRACE is to provide a fully automated capability to monitor political activity around the globe. This is accomplished by automatically converting news reports into structured indices that reflect the character and intensity of interactions between key leaders, organizations, and countries. The iTRACE system provides a data-driven view into *who* is doing *what* to *whom, when, where* and *how*. The system is based on open-source reporting from a large number of major and regional news services. iTRACE processes these news reports to extract the character and intensity of interactions between entities such as leaders, organizations and countries. The processed content may then be used by computational models to discover, identify and explore trends and patterns, and ultimately indicate potential of impending violence, crises or conflicts.

The training goal was to prepare the operational users at USPACOM to use the iTRACE system to meet the command's needs for HSCB information, such as providing information on event trends in countries of interest or interaction trends between countries or actors over time. Many of the learning objectives of the training dealt with being able to use the iTRACE system itself, such as navigating and using the iTRACE interface, but there were learning objectives designed to teach users how to aggregate content and generate visualizations of content that support a particular HSCB informational need. It is important to note that the iTRACE training packet assumed that the users had previous education regarding aspects of the human, social, cultural and behavioral domains being investigated, such as education in human dynamics, both general and specific to the region in question, giving the user awareness and understanding of what HSCB information is relevant to the mission context. This education allows the user to identify aspects of the investigation that he or she will use to configure the iTRACE analysis, such as what cultural or religious groups are of interest? What leaders or organizations are relevant? What kinds of events or intensity of events are most interesting?

The iTRACE training was broken down into three scenarios. The first consisted of a demonstration of the system; the second allowed the trainees to reproduce the analysis that we demonstrated in the first scenario; and the third scenario posed questions to the trainees for which they used the iTRACE system to answer. These questions were decomposed into three categories in which the trainees were to investigate (1) activities between actors (e.g., what activities in the last 10 years involved Philippines towards the United States?), (2) event filtering (e.g., find events that involved Philippine military activity toward insurgency groups between Jan 2001 and Oct 2009), and (3) actor filtering (e.g., determine what recent events involved the president Gloria Arroyo of the Philippines).

4.2.3.2. Task 2: develop relevant, data-driven assessments based on HSCB data and tools that capture aspects of a foreign populace relevant to COA development

iCAST provides forecasts of the likelihood of the occurrence of events of interests (EOIs), namely domestic political crisis, ethnic/religious violence, insurgency, international crisis and rebellion and

the key factors driving them. The primary objective of iCAST is to provide human, social, cultural and behavioral awareness to the user regarding a forecasted country state. This is accomplished by aggregating the forecasts of multiple independent HSCB models to create a single, aggregate forecast that is more accurate that any one single model. By integrating improved versions of best of breed models from multiple perspectives, iCAST achieves more accurate, precise forecasts than any one model alone.

The iCAST training packet had four training objectives: providing the trainee with the ability to

- View forecasts for different countries and EOIs (e.g., what is the anticipated probability of a specific EOI for a particular country at a future point in time?)
- Analyze aggregate model forecasts with respect to individual model contributions (e.g., how accurate are the models that are contributing to the aggregated forecast?)
- Analyze specific model forecasts with respect to underlying data parameter contributions (e.g., what are the key factors that contribute to the likelihood of a particular EOI occurring, or not occurring, for some country?)
- Explore data parameter sensitivity within a specific model forecast (e.g., what might influence the probability of EOI occurring, or not occurring, for a particular country?)

iCAST training guided trainees through the navigation and use of the various visualizations and content provided in iCAST to answer questions such as those presented above.

Once data has been explored and a knowledge and awareness of the space has been established, courses of action may be developed to realize mission objectives while regarding the human, social, cultural and behavioral dimensions of the operational environment.

4.2.4. Training learning objective #2: Red teaming

The process of red teaming provides alternative options to a decision. By generating alternatives, potential improvements in decision making are exposed. According to University of Foreign Military and Cultural Studies (UFMCS, 2011, p. 1), "Red teaming is a structured, iterative process, executed by highly trained, educated, and practiced team members that provides commanders an independent capability to fully explore alternatives to plans, operations, concepts, organizations, and capabilities in the context of the operational environment." Red teaming supports the decision making personnel in seeing the operational environment from varying perspectives including that of adversaries or coalition partners.

4.2.4.1. Task: challenge COAs by questioning assumptions, patterns, analysis, etc.

By questioning various aspects of a COA, red teaming can generate important analytical perspectives that the team may have previously overlooked. These perspectives include alternative analysis, consideration of other entities on the battlefield, identification of gaps or vulnerabilities, identification of sequences of events, and identification of measures of effectiveness. Red team training is conducted at UFMCS at Fort Leavenworth. According to U.S. Army Training and Doctrine Command, (2013, p. 6), "The basis for Red Team success relies on education and training grounded in theory, doctrine, cultural anthropology, the operational environment and focused Red Team techniques."

The curriculum at UFMCS is organized around five themes:

1. Critical and creative thinking
2. Red Team techniques (e.g., negotiations, group dynamics)
3. Understanding how culture impacts the operational environment
4. Understanding the critical variables found in the operational environment with respect to trends and interrelationships, and
5. Western, non-Western and non-military theory

According to the University of Foreign Military and Cultural Studies (2011), there are various techniques and procedures that support the development of red teaming capabilities including a nine step cultural methodology which promotes understanding of a foreign culture. The cultural analysis produced by the nine steps provides a perspective known as the "four ways of seeing," namely, "how X views itself," "how Y views itself," "how X views Y," and "how Y views X." The nine steps are:

1. Establish a base line of understanding by examining the four ways of seeing
2. What defines the Social System? (roles of family/tribe and ways of ascribing/acquiring status)
3. What are the sources of power?
4. What are the critical narratives of the cultural history?
5. What is the role of the formal and informal economy?
6. What cultural forms and semiotics are endemic to the society?
7. What sociolinguistics are evident?
8. What are their core emotional beliefs?
9. In what ways does the collected data shape how Y thinks?

Red Team courses are taught at UFMCS as seminars taught by academic and subject-matter experts. Training includes case studies for developing "best practices" capabilities.

5. Conclusion

Emerging technologies relevant to mitigation have the potential to improve planning, but require significant enhancements to current operational training. The knowledge needed to perform mitigation spans human dynamics, DIME actions and their potential impact on population-centric objectives, and ways to counter cognitive biases. To develop the necessary skills and knowledge, analysts and planners should receive training in human behavior awareness (a culture-general approach) and cultural awareness (a culture-specific approach). Training should also enable users to assess the impact of DIME actions on the operational environment and human terrain, discern threats and opportunities associated with the operational environment, identify planning assumptions, and recognize and minimize various biases in processing information.

Current science and technology can support training in these skills. Still, many training gaps exist, and the continued development and fielding of HSCB mitigation capabilities make innovations in training of the skills and knowledge needed to perform COA mitigation tasks imperative.

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