Virtual world learning…

Simulation Gaming Kit for Education

Illustrated game:

Operation Relief Worker

Rescue Challenge

4/2/2009

Table of Contents

Note: All labels and names used for the test simulation game actors, countries, and organizations are fictional. The simulation game is intended only for instructional purposes and views expressed in this document do not reflect official policy or positions held by the U.S. Air Force, DoD, or the U.S. government.

POC: Dr. Andrew G. Stricker, A4/6I, Innovations and Integrations Division, Bldg 941, Air University, Maxwell-Gunter AFB, AL. 36112-6610, DSN 493-1095, Commercial: (334) 953-1095, email: Andrew.Stricker@maxwell.af.mil

Simulation Gaming Kit for Education

The material included in this kit is provided to help planners with using a virtual world range for supporting simulation gaming for education. A test game is offered to help illustrate how the kit can be used to support the design, development, and execution of a simulation game at the range.

1. INTRODUCTION

While the Air Force is a leader in modeling and simulation, much work will be required to keep pace. Modeling and simulation is a key area where operations and training will need to be more closely integrated in the future. How will new technology enable the Air Force develop Airmen who are mentally flexible, agile, and capable of harnessing the intellectual capital of other Airmen? Are our established methods of training and educating adequate to maintain superiority with the accelerating pace of change? How do we educate and train a force of future warriors to out-think, out-maneuver, and out-fight numerically superior and intellectually equal future opponents, at a cost the country can afford to sustain? How will the military cope with this environment of accelerating change and the need for constant reinvention and continuous learning? The Air Force will do this by recruiting and developing Airmen with agile minds, capable of leveraging Air Force knowledge to accomplish the mission. They will provide a hedge against the vagaries of an uncertain and rapidly changing future threat environment. The Air Force needs to dramatically improve its ability to operate in the cognitive domain and increasing the intellectual capital of Airmen will be critical to the effort.

To succeed in its mission, the Air Force must enhance its traditional live training of Airmen. While getting the mix of live, virtual, and constructive delivery methods right is essential, the Air Force must move forward quickly in the development of new virtual and constructive simulation capabilities by leveraging both existing and emerging technology. One such development is the use of virtual worlds and immersive environments to facilitate learning.

One possible solution is MyBase, a U.S. Air Force virtual, exploratory and interactive environment and architecture that supports both continuous and precision learning. A future version of MyBase will be a private virtual environment providing for higher levels of security. The existing prototype version of MyBase is a public virtual environment in Second Life (SL). Second Life is a virtual 3D environment available to the public via the Internet (see http://secondlife.com).

MyBase is a virtual learning environment designed to enhance Air Force recruiting, training, education, and operations. It provides the means for Airmen to rapidly access the knowledge they need to make effective decisions and perform assigned tasks. Designed as a virtual Air Force Base, MyBase can be tailored to recruit the Millennial generation, inform the public, deliver precision learning, provide pre-deployment training or even conduct operational rehearsals.

Figure 1.
Depiction of Virtual Gaming Range.

An early benefit of MyBase for enhancing Air Force education is the capabilities provided for supporting simulation gaming in a virtual world. A test game, titled *Operation Relief Worker Rescue Challenge,* is illustrated in this kit. The test game is designed to be conducted using the MyBase Zeta gaming region located in SL. The game is played using SL avatars by participants (e.g., cadets, PME students, and instructors) and makes use of a 3D immersive environment wherein game participants collaboratively problem solve in a decision-making environment to address the game's challenge surrounding the rescue of hostages held by insurgents. The game is designed to support the instruction and assessment of interdependent leadership in a simulated naturalistic environment constructed on a virtual world gaming range. The gaming range encompasses a large virtual world area wherein avatars freely move about and interact with life-like terrain, buildings, devices and equipment in the environment (see Figure 1). The range can be readily configured to support adaptations to the game (e.g., cultural-geographic-history contexts, building structures, tools, and supporting documentation content); to include adaptations to the game on basis of participant performance. The range also is equipped with systems for supporting team membership identification, tracking, scoring, voice and text communication among team members, team briefing rooms, video recording of game activity, target damage and scoring, simulated weather, various day and night conditions, assignment of equipment and tools to each team member, and game goal-oriented task action, timing and feedback controls for use by game referees.

The use of a virtual gaming range for leadership development offers opportunities for flexible or seamless adaptation to rapidly shifting conditions while engaging learners via increased interactional bandwidth [see Hamilton, 2008]. Hamilton [2008] believes the means to provide opportunities for highly collaborative learning (e.g., how well people can learn together) and interactivity (across different parts of functional areas or organizations) increases the capacity for contextual mobility. Capacity for depth and layering of interaction with others and with content, involving high-speed interdependent activity provided by a virtual simulation game, can significantly enhance the learning experience and affective connection and meaning in learning [Hamilton, 2008, p. 5]. Virtual worlds offer prospects for contextual mobility in the learning environment via the means to [Hamilton, 2008, p. 5]:[1]

- Support learners and educators with moving in and out of virtual and real contexts
- Blend real and simulated face-to-face interactions
- Participate in and being part of the content learning space
- Provide greater emphasis on heterogeneous competencies functioning in unison within the learning space
- Provide for greater adaptation to individual learning needs, among peers, instructors, and with digital content
- Move in and out of collaboration, individual effort and reflective activity
- Facilitate organizational culture change

2. LEARNING FOCUS

The learning focus of the *Operation Relief Worker Rescue Challenge* game centers on interdependent leadership. The theoretical framework of interdependent leadership is based on a constructive-developmental theory with the premise that people actively construct ways of understanding and making sense of experiences, with the interpretations of experience developmentally growing more complex over time [McCauley, et. al., 2008]. From this perspective leadership developmental movement occurs to better face increased complexity in the environment.

McCauley and associates characterize leadership culture and practices along developmental levels or orientations of conformer (dependent), achiever (independent), and collaborator (interdependent) [McCauley, et. al., 2008; Hughes & Stricker, 2009]. The conformer orientation is broadly characterized by the assumption that only people in positions of authority are responsible for leadership. An achiever

[1] Hamilton's list [2008] was modified to include the addition of "Facilitate organizational culture change."

orientation assumes that leadership is based on knowledge and expertise, thus placing strong reliance on experts and individual performance. With the collaborator or interdependent orientation leadership is assumed to be a collective activity requiring mutual inquiry, sense-making and learning, with accompanied ability to work across organizational boundaries to address complex, ill-defined and dynamic challenges.

Using this theoretical framework we constructed a game to be sufficiently complex, ill-defined and dynamic to create a valid "laboratory" for practicing collective sense-making, learning, and complex collaboration in the context of military decision making. Our goal was to simulate a naturalistic decision making (NDM) environment wherein interdependent leadership practices can be experienced and assessed given that an ill-structured problem or challenge is introduced, the best course of action (COA) is uncertain, competing goals are present, time pressure and constraints are dynamically put into play. Multiple-event-feedback loops are also introduced with unfolding game events coupled with knowledge-rich sources of additional information presented to the participants by game leaders.

We believe the key for a successful outcome to the challenge lies in the team's interdependent leadership practices to initially construct a plausible COA, assess unfolding events and adapt the COA using a vigilant or hypervigilant decision making strategy as the situation demands. Table 1 depicts differences between vigilant and hypervigilant decision making strategies [Johnston, Driskell, and Salas, 1997]:

Table 1
Vigilant Versus Hypervigilant Decision Making

Vigilant Decision Making	Hypervigilant Decision Making
A. Decision maker thoroughly scans all available information B. Decision maker scans information in a systematic and sequential manner C. Decision maker devotes a consistent amount of attention to each data point D. Decision maker reviews all alternatives before making a decision	A. Decision maker scans only that information needed to make an assessment B. Decision maker scans information in any sequence C. Decision maker rapidly attends to selected data points D. Decision maker reviews needed information only when required

It is expected that for most of the game it will be beneficial to switch appropriately between a vigilant and hypervigilant decision making strategy depending on changing levels of time pressure and other constraints. In 1989, Gary A. Klein, introduced the recognition-primed decision (RPD) model which

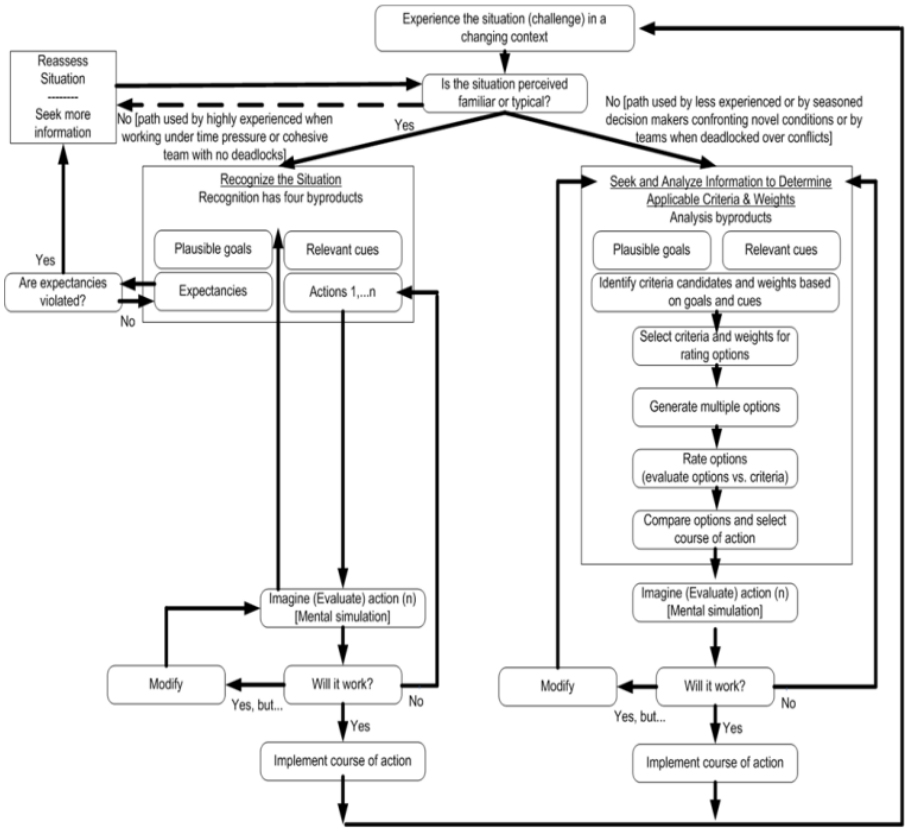
describes how decisionmakers can intuitively recognize a plausible COA without the use of a multiple option or detailed analytic decision making process when under time pressure. Klein [1989] argued that increased time pressure may prevent the use of analytic decision strategies. Klein suggested that it made little sense to adopt a time-consuming analytic strategy when time is severely limited, to painstakingly review all available information when experience can suggest what information is relevant, and to evaluate comparable data across all options when incomplete or ambiguous data make it difficult to compare options [1989, pp 58-59].

Research on the RPD model consistently shows skilled decisionmakers usually generate a good COA on their first try [Klein, et. al., 1995]. Further research, by Johnston, Driskell, and Salas [1997], showed intuitive decision processes result in higher performance than do analytical processes. Later, John F. Schmitt and Klein developed an applied version of RPD to better account for the value of collaborative adaptations, involving analytic strategies, to an initial COA [1999]. Continued studies of decision making in natural settings have demonstrated that decisionmakers employ hypervigilant and vigilant (analytic) strategies at different times, depending on the problem situation, their level of experience and other factors [Killion, 2000].

Thus, we believe by manipulating the problem or challenge time, situational novelty, and task constraints, the game context can be instructionally adapted for priming participants to consider whether to employ a vigilant or hypervigilant decision making strategy as the situation demands (i.e., when a team is not cohesive, there's deadlock over conflicts, members are inexperienced, or seasoned decisionmakers are confronting novel conditions). It is further believed a team's successful switching between and use of decision making strategies, to successfully address the challenge, will rest largely on the use of interdependent leadership practices.

Figure 2 depicts our strategy option decision (SOD) model constructed on the basis of Klein's initial RPD model and Killion's research on mixed modes of decision making. The SOD model serves to help game instructors evaluate the decision making strategy employed by participants. It is expected the effective use of interdependent leadership practices by the participants will be a significant factor for appropriate switching and application of a decision making strategy.

Figure 2
Strategy Option Decision (SOD) Model*



Interdependent leadership practices include the solicitation of diverse or fresh perspectives, facilitation or seeking out shared sense-making, co-construction of direction and commitment, staying open to adapting the COA and engaging in self-authorized switching of decision making strategies. In essence, we wanted to introduce the right mix of time pressure, situational novelty, and constraints with the game's ill-structured problem or challenge to provide opportunity for participants to gain experience and insight with using interdependent leadership practices and help with balancing the complementary analytic and recognitional decision making strategies.

3. DESIGN

Game design is dependent on the use of a framework for integrating an instructional approach for scenario-based learning anchored to a real-life challenge presented within a simulated NDM environment.

3.1 Game Scenario

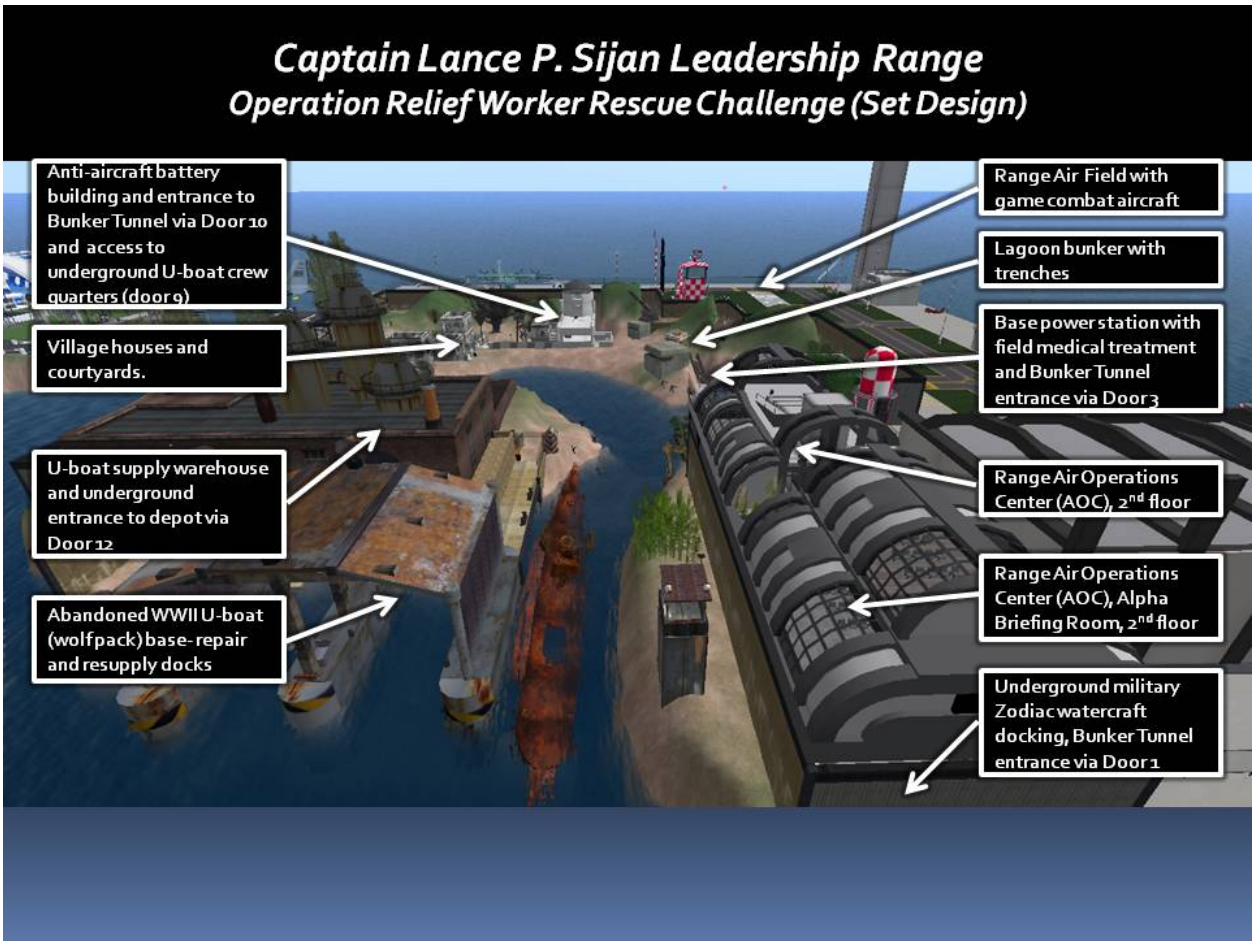
Overview of Scenario. The test game scenario involves relief workers that have been taken hostage by insurgents (the Red Team; membership consist of instructors) and held in the battle-torn area modeled for the game at the MyBase Zeta gaming region. The Blue team's (students) challenge is to locate and extract the relief workers to a safety zone within the region (announced by the game Referee Command Authority; referee members identified by orange jackets) within the time constraints for each of the phases of the challenge with as few casualties and minimal collateral damage as possible. Blue Team members are assessed on leadership practices associated with interdependent logic and competency with balancing vigilant and hypervigilant decision making strategies across game context phases associated with the challenge.

Detailed Scenario Description. A typhoon left little of the small island region of Ayab, inhabited by 800 or so villagers. After several weeks without relief effort, infectious diseases and starvation had begun to take a deadly toll on the villagers. Ayab is part of the country of Murma (under military junta control since the end of WWII). Very few foreigners are allowed into Murma and the country has been kept isolated from the international community under military rule since WWII. Over several generations, the population of Murma had endured harsh economic conditions, leaving little internal resources for providing relief assistance to its population in the event of natural disasters. Unfortunately, another typhoon was forming nearby in the region and was predicted to hit the small island of Ayab within several days. After considerable effort by the international community the military rulers of Murma were persuaded to allow a small international relief team to enter Ayab under strict conditions for treating immediate medical needs and to evacuate villagers to the mainland within 48 hours.

In response, a nongovernmental organization (NGO), The Global Medical Relief Assistance Organization, a medical first-responder group of volunteer physicians, nurses, and other relief workers had been rapidly formed by the World Relief Organization to provide emergency medical care, relief assistance, and evacuation of the villagers to the mainland before the next typhoon was expected to arrive at Ayab. The emergency response team, consisting of 12 relief team members, arrived at an abandoned WWII airstrip, on the northern side of Ayab. The relief effort went smoothly for the first 24 hours as most of the villagers needing medical care were treated and successfully evacuated to the mainland.

Reports soon came to the relief workers of other inhabitants of Ayab, living in the foothills, yet to be treated and evacuated. A small team, involving a physician, interpreter, and a local inhabitant, set out to find the remaining inhabitants in the foothills. After 2 days since the team's departure to the foothills, the interpreter returned to the airstrip relief camp with a report of a harrowing encounter with insurgents who had taken all of them hostage in the foothills.

An escape attempt was made by all three hostages but only the interpreter was successful in evading the captors. The interpreter believed the local inhabitant accompany them was killed during the escape attempt and also reported the physician was shot in the leg. It was not clear how seriously the physician was wounded in the escape attempt. The interpreter also described the surroundings of their hostage location used by the insurgents in the southern foothills of the island at what appeared to be a war-torn German wolfpack submarine base abandoned after WWII. The interpreter was not sure how many insurgents were at the abandoned base but had seen at least eight people at the building location where they were held captive. The building appeared to have been used as power station at the base but was in a state of disrepair. During the initial interrogation of the hostages, the interpreter was able to discern from the captors strongly held ideological beliefs similar to Islamic insurgents. From comments made by some of the insurgents the interpreter was able to discern some of them had been trained and fought as a fundamentalist-mujahideen proxy military force for al-Qaeda. During the course of the interrogation with the physician her captors learned she was the daughter of a very popular ruler of Murma during WWII. When her father was removed from power by the military, shortly after WWII, her mother had fled with her infant daughter from Murma; eventually both became citizens of the United States. It was unclear to the interpreter the intent of the insurgents for holding them hostage, but the importance of the physician to the insurgents appeared to increase significantly when her identity and nationality became known. The interpreter overheard the insurgents discuss plans for removing the physician off of Ayab to a more secure location, destiny unknown, within the next 48 hours.



The taking of the relief workers as hostages by insurgents soon became known to Murma leaders with the demand for all remaining relief workers to immediately leave Ayab in preparation for the arrival of a Murma military force to attack the insurgents. The Murma leaders expressed little concern for the outcome of the physician since she was now identified as a descendent of the popular ruling family they had removed from power after WWII and thus considered a potential threat to their existing military rule of the country. Nonetheless, given the situational factors of the unfolding crisis, intense negotiations were initiated with Murma leaders by the United States, including the assistance of several other international leaders. The negotiations resulted in an agreement for a U.S. led Multinational Force (MNF) to attempt the rescue of the hostages prior to the planned attack by the Murma military on the insurgent stronghold in the foothills. The MNF had the following rules of engagement restrictions placed on them by the Murma leaders:

- The extraction (rescue) attempt of the hostages must take place within 24 hours; after the deadline for the rescue attempt, the Murma military plans to use overwhelming force to destroy the insurgent stronghold in the Ayab foothills
- The coalition military rescue team must use only minimal force necessary for extracting the hostages; force can include land, air, and sea forces appropriate for an attempted extraction of the hostages within 24 hours; stop the use of force when it is no longer required; the Murma leadership wanted to keep the hostage incident and extraction attempt from news media until after the destruction of the insurgent stronghold; any escalation of combat with the insurgents during the rescue attempt would be considered unacceptable for drawing public attention to an insurgency presence in Murma
- If effective fire is received, direct return fire at a distinct target only
- Respect civilian property and protect innocent civilians from harm
- A member of the Murma military must be included on the coalition special operation military force team
- The extraction effort must cease NLT the 24-hour limit imposed by Murma leaders; Murma military leaders are to be provided access to coalition status reports on the rescue attempt with accompanied authority to cease the coalition operation if the rescue is perceived by them as escalating beyond a successful extraction as reported back by the Murma military team member on the coalition force

For purposes of conducting the simulation game within a 2-hour game limit, the 24-hour clock will be advanced according to pre-determined intervals introduced by the game leaders (the terrain time and lighting effects will be set and controlled by them, with the assistance of range staff, from the AOC). The game clock can be suspended without time lapse under referee game suspension conditions or as directed by game leaders (this will normally occur when new game phases are introduced with instructional note cards delivered to participants). Range sirens and game status lights will be toggled to signal game starts and suspensions as directed by game leaders or referees. See Appendix A listing range features (systems, devices and facilities) available for game planners. All game activity is to be restricted to the range area. Aircraft can be flown from the region airstrip into the range as part of game activity but no combat or other game activity is to be conducted outside of the range. Other rules for game participants include:

- Only weapons issued to game participants, or found within the range, are to be used during the game
- No special protective devices, region maps, or avatar location devices are to be used during the game; (Note: game maps, depicting intelligence for use by the rescue "Blue" team, are introduced into the game and permissible for use by team members)
- No avatar flying apart from aircraft usage
- No virtual fire is to be directed towards game referees (identified by orange jackets)
- All combat and range activities, including avatar movement, are to immediately cease when the range siren sounds for game suspension
- No outside communication (e.g., IM or emails) are to be used outside of the assigned team group channel for game communication by team members
- Any discontinued connection within SL by an avatar removes the avatar from the game (e.g., disconnect from SL)
- Any game participant can request a game suspension through a game referee by using one of the four suspension privileges granted to each team
- Avatar combat inflicted wound, inflicted by another game participant on the opposing team, results in a point accumulated for game scoring purposes; game scoring also occurs by points awarded by game leaders on the basis of overall team performance at each phase of the game (points are awarded on the basis of performance criteria, related to the game, as established by game leaders)

3.2 Game Context Phases

Phase I: Challenge Pre-Brief. Initial situation awareness and hostage rescue COA planning by Blue Team members (conducted in the range Game Situation Room located in the AOC). Rescue planning includes ground and air support for rescue operation and communication techniques (includes text and voice).

Phase II: Blue Team Insertion into Conflict Region of Zeta. Team members insert into battle torn area of Zeta and perform reconnaissance of situation to include location of hostage, number of insurgents (and assessment of insurgent strength and combat capabilities).

Phase III: Hostage Removal. Team members, adapting COA plan as required, extract hostage from battle torn area of Zeta while minimizing casualties and collateral damage.

Phase IV: Challenge Out-Brief. Red team conducts interviews with Blue team members using prompts associated with interdependent leadership practice assessments. Interviews are analyzed, and factored along with Red Team, Referee Command Authority, and Game Leaders observations (using assessment rubrics), for out-brief with Blue team members. The out-brief provides feedback on the degree to which Blue team performance reflected effective use of interdependent leadership practices for appropriate switching and application of a decision making strategy. The out-brief is conducted jointly by Referee Command Authority with Red team members providing feedback and discussion with Blue Team members. Additionally, pre- and post-challenge surveys are also administered and used to help with Blue team assessment and feedback.

3.3 Instructional Design Framework

Competent performance with military decision making strategies, using interdependent leadership practices, drove the overall instructional design of the test game. Competency-driven design (CDD) best describes our instructional design framework used to address the game's learning focus on interdependent leadership practices in the context of a simulated NDM environment.

CDD-based design depends on the use of instructional theories and principles that place emphasis on using real-life challenges for development [Bransford, et. al., 1990, Bransford, Brown, & Cocking, (Eds.), 2000, and Brophy, 2003, Aug]. Since we wanted our game participants to learn the value of adaptive decision making strategies with interdependent leadership practices we focused on Bransford's [1990] work with an adaptive expertise development approach named, "Anchored Modular Inquiry." Bransford's work has been applied and studied across several curriculum redesign projects involving Northwestern, MIT, Harvard, Vanderbilt, and University of Texas. Results, over the past several years, demonstrate significant gains in the development of adaptive expertise among their learners [Brophy, 2003].

With the use of Anchored Modular Inquiry in the CDD-based design framework, learners are introduced to authentic and open-ended problems and assisted with learning different decision making strategies to better discern and value how situations are actually addressed or solved in the real world. Situations take the form of complex, real-world challenges. The learner is engaged experientially to think and adapt as an experienced practitioner; to adaptively apply skills and decision making strategies successfully to a challenge. In particular, the approach focuses on the development of metacognitive knowledge and skills to better discern the appropriateness and effectiveness of decision making

strategies in the context of real-world problem solving. Thus, we wanted our CDD-based framework to support the use of Anchored Modular Inquiry, via a game, wherein participants can experience and learn to value interdependent leadership practices and appropriate decision making strategies in a simulated NDM environment. To this end, we used the following features of our CDD-based framework to help guide the design, development, testing, and implementation of the game:

- *Establish logic framework*. We identified leadership practices associated with interdependent logic and the core professional competence needed for effective use of vigilant and hypervigilant decision making strategies.

- *Develop high-level design to support the logic framework*. We developed a high-level design to support learning: (a) KNOWS IT MATTERS (VALUES): learns to value leadership practices associated with interdependent logic and core professional competence needed for effective vigilant and hypervigilant decision making strategies; (b) KNOWS HOW: knows how to apply leadership practices associated with interdependent logic and how to apply competencies associated with effective vigilant and hypervigilant decision making strategies; (c) DOES: demonstrates the application of leadership practices associated with interdependent logic, along with the competencies associated with effective vigilant and hypervigilant decision making strategies, in simulated context; and (d) THINKS (ADAPTS): can apply metacognitive knowledge and skills for adapting decision making strategies appropriately to changing demands, introduced during the game for successful performance.

- *Create detailed game design blueprint*. We designed the game phases to support the logic framework for the game. Learning resources and game tasks were identified and designed for each phase of the game.

- *Storyboard blueprint design for the game*. We identified, described, and prioritized game events and tasks within each phase, supporting data collection tools, instructional material, and simulated NDM environment features to support the logic framework of the game.

- *Develop, test, and pilot game phases, technologies, and resources using review stage releases.* We iteratively developed, tested, and piloted the game phases across development stages for

feature releases and fine-tuned for completeness and overall quality. Supporting technology and infrastructure were developed or put into place in sufficient time to adequately test and pilot game phases and supporting services across development stages.

- *Implement game and support services.* Implementation of the game was preceded with training game support staff and establishing game management and evaluation processes.

3.4 Assessment of Participant Learning and Performance

The CDD-based framework places emphasis on thoughtful observations and interpretive feedback provided to game participants. Also, emphasis is placed on the value of developing enduring understanding. Gardner and Hatch [1989], define understanding as a "sufficient grasp of concepts, principle or skills so that one can bring them to bear on new problems and situations, deciding in which ways one's present competencies can suffice and in which ways one may require new skills or knowledge." Thus, we wanted to assess game participants on their deeper understanding of interdependent leadership and decision-making experience encountered in the game's simulated NDM environment. Wiggins [1988] uses the term authentic assessments to describe the unique characteristics of assessing learners using performance tasks and activities involving real-world challenges. We developed rubrics to help us authentically assess how well game participants are able to understand, value and apply leadership practices associated with interdependent logic and core competencies associated with selecting and using decision making strategies (see Table 2 for an example).

Table 2
Assessment Rubric

Leadership practices associated with interdependent logic	Levels of Assessment				Context of Challenge				
	knows it matters (values)	knows how	does	thinks (adapts)	1	2	3	4	5
Solicit diverse or fresh perspectives									
Facilitate or seek out shared sense-making, co-construction of direction, alignment, and commitment									
Engage in dialogue to explore differences									
Actively manage polarities of diverse perspectives									
Open to revision and change of strategy or approach									
Engage in self-authorized decision making									
Core professional competence									
Recognize gaps in knowledge									
Generate questions									
Learn from experience									
Manage uncertainty									
Handle conflict									
Tolerate ambiguity and anxiety									
Show respect for others									
Display attentiveness									
Recognize cognitive and emotional biases									
Acknowledge and correct errors									

Rubrics are used to assess participants across the five challenge contexts of the game:

- Initial exposure to situation or challenge
- Assessment of situation
- COA determination
- Implementation of COA
- Feedback and interpretation

We also use data from participant interviews and surveys in the analysis on the role of interdependent leadership practices for the selection and use of decision making strategies (see Appendix D).

4. DEVELOPMENT

Working groups are used for organizing collaborative efforts across several areas of expertise and institutions to develop the game. Each working group is described below.

Game Stewardship. Members of this group include the chairs of each working group along with game

leaders. The Game Stewardship group establishes game rules and participant criteria under direction from game leaders. The working group also reviews game development steps to help ensure milestones are reached and various development efforts are integrated together for desired outcomes. Members also establish game development timelines, development reviews, organize a test-run of the game, and actual game execution. Many of the working group chairs and Game Stewardship members serve as members of the AOC or game referees during game execution.

Game Design. This working group (using the Competency-driven Design framework), works closely with game leadership to define the learning focus and supporting game logic, phases, and activities necessary for effectively addressing targeted competency-development needs, performance goals, and learning objectives for participants. The design work supports the learning focus of the game to instruct and assess interdependent leadership framing and practices by teams participating in a simulated NDM environment involving a tactical military operation to rescue relief workers. Members also work closely with the Game Assessment and Evaluation members to develop assessment rubrics and game development and execution evaluation methods.

Game Assessment and Evaluation. This working group develops assessment rubrics (to include the use of pre- and post-game interviews) and game development and execution evaluation methods. Assessment rubrics include real-time game assessment data collection during game play for use by game leaders to adjust game activity, support individual or team performance feedback or adaptation of the game on the basis of performance.

Game Process Scripting. Game Process Scripting members work closely with Game Design working group members to construct Sequencing Path Scripts (SPSs). SPSs visually depict planned game-path activity and options expected to be offered to participants at each phase (see Appendix C). Activity and options along possible participant paths are identified via nodes along the path. Each game-path node shows current game phase, challenge context, expected start, duration, exit times. Also, each node depicts expected participant information provided by game leaders, response choices and follow-on paths, supporting range systems and devices (to include data collected by systems or devices), and adaptations to systems or devices depending on data or other specified participant responses. Node information is organized in a table referenced back to the ID for the game path node. Each node table also includes space for game leaders and AOC members to record actual game times, choices, and outcomes. The SPSs are organized and provided to each game AOC member and used for game rehearsals and for conducting the game.

Range Systems and Game Devices. Members of this working group, along with Range Staff, help support the introduction, usage, adaptation or adjustments to range systems and devices expected to support planned game activity by participants. Range Systems and Game Devices members also help the Game Process Scripting working group with documenting the range systems, the type and frequency of data collected by each system or device at the appropriate game-path node (this is documented using the SPSs initially crafted by the Game Process Scripting working group).

Game Participant Community. This working group helps game leaders with identifying selection criteria for game participants (both Blue and Red team membership criteria). Members, working closely with game leaders, also help with soliciting, selecting and notifying game participants of game times, rules, game learning focus and phases (usually done in collaboration with game leaders providing information to participants via briefings and orientation tours). Members also help with substitution effort if a game participant is unavailable and help with participant arbitration during the game if disagreements arise over a game event or referee action. The Game Participant Community also helps the Game Assessment and Evaluation working group with participant interviews or other data collection efforts involving game participants. Members create and maintain a Game Roster showing all participants and roles (including AOC members and referees).

Game Set and Communication Media Design. Members of the Game Set and Communication Media Design assist game leaders with determining and establishing the design of supporting range terrain, buildings, equipment, tools, participant media (e.g, video, audio, and visuals; including interactive media and real-time communication devices), and other placement of range items in support of desired cultural, historical, and geographical context desired for the game. The Game Set and Communications Media Design working group may also assist with changing the game set design during the game as desired by game leaders. At the conclusion of a game, members prepare for and help package unique game fixtures for future reuse and assist range staff with cleaning up the range after game phases as necessary.

Range Staff. Members of this group consist of permanent range staff who maintain the range in-between games and help game leaders (with assistance from working groups) to configure and operate the range in support of a game. Members may also help with range orientation tours.

5. EXECUTION

We identified the following steps to help prepare for game execution in the virtual world gaming range.

Step 1. Game leaders use our range *Simulation Gaming for Education Kit*[2] to configure the game by identifying the desired learning outcomes and competencies for participants, supporting scenario, cultural-geographical-historical context, Red and Blue team composition, game referees, game reading assignments for participants, game contingencies for adapting the game on basis of team performance, performance and assessment scoring criteria, etc. Work on Step 1 occurs several weeks before game execution. Also, during Step 1, game leaders work closely with range staff to establish the desired terrain, buildings, tools, and other game items required to support the cultural-geographical-historical context for the game.

Step 2. Game leaders, with the help of range staff, host a pre-game orientation for team leaders and game referees at the range. Game terrain, buildings, tools, and other game items are pre-positioned in the range for the orientation. Orientation provides the opportunity for game leadership to acquaint other leaders with the game intent, structure, and phases with the range environment and to help with identifying and addressing known and anticipated constraints for game participants.

Step 3. Pre-game learning resources/assignments are provided to game participants (includes online readings and pre-game surveys, assignments for participants). Facilities and tools for pre-game assignments are provided at the range AOC building for game participants. Step 3 typically occurs within 1 to 2 weeks before the start of the game.

Step 4. Game activation at range site. Range equipment for supporting the game is tested and game leadership take positions in the AOC overlooking the range. Step 4 occurs 1 to 2 hours before the game starts for the participants.

Step 5. Game participants attend Challenge Pre-brief at range AOC Alpha briefing room. Game leaders introduce game staff, referees, brief participants on game scenario, game rules, range equipment and placed items, and game phases (with duration times). Step 5 is Phase I of the game. The range game

[2] The *Simulation Gaming for Education Kit* is an electronic document, with a supporting relational database, that can be used by game designers to identify and structure game phases and activities to address desired learning outcomes and competencies for game participants.

clock does not start until Phase II, thus Phase I can occur the day before the start of Phase II if desired by game leaders.

Step 6. Phase II starts by game participants taking positions in the range (initial team positions are determined by game leaders). The official game clock starts at Phase II, to include team score tracking on range displays. Phase II activities are focused on Blue team reconnaissance and assessment of situation.

Step 7. Phase III starts by determination of game leaders or as previously set based on elapsed time for Phase II activities to cease. Phase III activities for the test game is focused on hostage(s) removal by determination and implementation of a rescue COA plan while minimizing casualties and collateral damage. Phase III activities last as long as predetermined time constraints or as determined by game leaders on the basis of team performances. The range game clock ends at Phase III.

Step 8. Phase IV starts. The major activity of Phase IV is the Challenge out-brief for game participants. Since Phase IV involves the analysis, feedback, and interpretation of game participant performance (includes post-game surveys and interviews with participants, along with analysis of game data) the Challenge out-brief can be delayed for 1 or 2 days after the completion of Phase III to provide for sufficient analysis and out-brief development time for game leaders.

Step 9. Game closeout. The range and AOC area are cleaned up for future use by another game initiative. Unique game fixtures (buildings, tools, etc.) are stored for reuse by the game. Lessons learned from the game are used to improve the game for future use and effectiveness.

6. CONCLUSION

From maintenance to medicine to fire fighting and flying, education and training experiences can be enhanced through multi-media and multi-sensory inputs. Virtual learning, supported by well-designed simulation games for education and training, can supplement, or in some cases replace, live skills training when either cognitive or psychomotor. MyBase represents the capabilities that can power greater capability for our Air Force to be an agile and adaptive learning organization.

Our future Airmen are comfortable with simulation games and they will enjoy learning and working in virtual world environments. Due to the sophisticated social networking websites in operation today, our newest Airmen will be extremely comfortable networking, collaborating, and learning through MyBase.

Through MyBase, these interactions will be possible from any location around the world at any time of night or day.

References

Bransford, J., et. al. (1990). Anchored instruction: Why we need it and how technology can help. In Nix, D., & Spiro, R. (Eds.), *Cognition, Education, and Multimedia*. Hillsdale, NJ: Erlbaum.

Bransford, J., Brown, A., & Cocking, R. (Eds.). (2000). *How people learn: Brain, mind, experience, and school*. Washington, DC: National Research Council.

Brophy, S. (2003, Aug). Constructing Shareable Learning Materials in Bioengineering Education. *IEEE Engineering in Medicine and Biology*, 22 (4), pp. 39-46.

Gardner, H., & Hatch, T. (1989). Multiple intelligences go to school: Educational implications of the theory of multiple intelligences. *Educational Researcher*, *18*(8), pp. 4-9.

Hamilton, E. (2008, unpublished document). *Principles and grand challenges for the future: A prospectus for the computer-supported collaborative learning (CSCL) community*. US Air Force Academy, Center for Research on Learning and Teaching, Institute for Information Technology Applications, US Air Force Academy, CO.

Hughes, R. L., & Stricker, A. G. (2009, unpublished document). *Outside-in and inside-out approaches to transformation*. US Air Force Academy, US Air Force Academy, CO, and Air University A4/6 Innovations Division, Maxwell-Gunter AFB, AL.

Johnston, J. H., Driskell, J. E., & Salas, E. (1997). Vigilant and hypervigilant decision making. *Journal of Applied Psychology*, 82(4), pp. 614-622.

Killion, T. H. (2000). Decision making and the levels of war. *Military Review*, pp. 66-70.

Klein, G. A. (1989). Strategies of decision making. *Military Review*, pp. 56-64.

Klein, G. A., Wolf, S., Militello, L. G., & Zsambok, C. E. (1995). Characteristics of skilled option generation in chess. *Organizational Behavior and Human Decision Processes*, 66, pp. 63-69.

McCauley, C. D., Palus, C. J., Drath, W. H., Hughes, R. L., et. al. (2008*). Interdependent leadership in organizations: Evidence from six case studies*. A Center for Creative Leadership Report, Greensboro, North Carolina, pp. 8-9.

Schmitt, J. F., & Klein, G. A. (1999). A recognitional planning model. *Proceedings, Command and Control Research and Technology Symposium*, Newport, RI., 1, pp. 510-521.

Wiggins, G. (1998). *Educative assessment: Designing assessments to inform and improve student performance*. San Francisco, CA: Jossey-Bass Inc.

Appendix A: Range Features (Systems, Devices and Facilities)

The following table lists current range features (systems, devices, and facilities) available to game planners and participants (as determined by game leaders).

RANGE FEATURE	**DESCRIPTION**	**CONTROL DEVICE (if available; note: control devices are located inside range AOC building for use by game leaders and supporting game AOC operators)**
Combat team scoring	System supports the identification of multiple teams and scoring tabulation on basis of avatar hits using various weapons, including aircraft.	Combat scoring can be started and stopped using controls provided inside AOC.
Game activation notices	System supports game start and end alarms (lights, sound, and notices to participants) and closer of gates leading into range.	Alarms and gate controls are provided inside AOC.
Weather	Range weather conditions can be set for clear sky, storm clouds, fog, rain, lighting, and snow.	Weather control available inside AOC.
Game task flags	Color-coded flags (blue and red) are available for use in the game for activation by participants (e.g., task accomplishment, destination arrival, control established).	Flag activations and notices are controlled inside AOC.
Communication and notices	Text or voice communication and notices can be sent to all game participants, selected team leaders, or members. Also each team in the game has access to a private group communication channel (game leaders have access to all private group channels used by teams in the game). Internet connections, as determined by game leaders, can be provided via devices to participants (see Appendix E for iPod example).	Notices are sent under the direction of game leaders via controls provided in AOC. Note: that all game communications can be recorded for use by game leaders.
Weapons and aircraft	Hand-held weapons, heavy artillery, landmines, anti-aircraft weapons, missiles, watercraft,	Weapons and aircraft are dispensed to each member on the basis of game rules and pre-

	and color-coded aircraft are available for each team member (as determined by game leaders). Each weapon is connected to the combat team scoring system. A weapons depot, showing sample weapons for potential game usage, is located on the 1st floor of the AOC building. Intelligent agents or bots are also available for use to help adjunct roles in the game orin support red team activities.	game participant preparation with clothing, arms, and other game tools (e.g., parachutes) provided on the basis of game rules. Red team and/or scenario adjunct bots are placed and operated in the range according to specifications of the intelligent tutoring components employed in the game.
Facility Access	Multiple doors can be opened or closed throughout the range.	Doors controls are available in the AOC and can be set for usage rights on the basis of team membership, game events, or general access to all participants.
Team briefing rooms	Two team briefing rooms (in the AOC building) provide for video, slides, audio, voice and text communication briefings for game participants and leaders.	Briefing room media control panels are available in each room.
Range cameras	Cameras are located throughout the range to provide for close-circuit views of range areas.	Camera control and video screens are available in the AOC.
Dynamic range effects	Range effects involving fire, smoke, and placement of objects can be dynamically placed into the range area during game play.	Range effects controls are available in the AOC.
AOC control stations	Multiple AOC control stations are available for use by game leaders and game staff. Stations provide video screens, touch buttons, and displays for controlling various range features.	Control stations are located on the 2nd floor of the AOC building. The AOC control room also has a wrap-around glass window looking out onto the range.
Game timing clocks	Timing clocks can be set for game tasks (start and finish).	Timing clock controls are available in the AOC.
Region access	Access to the MyBase Zeta region can be restricted during game play for only authorized game participants.	Region access control is provided through range staff assisting game leaders with access rules.

Appendix B: Node Charts for Game Sequencing

<table>
<tr><td>Game Phase ID

1</td><td>Challenge Cycle Level ID (if multiple modules used)
A01</td><td>Challenge Step ID

1</td><td>Node ID & Expected Range Location
1.0 (AOC Alpha Briefing Rm)</td></tr>
<tr><td colspan="4">Time</td></tr>
<tr><td rowspan="2">Indicate if time unit should be displayed visually in AOC.

SL Time</td><td>Expected Node Start (ENS) T-0</td><td>Expected Node Duration (END) 20m</td><td>Expected Node Exit (ENE) T+ (Game clock start)</td></tr>
<tr><td>Actual Node Start (ANS)</td><td>Actual Node Duration (AND)</td><td>Actual Node Exit (ANE)</td></tr>
<tr><td colspan="4">Game Participant Communication (Notifications or Information to provide at Node)</td></tr>
<tr><td>Form of communication (avatar voice, video, note card, display board, direct communication):
avatar voice by game leaders using video</td><td colspan="3">Communication Summary:
Challenge overview presented by game leaders and scenario video presented along with mission rules of engagement.</td></tr>
<tr><td colspan="4">Node Response Options/Choices/Paths (Connecting Node IDs; also indicate if Task Flag is placed at node)</td></tr>
<tr><td>Provided Option (A) Node ID: Blue team proceeds directly to 2.0 after drafting initial challenge course of action (COA)</td><td>Provided Option (B) Node ID</td><td>Provided Option (C) Node ID</td><td>Provided Option (D) Node ID</td></tr>
<tr><td colspan="4">Actual Option Node ID</td></tr>
<tr><td colspan="4">Supporting Range System(S) and or device(S); also specify expected data to be collected or provided by system or device (e.g., game flag, door, virtual computer, weapon, tool, image, etc.; indicate flag or door id if used)</td></tr>
<tr><td>System or Device (A)
Inquisite survey tool used to collect pre-challenge survey responses</td><td>System or Device (B)
All range doors (1-12) are closed and locked</td><td>System or Device (C)
Video shown on plasma screen for introducing mission</td><td>System or Device (D)
Note card delivery to participants with Phase II start instructions</td></tr>
<tr><td>Expected Data Collected or Provided (A):
Survey responses</td><td>Expected Data Collected or Provided (B)</td><td>Expected Data Collected or Provided (C)</td><td>Expected Data Collected or Provided (D)</td></tr>
</table>

Game Phase ID 2	**Challenge Cycle Level ID (if multiple modules used)** A01	**Challenge Step ID** 1	**Node ID & Expected Range Location** 2.0 (AOC Zodiac dock)
Time			
Indicate if time unit should be displayed visually in AOC. SL Time	Expected Node Start (ENS) T+ (Clock starts)	Expected Node Duration (END) 5m	Expected Node Exit (ENE) T+5
	Actual Node Start (ANS)	Actual Node Duration (AND)	Actual Node Exit (ANE)
Game Participant Communication (Notifications or Information to provide at Node)			
Form of communication (C1 - mission note card delivered to Blue team)	Communication Summary: Landing position specified for Blue team (U-boat docks) at Ayab. Team leaves in Zodiacs to U-boat docks.		
Node Response Options/Choices/Paths (Connecting Node IDs; also indicate if Task Flag is placed at node)			
Provided Option (A) Node ID: Proceed directly to 2.1 after landing at docks	Provided Option (B) Node ID	Provided Option (C) Node ID	Provided Option (D) Node ID
Actual Option Node ID			
Supporting Range System(S) and or device(S); also specify expected data to be collected or provided by system or device (e.g., game flag, door, virtual computer, weapon, tool, image, etc.; indicate flag or door id if used)			
System or Device (A) Range doors 1-12 are closed and locked	System or Device (B)	System or Device (C)	System or Device (D)
Expected Data Collected or Provided (A):	Expected Data Collected or Provided (B)	Expected Data Collected or Provided (C)	Expected Data Collected or Provided (D)

Game Phase ID 2	**Challenge Cycle Level ID (if multiple modules used)** A01	**Challenge Step ID** 1	**Node ID & Expected Range Location** 2.1 (U-boat docks; lower level)
Time			
Indicate if time unit should be displayed visually in AOC. SL Time	Expected Node Start (ENS) T+5	Expected Node Duration (END) 15m	Expected Node Exit (ENE) T+20
	Actual Node Start (ANS)	Actual Node Duration (AND)	Actual Node Exit (ANE)
Game Participant Communication (Notifications or Information to provide at Node)			
Form of communication (Flag F1 contains instructions for recon efforts	Communication Summary: Blue team instructed to recon u-boat warehouse, depot, and anti-aircraft battery while also protecting extraction departure base (u-boat docks) where zodiac craft are kept		
Node Response Options/Choices/Paths (Connecting Node IDs; also indicate if Task Flag is placed at node)			
Provided Option (A) Node ID: Flag F1 is to be captured. Blue team recons 2.11 and 2.12 areas	Provided Option (B) Node ID	Provided Option (C) Node ID	Provided Option (D) Node ID
Actual Option Node ID			
Supporting Range System(S) and or device(S); also specify expected data to be collected or provided by system or device (e.g., game flag, door, virtual computer, weapon, tool, image, etc.; indicate flag or door id if used)			
System or Device (A) Flag F1 provided with note card; flag located by power generator for warehouse	System or Device (B) Weather system: rain and lightning starts for range area	System or Device (C)	System or Device (D)
Expected Data Collected or Provided (A): note card instructions for recon of U-boat warehouse, depot, and battery building	Expected Data Collected or Provided (B)	Expected Data Collected or Provided (C)	Expected Data Collected or Provided (D)

Game Phase ID 2	**Challenge Cycle Level ID (if multiple modules used)** A01	**Challenge Step ID** 1	**Node ID & Expected Range Location** 2.11 (U-boat warehouse and depot)
Time			
Indicate if time unit should be displayed visually in AOC. SL Time	Expected Node Start (ENS) T+20	Expected Node Duration (END) 10m	Expected Node Exit (ENE) T+30
	Actual Node Start (ANS)	Actual Node Duration (AND)	Actual Node Exit (ANE)
Game Participant Communication (Notifications or Information to provide at Node)			
Form of communication (Flag F2)	Communication Summary: Blue team reminded to recon anti-aircraft battery.		
Node Response Options/Choices/Paths (Connecting Node IDs; also indicate if Task Flag is placed at node)			
Provided Option (A) Node ID: Flag F2 is to be captured. Blue team recons 2.11 and 2.12 areas	Provided Option (B) Node ID 2.12	Provided Option (C) Node ID	Provided Option (D) Node ID
Actual Option Node ID			
Supporting Range System(S) and or device(S); also specify expected data to be collected or provided by system or device (e.g., game flag, door, virtual computer, weapon, tool, image, etc.; indicate flag or door id if used)			
System or Device (A) Flag F2 provided with note card	System or Device (B) Landmines cover walking path to anti-aircraft battery	System or Device (C) Range door 12 is unlocked so Blue team can open it when desired to access depot	System or Device (D) Weather system introduces fog with rain
Expected Data Collected or Provided (A): Note card contains reminder to recon battery	Expected Data Collected or Provided (B)	Expected Data Collected or Provided (C)	Expected Data Collected or Provided (D)

Game Phase ID 2	**Challenge Cycle Level ID (if multiple modules used)** A01	**Challenge Step ID** 1	**Node ID & Expected Range Location** 2.12 (anti-aircraft battery and rotunda room)
Time			
Indicate if time unit should be displayed visually in AOC. SL Time	Expected Node Start (ENS) T+30	Expected Node Duration (END) 10m	Expected Node Exit (ENE) T+40
	Actual Node Start (ANS)	Actual Node Duration (AND)	Actual Node Exit (ANE)
Game Participant Communication (Notifications or Information to provide at Node)			
Form of communication (Flag F3 with note card)	Communication Summary: Blue team reminded to recon warehouse and battery (if not previously done).		
Node Response Options/Choices/Paths (Connecting Node IDs; also indicate if Task Flag is placed at node)			
Provided Option (A) Node ID: Flag F3 is to be captured. Blue team recons 2.11, and 2.12	Provided Option (B) Node ID 2.11 (if not accomplished)	Provided Option (C) Node ID 2.2 (next destination)	Provided Option (D) Node ID
Actual Option Node ID			
Supporting Range System(S) and or device(S); also specify expected data to be collected or provided by system or device (e.g., game flag, door, virtual computer, weapon, tool, image, etc.; indicate flag or door id if used)			
System or Device (A) Flag F3 is to be captured providing Blue team with note card; flag is located in circular room inside battery	System or Device (B) Range door 11 is unlocked so Blue team can open it when desired to access battery building rotunda.	System or Device (C)	System or Device (D)
Expected Data Collected or Provided (A): Note card contains reminder to recon battery and proceed to recon U-boat crew quarters	Expected Data Collected or Provided (B)	Expected Data Collected or Provided (C)	Expected Data Collected or Provided (D)

Game Phase ID 2	**Challenge Cycle Level ID (if multiple modules used)** A01	**Challenge Step ID** 2	**Node ID & Expected Range Location** 2.2 (anti-aircraft battery or warehouse location)
Time			
Indicate if time unit should be displayed visually in AOC. SL Time	Expected Node Start (ENS) T+45	Expected Node Duration (END) 15m	Expected Node Exit (ENE) T+60
	Actual Node Start (ANS)	Actual Node Duration (AND)	Actual Node Exit (ANE)
Game Participant Communication (Notifications or Information to provide at Node)			
Form of communication (C2 with uplink to mission communication satellite)	Communication Summary: Blue team receives intelligence update from mission authorities on the likely location of the hostage in the U-boat crew quarters. Intelligence obtained via intercepted cell phone use by insurgents. Broadcast also contains perspectives from 3 previous MNF rescue mission leaders for Blue team consideration, as well as weather report (approaching typhoon expected to hit Ayab), and news broadcast of Murma unrest and pending invasion of Ayab by the Murma military.		
Node Response Options/Choices/Paths (Connecting Node IDs; also indicate if Task Flag is placed at node)			
Provided Option (A) Node ID: 2.3 (Note: if Blue team has not captured flags F2 and F3 by T+45 then Phase 2 is paused by game leaders)	Provided Option (B) Node ID	Provided Option (C) Node ID	Provided Option (D) Node ID
Actual Option Node ID			
Supporting Range System(S) and or device(S); also specify expected data to be collected or provided by system or device (e.g., game flag, door, virtual computer, weapon, tool, image, etc.; indicate flag or door id if used)			
System or Device (A) Uplink satellite comm. Device	System or Device (B) Range doors 10 and 11 unlocked to bunker tunnel and crew quarters	System or Device (C)	System or Device (D)
Expected Data Collected or Provided (A): Video	Expected Data Collected or Provided (B)	Expected Data Collected or Provided (C)	Expected Data Collected or Provided (D)

Game Phase ID 2	**Challenge Cycle Level ID (if multiple modules used)** A01	**Challenge Step ID** 3	**Node ID & Expected Range Location** 2.3 (U-boat crew quarters)
Time			
Indicate if time unit should be displayed visually in AOC. SL Time	Expected Node Start (ENS) T+60	Expected Node Duration (END) 15m	Expected Node Exit (ENE) T+75
	Actual Node Start (ANS)	Actual Node Duration (AND)	Actual Node Exit (ANE)
Game Participant Communication (Notifications or Information to provide at Node)			
Form of communication (Flag F4 is to be captured; location is in U-boat crew quarters; C3 communication by MNF authority, via note card)	Communication Summary: MNF authority updates intelligence informing Blue team that intercepted cell phone calls reveal hostage has been moved to an infirmary located at the power station on Ayab. Plans are being made by the insurgents to move the hostage off of Ayab within the next hour. Insurgent resistance is expected to be severe. Air support may be necessary with ground cover.		
Node Response Options/Choices/Paths (Connecting Node IDs; also indicate if Task Flag is placed at node)			
Provided Option (A) Node ID: 3.0	Provided Option (B) Node ID	Provided Option (C) Node ID	Provided Option (D) Node ID
Actual Option Node ID			
Supporting Range System(S) and or device(S); also specify expected data to be collected or provided by system or device (e.g., game flag, door, virtual computer, weapon, tool, image, etc.; indicate flag or door id if used)			
System or Device (A) Flag (F4)	System or Device (B) Inquisite survey tool	System or Device (C)	System or Device (D)
Expected Data Collected or Provided (A): Note card containing updated intelligence	Expected Data Collected or Provided (B) Team responds to survey questions on adaptation to planned approach for extracting the hostage	Expected Data Collected or Provided (C)	Expected Data Collected or Provided (D)

Game Phase ID 3	**Challenge Cycle Level ID (if multiple modules used)** A01	**Challenge Step ID** 4	**Node ID & Expected Range Location** 3.0, 3.11, 3.12 (U-boat crew quarters)
Time			
Indicate if time unit should be displayed visually in AOC. SL Time	Expected Node Start (ENS) T+75	Expected Node Duration (END) 5m	Expected Node Exit (ENE) T+80
	Actual Node Start (ANS)	Actual Node Duration (AND)	Actual Node Exit (ANE)
Game Participant Communication (Notifications or Information to provide at Node)			
Form of communication (C4 communication by MNF authority, via note card)	Communication Summary: MNF authority informs Blue team of immediate Predator UAV provided air support and ground cover.		
Node Response Options/Choices/Paths (Connecting Node IDs; also indicate if Task Flag is placed at node)			
Provided Option (A) Node ID: 3.2 (Note: nodes 3.11 and 3.12 are not actual team locations)	Provided Option (B) Node ID	Provided Option (C) Node ID	Provided Option (D) Node ID
Actual Option Node ID			
Supporting Range System(S) and or device(S); also specify expected data to be collected or provided by system or device (e.g., game flag, door, virtual computer, weapon, tool, image, etc.; indicate flag or door id if used)			
System or Device (A) Note card	System or Device (B) Predator UAV	System or Device (C)	System or Device (D)
Expected Data Collected or Provided (A): Note card containing updated Predator coverage notification	Expected Data Collected or Provided (B)	Expected Data Collected or Provided (C)	Expected Data Collected or Provided (D)

Game Phase ID 3	**Challenge Cycle Level ID (if multiple modules used)** A01	**Challenge Step ID** 4	**Node ID & Expected Range Location** 3.2 (U-boat crew quarters and outside of battery building)
Time			
Indicate if time unit should be displayed visually in AOC. SL Time	Expected Node Start (ENS) T+80	Expected Node Duration (END) 5m	Expected Node Exit (ENE) T+85
	Actual Node Start (ANS)	Actual Node Duration (AND)	Actual Node Exit (ANE)
Game Participant Communication (Notifications or Information to provide at Node)			
Form of communication (Flag F5 is to be captured by Blue team; flag located on hill next to Hill bunker; C5 communication by MNF authority, via note card)	Communication Summary: MNF authority informs Blue team of Predator UAV has departed area and the Hill and Lagoon bunkers must be captured asap along with protecting the extraction escape route at the U-boat docks.		
Node Response Options/Choices/Paths (Connecting Node IDs; also indicate if Task Flag is placed at node)			
Provided Option (A) Node ID: 3.2 (Note: nodes 3.11 and 3.12 are not actual team locations)	Provided Option (B) Node ID	Provided Option (C) Node ID	Provided Option (D) Node ID
Actual Option Node ID			
Supporting Range System(S) and or device(S); also specify expected data to be collected or provided by system or device (e.g., game flag, door, virtual computer, weapon, tool, image, etc.; indicate flag or door id if used)			
System or Device (A) Note card	System or Device (B) Range doors 5, 6, 7 & 8 are unlocked for access to Hill and Lagoon bunkers.	System or Device (C)	System or Device (D)
Expected Data Collected or Provided (A): Note card containing communication from MNF authority	Expected Data Collected or Provided (B)	Expected Data Collected or Provided (C)	Expected Data Collected or Provided (D)

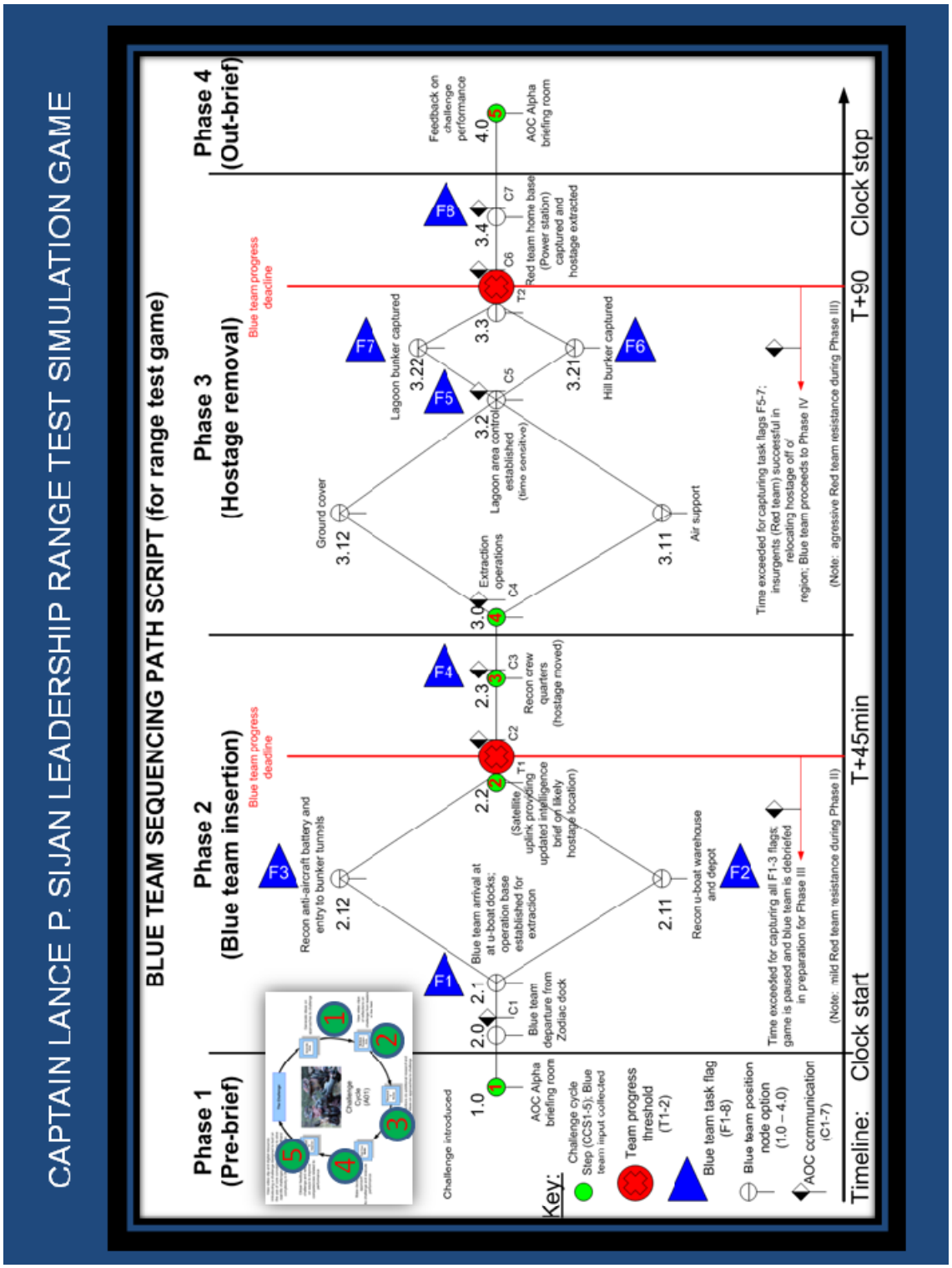
Game Phase ID 3	**Challenge Cycle Level ID (if multiple modules used)** A01	**Challenge Step ID** 4	**Node ID & Expected Range Location** 3.21 and 3.22 (Hill and Lagoon bunker)
Time			
Indicate if time unit should be displayed visually in AOC. SL Time	Expected Node Start (ENS) T+85	Expected Node Duration (END) 5m	Expected Node Exit (ENE) T+90
	Actual Node Start (ANS)	Actual Node Duration (AND)	Actual Node Exit (ANE)
Game Participant Communication (Notifications or Information to provide at Node)			
Form of communication (Flags F6 and F7 are to be captured by Blue team; flag F6 located inside of Hill bunker; flag F7 located inside Lagoon bunker)	Communication Summary:		
Node Response Options/Choices/Paths (Connecting Node IDs; also indicate if Task Flag is placed at node)			
Provided Option (A) Node ID: 3.3 (Note: 3.3 is not a new location)	Provided Option (B) Node ID	Provided Option (C) Node ID	Provided Option (D) Node ID
Actual Option Node ID			
Supporting Range System(S) and or device(S); also specify expected data to be collected or provided by system or device (e.g., game flag, door, virtual computer, weapon, tool, image, etc.; indicate flag or door id if used)			
System or Device (A) Flags F6 and F7	System or Device (B) Range doors 5, 6, 7 & 8 remain unlocked for access to Hill and Lagoon bunkers.	System or Device (C)	System or Device (D)
Expected Data Collected or Provided (A): Note: if both flags (F6 and F7 are not captured by T+90 then game leaders stop Phase 3)	Expected Data Collected or Provided (B)	Expected Data Collected or Provided (C)	Expected Data Collected or Provided (D)

Game Phase ID 3	**Challenge Cycle Level ID (if multiple modules used)** A01	**Challenge Step ID** 4	**Node ID & Expected Range Location** 3.3 (Hill and Lagoon bunker)
Time			
Indicate if time unit should be displayed visually in AOC. SL Time	Expected Node Start (ENS) T+90	Expected Node Duration (END) 5m	Expected Node Exit (ENE) T+95
	Actual Node Start (ANS)	Actual Node Duration (AND)	Actual Node Exit (ANE)
Game Participant Communication (Notifications or Information to provide at Node)			
Form of communication (C6 communication by MNF authority to Blue team members using note card)	Communication Summary: Blue team members receive urgent message to proceed directly to the power station to extract hostage due to intercepted cell phone conversation that the hostage is being moved to be taken off of Ayab by the insurgents.		
Node Response Options/Choices/Paths (Connecting Node IDs; also indicate if Task Flag is placed at node)			
Provided Option (A) Node ID: 3.4	Provided Option (B) Node ID	Provided Option (C) Node ID	Provided Option (D) Node ID
Actual Option Node ID			
Supporting Range System(S) and or device(S); also specify expected data to be collected or provided by system or device (e.g., game flag, door, virtual computer, weapon, tool, image, etc.; indicate flag or door id if used)			
System or Device (A) Note card	System or Device (B) Range doors 3 and 4 are unlocked for access to Power station via tunnel.	System or Device (C)	System or Device (D)
Expected Data Collected or Provided (A): Note card contains MNF message to Blue team	Expected Data Collected or Provided (B)	Expected Data Collected or Provided (C)	Expected Data Collected or Provided (D)

Game Phase ID 3	**Challenge Cycle Level ID (if multiple modules used)** A01	**Challenge Step ID** 4	**Node ID & Expected Range Location** 3.4 (Power station)
Time			
Indicate if time unit should be displayed visually in AOC. SL Time	Expected Node Start (ENS) T+95	Expected Node Duration (END) 5m	Expected Node Exit (ENE) T+100
	Actual Node Start (ANS)	Actual Node Duration (AND)	Actual Node Exit (ANE)
Game Participant Communication (Notifications or Information to provide at Node)			
Form of communication (Flag F8 is to be captured by the Blue team; flag is located inside the make-shift infirmary containing the hostage; C7 communication by MNF authority)	Communication Summary: MNF authority congratulates Blue team success. Game clock stops when Flag F8 is captured.		
Node Response Options/Choices/Paths (Connecting Node IDs; also indicate if Task Flag is placed at node)			
Provided Option (A) Node ID: 4.0	Provided Option (B) Node ID	Provided Option (C) Node ID	Provided Option (D) Node ID
Actual Option Node ID			
Supporting Range System(S) and or device(S); also specify expected data to be collected or provided by system or device (e.g., game flag, door, virtual computer, weapon, tool, image, etc.; indicate flag or door id if used)			
System or Device (A) Note card	System or Device (B)	System or Device (C)	System or Device (D)
Expected Data Collected or Provided (A): Note card contains MNF message to Blue team	Expected Data Collected or Provided (B)	Expected Data Collected or Provided (C)	Expected Data Collected or Provided (D)

Game Phase ID 4	**Challenge Cycle Level ID (if multiple modules used)** A01	**Challenge Step ID** 5	**Node ID & Expected Range Location** 4.0 (AOC Alpha briefing room)
Time			
Indicate if time unit should be displayed visually in AOC. SL Time	Expected Node Start (ENS) T-0	Expected Node Duration (END) Open	Expected Node Exit (ENE) Open
	Actual Node Start (ANS)	Actual Node Duration (AND)	Actual Node Exit (ANE)
Game Participant Communication (Notifications or Information to provide at Node)			
Form of communication (avatar voice, video, note card, display board, direct communication): avatar voice by game leaders using video	Communication Summary: Blue team game performance analyzed using assessment rubrics. Rubrics include: scoring weights addressing leadership model understanding and application skills (3/5 weight), avatar combat points suffered from Red Team members (inverse; where lower scores weigh higher for 1/5), and efficiency factor (addressed by performance time and captured flags; 1/5 weight). Rubrics and other collected survey data from participants are used by game leaders for out-brief to Blue Team on challenge performance. Post-game survey is also administered.		
Node Response Options/Choices/Paths (Connecting Node IDs; also indicate if Task Flag is placed at node)			
Provided Option (A) Node ID: Not applicable	Provided Option (B) Node ID	Provided Option (C) Node ID	Provided Option (D) Node ID
Actual Option Node ID			
Supporting Range System(S) and or device(S); also specify expected data to be collected or provided by system or device (e.g., game flag, door, virtual computer, weapon, tool, image, etc.; indicate flag or door id if used)			
System or Device (A) Inquisite survey tool	System or Device (B) Plasma screen	System or Device (C)	System or Device (D)
Expected Data Collected or Provided (A): Blue team members complete post-game survey	Expected Data Collected or Provided (B) Game videos and rubric feedback provided to participants.	Expected Data Collected or Provided (C)	Expected Data Collected or Provided (D)

Appendix C: Game Sequencing Path Script



Appendix D: Blue Team Game Participant Assessment Map

Pre-game	Concept map and survey (pre-game)
Phase I: Challenge Pre-brief	
Node 1.0	Observation Rubric and Survey Item Response (C1)
Phase II: Blue Team Insertion into Conflict Region of Zeta	
Node 2.0	Observation Rubric
Node 2.1	Observation Rubric (F1)
Node 2.11	Observation Rubric (F2)
Node 2.12	Observation Rubric (F3)
Node 2.2	Survey Item Response (C2)
Node 2.3	Observation Rubric (F4) and Survey Item Response (C3)
Phase III: Hostage Removal	
Node 3.0	Observation Rubric and Survey Item Response (C4)
Node 3.11	Observation Rubric
Node 3.12	Observation Rubric
Node 3.2	Observation Rubric (F5)
Node 3.21	Observation Rubric (F6)
Node 3.22	Observation Rubric (F7)
Node 3.3	Observation Rubric
Node 3.4	Observation Rubric (F8)
Phase IV: Challenge Out-brief	
Node 4.0	Observation Rubric and Survey Item Response (C5)
Post-game	Concept map and survey (post-game)

Challenge Context Survey Questions

Context	Survey Item
1	Describe the challenge situation.
2	Describe the most critical features of the current challenge situation.
3	Describe a plausible course of action for addressing the challenge situation.
4	Describe indicators for knowing whether to adapt the course of action.
5	Describe how well the course of action addressed the challenge situation.

Use the following scale to rate the degree to which you are currently:

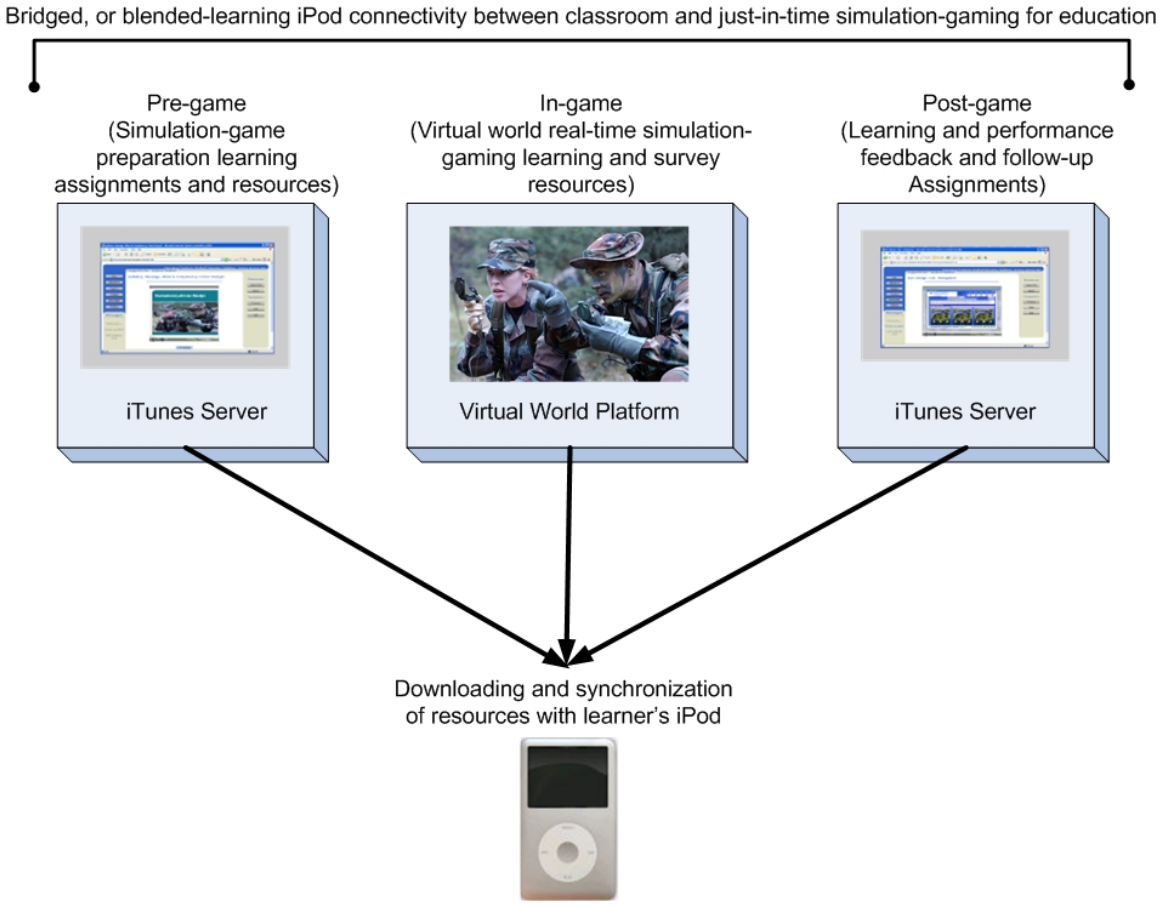
Absent	Emerging		Developing		Mastering	
0	1	2	3	4	5	6

1. Soliciting diverse or fresh perspectives from other team members.
2. Sharing information to help the team set or execute the direction of action.
3. Engaging in dialogue with other team members to explore differences in perspectives.
4. Managing differences you have with other team members.
5. Open to revision or change in the team's course of action.
6. Willing to make a change in your decision making strategy when necessary.
7. Recognizing gaps in your knowledge for addressing the challenge situation successfully.
8. Generating questions to gain understanding of the challenge situation.
9. Learning from unfolding events of the challenge situation.
10. Managing uncertainty of the challenge situation.
11. Handling team conflict successfully.
12. Tolerating ambiguity and anxiety related to your role on the team.
13. Showing respect to other team members.
14. Displaying attentiveness to unfolding events of the challenge situation.
15. Recognizing your own biases towards assessing the challenge situation.
16. Acknowledging and correcting your own errors to successfully address the challenge situation.

Appendix E: iPod Connectivity with Virtual World Simulation-Gaming for Education

An iPod can be connected to a game participant's computer in support of virtual world simulation-gaming for education. Pre-game reading assignments and other learning media can be downloaded from the iTunes server supporting the game. Example media can include audio lecture material (.mp3 format) and short instructional videos (.mov format). During the simulation game digital resources (e.g., maps, note cards, video, and audio files) can be pushed to the participant's iTunes for synchronization with their iPod. Post-game performance feedback and follow-up readings and assignments can also be pushed to individual participants.

The advantages of establishing and using connectivity between a participant's iPod with VW simulation-gaming for education are associated with portability and ease of access, just-in-time, or on-demand availability of learning resources. Thus, learning can be bridged or blended between in- and out-of-class times and further reinforced with pre-, during, and post-game provided resources and assignments (see diagram below).



Appendix F: Range Design Set for Test Game