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Identifying Command Post Staff Tasks for Simulation Augmentation
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ABSTRACT
Simulations are regularly used in the US Army for training and preparing leaders and units for military operations. Industry and business use simulations for data analytics and predictive analysis to support staff processes. In contrast, simulation technologies are only now becoming available to military staffs in a command post (CP) environment to better support planning and operations tasks. The US Army could leverage its existing and emerging simulation capabilities to enhance support to military operations in a similar manner.

This paper proposes a foundational methodology to assess how simulation can augment a given CP staff task in support of military operations. The analysis is based on identifying tasks that can benefit from the addition of simulation and the expectation that a sufficient level of trust can be achieved in the process. US Army leaders, as well as the experimentation and capability development communities, can use this analysis methodology as a starting point to determine the value of simulations in augmenting human staffs operating in a CP.

1. Introduction
The US Army has established an approach to using simulations during training events to prepare leaders and units for military operations. In support of this approach, the behaviors of personnel, characteristics of equipment, impacts of the operational environment (weather, terrain, human populations, etc.) and the outcomes of combat have been incorporated into various simulations.

Moving beyond preparation of leadership, simulation services are becoming available to warfighters in a command post (CP) environment to support military staff planning and operations tasks. As the capabilities of information systems improve, routine computational tasks are likely to evolve into complex, multi-faceted, multi-threaded analyses that truly augment the staff of a military unit and decrease the cognitive load of the personnel involved. Deployed units often operate in environments with limited bandwidth. Technology that improves bandwidth and enhance system performance are allowing deployed units to adopt simulation supported capabilities.

The US Army recently published its “Army Operating Concept” (AOC), which states that “leaders think ahead in time to anticipate opportunities and dangers and take prudent risk to gain and maintain positions of relative advantage over the enemy” [1]. The mission command system is the arrangement of personnel, networks, information systems, processes and procedures, and facilities and equipment that enable commanders to conduct operations [2]. Incorporating models and simulations (M&S) has the potential to help commanders and their staffs realize the conceptual statement from the AOC. Trusted M&S allow leaders to better support the art of mission command through enhancement of staff processes and procedures. Understanding, visualization,
(COA) analysis, and intelligence preparation of the operational environment can all benefit from such enhancements.

Incorporating M&S capabilities (i.e., faster than real-time COA analysis, model-based prediction for maneuver and logistics, and terrain visualization) into the current suite of mission command information systems will enhance unit, staff, and commander performance. Further, acceleration of experiential learning could be developed. Command and control (C2) of operations has consistently been a key target for enhancement using technology advancements. The development of automated mission command information systems (digital C2 systems) has occurred at an exceedingly rapid pace as methods of communications change from human to human towards system to system [3]. A large number of tasks performed by commanders and staffs during operations can be augmented by the application of simulation technologies. Simulations designed to facilitate COA development and analysis, rehearsal, and monitor execution could enhance the effectiveness of staffs and commanders [4].

Recent demonstrations of M&S technology in CP environments have verified that significant advances have occurred. Technology has improved in terms of server capacity, network sophistication, distributed operations, and set up tasks. Overall simulation interoperability with command and control systems has also improved. A coalition force focused demonstration in December 2013 received significantly improved comments over a similar demonstration in October 2009, “We have an exciting new capability and it works very well to improve some unmet needs of coalition C2, using interoperable simulations.” [5]

To support research and development activities, this paper proposes a foundational methodology to assess how simulation can augment a given CP staff task in support of military operations. The analysis of the task results in an expected benefit of simulation augmentation and the expectation that a sufficient level of justifiable trust can be achieved. The methodology offers requirement developers a starting point to determine the value of using simulation in augmenting human staffs operating in the CP environment.

2. Command Post Overview

FM 6-0 defines a CP as a unit headquarters where the commander and staff perform their activities [6]. The CP is being emphasized in the current draft of the Army’s Functional Concept for Mission Command [7]. At higher echelons, the complexity and size of a CP increases. Generally speaking, unit headquarters at brigade and above have access to the upper tactical internet and greater bandwidth necessary to apply simulations.

Each US Army echelon (Corps, Division, Brigade Combat Team (BCT)/Brigade, Battalion, Company/Battery, Platoon) has a CP. Echelons at Battalion and above are resourced with equipment and personnel to complete specific CP activities, while below
Battalion leaders perform CP duties in conjunction with daily tasks. Each US Army CP performs specific functions by design as well as specific tasks assigned by the commander. Activities common in all US Army command posts include: [6]

- Maintaining running estimates and the common operational picture;
- Controlling operations;
- Assessing operations;
- Conducting the military decision making process (MDMP);
- Developing and disseminating orders;
- Coordinating with higher, lower, and adjacent units;
- Conducting knowledge management and information management;
- Performing CP administration; and
- Supporting the commander’s decision making process.

A CP consists of functional cells (i.e., personnel (G1/S1), intelligence (G2/S2), operations (G3/S3), fires, protection, sustainment, etc.) and integrating cells (i.e., current operations, future operations, plans, etc.) (see Figure 1) that focus on specific military tasks.

![Functional and Integrating Cells in a CP (FM 6-0) [6]](image)

Individuals assigned to a military CP must be adept at dealing with problems of all magnitudes, from the smallest supply issue to the planning of echelon wide combat operations. The staff addresses two classes of planning constraints: controllable factors and uncontrollable factors. Controllable factors describe variables over which a
commander has some degree of jurisdiction (e.g., force composition, readiness, logistics). Uncontrollable factors, beyond a commander’s influence, consist of environmental conditions (sensors, terrain, weather), adversary forces (composition, location, readiness, willingness), and neutral / local population (pro U.S., anti-U.S., neutral) [8].

Effective military forces have a well-defined process for considering the different methods and various COAs that could be used to accomplish a mission and then issue orders to their units to complete the mission. The commander expects their CP staff to monitor the current situation (descriptive analysis), develop changes to orders (predictive analysis), facilitate the development of plans that address future operations (data analytics/predictive analysis), respond to higher echelon direction/requests, and respond to subordinate requests. To assist the commander of a military organization, command and control (C2) systems are co-located within a facility (mission command information systems in a US Army CP) to establish and maintain situational awareness/situation understanding (SA/SU). These same systems provide information for the commander and staff to consider when determining the optimum COA to accomplish their given mission. [9]

The CP staff concentrate on the commander’s decision points where a key decision must be made concerning a specific COA [6]. The quality of the information used to support a decision point has an impact, positive or negative, on mission accomplishment.

In general, the commander (or other senior officers) develops their intent (a concise expression of the purpose of the operation and the desired end state) and then gathers large groups of specialists from among their staff and subordinate units to receive that intent and begin planning. These specialists will organize, by functional or integrating cells, and work in their respective domains while at the same time coordinating across domains. This allows such specialists to conduct a thorough mission analysis, develop possible courses of action (COAs), analyze, compare and ultimately recommend one of the COAs to the commander [4]. Currently, COA development and analysis is a linear, sequential, resource intensive, and human endeavor that the military unit’s staff completes for the commander [9].

The same officers who develop the COAs are the ones who analyze them for strengths and weaknesses and determine the criteria used to evaluate the COAs. Despite their best intentions, the planning staff carries personal biases toward the COAs. Asking COA developers to evaluate their own COA can lead to group-think and distraction from mission accomplishment [10].
3. Identifying Command Post Tasks

A thorough knowledge of tasks performed by the CP is necessary before attempting to specify simulation capabilities to augment the process. Within each CP, staff tasks are based on one or more of the following:

- doctrinal approaches to functional or integrating cell (shown in Figure 1) requirements,
- type of unit (i.e., the staff tasks of a brigade combat team (BCT) and a sustainment brigade are not 100% the same),
- echelon,
- geographical area associated with the military operation.

A major difficulty in identifying CP tasks for analysis lies in selecting tasks at the proper level. Selection of a high level CP task could result in a multitude of subordinate and enabling tasks placing too many variables into the analytic process. However, selecting a low level task could end with a finite perspective without the need to address variables to accomplish the task. Tasks selected for consideration of simulation augmentation then require action by a collective group (functional cell or integrating cell) to provide an element of predictive examination, resulting in information to support a decision.

The list of references available to consult during the development or identification of CP tasks for simulation augmentation is nearly unlimited. For analytical purposes, it is best to examine a specific set of CP tasks because open-ended lists will not provide a proper analytic framework. References that can be used to identify tasks include, but are not limited to the following:

- Field Manual (FM) 6-0, Command and Staff Organization and Operations [6];
- Field Manual (FM) 7-15, Army Universal Task List (AUTL) [11];
- Chairman, Joint Chief of Staff Manual (CJCSM) 3500.04F Universal Joint Task List (UJLT) [12]; and
- Combined Arms Training Strategy (CATS) [13].

4. Value of Incorporating Simulation Capabilities

The US Army's network focused concept of operations (CONOPS) for command posts delineates the value of using simulations in a CP:

Use of simulations in the command post provides capabilities to the Warfighter that allow operational variables to be refined and outcomes to be analyzed prior to committing forces to the battle. Appropriate simulation use does not hinder command post operations and assists the commander in preparing for and visualizing the outcome of an operation and ensures that all aspects of the mission will be successful. [14]

US Army organizations continue to conduct research to bring simulation capabilities into the CP [5] [9] [15]. The objective of these research and development activities is to
allow the commander and staff to spend less time collecting information about upcoming decision points and allow more time for cognitive tasks better suited for the human than the machine. This, in turn, supports enhanced understanding and development of a correspondingly improved decision spectrum. Such augmentation allows commanders and staffs to feel and visualize the battlefield and explore multiple application of variables in support of mission accomplishment [4].

A recent assessment of US Army staff training indicate that deliberate planning prior to the start of military operations involve the entire CP staff (functional and integrating cells). However, subsequent planning efforts are often tasked to junior officers, who often begin executing without considering what MDMP steps are required. Consequently, when the staff assembles, the junior officers have little to no guidance as to what inputs are required to start planning. The assessment contains recommendations that a generic method of cross-functional analysis occur before settling on a scheme of maneuver and that integration of the entire staff is essential all planning efforts [16]. Use of simulations can provide cross-functional domain knowledge to junior officers as they complete their planning tasks. The CP staff also receives enhanced analysis from the use of simulations beyond the abilities of junior officers.

Other potential criteria for measuring value could include the reduction of planning time at a given US Army echelon, providing additional planning time to subordinate echelons, or higher quality assessments during planning. Each of these potential criteria support increased collaboration activities based on improved time management within a CP.

5. Identifying Simulation Capabilities

A simulation in support of operational CP tasks identifies potential solutions to problem sets. These solution sets augment staff processes completed by CP individuals within integrating and functional cells.

A critical capability for successful application of simulation in the CP is that the simulation must be accessed from the C2 systems within the CP. The presentation of simulation controls should closely mirror the C2 system controls in order to decrease the training requirements for CP individuals. This capability is a gate that must be passed through before considering any other capability.

Simulations in the CP must synchronize relevant information with C2 systems. This synchronization must keep the state of the simulation (including the simulation clock) within a small variance of the C2 system. This does not mean that the simulation must be running in real time. The difference between the simulation state and the C2 system to which it is synchronized should be small (or at least constrained by some small tolerance) [17].

The simulation must be able to integrate all relevant information about the operational environment, to include enemy and friendly activities, the weather, the terrain, sensor reports, etc. [18] [17]. A simulation system must provide a planned state after an action
is taken, the list of preconditions required for completion of that action, and the confidence of achieving that planned state [19]. Having a robust simulation capability can provide C2 tools that enable commanders and CP staffs to quickly provide optimal solutions for a multitude of complex situations [10].

The simulation must be capable of running extremely fast during planning and rehearsals and in near real time during operations [4]. The key to this is to collect, fuse, and disseminate accurate, timely, and relevant information with much greater rapidity (ideally operating in real-time) to help provide a common understanding among commanders across all levels [17].

When the simulation system is invoked, the resultant output should be repeatable given the same inputs. If the output from subsequent runs offers substantially different outcomes, the simulation system must provide a summary or listing of the differences in the outcomes and a description of why these differences occurred. It should also indicate a level of probability of a given result to assist the CP staff in identifying the “most dangerous” COA.

The simulation should provide tools that enable leaders and staff to generate and evaluate the effects that might result from an action or the actions that could be employed to achieve a desired effect [20]. The simulation should suggest how different outcomes could be achieved with the application of different resources (time, units, etc.). A descriptive analysis must be accompanied by access to a narrative to assist the individual in determining the viability of the information.

When the simulation system is invoked, it should be able to determine the information that supports the plan’s decision points or the commander’s critical information requirements (CCIR). Simulation runs should be ranked by the number of decision points/CCIR that are clearly supported and provide sufficient detail that allows the CP staff to trust the supporting information.

Simulation capabilities are changing, and will continue to change, as technology changes. As is the case for any analysis, the changes in capabilities and technology have an impact on the current validity of the analysis.

6. Trust

Trust is implicit in all discussions on using simulation to support staff processes in the CP. The use of simulation to support planning of combat operations hinges on trusting its output, which is only established through proven usage [15] and appropriate rigor. Key to augmenting staff processes is achieving trust of simulations abilities to provide accurate information. Without trust, simulation systems become a distracter to the CP staff. Confidence and trust in simulation systems must be developed over time. As a unit completes a military operation, the results of the operation must be captured and compared to the results of the simulation to enhance rigor in the future. These variances must be clearly explained and should be incorporated into the simulation for future use.
Failure to attain trust negates the use of simulations in any situation, but especially in consideration of the military operations environment. If the simulation capability cannot deliver a trusted and rigorous response then any analysis will be suspect. Trust is a baseline criteria that must be attained before making recommendations on integrating simulations into a CP staff’s analytical tasks.

7. Methodology

Cognitive ability is the capacity to perform higher level mental processes of reason, remembering, understanding, and problem solving [21]. Procedures that entail a high number of complex tasks in a short time period can result in cognitive load resulting in sub-optimal reasoning and decision making. Knowledge, skills and abilities for operators, maintainers and other support personnel continuously develop with the increasing complexity of emerging systems. [22]

The current staff processes and simulation capabilities are evaluated against human-system interfaces (HSI) aligned with assessment criteria in the analysis of how much of a given CP task can be supported or augmented by simulation. The Defense Acquisition Handbook describes eight interfaces: Functional, Informational, Environmental, Cooperative, Organizational, Operational, Cognitive, and Physical [22]. The informational and cognitive interfaces are of particular interest to this analysis (Table 1).

Table 1 – Example assessment considerations

<table>
<thead>
<tr>
<th>Interface</th>
<th>Description</th>
<th>Assessment Considerations</th>
</tr>
</thead>
<tbody>
<tr>
<td>Informational</td>
<td>information and characteristics of information that provide the human with the knowledge, understanding and awareness of what is happening in the tactical environment and in the system</td>
<td>Computational. The use of simulation capabilities should augment or replace current computational tasks and provide value added to the functional or integrating cell.</td>
</tr>
<tr>
<td>Cognitive</td>
<td>decision rules, decision support systems, provision for maintaining situational awareness, mental models of the tactical environment, provisions for knowledge generation, cognitive skills and attitudes, memory aids</td>
<td>Friendly. The portrayal of friendly force capabilities must be current.¹ Threat. The portrayal of threat force capabilities must be current.¹ Relevance. The simulation must provide understandable, relevant output. It must be aggregated or decomposed at a level appropriate for the CP’s echelon.</td>
</tr>
</tbody>
</table>

¹Using inaccurate locations, organizations, weapons systems, or capabilities do not support an accurate analysis. Information in the simulation must be current and reflect on the ground dispositions in order to gain trust in the output.
Objective Methodology

The methodology’s objective is a contrast between how a task in the CP is currently being accomplished as compared to applying simulation capabilities against the same task. Table 2 provides the detailed steps of the methodology.

Table 2 – Objective Methodology

<table>
<thead>
<tr>
<th>Step</th>
<th>Title</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>Step 1</td>
<td>Identify a CP task that may allow a portion of it to be augmented by simulation.</td>
<td>As previously addressed, a task considered for simulation augmentation should require action by a collective group (functional cell or integrating cell) to provide elements of predictive examination that ultimately produces information in support a decision.</td>
</tr>
<tr>
<td>Step 2</td>
<td>Evaluate how the staff currently carries out the task.</td>
<td>Determine the amount of human interface (informational and cognitive) in the human-system interfaces. The areas evaluated may vary from task to task but must be applied consistently with Step 3.</td>
</tr>
<tr>
<td>Step 3</td>
<td>Identify simulation capabilities to address “how could the staff benefit from using simulation to accomplish this task.”</td>
<td>Determine the amount of system interface that must be used. Investigate each assessment consideration with the task to determine the steps that can be augmented by simulation.</td>
</tr>
<tr>
<td>Step 4</td>
<td>Identify the specific benefits of using simulation.</td>
<td>Determine the specific benefits to the commander and CP staff of supporting the task with simulation.</td>
</tr>
</tbody>
</table>

Sample Application of Objective Methodology

The above steps are used in the sample application of the methodology below.

**Background:** A US Army deployed CP received a mission change from higher headquarters. The commander develops the initial intent and the staff conducts mission analysis. The staff in the CP have the necessary key input items (mission statement, assumptions, COA evaluation criteria, initial intent, planning guidance, CCIRs, essential elements of friendly information (EEFI), and updated intelligence preparation of the battlefield (IPB)) [6] on hand and are ready to complete COA development.

**Step 1. Identify a CP task that may allow some portion it to be augmented by simulation.**

Task Description: A COA is a broad potential solution to an identified problem. The COA development step generates options for subsequent analysis and comparison that satisfy the commander’s intent and planning guidance. During COA development, planners use the problem statement, mission statement, commander’s intent, planning guidance, and various knowledge products developed during mission analysis [6].
**Step 2. Evaluate how the staff currently carries out the task.** See Table 3.

**Step 3. Identify simulation capabilities to address “how could the staff benefit from using simulation to accomplish this task.”** See Table 3.

### Table 3 – Step 2 and 3 assessment considerations for the COA development process

<table>
<thead>
<tr>
<th>Sub-Processes</th>
<th>Informational Considerations (Computational)</th>
<th>Cognitive Considerations (Friendly, Threat, Relevance)</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Current process</td>
<td>Augment with sim</td>
</tr>
<tr>
<td>Apply key inputs(^a): Updated IPB</td>
<td>Update C2 systems</td>
<td>Update simulations from C2 systems(^1)</td>
</tr>
<tr>
<td>Assess relative combat power</td>
<td>Manual computation of friendly and threat combat power within geospatial box</td>
<td>Compute based on friendly and threat forces within geospatial box(^1)</td>
</tr>
<tr>
<td>Generate options</td>
<td>Annotate sketch or PowerPoint</td>
<td>Identify repositioning times(^4), Determine relative combat power(^4)</td>
</tr>
<tr>
<td>Array forces</td>
<td>Annotate sketch or PowerPoint</td>
<td>New Task Order allows immediate feedback on resource consumption(^4)</td>
</tr>
<tr>
<td>Develop a broad concept</td>
<td>Annotate sketch or PowerPoint</td>
<td>None</td>
</tr>
<tr>
<td>Assign headquarters</td>
<td>Manual</td>
<td>None</td>
</tr>
<tr>
<td>Develop COA statements and sketches</td>
<td>PowerPoint on SharePoint, Pasteboards on CPOF</td>
<td>Automatic output: resource consumption(^2,4), relative combat power(^2,4)</td>
</tr>
</tbody>
</table>

### Simulation Capabilities

1. Synchronize relevant information with C2 systems data
2. Run in real time and faster than real time
3. Provide repeatable outcomes and explanations of variances
4. Provide tools to explore options
5. Identify the number of achievable key points in a plan

### Acronyms

- CCIR: commander’s critical information requirements
- COP: Common Operational Picture
- CPOF: Command Post of the Future
- EEFI: Essential Elements of Friendly Information
- MCOO: Modified Combined Obstacle Overlay
Step 4. Determine the benefits of supporting the task with simulation.

Simulation can support analysis during the COA development CP task and provides additional information for each COA in regards to the following:

- understanding the impact of terrain and obstacles (MCOO),
- executing timelines,
- identification of decision points and CCIRs, and
- visualizing COAs.

8. Conclusion

Simulations and technologies have matured and can now be of considerable utility to CP tasks that require examining and comparing significant operational details. C2 systems will soon begin to better incorporate simulation-supported capabilities into software releases. Therefore important to identify precisely where and how simulation can best support various CP tasks, including what the limitations, risks, and opportunities are such an endeavor. This paper has introduced a foundational methodology upon which to base this analysis. Further development and maturation of this process will lead to a more robust command and control capability that applies the advantages of simulation technology to support a variety of data analytics that will enhance CP tasks in the future.

References


[12] Chairman, Joint Chief of Staff Manual (CJCSM) 3500.04F Universal Joint Task List (UJLT)


[21]  
http://college.cengage.com/psychology/bernstein/psychology/6e/students/key_terms/ch10.html accessed 17 Apr 15.

[22]  