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COMMUNICATION MISSION-TYPE ORDERS TO VIRTUAL COMMANDERS

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ABSTRACT

This paper discusses issues in modeling C4I and cognitive processes in next generation simulations and applications to Force XXI command and control. We propose a modification to the way military operations orders are written and published to achieve simulation/C4I interoperability. We suggest that the standard five-paragraph format be retained but that significant structure be applied to its free text components. We also propose a significant reduction in the size and content of divisional and corps orders, while promoting increased clarity and conciseness in them. We discuss issues related to the transfer of this initiative to field usage. We also address its impact on the next generation of simulations and training in a digitized force structure.

1 PREMISE

The Defense Modeling and Simulations Office (DMSO) has focused on creating an interface between C4I systems and the High Level Architecture (HLA) Runtime Infrastructure (RTI) which forms the basis for the next generation of simulations. The integration of C4I with simulations has thus far concentrated on extracting information from the simulation. With the development of large-scale, entity-level simulations, and the need to reduce the support staff overhead in running large exercises, a requirement has arisen for Command Entities (CEs) or "virtual commanders." Human participants in exercises must be able to use their real-world C4I systems to create and distribute mission orders to these virtual commanders embedded in the simulations.

The C4I systems primarily employ the US Message Text Format (USMTF) as their data communications structure. Many fields within the USMTF are composed of data that can be interpreted by simulations. The most crucial elements of command and control, such as Paragraph 3 of an operations order, however, are written in free text. These elements contain the crux of the interpersonal communications between commanders, such as intent, priorities, and phasing, and they rely heavily on natural language patterns, unit-specific vocabulary, and broad situational context. To date no effective method has been developed for translating these critical and complex free text fields into data which can be accurately processed and understood by simulations.

2 BACKGROUND

Player/controllers currently provide the interface between the training audience and the computer simulation. These player/controllers are located in work cells and equipped as if they were a tactical operations center in the field. They use a computer keyboard to input information into the simulation and relay tactical situation reports to the training audience using C4I systems. The C4I systems consist of real-world systems such as the Army's Tactical Command and Control System (e.g., AFATDS, MCSP, ASAS). The training audience in the field communicates with player/controllers in the work cells, who in turn transform this military communication into computer commands for input into the simulation. As battlefield results emerge from the simulation, the player/controllers transform these reports into the proper tactical format for transmission to the training audience. The exercise support personnel for large training events can be as large or larger than the training audience.

The growing requirement to achieve simulation/C4I interoperability is driven by the fielding of computerized command and control systems such as the Advanced Field Artillery Tactical Data System (AFATDS). To achieve this interoperability we must ensure that the simulation generates all the information required by the C4I systems and that the information is formatted as required by the real-world C4I system. The first issue is being addressed by developing more complex, higher fidelity simulations within the context of the Joint Simulations (JSIMS) program. DMSO is seeking to resolve the second issue with its Modular Reconfigurable C4I Interface (MRCI) program.

3 DISCUSSION

As members of DARPA's Synthetic Theater of War (STOW) integrated development team, we participated in the design, development, implementation and application of the Command Forces (CFOR) and MRCI programs within the Army Forces domain. The STOW development team chose the high-fidelity, entity-based Modular Semi-Automated Forces model, ModSAF, as the basis for its simulation. This model was developed, along with high fidelity representations of terrain, environmental factors, phenomenology, weapons interactions, and advanced behavior and control representations, to produce a realistic stimulation for the training audience.

From the outset STOW management recognized that the large number of operating entities and the requirement to reduce support personnel would require the development of automated CEs. DARPA's CFOR program funded the development of these automated CEs within the various Service domains. Within the Army domain, we supported the development of fully functional maneuver and fire support CEs at the heavy force company team level, company CEs for the AH-64 attack helicopter companies, and a limited-capability CE at the heavy maneuver battalion level.

The CFOR program also developed the Command and Control Simulations Interface Language (CCSIL), which enabled communications between the CFOR CEs and the semi-automated forces that they would "command," between various CEs, and between the CEs and their human "commanders." CCSIL includes a set of messages and a vocabulary of military terms needed to fill out messages. The movement of CCSIL messages within the simulation represents the message flow that occurs in the real world, whether by voice, radio, or C4I system.

At the outset the intent was for these CEs, or virtual commanders, to be commanded and controlled by uniformed personnel at the next higher echelon. The proposed interface between the human and virtual commanders was to be the appropriate, operational automated C4I system, in this case the Army's MCS/Phoenix and AFATDS. To accomplish this, DMSO's MRCI program undertook an effort to map and translate various USMTF messages used by the C4I systems to CCSIL messages used within the simulation, thus enabling direct, two-way communications between the real-world commanders and their subordinate virtual commanders.

Logicon RDA researchers working in the USMTF to CCSIL mapping and translation effort realized that there are two distinct categories of messages that must be considered. In the first category, messages primarily consist of defined and arrayed data elements with clear mappings between the two systems. Examples of these are the USMTF A400 SITREP, which directly maps and translates to the CCSIL 202 Unit Status Message, and the USMTF D210 Fire Mission Call for Fire, which correlates to the CCSIL 401 Fire Request. In the second category, messages are composed in free text, such as the operations order (USMTF message A423, Order). While this clearly maps to the CCSIL 101 Operation Order, a simple and accurate automated translation is currently impossible. Although this paragraph has a standardized format, it relies on natural language patterns, unit-specific vocabulary, and broad situational context to communicate the commander's intent, objectives, priorities, and guidance.

During the actual STOW-97 Advanced Concepts Technology Demonstration, a number of the clear mapping-type messages were exchanged between the simulation and the MCS/Phoenix and AFATDS systems. The free-text operations orders, however, were communicated to the CEs artificially. For both the ground maneuver and attack helicopter units, a detailed five-paragraph operations order was developed in the standard military format. This order was translated and entered into a commander's workstation, and then distributed to the subordinate CEs via CCSIL messages. This process required individuals knowledgeable in both simulation and military domains and once again separated the uniformed personnel from the simulation.

4 PROBLEM

The problem we address is how to develop a seamless interface between training audiences using real-world C4I systems and the next generation of simulations that represent subordinate units in the force structure. The key is to provide a doctrinally realistic linkage between actual commanders using C4I systems and their subordinate virtual commanders. During our initial efforts it was suggested that the human commanders write their free text Paragraph 3 of the operations order as a series of sequential Army Training and Evaluation Program (ARTEP) task strings, which would translate neatly into CCSIL orders. This suggestion was not pursued because it violates the basic Army premise of issuing mission-type orders. FM 100-5 states, "Mission (type) orders, which specify what the subordinate commands are to do without prescribing how they must do it, are often the best." FM 101-5 states, "The commander delegates authority to subordinate and supporting commanders to execute the plan by telling them what he wants done, not how to do it." In addition to this translation/format problem, the size and complexity of the orders is an obstacle to achieving a clean interface between real-world C4I systems and the simulations.

A typical division or corps order is 400 to 500 pages long, as well as repetitive, complex, and unclear. We recently reviewed a Corps order created for a Battle Command Training Program (BCTP) Warfighter exercise that was 452 pages in length. A typical order contains much repetitive information, much of which is contained in

the unit's Standing Operating Procedures (SOP) and need not be included in the order. Additionally, much of the information in the order could be passed through the real-world C4I systems as database exchanges.

Another problem with operations orders is the non-doctrinal use of terms and graphics. Although this situation has improved greatly in the past few years, there is still a tendency to use terms incorrectly or to mix terms that confuse the meaning. For example, there may be a mixture of the terms "defeat" and "destroy" between the commander's intent paragraph and the concept of operations paragraph. Both of these terms have very specific meanings and implications for subordinate commanders. When they are mixed, further discussion and human interaction is required to clarify the intent. Often a term used in an order is surrounded with extra words that confuse its doctrinal meaning. Finally, commanders may use adjectives and adverbs to emphasize a term unnecessarily. For instance, you may see the statement "I want 1st BDE to on order attack aggressively to seize and secure OBJ DOG." "Aggressively" is unneeded since all attacks should be aggressive by nature. The use of the term "secure" is unneeded since, if the unit "seizes" the objective, it by the definition of "seize" accomplishes the "secure" task.

5 SOLUTION

So, if the use of free text is a problem, how do we solve it? Our experience in working with CCSIL shows that in almost every case, commanders can describe what they want a unit to do by using doctrinal terms only, especially if they adhere to the defined meanings of the terms contained in FM 101-5-1 or JCS Pub 1. While doing this may restrict the "style" of the commander, it does not restrict nor limit the content and intent of the written order. We can create a vocabulary of doctrinal terms that can be processed by a simulation in a predictable manner. It is possible to describe any mission or task given to a subordinate in a standardized manner with a who (relates to a task organization database entry), what (in doctrinal terms), when (specified time, on order, or keyed to a trigger event), where (related to a coordinate or graphical control measure), and why (in doctrinal terms).

The following example demonstrates the application of these techniques. In the first paragraph we have the commander's intent portion of an actual Corps operations order that was developed during an Army BCTP Warfighter exercise. (Note: Unit designations have been altered in order to maintain anonymity).

Example paragraph 1. INTENT: I want to conduct an aggressive attack to achieve two goals. The first is to link up with FROKA vic HONGCHON (DS 0271) completing the encirclement of enemy forces on the Corps' east (right) flank, and subsequently contain those forces until they are destroyed by FROKA. The second is to achieve conditions which will allow rapid passage of the XII (ROK) Corps to the north to attack and restore the MDL to its pre-war location. I intend to set the overall conditions for a successful operation by using Corps deep operations to destroy the effectiveness of the enemy's ADA and artillery, which is critical to reducing the enemy's flexibility and countering his center of gravity. To achieve link-up and encirclement, I intend for the main attack in the center of the Corps' zone and the supporting attack in the east to rapidly and decisively penetrate the enemy's main defense and defeat his counterattack forces. In addition, the supporting attack in the east will protect the right flank of the main attack. Upon link-up with FROKA Corps forces will reorient to the southeast. The supporting attack in the west will protect the Corps' left flank, which will be increasingly extended as the attack progresses, and achieve the critical conditions to allow the passage of the XII (ROK) Corps to the north: (1) secure crossing sites over the PUK AN river and (2) clear and secure passage routes north through its sector. I see the enemy's most likely course of action as to defend well forward. Once the enemy determines that a penetration is likely, I anticipate that he will use operational exploitation forces to attempt to attack the flanks of the penetration. We will counter this threat with aggressive deep operations and counterattacks by ground and air maneuver forces. Throughout the operation we must protect the force. Special attention must be paid to defense against chemical weapons and to counter-reconnaissance in the Corps, Division, and Separate Brigade rear areas. The worst thing the enemy could do to us is to destroy our fire support assets, especially MLRS, and our attack helicopters. Each of the forward units will insure the security of critical assets within their zones to include ADA, Artillery, and fire finding radar. Following the containment and passage of the XII (ROK) Corps, I (US) Corps will posture itself to conduct future offensive operations as directed by TROKA. The keys to our success are conducting successful deep operations and retaining flexibility to exploit enemy weaknesses.

While fairly straight forward and clear, this 417-word paragraph has been reduced to 214 words in the following revision.

Example paragraph 2. Intent: X Corps attacks to link-up with FROKA vic HONGCHON (DS0271) to complete the encirclement of enemy forces on our east (right) flank and allow FROKA to contain then destroy them, and to pass XII (ROK) Corps to the north to attack and restore the MDL. After link-up Corps orients to the southeast. Our deep operations destroy enemy ADA and artillery, his center of gravity. We will do this with a main attack in the center of our zone to penetrate the enemy's main defense and defeat his counterattack forces. We will conduct supporting attacks in the east and west to protect

the main effort. Additionally, the supporting attack in the west will secure crossing sites over the PUK AN river and secure passage routes. The enemy's most likely course of action is to conduct a positional defense well forward and use operational exploitation forces to attack the flanks of our penetration. We will counter this threat with deep operations and ground and air counterattacks. Special attention should be paid to counter-reconnaissance and defense against chemical attack. Our critical assets are fire support (MLRS, attack helicopters, artillery, fire finder radar, and ADA). Our end state is the Corps linked-up with TROKA, XII (ROK) Corps completed passage and the Corps prepared for future offensive operations.

This information can be further reduced to fewer than 100 words, as shown in the intent matrix in Table 1. The terms used in these columns fit the characteristics mentioned. Definable parameters associated with doctrinal terms are stated within parentheses. These terms and parameters can be built into CCSIL messages interpretable by CEs. Commanders may argue that they need great leeway in the free text to put their personalities and emphasis into orders. While the authors understand this on a visceral level, objectively we do not believe that it is necessary. Current doctrine holds that orders written for human subordinates should be issued to the subordinates face-to-face. The written order then serves as a reference and a record. A commander can, and should, impart his personality and emphasis during this face-to-face exchange. The written order should be clear and concise, and contain the bare minimum needed for subordinates to execute. For automated CEs their process already accomplishes this by stripping away all of the aspects of personality and emphasis and dealing with the clear, defined aspects of the missions and tasks.

As we move to the future and a digitized force, many of the problems that we currently face with command and control of simulations are likely to occur in the command and control of operational battle forces. Based on the tenets of Joint Vision 2010 and experiences gained during the Warfighter XXI experiments, the Army believes that future operations will be conducted by dispersed forces, operating rapidly and with significantly reduced decision-making cycles. Distributing large amounts of data, information, orders and guidance via high-speed automated C4I systems will enable this capability. Current concepts call for the dispersed commanders to conduct their planning and decision making via voice and video teleconferencing. Issues of bandwidth, information warfare, and battlefield environment may preclude this "virtual face-to-face" interaction, however. In this case, dispersed commanders will have to conduct their operations based on clear, concise orders in much the same way that our emerging automated CEs function.

6 CONCLUSION

The authors propose that the doctrine, training, simulations, and C4I development communities embark on a defined joint effort to revise the method of writing the five-paragraph operations order. This effort would retain the standard formatting but apply a significant degree of standardization, rigor, and protocol that are directly related to FM 101-5-1 and other appropriate doctrinal publications. Additionally, aspects of the Standard Generalized Markup Language (SGML) or Extensible Markup Language (XML) might be applied, thus allowing commanders some leeway in terms of style, but ensuring that the order is easily parseable, by either human or virtual commanders, into its critical, fundamental components and meaning. Such an effort would ensure that the emerging aspects and opportunities of all of the communities are integrated into a process that will provide total support to the Warfighter, whether in training, rehearsals or operations.

The authors recognize that changes to functional processes come slowly and only with the acceptance of the user community. We are arguing that an effort to change the method of writing operations order will do more than facilitate the development and execution of simulations. It may well be a fundamental requirement associated with a digitized force conducting information operations. If the multiple interested communities recognize that the problems and solutions currently encountered in high-fidelity, entity-level simulations are a harbinger of those that must be dealt with in a digitized force, perhaps cooperation and synergy can be achieved in finding common solutions to these problems.

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Table 1: The Intent Matrix Reduces the Order to Less Than 100 Words

Who (task organization database, battle-field description)	**What (doctrinal mission, task)**	**When (time, event)**	**Where (grid location, control measure)**	**Why (doctrinal purpose)**
X Corps	Attacks	On order, H-hour	In zone	Link-up (with: FROKA; Link-up Point DS0271)
Main effort	Penetrates		In zone	Defeat (enemy counter-attack forces)
Supporting Effort	Attacks		In zone	Protect (east flank)
Supporting Effort	Attacks		In zone	Protect (west flank), Secure (crossing sites over PUK AN river), Secure (passage lanes)
Deep Operations	Attack	On order	In zone	Destroy (artillery, ADA, and counterattack forces)
Maneuver forces	Counter attack	On order	In zone	Destroy (enemy operational exploitation forces)
	Counter reconnaissance		In zone	Protect (fire support – MLRS, attack helicopters, artillery, fire finder radar, ADA)
X Corps	Link-up complete Passage complete Prepared for future offensive operations			