BDM 9-23-86

INSTRUMENTED TACTICAL EXERCISE WITHOUT TROOPS for AIRLAND BATTLE

Short Title: **ITEWTALB**

Prepared for **The BDM Corporation**
at the direction of
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Attachment A -Task 1

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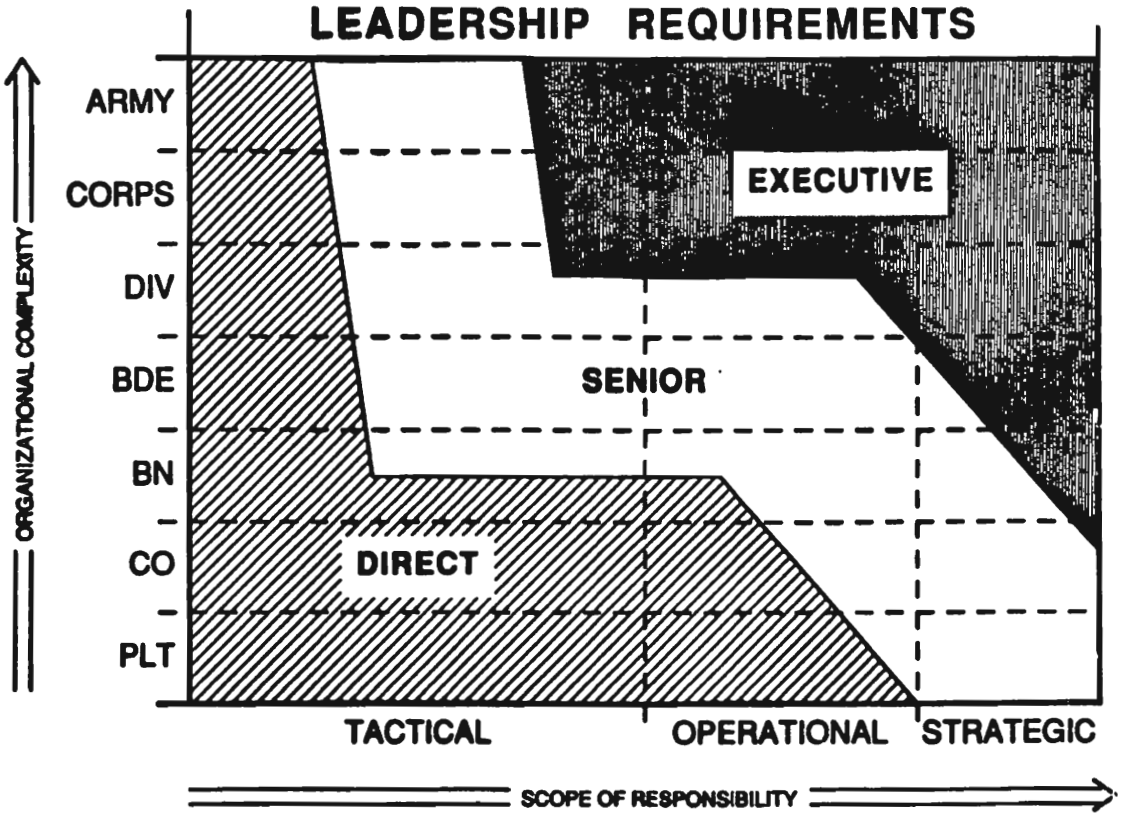
"Corps operations today are similar to World War II field army operations in both complexity and scope. Corps, as fighting and maneuver headquarters, may enjoy less time to make and execute decisions than was available to field armies during World War II. Correspondingly, the responsibilities of World War II corps have been assumed by today's divisions. Division sectors are wider and deeper, and division missions are more extensive. Further, communications and information sharing technology offer more opportunities to leaders..." FC 22-999 (1985)

The Army knows that its current doctrine, AirLand Battle, makes unprecedented demands of top commanders in the field, and that its accustomed training methods can neither evaluate their readiness for tomorrow's battles, nor improve it. The Army knows in its soul that at any echelon, the competence of the commander profoundly influences the performance of his unit. It knows surely that a maladroit Corps commander could obviate in minutes billions of dollars spent over the years on modernization or improved training methods for combined arms battalions, and that, should he bungle his job, no amount of tactical proficiency at the front would be likely to save the day. Therefore, the latest version of Army Regulation 600-100, "Army Leadership" (27 May 1986), draws distinctions among three levels of responsibilities: (1) Executive-level leaders; (2) Senior-level leaders; and (3) Direct-level leaders. Colonel Stewart Sherard, Director of the Center for Army Leadership at Fort Leavenworth, has related Executive-level leadership mainly to the command of field army and corps, and to responsibilities strategic and operational in scope; Senior-level leadership mainly to the command of divisions and brigades, and to tactical and operational responsibilities; and Direct-level leadership to the command of battalion, company, and smaller organizations, with principally tactical responsibilities.



Over the past two decades, perhaps understandably, given the demands of the war in Southeast Asia and its aftermath, the Army's attention has been focused mainly on Direct-level leadership. Its innovations in training methods -- e.g., engagement simulation, battle simulations, and the National Training Center-- have been directed at Tactical as opposed to Operational or Strategic responsibilities. But there is now deep concern manifest within the high command of the Army over methods and means for preparing Executive- and Senior-level leaders for their responsibilities, and for training and evaluating them on the job.

In March of 1985, the Vice Chief of Staff, General Thurman, sent a letter to Commander, TRADOC, on the subject of "standards of performance" in which he called for a plan to establish such standards horizontally across the several arms, and vertically from the individual soldier to the highest echelon of the Army afield. Currently, the Army Research Institute and TRADOC are working with the United States Readiness Command toward using the latter's planned Joint Warfare Center for training and evaluating the Army Corps under its operational command. The JWC will have automated battle simulations for training commanders and staffs in joint operations, either at the Center or in garrison. The Warrior Preparation Center in Europe is working toward the same ends, as are U.S. forces in Korea. While the Army initially sought its own exercise drivers, it has come to pin its hopes on the JCS-sponsored Modern Aids to Planning Program (MAPP), which is now developing the Joint Exercise Support System (JESS) and the Joint Theater Level Simulation (JTLS), both of which will be used in REDCOM's Joint Warfare Center. The objective is for these models eventually to underwrite a simulation of combat in the air and on land for commanders and staffs at echelons down to brigades, with unit resolution within the model down to battalion. For the near-term, however, the models will function best for the highest echelons. A description of JESS, the centerpiece system, is attached as Appendix 1.

Some senior generals have already expressed concern over trying to use models alone for the purpose of training and evaluation, given their inherent limitations: models can be little more than extrapolations from observed data on relatively small units, plus estimates of threat capabilities, and inferences as to how developing weapons and sensors will interact with same. Moreover, it is not evident that command-post exercises at battle simulation centers, or tied to them, can adequately represent the real-world challenges facing communicators in supporting command, control, and intelligence under the time strictures and over the long distances inherent in modern conflict, let alone coping with enemy electronic warfare and destructive ordnance. Nor can computer models credibly replace exercises on the ground as a way of teaching tactical or operational commanders appreciation of terrain and troop-leading procedures. "Centers", while convenient, substitute fixed facilities and assured communications for those soldier-manned portable systems which often prove troublesome in the field, and they can only approximate the reality of weather and terrain as these challenge commanders at all echelons. And both the JMC and the Warrior Preparation Center suffer from being American, so that interoperability can be exercised only

dubiously. Neither the commanders undergoing evaluation via the Centers' models, nor the Chief of Staff of the Army who will have to relate results to readiness, are likely to be satisfied.

One answer might be to upgrade conventional combined field exercises, such as the annual AUTUMN FORGE exercises in Europe, to put greater demands upon senior commanders and their C^3I systems, and to incorporate more realistic land-air interactions, particularly for deep attack and deep maneuver. But large field exercises --even the current, ballet-style undertakings-- are very expensive, and engender increasingly staunch political opposition. It would be unrealistic, to say the least, to expect agreements from German local authorities which would permit more extensive use of air space, or more free maneuver of any kind. It is also likely that NATO itself would resist an enhanced AUTUMN FORGE, citing costs, but reflecting deep-seated political opposition in every member nation. Moreover, AUTUMN FORGE must take place almost literally under the noses of the Group of Soviet Forces Germany, and the Soviet Military Missions stationed in the Federal Republic of Germany, so that counterintelligence concerns tend to dictate an error-free fixed scenario, as opposed to an event-driven free-maneuver. Larger maneuvers in Europe do not seem to be in the cards.

Nor can there be much doubt that resistance would quickly materialize in CONUS were the Army again to essay large unit exercises off post. There has not been a major maneuver in the United States since 1964 --referring to corps-size units exercising outside military reservations. Modern heavy forces, helicopters flying nap-of-the-earth, and even today's logistical activities, pose environmental threats unimagined when the "Louisiana Maneuvers" were the Army's standard for training the field army and its corps. Cost considerations alone probably rule out returning to such a standard. In any event, big maneuvers are themselves only simulations, approximations of battle, and if constrained by concerns over maneuver damage, civilian and troop safety, and civil and military traffic management, may reveal less about the real capability of commanders and their staffs than the computer models. Doubts within the military profession about the efficacy of conventional FTX were well expressed by the late "Ace" Collins, who in his classic Common Sense Training wrote:

> **"The benefits from a field-training exercise extend to units two units below the highest headquarters participating. In a company-level exercise, the platoons, squads, tank crews, and gun sections derive the most benefit; a battalion exercise benefits the company and platoon level; a brigade exercise benefits the battalion and company; and so on. If this is a sound rule of thumb, and if the training of individuals and small units is the real key to successful training, then field exercises above battalion do not add much to the quality of training. The larger-unit exercises consume time and resources that could be better used to improve individual and small-unit training, the foundations of unit readiness."**

"Ace" Collins would be pleased with the way that engagement simulation, using laser direct-fire simulators on instrumented ranges, has improved the efficiency of, and added to troop interest in, training for combat arms battalions and their subordinate units* --training methods of which the National Training Center is the most advanced expression, a counterpart of which will shortly be available at Hohenfels, in Bavaria, under the Seventh Army Training Center. But the requirement for training higher echelons, especially the C^3I elements thereof, remains, and becomes the more pressing as new sensors and weapon systems enter the forces, and as the capabilities of Soviet forces increase.

It is not necessary to use tens of thousands of soldiers, and thousands of heavy tactical vehicles and combat aircraft as training aids for Executive-level and Senior -level commanders. Nor is it necessary to shackle training of the latter and their C^3I elements to certain software for a given set of computers, as JESS is described in Appendix 1. Over the years, notably in the 8th Infantry Division in Europe, a variety of techniques have been developed for exercising higher commanders and staffs while the remainder of the command pursues other training objectives --multi-echelon training, as it is termed. Such training architecture is not a trivial accomplishment, and deserves both technological upgrade and broader application throughout the Armed Forces. And if the concept proposed here could free C^3I training from the confines of computerized "centers," so that it were conducted in the field --"train as you fight"-- joint readiness would be indeed well served. In fact, training Executive-level and Senior-level American commanders, together with their key tactical leaders, to utilize both the major advantages which accrue to the defender from familiarity with, and skill in using terrain, and the flexibility which is the hallmark of their men and materiel, should be accorded a much higher priority than ever before if our forces are to prevail against the sort of determined and resourceful foes they confront. AirLand Battle postulates outthinking a wily and powerful adversary, literally gaining advantage through mind-power over a numerically, and possibly qualitatively superior foe. But the mind of a higher-echelon commander is no more sentient than his C^3I system's ability to put actionable information between his ears, and no more agile than its ability to communicate his orders and follow-up on their execution. Executive-level and Senior level commanders should be evaluated by the performance of their C^3I system at simulated combat tasks, to demanding standards of precision and synchronization, under field conditions.

Ergo, an Instrumented Tactical Exercise Without Troops for AirLand Battle.

* Note: For a recent testimonial, see Bolger, Daniel P., Dragons at War,Presidio Press, Novato CA, 1986.

What should interest BDM is that the Army, despite its obvious requirement for ways to train and evaluate Executive-level leaders and higher-echlon staffs, is not exploring any mechanisms other than computerized math-model drivers for command post exercises. Moreover, the vision of the Joint Chiefs of Staff and the U.S. Readiness Command seems similarly focused.

BDM has the expertise, experience, and technological capability to devise an alternative to both large maneuvers and automated CPXs: a major field exercise which deploys "blue" command posts and communications in full strength down to battalion level. Subordinate units of company size or less would be represented on the ground by one light vehicle, and single aircraft would execute missions assigned to flights. These "subunit-surrogates" would be tracked by instrumentation such as MAFIS, or that sought for the National Training Center upgrade, or by transponders linked to a USAF E3A, or to another "eye in the sky". The "red" situation would be played on a battle simulation model, and portrayed to the "subunit-surrogates" via voice message or graphic display, or direct to sensors where indicated, or to participating headquarters by controller message. Combat results would be adjudicated by the models --the most accepted function of battle simulations --and suitably portrayed.

BDM can readily put the foregoing together: it assuredly has the modeling experience to qualify it as expert in battle simulation; it knows equally well engagement simulation, the National Training Center and its USAREUR counterpart; it is an acknowledged authority on ALB and its implications for C^3I within higher echelons; it has worked with TACSIM and other aspects of sensors and sensor stimulation and/or spoofing; its Mobile Army Field Instrumentation System for Fort Hood places it in the forefront of designers of transportable field exercise instrumentation. In short, BDM is uniquely positioned to propose to the Army cooperative design of, and field support for, an Instrumented Tactical Exercise Without Troops for AirLand Battle (ITEWTALB), which capitalizes on not only the Army's existing and foreseeable progress in both battle simulations and engagement simulation instrumentation, but also BDM's proven capabilities as a systems integrator.

The advantages of ITEWTALB over conventional field training exercises would be as follows:

(1) Exercise area large enough to accomodate "deep attack" and bold maneuver over long distances, as contemplated by ALB.

(2) Sound field training and evaluation for the entire C^3I system possible.

(3) Realistic time and space factors constantly present.

(4) Tactical and operational commanders contend with weather and terrain as they would in war.

(5) Results of fire and maneuver more accurately portrayed for commanders and staffs, and simulation of electronic warfare, chemical warfare, employment of nuclear weapons, and tactical catastrophe much facilitated.

(6) Combined ITEWT feasible; allied participants do not need American hardware or software.

(7) Chances of serious maneuver damage and accidents, or of deliterious environmental impact, significantly reduced --participants could utilize state and national forests, and "maneuver" through agricultural areas and villages without damage or civil interference.

(8) Avoids heavy O&M costs and damage claims associated with using large amounts of tactical equipment for force portrayal.

Sketched below is an approach BDM might take toward designing an ITEWT for ALB.

Objectives
Principles of System Design
Major Control Subsystems
Illustrative Example
Proposed Actions

OBJECTIVES OF ITEWTALB:

-- To conduct a field exercise which trains and evaluates the Executive- and Senior-level leaders, and all the C^3I mechanisms of the Strategic, Operational and Tactical echelons within formations as large as theater army/army group, together with correlative U.S. Air Force elements, in actualizing AirLand Battle doctrine (NATO: Follow-On Forces Attack).

-- To minimize maneuver damage, accidents, and intrusion upon civil activities.

-- To draw upon the best of current technology to devise transportable instrumentation in the hands of expert controllers for an FTX which could advance readiness of joint forces in CONUS, and wherever U.S. forces are stationed abroad, combined forces as well.

-- To acquire empirical data on the functioning of higher echelon C^3I, both to improve existing battle simulations, and to assist in programming better battle models, and expert systems (or artificial intelligence) for future C^3I.

PRINCIPLES OF SYSTEM DESIGN:

-- Build ITEWTALB via evolutionary development; start exercises with whatever the customers have, then identify with them what they need to upgrade. Lease before buy, but if procurements are necessary, buy NDI, and accept an inexpensive 60% solution in preference to a 90% solution which is twice as dear. Start with minimal OPFOR representation on the ground or in the air, and add "red" participants where these promise high pay-off in exercise effectiveness.

-- Design around functional requirements. Find ways to get the training job done, as opposed to ways of using specific hardware or software. Accomodate unique combinations of materiel, concepts and procedures, which in any event will probably have to be tailored for locale and command, and if allies are included, be adaptable to their equipment and SOP.

-- Assure maximum realism for the primary participants, the commanders and staffs of the "blue" force from battalion rearward.

(1) Rule out any participant's performing duties outside wartime missions; in particular, foreclose their acting simultaneously as exercise directors or controllers.

(2) Require participants to use their own C3I as they would in war.

(3) Draw subunit-surrogates from each primary participant in sufficient numbers to represent at least company-size elements on the ground and aviation flights in the air, allowing for finer-grain representation where exercise objectives require same. Subunit-surrogates should preferably be commanders/leaders of the outfits they portray, should be enabled to communicate with their superior as they would in war, and should be mounted in a light vehicle or their own type aircraft. N.B., ITEWTALB will be an effective, but insufficient simulation for these subunit surrogates, who will continue to require engagement simulation and other exercises to build collective efficiency within their units.

(4) Expect participants to provide logistic support for attached controllers.

-- Obtain controllers from non-participating units whose mission is similar to that of the primary participant being served.

(1) Controllers should be equipped with their own communications and transportation, independent from those of participants. Controller equipment may be commercial, and should be as light and small as possible, consistent with mission.

(2) All controllers should be provided access to the disposition and status of both sides as these pertain to the participant each serves.

(3) The controller organization should be staffed and equipped to stimulate or emulate friendly sensors, and otherwise to portray the enemy as the latter would appear to each participant echelon, including the subunit-surrogates, ground and air.

MAJOR SUBSYSTEMS:

-- ITEWT requires four major subsystems, each of which must function in concert with the others.

(1) **The Participant Positioning Subsystem**: means of locating each participant with sufficient precision to array accurately the blue force within the Battle Simulation Subsystem, and thus to permit appraisal of force-on-force engagements, and the effects of enemy (or friendly) EW or munitions. Available means include MAFIS, coded beacons or transponders which interact with an E3A display, LORAN or other navaids which transmit position, or simply voice or graphic transmissions from accompanying controllers.

(2) **The OPFOR Subsystem**: one or more teams of Controllers thoroughly familiar with Soviet doctrine, force structure and capabilities, who are well prepared to operate according to our best understanding of Soviet behavior, and who manipulate the OPFOR within the Battle Simulation Subsystem. These Controllers might usefully be provided by contractor so that the ITEWTALB would be somewhat the same from theater to theater, and the Controller critique and feedback to participants thereby advantaged. The OPFOR Subsystem could, to meet specific exercise objective, include both "red" Subunit-surrogates to portray threat arrays for "blue" sensors, and "red" Sensors to evaluate "blue" camouflage, dispersion, emission control, and other counterintelligence measures. OPFOR Controllers would input "red" decisions direct to the Battle Simulation Subsystem.

(3) **The Battle Simulation Subsystem**: one or more combat models which obtain "blue" arrays from the Participant Positioning Subsystem and "red" arrays from the OPFOR Subsystem, and indicate the results of reconnaissance, the effects of fires, and the outcomes of engagements. This Subsystem would also function as a record of the exercise for use in evaluation, feedback to participants, and post-exercise training. Such a record of an ITEWTALB, involving C^3I accomplishments in real time and space, could also be useful in validating or improving the models used for battle simulation. While the best model(s) available should be sought, one model

which embraces all the echelons envisioned for ITEWTALB does not yet exist. The Battle Simulation Subsystem will have to compensate for lacunae which probably exist among macro-models like the Joint Exercise Support System (JESS) and the Joint Theater Level Simulation (JTLS), and fine-grain battle simulations capable of portraying combat at the company and battalion level. Man-in-the-loop graphic interfaces and/or improvised automation will be necessary. A coherent family of models, or a single catholic model should ultimately be sought.

(4) **The Blue Controller Subsystem**: a hierarchy of teams trained in using the foregoing subsystems and in observing and reporting upon the performance of the exercise participants. One function of the Controllers will be evaluation and provision of feedback to participants; again, in the interest of authority and continuity, it would probably be useful to obtain especially well-qualified Controllers, especially senior Controllers, via contract. Communications will be critical to the control function. While participants should employ only their tactical communications, controller communications should exploit the latest technologies for transmitting information efficiently to all parts of the controller system. Especially important will be means for transmitting in real-time the changing micro-situation to the controllers of Subunit-surrogates, preferably in graphic forms which will facilitate the latter's reacting to the depiction as each might to real events, and reporting appropriately up his chain of command. While fully automated data links might be a desideratum, as might multiple-subscriber radiophone equipment to obviate wires, more immediately available and less costly means like voice-channel freeze-frame video should be used, at least initially.

ILLUSTRATIVE EXAMPLE.

The following narrative is futuristic, but descriptive; its intent is to show how ITEWTALB might come into being, and how it might work.

In early Fiscal Year 1987, Commander, TRADOC received an unsolicited proposal from BDM proposing a novel form of large-formation maneuver entitled "ITEWTALB." BDM was well known to TRADOC, and had an excellent reputation for its work with training and training management. Moreover, BDM was respected throughout the Army specifically for its work on both engagement simulation and battle simulation, and for instrumenting field exercises. So TRADOC-6 read the BDM proposal with interest, and tasked his subordinates to explore it constructively.

The proposal was well-timed. The U.S. READINESS COMMAND was looking for ways of fulfilling its mission of joint training and evaluation for readiness, and the new Chief of Staff of the Air Force was anxious to extend Army-Air Force cooperation along the lines promised by the AirLand Battle doctrine. Commander, TRADOC, discovered that

there was not only interest among his colleagues, but money as well, and he successfully proposed a cooperatively funded, joint development program to expand the Joint Warfare Center concept to embrace ITEWTALB.

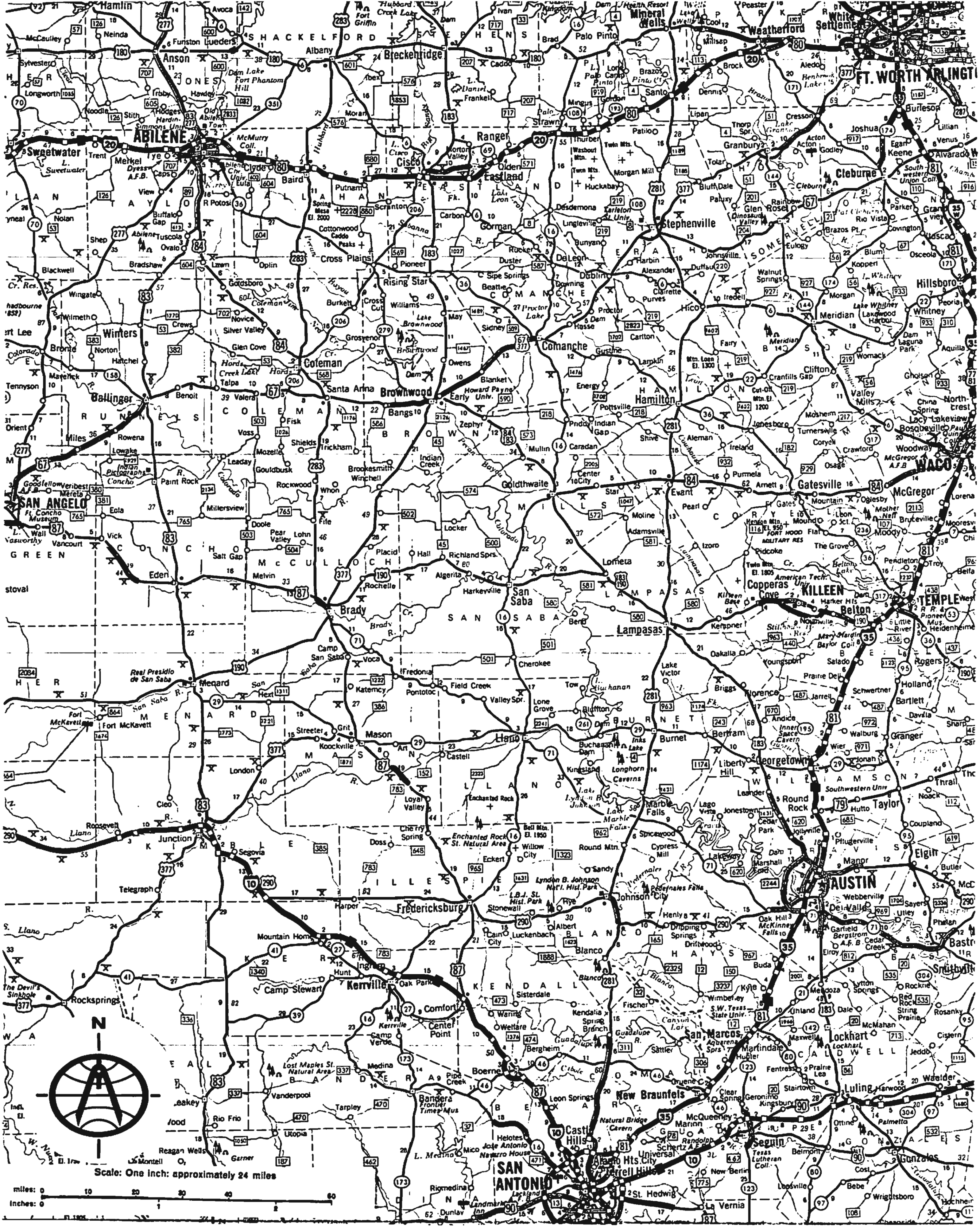
At first it seemed that the project, as BDM proposed it, would be slow in materializing, because the models available to the JWC, JESS and JTLS, would not admit of portraying company-level combat. But BDM showed JWC how it could use one of the Army's battalion battle staff simulations, such as BABASS, in conjunction with JESS, not by direct data transfer, but with a manned graphic interface within the OPFOR Subsystem. BABASS input terminals were placed in view of a JESS output display, so that controllers could transfer a portion of the JESS red situation into each BABASS situation as red forces entered its sentience --pre-plotted on the JESS display. BABASS was simultaneously being fed by controllers with blue data derived from the Participant Positioning Subsystem. BABASS outputs were then transmitted over scrambled voice nets to controllers accompanying Subunit-surrogates via video frames "grabbed" direct from the BABASS workstations.

Then it appeared that there might be difficulty in breaking into the tightly planned and already funded training activities of the services, especially in the Army, since FORSCOM had received significantly fewer O&M dollars than it had requested. But the Commander, III Corps, indicated that he would be willing to scrap a number of other exercises in the interests of trying ITEWTALB, and rounded up Air Force counterparts who were willing to do likewise. With those proponents, reprogramming became practicable, and dates were set for the exercise.

III Corps proposed, and other participants agreed, that the maneuver area would encompass Fort Hood, and an area extending some 100 miles to the north and west, a quadrilateral with Kileen, Mineral Wells, Abilene, and San Angelo at its angles. With FAA approval, a temporary restricted air space was established to cover the period of the exercise.

A scenario was agreed upon, which had it that a Soviet field army concentrated between San Angelo and Abilene, beyond an international border (Highway 83), was ordered to advance southeast to capture Houston, and that III Corps --then in positions on or near Fort Hood-- was ordered, in conjunction with XVIII Airborne Corps, to defeat OPFOR west of Highway 81 (Interstate 35).

The Blue Controller Subsystem was built around X Corps, and 1st and 4th Infantry Divisions (Mechanized), supplemented with contractors. Rather than airlift tactical vehicles into Texas for these controllers, BDM sought sub-contractors by competitive bid to lease vehicles. A substantial part of controller communications was obtained the same way, including lease of imaging teleconferencing sets, and mobile, all-digital radiotelephone systems.


Hamlin
Anson
Abilene
Sweetwater
Merkel
Clyde
Baird
Albany
Breckenridge
Cisco
Eastland
Ranger
Mineral Wells
Weatherford
White Settlement
Ft. Worth
Arlington
Palo Pinto
Strawn
Granbury
Cleburne
Burleson
Stephenville
Comanche
Dublin
De Leon
Hico
Hamilton
Brownwood
Coleman
Santa Anna
Ballinger
Winters
San Angelo
Cross Plains
Rising Star
Hillsboro
Meridian
Clifton
Gatesville
Waco
McGregor
Goldthwaite
San Saba
Lampasas
Brady
Mason
Menard
Eden
Junction
Llano
Burnet
Georgetown
Round Rock
Austin
Taylor
Temple
Belton
Killeen
Copperas Cove
Marble Falls
Johnson City
Fredericksburg
Kerrville
Comfort
Boerne
San Antonio
New Braunfels
San Marcos
Seguin
Lockhart
Luling
Gonzales
Rocksprings
Bandera
Camp Wood
Leakey
Utopia
SHACKELFORD
JONES
TAYLOR
CALLAHAN
EASTLAND
RUNNELS
COLEMAN
BROWN
COMANCHE
ERATH
HAMILTON
McCULLOCH
SAN SABA
MILLS
LAMPASAS
MENARD
MASON
LLANO
BURNET
WILLIAMSON
KIMBLE
GILLESPIE
KERR
KENDALL
BLANCO
HAYS
CALDWELL
BANDERA
REAL
Scale: One inch: approximately 24 miles
miles: 0 10 20 30 40 50 60
inches: 0 1 2

Five days before STARTEX, OPFOR and Blue Controllers, some serving military, others civilians (including a number of retired military) assembled at Waco by commercial air, and went through training in their assigned duties, using the equipment that they would be dependent upon during the exercise, under the tutelage of BDM, the system integration contractor. On Day E-3, Blue Controller field headquarters were activated at key nodes in the Battle Simulation Subsystem, and manned by both OPFOR and Blue teams. The same day, data and voice links with the Joint Warfare Center were activated and tested. On Day E-2, controller teams were attached to the principal participant headquarters, and paired with the subunit-surrogates. On E-1, tactical warning of an impending OPFOR attack was received, and blue elements moved into their initial dispositions. At 0001, E-Day, OPFOR crossed the frontier, and blue commenced deep aerial reconnaissance, and cautious advances to contact on the ground.

The Air Force got in the first licks. A single F-16, flying an attack profile representing a flight of 4 missioned for a dawn attack of crossings of the Colorado River at Ballinger, encountered heavy SAM and gunfire, suggesting the presence of a sizeable armored force. Controller voice-tell related to the flight leader the narrative of his flight's progress --his loss of his wingman, severe damage to a third plane which turned back, the remaining pair's pressing on to target, delivering ordnance, and successfully regaining friendly airspace-- all of which he dutifully relayed back to his command center...

Then, acting on reports of armor columns advancing from Winters towards Coleman, other air attacks were launched, and the air war was on in earnest. But to farmers and shoppers, the air activity seemed not much different from what they were used to...

Nor was the appearance of Troop A, the point cavalry troop of the advancing III Corps, calculated to put a lump in the throat of any patriot: one jeep with two soldiers in field gear, followed by a rental van containing two other soldiers. Around noon on E-Day, west of Brownwood a group of curious patrons from a rural store rubber-necked while Troop A exchanged its first "direct fire" with the advancing Soviets. The two vehicles pulled into the parking lot in front of the store, and while the two drivers went for the Coke machine, the officer in the van showed the one in the jeep a 12-inch square screen on which the store appeared on the bottom of the screen, and the highway meandered up the center. Arrows and other symbols were along the road on the hillock a mile to the front, which, the controller said, represented tanks which had just opened fire, and a missle launcher which had just sent a near-miss overhead. One Troop A tank was burning near the gas station up the road, and an APC had been hit one hundred meters to its rear. What did the commander want to do?

The cavalryman quickly sketched a plan of action: deploy platoons on both sides of the road; have them seek to envelop the hillock, covered by fires from the third platoon in positions around the store. As he talked, the controller drew on his map with a grease pencil, and while the cavalryman reported to his squadron

headquarters, the controller transmitted the marked map to controllers interfaced with BABASS. Within five minutes a return graphic was on the screen, and further decisions were sought from the cavalryman: there were a lot more OPFOR tanks out there, and he had lost four more vehicles; what now?

To the onlookers, it seemed pretty mundane --just men hunched around a portable TV, talking shop. Hardly the excitement media reports had seemed to promise. None of the civilian observers could appreciate that one of the antennae mounted to the van on suction cups was sending a coded signal to a distant Air Force E3A, part of the Controller Subsystem, conveying the location and status of Troop A, automatically displayed in key controller headquarters. A single helicopter roared by, a bit lower than normal, but not much.

The squadron had diverted a flight of attack helicopters from another mission, and these saved Troop A from headlong attack by the advance guard of a tank regiment. On orders from squadron, the troop commander pulled back to the outskirts of Goldthwaite. Corps prepared an MLRS delivered minefield for his front, and a second troop hurried forward to reinforce: the III Corps Covering Force was going to fight for Brownwood...

On E+1, 2d Armored Division was establishing defensive positions, with one flank on the Colorado, and the other refused, north of Goldthwaite. Battalion commanders were out reconnoitering with their company commanders, while their staffs scrambled to assimilate the flood of reports coming in about the fighting to northwest. Divarty was stockpiling ammunition on position, and preparing to meet a deliberate OPFOR attack with a rate of fire of 275 rounds per tube per day. Since the III Corps Commander had early asked his Deputy Senior Controller --a retired officer who had been a Corps Commander in Germany-- to critique this scheme, the Subunit-surrogates included truck platoons, and the Controller Subsystem was tracking the putative flow of ammunition from the Corps ASP near Waco forward to the battery positions, and was prepared to account in detail for its ultimate disposition...

At III Corps Tactical Command Post on E+3, the staff was sore beset in absorbing all the information arriving through the numerous portals to higher, lower, and adjacent units. And the Corps Commander, as the fog of war settled in --the 2d Armored being flanked, severe jamming reported in 1st Cav, heavy air strikes on his Main CP, only sporadic communications with his Rear-- had reason to be thankful that this was a scrimmage, and not the Big Game....

On E+4 the Command Sergeant Major of 1st Brigade, 1st Cavalry Division stood beside a tank trail on Fort Hood with a group of his battalion command sergeants major, observing a column of armor moving in from three days of field exercises. The brigade was due to go to the NTC in two weeks, and the Colonel had charged his CSM with continuing the preparations in the absence of the Brigade's officers. The CSM was vocally critical of the handling of the march back to garrison, but the battalion CSMs knew from his demeanor that he was pleased and proud of the way they and their First Sergeants had

handled the drills, especially the teamwork in minefield emplacement, clearing, and crossing which the Colonel had wanted stressed. They had accomplished what they set out to do, even though for many of their NCO's, it had been the first time that such responsibilities had been thrust upon them...

On E+9, as III Corps' counteroffensive devolved into a mopping-up of Soviet remnants, the Controllers declared ENDEX, and promptly conducted the second of three after-action reviews --the first had been on E+4, just before the Corps moved out of its defense into the attack, and the final AAR would be held some 30 days following ENDEX, accompanied by in-depth analysis of the computer records, and submission of a formal report. Following the ENDEX AAR, the controllers turned their equipment over to BDM. Some of the gear, together with selected contract controllers, would then deploy to Europe, there to help stage for USAREUR an ITEWTALB as part of REFORGER/AUTUMN FORGE...

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PROPOSED ACTION:

-- With BDM as system integrator, the services could translate the foregoing scheme into reality within 12-18 months. Absolute costs should really not be an issue, for programs exist for JWC, JESS, JTLS, BABASS, and for training exercises of lesser potential effectiveness. III Corps will be exercising its C^3I in some fashion, and probably no less expensively than outlined above.

-- **Therefore, BDM should proffer an unsolicited proposal to Commander, TRADOC, offering to support a three-month joint study of how it might be done, and what it would cost to demonstrate a III Corps/two division/Numbered Air Force ITEWTALB in Texas in the spring of 1988.**

-- Based on the proposed cooperative study, BDM would prepare a report which would describe options for each ITEWTALB Subsystem, with an analysis of associated cost and effectiveness. Specifically:

-- For the **Participant Positioning Subsystem**, the BDM report would:

(1) List possible principal participants and subunit-surrogates.

(2) Identify options for tracking these, and providing positional data to the Battle Simulation Subsystem.

(3) Furnish information on sources for requisite materiel and services, with cost estimates.

-- For the **OPFOR Subsystem**, the BDM report would:

(1) Identify the number and type of "blue" sensors, and describe options for addressing each to portray "red" forces, with associated cost.

(2) State options for "red" sensors for evaluation of "blue", with costs.

(3) Describe feasible OPFOR interfaces with the Battle Simulation Subsystem, with costs.

-- For the **Battle Simulation Subsystem**, the BDM report would:

(1) Inventory available models, identifying hardware and software, degree of definition for each echelon modeled, compatibility among models, interface options, and input/output methods, together with costs.

(2) Set forth criteria for evaluation, and describe evaluation methods.

-- For the **Blue Controller Subsystem**, the BDM report would:

(1) Prescribe manning and training for Controller Teams.

(2) Provide a design for Controller communications, listing nodes, requirements for each, and options for meeting requirements, with cost and effectiveness analyses. (3) Describe options for providing other requisite materiel and services, e.g., transportation, shelter, utilities, from commercial sources, with estimated costs.

-- For the proposed ITEWTALB in Texas, recommend a set of the above calculated to meet training objectives at least cost.

-- Sketch concepts for applying the same methodology in Europe and Korea, taking into account allied participants.

-- Propose that, with Commander, TRADOC's approval, the project would proceed on the following schedule:

Phase	Action	Time	Deliverable
I	Concept Developed	2Q,FY 87	Above
II	Develop Prototype	12 mos	Set up ITEWTALB I
III	Test Prototype	3 mos	ITEWTALB I (Texas)
IV	CTEA of ITEWTALB	3 mos	Brief CTEA, Draft RFP
V	Army release RFP for 5 Yr Contract	3 mos	

APPENDIX 1

JESS

Joint Exercise Support System

OVERVIEW

The Joint Exercise Support System (JESS) is a computerized battle simulation system. It is designed to drive a Joint Readiness Exercise (JRX), which is a joint task force command post exercise (CPX). The heart of the system is an interactive computer model of military field operations. Simulated battle results from JESS are used in real time to provide realistic data to train commanders and staffs in JRXs. This system replaces the manual battle boards that have been used previously in training exercises.

JESS fulfills three major requirements as an exercise driver:

1. Realistic combat effects, combined with the operative aspects of logistics, maintenance and other real-world functions, are coordinated within the model and provided to commanders and staffs being exercised. JESS provides the same information that they would receive from units engaged in actual combat.

2. Efficient exercise control is obtained through the computer simulation. The automated system replaces the labor-intensive manual map boards currently used and gives the Senior Controller tighter control over the exercise.

3. Enhanced post-exercise analysis can be realized by utilizing the automated system to more effectively gather, consolidate, and manage the large amounts of data involved.

A prototype corps-level system is installed and operating at Fort Lewis, Washington. Although JESS is still in the development phase, it will support the I Corps exercise CASCADE PEAK III in November, 1985. For this exercise, JESS has been configured to train a 3-division corps with an Armored Cavalry Regiment (ACR), a separate brigade, and supporting air units.

USE OF THE SYSTEM

A CPX using JESS includes three interacting groups: Blue force controllers, command post personnel undergoing training, and opposing force (OPPFOR) controllers.

The Blue force controllers operate the Blue workstations, interfacing with the combat simulation via the workstation input devices, printers and graphics. The controllers also interface with the command post via unit organic communications. The controllers act as subordinate unit commanders, translate (when necessary) and enter command post orders into the combat simulation, and interpret and communicate combat simulation outcomes back to the command post. The ability of the controller to portray a combat environment through his reports and responses to orders provides a key element in the realism perceived by the command posts.

The command post units staff their respective tactical operations centers, execute operations plans, and respond to contingencies by communicating with Blue force controllers, who represent their subordinate units.

Under the direction of the Senior Controller, the OPPFOR controllers also interact with the combat simulation. They manuever and control Red forces to provide active opposition to the Blue forces in a way that contributes to the training objectives of the exercise.

The entire exercise is coordinated by the Senior Controller, who monitors and controls the flow of battle so that exercise objectives are met. He is supported by technical controllers who have direct access to the combat simulation software that allows them a measure of intervention over simulation outcomes. Further control over the simulation depends on controller discipline and role-playing ability.

THE SYSTEM

JESS utilizes a network of mini- and microcomputers. This network contains a central processor in which the simulation program runs, and an array of workstations (currently 30) for user (controller) input and output. Each workstation comprises:

Two video terminals for order entry and report display

A graphics display of unit locations and status

A printer for hard-copy printouts of reports.

The JESS simulation program is written in SIMSCRIPT II.5; workstation and network software is written in the C language.

The software in each workstation controls the graphics and provides a menu-driven user interface to the combat simulation in the central processor. It also maintains a copy of the ground-truth data base and services the network communications channel.

The central processor software controls the network, performs the combat simulation, and broadcasts ground truth. Functional capabilities of the combat simulation are outlined in the "Model Capabilities" section at the end of this paper.

The operational JESS is complemented and supported by additional programs that are used in unit data base preparation, terrain data base preparation, exercise operations, and system testing.

Workstations are apportioned as follows:

1. At corps level
   --A corps fire support workstation representing the units of corps artillery
   --A corps combat support workstation representing the nondivisional units of the corps, except for those of the Corps Support Command (COSCOM)
   --A corps admin/log workstation representing the units of COSCOM.

2. For each division
   --Brigade workstations representing the headquarters and manuever battalions of the brigade
   --A division fire support workstation representing the units of division artillery
   --A division combat support workstation representing the other units of the division except those of Division Support Command (DISCOM)
   --A division admin/log workstation representing the DISCOM's subordinate units.

3. For OPPFOR controllers
   --Manuever/fire workstations
   --A tactical air workstation
   --A control/log workstation.

4. To assist in overall control of the exercise
   --A theater logistics workstation
   --A Blue tactical air workstation
   --A Senior Controller workstation.

MODEL CAPABILITIES

Model capabilities for JESS version 1.0 are summarized below. This version will be completed in the Fall of 1986, including items noted by an asterisk, which are now under development.

SYSTEM UTILITIES
- -Checkpoint/Restart/Replay
- -Senior/Technical Controller Functions
- * Move a unit to any location instantly (partially operative now)
  - Change a unit's logistics status instantly
  - Change game-time/real-time ratio

TERRAIN/ENVIRONMENT REPRESENTATION
- -Based on 3-km hexes
- -Hex interior characteristics: mobility, trafficability, urbanization, vegetation, average roughness, and average elevation
- * -Hex edge characteristics (barriers): roads, rivers, engineer barriers (partially operative now)
- -Three global weather states and day/night
- -Targets: runways, bridges, choke points

GROUND COMBAT
- -Ground unit representation
  - Unit of resolution is nominally battalion
  - Unit located at a point
  - Unit "occupies" an entire hex
  - Unit has individually ranged weapons (combat systems)
  - Unit has mission and posture, combat and combat support systems, supply status array, 70 to 80 additional attributes
- -Organization for combat allows real-time task organizing
- -Movement may be time- or distance-optimized
- -Units automatically change posture based on combat power threshold values
- -Units are "in combat" when in adjacent hexes and appropriate postures
- -Direct fire attrition is heterogeneous Lanchester (combat system type by combat system type, deterministic or stochastic)
- -Attrition coefficients depend on Red/Blue, day/night, weather, and combatant posture
- * -Casualty rate affected by terrain characteristics, POL and ammunition status, and engineer effects
- -Indirect fire may be Lanchestrian or explicit probability of kill
- -Ammunition types include HE, DPICM, chemical, nuclear, and FASCAM
- -Artillery is vulnerable to counter-battery
- * -Engineer functions include
  - Create/breach point/linear obstacle
  - Create/install/repair bridge
  - Create/clear/breach minefield
  - Create fortifications

TACTICAL AIR
- * -Sortie rate constrained by surge rate, maintenance, refuel/rearm delay (partially operative now)
- * -Controller may control launched mission target change, TOT change, mission type change
- * -Controller may cause deploy, disperse, divert, flush, recall, manual CAP/DCA pairing, automatic QRA of DCA/CAS, mission package creation
- -Air/ground includes: air-ground attack, armed RECCE, and close air support
- * -Electronic combat includes: ECM escort, stand-off jamming, AWACS effects
- * -Airlift/airdrop

ARMY AVIATION

* -Multiple flight profiles
* -Operations
  - Attack helo - reinforcing, targeted
  - Reconnaissance/surveillance
  - Lift
  - Aerial mining

AIR DEFENSE

* -Acquisition radars cue air defense sites
* -Acquisition radars and fire control radars have emission signatures
* -Terrain masking affects acquisition probability
  -Positive weapons control
* -BDA is stochastic, depends on weapon/target type, target flight profile, terrain masking

LOGISTICS

1. Supply

* -Supplies may be stored in unmanned supply dumps
  -Consumption may be daily, per person per day, or as-used
  -Track all supply classes except II & VI
  -Supply classes subdivided into categories
  -Convoys are detectable by enemy ground units and armed RECCE air missions; vulnerable to ground units, artillery and air attack missions
  -Convoy trucks and supplies subject to attrition
  -Blue convoys created, diverted, or cancelled
  -Red convoys managed by push and push-delete orders
  -Red convoys automatically generated as supplies are consumed
  -Combat unit supply management
    - Draw supplies (blue only)
    - Change non-TOE level
    - Crosslevel

2. Maintenance/medical (Blue only)
   -Battle and non-battle equipment damage/casualties
   -Random repair/medical actions to damaged equipment/casualties

* -Assign crew casualties
  -Direct and general maintenance/medical facilities
  -Track each equipment item under repair

3. Personnel

* -Personnel management mechanism
  - Associate crews with equipment
  - Generate personnel daily summary report
  - Personnel identified by CMF, MOS

TACTICAL INTELLIGENCE

-Controller capability
- All Red and Blue units visible
- Visual display of weighted strength, orientation, location of all units
- All Red and Blue control lines and targets visible

* -TACSIM Interface
  - Transmit from JESS to TACSIM using TACSIM message format and communications protocol:
    - Red unit location and status
    - BDA-to-Red units
    - Blue RECCE mission sensor on/off times, cancel/in-flight kill

SUMMARY

The Joint Exercise Support System is being developed for the United States Readiness Command by the Jet Propulsion Laboratory. This development began in 1983 and refinement is planned to continue for several more years. System integration and testing began in September 1984 and continue as more functional capabilities are added to the system.

A corps-level system has been installed and tested at I Corps headquarters, Fort Lewis, Washington. I Corps is providing the test bed for JESS where most of the functional validations are conducted. To date, four functional validations have been conducted prior to its first use at an exercise--CASCADE PEAK III.

The first use of JESS to drive a U.S. REDCOM exercise is planned for BOLD VENTURE 87. Beyond BOLD VENTURE 87, a number of major new functions will be added, including air and ground combat enhancements, engineer effects, multicorps play, and amphibious and naval/maritime operations. When completed, JESS will be capable of driving joint exercises relating to most conventional missions of the unified commands.

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