The Future of Tactical Engagement Simulation

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Notes for: The Future of TES

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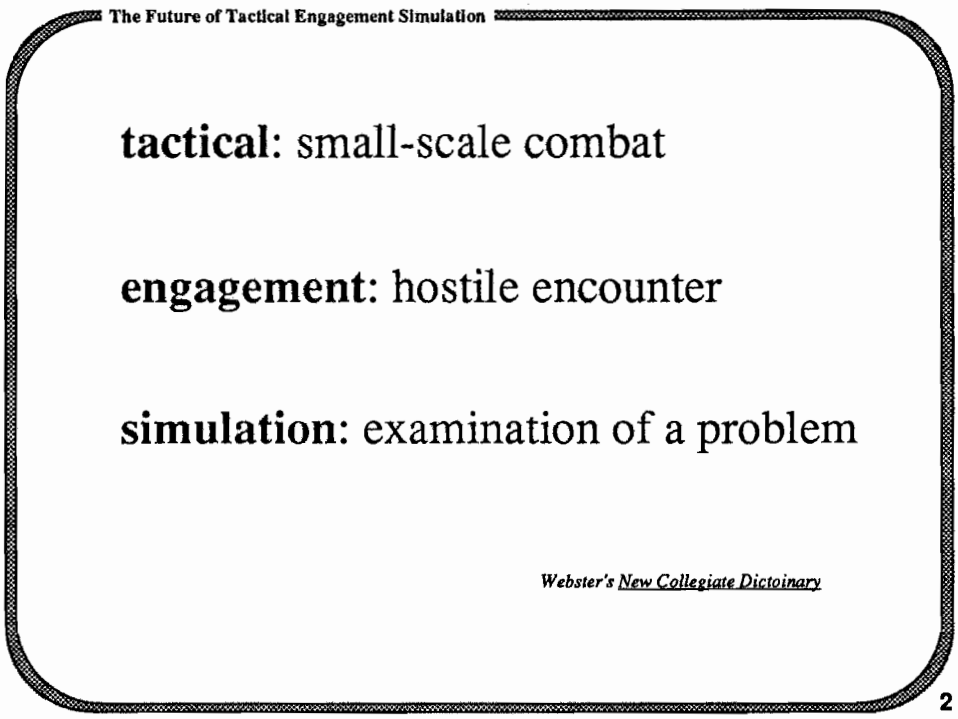

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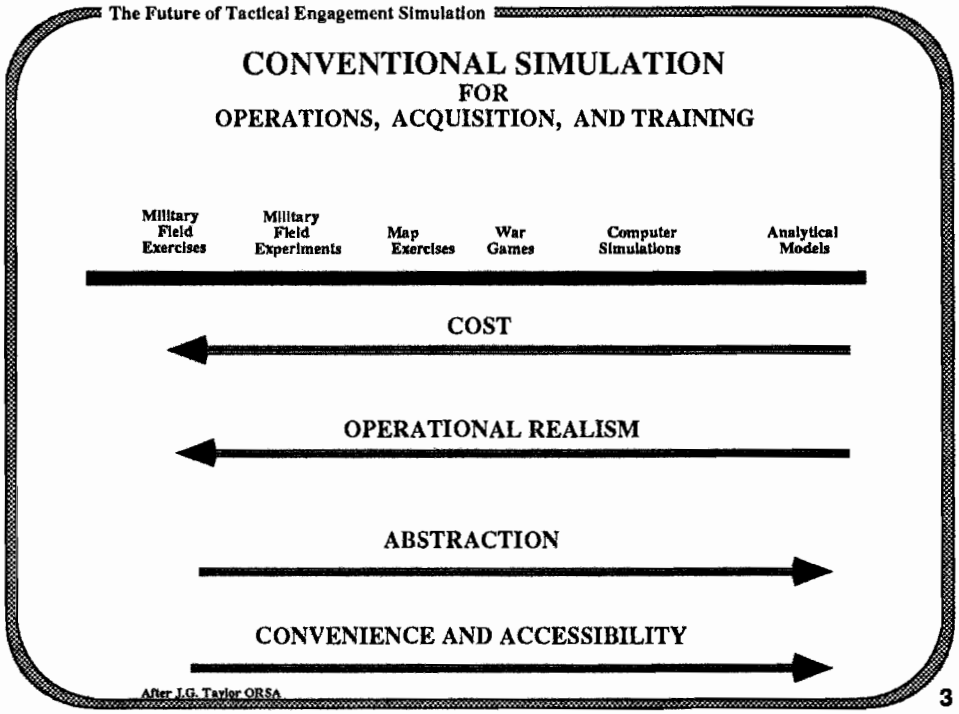
There is consensus in the Pentagon, among military and civilian leaders alike, that one of the prime ingredients of victory in DESERT STORM was **superior training**. Further, despite pending reductions in force structure and annual operating funds, each service is determined to continue those training activities it regards as particularly germane to performing its mission in future operations. Thus, the Army has stated emphatically that whatever else may be cut back, its Combat Training Centers, like the National Training Center at Fort Irwin, California, will continue to operate. Similarly, the Navy has identified its "Strike University" at Fallon Naval Air Station in Nevada as its single most effective training undertaking, and the Air Force holds in the same high regard its "RED FLAG" exercises for fighter squadrons at Nellis Air Force Base. The Marine Corps views in much the same light the maneuver training for air-ground teams it conducts in California. Further, all four services, and the Joint Chiefs of Staff, in recent years have used computer simulations of military campaigns to train command groups, and to evaluate plans.

All of the cited training activities are forms of mock-combat, military exercises in which the engagement of opposing forces are simulated: **Tactical Engagement Simulation, or TES.**



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This a conventional view of simulations and models of war. It correctly recognizes that all forms of military training, if they attempt to portray the circumstances of combat, are a simulation. Even a rifle range is a simulation of a sort.

But this spectrum of simulation forms is no longer adequately descriptive.

What is new is the development of techniques --chiefly the outgrowth of the information technologies of the last twenty-five years-- for simulating the circumstances and outcomes of engagements at the weapon system level, and for recording these for careful review and analysis: Tactical Engagement Simulation (TES).

Tactical Engagement Simulation

constructive: TES portrayed by model; intellectual synthesis

subsistent: TES with real forces

virtual: TES that seems real; computer-generated forces

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TES exists in three distinct forms: **constructive** TES, in which the engagement is modeled, or described by a mathematical construct. Usually, constructive TES drives exercises for command groups. More recently, **subsistent** TES has been developed, in which simulators mounted on actual weapons have made possible field exercises with real-time casualty and damage assessment. Within the past few years **virtual** TES has been demonstrated by the Defense Advanced Research Projects Agency: exercises with the large-scale Simulation Network [SIMNET] for a thousand or so manned simulators of air and ground vehicles, separated by hundreds of miles, all projected onto a common synthetic battlefield generated by computers.

The Future of Tactical Engagement Simulation

Subsistent TES Payoff in Air-to-Air Combat:

Years	MiGs Killed	U.S. Losses	Overall Kill Ratio	USAF Ratio	USN Ratio
1965-68	110	48	2.29	2.25	2.42
1970-73	74	27	2.74	2.00	12.50

Subsistent TES Payoff in Land Combat:

"RESULTS SHOWED THAT [T.E.S.] TRAINING INCREASED THE ODDS OF WINNING AN OFFENSIVE MISSION BY:

30:1 FOR LIGHT INFANTRY PLATOONS [N=237]

15:1 FOR COMBINED ARMS TEAMS [N=58]

5:1 FOR REGIMENTS OR BRIGADES [N=428]"

Sulzen, 1987

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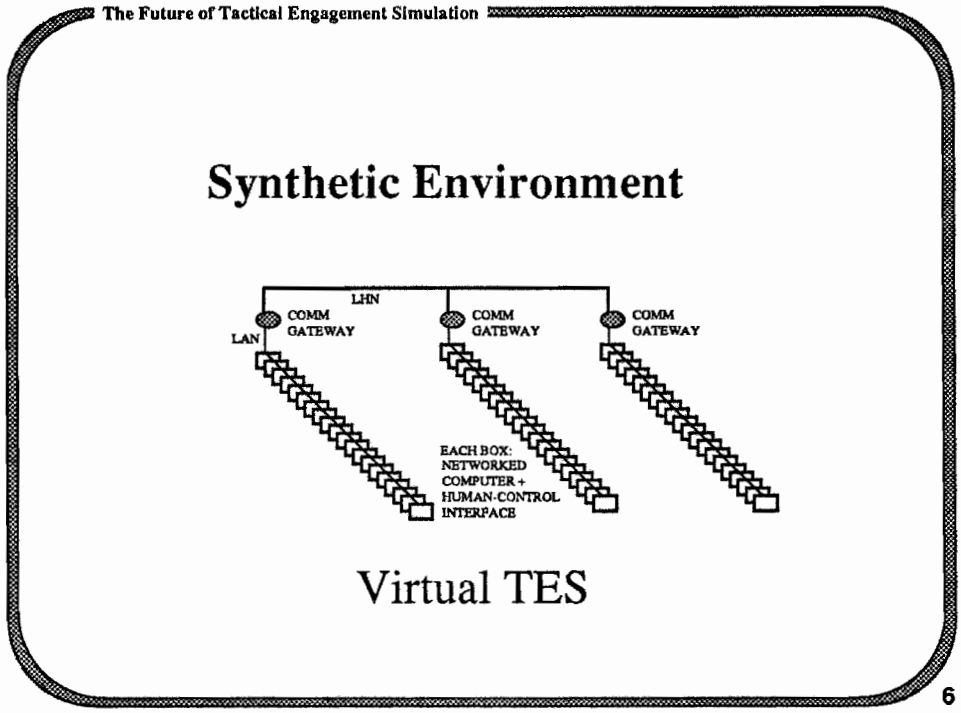
War in the air over North Vietnam proceeded in two periods: combats from 1965 to the partial truce of 1968, and those from 1970-1973. During the first period, the kill-to-loss ratio of U.S. Navy aviators was virtually identical to that of U.S. Air Force fliers: about 2:1. During the lull in the air war 1968-1969, the U.S. Navy started its TOP GUN program at Miramar Naval Air Station in California, a training program using TES in which trainees were required to dogfight instructors flying aircraft that emulated those of the North Vietnamese. TOP GUN graduates were salted into each fighter squadron deploying to Southeast Asia. Naval aviators believe that this well-trained elite brought about the improvement in engagement outcomes evident during the second period of the air war: the Navy exchange ratio improved by a factor of five; it is relevant that USAF aviators, often flying F-4 fighters like the F-4s of the Navy, did not improve their exchange ratio at all.

Beginning about 1973, tests of TES documented by ARI got underway. Typically, in such a test one group of participating units would receive conventional training -- that training methodology the U.S.Army then used in training individuals in its schools and training centers that emphasized doctrine, principles, terminology, and procedures, and used evaluation verifying observance of what had been taught. Each unit was allowed to use its best-reputed instructors for its training. They were then tested in performing a tactical mission, and rated against a comparable unit trained for the same amount of time using TES.

n 1987 an ARI researcher reported that hundreds of recorded exercises had demonstrated that TES increased the odds of successfully executing an offensive mission: (Sulzen 1987)...

As the analysts put it: "The results reported support the historical observation that small but well-trained and intelligently led forces can defeat larger but poorly trained and led forces." (Hart 1988) Subsistent TES offered the U.S. Army distinct advantage.



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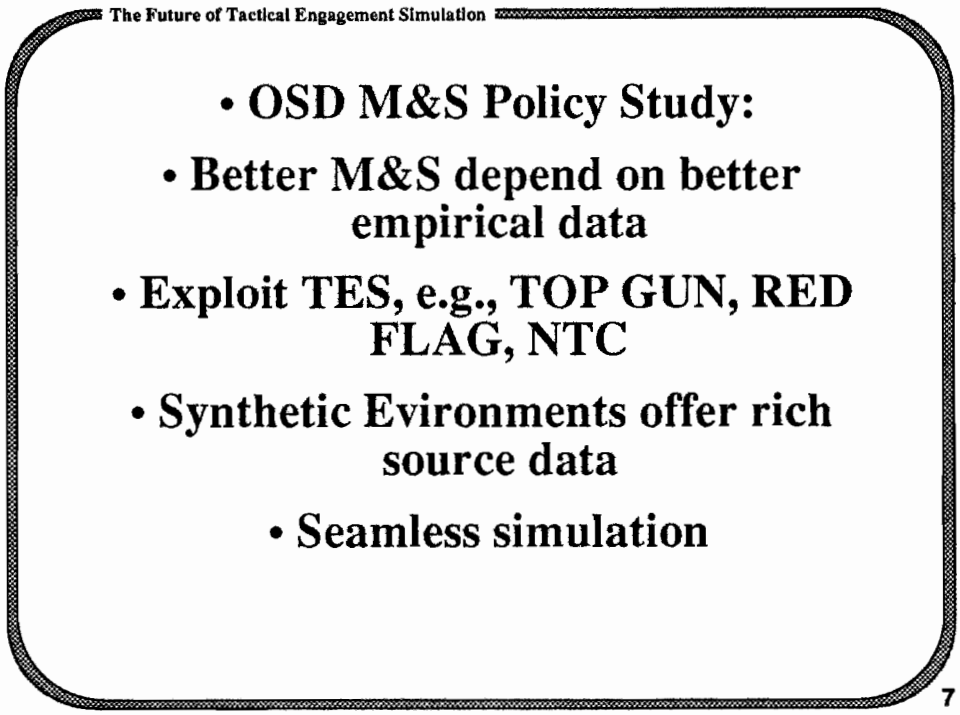
On April 23 of this year, Dr. Victor Reis, then Director of DARPA (now Acting Director of Defense Research and Engineering) testified before the Subcommittee on R&D of the House Armed Services Committee. He cited among the key technologies developed by DARPA "synthetic environments", the chief application of which within the Department of defense has been virtual TES.

"Synthetic environments are simulations created by computers, but with much more realism and depth than ever before. They are so powerful and convincing, that people become immersed in these articial realities. Once there, designers, system engineers, planners, and warfighters can operate more quickly, safely, and with less cost than in the real world. Most importantly, what they can do is qualitatively different. Syntheitc environments have become catalysts for fundamental change."

The principal demonstration of this technology is the Large-scale SIMulation NETwork, SIMNET, that has successfully represented over 1000 moving objects on a virtual battlefield, and has been successfully applied to land, sea, and air TES.



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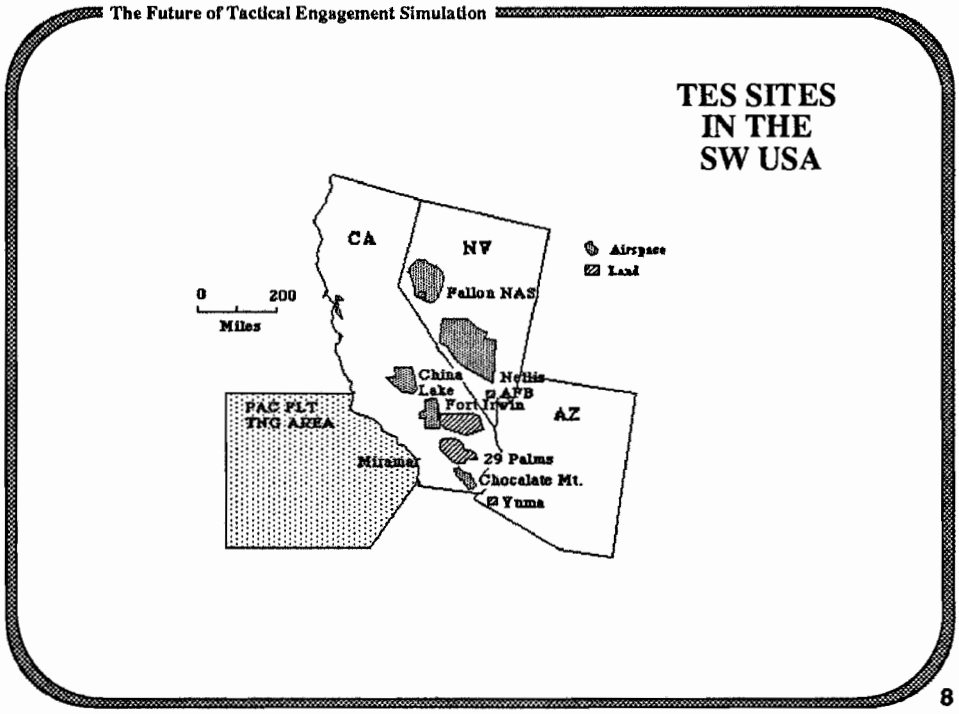
- The recent OSD Simulation Policy Study found that improvements in models and simulations should be predicated on observed behavior of combatants in actual warfare or its closest approximation, Subsistent Tactical Engagement Simulation (TES), such as TOP GUN, RED FLAG, and NTC. SIMNET/CCTT is Virtual TES.

- TES requires all the capacity for "tracking" individual fighting entities within a battle-environment demonstrated in SIMNET. Presently, Subsistent TES works with obsolecent instrumentation, but a technology transfer from SIMNET offers (1) significantly richer data; (2) higher cost-effectiveness; (3) much faster, smoother acquisition that present program could provide; and (4) cost-avoidance which would more than offset the R&D entailed in the technology transfer. Most importantly, SIMNET-like TES instrumentation would enable SEAMLESS SIMULATION--composite synthetic environments for acquisition, training or operations.

- Five technology initiatives are required: (1) means for unobtrusive interaction among TES forms, (2) distributed communications, (3) better instrumentation for subsistent TES, (4) individual portals into virtual TES, and (5) large-scale exploitation of TES-derived information.



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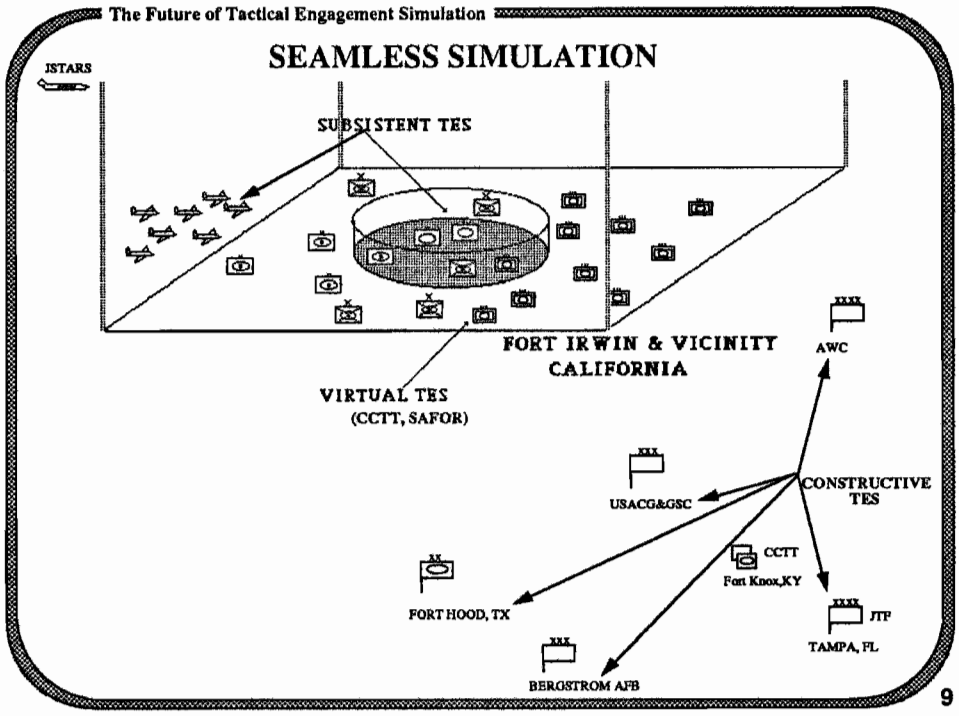
In the Southwestern United States, more land, sea, and air space is set aside for military purposes than in any other part of the world. The instrumented ranges, airfields, maneuver areas, and other training facilities already in use there, mostly for TES, constitute a strategic resource which deserves careful husbanding and thoughtful improvement. At the present time, these facilities are largely used for single-service activities. But should a common instrumentation system be devised capable of supporting subsistent TES throughout the region, extensive joint training would be immediately practical. In fact, the region could serve as a surrogate theater of war, wherein the several services could develop and hone techniques for projection of military power into any corner of the globe.

At subsistent TES sites, the communications problem may be eased by taking advantage of the long-endurance aircraft that are usually present over modern land, sea, or air engagements for the purposes of command, control, communications and intelligence --surveillance systems such as the E3A AWACS, the E2A HAWKEYE, and the Joint Surveillance and Target Acquisition Radar System (JSTARS), that proved their value in Southwest Asia.

In fact, imperatives for training with these systems require interaction among the forms of TES, for it is evident that it would exorbitantly expensive to flood a region with enough military entities to portray a theater's worth of surveillance targets. Rather, most targets for an AWACS or a JSTARS should be generated by constructive or virtual TES, with only a subset appearing from actual vehicles deployed for subsistent TES. The desideratum, however, is to simulate a full target array, for the modern problems with intelligence are less collection than analysis and dissemination.



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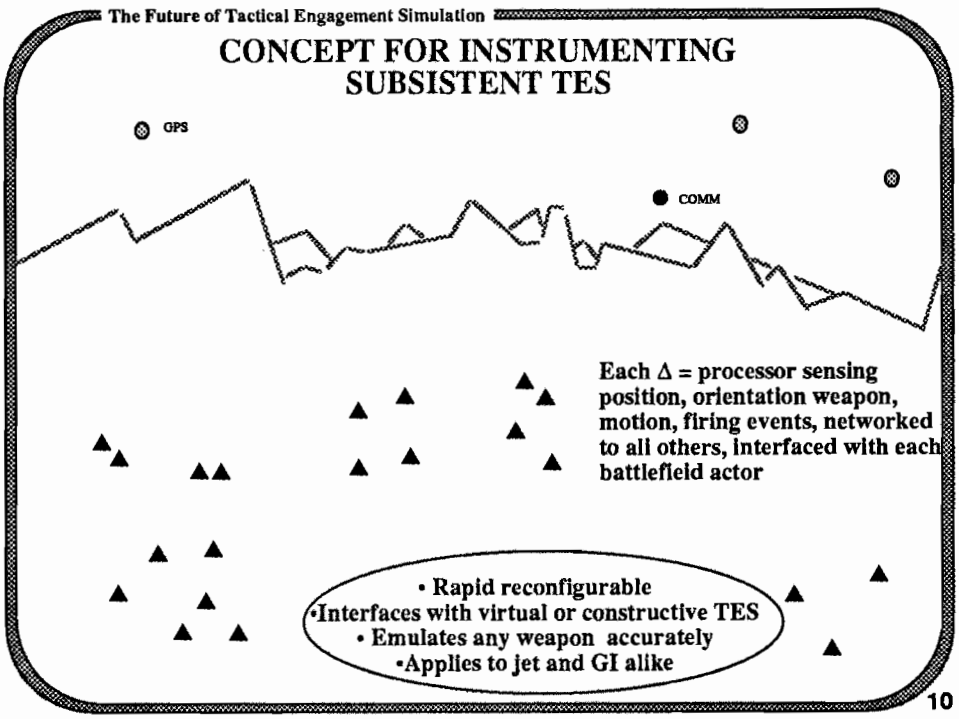
In the diagram, a subsistent JSTARS [with its radar "seeing" a mixture of subsistent and virtual objects] observes friendly and opposing forces engaged in TES in SWUSA. Units of friendly forces on the flank appears on the JSTARS screen generated from virtual TES, participants in which are manning simulators at the Armor School at Fort Knox, Kentucky. The JSTARS also "observes" the reserve units of the opposing force, generated from constructive TES, participants in which are located at the Intelligence School, Fort Huachuca, Arizona. The entire array of forces shown, plus others to in the "theater," are being directed by a corps headquarters located at the Command and General Staff College, Fort Leavenworth, KS, which interacts with higher echelons as shown.



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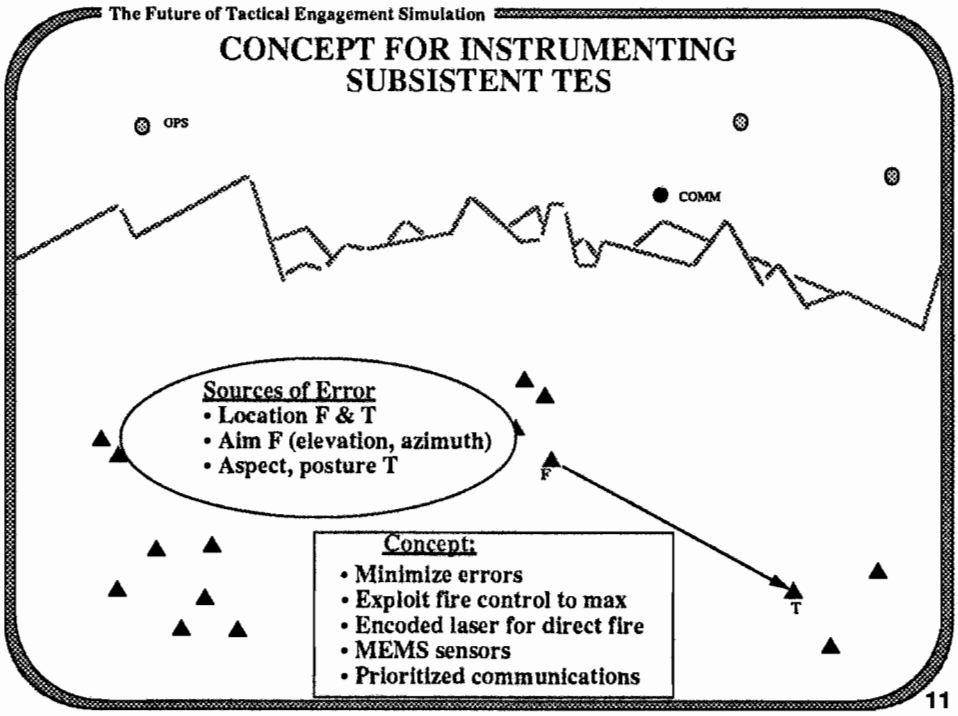
Existing instrumentation for subsistent TES, at the sites in the southwest and elsewhere, use fixed communications and buildings for housing staff, processors, and displays. It now appears possible to develop entirely transportable equipment, the key element of which would be a pod for each participant capable of (1) ascertaining precise, three-coordinate position; (2) sensing movement; (3) interacting with fire control systems; (4) processing information; and (5) communicating with other pods. The postulated pod would be comprised of a high-density parallel processor integrated with micro-electric-mechanical systems, interfaced to the degree feasible with computer(s) integral to the instrumented weapon. All pods might have a miniaturized Global Positioning System component, conceivably supplemented by a local emitter for higher precision. A pod for a dismounted combatant would be small, light and low powered: pocket-size. For a tank, it might be significantly larger, devised to extract substantial data from the tank fire control computer, and to sense where the machine guns were being aimed. For an aircraft, it would include micro-accelerometers. Taken together, these pods would comprise the Joint Tactical Engagement Simulation System (JTESS). The Chairman of the Joint Chiefs of Staff should sponsor the development to ensure that the service components of JTESS are able to support applications of JTESS to joint materiel acquisition, joint training, and joint operations.



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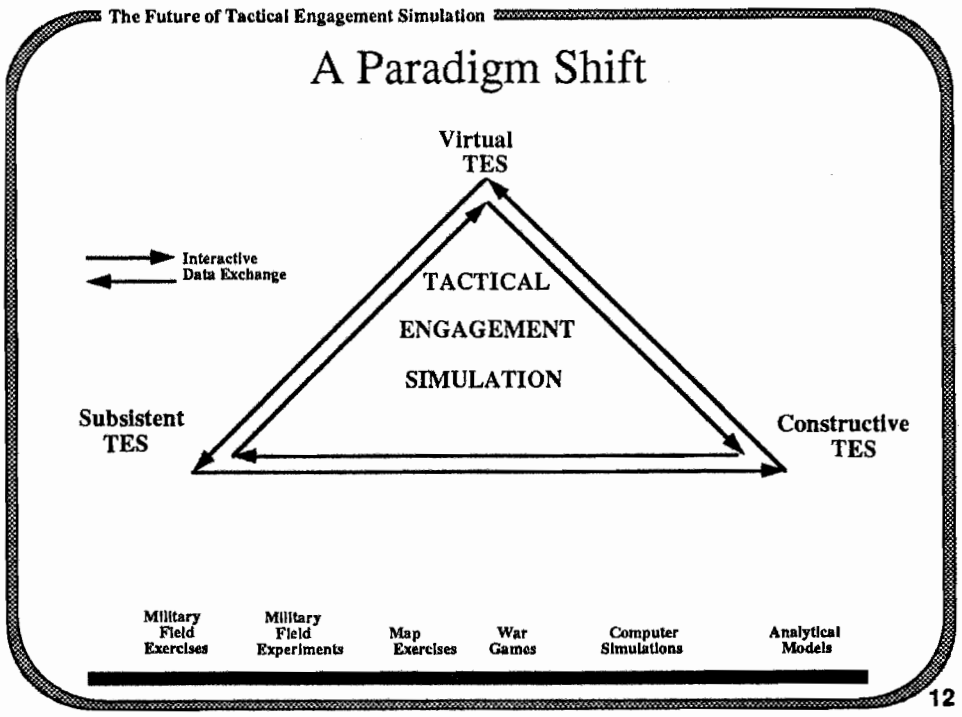
Just as it is desirable to instrument dismounted combatants in subsistent TES --up to now, not feasible-- it is important to enable dismounted combatants to operate within virtual TES. Forward observers for indirect fire systems, scouts afoot, shoulder-fired anti-armor and anti-aircraft weapons, and other individuals influence vehicles on the ground or in the air. Hence, it is important for DARPA to proceed with the development of the Individual Portal (I-Port) proposed for synthetic environments.



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The TES systems described above, interactive among all three forms of TES, and capable of supporting exercises of joint forces in a theater of war, could generate extensive amounts of data on human behavior and the performance of materiel. Difficulties have been encountered in learning from relatively primitive subsistent and virtual TES, and these difficulties are bound to be amplified in the proposed versions. But TES offers an unprecedented opportunity to probe the frontiers of knowledge on training, and on men and machines under stress. Decision to proceed with the technology initiatives proposed above should be accompanied by a determination fully to exploit TES.

The armed forces of the United States may soon be significantly smaller. But they need not be less capable. Through improved TES, they can be endowed with enhanced adroitness in battle, a deterrent to would-be aggressors, and a reassurance for allies the world around.