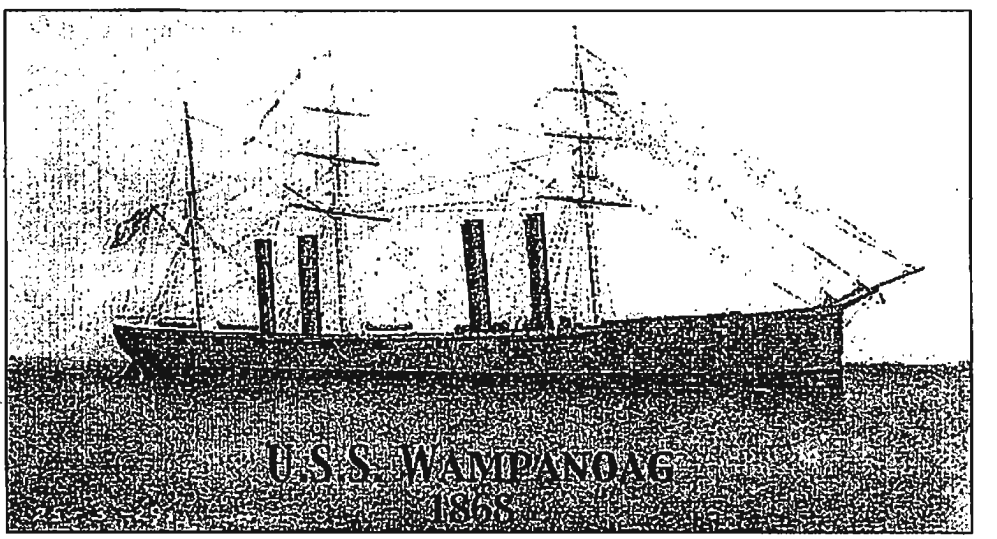
Gorman's Corollary to Murphy's Law

For the Army Science Board

Had I been asked to suggest preliminary readings for this event, I would have nominated Elting Morison's lectures of the 1950's and '60s, and his great uncle's papers, from the 1890s, published one hundred years ago. The younger Morison presented one of the more perceptive commentaries on the interaction of innovative technology with American military institutions, while the elder was, as far as I am aware, one of the first to observe that such transformation is inherently disruptive:

"...in many ways the new epoch must open as an era of destruction... both in the physical and the intellectual world, of old buildings, and old boundaries and monuments, and furthermore, of customs and ideas, systems of thought and methods of education...the danger is that the destructive changes will come too fast, and the developments which are to take their place not fast enough. The trouble will lie in the gap between the two. The next two or three centuries may have periods of war, insurrection and other trials, which it would be well if the world could avoid..."

The more recent Morison was impelled to undertake studies of the impact of disruptive technology by inventions that transformed the U.S. Navy from sail to steam, especially an initial step that he referred to as "the strange history of the steam vessel ***Wampanoag***."



Laid down in 1863 to meet the threat of Confederate commerce raiders, this warship set world records for sustained speed on her initial sea trials in February 1868. Her commanding officer, in his report on the trials, described her as "faultless," and "the fastest in the world." She was, moreover, one of the more heavily armed ships of that time.

In 1869, a newly appointed Secretary of the Navy convened a board of naval officers to assess all steam machinery afloat. Their report (U.S. Document 1411, 41st

Congress, 2d Session, 1869-70, Vol. One, Part One) enumerated several particulars in which ***Wampanoag's*** design departed from convention, including a criticism that under sails alone, she enjoyed no advantage over other cruisers. But in their perception, the ship's main drawback was that it could not serve the purposes of training. The ship was "a sad and signal failure, and utterly unfit to be retained in the service." To quote the further:

> Lounging through the watches of a steamer, or acting as firemen and coal heavers, will not produce in a seaman that combination of boldness, strength, and skill which characterized the American sailor of an elder day; and the habitual exercise of an officer, of a command, the execution of which is not under his own eye, is a poor substitute for the school of observation, promptness and command found only on the deck of a sailing vessel.

The Secretary sought a second opinion of two other officers who had been favorably impressed with ***Wampanoag's*** "steady," "efficient," and "easy" performance at sea, but these thought she should be substantially modified in that they believed that the Navy no longer had a strategic or tactical requirement for a vessel of such high speed and long range. Still another group of senior officers advised the Secretary against proceeding further with steel and steam noting that, while ironclads were absolutely necessary for war, given the availability of eastern timber to build more sailing vessels, risks could be accepted in the interests of the economy as a whole, and the livelihood of eastern shipwrights in particular.

Its innovations being too threatening, too disruptive to the naval culture of the times, ***Wampanoag*** was removed from service. Naval officers considered the perpetuation of sail propulsion essential to the Navy's future, and, anxious as most Americans to regain "peacetime," they no longer perceived a politico-military justification for advanced technology. In Morison's view, "The problem is not primarily engineering or scientific in character. It's simply human." The US Navy waited twenty years before there was in the fleet a vessel comparable to the **Wampanoag**, the USS ***Philadelphia***, about the same size and speed, but less well armed, albeit more heavily armored.

The lessons for our era are evident:

Technology can catalyze transformation, and frequently is a prerequisite for same, but it is rarely sufficient for transformation. In short, viewing transformation in terms of introducing new technology, without providing for its impact on service culture, is futile.

DTLOMS — the pronounced acronym is the Army's mantra for change — can constrain rather than liberate. Effective **D**octrine is consensual, **T**raining is the means of developing that consensus, **L**eadership and **O**rganization reflect both, enabling **M**ateriel is essential, and **S**oldiers are fundamental. But consensual views must be transformed from time to time to adapt to changed strategic circumstance, to exploit novel technology, and to draw upon the strengths of other services. Culture must not be allowed to inhibit significant advances in the combat effectiveness of America's forces no matter how disruptive the technology.

Problems with service culture persisted over the century and a half past, and they

have plagued recent transformations, including the one now underway. Two case examples from the U.S. Army's recent experiences with disruptive technology follow: (1) the introduction of Tactical Engagement Simulation, (2) C4ISR for Future Combat Systems.

The first example took place during the aftermath of the War in Southeast Asia. During the 1970s and 1980s, the training of the U.S. Air Force and U.S. Army evolved on strikingly parallel paths:

U.S. Air Force	U.S. Army
Flying hour program	**Army Training Program (ATP)**
Specified events	**Army Training Tests (ATT)**
Unit Desired Operational Capability (D.O.C.)	**Army Training Evaluation Program (ARTEP)**
Aggressor Squadrons	**OFOR Units**
Multi-threat Ranges and force-on-force exercises (RED FLAG)	**Tactical Engagement Simulation (TES) and Combat Training Centers (CTC)**

Yet it was US naval aviators that showed the other services the advantages of abandoning time-managed training for performance-orientation, and of expending the resources required to train against forces that used dissimilar equipment and tactics, and to instrument mock combat to keep track of behaviors that lead to a casualty.

While these changes of the '70s and '80s may not meet all of the Defense Department's present criteria for transformation, they were the product of a modest amount of inter-service cooperation, they did lead to new methods of warfighting, and they proved to be responsive to a wide range of threats. Yet it took the services nearly two decades — remember the Wampanoag — to bring about these changes, for they were openly opposed as more expensive and less effective than previous methods, as entailing a higher risk of accidents, and —in the Army, at least— being dysfunctional for good order and discipline in units. The Army's Tactical Engagement Simulation (TES) proved to be particularly disruptive technology: the essence of TES is an After Action Review (AAR) in which a dispassionate observer critiques, in detail and in an open forum, a unit's performance while contending with long odds in a tactical exercise against a wily opposing force. Senior officers and old sergeants were repelled by this procedure, and few other armies have been able to stomach such exposure to all ranks of leader-blunders, poor plans and faulty execution. In short, seniors opposed exposing their tactical shortcomings to juniors, and resisted the training technique.

Countering cultural antipathy usually requires "top cover," and in the Post-Viet

Nam ere, both the Air Force and the Army training transformations of had strong protagonists: e.g., General Bob Dixon of the Tactical Air Command at Langley AFB, VA, and General Bill DePuy of the Army's TRADOC at Fort Monroe both pressured peers and subordinates to suppress opposition and to expedite adoption of TES. Today the AAR is almost universally practiced, in training and in combat, even by Special Forces A teams in Afghanistan.

Army leaders, to show the efficacy of TES, conducted numerous structured experiments comparing units prepared by conventional training with similar units trained with TES. These trials demonstrated that TES improved odds of winning a force-on-force engagement in close combat by 49:1 for infantry squads, 30:1 for light infantry platoons, 15:1 for combined arms teams, and 5:1 for regiments or brigades. Moreover, the time and costs required to produce such advantages were patently much less than the time and funds needed to produce technology capable of exerting similar leverage upon combat effectiveness. Yet it still required nearly 20 years before TES was fully accepted.
[Cf.,Sulzen,R.H. and Whitmarsh, P.J. "Effects of Repetitive Training on Simulated Combat Outcomes for Rifle Squads."ARI paper presented at the American Educational Research Association Meeting, San Francisco, 29 March 1989.]

One measure of the teaching-power of the Army's TES is the literature it has evoked: books like J.R. McDonough's The Defense of Hill 781 and D.P. Bolger's Dragons at War are vivid descriptions of "battles" at Fort Irwin, CA, in the mid-'80s. Bolger has also written The Battle for Hunger Hill, a book about his experiences as a commander in two mid-'90s exercises at the Joint Readiness Training Center at Fort Polk, LA. At the JRTC Bolger learned that time was an important aspect of combat effectiveness, and came to disbelieve what the Command and General Staff College taught about how commanders ought to make decisions: he found the prescribed nine-step process of course of action analyses via commander-staff interaction was too time-consuming and laborious, and that planning time almost always exceeds any plan's operational relevance.

Circumstance	No. of CA Analyzed	Time Required
Deliberate	**3**	**16-24 hours**
Combat	**2**	**10-16 hours**
Quick	**1**	**< 10 hours**

Lt. Col. Dan Bolger also learned during JRTC 94-7 that his TOC was **"...a poor excuse for a command post despite having all the proper items and men. Bad as it was at operating, its survivability promised to be even more problematic. Slow to move, obvious with its unique tents and forest of radio antennas and parked Humvees, the TOC offered a wonderful opportunity to the [OPFOR]..."** That

experience led Bolger to reorganize for a return match with the OPFOR during JRTC 95-10 by storing his TOC tents and other paraphernalia, and by reassigning his TOC personnel. He abandoned the concept of a static Tactical Operations Center, and in its stead he organized four small, HMMWV-mounted cells: two for operations, each headed by a major, one for C2 12 hours on/12 off, the other resting or planning; one cell for logistics, and another for personnel. He placed one NCO with each line company commander to report position and status, and he positioned himself wherever he figured he could best affect the battle.

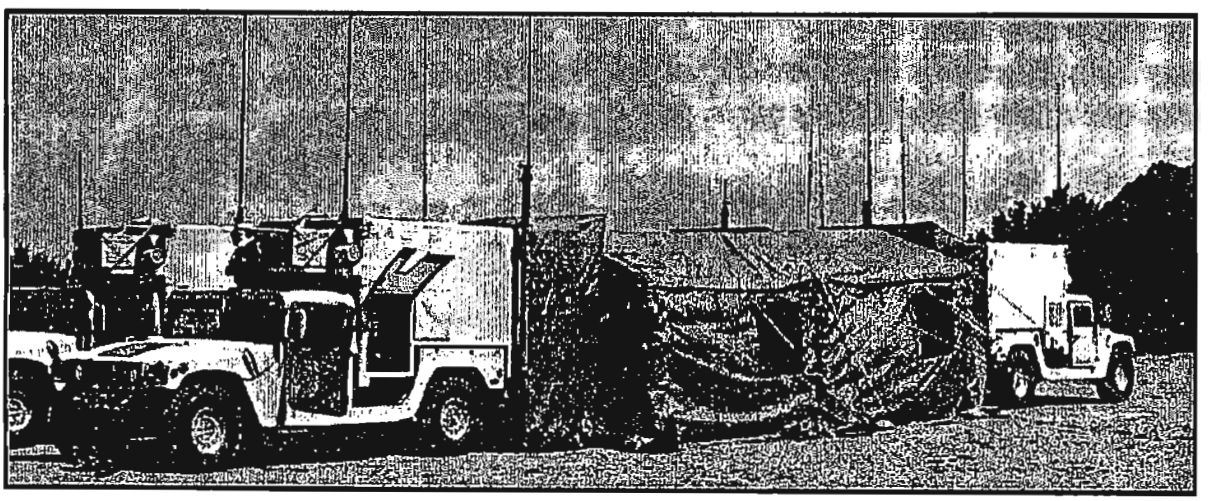
Another officer who perceived that Army command and control needed innovation was then Major General Paul Kern, commanding the 4th Infantry Division (Mechanized), undergoing conversion to "digitization". Kern was promoted and brought to Washington to head the Army's Acquisition Corps, where he concerted with the Director of DARPA to form a study group to consider what might be done with technology to create Future Combat Systems. That study group independently reached the same conclusions as Lt. Col. Bolger: TOCs must give way to networked cells.

The FCS Senior Advisory Group, chaired by Larry Lynn, former Director of DARPA, was formed in the spring of 1999, and charged by Lt.Gen. Kern and by Dr. Fernandez, the serving Director of DARPA, to think unfettered by current programs or plans, or by existing doctrine, tactics, techniques or procedures, and to propose distinctly superior concepts of operations for an Army component in a joint operation post 2010.

Our survey of oncoming technology led us to postulate that the Army could field ca. 2012 a unit with the following characteristics:

- We can design a combatant unit that, compared with a modern counterpart, will effectively control three times as much battlespace with one third the weight and personnel
- The units will be very fast, agile among missions, and capable of adapting to the unexpected, of operational maneuver from strategic distances, of tactical maneuver in three dimensions, and of relentless, continuous combat that seizes and maintains the initiative to win decisively against any enemy, anywhere
- The key element of the design will be a network enabling collaboration by all components of that unit, a flattened command structure, and elimination of TOCs.

That was in 1999. As I speak, the US Army is still spending over $100 million each year to purchase facilities, like the "Light TOC" shown below, wherein to practice course-of-action analyses and centralized command control.



Means to identify and to target such a distinctive gathering of materiel can now be purchased from vendors in the U.S., Germany, Australia, Japan, France, ROK, Russia, India, China, Brazil, and Taiwan. Multi-spectral sensors are also available for aircraft. The technology is not yet perfected, but is moving rapidly toward high probability of detection and low false alarm rate, with distinct prospects for automated classification and targeting. A panchromatic image of one HMMWV can detect the vehicle with one pixel, but requires 24 pixels for classification. In a hyper spectral image, the spectral signature of a HMMWV —information that detects, classifies, and even identifies material — is present in one pixel. Tests have been conducted with one actual and decoy HMMWVs in high background clutter in which the spectral signature unerringly identified the real HMMWV.

The Army's Training and Doctrine Command has already decreed that the future force will operate with "virtual command centers" rather than the present static TOCs and command posts. Your speaker constructed and used such a virtual command center in Germany back in the late 1970s, and did so before computers and cellular telephony. Our broadband carrier back then was millimeter wave radio, which proved adequate to carry not only all our customary operational and logistical traffic, but color TV imagery. In some eighteen months of field exercises, this configuration was demonstrated to be distinctly superior: far less vulnerable, more functionally effective, and more supportive of commanders and staff personnel alike.

In my view, a "virtual command center" ought to embody some combination of the following characteristics:

Dispersion entails spreading a TOC over a larger area to make its components easier to hide and harder to find. Dispersal requires a broad-band wireless LAN. The experience of 8ID two decades ago showed that "digitization" is not a prerequisite for dispersal, and that virtually any TOC can (and should) be dispersed. In a dispersed TOC, staff briefings are on demand, and all staff sections can "eavesdrop" on the transactions among commanders. The question obtrudes whether dispersal is dysfunctional for teamwork, depriving staff members of contact with others, and denying them periodic updates on unit operations. After Action Reviews in 8ID established that the technologies adopted for dispersion actually improved teamwork, broadened contacts, and improved staff understanding of both the commander's intent and the division's performance.

Distribution is dispersal of cells over longer distances, plus reorganization to allow commanders to operate forward supported by functional staff groups or cells to the rear. The latter can include a personal representative of each supported commander. If reliable, robust and fast communications are provided, this arrangement could potentially facilitate networking.

Downsizing is aimed at minimum manning of whatever C^2 architecture may be adopted.

Deletion implies technology that obviates the need for certain TOCs, particularly those that now perform CS and CSS functions that can be automated.

The US Army seems about to move in this direction. Note, however, that the length of time required for modernization has been twenty years, the same time as separated ***Wampanoag*** and ***Philadelphia***.

I close by observing that if we are to take advantage of the pace of technological change that clearly outstrips that of past eras, we must find a way to deal with cultural antipathy in the armed services. Here is a short list of current technology opportunities being blocked by military culture:

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If a technology can disrupt, it will.

- **Distance Learning**
- **Simulation**
- **Communications**
- **Intelligence**
- **Cannons and mortars**
- **Trucks**
- **Physiological Status Monitors**
- **UAV and UGV**
- ***Et cetera, ad infinitum...***