Implementing New Educational Technology for 21st Century DoD Leadership Development

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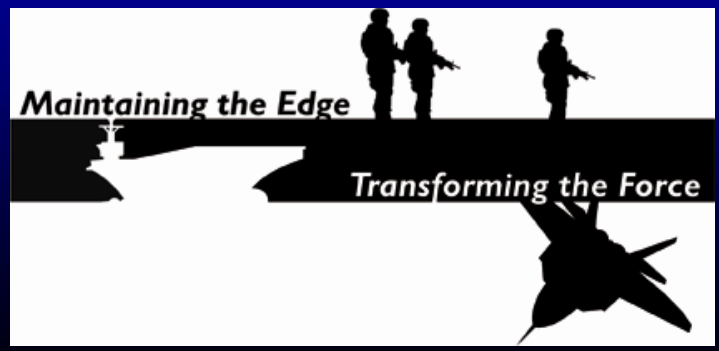


Outline

- Background
- Constraints on DoD Education
- Pedagogy and Performance
- Technological Enhancement
- Early Experience with HPC in Education
- DoD Experience with Distributed HPC (High Performance Computing)
- Current trends and coming capabilities
- Conclusions
- Acknowledgements, Caveats and Disclaimers

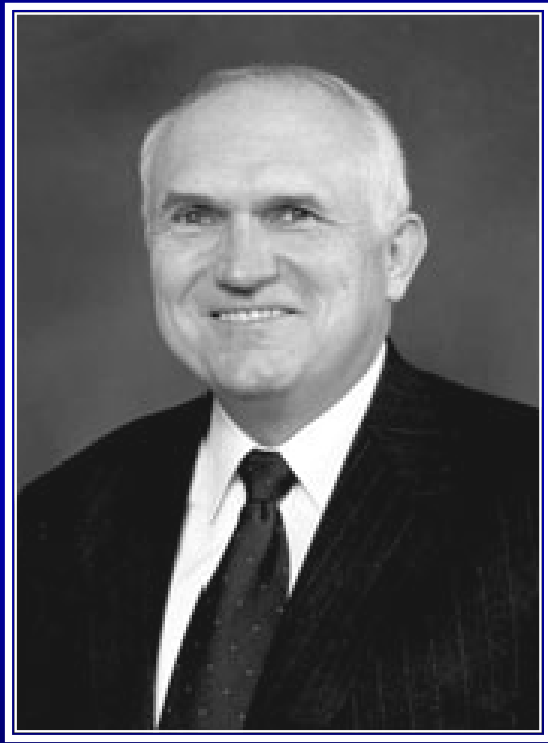
Background

- History tells us leadership is important
- Notwithstanding Tolstoy, Senior Officers matter
- From Alexander to MacArthur, military leaders;
  - Had to survive early experiences
  - Were judged on success
  - Invariably faced very non-military challenges late in career
- LTC Paul Yingling article in Armed Forces Journal
  - "… do not necessarily reflect those of the Army or the Defense Department. "
  - Solution offered therein
- Where the authors see the opportunity

Major General Robert Scales, PhD:
Comment on U.S. Army Education

"In 1976 the Army sent 7,400 officers to fully funded graduate school.

Today the Army sends only 396, half of whom are en route to West Point."



Statement of Major General Robert Scales, USA (ret.)

Testifying before the House Armed Services Committee on July 15, 2004

Constraints on DoD Education

- **Educators, learners and evaluators all:**
  - **Globally distributed**
  - **Frequently with very limited communications**
  - **Often under tremendous operational or survival stresses**
- **Junior officers are educated and evaluated by senior officers who control their careers**
- **MG Bob Scales suggests educational opportunities vary in accordance with subjective criteria**

Pedagogy and Performance

- **There is a very large body of well designed and verifiable research on leadership education**
- **The military and academic environments have both proven to be limited in different ways in their leadership development**
- **Cross-pollination across environments would stimulate more effective growth**
- **One common impediment to education at all levels is perceived risk of the learner to derision or condemnation for inappropriate initiatives**
- **This hampers learning**

DoD Performance Considerations

- **The tendency to avoid risk in learning situations can only be exacerbated if the learners are being monitored by seniors who will determine future of the learner's careers**
- **This effect would correspond closely to COL Yingling's thesis of why there is a leadership failure**
- **Young officers (and neophyte civilian leaders as well) need to be trained just beyond their existing level of competence**
- **Collaborative learning is also a *sine qua non* of educating 21st Century leaders**

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Pedagogy Prevented

- **Leaders need to fill all the potential roles during the learning experience**
- **This is difficult when that involves combat conditions, either real or staged**
- **The very requirements listed as desirable for optimal training of leaders is contraindicated by military life:**
  - **Globally distributed troops find it had to collaborate with peers**
  - **Limited communications foils attempts to have external evaluation**
  - **Environmental stress exacerbates hesitancy to take risks in learning environment**

Meta Cognition and Learning

- **Meta cognition is contemplating one's own thought processes**
- **There is ample research showing that it is an effective way to inculcate educational goals in the most beneficial way**
- **This contemplative level of functioning is clearly inhibited by senior involvement, combat stress and accelerated operational tempos**

Technological Enhancements

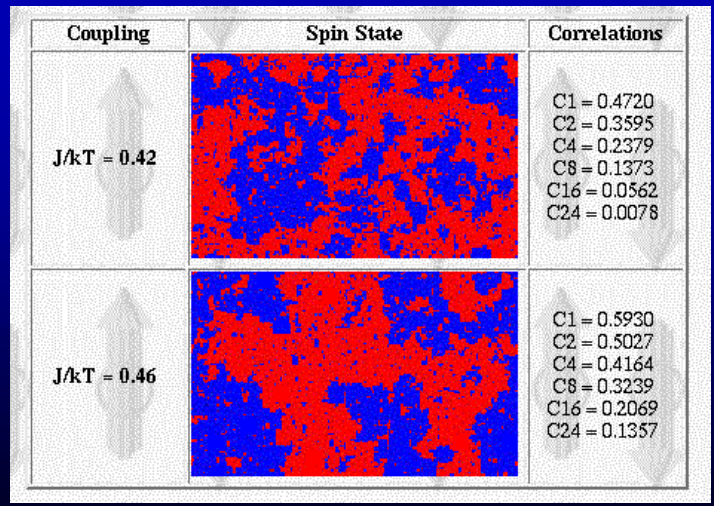
- There are some issues where technology may not be the panacea, but there are benefits to be implemented
- Education has been try technology at many levels, despite drawbacks, failures and “over-promising”
- Analogies exist between the definitions of civilian educational parameters and those in the DoD
  - Learners have varying skills, abilities and graces
  - Paucity of “hero teachers” and role models exists
  - Limited resources with which to address issues
- Interactive instruction can be augmented with HPC
- Not a new concept; has been shown to work

Early Experience with HPC in Education

- **Some educators saw limits of classroom computers to achieve what they needed**
- **Conceived different ways of using HPC in educational contexts**
- **One approach was the Interactive Virtual Museum concept**
- **Would allow student a high-res, interactive visit to local museum**
- **Could be done from remote Hawaiian Islands**

Hrothgar Project

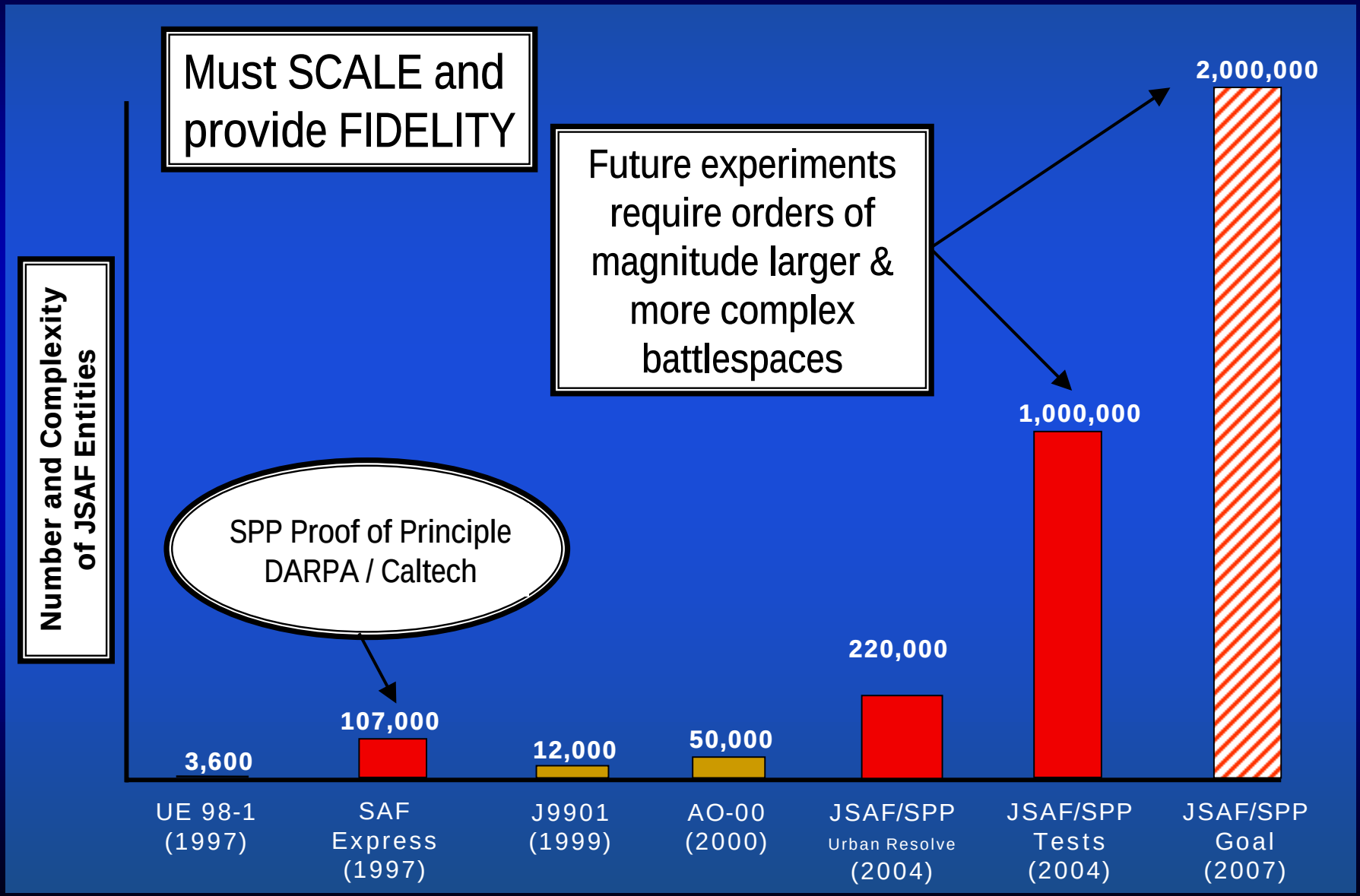
- Used HPC to teach HPC
- Taught “thinking like physicist”
- Validated by student reaction
- Program showed students how to parallelize a code
- Was batch, not interactive
- Gave demonstration of HPC in educational setting as:
  - Accessible
  - Stable
  - Robust
  - Reliable
  - Inexpensive



DoD Experience with Distributed HPC

- **HPCMP is DoD's HPC provisioner; mostly simulation**
- **Interactive use by hundreds of personnel provides important Human-In-The-Loop (HITL) results**
- **Many user/operators are uniformed warfighters**
- **Local Area Networks - typical, limited environment**
- **A new scalable version of JSAF (Joint Semi-Automatic Forces)**
- **Now scales to hundreds or thousands of nodes**
- **Wide area net: 4 sites and two computer clusters**
- **Simulated hundreds of thousands to millions of JSAF entities, *e.g.* pedestrians, vehicles, forces, …**
- **DoD made good use of Maui and Ohio clusters**
  - **Maui High Performance Computing Center**
  - **Aeronautical Systems Center, Major Shared Resource Center**

Why the DoD Needs HPC: JFCOM Simulation Needs



Current Trends and Coming Capabilities

- **Introduction of “serious” gaming into education**
- **Expanded capabilities via new technology:**
  - **Advanced displays**
  - **Sophisticated heuristics**
  - **CPU acceleration via heterogeneous computing**
  - **Quantum computing**
- **Recognition of the need for leveraging “hero teachers”**
- **New-found openness to objective measurement of success in all areas of education**
- **Improved communications protocols and technologies to reduce current bandwidth constraints**

An HPC-Enabled Educational Vision for the DoD

- **Leverage the best and brightest educators**
  - **When we establish one who has the vision, extend it to all**
  - **Use new technology to capture the passion and the concepts**
- **Provide managed-risk environment**
- **Use goals set by visionaries and validated by veterans**
- **Employ proven pedagogical techniques to optimize learning and inculcate desired attitudes**
- **Create an "Augmented Intelligence" (A/I) program to:**
  - **match educational goals**
  - **adjust to changing world**
  - **pace individual learners**
  - **validate progress**
- **Implement HPC and Communications techniques from physical sciences to achieve all of the above.**

Conclusions

- **To keep up with modern demands, DoD education needs newly developed capabilities**
- **High Performance Computing has benefited evaluation and training**
- **DoD operations force geographical dispersion of users, educational assets, and computing systems**
- **DoD educational systems can use HPC power to meet these needs**

Acknowledgements, Caveats and Disclaimers

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