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Future Strategic Issues/Future Warfare [Circa 2025]

- Capabilities of the "Enemy After Next"
  - -Ongoing Worldwide Technological Revolutions
  - -Economic Trends
- Potential Nature of Farther Term Warfare

This is the "Readers Digest" version of a 2-hour Presentation put together at the request of the Army War College/SSI

Presentation has been written up by Bill Stryker of DIA/Futures as the Future Threat for Global War Games etc., available on INTELNET

THIS PRESENTATION BASED UPON "FUTURES" WORK FOR/WITH

- USAF NWV
- USAF 2025
- National Research Council
- Army After Next
- ACOM Joint Futures
- SSG of the CNO
- Australian DOD

- DARPA, SBCCOM
- DIA, AFSOC, EB
- CIA, STIC, L-M
- APL, ONA, SEALS
- ONI, FBI, AWC/SSI
- NSAP, SOCOM
- MSIC, TRADOC
- JWAC, NAIC, IDA
- JFCOM, TACOM
- SACLANT

Utilization/Application of 2025+ Projections

- Inputs to Future Warfighting Concepts Development(s) (Enemy After Next & Blue)
- Inputs to New Procurement Decision (15+ years to Produce, 40+ years in Inventory
- “Heads Up” for Intel Community (“Watches and Warnings”)
- Inputs to DOD R&D Planning

“Going In” Assumptions

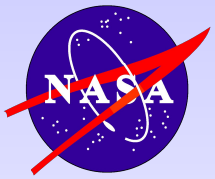
- Politics can/does change “overnight” (e.g. Russia, Iran, Iraq, Pakistan, etc.), Potential CAPABILITIES is the future warfare issue, not Who but WHAT
- Order of 10+ years required to develop/field new systems, in inventory for 30+ years, should be designed for middle of inventory period, hence 2025 time period

CURRENTLY

- Order of 70% of Worlds Research conducted outside of U.S. (to first order, a % of GDP, U.S. produces order of 18% of worlds GDP)
- Order of 70% of U.S. Research now "Commercial" (as opposed to Government sponsored)

Technological Ages of Humankind

- **Hunter/Killer groups [Million BC~10K BC]**
- **Agriculture [10K BC~1800 AD]**
- **Industrial [1800~1950]**
- **IT [1950~2020]**
- **Bio/NANO [2020-?]**
- **Virtual**



- **Hunter-Gatherer - “Nature Provided”**
- **Agriculture - <u>Controlled</u> Nature (Plants/Animals)**
- **Industrial - <u>Mechanized</u> Agriculture**
- **IT/BIO/Nano - <u>Automating</u> Industry/Agriculture**
- **Virtual - <u>Robotization</u> of IT/Bio/Nano/Industry/Agriculture**

Worldwide IT Revolution

- **Comms/Computing/Sensors/Electronics**
- **U.S. Commercial IT R&D ~ $100B/yr.**
- **Factor of 1 Million further improvement [Silicon,Molecular,Quantum,Bio,Optical]**
- **Beyond Human AI?**
- **Automatics/Robotics “in the large”**
- **Immersive multi-sensory VR/”Holodecks”**
- **Ubiquitous multi physics/hyperspectral sensors [land/sea/air/space]**
- **Micro/Nano sats/GNC/sensors,etc.**

[Worldwide] Impacts of Ongoing IT Revolution Upon Society

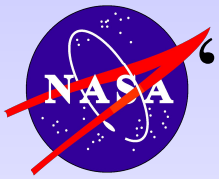
- **Tele-commuting**
- **Tele-shopping**
- **Tele-entertainment**
- **Tele-travel**
- **Tele-Education**
- **Tele-medicine**
- **Tele-commerce**
- **Tele-politics**
- **Tele-socialization**

Inexpensive Motivational Asynchronous Web-Based Distance Education Enables:

- **Demise of the U.S. "underclasses"**
- **Wealth Creation from enabled "Invention"**
- **Stabilization of World Population**
- **[Even More] Rapid Technology Diffusion**
- **Equalization of "Haves" and "Havenots"**
- **Altered Political/military outlooks Worldwide - I.E. Changes "Everything"**

IT Status

- **10E6 improvements in Computing since ‘59, 10E8 further possible next 30 years (10E3 provides “better than Human” capabilities)**
- **100 Million Telecommuters Worldwide NOW (expected to at least double in 15 years)**
- **India graduates three times more software engineers than the U.S., More software written in Bangalore than Southern CA**
- **IW effectively constitutes a 4th WMD**



"In this [Worldwide] economy our ability to create wealth is not bounded by physical limits/resources but by our ability to come up with new ideas"

[However,even "universal wealth" will not obviate the other causes of warfare which include Politics,"Face",Religion, Megalomania and Territorial Disputes]

Current Competitive Landscape

- U.S. produces only 18% of Worlds GDP
- ~70% of Research conducted offshore
- $300B/yr trade deficit
- 32 other nations devote a larger % of their GDP to Research
- 5th in No of R&D personnel/labor unit
- 3% savings rate vs. 30% in Asia
- Proliferation of IT,bio,nano,Space Technology etc.

Bio Revolution Applications

- **“Pharm Animals” [drugs, spare parts]**
- **Fast Growing plants on/near sea surface & sea water irrigated plants for biomass energy/closed CO2 cycle**
- **Polymer growing plants**
- **Spider genes in goats allow spider silk spinning from goat milk for “Biosteel”, 3.5X strength of aramid fibers for Armor**
- **Binary Bio-weaponry**

Advantages of Shallow Sea/Desert Production of Biomass (Via Seawater Irrigation)

- Closed CO2 Cycle (Obviates Global Warming)
- Food
- Petro-chemical feedstock
  - Materials/clothing, etc.
  - ENERGY (end reliance on Middle East)
- Terraforming, alter desertification etc.
- Preservation/Production of Fresh Water
- Rich Mineral source (Seawater)
- Utilization of “Wastelands” (Sahara, etc.)

Carbon Nanotubes

- C1,000,000, Buckminister Fullerine Carbon
- 100X strength, 1/6 weight of steel
- 8X better Armor
- Low energy Molecular/Petaflop Computing
- Ultra Capacitor/High Temperature SC
- Non-Cryo H2 storage

Free Form Fabrication

- Powder/Wire Metallurgy using robotic magnetically steered electron beams to create accreting local melts - GROW instead of CUT
- No fasteners, no strong backs for fasteners
- Nearly infinite fatigue life, excellent metallurgy
- (Repairable) metals at lower weight than far more expensive composites

Aluminum/Vortex Combustor

- Micro powdered Aluminum fed into a vortex combustor "burns" SEAWATER
- Provides AIP with high energy density/efficiency for:

  -inexpensive SS with "near SSN" perf.

  -Transoceanic UUV's
- Would allow "Enemy After Next" to AFFORDABLY Threaten CONUS via Multitudinous in-shore short-time-of-flight "popups"

(Sample) New(er) Sensors

- **Lidar w/ 50% efficiency via S-C optical Amplifiers, Also Fempto-second Lasers**
- **Molec./Bio Sensors**
- **Nanotags**
- **Smart Card Sensors**
- **Sensors implanted during Manuf./Servicing**
- **Nano IR (10E-6 Sensitivity)**
- **Smart Dust**

Some Sensor "Swarms"

- SMART DUST
  - Cubic mm or less
  - Combined sensors, comms and power supply
  - Floats in air currents for up to 2 years
- NANOTAGS
  - Placed on everything/everywhere
  - Identification and Status Info
- Co-opted INSECTS

"Givens" (Now-to-"Soon")

- Gb data transfer rates, optical comms
- Terraflop-to-petaflop computing
- Exceptional AI (from Bioinfomatics, biomimetics)
- Wonderous/Ubiquitous land/sea/air/space multiphysics/hyperspectral sensor swarms (military/commercial/scientific)
- Survival requires dispersion/size reduction and concealment
- Robotic/swarm technologies primarily commercial/endemic worldwide

(Agreed Upon) Assumption, Combat in 2025

- **Proliferation of TBM's, IT, Precision strike/targeting, ubiquitous micro sensors, camo/spoofing, robotics, bio/chem munitions**
- **Logistic assets highly vulnerable in or out of theater**
- **In and near theater ports/airfields possibly unusable**
- **Beam weapons increasingly prevalent**

“Volumetric” Weaponry

[Alternatives to HE]

- EMP
- Info/Net/Psy warfare
- Miniature brilliant sensor/mine combo’s
- Fuel/air & dust/air
- RF
- Chem/bio Antifunctionals/antifauna
- Isomers, Strained Bond Energy Release, etc.
- Carbon fibers/Acoustics etc.

Some Interesting "Then Year" BW Possibilities

- Aflatoxin - ("natural," parts-per-billion, carcinogen)
- Airborne varieties of Ebola, Lassa, etc.
- Binary agents distributed via imported products (Vitamins, Clothing, Food)
- Genomicaly (individual/societal) targeted pathogens
- Long term/fingerprintless campaign (as opposed to "shock and awe" BW)

Blast Wave Accelerator

- Global Precision Strike "On the Cheap"
- No barrel, ~100 ft. notched rails, sequentially detonated Distributed HE
- Mach 27 or less as desired, up to 3000 lb
- Base anywhere, ~$200/lb of projectile
- Excellent stealth [no plume], affordability, ferocity, reaction time, survivability, recallability, effectiveness
- Being worked at Aberdeen and NASA MSFC for lofting of Fuel and Nanosats

“Slingatron” for Global Precision Strike

- 10Kg projectiles, up to thousands/minute
- Global, or less, range
- $20M/device
- Mechanical “on-the-ground” propulsion via Gyrating Spiral Guide Tube (a multiple “hula hoop”
- “Poor Mans” Global Precision Strike/“Takedown Weapon”

Then Year Targeting/ Connectivity etc.

- **MILITARY overheads/systems**
- **Ubiquitous COMMERCIAL overheads/systems**
- **SCIENTIFIC overheads/systems**

IN the context of:

- **Inexp. Reconstitution via micro/nano sats**
- **Optical comms /GPS etc.**
- **Ubiquitous inexp. UAV/HALE adjuncts**

Summary - Major Influences of IT/Bio/Nano Upon Future Warfare

- Ubiquitous miniaturized/networked multi physics,hyperspectral sensors
- Robotics/Automatics “in the large”
- Long range precision strike/targeting
- Info/net Warfare
- Mini/micro/nano Sats, Cruise, UAV’s
- Binary Bio Weaponry
- Miniature/ubiquitous “smart mines”

Potential Future "Orders of Magnitude" Increases in Overall Weapon Effectiveness/Availability at Orders of Magnitude Reduced Cost(s)

- Bio/Chem/Molec./Nano Computing - (E6)
- Ubiquitous Optical Comms - (E4)
- Micro/Nano/Ubiquitous Sensors - (E4)
- BioWeaponry - (EN)
- Co-operative Swarms of Cheap/Small Weapons/Sensors - (E4)
- Volumetric Weaponry - (E4)
- Cyber/Artificial Life (Beyond AI) - (E?)

Potential En-route Logistic Vulnerabilities

Logistic surface ships and aircraft are non-LO and undefended, could be targeted and attrited inside the continental shelf by:

- **"Eggs" [subsurface floating encapsulated missiles implanted by freighters/SS/air]**
- **SS [torps/missiles/subsam]**
- **Transoceanic UUV's, UAV's**
- **Blast wave accelerator**
- **Cruise, TBM's**
- **MINES**

Fundamental Problem With Future U.S. Power Projection

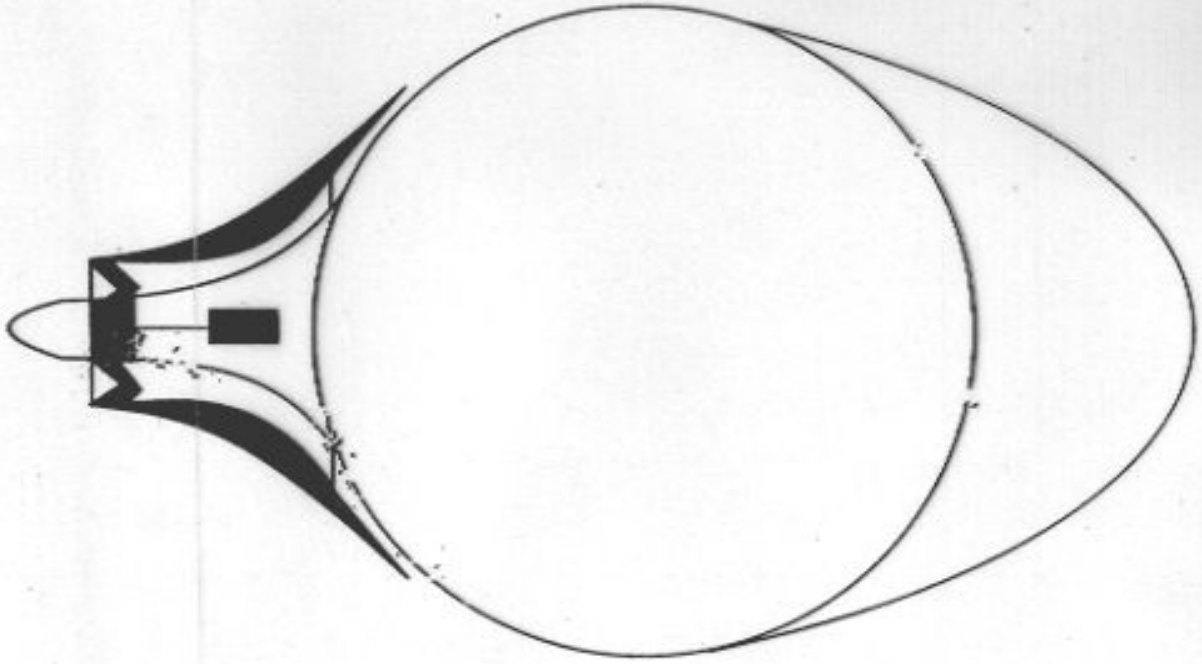
- **“EAN” can have “country sized magazines” filled with hordes of inexpensive Precision strike “Munitions” - Area Denial**
- **U.S. Forces run out of “bullets” and die**

  [Beam weapons not panacea, inexpensive workarounds available]
- **Deep Water Subs with large loadout/“swimin” weaponry only survivable “Close-in” platform**

THE INSHORE DETECTION VULNERABILITIES (+ ACTIVE) ACOUSTICS

- **Visual, lidar, IR, bio-lum, turbidity**
- **Press. pertub. effects on water column chem., H_2 bubbles, salinity, chem. releases**
- **Internal waves/surface waves--surfactant layer mods, in situ turb./wakes, atmos. mods**
- **Magnetics, coms, periscope/radar, neutron flux**

OPERATED ON "TAKE-A-VOTE"



An ALTERNATIVE?
"A Spherical Submarine"

- Obviate wave drag via submergence
- Optimal structural configuration
- Optimal (Goldschmeid) Propulsion Integration
- Minimal wetted area/volume (large radius)
- Onboard Polymer plant for TDR
- Minimal Interference & "controls" drag (thrust vectoring)

Example 'Then Year" Direct Conus Attack Capabilities

[~80% of CONUS population/infrastructure within ~ 50 Miles of a "coastline"]

- Inexp. Transoceanic UUV's/UAV's/Cruise
- Inexp. Blast Wave Accelerators
- Inexp. Info/Net/Psywar
- Inexp. Inshore AIP SS [mines/torps/SLCM]
- Inexp. Binary Bio into Food Supply
- Inexp. Semi-submerged Missile "eggs"
- Inexp. 'Trojan Horse" "civilian" systems

[Above in addition to ICBM/TBM]

Future Warfare "On The Cheap"

- Info/net warfare
- Binary bio [anti-functional/fauna]
- Non-lethals
- Miniature brilliant sensor-mines
- Micro/Nano Sats
- LO/Long leg/precision UUV's/UAV's/Cruise
- Inexp./Superb/survivability ISR/comms
- Blast wave accelerator

“Then Year”
“Peer Competitors”

Peer Competitor no longer defined by “megatonnage” of obsolescent Industrial age steel and aluminum Artifacts. The Drastically reduced entry investment enabled by “Warfare on the Cheap” ensures almost any nation or sizable organization can be a very worrisome Military “peer.”

Fundamental Military Issues/Metrics

- **Affordability** ["Warfare on the Cheap"]
- **Survivability** ["Can see everything, Anything you can see you can kill"]
- **Effectiveness** [Lethality of Precision and Volumetric weaponry]

I.E. Simultaneous ongoing Revolutions in all three of the major Warfare Metrics

Given the Superb/Ubiquitous World Wide Sensor Suites and Precision Strike Capabilities "Then Year" the Following <u>WILL NOT BE SURVIVABLE</u>

- **APODS/SPODS**
- **Runways**
- **Surface Ships**
- **Manned (logistic/combat) Aircraft**
- **Manned (logistic/combat) Ground Vehicles**

<u>Due to their size & (multi-physics) signatures</u>

Trends Summary

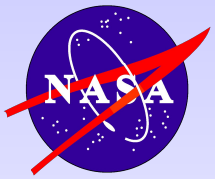
- Tele-everything
- U.S. just “one of the crowd” economically
- “Warfare on the cheap,” many potential “peers”
- Warfare Increasingly Robotic
- Survivable/Affordable power projection via deep water subs and Blast Wave Accelerators
- CONUS and Logistics Defense increasingly worrisome

“Circa 2025”

- **Machines as creative/“smart” as humans “Robotics” the “norm”**
- **Zeroth order “warstopper” - Binary bio into nation’s agric./food distrib. system (every home/fox hole)**
- **Next level of concern: Ubiquitous/Cheap micro-to-nano EVERYTHING (sensors, munitions, weapons swarms/hordes)**
- **Battlefield attrition/CNN syndrome forces U.S. Army to look/act like SOCOM**

(Suggested) Major U.S. Future (2025) Warfare Issues

- **CONUS Defense (Requirement(s) for, potential approaches)**
- **Logistics Defense/Protection (in/out of theater)**
- **Survivability/Effectiveness of U.S. Forces on/near the "Killing Ground" in an era of affordable ubiquitous multiphysics hyperspectral sensors, precision strike, volumetric weaponry, "swarms" and hardened munitions**



- **“Non-explosive Warfare” (psywar, biowar IT/net war, “anti-operability war,” Beam weaponry including RF, Spoofing/Cammo**
- **Robotic Warfare “in the large”/better than human AI/“Cyber life”**
- **Alternative Power Projection Approaches (e.g. Deep Water depth/death sphere, blast wave accelerator, etc.)**

Future "Power Projection"?

- Humans "hold" instead of "take" ground (go in after "Sanitization")
- Sanitization via:
  - IW/Psywar
  - Global Reach "Guns" (BWA/Slingatron)
  - Deep water/large loadout Subs w/"swimins"
  - "Robotic Everything" w/Volumetric weaponry non-explosive warfare

Changing Nature of Warfare

Hunter/ Gatherer	*Hunting Grounds*	*Tribal Bands*	*Hand Held/ Thrown*
Agricultural	*Farm Lands*	*Prof. Armies*	*Hand Held/ Thrown*
Industrial	*Natural Resources*	*Mass Levee*	*Mech./Chem.*
IT/Bio/Nano	*Societal Disruption*	*Everyone*	*IT/Bio/"Bots*

RMA Planning "Shortfalls" (NPS)

- **"Indications of the innovative paths adversaries might take or how they might adapt technologies from the civilian world"**
  (Being worked in the "Technical War Games")
- **"The path from todays systems and capabilities to those hypothesized for the future (2020+)"**

What is needed is a "Then Year" (~2030) Serious/Holistic Vision of Warfare Changes Resulting from the On-going IT/Bio/Nano/Virtual Technological Revolutions

- Such does not exist, "bumper sticker" attempts extant.
- All are agreed, warfare will become increasingly robotic and probably more affordable, swarms of sensors/shooters are a given.
- A longer term "Vision" of these changes would enable "mapping" from the present, NOT AT ALL CLEAR HOW TO "Get There From Here" as do not know where "there" is!