Technology Convergence and Disruptive Technology: Some Perspectives from the "Emerging RMA"

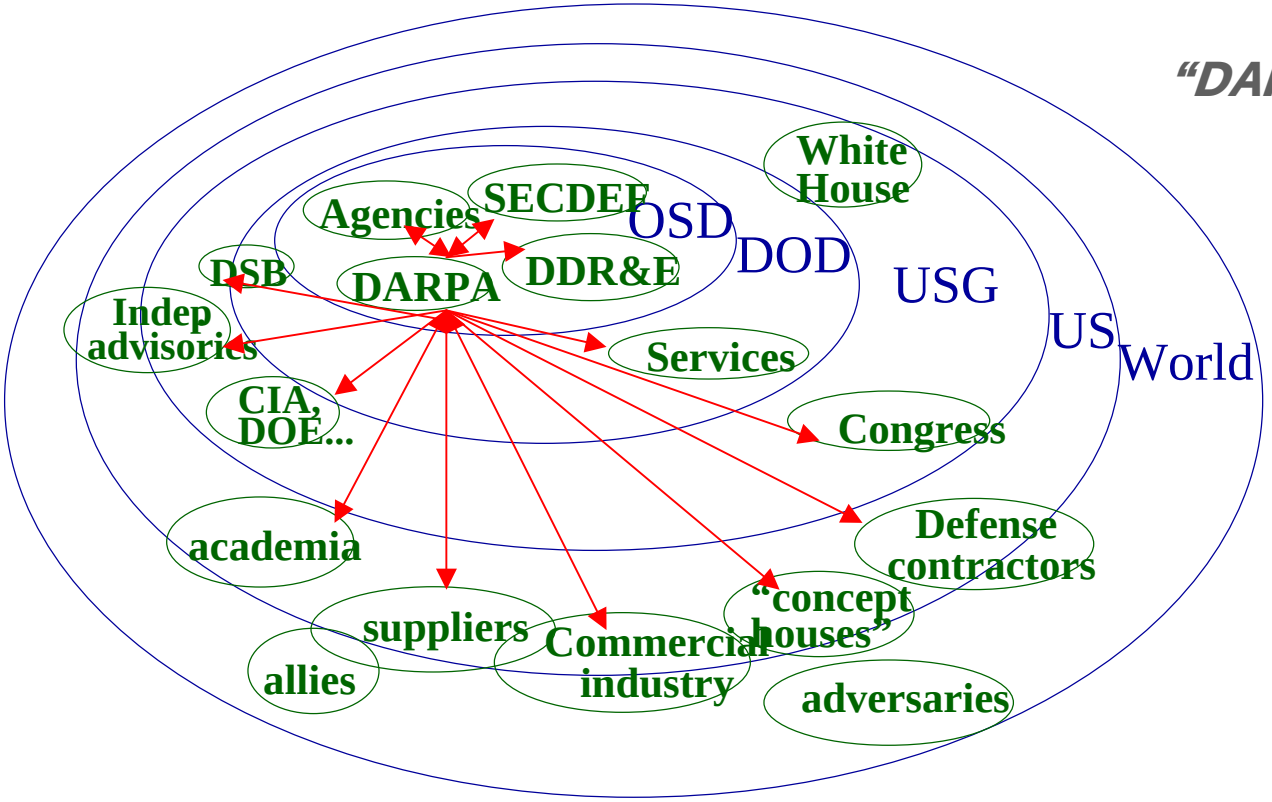
April 14, 2003

Dr. Richard Van Atta (rvanatta@ida.org)
Institute for Defense Analyses

Outline

- **Background**
  - Transformation and the Revolution in Military Affairs (RMA)
- **Historical Perspective**
  - Challenges and responses
  - Stealth
  - Precision Strike
  - Real-time ISR
- **Today's Challenges**

"Success has many fathers"
Discerning DARPA's Contribution



"DARPA played a key role in system of systems demos that Services wouldn't do...."

"ASSAULT BREAKER had no impact on AirLand Battle..."

"Air Force was doing stealth all along... "

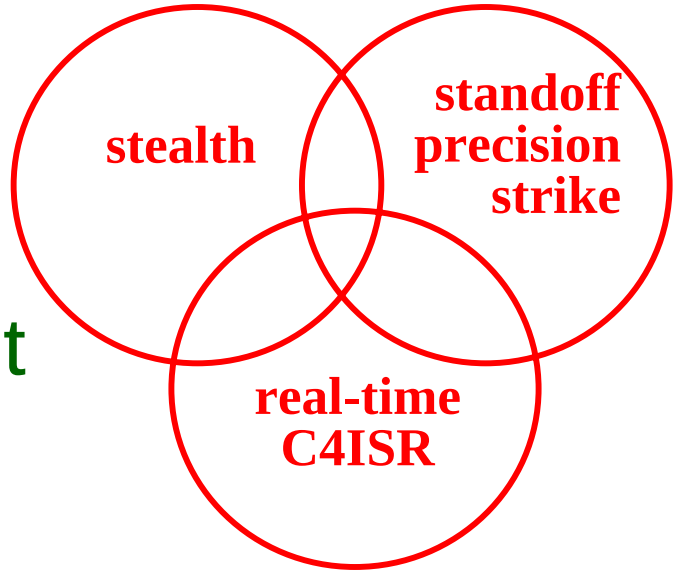
DARPA's success depends on
making linkages with other organizations and
facilitating action on security problems

Pathway to "Transformation"

- Instigate radically advanced technologies
- Conceive & demonstrate "disruptive" capabilities
  - Technology *per se* is not disruptive
  - *Disruptive capabilities* based on operational, organizational, and cultural adaptation
- Foster RMAs
  - Translate capabilities into defense strategies
  - Transition capabilities into application

What is the "Emerging RMA"?

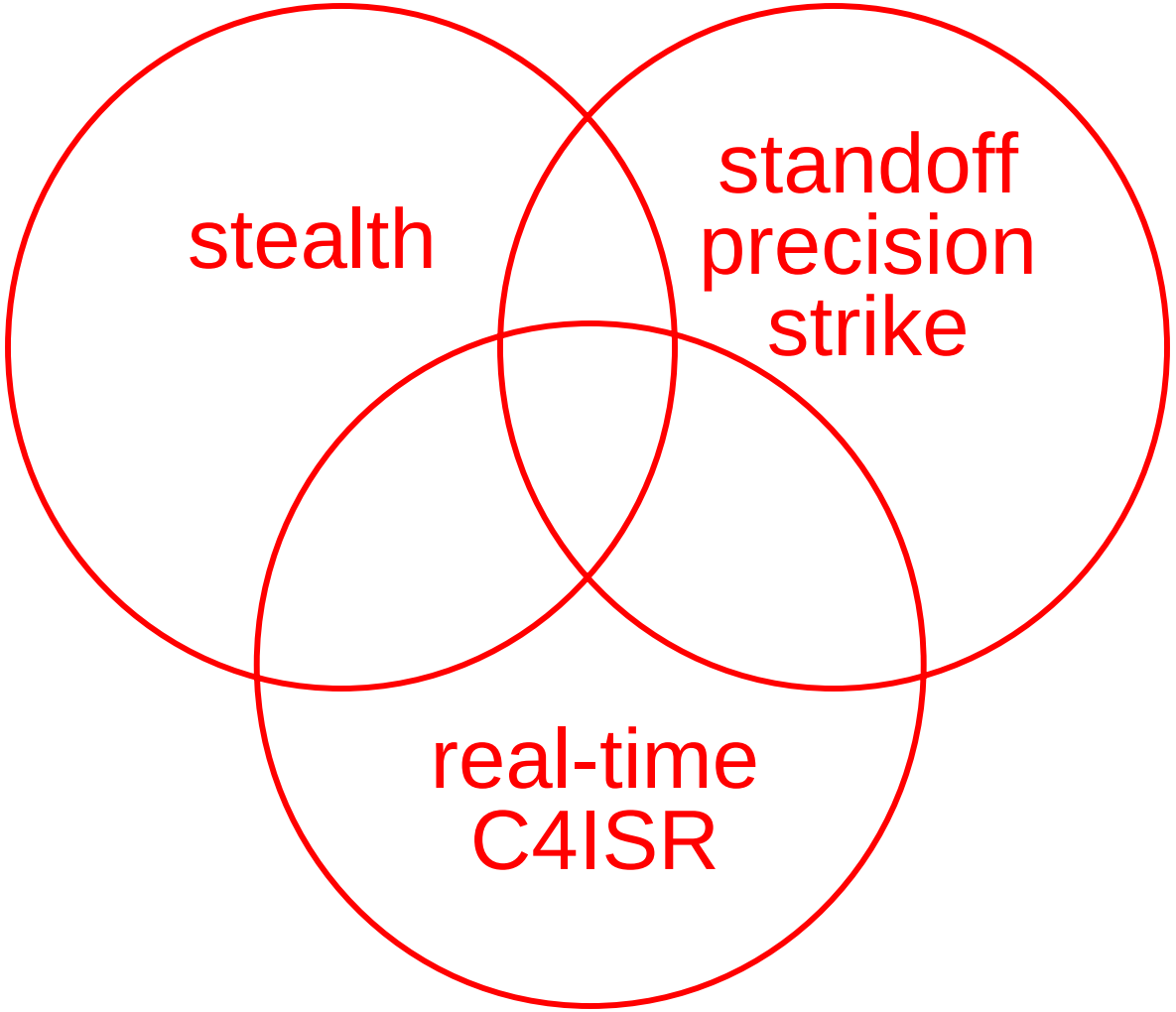
- Desert Storm demonstrated interrelated, synergistic capabilities ("system of systems") that undermine warfighting approaches built around large platforms



- Emerging RMAs
  - Today: *Pervasive global impact of microelectronics and "information technologies"*
  - Tomorrow: *Nanotechnology? Biotechnology?*

    Bio-nano-opto-mecha-tronics?

Case studies

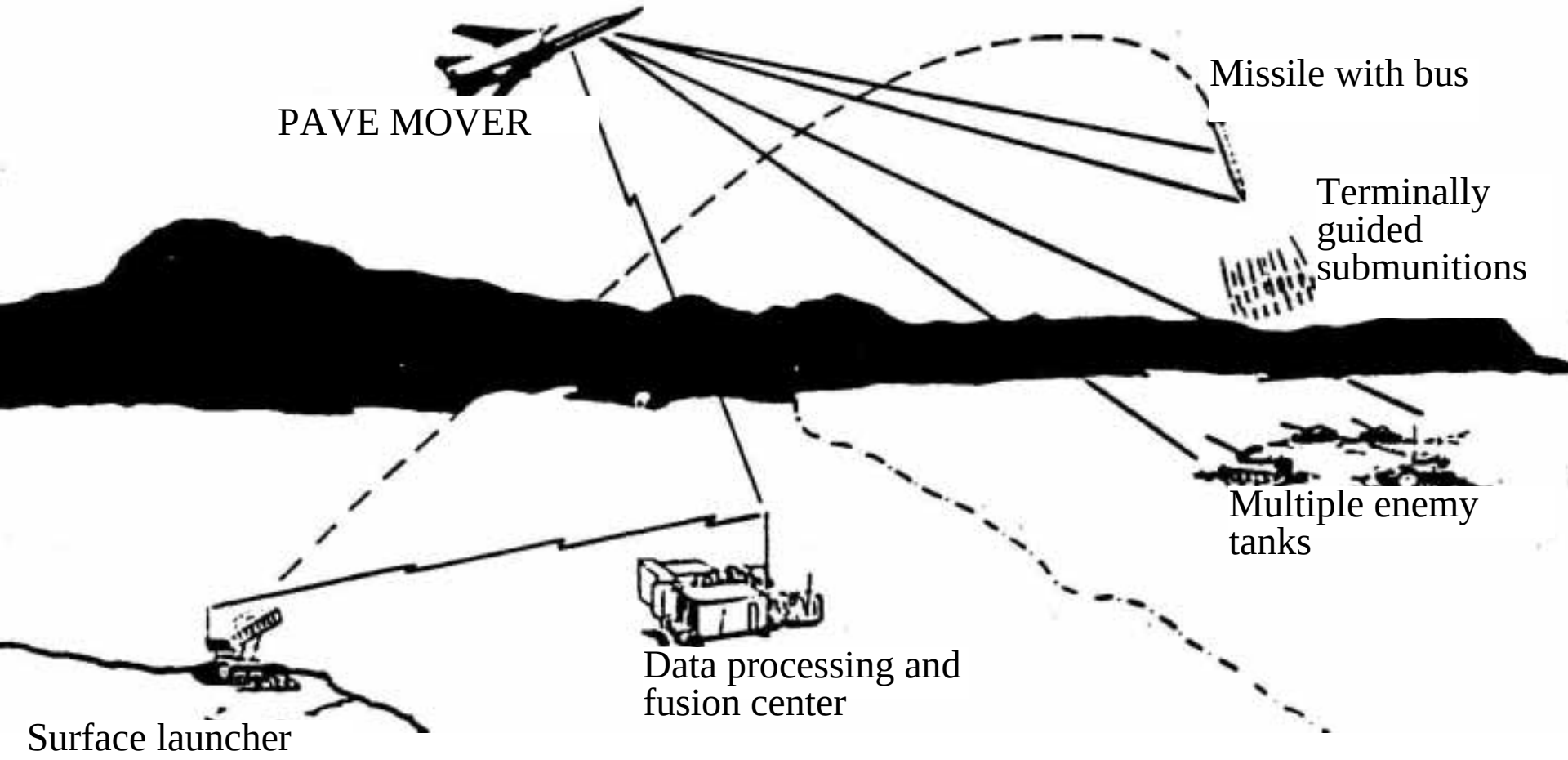


Stealth implementation

- 1979: Based on HAVE BLUE success, Perry decides to build F-117A with 4-year IOC
  - No prototype
  - "Technology limited, not funding limited"
  - Executive reviews chaired by Perry

- 1983: Air Force set up secret F-117A wing
- DARPA funds stealth on several platforms
  - Umbrella program office under AF Colonel Kaminski
  - TACIT BLUE keeps Northrop in stealth business, leading to the B-2 and other airborne stealth
  - SEA SHADOW applies stealth to surface navy
  - Counter-stealth research

Standoff Precision Strike: ASSAULT BREAKER concept



In one of the most complex and integrated DARPA demonstrations ever attempted, a radar-guided missile dispensed five terminally-guided submunitions above a field with five tanks. Result: five direct hits.

Implementation of precision strike: A continuing story

- Precision strike is now a core military idea, intrinsic to most tactical concepts
- Important individual systems fielded
- *USSR reacted to ASSAULT BREAKER efforts after only partial deployment*
- Despite DARPA demonstrations & operational concept development, Services focus development on their particular platforms
  - Air Force: air-delivered munitions
  - Army: ground and helicopter delivery
- Truly "smart" weapons still seeking acceptance

Real-time ISR systems

- Enabling technologies
  - IR
  - Millimeter wave
  - Ladar
- Standoff, air-based ISR (JSTARS & AWACS)
- Satellite-based ISR
  - From National to CINC ownership (Discoverer II)
- Sensor nets
- UAVs

UAV Origins

- DARPA experimental programs in Vietnam for ISR, communications and strike
  - Snoopy (TV, comms, MTI radar, laser designator, weapons)
  - NITE PANTHER and NITE GAZELLE (Target acq. & strike)
  - Praeire and Calere (TV, laser designator, FLIR, EW)
- Heilmeier to Congress (1977):
  "We are successfully completing and transitioning these technologies to the Services"
- UAV development and deployment would prove long and difficult

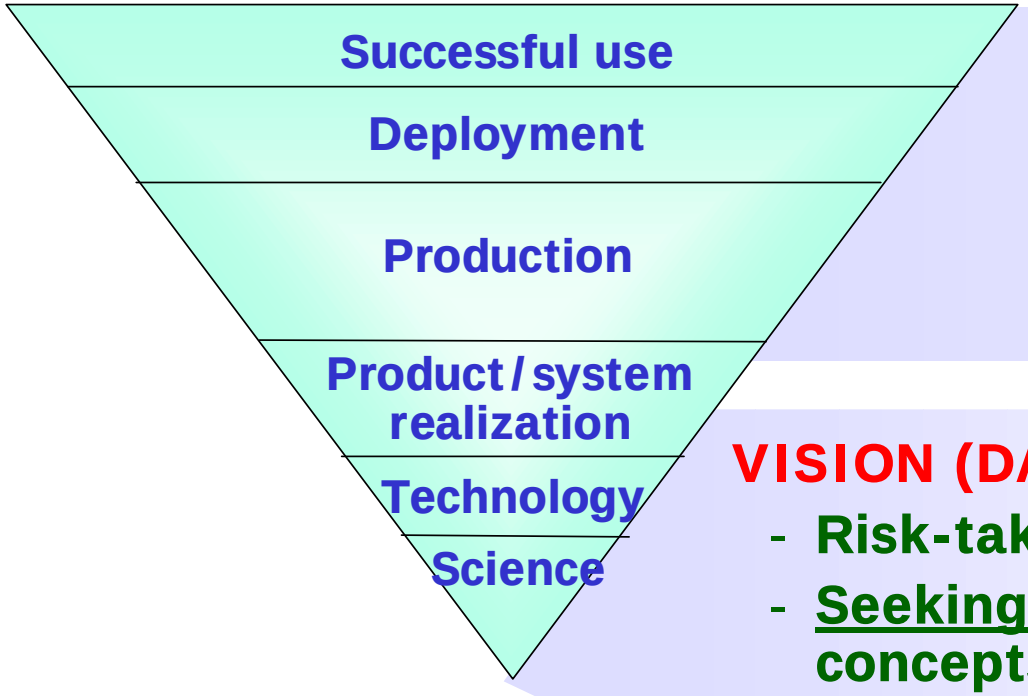
High level leadership spurred UAV implementation and deployment

- Gulf War highlighted serious deficiencies in airborne ISR, particularly wide-area coverage
- DSB and OSD/Intelligence reviews
  - UAV development requires central leadership (DARO)
  - Push medium-altitude endurance UAVs (Predator)
  - Initiate high-altitude endurance UAV program with $10 million flyaway cost (Global Hawk)
- Predator delivered in 6 months using ACTD process
- Air Force forms operational UAV squadron
  - Deployed in Bosnia, Kosovo, Iraq, and Afghanistan

Stealth vs. UAVs vs. ASSAULT BREAKER

	Stealth	*UAVs*	*ASSAULT BRK*
Mission clarity	Relatively narrow and stable missions	Multiple missions, ops. concepts & tech. needs	Change in mission need during development
Mission Competition	Focus on missions that existing aircraft could not perform	Overlapped large platform missions	Substitute for a core mission of large platforms
Jointness	Attached to single platform owned by individual service	Multiple platforms but single-service deployment	Intrinsically joint, requiring major changes in doctrine
Integration	Distinct platform implemented sole-source	Multiple platforms but single contractor for each	Multiple contractors for each "system of systems" component
Openness	Secret and "black" (compartmentalized)	Mixed secret/black and open	Open
Timing	Brought to acq. decision during a single administration	Successful transition once top-level imprimatur given	Demonstration completed after initial decisionmakers gone

Two aspects of success: Vision and Leadership



LEADERSHIP (OSD focus)

- Top-down interest and involvement crucial for implementing disruptive capabilities

VISION (DARPA focus)

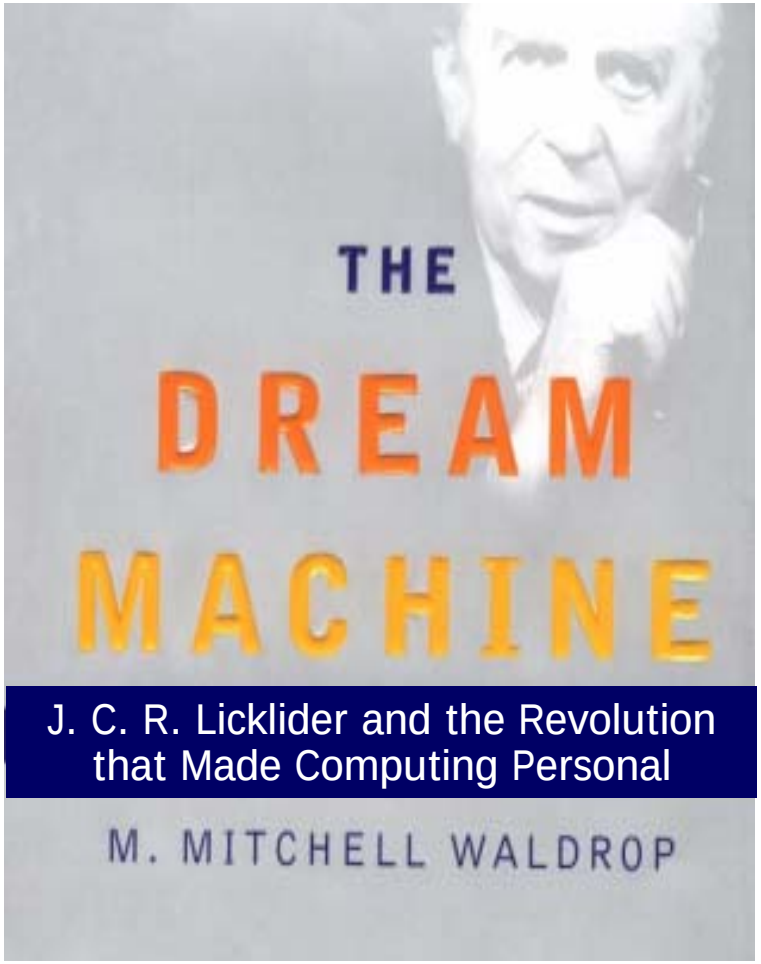
- Risk-taking, committed PMs
- Seeking and developing disruptive concepts
- Fighting against internal & external resistance

If transformational capabilities are the objective, it is insufficient for DARPA to create an example and then rely upon the ordinary Service acquisition system

Create surprise, don't just seek to avoid it

VISION

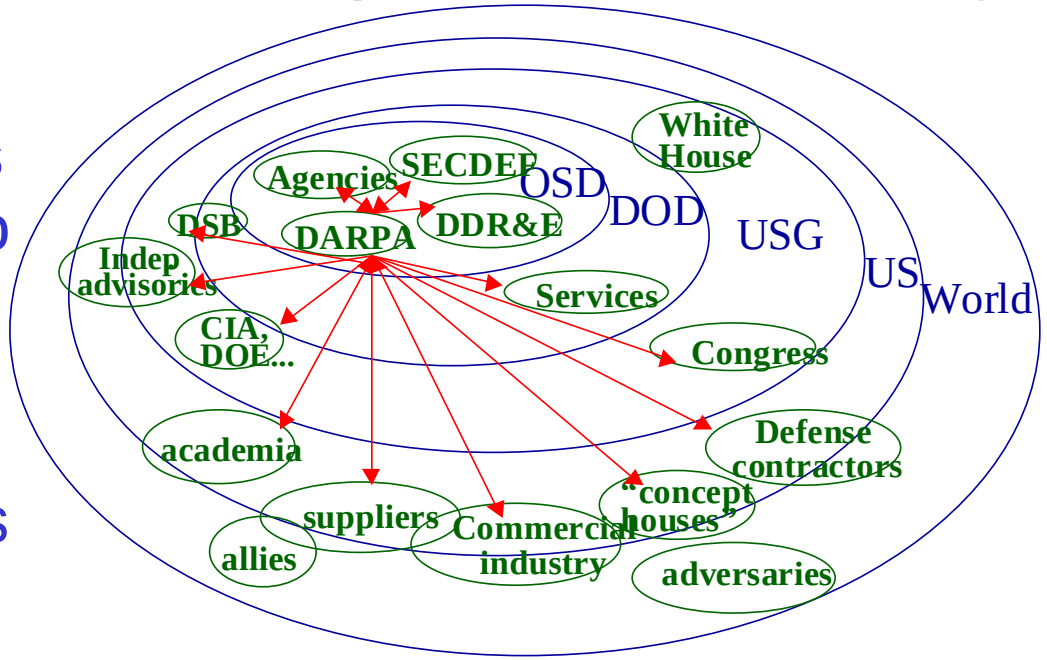
- Pursue technologies with potential to create disruptive capabilities
- Make sustained investments, building from initial science into progressively more integrated systems
  - Some investments are impossible to justify in purely accounting terms



Build communities of change-state advocates

VISION

- DARPA is at its best when it instigates cooperation among forward-looking researchers, operational experts, and industry
  - DARPA ability to undertake projects that are not tied to validated military requirements distinguishes it from other sources of Defense S&T funding



DARPA's success depends on **making linkages** with other organizations and **facilitating action** on security problems

Define challenges, develop solution concepts, and demonstrate them

VISION

- Define strategic challenges *in detail* across multiple scenarios
  - DARPA research priorities have been informed by studies that provided specific, well-articulated challenges and guidance
- Develop disruptive concepts for assessment
  - Support development of **integrating concepts** -- not just individual capabilities -- beyond purview of a single service
  - Facilitates a “critical mass” of research effort
- Test promising concepts in large-scale, integrated “proof of concept” demonstrations
  - Maintain a scientific process (unlike acq. programs)

Controversy about and tension between DARPA roles

VISION

Accepted role

Pursuer of new breakthrough technologies *independent of defined needs*

- Open, wide-ranging, slow process aimed at discovery of better solutions

Debated role

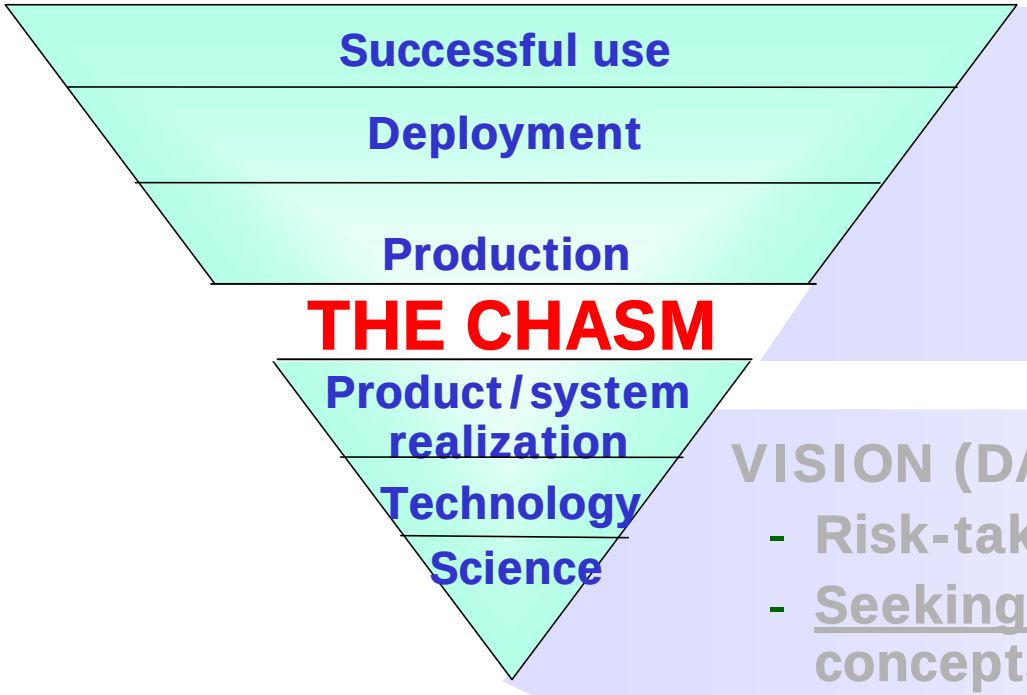
Developer of concept prototypes and demonstrations that *address needs* (but not defined requirements)

- Process of closure: refinement and tradeoffs among known properties and implementation of imperfect solutions

DARPA Director needs to mediate these missions and bridge these communities

Integration can be as "high risk" as technology development

Two aspects of success: Vision and Leadership



LEADERSHIP (OSD focus)

- **Top-down interest and involvement crucial for implementing disruptive capabilities**

VISION (DARPA focus)

- **Risk-taking, committed PMs**
- **Seeking and developing disruptive concepts**
- **Fighting against internal & external resistance**

If transformational capabilities are the objective,
it is insufficient for DARPA to create an example
and then rely upon the ordinary Service acquisition system

Launching disruptive concept programs

LEADERSHIP

- Broker deals with Service Leadership
  - Entails “firm handshakes and strong arms”
  - OSD may have to “create” a customer
- Create an independent capability either within the Service or in an outside agency
  - Need an organizational home for acquisition
  - External organization particularly helpful for joint capabilities that no single Service feels they own
- Work with Congress to protect funding
  - Always an uphill battle if disruptive capabilities compete with a large platform
- **Provide high-level imprimatur for potentially “disruptive” programs**

Some of today's challenges

- Threat and strategy ambiguity
  - Post Cold War ==> small unit precision engagement?
  - Lessons of Somalia, Kosovo, 9/11, Afghanistan, Iraq
  - War on terrorism
- Globalization and commercialization
  - Maintaining technological superiority in an open, networked, global marketplace
  - Infrastructure supporting confluence and convergence of potentially disruptive technologies
  - Linking development of new technologies and defense industry mega-integrators

"The best way to predict the future is to help create it"