

ARPA-E AND DARPA: APPLYING THE DARPA MODEL TO ENERGY INNOVATION



William B. Bonvillian & Richard Van Atta
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Background:

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- *DARPA -*

- Formed from Sputnik Challenge, 1958
- Avoid “technology surprise” → create technology surprise
- Spurred fundamental military and commercial breakthroughs

- *ARPA-E -*

- Proposed in NAS’ “Gathering Storm” 2006 report
- Authorized in “America Competes Act” 2007
- Initial Appropriations: \$300m FY2009/10 ARRA
- Current Appropriations : \$275m in FY12
- Conscious attempt to apply DARPA model to energy

TOPICS:

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- DARPA:
 - Traditional DARPA ruleset
 - Less-known DARPA elements
- ARPA-E:
 - Rules adapted from DARPA
 - New rules developed in response to energy sector
 - Lessons from other DARPA elements for ARPA-E
- Challenge to both DARPA and ARPA-E: technology implementation

I. The DARPA Model:

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Well-known Elements in the DARPA Culture:

- Flat organization with empowered program managers
- Challenge-based “right-left” research model
- Emphasis on talented, entrepreneurial program managers (PMs) who serve for limited (3–5 year) term
- Research is performed entirely by the top outside performers, no internal research laboratory
- Projects focused on “high-risk / high payoff” motif aimed at achieving a demanding capability or challenge
- Initial short-term funding for seed efforts that can scale to significant funding for promising concepts
- Clear willingness to terminate non-performing projects

Less Known Elements in the DARPA Model:

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- **Multigenerational Technology Thrusts**
 - By working challenges over an extended period created enduring technology “motifs” which changed the technology landscape – IT, precision strike.
- **Complementary Strategic Technologies**
 - Launched related complementary technologies, which help build support for the commercialization or implementation
- **Confluence with an Advocate Community**
 - Played an intermediary role to build “communities of change–state advocates”

Less Known DARPA Elements, Con't

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- **Connected to Larger Innovation Elements**
 - Acts within larger innovation environment – usually as instigator to spawn researchers and new firms to effect overall vision
- **Takes on Incumbents**
 - Has taken on the turf of powerful companies or bureaucracies: desktop personal computing and the internet against the mainframe model; on military side it drove stealth, unmanned systems, precision strike and night vision
- **First Adopter/Initial Market Creation Role**
 - Has taken on technology insertion or early adoption role to foster initial or first markets for its new technologies. Key has been link to OSD for mil implementation.

Less Known DARPA Elements, Con't:

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- Ties to Leadership
 - Particularly effective when its programs have been tied to senior leaders in DOD or elsewhere – Perry, Foster
- Doesn't Necessarily Launch into a Free Market
 - Embodies “connected R&D”: hasn't just thrown its prototype technologies “over the wall”
 - DOD procurement needed to further its military advances
 - Has supported companies efforts to commercialize their products
 - Has tried various approaches to link mil and commercial dynamics.

II. Comparing the ARPA-E and DARPA Models:

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A) ARPA-E has incorporated the DARPA model:

- *Flat, non-hierarchical structure*
- *“Empowered” program managers*
- *Streamlined project approval process*
- *challenge-based “right-left” research model*
- *Focus on revolutionary breakthroughs*
- *Seeks world-class talent – experience in both academic research and in industry*
- *Waiver of civil service hiring authority*
- *Project duration is the life of the PM*
- *“Other transactions authority”*
- *“Hybrid” model*
- *Island/bridge model*

New Elements at ARPA-E

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- **Forcing Mechanism: Energy challenge different**
 - Differs from DARPA challenges – Faces complex, established “legacy” sector (CELS) [DARPA avoids]–needs new rules
- 1) **Sharpening Research Visioning, Selection, Support:**
 - “White Space” of tech opportunities
 - Two–stage selection process
 - Empowered Program Manager Culture
 - Fellows Program
 - Portfolio Approach
 - “Hands–on” relations with awardees

New Elements at ARPA-E, Con't:

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2) Building a Support Community:

- Have to get political support model right as well as substantive model
- Building internal connections within DOE
 - Office of Science, applied agencies, labs need to view ARPA-E as their supporter not contender for funding
- Summit
 - Community for its award losers, connect to investors and possible partners
- Support Community
 - VCs, companies and universities starting to create outside advocacy community

New Elements at ARPA-E, Con't:

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3) Technology Implementation:

- Considers the implementation process during award and research processes
- Uses “In-reach” within DOE
 - Ties to applied DOE agencies to move technologies to next stage
- Tie to DOD for testbeds and initial markets
- “Technology-to-market” team within ARPA-E
- Use “Halo Effect”
 - Select top performers; this enables VC/company follow-on – Plus: conscious ties to VCs/companies

New Elements at ARPA-E, Con't:

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- Understands VC 5/yr. yardstick
 - Energy 10/yr.+ yardstick – need to invent new model
- Connecting to the Industry Stage Gate Process
 - Industry R&D weeding out process very different from ARPA-E/DARPA
 - But ARPA-E technologies must connect to stage gate
- Encourage consortia within sectors
- Use of prize authority being considered

Relevance of Add'l DARPA Features to ARPA-E:

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As ARPA-E matures and starts to move its technologies to implementation, DARPA offers additional lessons...

- Multigenerational technology thrust
 - How to handoff between generations of PMs to maintain sectors of advance over time
- Strategic Relations between Technologies
 - Move related technologies that reinforce each other – storage and grid and renewables
- Confluence with an Advocate Community
 - Keep building community of researchers, companies, PM alumni

Relevance of Add'l DARPA Features to ARPA-E, Con't:

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- Connection to Larger Innovation Elements
- Takes on Incumbents
 - Because of Energy Legacy sector problem, deep problem for ARPA-E – lessons from DARPA IT on how to do
- First Adopter/Initial Market Role
 - ARPA-E must develop links; connect to DOD for testbeds, procurement
- Ties to Technology Leadership
 - ARPA-E used initial ties to DOE Sec. Chu, CFO, and House Sci. Comm. ex-chair Bart Gordon – now quite networked
 - Has informal industry advisors, too

III. The Remaining Technology Implementation Challenge for both DARPA and ARPA-E

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- Tech implementation challenge will get harder for DARPA
 - Defense procurement in decline and stretching out
 - Venture-based commercial pathway more difficult (less venture / less capital, greater foreign competition)
- Already hard for ARPA-E
 - Legacy Sector problem in energy is a major hurdle
 - ✦ VCs pulling out (standup takes too long in energy for their 3+3 year model), China & others offering low cost financing
 - ✦ Whole implementation process in energy is broken
- Both agencies will need to focus more on the innovation system “back end” for implementation

The Remaining Implementation Challenge, Con't:

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- DARPA developing “BAA – itis”?
 - Concern that DARPA moving too far in prescribing the solution, rather than challenge to be solved?
- DARPA & ARPA–E face big pressures to “deliver”
 - But funds for next–level prototyping and demonstration will be even more scarce – DOE doesn’t have; lacks acquisition like DOD
 - *DOD is failing in tech transition* – e.g., Army Future Combat System & Global Hawk
 - DARPA: more focus on how to proceed beyond DARPA; ARPA–E ahead on this (ties to DOD; technology–to–market team)
 - For both: the means to go further are beyond them—requires sustained organizational commitment from the top

Conclusions:

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- DARPA standard rules well-known, but there is a less-understood group of additional DARPA rules that are key to its effectiveness
- ARPA-E has absorbed DARPA's standard rules
- The energy sector forcing ARPA-E to evolve its own rules
- Additional DARPA rules offer lessons for ARPA-E as its technologies start to emerge and it moves to its next stage
- Both DARPA and ARPA-E need to focus on their technology implementation capabilities
- However--"Change-state" vision is still key role for both... pressures to implement must not dilute this