Basic Research Commercialization: New Approaches to Drive Technology Maturity

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ASD(R&E)/Basic Research Office

What is Basic Research?

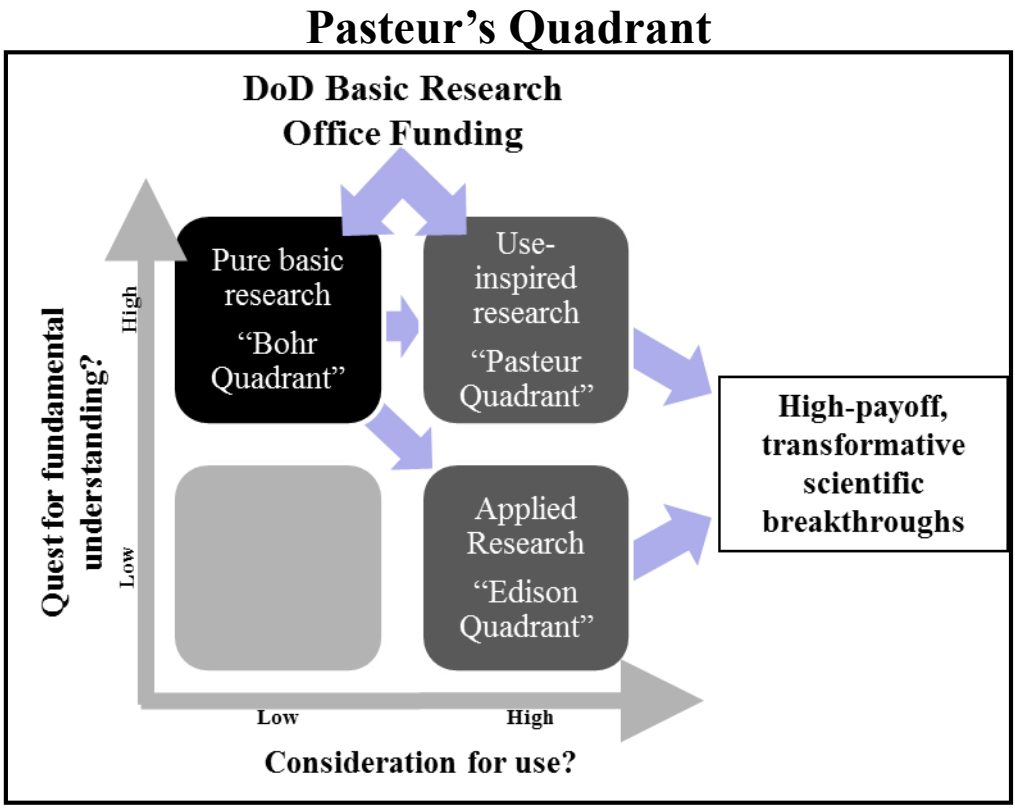
"Systematic study directed toward greater knowledge or understanding of the fundamental aspects of phenomena and of observable facts…"

(DoDI 3210.1 dated September 16, 2005 *Administration and Support of Basic Research by the Department of Defense*)

The Basic Research Office

Pursuing basic research investments with the potential of creating high-payoff, disruptive scientific breakthroughs and capability for the Department of Defense

Basic research focused on stimulating the initiation or support of promising areas of research, and those of potentially plate-shifting significance to future Defense capabilities.



Adapted from "*Pasteur's Quadrant: Basic Science and Technological Innovation*" by Donald E. Stokes, Brookings Institution Press, Mar 1, 2011.

Why DoD Invests in Basic Research

- Basic research probes the limits of today's technologies and discovers new phenomena and know-how that ultimately lead to future technologies and a future military advantage.

- Basic research funding attracts some of the most creative minds to fields of critical DoD interest, and creates a community of U.S. researchers with expertise in defense enterprise needs.

- Basic research funding creates a knowledgeable workforce by training students in the U.S. in fields of critical DoD interest.

- Basic research funding ensures U.S. dominance in the global technological competition, by investing in potentially disruptive science and preventing technological surprise by adversaries.

- Basic research is essential for maintaining U.S. economic and military strength.

Basic research provides a broad perspective to prevent capability surprise by fostering a community of U.S. experts who are accessible to DoD, and who follow global progress in both relevant areas, as well as those that may not seem relevant — until they are.

Basic Research Office Strategy

Vision:

To be a pacemaker for technological progress in DoD and for the United States through purposeful identification and communication of new principles and concepts such that they may be incorporated as new technologies.

Mission:

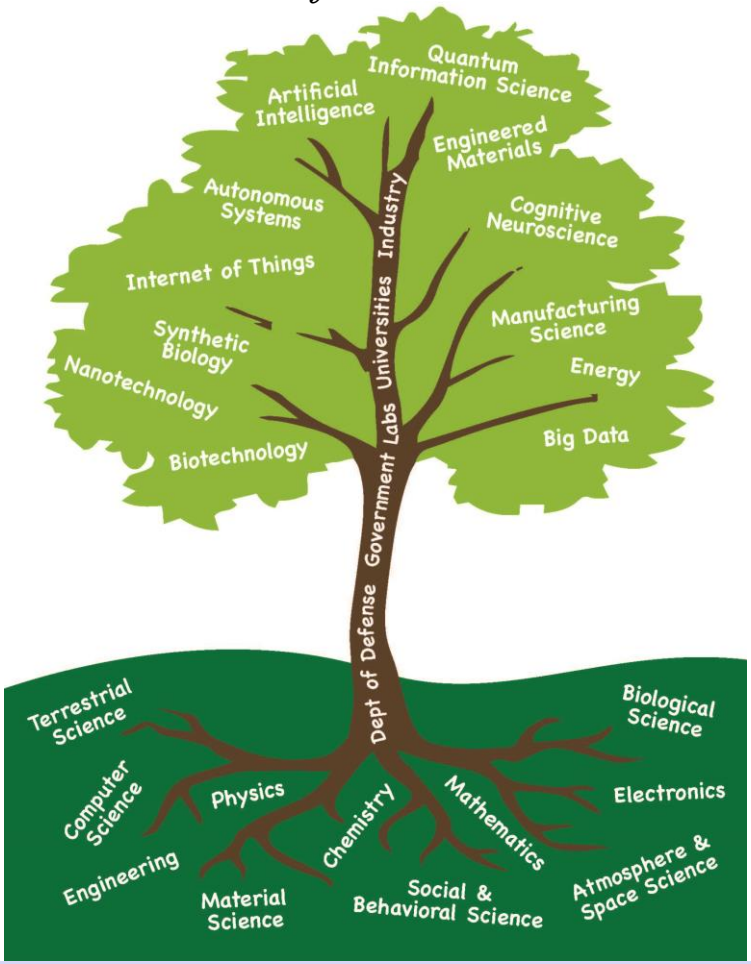
The Basic Research Office is the Department-wide strategic thread in ensuring future capability, and makes investments in areas where the Services may not be able to. We work with academia, industry, and government partners to foster collaborations, shape priorities, and forge pathways in scientific investment areas that aim to establish new and strengthened alliances with international allies, insertion of new innovations into programs of record, and long-term scientific and technological superiority.

Basic research is the basis for elucidating fundamentally new ways to defend our nation.

Key Basic Research Investment Areas

- **Artificial Intelligence/Machine Learning**
- **Quantum Information Science**
- **Neuroscience**
- **Novel Engineered Materials**
- **Understanding Human and Social Behavior**
- **Engineered Biology**
- **Manufacturing Sciences**
- ***What's next?***

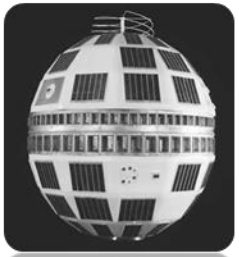
"Tree of Innovation"

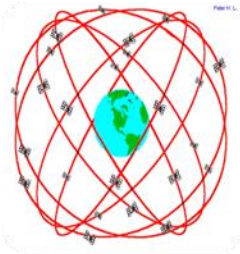


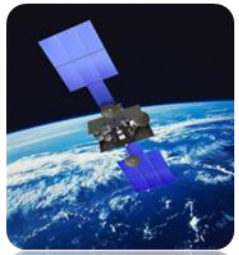
Basic research empowers the future of science and technology to help enhance the warfighter capability of the future

Basic Research: Foundations of Progress









40s	50s	60s	70s	80s	90s	00s
Nuclear weapons	*Digital computer*	*Satellite comm.*	*Airborne GMTI/SAR*	*GPS*	*Wideband networks*	*GIG*
Radar	*ICBM*	*Phased-array radar*	*Strategic CMs*	*UAVs*	*Web protocols*	*Armed UAVs*
Proximity fuse	*Integrated circuits*	*Defense networks*	*IR search and track*	*Night vision*	*Precision munitions*	*Optical SATCOM*
Sonar	*Laser technology*	*Stealth*	*GaAs MMICs*	*Personal computing (VLSI)*	*Solid state radar*	*Data mining*
Jet engine	*Nuclear propulsion*	*Airborne surv.*	*Space track network*	*Counter-stealth*	*Advanced robotics*	*Advanced seekers*
LORAN	*Digital comm.*	*MIRV*	*C2 networks*	*BMD hit-to-kill*	*Speech recognition*	*Decision support*
Transistor		*Kalman filter*				*MRAM*

Basic Research Office Investment: Commercializing Research

Leveraging investments in basic research and assisting scientific breakthroughs in becoming new technologies and products

Innovation Corps @ DoD program (I-Corps @ DoD)

•Trains scientists in principles of entrepreneurship

•Acts as a bridge between investigators and the marketplace, to foster eventual commercialization and technology transfer, as is done through SBIR/STTR and RIF programs.

Defense Enterprise Scientific Initiative (DESI)

•Fostering collaborations between academia and industry

•Drive technology maturity through basic research investment

Proof of Concept Commercialization Pilot Program

- **10 USC § 2359 – "Science and technology programs to be conducted so as to foster the transition of science and technology to higher levels of research, development, test, and evaluation"**
  - Purpose "to accelerate the commercialization of basic research innovations"

- **Note – "Proof of Concept Commercialization Pilot Program"**
  - Amended in the FY15 NDAA to authorize the use of basic research funds for such a pilot program
  - Funds from an award used to evaluate the commercial potential of existing discoveries, including:
    - technical validations
    - market research
    - clarifying intellectual property rights
    - investigating commercial and business opportunities.
  - Funds from an award ***not*** for basic research, or to fund the acquisition of research equipment or supplies unrelated to commercialization

NSF I-Corps™ Program

http://www.nsf.gov/news/special_reports/i-corps/

- **Intensive, curriculum-based program designed to provide researchers with entrepreneurship training and mentorship**
- **Ultimate goal is to foster the commercialization of technologies derived from government-funded research**
- **Three components:**
  - **I-Corps™ Teams**
  - I-Corps™ Nodes
  - I-Corps™ Sites

NSF I-Corps™ Teams

- **Each I-Corps™ Team has the following makeup:**
  - **Principal Investigator** - the technical lead and expert who is also responsible for overall grant management
  - **Entrepreneurial Lead** - a postdoctoral researcher or graduate student with relevant technical expertise who is committed to understanding the commercial landscape around the technology
  - **Mentor** – a third-party resource with industry/entrepreneurial experience

- **7-week curriculum**
  - In-person introductory workshop
  - Weekly web-based discussions
  - In-person “lessons learned” discussion
  - Outbrief/Final Pitch

I-Corps @ DOD

- **Awards of $45k + IDCs to up to 12 teams to attend the NSF I-Corps curriculum**
- **Applicants must have a current or former (last 5 years) DoD research grant from 6.1 funds related to the technology**
- **Solicitation released May 2016 (6 teams funded), new solicitation released July 2017 with teams entering the fall/winter cohorts of NSF I-Corps™**
- **Possible outcomes**
  - Licensing a new technology
  - Starting a company
  - Competing for SBIR/STTR, RIF, MPP, etc…

Early Results From DoD teams

- **5 teams have completed the program, one still to go (late Aug), early outcomes include:**

- **<u>Private Capital:</u> One team has already raised $1.4 million in private capital to make fiber-welded cotton products; applied for ARO SBIR to make flame retardant tents.**

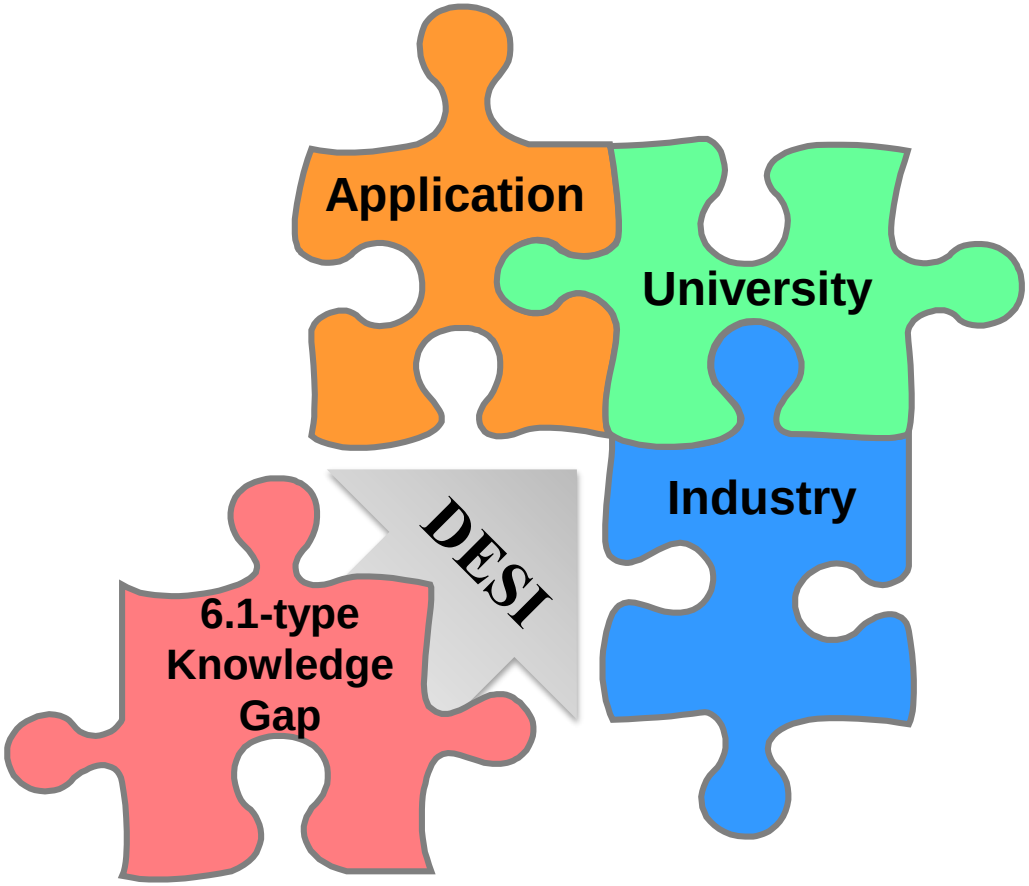
- **<u>Technology Pivots:</u> A team focused on high power laser optics pivoted from energy weapons to airplane countermeasures based on feedback received.**

- **<u>Entrepreneurial Mindset:</u> Entrepreneurial lead of a team producing carbon fibers for lightweight airplane components won the "most improved" award for the NSF cohort of 20 teams.**

Defense Enterprise Scientific Initiative

- Pilot Project organized by Office of Basic Research
- Objective: Accelerate solutions to key DoD knowledge and capability gaps through *use-inspired basic research*
- Goals:
  - Support Industry-University collaboration
  - Expand pool of outside researchers with expertise in DoD operational context
  - Create unique opportunities for industry to develop and offer new and superior capabilities
  - Strategically employs ~$3M of FY16 Office of Basic Research Funds for Defense Enterprise impact.

DESI's Role in Technology Development: Fill Knowledge Gaps



University Role

- Leverage emerging science address key operational challenges

Industry Role

- Provide operational context
- Transition new knowledge into capabilities for DoD

DESI is aimed at projects with a known **application**, **university** interest, potential for **industry IRAD**, and a 6.1-type **foundational knowledge gap**.

STIX

Science, Technology & Innovation Exchange

STIX

Science, Technology & Innovation Exchange

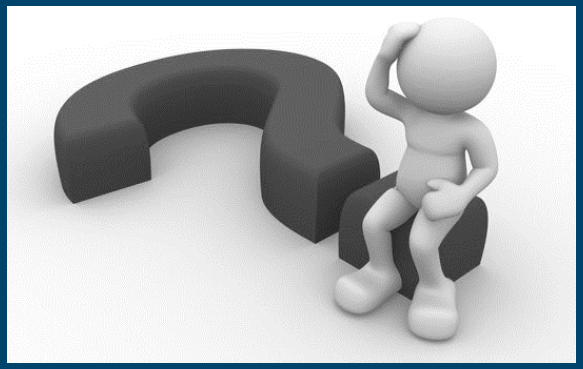
- BRO pilot, 1st Defense-wide event of its kind
- TED-style event
- Short, carefully prepared presentations
- 2 day meeting in Crystal City, VA and livestreamed online
- Event theme:

"THE BIG QUESTION"

I. …that my research seeks to answer

II. …that my technology addresses

III. …identifying, nurturing, recruiting, retaining top STEM talent to ensure the nation's present and future security



@DoD_STIx **#thisisDoDscience**

STIx

Science, Technology & Innovation Exchange

STIx presenters:

- ✓ Physics Nobel Laureate
- ✓ DoD lab scientists
- ✓ PECASE winners
- ✓ university profs/deans
- ✓ university center directors
- ✓ students

Organizations:

- ✓ BRO
- ✓ DARPA
- ✓ NIU
- ✓ NRO
- ✓ ARL, AFRL, & NRL
- ✓ Universities large and small (MIT→ SIPI)

STIx

Science, Technology & Innovation Exchange

Audience:

- ✓ University administrators, professors, researchers, & students
- ✓ Industry researchers, R&D executives
- ✓ Middle, high school administrators, educators, & students
- ✓ Anyone interested **in learning about DoD S&T**

Ways to Participate:

- ✓ Attend the live event **(SOLD OUT)**
- ✓ Livestream
- ✓ Watch videos

REGISTER HERE: bit.ly/2gXepi2

WE WANT YOU…

to attend STIx!

Closing Thoughts…

The publicly and privately supported colleges, universities, and research institutes are the centers of basic research. They are the wellsprings of knowledge and understanding. As long as they are vigorous and healthy and their scientists are free to pursue the truth wherever it may lead, there will be a flow of new scientific knowledge to those who can apply it to practical problems in Government, in industry, or elsewhere.

https://en.wikipedia.org/wiki/Vannevar_Bush

Basic research is "the pacemaker of technological progress". "New products and new processes do not appear full-grown…They are founded on new principles and new conceptions, which in turn are painstakingly developed by research in the purest realms of science."

Vannevar Bush

BACKUP

Outcomes of the NSF I-Corps™ Program

Data from 2011 through Spring 2017:

- **Out of 904 teams, 361 companies have been formed**
- **$105 million follow on capital raised:**
  - $39.5 million from private sources (Angels, Corporate, VCs)
  - $49.0 million from public sources (federal or state agencies)
  - $16.8 million from other sources (incubators, accelerators, etc.)
- **~1/3 of I-Corps teams have gone on to receive an SBIR award**
- **I-Corps @ DOD will be unique from the NSF program in the DOD is also a potential customer**

DESI's Place in Basic Research Investment Strategy

	Mainstream 6.1	MURI	DESI
Structure	Single Investigator	Teams that intersect multiple disciplines	Teams that intersect and link universities and industry
Context	Unfettered Exploration	Exploration loosely tied to applications	Use-inspired basic research
Outcomes	New knowledge that is the foundation for new possibilities	New knowledge that is the foundation for new capabilities	New knowledge that is the foundation for new solutions to key operational challenges
Growth in Research Base	Expert scientific knowledge in specific domains	Expert scientific knowledge across multiple domains	Expert scientific awareness of DoD operational context