



National Defense Industrial Association
Science & Engineering Technology Division
Executive Breakfast

The Missing Middle

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National Security and International Affairs

Office of Science and Technology Policy

May 10, 2011

National Security S&T is a Presidential Priority



“Reaffirming America’s role as the global engine of scientific discovery and technological innovation has never been more critical ... Our renewed commitment to science and technology ... will help us protect our citizens and advance U.S. national security priorities.”

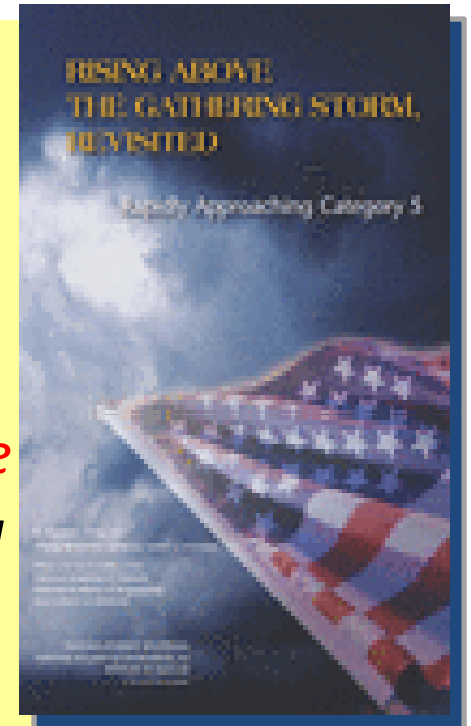
National Security Strategy, May 2010

Elements of Innovation

“How then is America to maintain, or preferably enhance, the future standard of living of its citizenry? The answer (and seemingly the only answer) is through innovation.

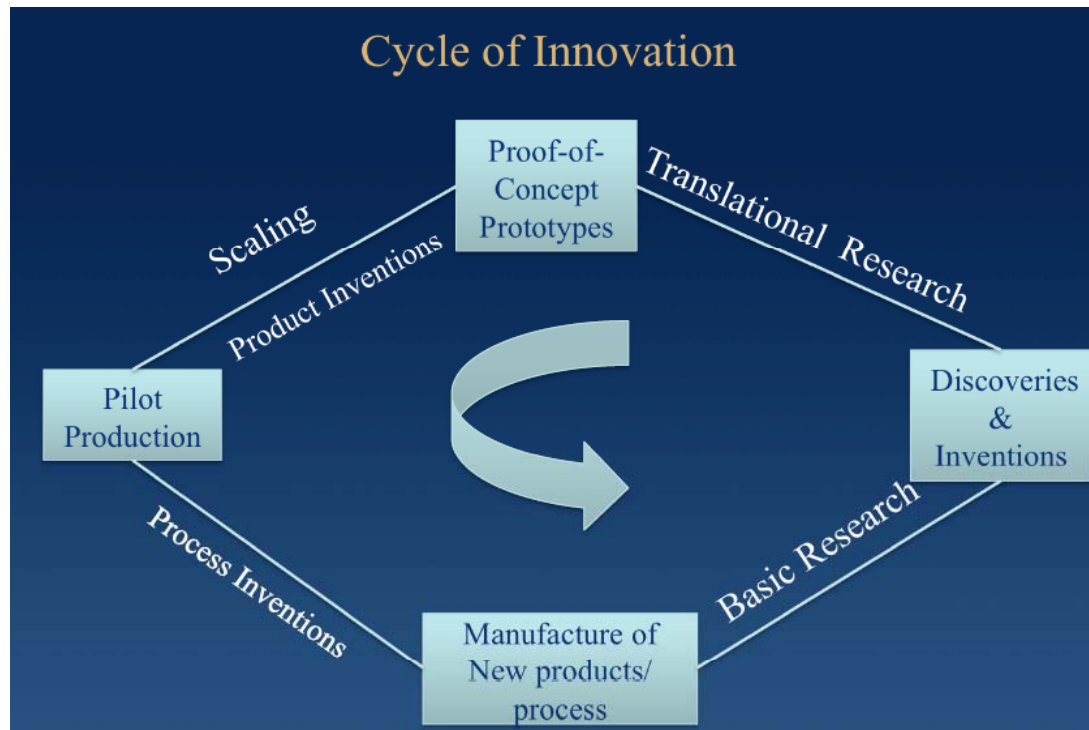
*Innovation commonly consists of being **first to acquire** new knowledge through leading edge research; being **first to apply** that knowledge to create sought-after products and services, often through world-class engineering; and being **first to introduce** those products and services into the marketplace through extraordinary entrepreneurship. “*

*Rising Above the Gathering Storm, Revisited –
Rapidly Approaching Category 5 (2010)*



Industrial Commons

Industrial Commons – Engineering R&D, materials, standards, tools, equipment, scalable processes, components, and manufacturing competencies in platform technologies needed to produce cost-effective, safe and reliable products. (Pisano & Shih, “Restoring American Competitiveness”, HBR, July 2009)



Completing the innovation cycle establishes the industrial commons. Without the Commons we cannot manufacture, and we lose our ability to innovate next generation products.

The Missing Middle

The “Missing Middle” – A gap in access to capital or other key resources at a crucial step in the development of new businesses or new technology.

The gap often occurs at the stage of development where opportunity and uncertainty are both high.

Going...Going...Gone

Many high-tech products can no longer be manufactured in the United States because critical knowledge, skills, and suppliers of advanced materials, tools, production equipment, and components have been lost through outsourcing. Many other products are on the verge of the same fate.



Semiconductors

ALREADY LOST

"Fabless" chips

AT RISK

DRAMs

Flash memory chips

Lighting

ALREADY LOST

Compact fluorescent lighting

AT RISK

LEDs for solid-state lighting, signs, indicators, and backlights

Electronic displays

ALREADY LOST

LCDs for monitors, TVs, and handheld devices like mobile phones

Electrophoretic displays for Amazon's Kindle e-reader and electronic signs

AT RISK

Next-generation "electronic paper" displays for portable devices like e-readers, retail signs, and advertising displays

Energy storage and green energy production

ALREADY LOST

Lithium-ion, lithium polymer, and NiMH batteries for cell phones, portable consumer electronics, laptops, and power tools

Advanced rechargeable batteries (NiMH, Li-ion) for hybrid vehicles

Crystalline and polycrystalline silicon solar cells, inverters, and power semiconductors for solar panels

AT RISK

Thin-film solar cells (the newest solar-power technology)

Computing and communications

ALREADY LOST

Desktop, notebook, and netbook PCs

Low-end servers

Hard disk drives

Consumer-networking gear such as routers, access points, and home set-top boxes

AT RISK

Blade servers, midrange servers

Mobile handsets

Optical-communication components

Core network equipment

Advanced materials

ALREADY LOST

Advanced composites used in sporting goods and other consumer gear

Advanced ceramics

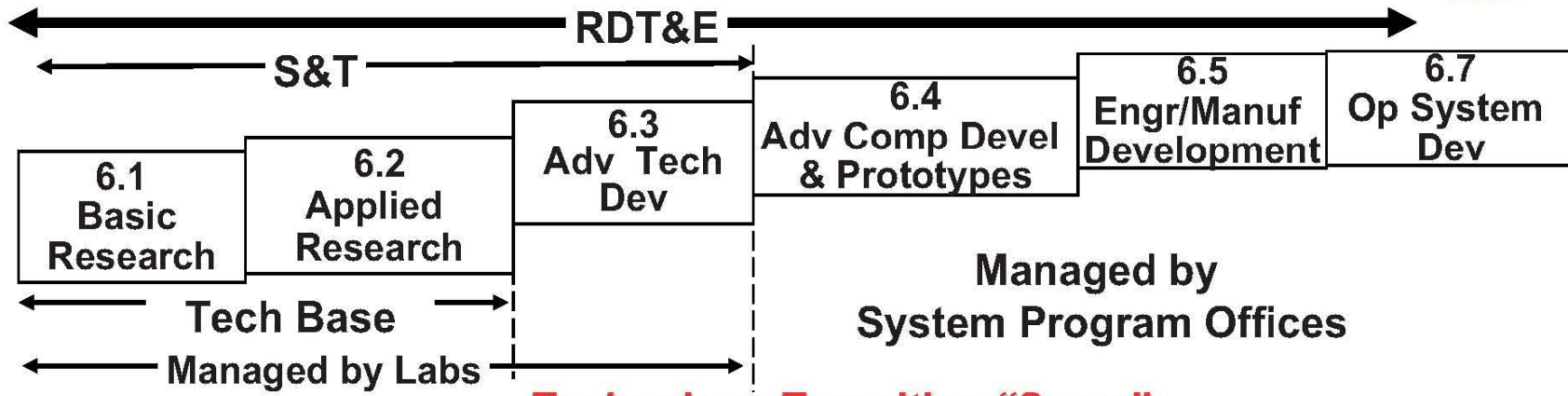
Integrated circuit packaging

AT RISK

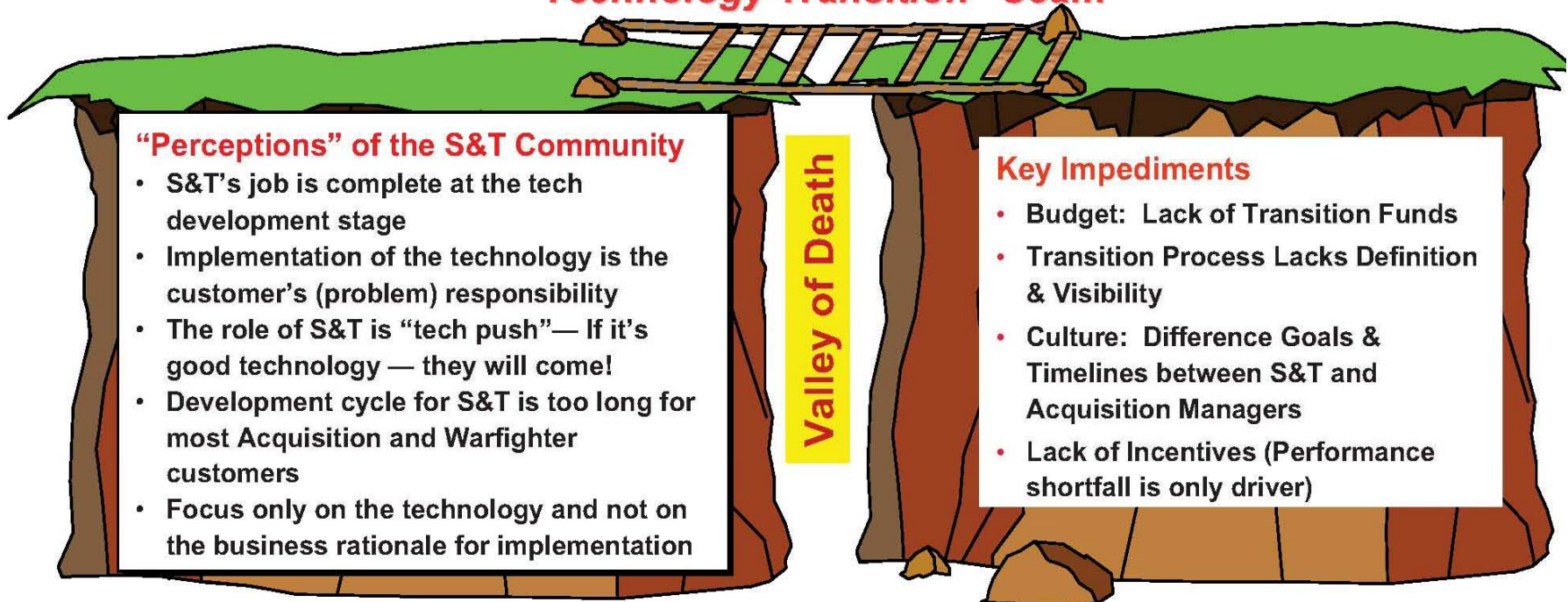
Carbon composite components for aerospace and wind energy applications

Taken from Gary Pisano and Willy Shih, "Restoring American Competitiveness", Harvard Business Review, July-August 2009

The Technology Transition Challenge



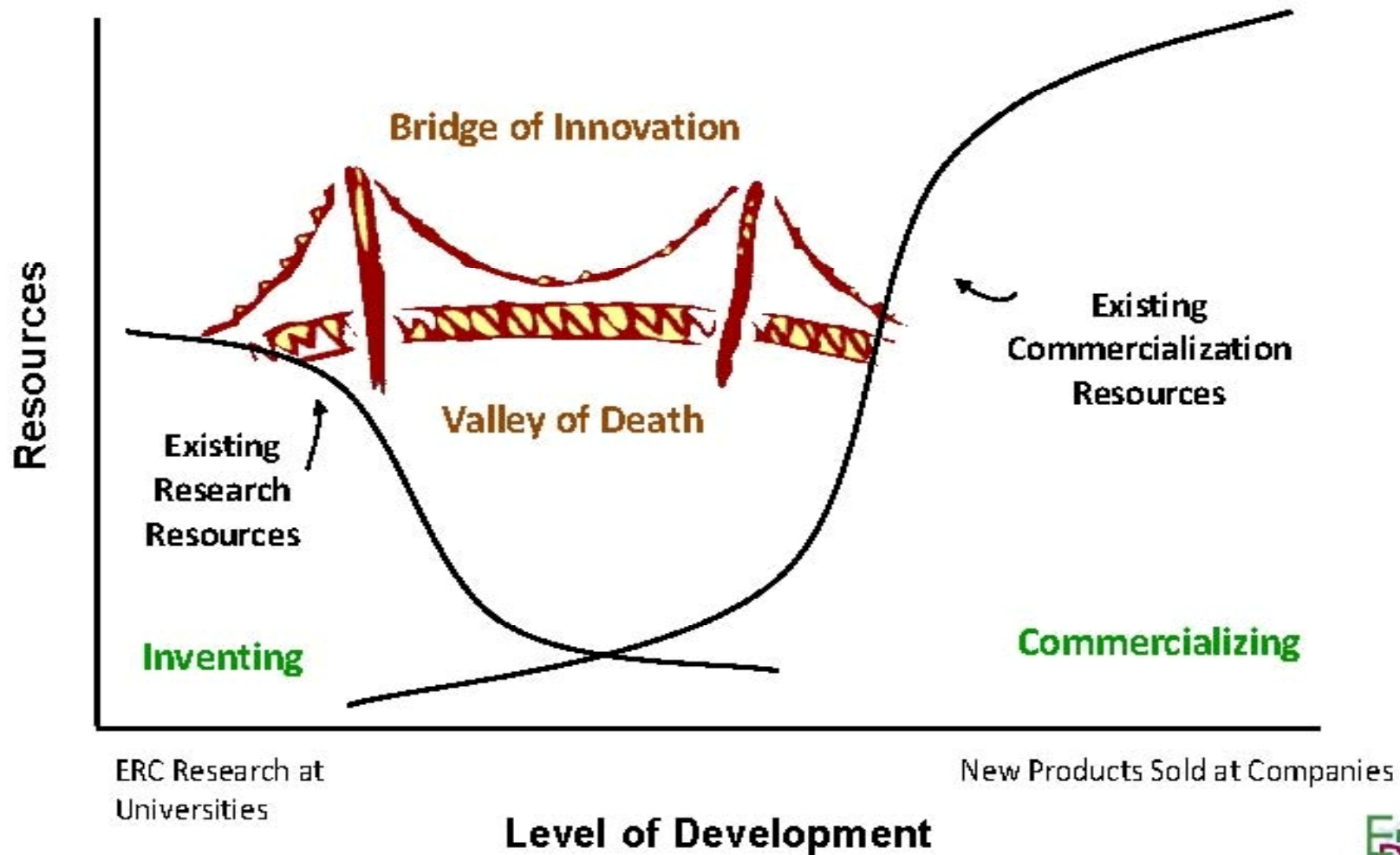
Technology Transition "Seam"





Between Invention and Commercialization

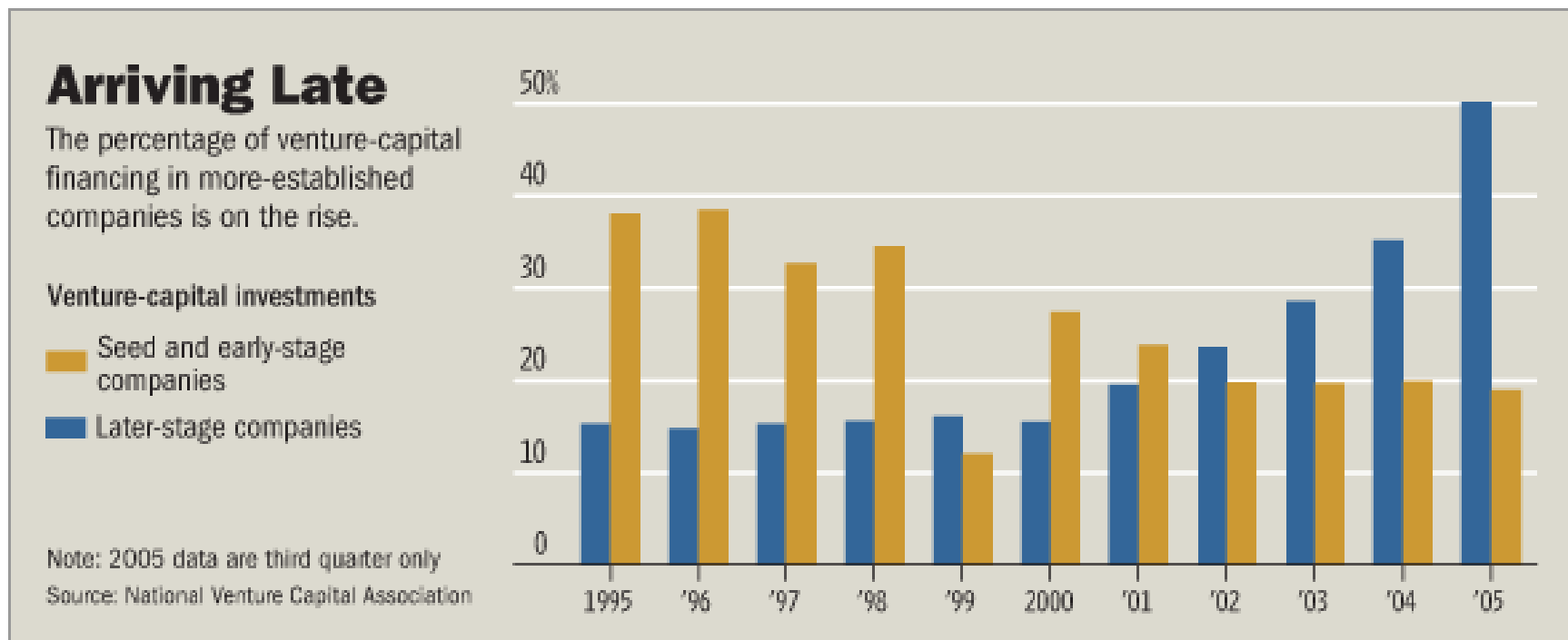
Innovation Program to Bridge the Valley of Death



Adapted from Dr. Deborah Jackson, 2011

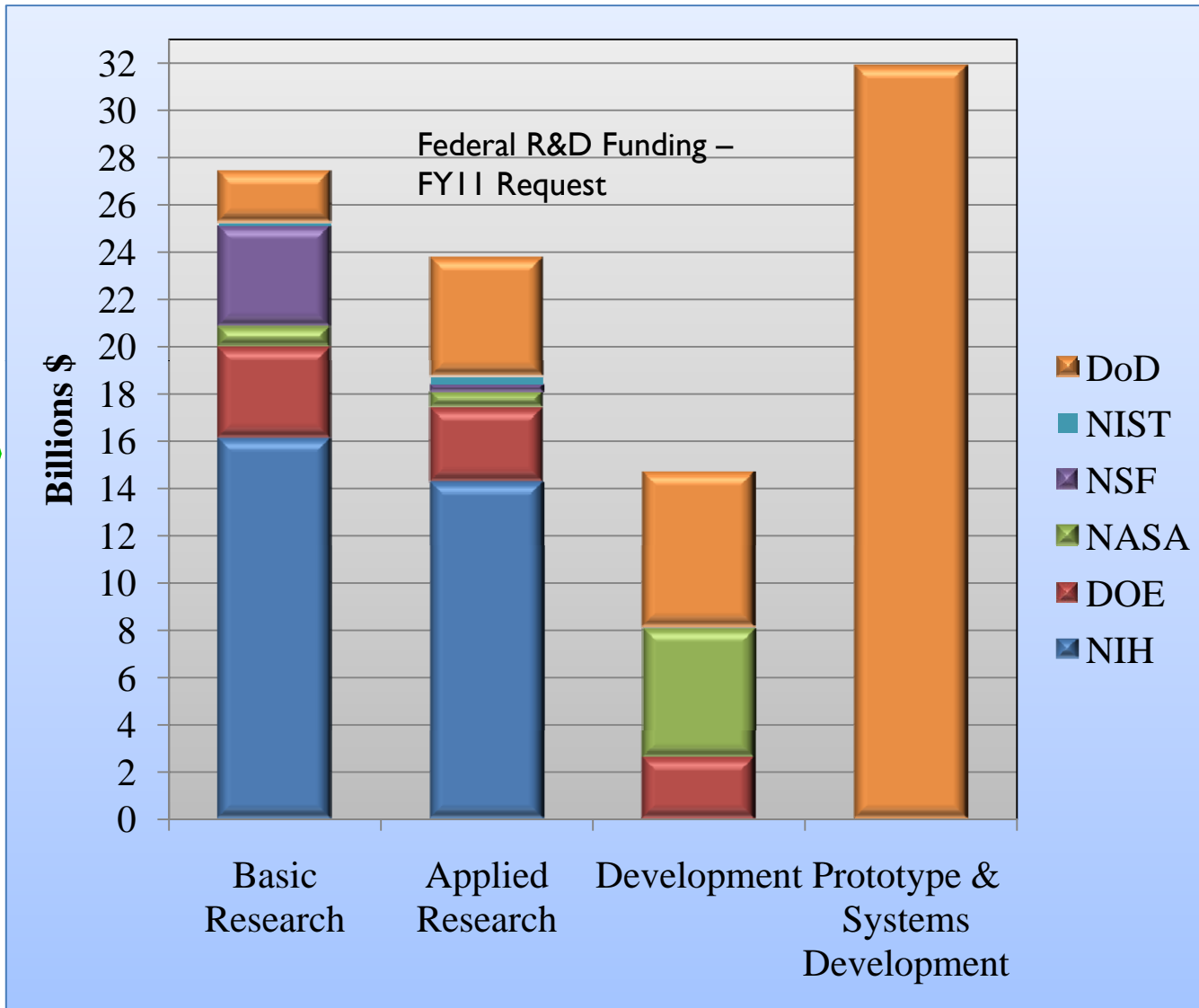


Early-stage funding for startups is drying up as venture capital seeks later-stage investments



Federal R&D Portfolio

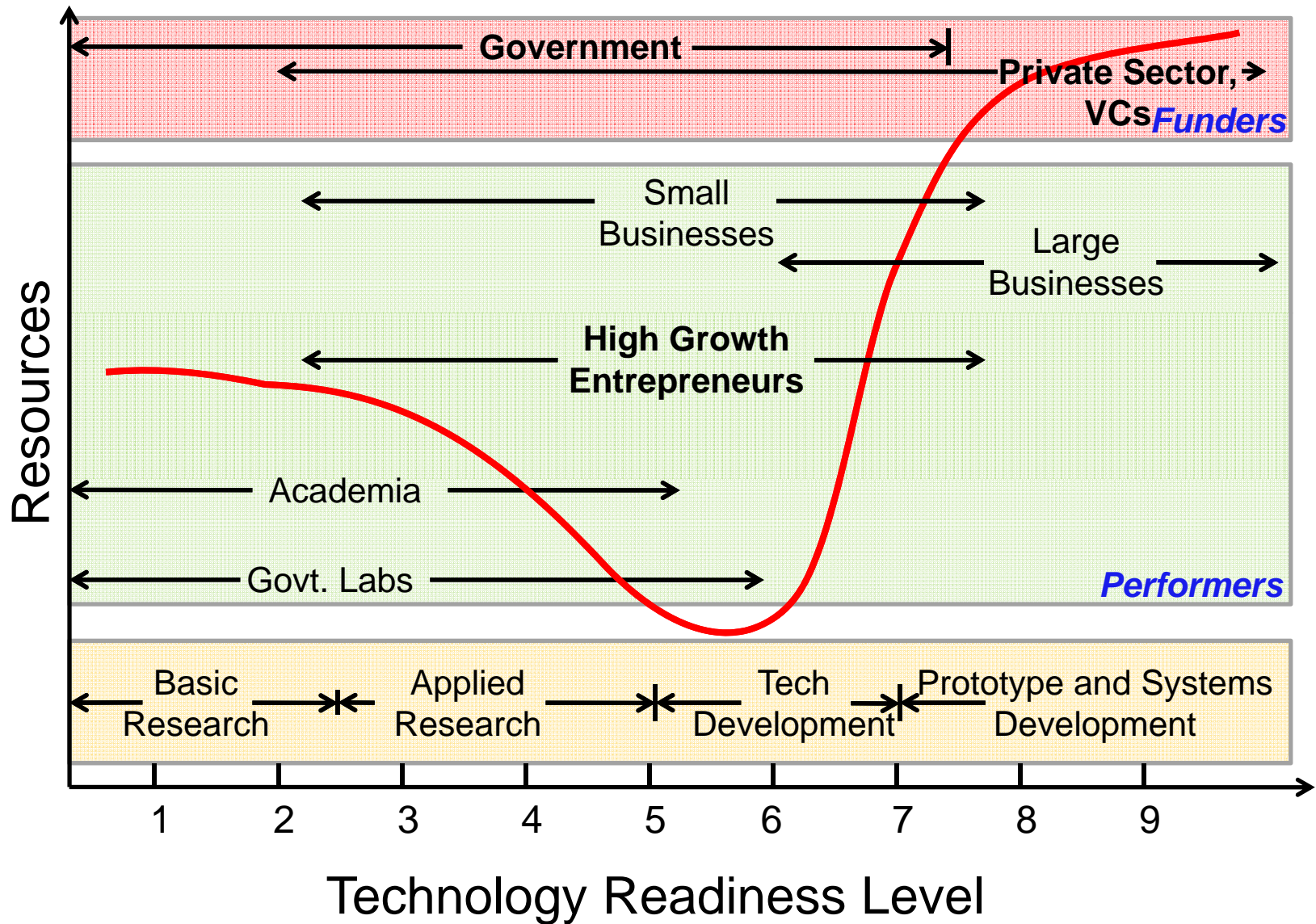
~\$100B
Annual
Federal
Investment



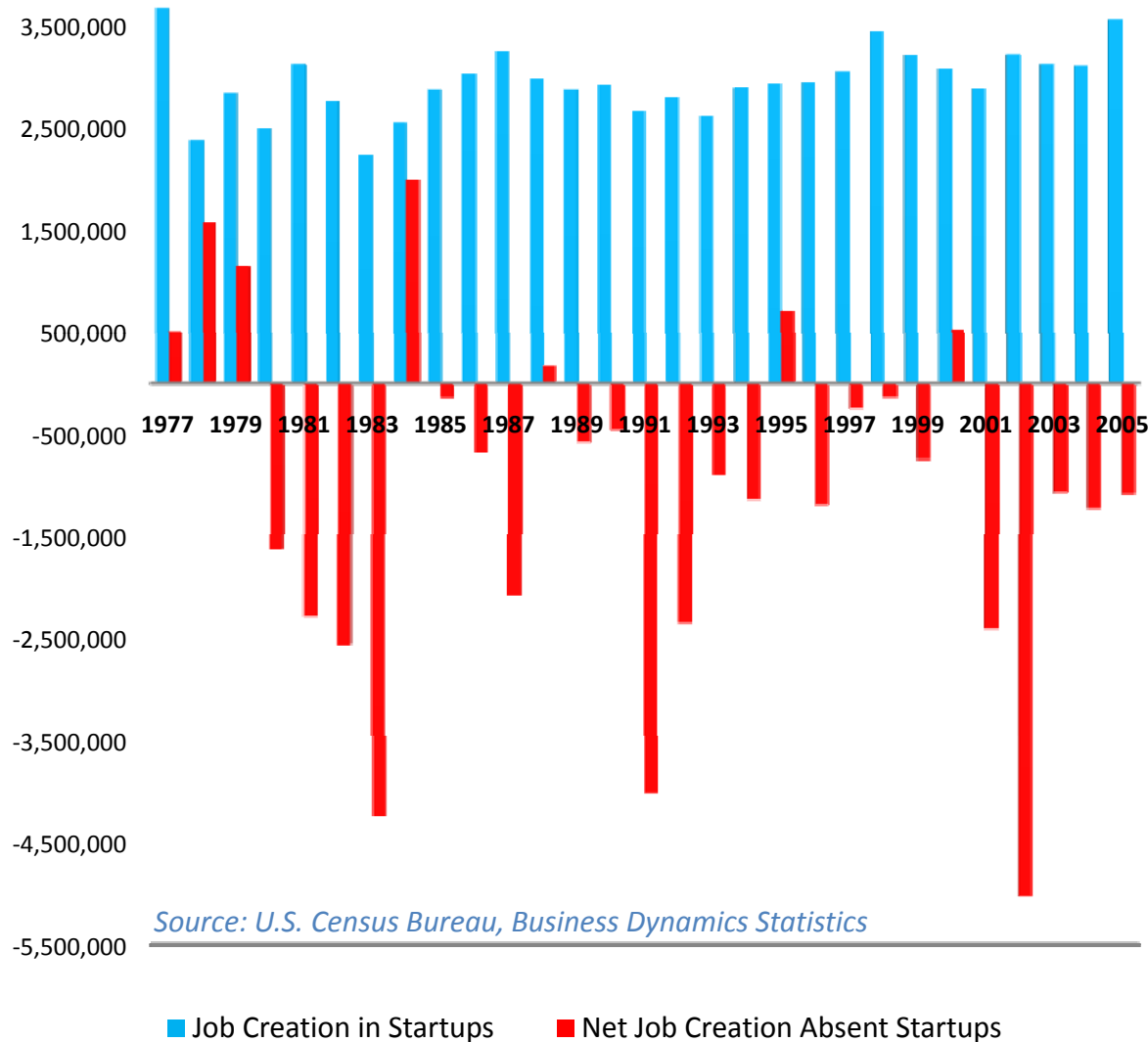
~\$80B
Annual
High Tech
Trade
Deficit*

* SOURCE: NSF Science & Engineering Indicators, 2010

Elements of the Valley of Death



Net Job Creation within Startups vs. without Startups

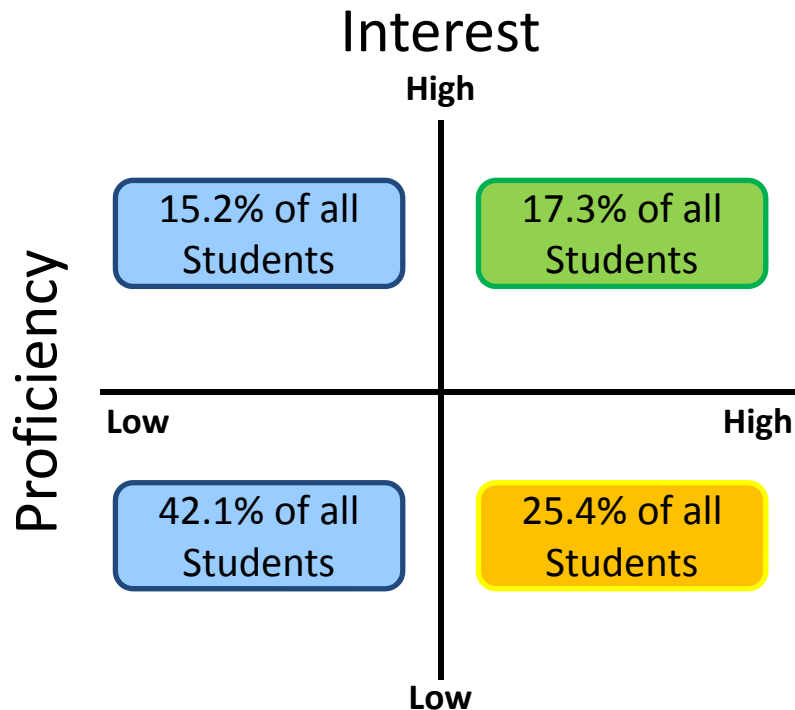


- High-growth firms or “gazelles” account for a disproportionate share of job creation in any given year, generating roughly 40 percent of new jobs in any given year.
 - The fastest-growing young firms (between the ages of three and five) account for less than 1 percent of all companies in the economy, yet generate 10 percent of new jobs each year.
- Source: Kauffman Foundation Research Series: Firm Formation and Economic Growth High-Growth Firms and the Future of the American Economy, March 2010.

Workforce

“In recent years one-fourth of the graduates of MIT are said to have opted to go to work for financial firms on Wall Street.”

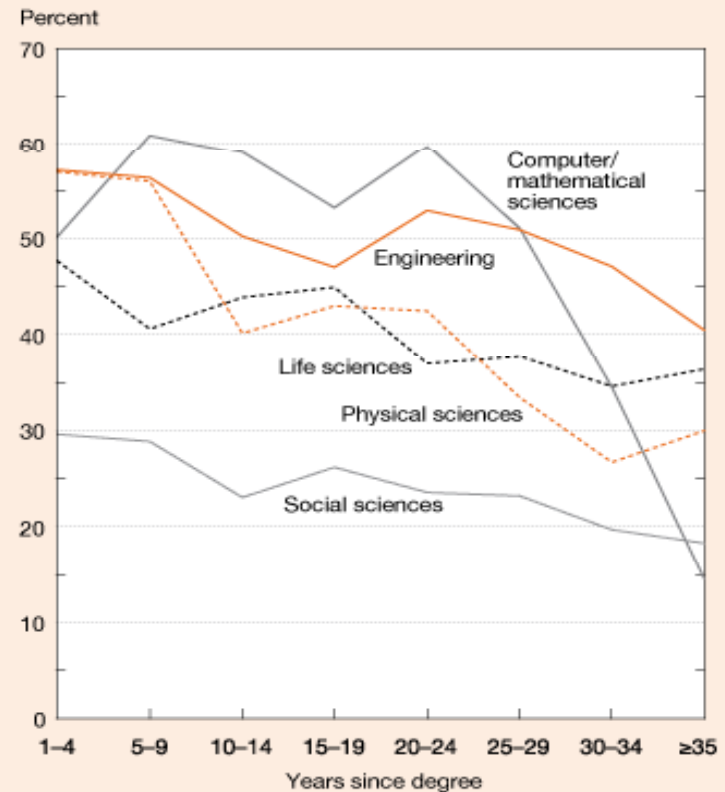
Norm Augustine to Senate Armed Services Committee, May 2011



Data from American College Testing (ACT) indicate that fewer than one in five students are both interested and proficient in STEM subjects.

SOURCE: Business Higher Education Forum: “Confronting the STEM Challenge: A New Modeling Tool for U.S. Education Policymakers”

Figure 3-9
S&E bachelor’s degree holders employed in jobs closely related to degree, by field and years since degree: 2006



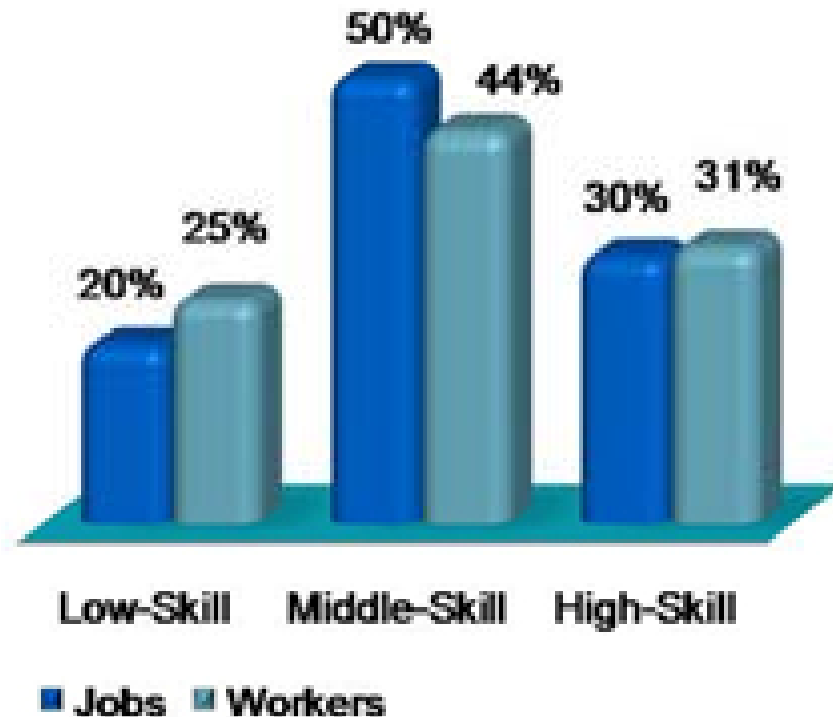
SOURCE: National Science Foundation, Division of Science Resources Statistics, Scientists and Engineers Statistical Data System (SESTAT) (2006), <http://sestat.nsf.gov>.

Science and Engineering Indicators 2010

Middle-Skills Gap

- Middle-skill jobs, which require more than a high school education but less than a four-year degree, currently make up the largest segment of jobs in the U.S. economy.
- In 2006, about 50 percent of all jobs nationally were classified as middle-skill, but only 44 percent of workers had the education and training required to fill those positions.
- During a month in 2009 when the economy lost a quarter of a million jobs, more than 60 percent of employers reported difficulty finding qualified applicants to fill current vacancies.

America's Middle-Skill Gap, 2006



Persistent shortages of middle-skill workers inhibit industry growth and U.S. competitiveness.

SOURCE: National Skills Coalition

*The Missing Middle:
Ideas for the Future*

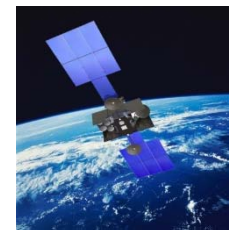
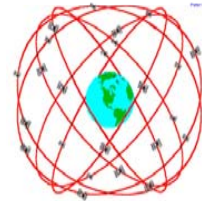
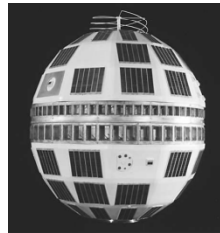
Winning the Future Through Investments in Innovation, Education, and Infrastructure



“We know what it takes to compete for the jobs and industries of our time. We need to out-innovate, out-educate, and out-build the rest of the world.”

*- President Barack Obama
January 25, 2011*

Science and Technology Enable Progress



40s	50s	60s	70s	80s	90s	00s
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<ul style="list-style-type: none"> • Nuclear weapons • Radar • Proximity fuse • Sonar • Jet engine • LORAN 	<ul style="list-style-type: none"> • Digital computer • ICBM • Transistor • Laser technology • Nuclear propulsion • Digital comm. 	<ul style="list-style-type: none"> • Satellite comm. • Integrated circuits • Phased-array radar • Defense networks • Airborne surv. • MIRV 	<ul style="list-style-type: none"> • Airborne GMTI/SAR • Stealth • Strategic CMs • IR search and track • Space track network • C2 networks 	<ul style="list-style-type: none"> • GPS • UAVs • Night vision • Personal computing • Counter-stealth • BMD hit-to-kill 	<ul style="list-style-type: none"> • Wideband networks • Web protocols • Precision munitions • Solid state radar • Advanced robotics • Speech recognition 	<ul style="list-style-type: none"> • GIG • Armed UAVs • Optical SATCOM • Data mining • Advanced seekers • Decision support
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S&T supports new DoD capabilities



(\$ M)	FY 2011 Request	FY 2011 Appropriation
"Science and Technology" (S&T; "6.1" through "6.3")		
DOD S&T ("6.1" - "6.3")	11,833	12,102
DOD basic research ("6.1")	1,999	1,947
DOD applied research ("6.2")	4,476	4,492
DOD adv. Tech. ("6.3")	5,359	5,663



Manufacturing Initiatives

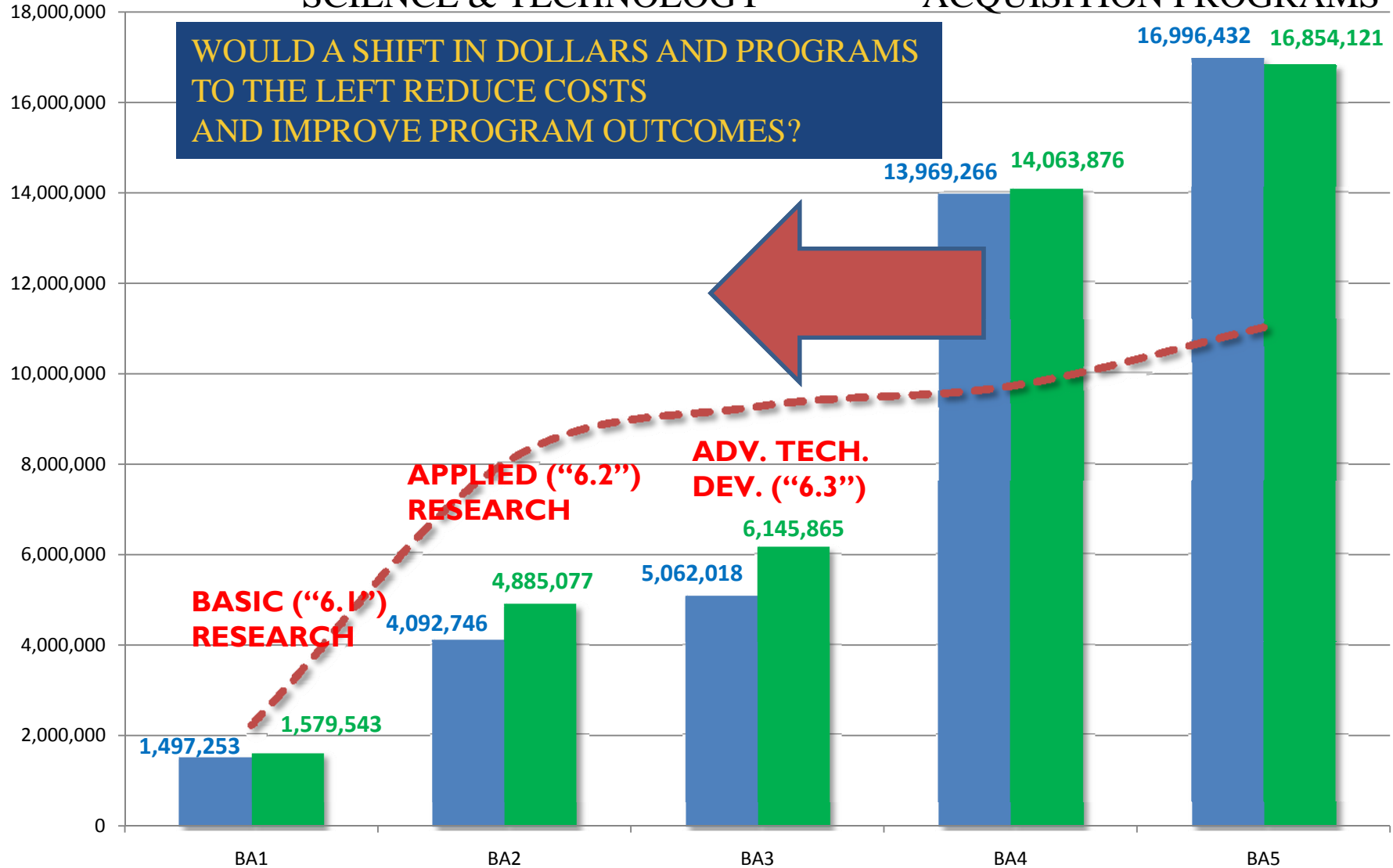
- FY12 Budget Request strongly supports Advanced Manufacturing
 - DOD: \$2 billion in Advanced Manufacturing over five years in DARPA and Manufacturing Technology Program (Mantech)
 - DOE: \$500 million for DOE to support R&D for Advanced Manufacturing Technologies in energy
 - NSF: increase of \$87 M in basic & applied research funding to support Advanced Manufacturing
 - NIST: \$75 million for TIP (Technology Innovation Program), \$12 million to establish public private consortia, \$763 million for NIST laboratories
- Organizational & Policy Changes
 - PCAST Study on Advanced Manufacturing
 - NSTC: Interagency strategic coordination on Advanced Manufacturing
 - Ron Bloom (Assistant to the President for Manufacturing Policy)
 - Deputy Assistant Secretary of Defense (Manufacturing & Industrial Base Policy) Brett Lambert
 - Manufacturing Readiness Level usage & Acquisition Reform

Resource Allocation in DOD FY2002-FY2011* Average

■ PB Average
 ■ Appropriation Average
 — Suggested
 *Only PB Average includes FY11 Request

SCIENCE & TECHNOLOGY

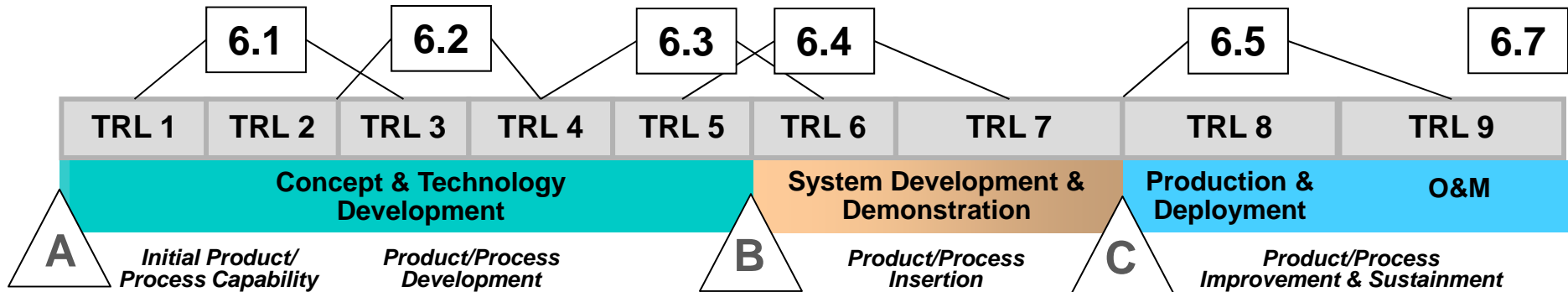
ACQUISITION PROGRAMS



Basic Research

Development

DoD Technology Transition Programs



Quick Reaction Special Projects (QRSP)

Joint Warfighting Program (JWP)

ACTDs / JCTDs

Foreign Comparative Test

USAF Technology Transition Program

Industry Independent Research & Development

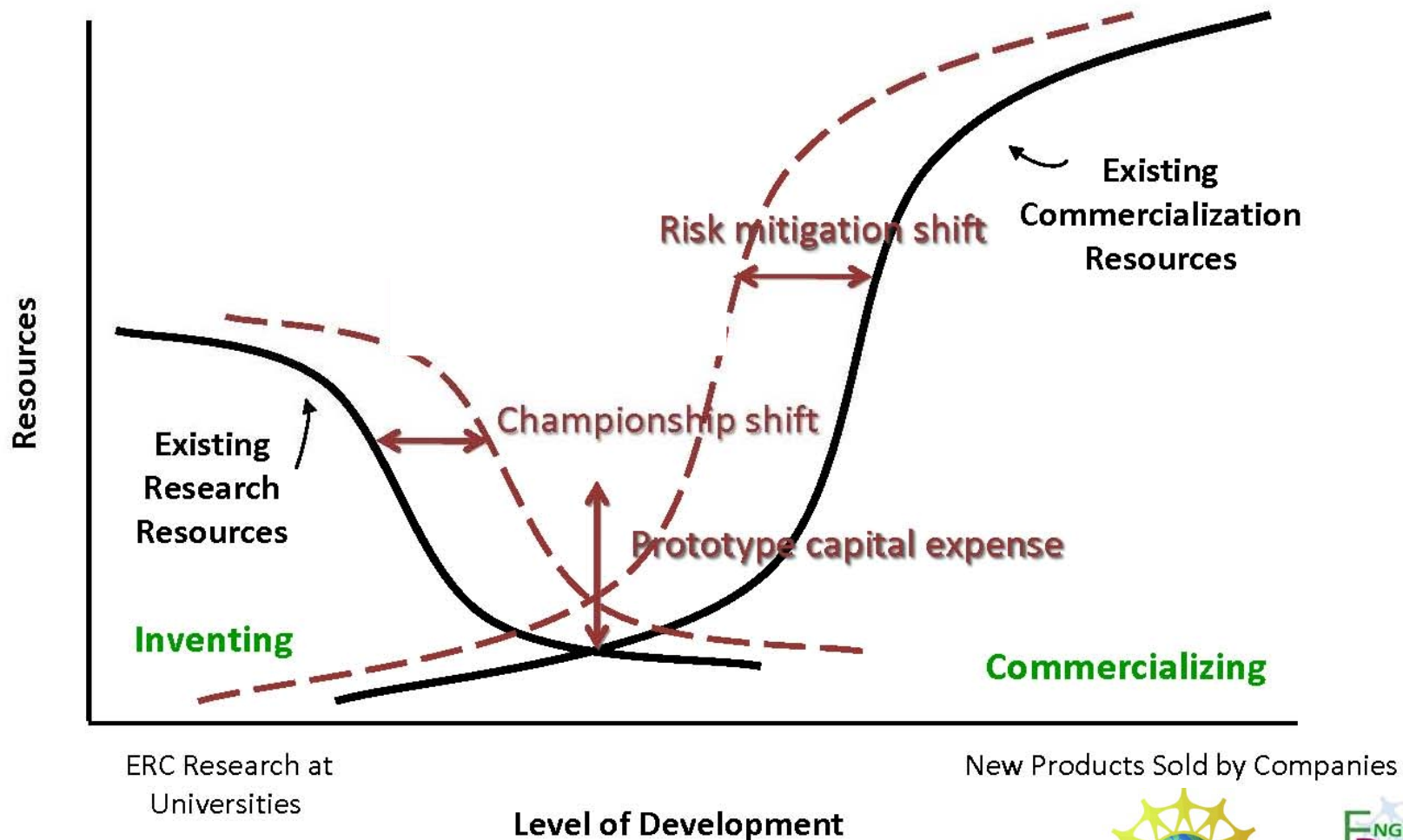
Manufacturing Technology

DPA Title III

USN Rapid Technology Transition



Shrinking the Missing Middle through Innovation



Adapted from Dr. Deborah Jackson, 2011

Missing Middle: Performers



Technology and Manufacturing Readiness Levels



- 59 Institutes, 17 000 employees
- Non-profit organisation
 - ≈ 33 % basic funding by government
 - ≈ 33 % public funded projects
 - ≈ 33 % direct contracts by industry

- Information and Communication Technology
- Life Sciences
- Microelectronics
- Light & Surfaces
- Production
- Materials and Components - MATERIALS
- Defense and Security

Fraunhofer-Gesellschaft: Undertakes applied research of direct utility to private industry.

Clustered approach with pilot production centers to close the gap between research and products



- Information and Communications
- Material, Chemical and Nanotechnologies
- Biomedical Technologies
- Advanced Manufacturing and Systems
- Energy and Environment
- Total Patents: **10,132**
- Start-Ups: **158**

Taiwan's ITRI



ITRI is the Winner – Wall Street Journal Technology Award Sept. 2010.

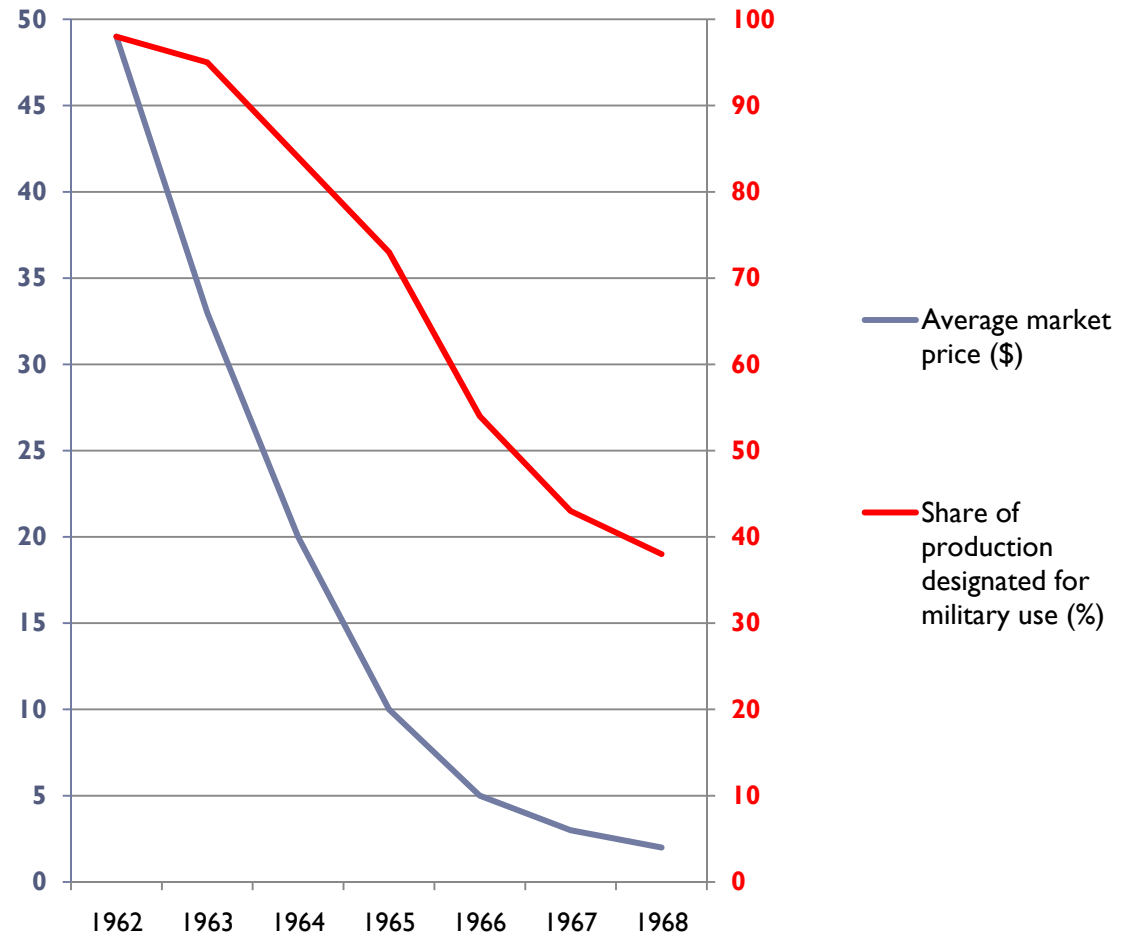
Department of Defense Labs?
University Research Centers?
DOE Contractor Labs?

Non-profit institutes?
“Bell Labs”?
Other?

Government Procurement as a Catalyst

- ▶ Early military use helped drive semiconductor market development
 - ▶ Helped to push prices lower
 - ▶ Lower prices spurred commercial applications
- ▶ Today's market is dominated by commercial applications
 - ▶ Global market over \$200 billion¹
 - ▶ DoD share only 1-2%¹

US Semiconductor Market Price and Military Use, 1962-1968²



Source: ¹Morris, Peter Robin. *A history of the world semiconductor industry*. 1990, pg 75; ²Defense Science Board, "High Performance Microchip Supply", 2005.

Early Adoption Opportunities

Biofuels



Electric Vehicles



Solid State Lighting



Prosthetics



Photovoltaics



Expanding the Defense Industrial Base



The screenshot shows the Startup America Partnership website. At the top, it says 'STARTUP AMERICA PARTNERSHIP' with a red arrow icon. Below is a navigation menu with 'HOME', 'ABOUT', 'LEADERSHIP', 'COMMITMENTS', 'NEWS', and 'MULTIMEDIA'. The main content area features 'KAUFFMAN The Foundation of Entrepreneurship' and 'THE CASE FOUNDATION'. A text block reads: 'Stepping Up to the Plate. The Startup America partnership marshals and highlights commitments from private sector institutions that want to spur entrepreneurship in the U.S. in a big way. From Kauffman and Case Foundations to Intel and IBM, learn who was first to stand up and how their contributions are paving a path towards success!' There is a 'LEARN MORE >' button and a 'MEMBER COMMITMENTS' section at the bottom with a 'VIEW ALL >' link. Logos for Intel, Facebook, Techstars Network, and The Kauffman Charitable Foundation are visible at the bottom.



The screenshot shows the InnoCentive website. The header includes 'INNOCENTIVE' and navigation links like 'About Us', 'News & Events', 'Blog', 'Contact Us', 'Register', and 'Login'. Below the header is a navigation bar with 'My InnoCentive', 'Products & Solutions', 'For Solvers', 'Challenge Center', 'About Us', and a 'Challenge Search' input field. The main content area has a 'Welcome To InnoCentive' section with a description of the platform and a 'Tell me more >>' button. To the right is a network diagram with a central orange circle and several smaller circles connected by lines. Below this is a 'NEWSFLASH' section with a link to an 'Executive Webinar on May 12: The Open Innovation Marketplace'. At the bottom, there is a 'Challenge Search' section showing 'Open Challenges' and 'Featured Challenges'. A specific challenge is listed: 'Communication Platform to Connect Vulnerable Communities with Climate Change Solutions' with a '\$10,000 USD' prize and a deadline of '06/12/2011 | 113 active solvers'.

Prizes and Challenges

GLOBAL SECURITY CHALLENGE



Partners: TSWG and ONR Global

Air Force Open Innovation Pavilion



[TecEdge Pavilion Home](#)

[TecEdge Challenges](#)



Filters

All Challenge Disciplines

- Business & Entrepreneurship
- Chemistry
- Computer/Info. Technology
- Engineering/Design
- Food/Agriculture
- Life Sciences
- Math/Statistics
- Physical Sciences
- Requests for Partners

[+ Advanced Filters](#)

You Are Viewing: TecEdge X		Show: 10				
Show Challenge Types:		<input checked="" type="checkbox"/> All	<input type="checkbox"/> Ideation	<input type="checkbox"/> Theoretical	<input type="checkbox"/> RTP	<input type="checkbox"/> eRFP
	Title	Posted	Deadline	Award	Solvers	
	Remote Human Demographic Characterization TAGS: Computer Science/Information Technology, Engineering/Design, Life Sciences, Math/Statistics, TecEdge, Theoretical-licensing + View More	3/02/11	5/02/11	\$20,000 USD	303	
	Vehicle Stopper TAGS: Chemistry, Engineering/Design, Physical Sciences, TecEdge, Theoretical-licensing + View More	3/02/11	5/02/11	\$25,000 USD	581	

Urban Challenge



DARPA Network Challenge

Global Partnerships

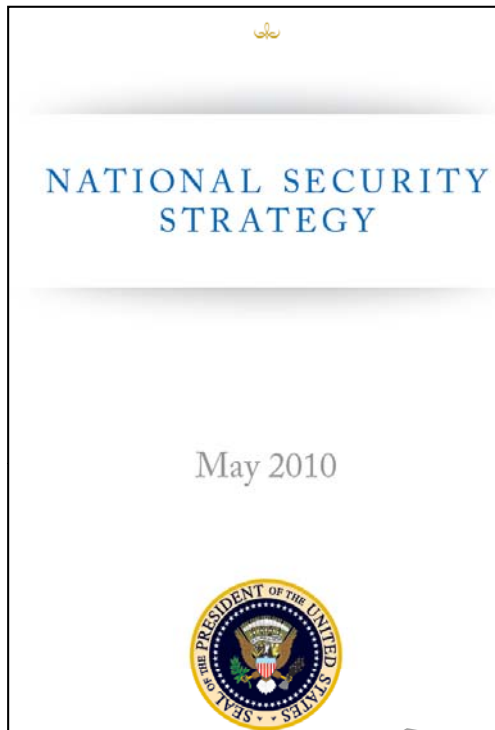


FIGURE 1. ECONOMIST INTELLIGENCE UNIT SURVEY QUESTION—FUTURE INVESTMENT TOP 10 LOCATIONS

In which of the following countries does your company plan to spend the most on R&D in the next 3 years (excluding your domestic market) (top 10 locations out of 54)?

1. China	39
2. United States	29
3. India	28
4. United Kingdom	24
5. Germany	19
6. Brazil	11
7. Japan	10
8. France/Italy	9
10. Czech Republic	8

Defense Acquisition University, January 2011

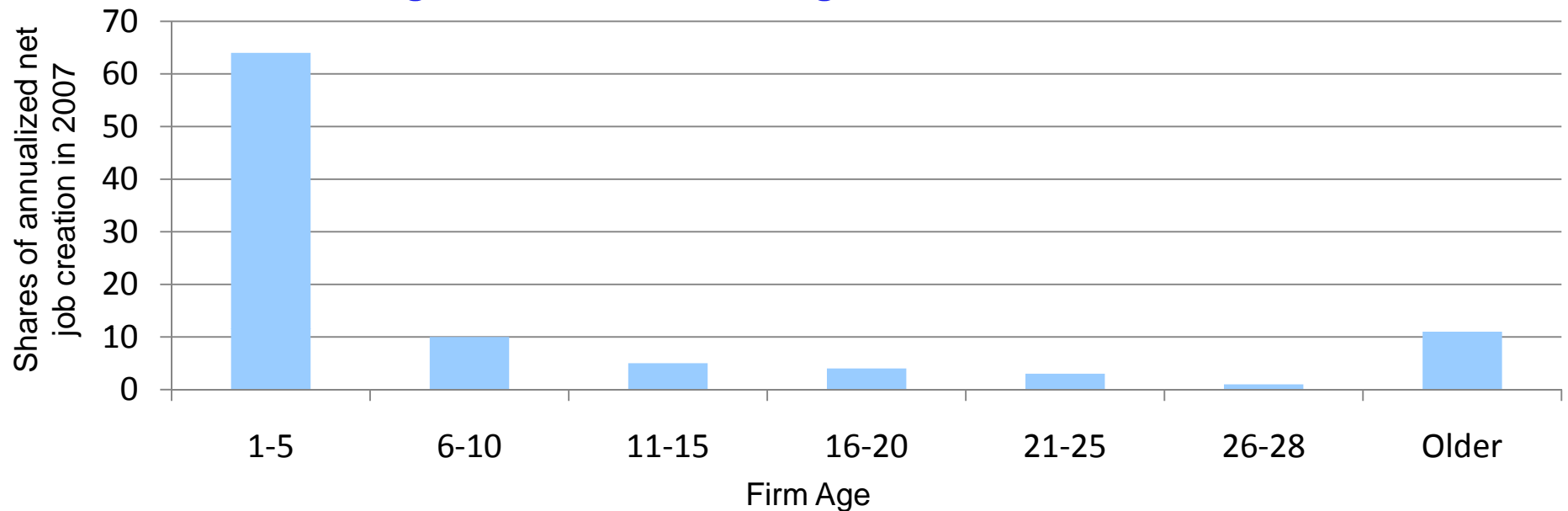


III. ADVANCING OUR INTERESTS

Expand International Science Partnerships: America's scientific leadership has always been widely admired around the world, and we must continue to expand cooperation and partnership in science and technology. We have launched a number of Science Envoys around the globe and are promoting stronger relationships between American scientists, universities, and researchers and their counterparts abroad. We will reestablish a commitment to science and technology in our foreign assistance efforts and develop a strategy for international science and national security.

The Role of Young, High-Growth Firms

Young Firms Account for Largest Share of Job Creation



What to Do?

- focus on creating new firms
- remove barriers to emergence of high growth companies
- target areas that are resources for high-growth firms:
immigrants and universities



Startup America

- Expands access to capital for high-growth startups throughout the country
- Expands entrepreneurship education and mentorship programs to create jobs
- Strengthens commercialization of federally-funded research and development
- Identifies and removes unnecessary barriers to high-growth startups
- Expands collaborations between large companies and startups

“The spirit of service and selflessness that is seen in military communities across our country represents what is best about America, and as a Nation we owe our brave service members and their families more than gratitude – we owe them the support they have earned...each of us has a role to play in reconnecting with military families in our communities.” – First Lady Michelle Obama



*“As a military mom, I know how a simple act of kindness can make a difference to a soldier. It is our sacred duty to honor the service of those who sacrifice for our country – and we can all play a role with a simple act of service.”
– Dr. Jill Biden*

JOINING FORCES

TAKING ACTION TO SERVE AMERICA'S MILITARY FAMILIES

JOINING FORCES:

- Brings attention to the unique needs and strength of America's military families.
- Works to ensure veterans and military families have the opportunities, resources, and support they have earned.
- Creates greater connections between the American public and the military.
- Partners with citizens, communities, businesses, nonprofits, faith based institutions, philanthropic organizations, and government



In Employment, Joining Forces will:

- Highlight the workforce potential of veterans and military spouses
- Expand employment and career development opportunities for veterans and military spouses
- Help employers create military family-friendly workplaces

In Education, Joining Forces will:

- Help schools become more aware of and responsive to the unique needs of military children and families
- Promote and support higher education institutions and programs that expand education opportunities,
- Ease transferability for military-connected students and expand job training opportunities for spouses and veterans

In Wellness, Joining Forces will:

- Call attention to the critical issues facing veterans and military families
- Expand access to wellness programs and resources for military spouses and families

For more information on ways to support military families in your neighborhood, go to

www.joiningforces.gov

Workforce Development



JOINING FORCES

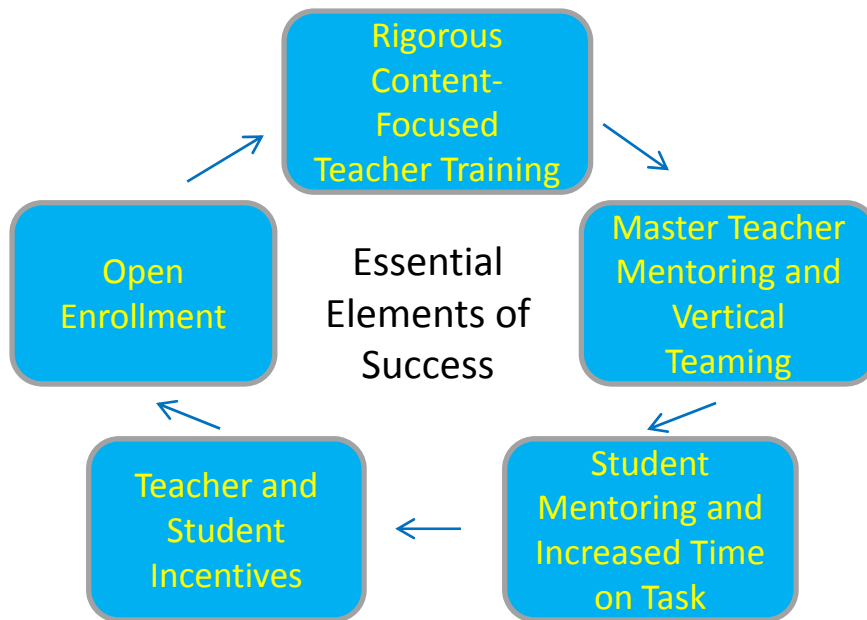
TAKING ACTION TO SERVE
AMERICA'S MILITARY FAMILIES

NATIONAL
MATH + SCIENCE
INITIATIVE



Advanced Placement Training and Incentive Program

NMSI's APTIP program increases dramatically participation and performance of public high school students in rigorous college-level work in math, science, and English, and expands access to college-level courses, especially among traditionally under-represented students. The APTIP program is a proven, comprehensive approach that increases teacher effectiveness and student achievement through content training, teacher and student support, vertical alignment of teachers, open enrollment, and incentives.



Workforce Development & Sharing

- Shared funding of scholarships/performance of graduate researchers
- Industry participation in federal STEM programs
- Industry IPA programs for DOD research and PM assignments
- Rotational assignments for federal S&Es into industry
- Adjust curriculum to encourage entrepreneurship



SMART
SCIENCE, MATHEMATICS
& RESEARCH FOR
TRANSFORMATION
BRIEF FOR THE NATIONAL DEFENSE
EDUCATION PROGRAM



How You Can Contribute

- Participate in Startup America Programs
- Participate in Personnel Exchanges
- Participate in STEM initiatives
- Policy Recommendations
 - Public-Private Partnership Mechanisms
 - Early Procurement Activities
- Good News Stories
- Ideas for Facility Visits
- ...

Many Challenges Remain

