

The Innovation Imperative: Myths, Opportunities and the Programs to Exploit them



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The Global Innovation Imperative

- Key Points
 - **Innovation** is Key both to Grow and Maintain a Country's Competitive Position and to Address Global Challenges
 - **Collaboration** among Small and Large Businesses and Universities Contributes to Regional Growth and Job Creation
 - **New Laws, New Institutions, and New Incentives**, are necessary to foster innovation and collaboration

Current Global Mega-Challenges

- Fostering Economic Growth through Innovation
 - Driving domestic Growth and Employment
- Developing New Sources of Energy
 - Commercializing renewable alternatives to oil
 - Increasing the capacity to fuel growing global demand for electricity
- Addressing Climate Change
 - Growing a Green Economy; A major Growth opportunity
- Delivering Global Health
 - Transforming large investments in research to affordable and personalized treatment and care
- Improving Security
 - Through all of the above
- Addressing these Global Challenges requires, indeed, demands innovative solutions.

A Key Theme for the Talk Today is the Need for Change

- A desire for different or better outcomes in the innovation space requires:
 - A recognition of the need for change
 - An emphasis on the importance of learning from others, and from experience
 - Learning is necessary to effectively adopt and adapt new principles & programs
- Its important to keep in mind, “You don’t have to be doing badly to be able to improve”

Both Government and Universities Need to be Entrepreneurial

- If Spain is to fully achieve its potential, the regional authorities and universities need to adopt more supportive innovation policies:
 - These policies can help address problems while they emerge through innovative procurement
 - They can also act on opportunities in the global marketplace as they emerge
 - Using existing technologies in new forms for new applications that can serve social needs while generating employment & growth
- **Universities need to be willing partners**

What Drives Innovation both in the U.S. and Spain?

Attitudes
Risks
Opportunities
Funding

Framework Conditions:

Major U.S. Advantages in Innovation

- Openness to science and innovation
 - Trust in Science & Scientific Institutions
 - Positive Social Norms
 - High Social Value on Commercial Success
 - Forgiving Social Norms allow more than one try
 - Entrepreneur-friendly Policies
 - Markets Open to Competition
 - Gentle Bankruptcy Laws permit rapid recovery
 - Taxes give Prospect of Substantial Rewards
 - Strong Intellectual Property Regime:
 - Encourages Research & Diffusion of Research Results
- 

U.S. Strengths in Innovation

- **Government investments in R&D:** ~\$150B a year
- **Private investments in R&D:** ~\$270B a year
- **Research Universities:** some with a culture of innovation
- **Entrepreneurial spirit** and laws to support it
- **Talent:** from the U.S. and from around the world
- **Capital:** Broad, deep, and efficient capital markets with significant angel (\$22.5 Billion*) and venture funding (\$28.4 Billion**)

– Sources:

* Jeff Sohl, UNH Center for Venture Research

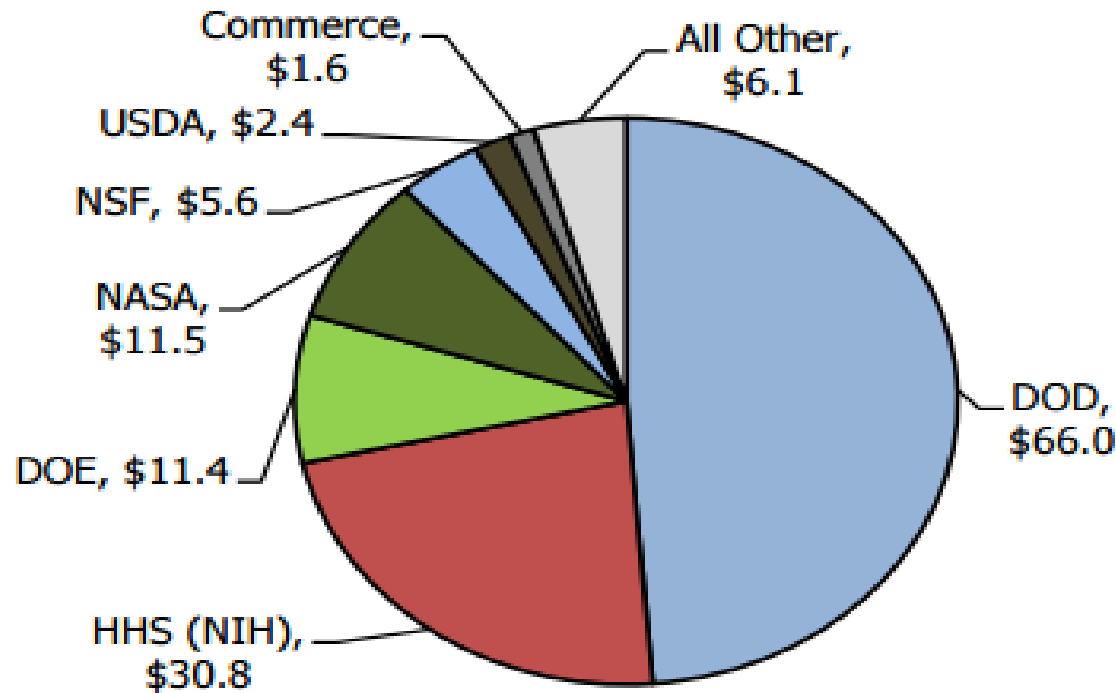
** 2012 Money Tree Report

A Key Advantage of the U.S. System

Mission-oriented, competitively
awarded research in well funded,
competitive universities

U.S. R&D is Mission-Driven

Figure 2: R&D by Agency, FY 2014
budget authority in billions of dollars



Source: OMB R&D data, agency budget justifications, and other agency documents and data. R&D includes conduct of R&D and R&D facilities.
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A Broad-based Federal Effort to Support Science and Innovation

- Innovation is driven, in part, by well-developed mission driven institutions:
 - **DARPA:** From the forerunner of the Internet to tomorrow's driverless cars
 - **NSF:** Supports basic research (some led directly to Google) but also supports manufacturing
 - **NIH:** Funding for research underpins the modern pharmaceutical and biotechnology industries. It drives start-ups and spin-offs.

DARPA: The Culture of the Entrepreneurial Agency

- The DARPA culture involves tacit rules that endure and are not typical of other R&D agencies – now copied by ARPA-E.
- The rule set includes:
 - A flat, non-hierarchical organization of some 200 federal employees managing \$2.89 billion per year
 - Program managers are empowered to take risks (and allowed to fail-- or just stop!)
 - Program Managers are well paid, talented but also entrepreneurial, and serve for a limited duration
 - Research is performed outside DARPA, not inside

A Caveat: The Major Risks to the U.S. (and Spain?)

- **Complacency** about our competitive position
 - Focus on **current consumption** rather than investment for the future
- Insufficient **investment in R&D, Universities, and Infrastructure** on the scale of our fathers, and our competitors
- Limited attention to the **composition of the economy**.
 - Can we make what we invent, and create jobs?
- Failure to provide enough support for the **commercialization** of research and for new opportunities in manufacturing



Innovation is how nations grow and compete in the 21st Century

Innovative Small Businesses are a
Competitive Asset

Small Companies Drive High-Technology Innovation

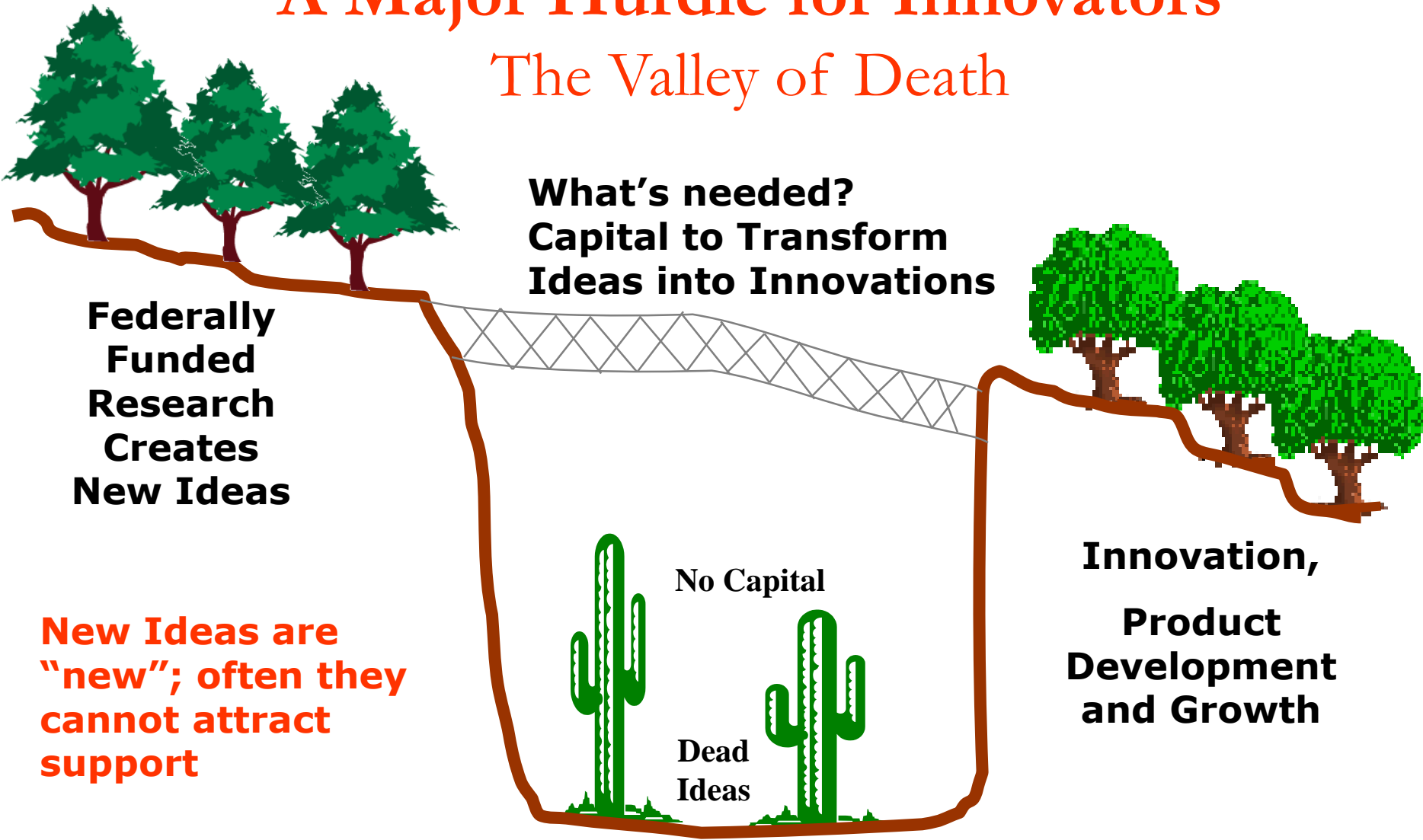
- Small Companies are Key Players in Bringing New Technologies to Market (Audretsch & Acs)
 - Large returns to national economic and strategic capabilities can result from relatively small national investments
 - Innovations—with the right policy support—can become new products and services for the market and provide support for government missions
- But small companies don't have the capital needed to transform ideas into innovations

The Myth of Perfect Markets

- Strong U.S. Myth: “If it is a good idea, the market will fund it.”
- Reality:
 - Potential Investors have less than perfect knowledge, especially about innovative new ideas
 - “Asymmetric Information” leads to suboptimal investments
 - George Akerlof, Michael Spence and Joseph Stiglitz received the Nobel Prize in 2001, “for their analyses of markets with asymmetric information”

A Major Hurdle for Innovators

The Valley of Death



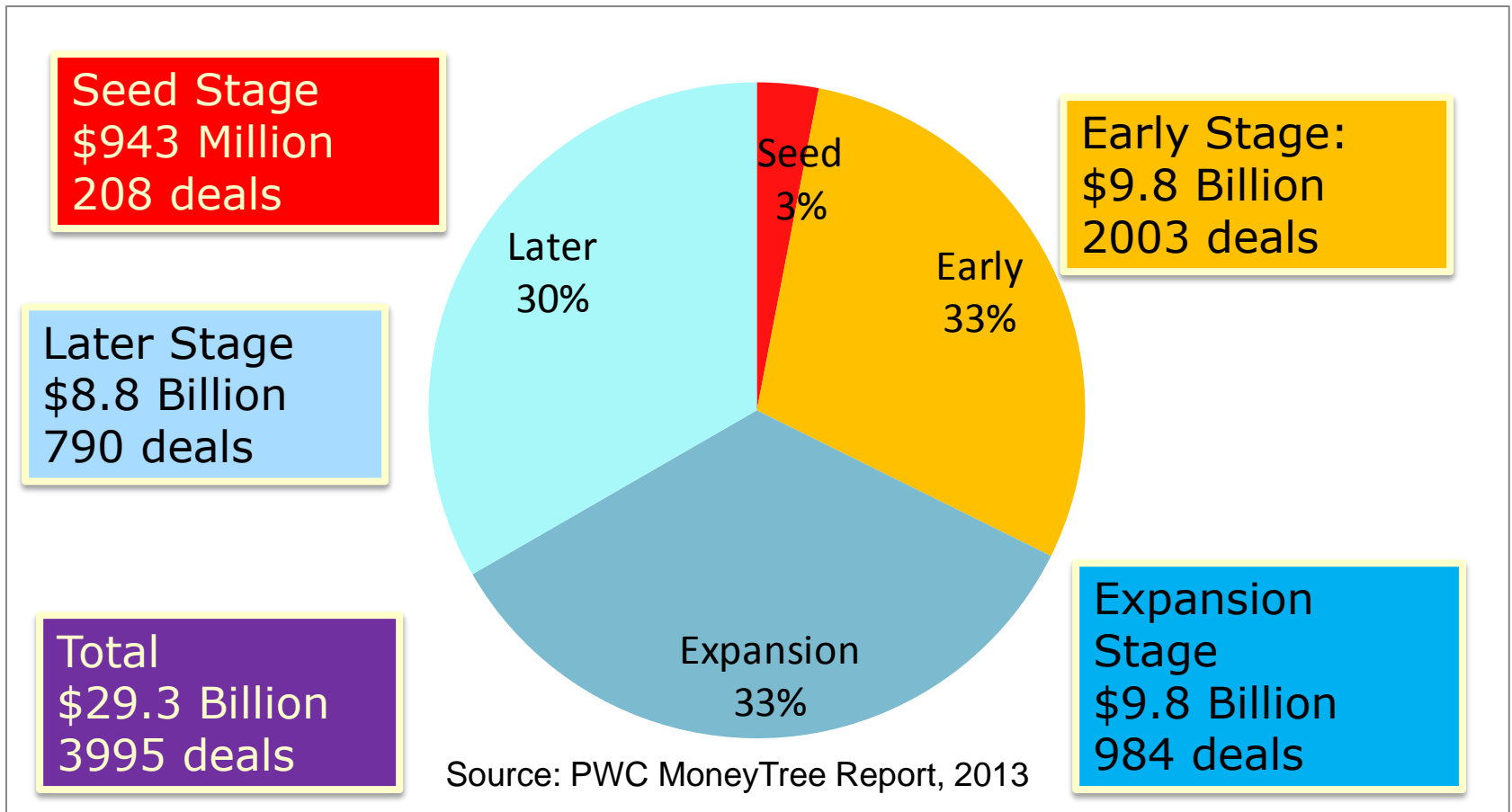
Isn't Venture Capital the Way Across the Valley of Death?

This is an American myth
and a European policy fixation:
VC is important, but it is only part of the
ecosystem

The Myth of Perfect Venture Capital Markets

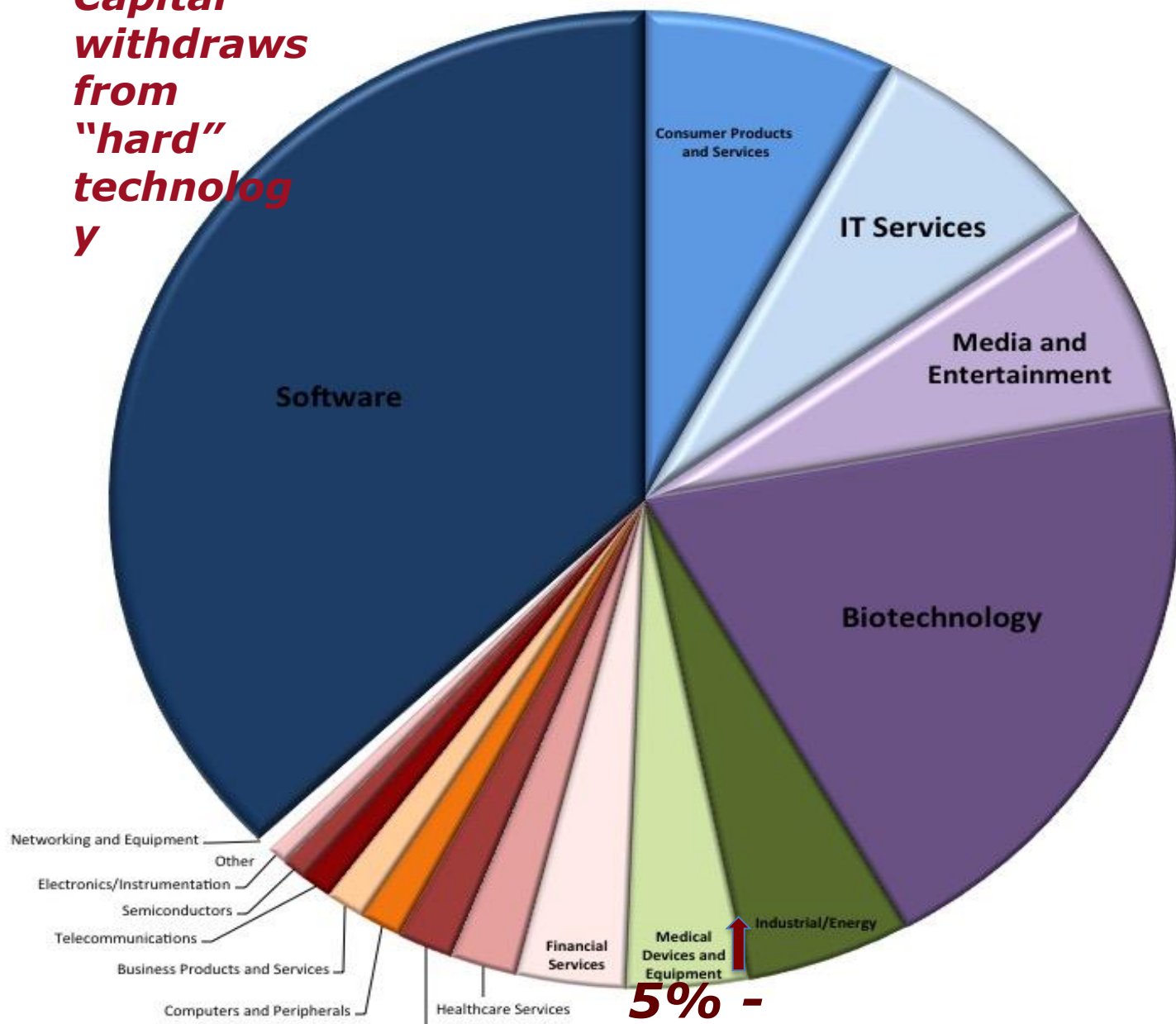
- Myth: “U.S. VC Markets are broad & deep, and are the major source of funding for innovative start-ups”
- Reality: Venture Capitalists have
 - Limited information on new firms
 - Prone to herding tendencies
 - VC investments have moved towards later, less risky stages of technology development
 - Limited (and declining) investments in the seed stage of investment

VC Investments in 2013

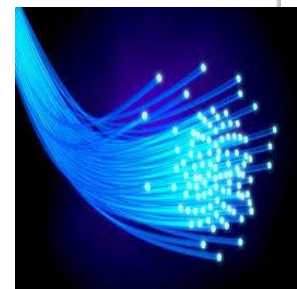


**Point:
Venture
Capital
withdraws
from
"hard"
technolog
y**

Total VC Investment in 2015



Source: P. Singer, MIT, 7/16 from NVCA



The Venture Capital Oversell

- Investment in Public VC Funds involves Substantial Risk of Loss
- High skew in returns on VC Investments
 - Many investments fail completely
 - Most just give back the invested funds
 - A handful give a return greater than 1,000 percent!
 - Source: John H. Cochrane, "The Risk and Return of Venture Capital," *Journal of Financial Economics*, 75(1):3-52, 2005.
- Most Important: Many companies live and grow without Venture Funding

Two US.Policy Initiatives Address The Innovation and Manufacturing Challenge

SBIR addresses the challenge of
converting research to products
The new Manufacturing Institutes
address the challenge of making
them in the United States

A Key U.S. Asset is Government Support For Innovative Small Businesses

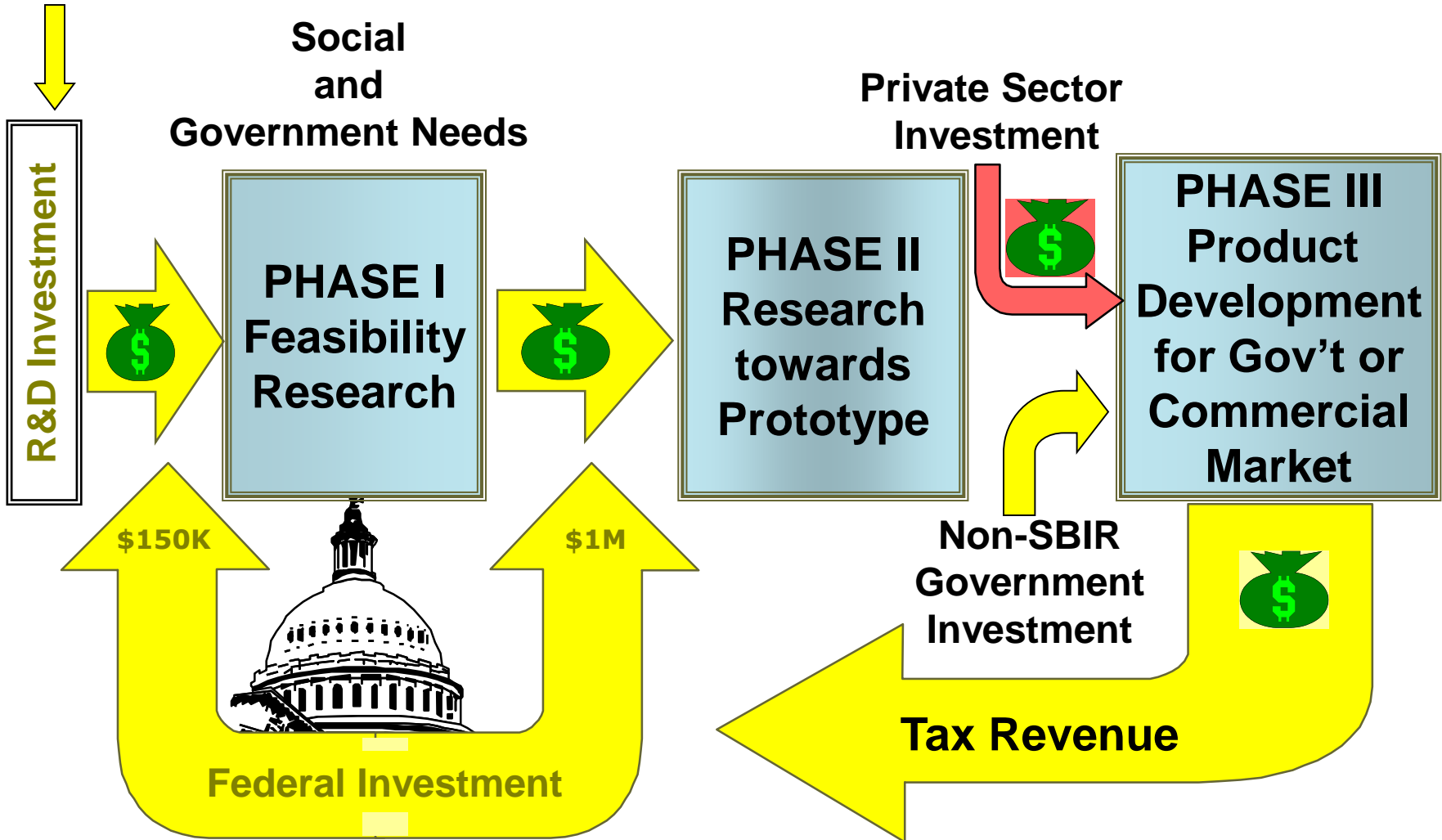


What is the Small Business Innovation Research Program (SBIR)?

- **Competitive: Awards to** support for technological innovation with over 6,500 awards and \$2.8 billion a year to small businesses
- **Phasing:** Uses up to **three-phased awards** from federal research funds to address government mission needs.
- **Focus on Early-stage/High Risk:** “SBIR provides funding for some of the best early-stage innovation ideas -- ideas that, however promising, are still too high risk for private investors, including venture capital firms.” Roland Tibbetts

\$150 billion

The SBIR “Open Innovation” Model



SBIR's Best Practice Features

- **Focus on Valley of Death:** Funds Proof of Concept and Prototype: “The first money is the hardest”—the EU SME Instrument is modeled on SBIR...
- **Decentralized & Flexible:** Each Government Department or Agency uses its funds to support research by small companies to meet its unique mission needs
- **Competitive:** ~20% success rate
- **No Program Capture:** One-third of participants are new to the program every year

More Best Practice Features

- **Stable Program and Budget:** Long reauthorizations give stability as does sizeable $\sim 3\%$ allocation of Agency R&D budgets for small business awards & contracts
- **Large Scale:** Largest U.S. Innovation Partnership Program: Currently a $\sim \$3.2$ billion per year
- **Portfolio Effect:** Substantial sums invested in new companies over a long period increase success--- 6,500 awards annually
- **Important! Encourages** price and quality competition in public procurement



*After nearly 20 years of operation,
The Congress asked our National Academies:*

How well is SBIR Working Overall?

Following a Comprehensive Assessment,
The National Academies found that :

“The SBIR program is
sound in concept and
effective in practice.”

SBIR Success takes Many Forms

- **Employment Success**
 - SBIR helps new Start-ups grow, creating the high quality jobs of the future
- **Innovation Success**
 - New products, patents, licenses, and publications
- **Government Mission Success**
 - Acquisition and Procurement
 - NASA uses SBIR-funded Lithium-ion batteries to power the Mars Rover
 - DOD uses SBIR developed armor to shield against IEDs
- **NASDAQ Success**
 - SBIR investments contributed to the success of companies like Qualcomm, ATMI, Martek, Symantech

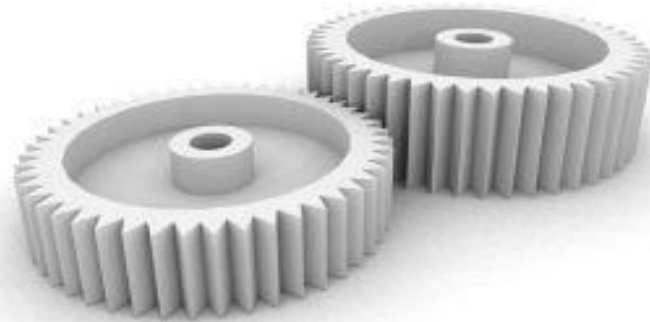
SBIR is Increasingly being Adopted Around the World

--Recognized as Best Practice--

- **Finland** has adopted a 3-Phase SBIR type Program
- **Sweden** has created a small but successful SBIR type program called "Innovation and Growth"
- **Russia** has an active and effective SBIR program
- **UK** SIRI program is similar in concept but lacks obligation...
- **The Netherlands** government adopted SBIR in 2004
- **Japan, Korea, & Taiwan** have adopted SBIR programs
- **India** launched an initiative called "SBIRI" in 2005 for the biotech, agriculture industry, and environment sectors
- **Singapore** implemented a similar program
- **Both Australia and Canada are planning** SBIR programs
- **The EUSME Instrument** adopted the SBIR model for H2020
 - Most had consultations with us.

Can Spain Use an SBIR Program?

- If funding is easy and entrepreneurs can easily access government markets there is no need...
- If not, then SBIR offers a way to fund innovative new ideas to meet societal challenges from health to energy to security with new ideas generated by Italian researchers and entrepreneurs
- **SBIR has a key advantage—it works!**



Another U.S. Challenge: Revitalizing Manufacturing

New Initiatives to Support the
Commercialization and Manufacture of
U.S. Developed Technologies

New High-Tech Opportunities for Production in the U.S. and Spain

- Mass customization by firms and smaller facilities is creating opportunities to:
 - Reorganize the geographic distribution of supply chains and importance of wage levels
 - Reduce lead times
 - Better integrate manufacturing with R&D to enhance and accelerate innovation
- Use of new materials and production technologies based on artificial intelligence and digitalization will create new possibilities for where and how manufacturing occurs

Ambitious New Consortia Designed to Spur U.S. Manufacturing

- **Manufacturing USA represents a major case of the U.S. learning from others**
 - The initiative is modeled in part on the successful German Fraunhofer system with 68 centers and \$2 billion budget
 - It deploys precompetitive consortia for applied research on new technologies and design methodologies
 - \$1 billion partnership program aimed at commercializing and manufacturing U.S. developed technologies.
 - Multiple institutes, each supporting a regional ecosystem of manufacturers, skilled workers, researchers

Source: www.whitehouse.gov

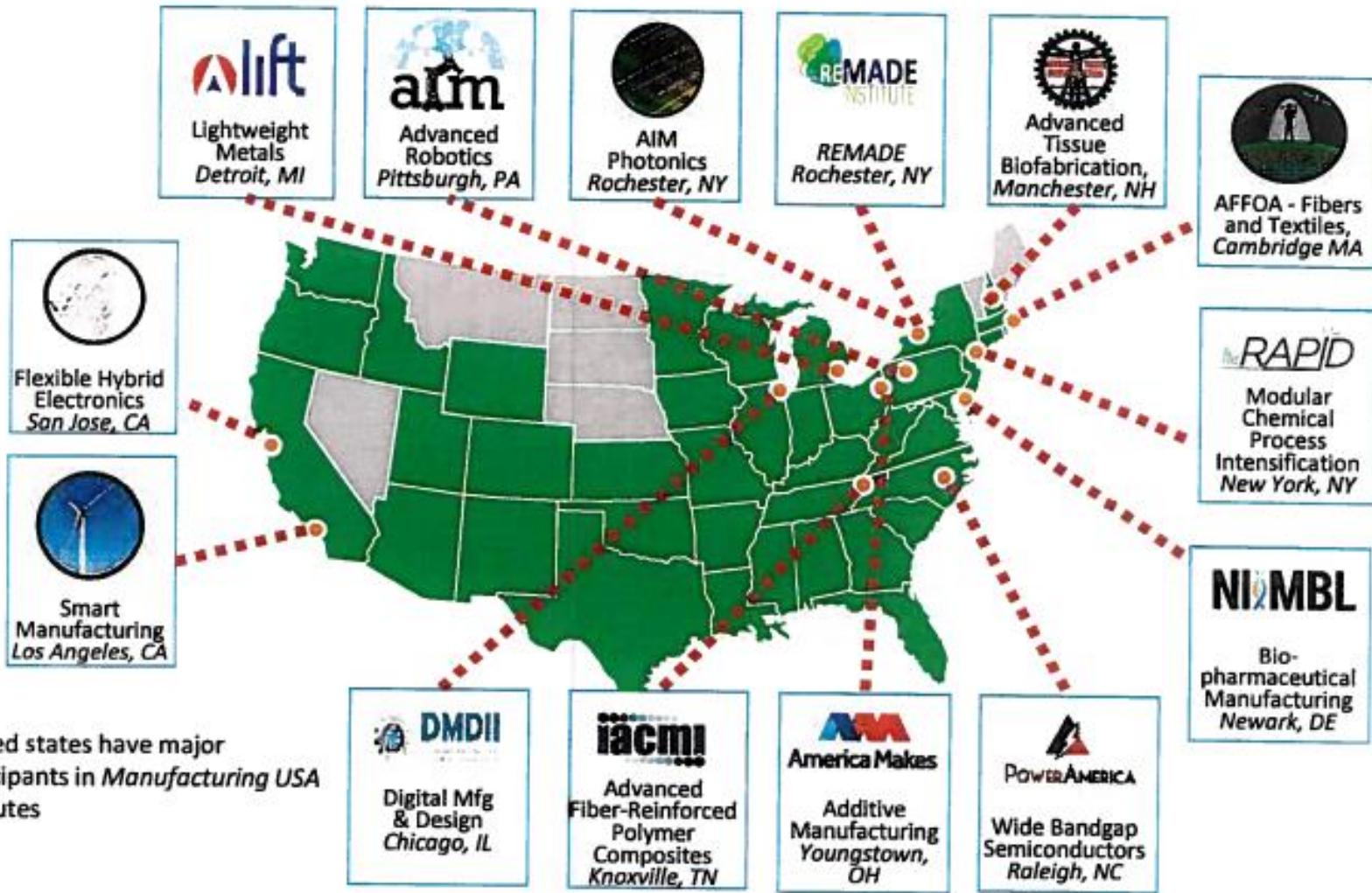
Benefits of Partnerships

- **Manufacturing USA** partnerships serve a major coordinating role intended to:
 - Facilitate knowledge exchange to speed innovation and encourage cooperation between large companies and SMEs and across different industries.
 - Provide access to shared pools of intellectual property on a pre-competitive basis
 - Provide access to equipment that is expensive, complex, and hard to use.
 - Align member goals through technology road-mapping and strategic planning
 - Collaborate on IP development and standards for new technologies.

The Centers are Focused on Promising New Technologies

Each has the potential to become
a new industry or transform
existing industries

Manufacturing USA Network



Shaded states have major participants in *Manufacturing USA* Institutes

Key Challenges for Manufacturing USA

- Consistency of purpose to overcome the challenges of growing new institutions
- Long term commitment of partners
- Substantial and sustained funding from the government on **a scale needed to make a difference**
 - Are government contributions adequate?
- Providing effective management
- Overcoming the challenge of U.S. presidential succession and Republican Congress – is it U.S. based manufacturing or an Obama initiative?

Key Lessons from (and for) the U.S.

- New outcomes often require new institutions and new incentives:
 - SBIR is a powerful, proven model
 - DARPA is a powerful ground breaker, but harder to emulate
- Fundamentally, the key thing is to accept the need for change and **adopt & adapt** successful policies & programs of others
- This is hard (for all of us)

The future is what we make of it.

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