

Responding to the Innovation Imperative

Policies, Programs, Partnerships



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The National Academies

The National Academies



- National Academy of Sciences
 - Chartered by Congress in 1863
 - A self-perpetuating Honorary Society
- National Research Council (1916)
 - The Operating Arm of the National Academies
- National Academy of Engineering (1964)
- Institute of Medicine (1970)

Today's Presentation

- The Innovation Imperative
 - What is the Recipe for Success?
- Myths and Realities in Innovation Policy
 - The Myth of Linear Innovation
 - The Myth of Perfect Markets
 - The Myth of the Venture Capital Solution
- Enhancing Innovation through Partnerships
 - The SBIR Program—Concept and Operation
 - S&T Parks
 - Research Consortia
- Conclusions
 - Innovation Partnerships are a Global Phenomenon
 - Cooperation and Mutual Learning are Essential for Success
- Today's Presentation reflects my personal views!

The Global Innovation Imperative



4 Key Points

- **Innovation** is Widely Recognized as Key to Growing and Maintaining a Country's Competitive Position in the Global Economy
- **Collaboration** is Essential for Innovation as Small Businesses and Universities Play a Growing Role in the Innovation Process
- **Institutional Change** is Necessary to Compete Successfully
- **New Incentives** are Required for Change

There is a Proven Recipe for Success

- Positive Framework Conditions to support Growth
- Focused, Proven Programs
 - Well funded by a patient government
- 21st Century Universities
- New Institutions—e.g., S&T Parks
- Dynamic Small Business Entrepreneurs supported by all the above

Framework Conditions for 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
- A Regulatory Perspective that Encourages Innovation

Public-Private Partnerships

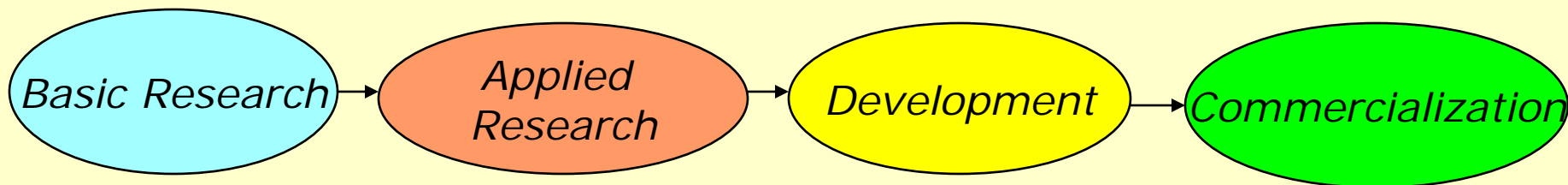
- Partnerships Play a key role in Encouraging Collaboration needed to Develop and Market New Ideas
- Proven Partnership Mechanisms Include:
 - Innovation Awards
 - Industry-University Cooperation
 - Cooperation S&T Parks
 - Research Consortia
- These mechanisms work best when they work together

Partnership Programs Work but they Encounter Powerful Myths!

Why do Myths Matter?

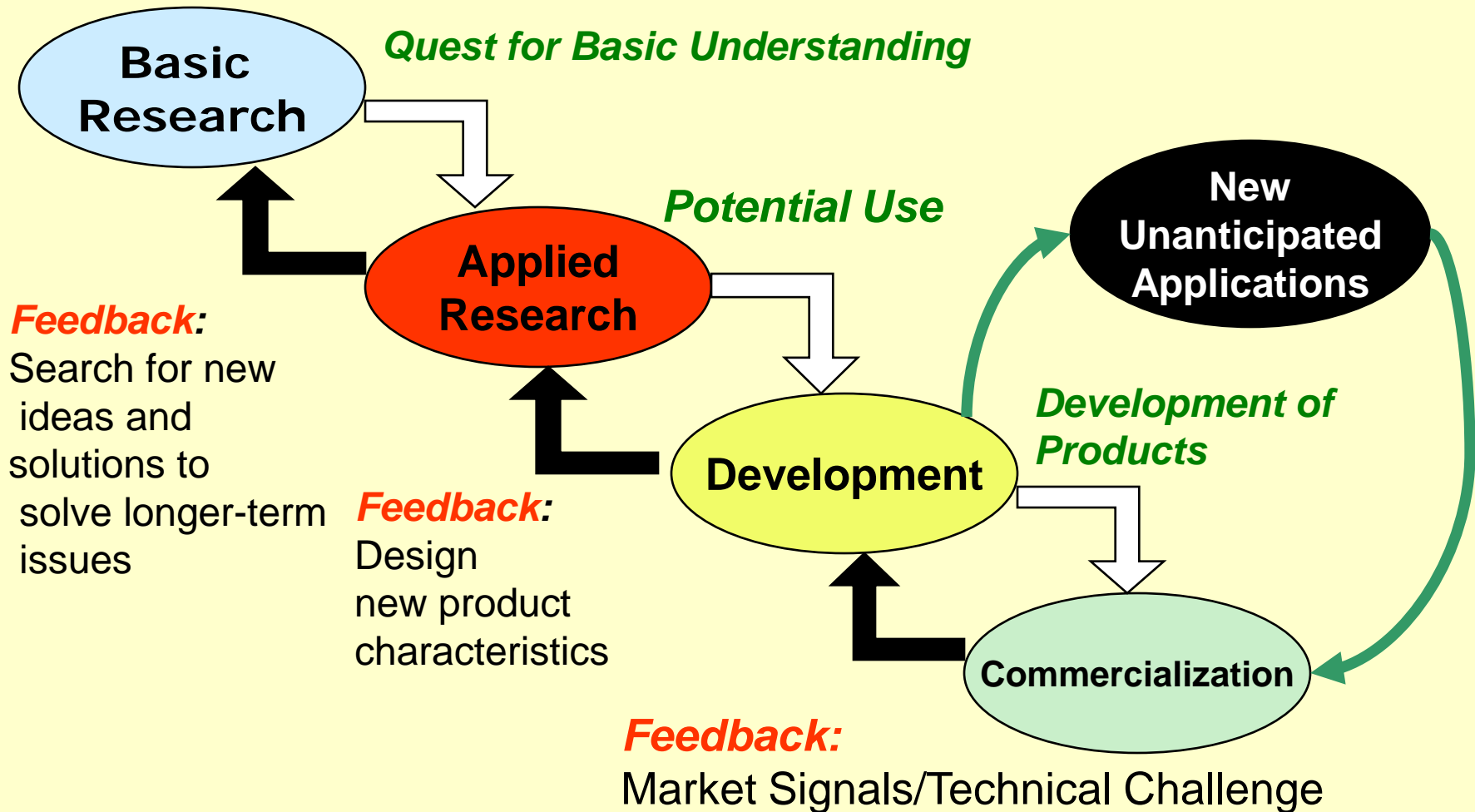
- Policy Myths often derived from elementary Economics models
 - Assume perfect information and costless transactions
 - Some Economists Argue about what “ought to be done” instead of what nations actually do
- Impact: Sometimes, these myths distort US policymaking
 - Mask problems in the innovation system
 - Fail to recognize the role that institutions play in creating incentives for cooperation
- What are some common myths?

The Myth of the Linear Model of Innovation



- **Reality: Innovation is a Complex Process**
 - Major overlap between Basic and Applied Research, as well as between Development and Commercialization
 - Principal Investigators and/or Patents and Processes are Mobile, i.e., not firm-dependent
 - Many Unexpected Outcomes
 - Technological breakthroughs may precede, as well as stem from, basic research
- **Many of our policies and institutions remain based on this linear model**

Non-Linear Model of Innovation



The U.S. Myth of Perfect Markets

- Strong U.S. Myth: “If it is a good idea, the market will fund it.”
 - Recent Manifestation: “If you have a good idea, a good team, and you sell it well, you will be funded”
 - George Scalise, President SIA, 29 April, 2008
- 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”

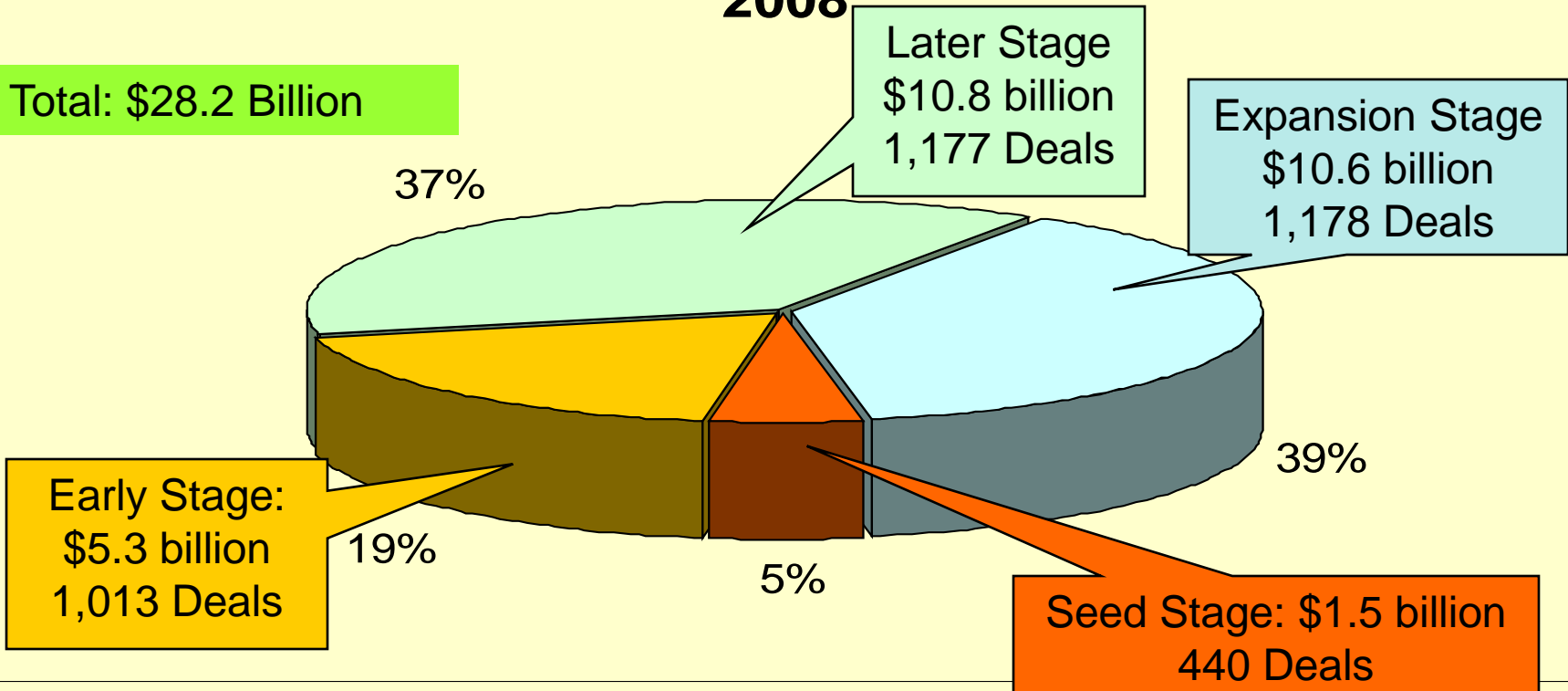
Another Common Myth

- Myth: “U.S. VC Markets are broad & deep, thus there is no role for government awards”
- Reality: Venture Capitalists have
 - Limited information on new firms
 - High overhead costs
 - Prone to herding tendencies
- This means that they focus on later stages of technology development
 - Most VC investors seek late entry and early exit

Large U.S. Venture Capital Market is Not Focused on Seed/Early-Stage Firms: Aggregate Amounts are Falling

U.S. Venture Capital by Stage of Investment 2008

Total: \$28.2 Billion



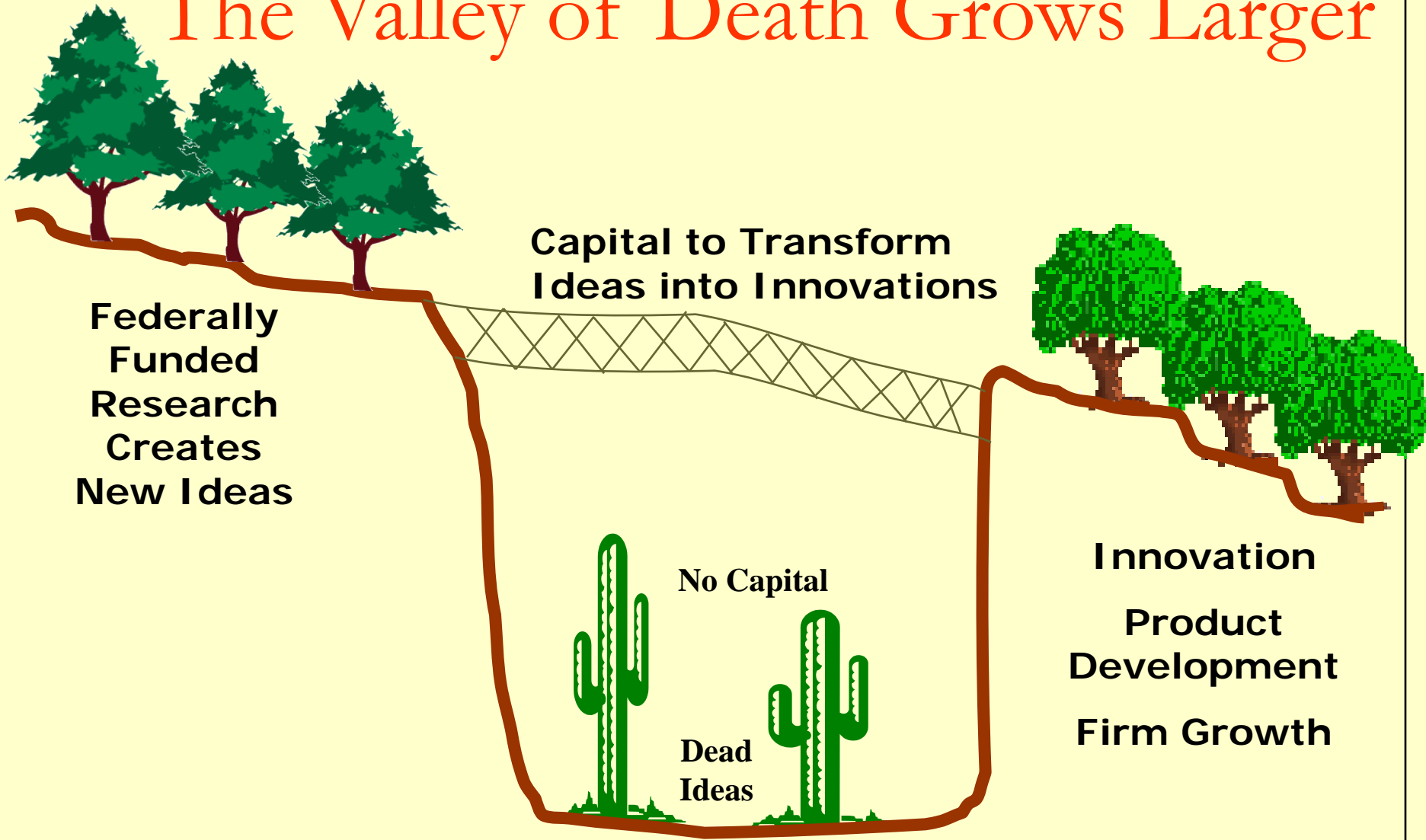
Source: PriceWaterhouseCoopers/Thompson Venture Economics/ NVCA 2009

What is the Impact of the Current Financial Crisis on the Venture Capital Market?

Venture Capital Markets are in a 'Pause' Mode

- Markets are cyclical, and so is venture capital
 - Majority of venture firms are “waiting until market conditions improve.” [NVCA 2009 1st Quarter Report]
- **Few Exits:** For the market to function, liquidity events, (i.e., acquisition or initial public offering) must be possible
 - Last year, Silicon Valley saw only one IPO
- **Few Entries:** Venture Capitalists are retrenching
 - VC funds are conserving Capital to preserve the existing portfolio investments
 - Few new investments are being undertaken
- **Markets are drying up: Promising New Companies with Valuable New Ideas are at Risk**

The Valley of Death Grows Larger



How can we help Small Innovative Firms Cross the Valley of Death?

Use Awards to Drive Innovation

The U.S. Example: The Small Business Innovation Research (SBIR) Program

What is SBIR?

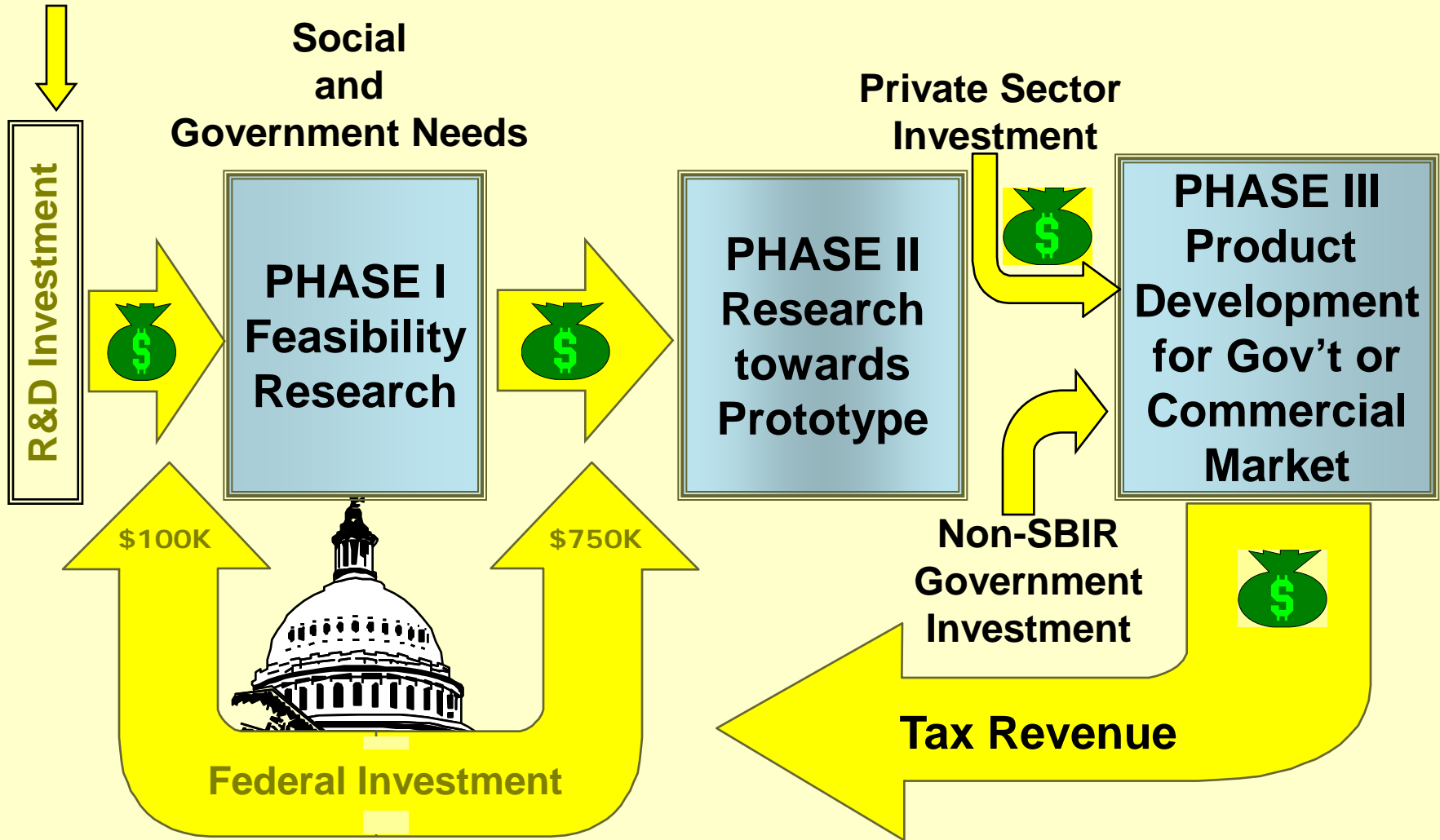
- It is a gated innovation system, providing awards to small companies to
 - Provide Proof of Principle
 - Develop Prototypes
- Successful Companies Attract Private Capital and/or win Public Contracts
- The Program converts Knowledge into Products to meet Social Needs

SBIR Program—Key Features

- **Large Scale:** Largest U.S. Innovation Partnership Program: Currently a \$2.3 billion per year
- **Focus:** Funds Proof of Concept and Prototype
- **Role:** Helps firms across the Valley of Death and attract private capital or public contracts

\$151 billion

The SBIR “Open Innovation” Model



Key Finding of the National
Academies' Recently Concluded
Assessment of SBIR

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

Government Ministries, Entrepreneurs
and Universities increasingly find SBIR to
be a Useful Tool

Why do Government Ministries like SBIR?

SBIR Brings Innovative
Solutions to Complex Mission
Challenges

SBIR is Flexible and Scalable

Why do Government Ministries increasingly like SBIR?

- Government Ministries are discovering that SBIR helps them solve mission-related problems
 - **NIH:** Imaging Software, Audio-Visual Health Materials, Medical Devices, & Health Aids
 - **DOD:** Low-cost, High-performance Drones
 - **NASA:** Instruments for Air Quality
- SBIR Converts Ideas into Potential Products, Provides new sources of Innovation, and Increases Competition in Public Sector

SBIR is a Flexible Program that Adapts to Diverse Agency Missions, Agency Culture, and Technology needs

- Each agency typically has its own manner of choosing awardees and screening applications
- Different metrics reflect unique agency missions and needs
- Different Metrics by industrial sector, e.g., software vs. drug development vs. weapon components

SBIR is Effective at Many Scales

Major SBIR Agencies		Minor SBIR Agencies	
Defense DOD	\$941 million	Homeland Security DHS	\$31 million
Health HHS	\$561 million	Agriculture USDA	\$19 million
Space NASA	\$103 million	Commerce DOC	\$8 million
Energy DOE	\$87 million	Education ED	\$8 million
Science NSF	\$101 million	Environment EPA	\$6 million
		Transportation DOT	\$2 million
		2005 Figures	

Why do Entrepreneurs like SBIR?

No dilution of Equity

Incentive to Start Firms and Initiate Research

Certification of Technical Quality and

Commercial Potential Attracts Private Investors

Academies Research Reveals SBIR Impact on Firm Formation and Growth

- **Company Creation:** 20% of responding companies said they were founded as a result of a prospective SBIR award (25% at Defense)
- **Research Initiation:** SBIR awards played a key role in the decision to pursue a research project (70% claimed as cause)
- **Company Growth:** Significant part of firm growth resulted from award
- **Partnering:** SBIR funding is often used to bring in Academic Consultants & to partner with other firms

SBIR Helps Attract Additional funds from Angels, Venture Capitalists

- **Angel Investors:** 37 percent of NRC survey respondents attracted additional investment from Angels and other sources
- **Venture Funding:** SBIR is a signal of research quality and commercial potential. Over \$1.5 billion in added VC investments between 1992 and 2005
- **Acquisition:** e.g., Philips acquisition of Optiva for \$1 billion
- **Provides Greater Choice:** New Options and Competition for Public Procurement

Why do Universities Like SBIR?

They increasingly find it a useful
tool to move Ideas from the
Laboratory to the Market

SBIR links the University with Industry and helps create new Spin-outs

- SBIR Innovation Awards Directly Cause Researchers to create New Firms
 - **Lowers Risk:** Faculty does not have to give up University post
 - **Lowers Overhead:** Don't need to have a company to apply
 - 15 to 20% success rates—comparable to other grants
- New firms help grow the region and provide returns on R&D investments

Major Finding: SBIR Awardees Come From & Work Closely with Universities

- Over a third of the respondents in the NRC survey Phase II Survey of 4000 firms reported university involvement in their SBIR project. Of these:
 - More than 80% of NIH respondent companies had at least one founder from academia
 - About 1/3rd of founders were most recently employed as academics before founding the company
 - About 1/3rd of projects had university faculty as contractors on the project and 1/4th used universities themselves as subcontractors
 - 15% of SBIR awards involved graduate students.

Universities play a Growing Role in Commercializing Innovation

Universities that are able to connect with
Industry Drive Regional Development and are
Assets for National Competition

From the “Ivory Tower” to the Marketplace

- “Pure” Research is not the only University Role
- Research Related to Industry Helps Generate Training and Skills Necessary for Productive Lives
 - (and the tax dollars for Research)
- Industry’s Needs and Questions can Drive Research and be a Source of Relevant Publications



The 21st Century University must:

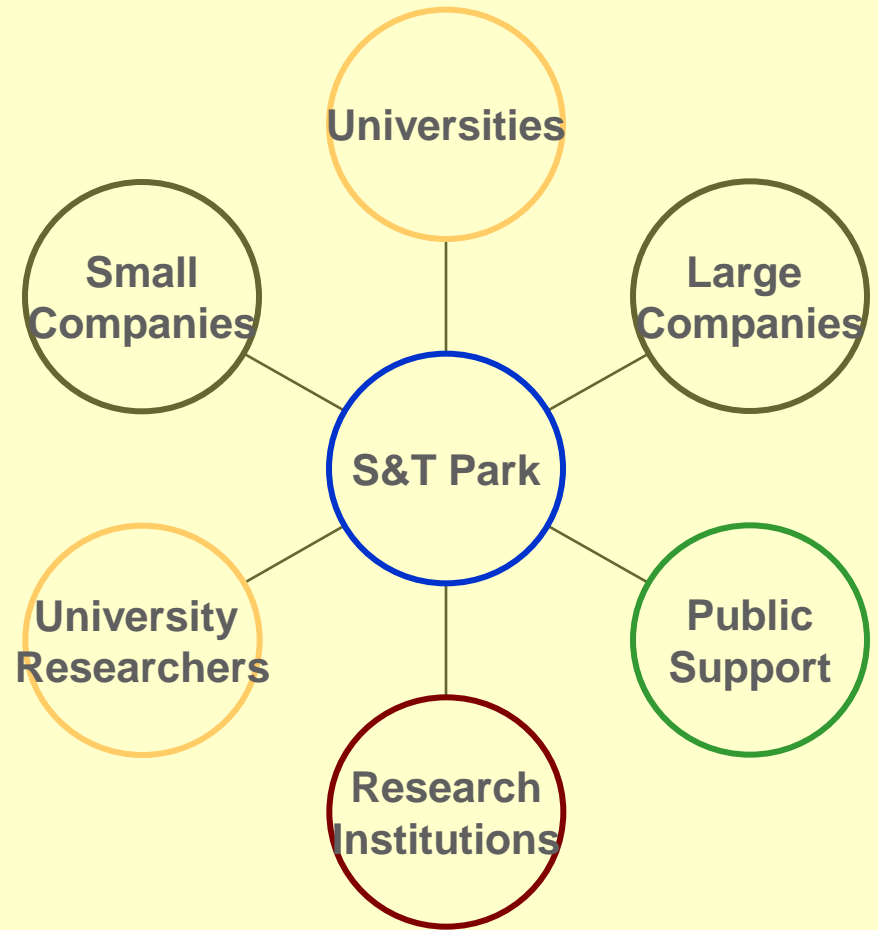
- **Teach the next generation**
 - With up to date laboratories on real market questions
 - About the sciences needed to address current and future questions (e.g., nuclear waste, stem cell research, genetically modified food)
- **Conduct Research**
 - “Curiosity-driven Research,” certainly but
 - the University also needs to bring Science to bear on Social Problems and Industry Needs
- **Commercialize**
 - New Science-led solutions to societal problems
 - New Products, Processes
- **Generate Market-ready students**
 - Create a cadre of creative and curious team players

University-Industry Linkages Enhance Local Growth & National Competitiveness

- Universities that are able to connect with Industry Grow the Economy and are Assets for National and Regional Competitiveness
- We need Innovative Universities to Keep and Improve our Standard of Living
- A Variety of New Incentives and New Institutions are Needed
 - Innovation Awards like SBIR are one means to encourage greater university-industry collaboration

S&T Parks Link Universities with Industry and are a Catalyst for Jobs & Growth

- Well-conceived and regularly assessed S&T Parks can
 - Advance university missions
 - Help create companies
 - Build partnerships among researchers, small companies, and large companies
 - Increase public support and help justify increases for university funding



R&D Consortia are another Tool to Link Universities with Industry

- R&D Consortia coordinate Pre-Competitive Research to Develop New Technologies
- U.S. has experience in Successful R&D Consortia
 - **Sematech Consortium** was successful in helping to restore the health of the U.S. Semiconductor Industry in the 1990's
 - Focus Centers teams universities to conduct exploratory research needed for next-generation technologies
- Consortium Model is now Emulated abroad, often on a larger scale—e.g., IMEC in Europe
- New Consortia can Provide a Proven Path Forward for New Technologies and New Opportunities
 - Flexible Displays and Battery Technologies

What is the Impact of SBIR?

New Innovative Technologies Commercialized

New Knowledge Created

New Employment and Growth Fostered

SBIR Brings New Ideas to the Market

- Small Firms use SBIR to
 - Advance Projects
 - Develop Specific Capabilities
 - Attract Additional Research Funding
- Commercialize Academic Research
 - SBIR Awards encourage academics to found new firms that can commercialize research results
- Commercialize Products
 - Nearly half of projects reach the marketplace in some form (NRC Phase II Recipient Survey)
 - Results are highly skewed—Small number of big pay-off awards

SBIR Success takes Many Forms

- **NASDAQ Success**
 - SBIR investments contributed to success of companies like Qualcomm, ATMI, Martek, Luna
- **Innovation Success**
 - New products, like the electric toothbrush, brought to market by Optiva—now acquired by Philips
- **Government Mission Success**
 - Simulation Software for Navy Seals saves lives and costly equipment
 - NASA Mars Rover uses SBIR-funded Lithium-ion batteries to power the Mars Rover at low temperatures
- **Employment Success**
 - SBIR helps new Start ups grow, creating high quality jobs of the future

DOE: New Battery Technology

- The A123 Systems Story
 - 2003 SBIR award from the Department of Energy funded research on “an advanced cathode material for lithium-ion batteries.”
 - SBIR was the company’s first source of outside funding
- New battery technology combines unprecedented power, safety and long-life
 - applications for computers, power tools and – most significantly – for hybrid-electric vehicles
- New company has grown over five years—
 - Today employs over 1,100 people

SBIR: Positive Employment Effects

- Direct Impact of Awards on Employment:
 - The NRC Phase II Survey respondents estimated that, their firm was able to hire an average of 2.4 employees, and to retain 2.1 more as a direct result of the award
- Employment Gains from Firm Growth:
 - Addition of 30 full-time equivalent employees on average per firm during period surveyed
- Overall Job Gains:
 - NRC survey respondents reported direct and indirect gains of 57,808 full time equivalent employees, during period surveyed (1992-2002)

Source: NRC SBIR Phase II Survey 2002 (1,916 survey responses)

SBIR Awards Generate New Knowledge

- SBIR Generates Knowledge
 - **Patents:** About 30 percent of NRC survey respondents received patents related to their SBIR research.
 - About two-thirds of projects generated at least one patent application
 - **Publications:** Slightly more than half of NRC survey respondents published at least one related peer-reviewed scientific paper
- SBIR Broadens Scope & Speed of Research
 - Helps firms initiate new high-risk research
 - Helps broaden the scope of existing research

Can Innovation Partnerships Work Outside the United States?

Yes! Institutions and Incentives
have to be adapted to local
Realities

Invest in Education & Research

- Invest in education and skills—and harvest them
 - Produce and Attract Skilled Researchers and Engineers
 - Build Top Quality Research Facilities
 - Encourage International Exchanges to Build Networks
- Invest in Research Universities
 - Reinforce Success with new resources
 - Smaller countries should concentrate resources, both on best bets and existing strengths and needs
 - Build links across existing institutions
- Focus Research on Traditional Areas of the Economy as Well as Emerging Sectors

Foster an Innovation Mindset

- Provide Incentives and Drop Disincentives
 - Easier Labor rules & Taxes for Start-ups
 - Encourage new businesses, job creation and competitiveness
 - Eliminate outmoded Bankruptcy Laws
- Reinforce Cooperation and Entrepreneurial Activity across private sector, universities, and governments
- Public Funding is the Catalyst!

Adopt and Adapt Proven Mechanisms

SBIR is Recognized as Global Best Practice

- **Finland** has adopted a new 3-Phase SBIR Program
 - **Russia** has adopted an SBIR-Type program
 - **UK** SIRI program is similar in concept; now being upgraded
 - **The Netherlands** government has recently adopted SBIR, following a pilot program
 - **Japan, Korea, & Taiwan** have adopted SBIR concept
 - **India** has launched an SBIR Initiative for the biotechnology sector
 - **Singapore** is implementing a program
- All had consultations with the NAS

From Post War Industrial Policies to 21st Century Innovation Policy

- Traditional Focus of Technology Policies
 - Financial support for R&D in firms, universities, laboratories
 - Functional infrastructure (Laboratories)
 - State support for specific technologies and sectors (e.g., subsidies and trade policies)
- New Innovation Policies focus on
 - Creating institutions and incentives for collaboration
 - Supporting dynamic 'ecosystems' where ideas are created, developed, and diffused
 - Encouraging entrepreneurship and firm creation

“Innovation” is the Key to how Nations Compete and Grow in the 21st Century

- Innovation is not a “Hobby”
- Supporting innovation should be recognized as a central function of the government
 - Key to a nation’s wellbeing and competitiveness
- Successful Innovation policies require sustained attention & regular review
 - Requires an understanding of the innovation ecosystem and the ways to enrich it.
- Learning from each other is a must

The National Academies' Program on Technology, Innovation and Entrepreneurship is an Internationally Recognized Center of Excellence

- We have major outreach programs to Asia, Europe and the Middle East
- We seek to collaborate more closely with Latin America
- Mutual Learning and Cooperation are Essential for our Common Future
 - More Hands-on Cooperation is Required

Thank You



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