Government Programs to Encourage Innovation by Start-ups & SME's

The Role of Innovation Awards

21st Century Innovation Systems for
Japan and the United States:
Lessons from a Decade of Change"

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Board on Science, Technology and Economic Policy
National Research Council

Presentation Topics

- The Global Innovation Challenge
  - U.S. and Japanese Challenges in Innovation
  - The Importance of Innovation
- The Importance of Openness
- The Role of Small Businesses in Innovation
- Policy Myths and Market Realities about Small Business Innovation
  - Myth of Perfect Markets
  - The VC Myth & the Valley of Death
- The Role of Innovation Awards
  - Fostering Small Business Innovation
  - The SBIR and ATP Models
- Conclusion
  - Learning from Each Other

The Global Innovation Challenge

Japan and the U.S. face Common Realities

Our ability to ability to invent, design and manufacture goods and services are vital to our future prosperity

What are the Sources of these Structural Changes in the Global Economy?

- The Internet and the Death of Distance are integrating the Indian, Chinese & other economies into the Global Market
  - Aided by Business Outsourcing and Global Sourcing—e.g. Wal-Mart
- Rapidly Growing Markets and the Competition for Share combined with…
- Major Programs Designed to Attract, Nurture, & Support High-tech Industry within the National Economy

China—Strengths

- Structural Advantages
  - Very high savings and investment rate
  - Low wage advantage
  - Efficient export trade logistics
  - Becoming world's manufacturing base
- Government with strong sense of national purpose
  - Strong investments in education and training
  - Strategy to move rapidly up value chain from labor intensive to more technology intensive exports
  - Effective requirements for training and tech transfer
  - Critical mass in R&D is beginning to be deployed to generate autonomous sources of innovation & growth

Modified from C. Dahlman

India – Strengths

- Structural Advantages
  - Large critical mass of educated, skilled, and English speaking knowledge workers—260,000 engineers p.a.
  - Strong science and engineering capabilities centered in chemical, software, and IT sectors
  - Has network of successful Indians in U.S. and Europe providing links to markets, technology, and finance
  - Relatively deep financial markets; rule of law
- Policy Liberalization now Unleashing Growth
  - Growth jumped from traditional rate of 2-3% growth in past decades to 6-8% last decade
  - Emerging as world's service center for software development, back office services
  - Now a cutting-edge innovation center for global companies including major R&D centers for core products for GE and Intel (BusinessWeek 6 Dec 2005)

Innovation is Key to Maintaining Competitive Position in Global Economy

- Innovation is essential to compete in the global economy
  - Raise productivity and growth levels
  - Position ourselves to compete effectively against low-wage, newly-emerging economies
- To advance our knowledge-driven economies, we need to
  - Strengthen our science and technology base
  - Become the knowledge hubs of the world
  - Create incentives for R&D and knowledge transfer by improving links between Universities, Industry, and Government

U.S. Enjoys Advantages in Innovation…

- A large and integrated domestic market
- An economic and institutional infrastructure that quickly re-deploys resources to their most efficient use
  - Strong and diverse higher educational infrastructure
  - Deep and flexible capital and labor markets
  - Strong S&T institutions
  - Flexible managerial and organizational structures
  - Entrepreneurial Culture
  - Ability to grow new Large Firms

…but U.S. Also Faces Major Challenges

- Improvement needed in Education System
  - K-12 Challenges in Science and Math
  - Fewer students pursuing Science Careers
  - Post 9/11 Reductions in Foreign Students
- Uneven & Insufficient R&D Funding
  - Physical Sciences and Engineering Funding is down or flat
  - Too Much Focus on Military R&D
- Insufficient Support for Commercialization
  - Few programs—Effective, but limited scope
  - Too few Consortia—Limited Funding & Evaluation
  - Ideological Blockages limit the Commercialization of R&D

Growing Chorus of Concern on U.S. Innovation Policy

- PCAST Report 2005
  - Academy Contribution of Innovation Ecosystem Concept
- National Innovation Initiative
  - Led by IBM and leading Universities
  - Ignored by the White House but not by the Congress
- Congress Tasked the National Academies with an Assessment of U.S. Innovation and Competitiveness

"Rising Above the Gathering Storm"

A New National Academies Report*

- Scientific & Technical Building Blocks of U.S. Economic Leadership are Eroding
  - Weakening commitments to S&T puts future U.S. prosperity in jeopardy
  - Risk of an abrupt loss of U.S. leadership in S&T
- Report calls for more support to Education, more focus on Energy Research, & more support for Innovation
  - Need new policies that address emergent realities
  - Popular policy Myths often obscure need for pragmatism

*October, 2005

Japan Shares U.S. Concerns but Remains one of the World's Top Technology Powerhouses

- A world leader in patents
  - Five of top ten global companies for patents are Japanese
  - Most patents in IT, telecomm, electronics
- Leader in Integrated Manufacturing
  - Machine tools, automobiles, high-end electronics
- Still, there is concern that Japan's "innovative genius is more suited to constant improvements in integrated manufacturing than to blue-sky inventions."
  - Financial Times, Oct 12, 2005
- Others Point out that Incremental Approaches have Proven Effective in the Past and are Likely to Work Again, e.g., in Solar Energy
  - Economist, Dec 17, 2005

Japan is Focused on Strengthening its Innovative Potential

Japanese policymakers recognize that:

- Innovation in Japan is traditionally concentrated in large firms (prompting incremental improvements); less breakthrough innovation, e.g., Google
- Institutional links between Universities and Industry are not well developed
- Keiretsu structure may make it difficult for new firms to break into markets

New Positive Incentives to Improve Innovation in Japan

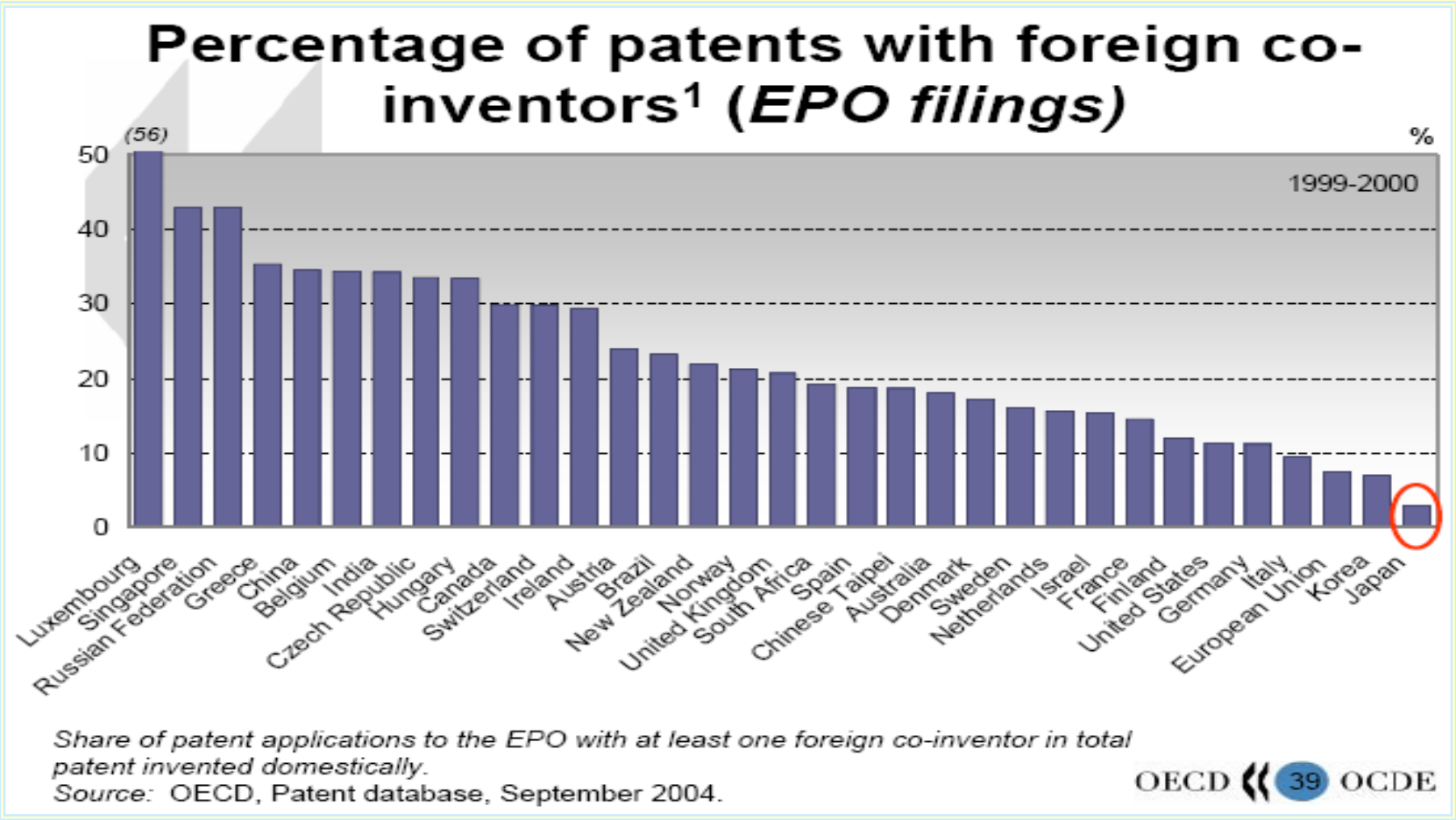
- 1995 Basic Law encourages University-Industry partnerships
- More public investment in universities and new graduate programs designed to avoid hierarchical limitations of traditional universities
- Government is seeking to create conditions for new, entrepreneurial firms
- Japanese and foreign venture capitalists are showing more interest in new firms
- Some Analysts Emphasize the Importance of greater openness to new global economy for Universities, Cooperative Research, and Foreign Investment

OECD's Tanaka: Openness has Positive Consequences for Innovation

- Successful innovation closely linked to openness
  - Cross-border Openness of S&T environment, foreign students, companies (FDI), and new products
  - Openness among public research, academia & business
- Open & Attractive Environment
  - Attraction of foreign R&D funding and students
  - Mobility of intellectual property
  - Mobility of highly skilled human capital both domestically and internationally

Source: Nobua Tanaka, Director, DSTI/OECD, 11-04-05

OECD: Japan's Industry-centered R&D System is Relatively Closed



More International Universities Promotes Openness and Innovation

- U.S. benefited from postwar Internationalization of University Research
  - Access to best minds in the world—many of whom stayed and in the U.S. and contributed
  - Returning students often a source of research collaboration, business relationships, and political support
  - Exposure helped U.S. students to function in an integrated world
  - National Academy of Sciences studies (1982, 1987) found open research laboratories in U.S. national interest
- Today, Japan is sponsoring more university-based research; encouraging more cooperation with small business

The Importance of Small Business for Innovation

Small Businesses are a Key Driver of the U.S. Knowledge-Based Economy

- Major Employment Generator
  - Generated 60% to 80% of Net New Jobs in the 1990s
  - Created 2.5 million of the 3.4 million total jobs created in 1999-2000
  - Locus of all net new jobs 2000-2001
- Employs 39% of High-Tech Workers—Scientists, Engineers, Computer Workers
- Produces 14 times more Patents per Employee than Large Patenting Firms
  - Patents are of High Quality
  - Twice as Likely to be Cited
- Source: SBA Office of Advocacy 2005

The Importance of Equity-Financed Small Firms

- Equity-Financed Small Firms are a Leading Source of Innovation in the United States
- Equity-Financed Small Firms are One of the Most Effective Mechanisms for Capitalizing on New Ideas and Bringing Them to the Market
  - Audretsch and Acs
- Key Goal: Encourage New Equity based Hi-tech Firms that bring Innovation, Jobs, and Growth
  - U.S. Strengths: Firm Creation & Growth—Microsoft, Intel, AMD, FedEx, Qualcom, Adobe have changed the U.S. Economy
  - Case of Sweden: No new large firms since 1970
  - Postwar Japan: New Firms and Rapid Growth

U.S. Norms and Policies Create Positive Incentives for Entrepreneurs

- Positive Social Norms
  - High Social Value on Commercial Success
  - Forgiving Social Norms allow more than one try
- Entrepreneur-friendly Policies
  - Markets Open to Competition from new Entrants
  - Gentle Bankruptcy Laws permit rapid recovery
  - Taxes give Prospect of Substantial Rewards
- Strong Intellectual Property Regime:
  - Personal Incentive for Invention
  - Encourages Research & Diffusion

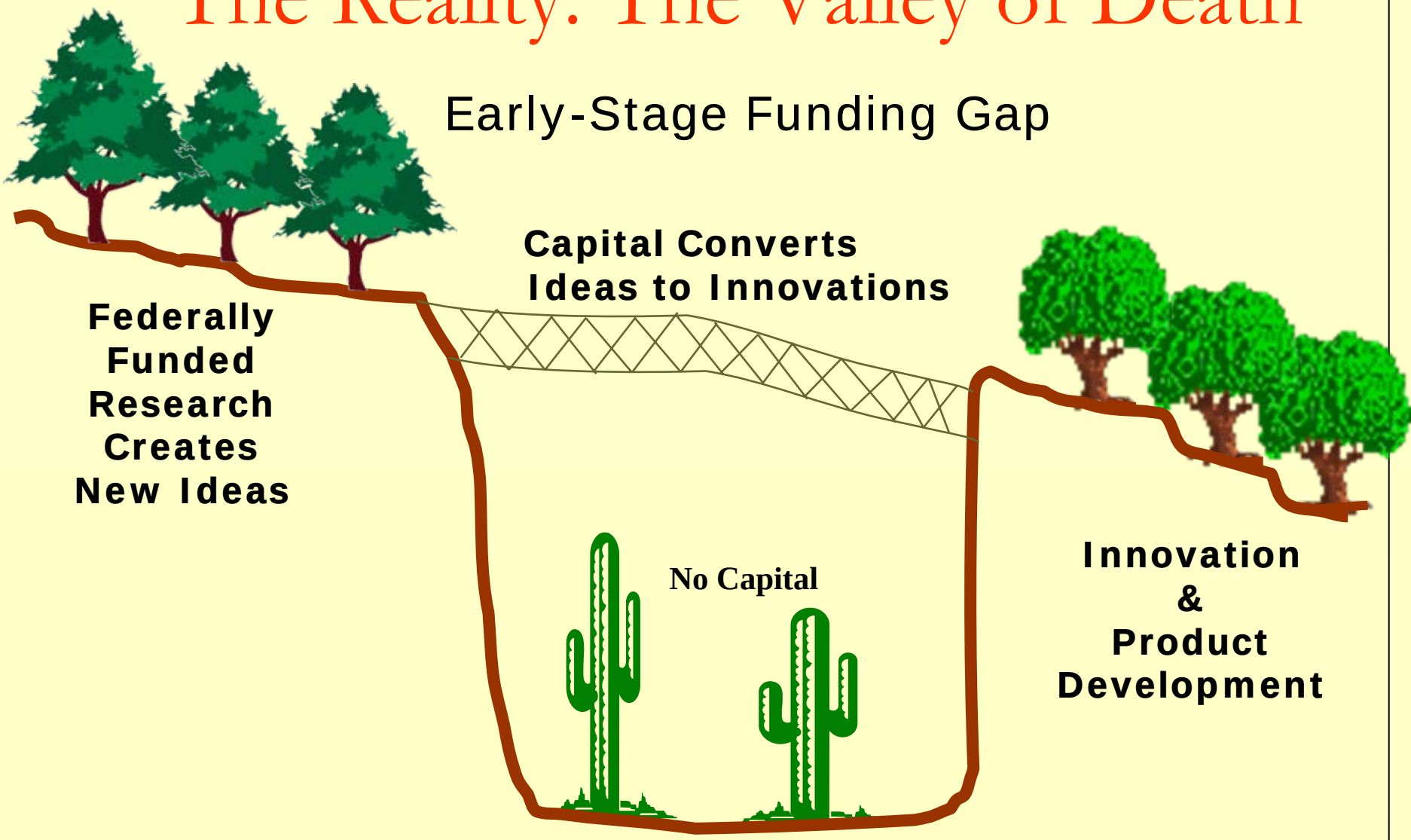
U.S. Myths about the Innovation Process are an Obstacle to Small Firm Development

U.S. Policy Myths about Perfect Capital Markets

The Myth of Perfect Markets

- Strong U.S. Policy 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
    - This means that it is hard for small firms to obtain funding for new ideas
  - Development of new technologies within an economy is not automatic
    - Technology trajectories are not pre-ordained
- Firms with Promising Ideas Face Major Challenges

The Reality: The Valley of Death

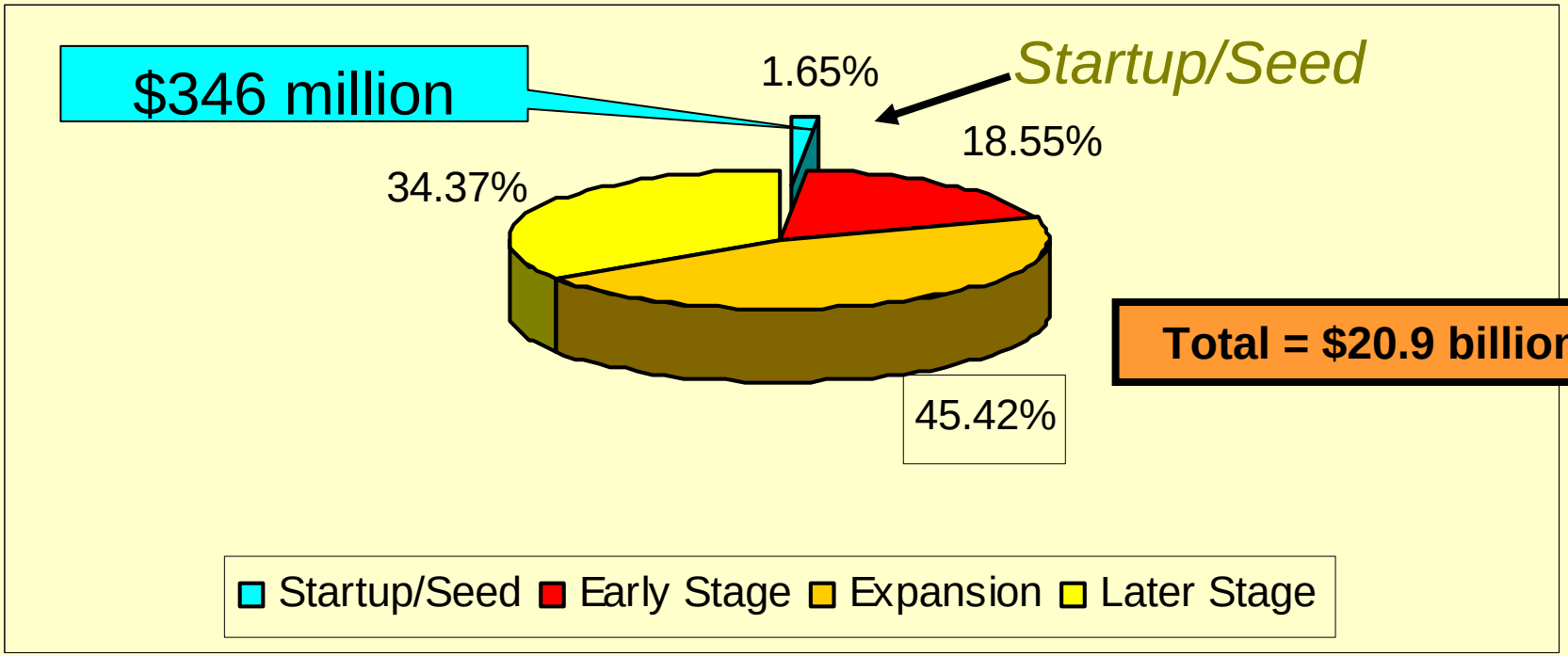


The Myth of U.S.Venture Capital Markets

- 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
  - Prone to herding tendencies
  - Focus on later stages of technology development
  - Most VC investors seek early exit
- Large U.S. Venture Capital Market is Not Focused on Early-Stage Firms
  - See the current Funding break out

Large U.S. Venture Capital Market is Not Focused on Early-Stage Firms

Breakdown of U.S. Venture Capital by Stage of Development-2004

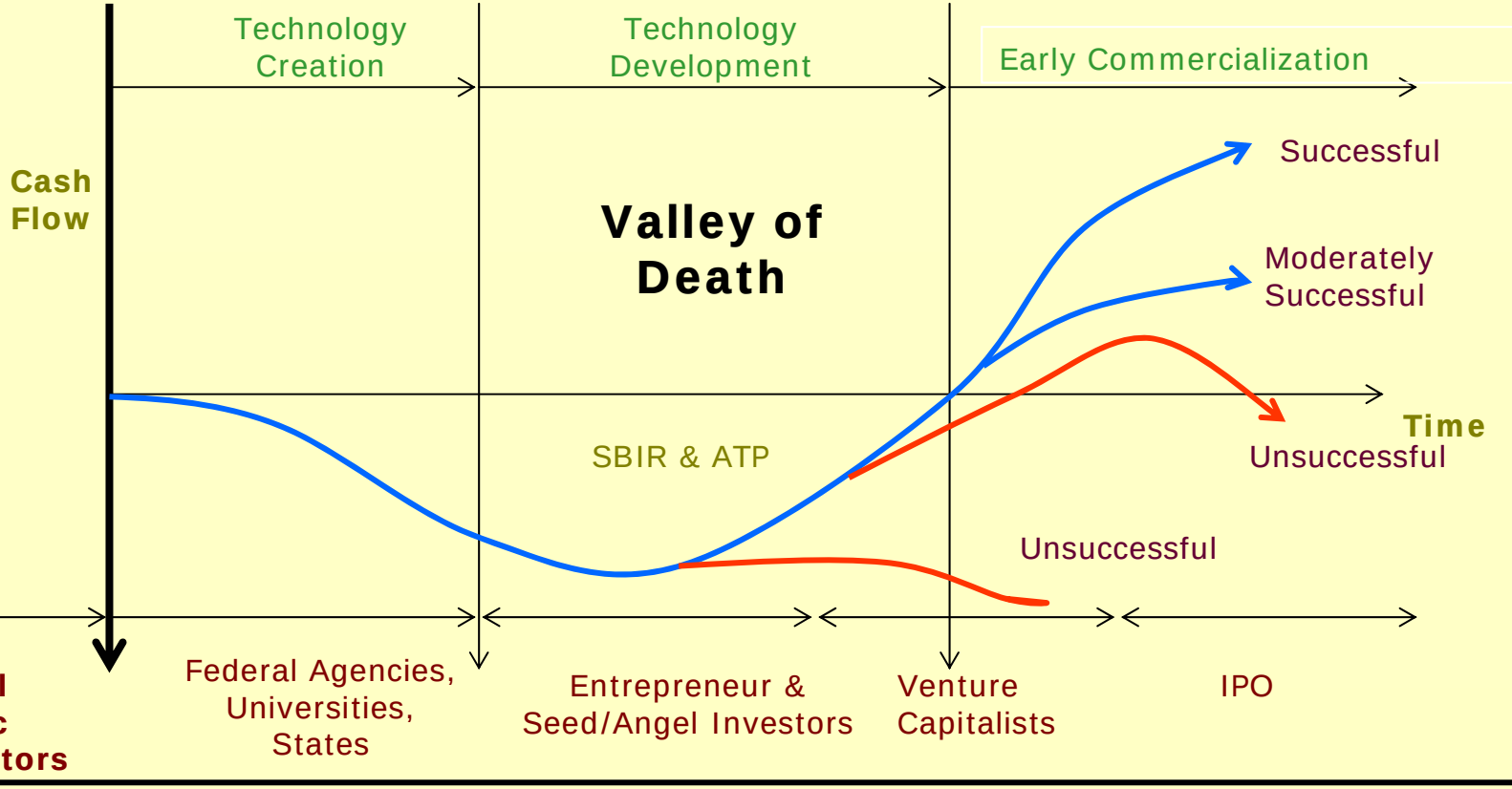


The Valley of Death: A Venture Capitalist's View

- A Series of Gaps
  - Gaps in Information between Entrepreneur and potential Investor about
    - Technology: What is it? Will it work?
    - Potential of Technology: What can it do?
    - Business Opportunity
      - What size is the market?
      - What is the competition?
    - What level of risk do investors want to accept?
      - Changes over time and by sector
  - ➢ Result=Gaps in Financial Resources necessary to develop technology from prototype to market

The Public-Private Funding Transition & the Valley of Death

Adapted from: L.M. Murphy & P. L. Edwards, **Bridging the Valley of Death—Transitioning from Public to Private Sector Financing**, Golden CO: National Renewable Energy Laboratory, May 2003



How does the U.S. fill the Funding Gap?

- The Early Stage Finance challenge is complex:
  - There is no single solution!
  - Money to large companies is not the solution
  - A multi-phase approach is required
- The U.S. system includes a mixture of institutions and mechanisms:
  - University Research and DARPA Funding
  - Proof of Principle & Prototype with SBIR
  - Joint Ventures with ATP
  - Industry-led Consortia for Standards & Joint Research
  - Broad R&D Tax Credits
  - All complemented by an Entrepreneurial-friendly Policy Environment

The Government Role in Crossing the Valley

The Role of Innovation Awards: The Case of SBIR

Funding Sources for Early-Stage Technology Development in the U.S.

Multiple Actors

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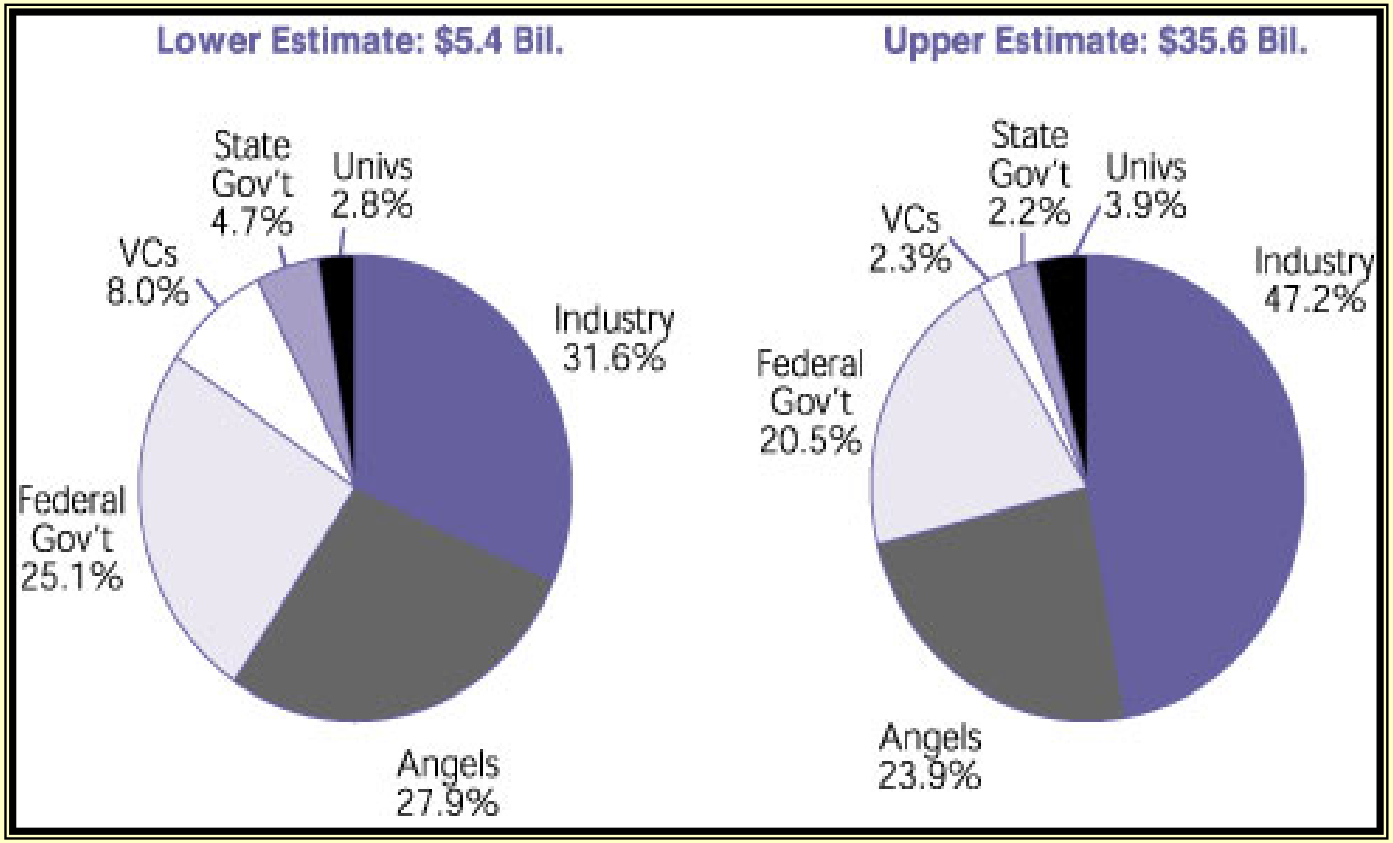
Multiple Sources of Finance Focused on Different Stages

*

Government Role is Significant



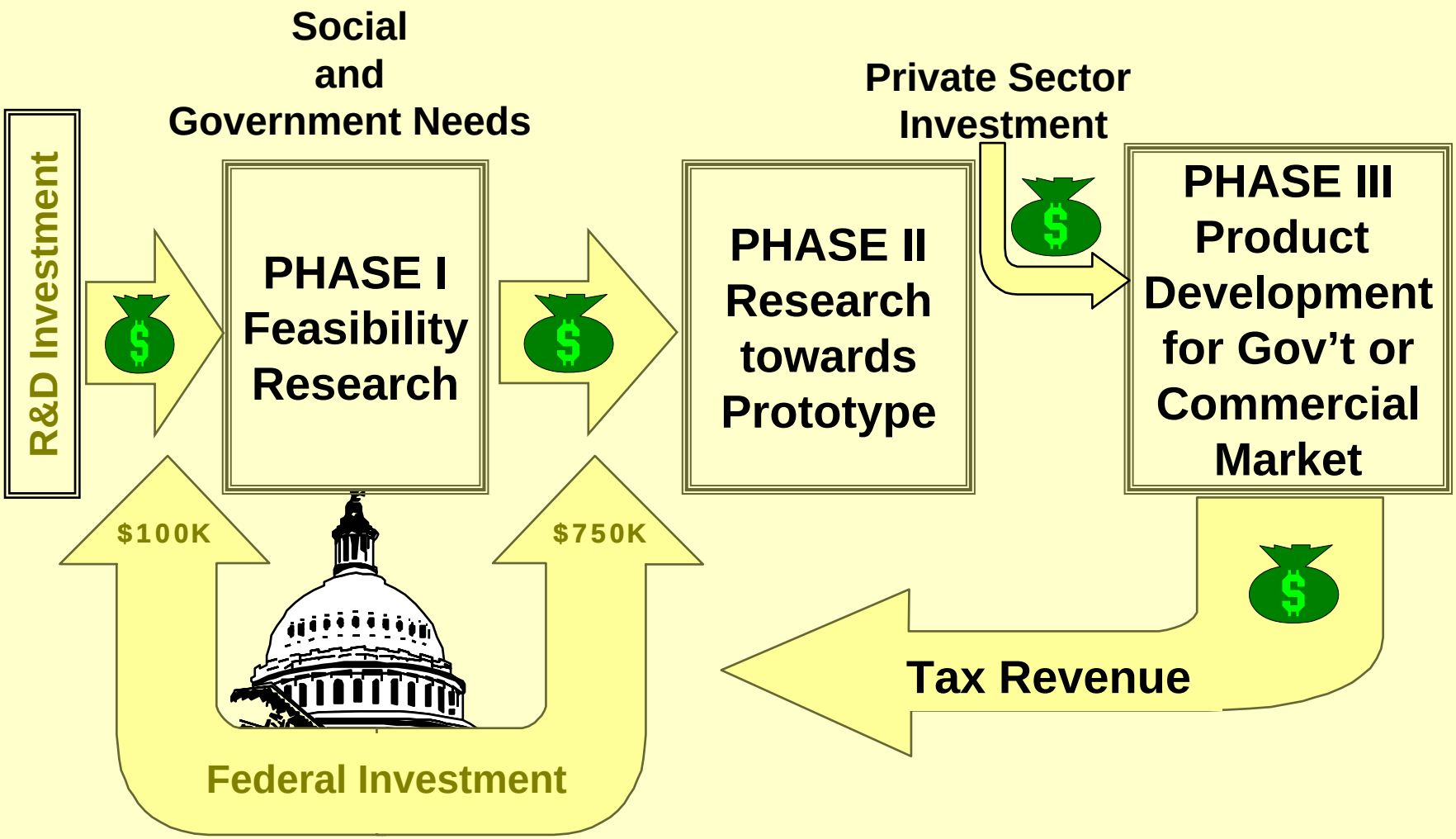
Branscomb & Auerswald, *Between Invention and Innovation An Analysis of Funding for Early-Stage Technology Development*, NIST, 2002

Figures based on 1998 data

The SBIR Program

- Created in 1982, Renewed in 1992 & 2001
- Participation by all federal agencies with an annual extramural R&D budget of greater than $100 million is mandatory
  - Agencies must set aside 2.5% of their extramural R&D budgets for small business awards
- Currently a $2 billion per year program
  - Largest U.S. Partnership Program
- The National Academy is Reviewing SBIR Program Operation and Performance

The SBIR Model



SBIR Concept Advantages

- Program is Focused on Government and Societal needs in health, security, environment, & energy
- Proposals are Industry-Initiated
- 2-Phase Filter to Screen Bad Ideas
- No new money, hence politically viable
- Program ownership rests with many agencies, not a single “tech agency”
- Changes incentives within Organizations for those who wish to change, e.g., Universities, Laboratories, and Small Firms

How Easy is SBIR for Firms to Use?

- SBIR uses a Self-Select Mechanism
  - A Bottom-up approach
  - Agencies post broad Solicitations; Companies define terms of Proposals
  - Most Agencies permit Multiple Proposals from Companies
  - Low Paperwork
    - 15-page description for Phase I award
    - Relatively easy to fill out

Why do Entrepreneurs like SBIR?

- Additional Research Funds: $850+
- No dilution of ownership
- No repayment required
- Grant recipients retain rights to IP developed using SBIR funds
- No royalties owed to government
- Awards attract private capital
  - Certification Effect

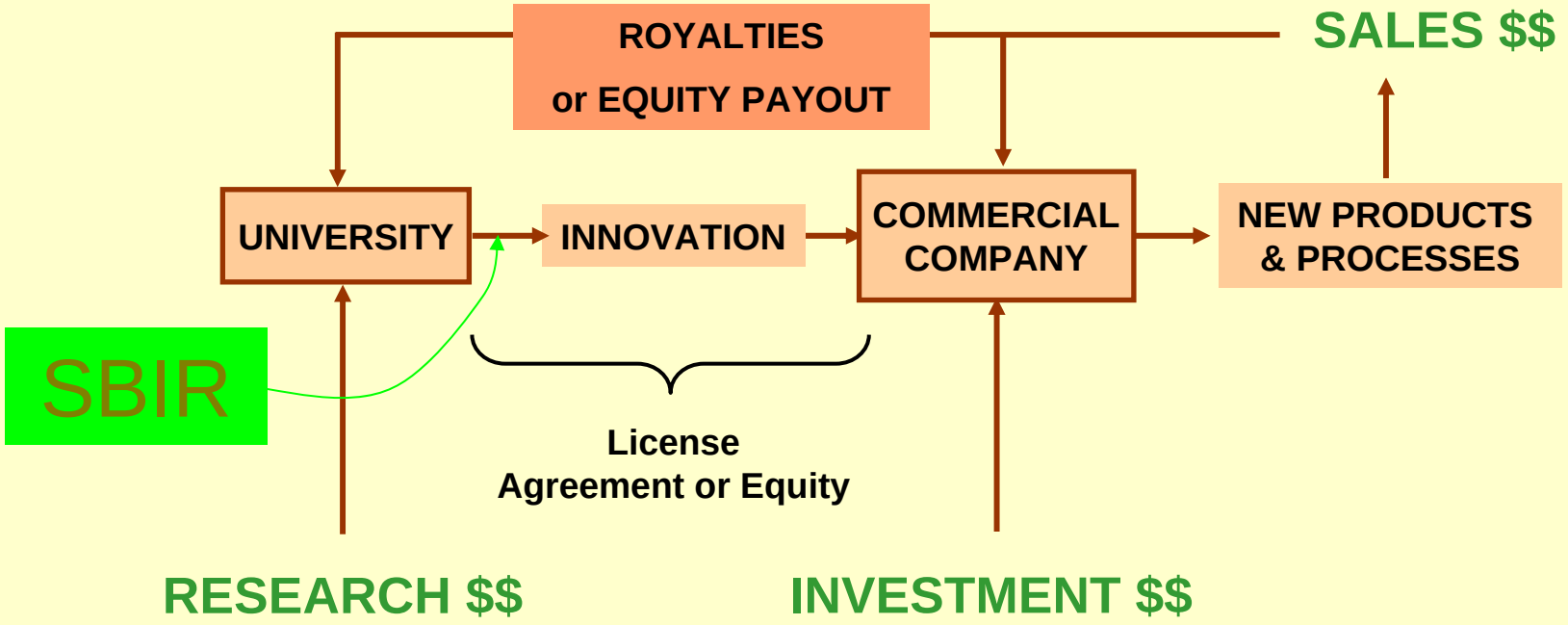
Why do Governments like SBIR?

- SBIR helps Agencies solve their Problems
  - NIH:
    - Biotechnology Research Tools
    - Medical Devices
    - Computer Software & Audio-Visual Health Materials
  - DOD:
    - Vaccines
    - Low-cost, High-performance Drones
  - NASA:
    - Aeronautics and Aircraft Systems
    - Robots to assist in surgery
- Private Sector Ingenuity helps address Public needs

SBIR links the University with Industry

- SBIR Innovation Awards Directly Cause Researchers to create New Firms
  - Faculty does not have to give up University post
  - Cooperation creates High-Tech Jobs
- Universities help diversify and grow the job base
  - Increasingly universities are the largest regional employer for all types of employment
- Cooperation validates Research Funding
  - Returns to Society in Health, Wealth, & Taxes
  - SBIR is a proven mechanism in an uncertain game

SBIR Primes the Pump of University Technology Transfer



- Licensing to existing companies – brings royalty $
- New company formation – brings royalties and/or equity
- Other, less direct, contributions to regional economic activity

Drawn from C. Gabriel, Carnegie Mellon University

The Government Role in Crossing the Valley

The Role of Innovation Awards: The Case of ATP

ATP is the "Next Rung" on the Innovation Ladder

- Larger award is in effect an 'SBIR-Phase III'
  - ATP focuses on the next stage—Competition and Commercialization
  - Helps bring early-stage, high-risk, enabling and innovative civilian technologies to market

The ATP Approach: Industry Leadership

- Industry-initiated proposals: Bottom-up approach
- Industry Managed Projects
- Highly Competitive: Only 12.5% receive awards
  - Rigorous independent selection process
    - Evaluation of the project's technical merit
    - Commercial worthiness and broad-based benefits
- Industry cost-share required
  - All ATP awards are cost shared with industry

ATP Encourages Synergies between Small and Large Companies

- Programs like ATP enable business partnerships between Small and Large Firms
- Why Small Firms like ATP
  - Provides significant capital and a powerful certification effect
  - Provides access to Large Firm technologies, skills, management and marketing reach
  - Allows shift from a supplier role to full partnership in an ongoing relationship
- Why Large Firms like ATP*
  - Helps Large Firm keep up with faster pace of innovation
  - Provides access to niche expertise and unique talents of small companies
- ATP Encourages Partnering Between Large and Small Firms, Inventors and Labs

* Kathleen Kingscott, IBM

The U.S. Approach to Innovation Partnerships

- Highly Competitive—Not a Right
- Awards are limited in time
- Awards are limited in amount
- Partnering encouraged: Small companies, large companies, and (increasingly) universities participate in the programs
  - Dissemination of enabling technologies is key to public benefits for ATP
  - Mission support for SBIR

U.S. Myths Remain Powerful

- U.S. Has Been Slow to Renovate its Innovation System
  - Limited Appreciation of Scope and Scale of Foreign Programs
  - Limited Recognition of Need to Facilitate Transition of Technology to Products
- U.S. Ideology on Perfect Markets limits Innovation Policy
  - SBIR under siege by Office of Management and Budget
  - ATP Budget for New Awards frozen at zero for 2nd year
- Recent Experiments such as HSARPA have Shown Limited Impact
- Congressional Action is Probable

Conclusion

Japan and the U.S. Face Common Challenges

- National Innovation Systems are Different in Scale and Flexibility
  - Flexibility is a differentiator
  - It is less how much is spent but *how well*
- All Systems Have Common Challenges
  - Need to justify R&D expenditures by creating new jobs & new wealth
  - Need to reform institutions (or invent new ones)
  - Need to try new mechanisms that shift innovation incentives in a positive way
- Learning from each other is a Pathway to Progress--That is why we are here

Thank You

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