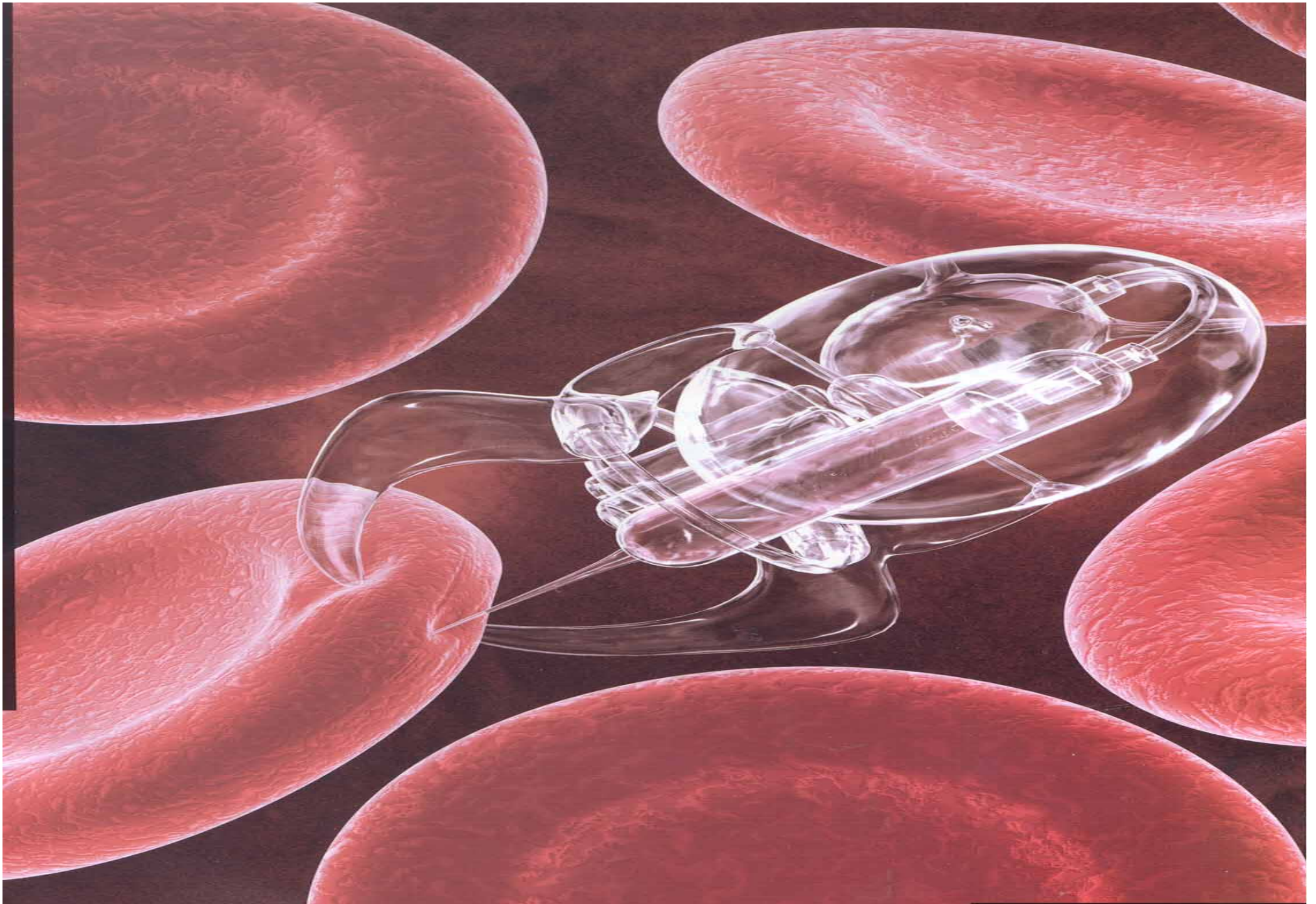




**Bio Connect**  
I R E L A N D

THE NETWORK FOR BIOTECH IN IRELAND



# Biology, Bioconvergence, Information and Enterprise

## Taking the Broad View

Dublin September 2<sup>nd</sup> 2004

**BIOCENNECT IRELAND**

Alan Barrell

# Biology, Bioconvergence, Information and Enterprise

- Inspiration
- Driving Forces of Biotechnology
- Convergence and Common Purpose
- Clusters – Theories and Realities
- Back to Inspiration – Enterprise and Entrepreneurs
- A WORLD of Biotech – Emerging Asia, Fast Moving China
- The Future – Some Key Issues
- Bioscientists of the Future



## Innovation and Invention

**“90% of all the scientists born in the human race are alive today”**

*Prof. John Story - INSEAD*

Discovery comes from within...  
through seeking...

- “The Source of Real Discovery consists not in seeking new Landscapes .....
- But in having NEW EYES”

*Marcel Proust*

## The “C” Word – CONVERGENCE – some Elements

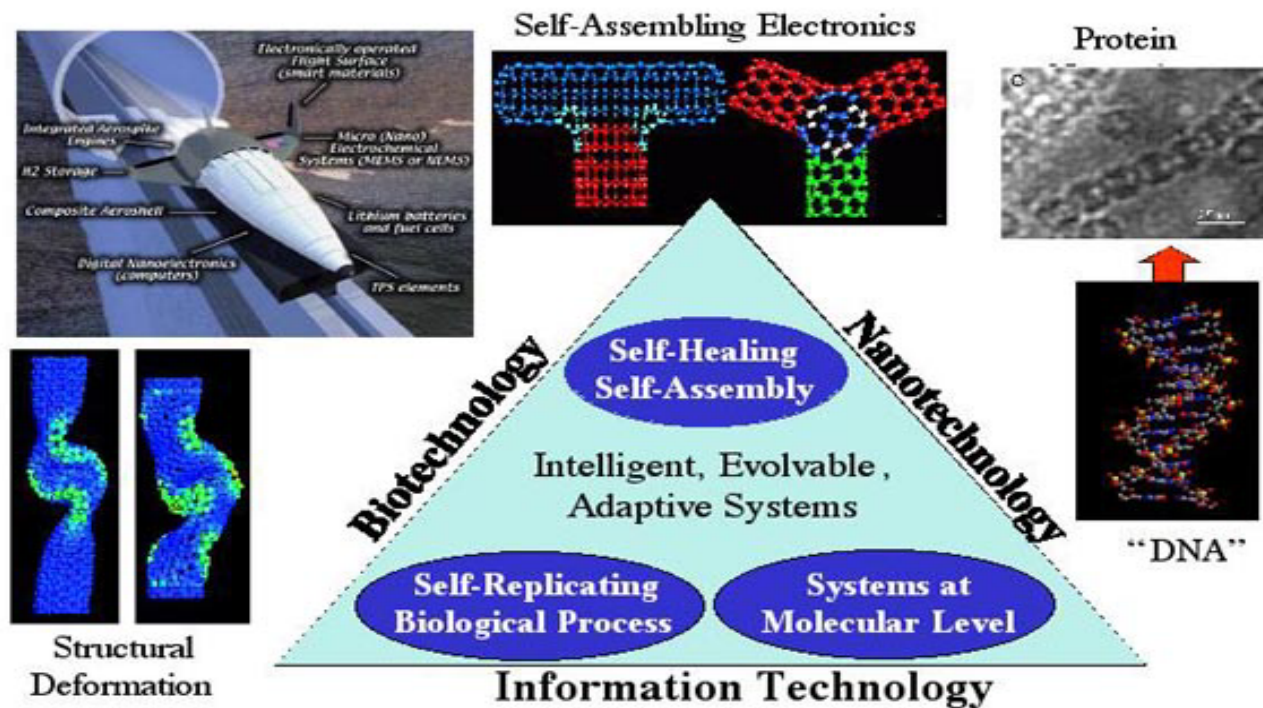
- Biotechnology
- Biohealth
- Information Technology and Informatics
- Communications Technology
- “E” Science and “E” Health
- Materials Science
- Robotics
- Physics
- Chemistry
- Nanotechnology

## Examples – Convergent Sectors

- Biosensors
- Biomaterials
- Biophotonics
- Bionanotechnology
- Biochips “Lab on a Chip”
- Medical robotics
- Diagnostics Imaging
- Biometrics Bioinformatics
- In Silico Discovery and Screening

# Integration Across Multiple Industries

*Revolutionary Technology Vision: Focus on  
“Zone of Convergence”*



Source: NASA Aerospace

## Driving forces of Biotechnology (1)

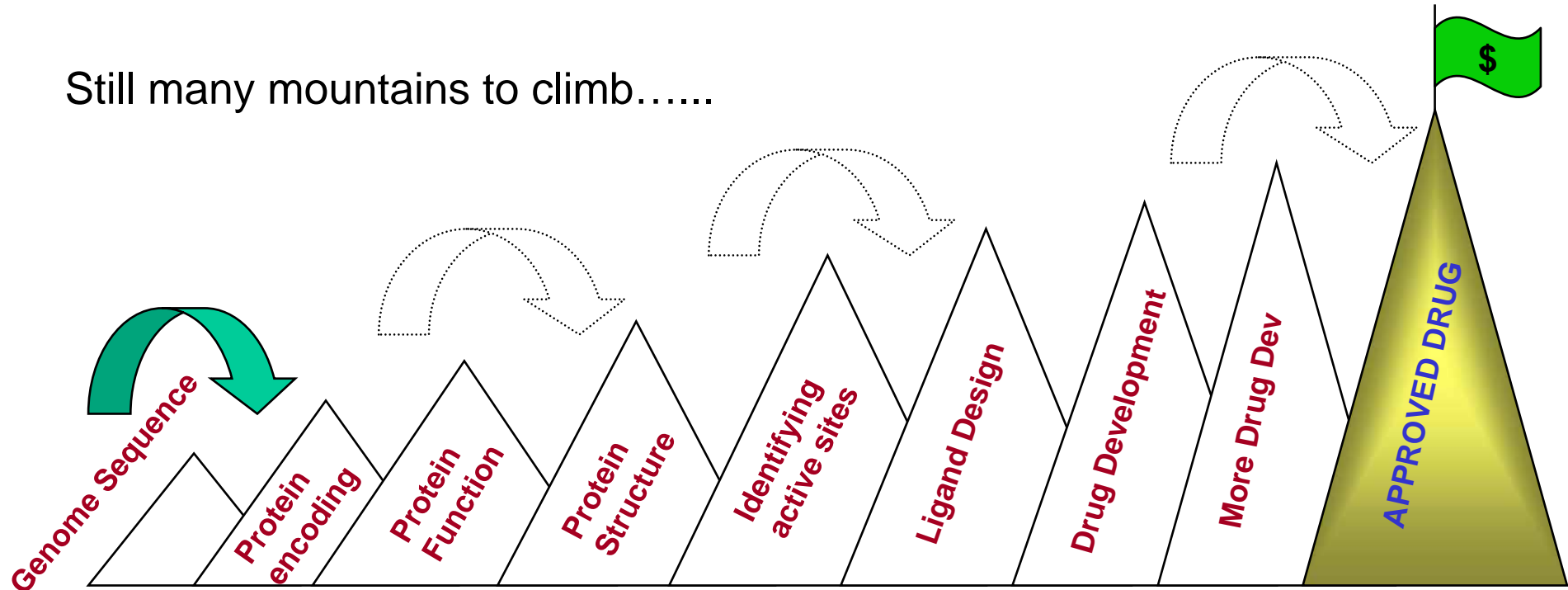
- Inspired quest for new scientific knowledge
- Rapidly developing pools of Intellectual Capital ( 90 % of Scientists born during History of the Human Race are alive today ! )
- Altruism and the search for improved health and relief of suffering
- Governments agendas for Health and Industrial Development / Regeneration
- Current progress with gene sequencing etc – Human Genome Project
- Convergence of technologies needed for forward progress – eg Genomics, Proteomics Medical Informatics, Software, Insilico Drug Discovery

## Driving forces of Biotechnology (2)

- Pharmaceutical Industry – slowing growth, end of “The Age of Dominance” – ascendancy of Generic Drug Companies as patents expire. Cost of new product development and time to market. Loss of speed and creativity – “Dinosaur Factor” Costs to bring new drug to market – and super costs of picking the wrong ones.
- A new “Symbiosis” – Biotech and Pharma. Flexibility of Biotech models.
- “Columbus Spirit” – Development of Entrepreneurial Culture in centres of science and technology – including Universities.
- Growing Knowledge and expertise in Bio-Incubation
- Role Models and Business Angels in Bio-Entrepreneurship
- Developing Business Support Structures – Many examples now
- Investment Finance.....despite downturn !
- Regional and National Competitiveness.

# Beyond the Human Genome - The Climb

Still many mountains to climb.....



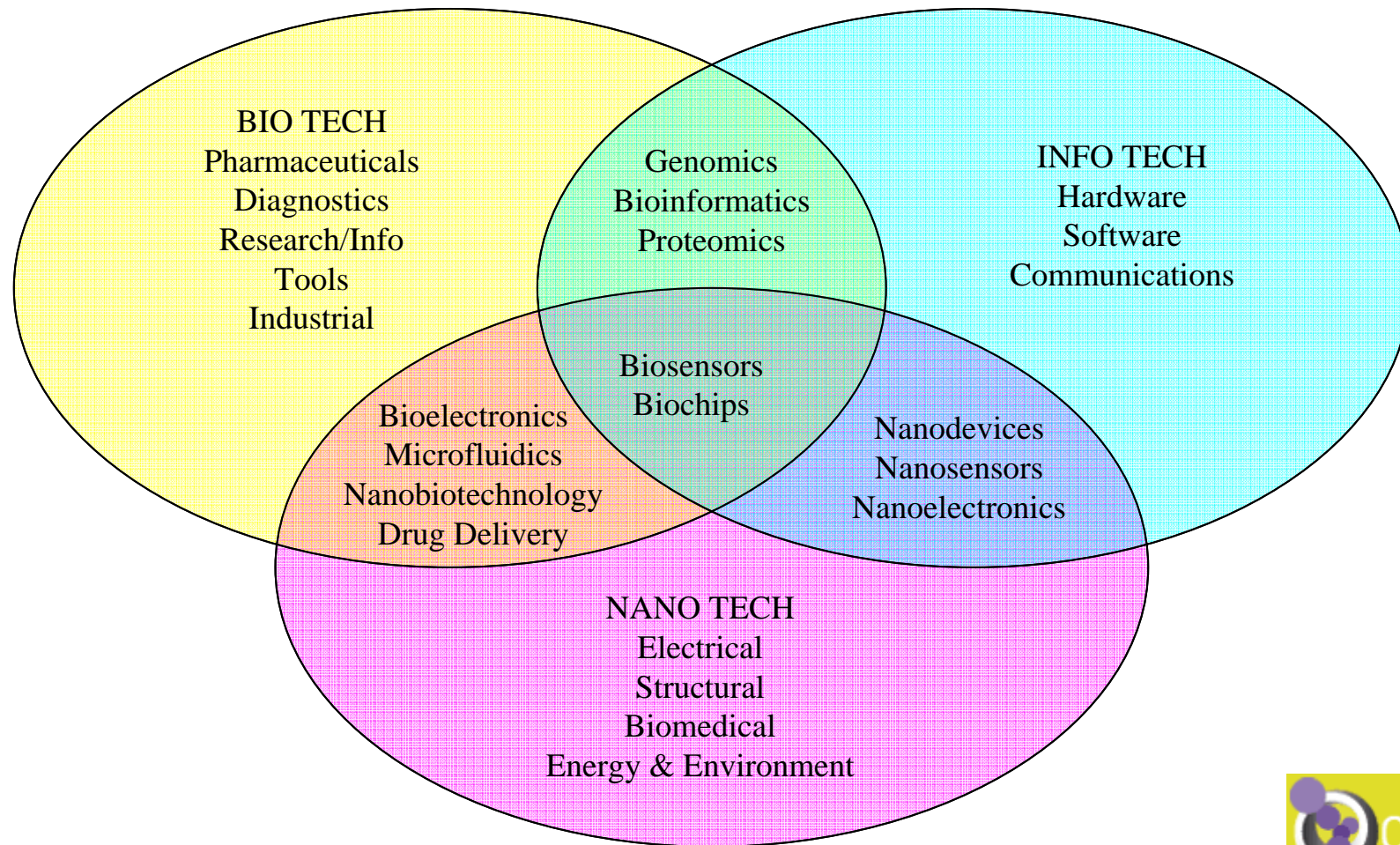
*As a consequence, a need for a variety of approaches and technologies to determine protein function and their impact on diseases will emerge*

## Integration

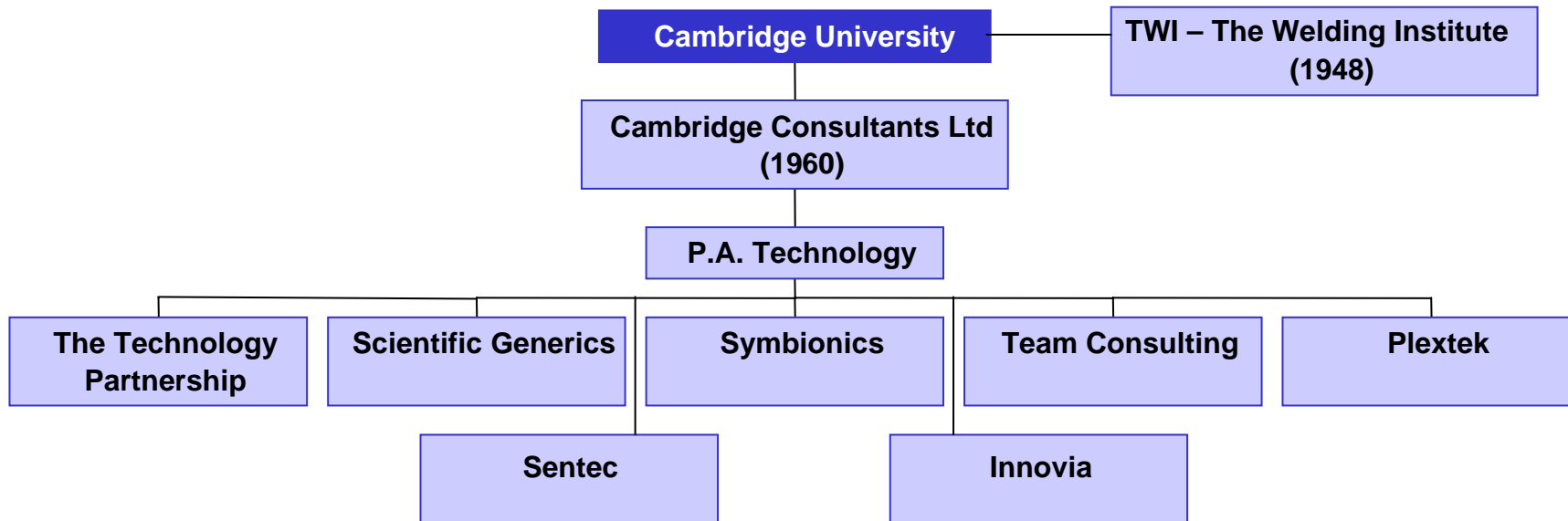
- Technology explosion in the post-genomic era is changing the industry infrastructure
- No one company can do it all from genetic research to product marketing
- Survival is through integration with other industries
- Biotech is becoming a matrix of supply chain relationships along drug discovery process
- An increasing reliance on technology alliances and partnerships
- “Convergence” – takes on a broader meaning – embracing companies / organisations – as well as science

# Three Converging Revolutions

## Three Pervasive Technology Platforms

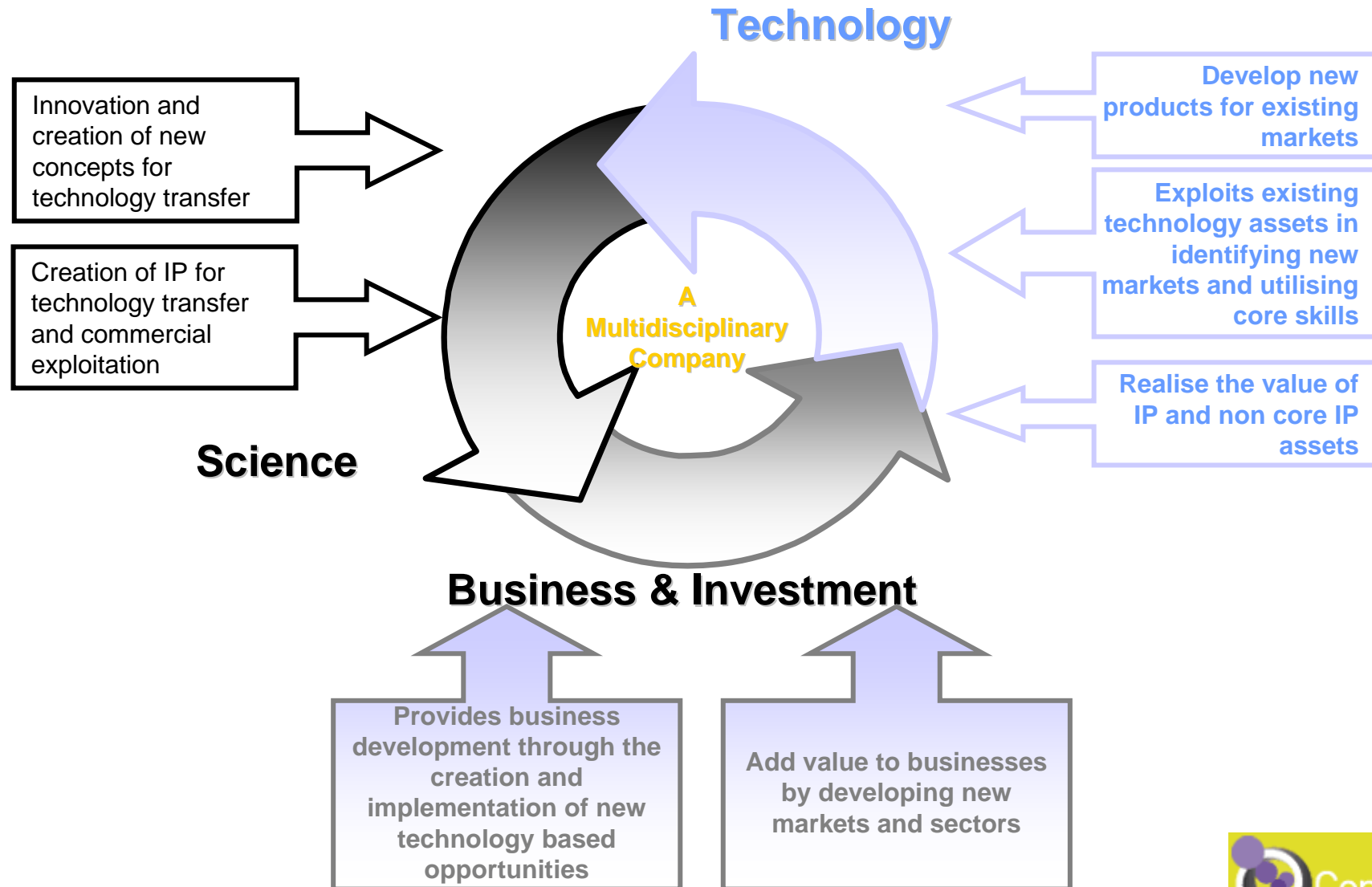


# Are “Clusters” Important ? Example of a Technology Cluster

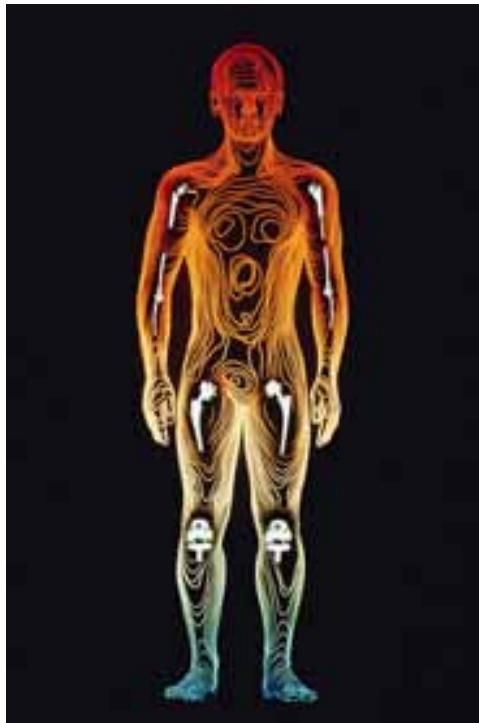


- Combined headcount of technology providers currently exceeds 1,200 in UK
- PA Technology employs 3,500 Worldwide
- Combined revenues estimated at \$160 millions – UK- \$2.5billions Worldwide
- PA technology – Revenues \$750millions
- Some players have seed funds
- 60 identified spin-outs - highly successful incubator models

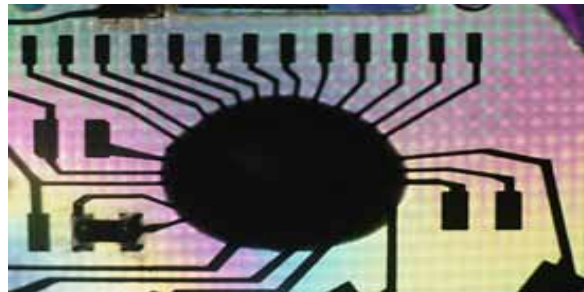
# Interdisciplinary Linkages



# Integrated Technical Skill Base



**LIFE SCIENCES**



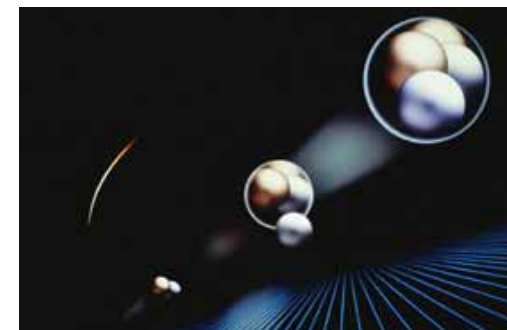
**ELECTRONICS & COMMUNICATIONS**

**ENGINEERING**



**CHEMISTRY & MATERIALS**

**MICROFABRICATION**



**OPTICS, ACOUSTICS & PHOTONICS**

## Integrated Business Skill Base

### STRATEGY

- corporate
- competition,
- markets
- technology



### BUSINESS DEV

- business & financial
- planning
- resource management

### MARKET RESEARCH

- S&M plans
- implementation



### FINANCIAL

- economic,
- finance modelling
- corporate & venture finance

### MANAGEMENT

- projects
- operations
- R&D

### CORPORATE

- due diligence
- M&A
- IP
- brand valuations

## Bioscience Clusters - Reflections

- USA/Canada There are many – here are some of those with International reputation :-
  - Kendall Square, Boston, Mass
  - Research Triangle Park – North Carolina
  - San Diego and S. California Region
  - Austin Texas
  - Ontario
  - Ottawa

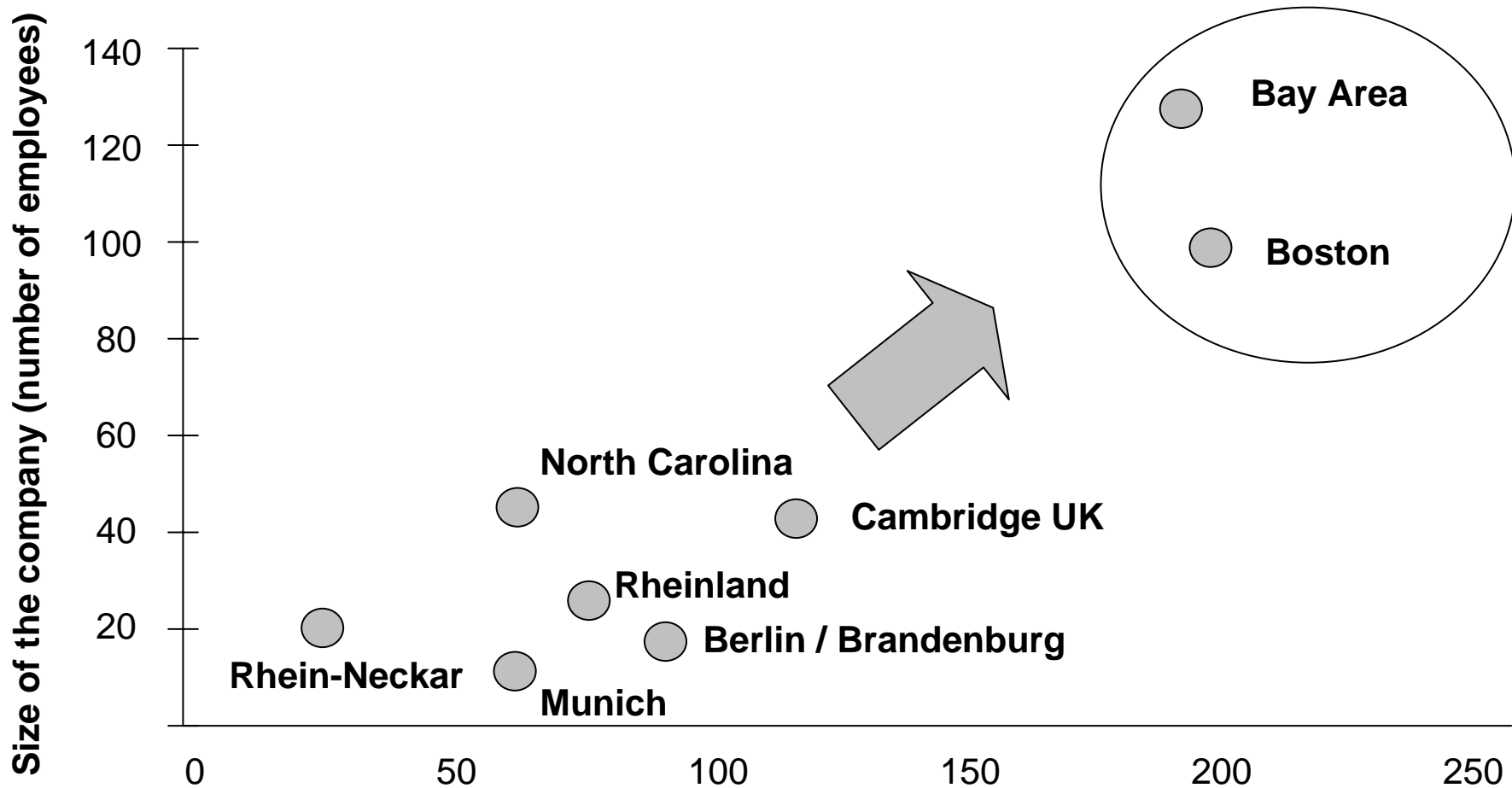
## More examples of Emerging Clusters

- Europe and Mid East

- Cambridge
- Oxford
- Norwich
- Manchester
- Glasgow/Edinburgh
- York
- Dublin
- Evry
- Vienna

- Sophia Antipolis
- Lieden
- Maastricht
- Leuven
- Munich
- Cologne
- Trondheim
- Upsalla
- Arhus
- Israel

## Leadership in company size of US biotech clusters



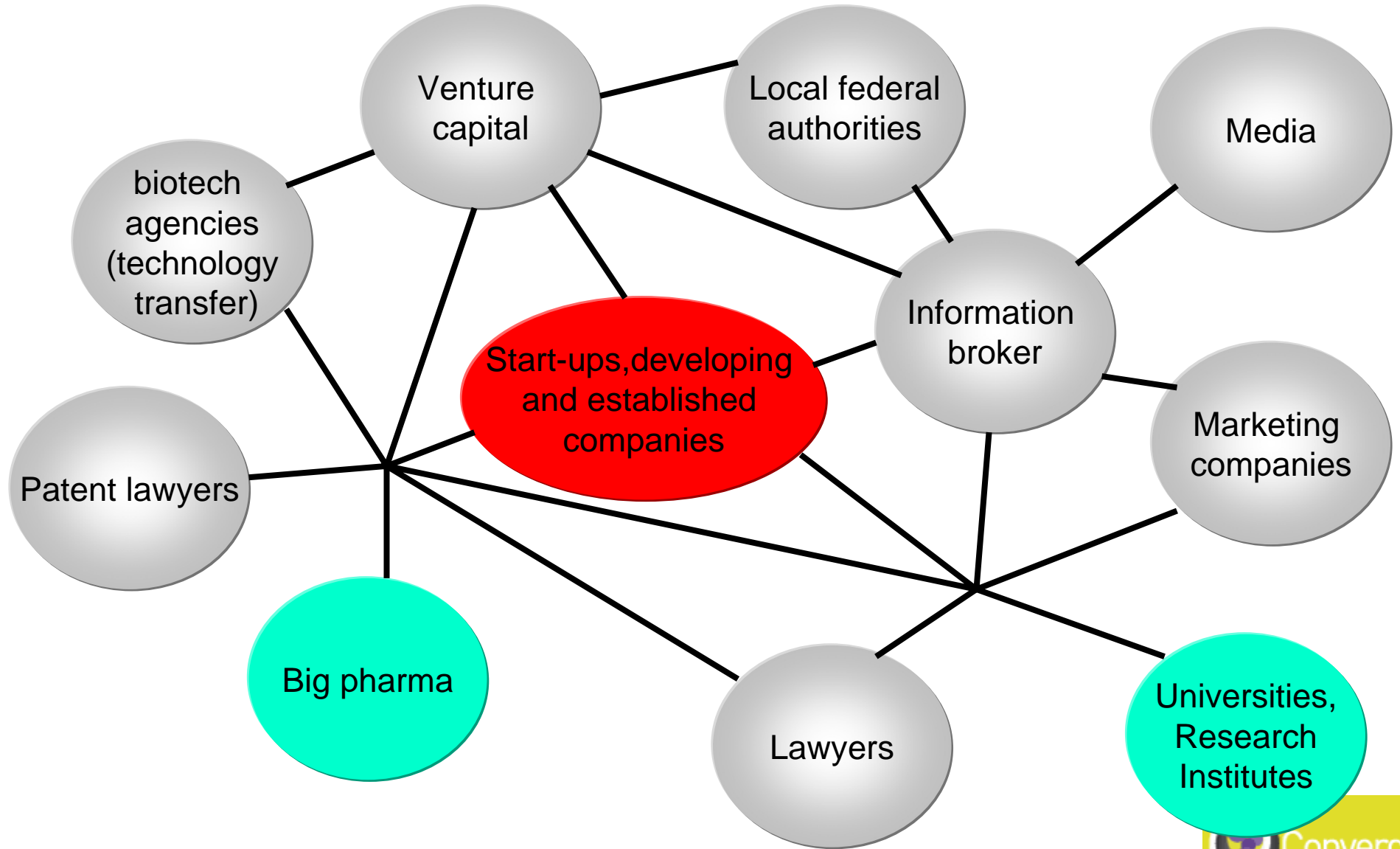
Source: BCG-Analysis

## Critical factors for cluster development

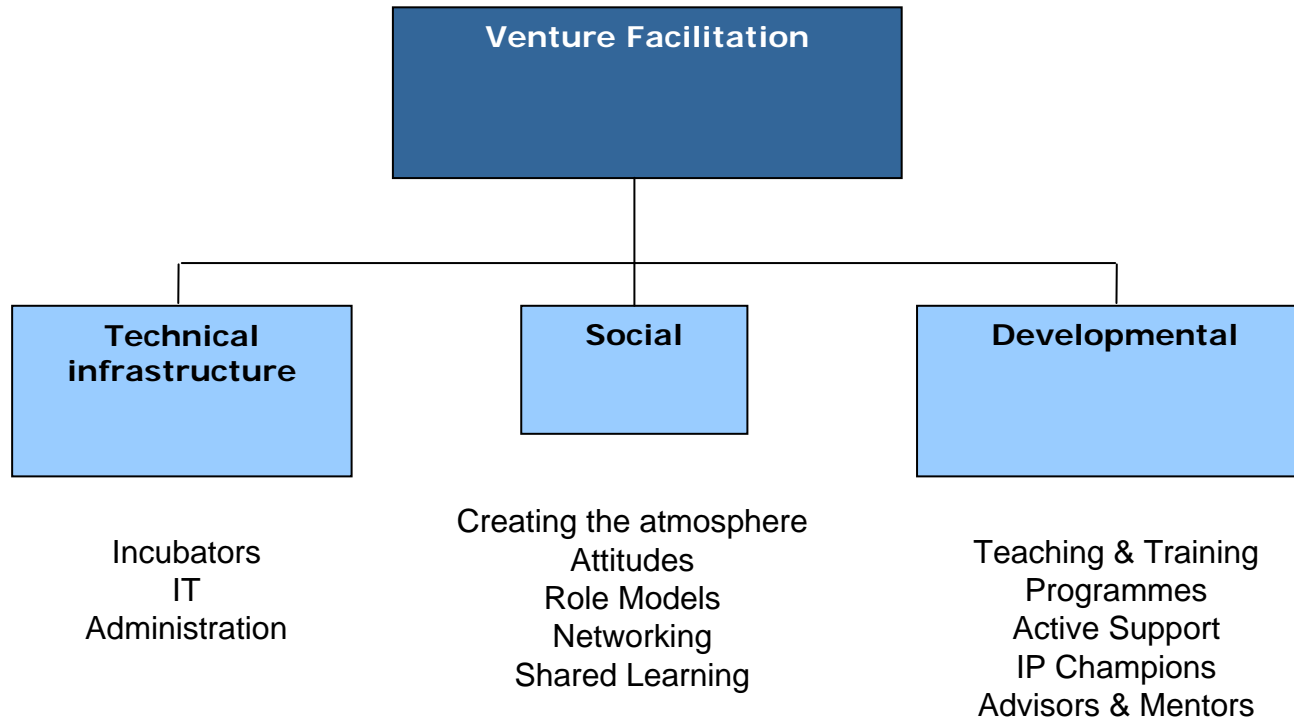
- Strong science base
- Entrepreneurial culture
- Growing company base
- Ability to attract key staff
- Availability of finance
- Premises and infrastructure
- Business support services and large companies in related industries
- Skilled workforce
- Effective networks
- Supportive policy environment

Department of Trade & Industry report 'Biotechnology Clusters' August 1999

# The Case for Bio-Clusters



# The Stanford model



## Kendall Square Biotech Cluster

- Once the domain of software start-ups, Kendall Square has become the anchor of Cambridge's growing cluster of biotech and drug companies.
- The Kendall Square Biotech cluster employs more than 25,000 workers.
- 13 of the 25 largest biotech firms in Massachusetts have set up operations within one kilometer of MIT.
- Adding visibility and momentum to the cluster:
  - Biogen is building a huge new HQs campus
  - Genzyme recently built an enormous HQs and lab
  - Novartis has decided to establish its new lab
    - 250,000 sq. ft. (22,500 sq. m.) of labs and offices in MIT-owned Technology Square, plus...
    - 150,000 sq. ft. (13,500 sq. m.) at the Bent St. development.

## How did we get here? - Boston

Three elements:

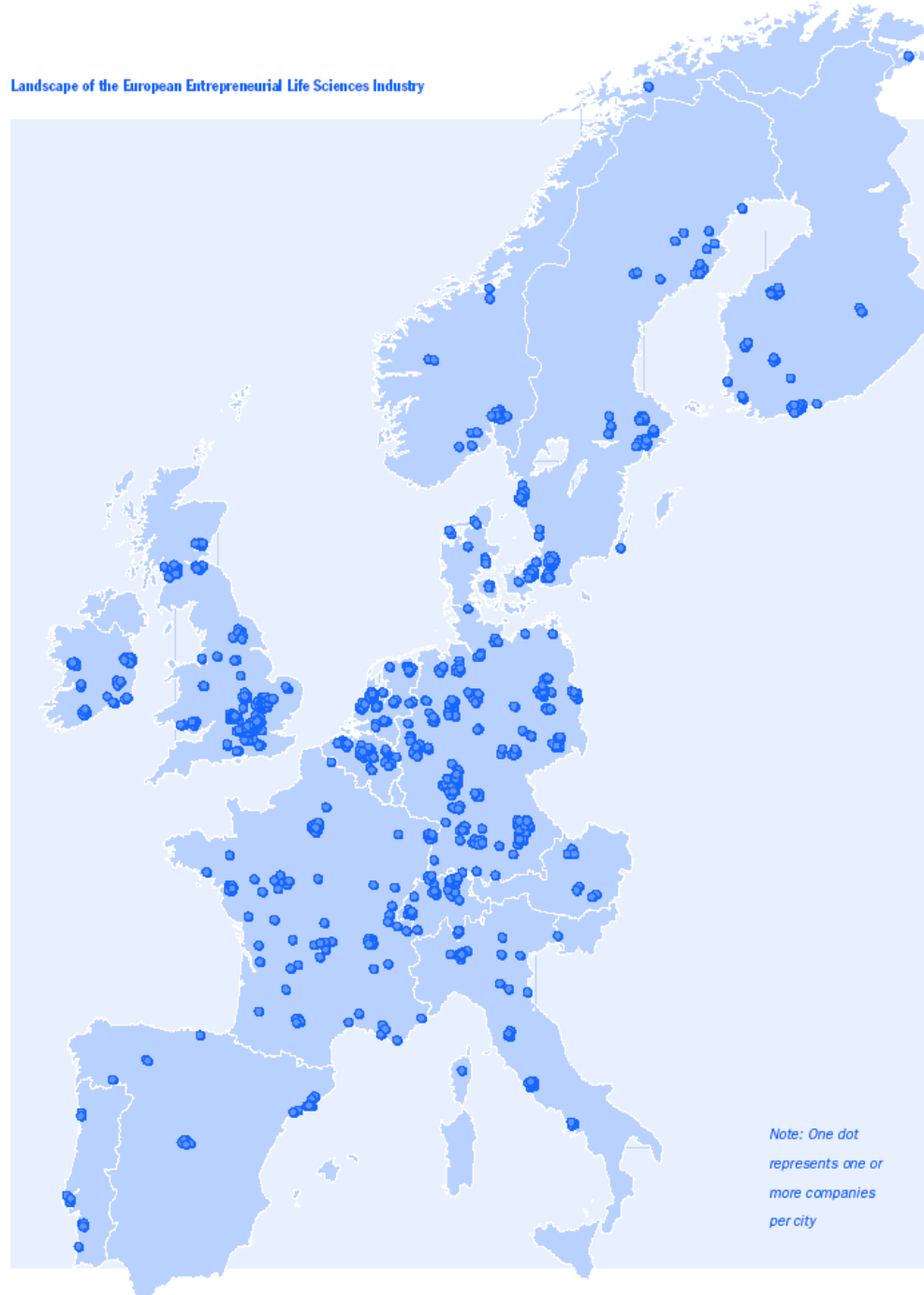
1. Scientific Progress
2. Institutional Change
3. Entrepreneurial Passion

These three elements are intertwined...

# Landscape of the European Entrepreneurial Life Sciences Industry

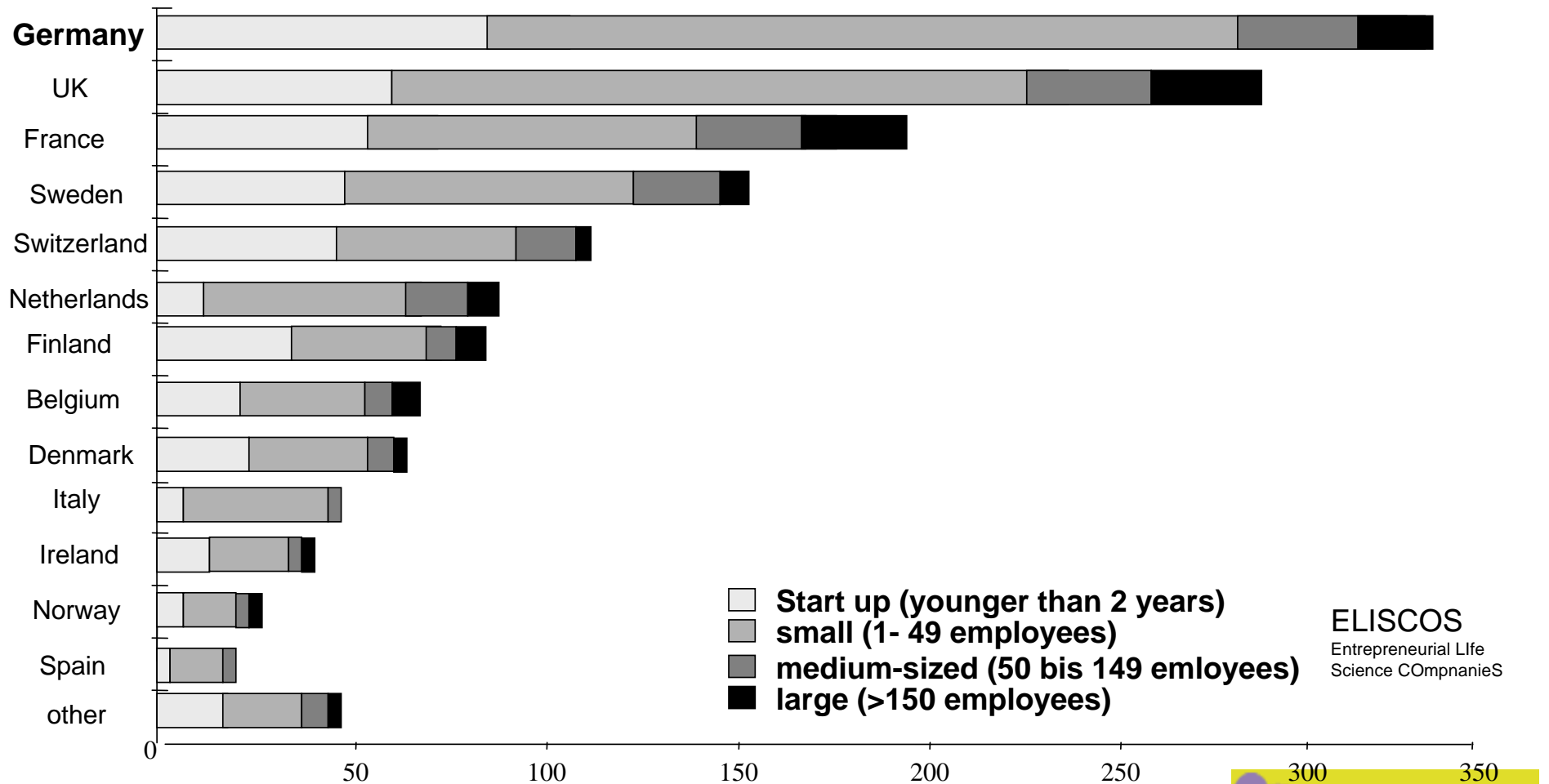
Department of Trade & Industry report  
'Biotechnology Clusters' August 1999

Landscape of the European Entrepreneurial Life Sciences Industry



# Biotech companies in Europe

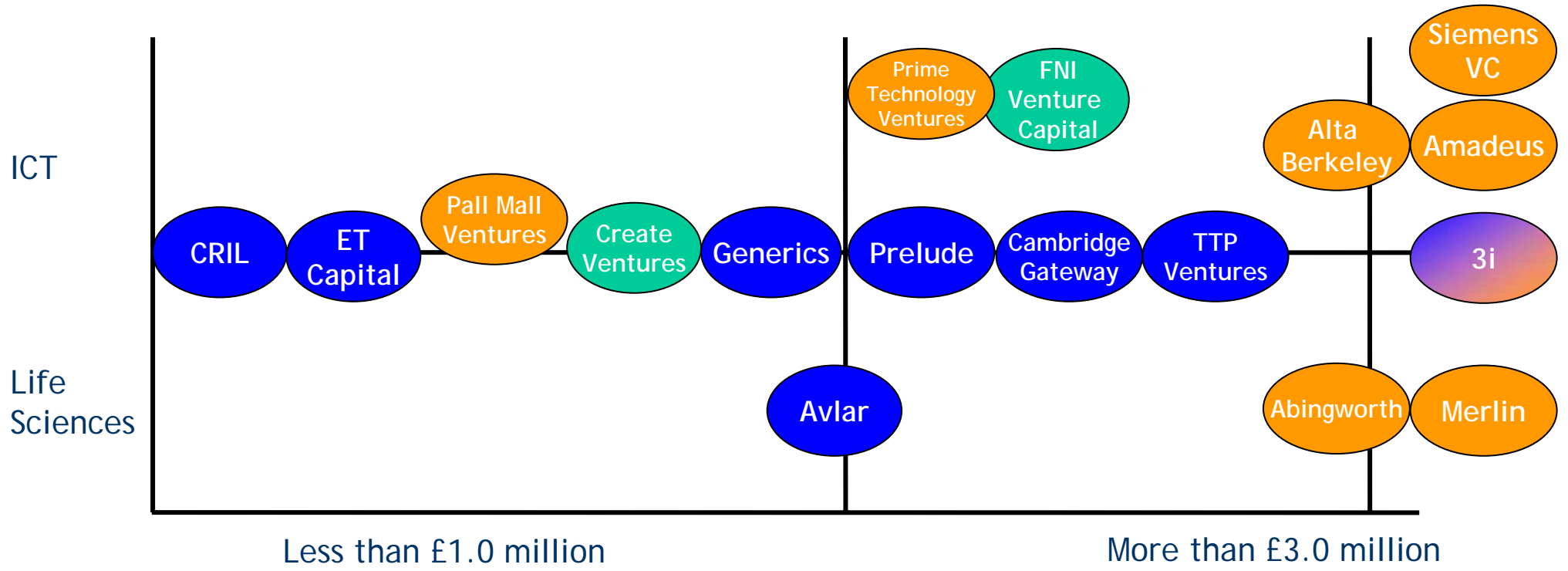
Size of European Biotech Companies (number of employees)



ELISCOS  
Entrepreneurial Life  
Science COmpanies

Source: Ernst & Young 2000

# A Financial Cluster follows The Technology Cluster



- - Cambridge Region only
- - UK only
- - UK and Europe

*Cambridge Venture Capital Scene - Estimated total value of funds: in excess of £1.5 billions*

# One View – An Evolving Bioscience Industry

Step 6 Migration of companies to cheap-labor countries



Step 5 Maturation: Increase in company size, consolidation



Step 4 Increase in company number



Step 3 Implement infrastructure: Incubation, VC, expert advice



Step 2 Develop national and regional strategy

Step 1 know-how: Education, academic research





**“You look at things and  
ask - why?”**

**but I dream of things  
that never were and ask**

**-**

**why not?”**

*George Bernard Shaw*

## Entrepreneurship

**“Entrepreneurs blow gales of creative destruction - Create new industries, products and practices”**

*Joseph Schumpeter, 1911*

# Entrepreneurship

**“Entrepreneurship is America’s most important strategic advantage. It’s what America does much better than any other advanced industrial nation.”**

**“Innovation + Entrepreneurship = PROSPERITY!”**

*William Bygrave  
Babson College  
2000*

## Entrepreneurship and Vision

**“Vision without action is a daydream.**

**Action without vision - is a nightmare”**

*Japanese Proverb*

## Supporting Enterprise and Entrepreneurs Cambridge Entrepreneurship Centre

- Education and Training
- Mentoring
- Business Creation
- Incubation
- Research
- International Networking – Best Practices
- Student Business Plan Competition
- Cambridge Enterprise – Technology Transfer/ IP Exploitation/Business Creation/Seed Funding/Mentoring

## A WORLD of Bioscience

- North America and Europe have been trail blazers.....BUT
- Worldwide trends indicate a different future balance
- Asia increasingly active and successful – Japanese example
- “Watch out World” – for CHINA !

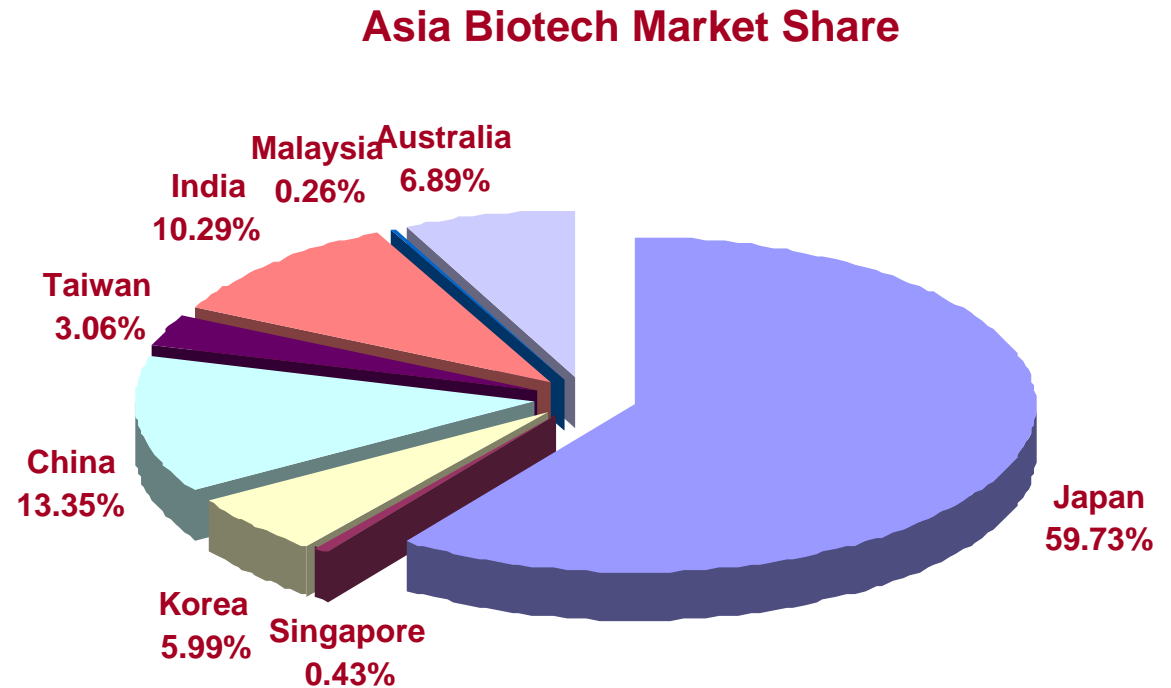
## Overview of Asian Biotechnology

- Asia - Japan, China, Korea, Singapore, Taiwan, Malaysia, India and Australia
- Grown from humble beginnings 10 years ago to reach \$19bn in 2001
- Rates at 10%-40% expected in the foreseeable future
- Generally spearheaded by their respective Governments
- Regarded as key to economic prosperity
- Firms have been typically small - look to US and EU for additional investment, new technology and commercial expertise

*Source: Asia Marketing and Management, 2002*

## Focus and Markets

- Biotech in Asia - origins in producing new crops and food products - feeding the massive populations
- Emerging is in new drugs to cure prevalent diseases in Asia eg respiratory, infectious diseases
- Rapidly ageing populations of Asia have spurred new developments in biotechnology
- China today has 130 million people age 60 or older
- Likewise 45% of the population is aged between 15-25 - demands of the *nouveau riche*



Source: AsiaBiotech, 2003

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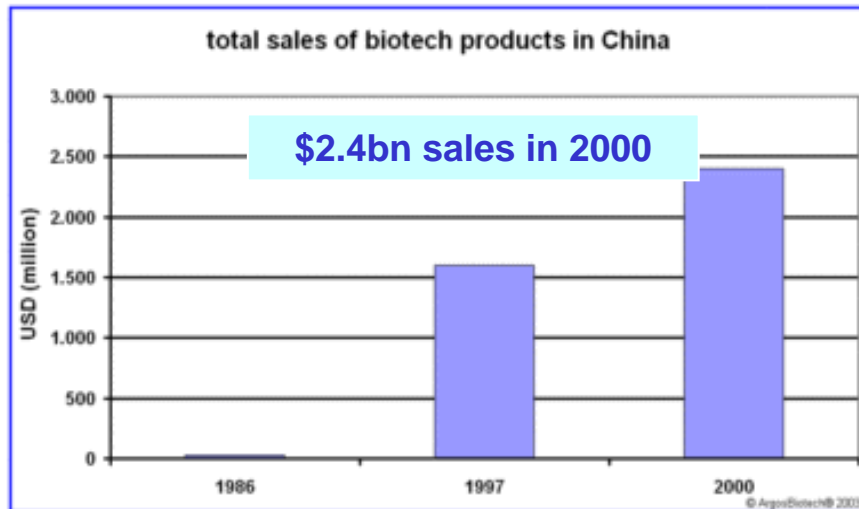
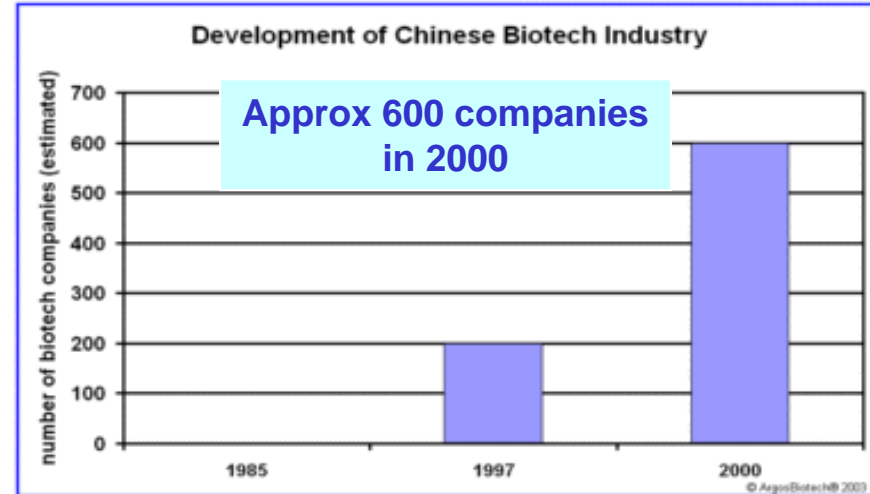
# Biotechnology in China

高恩慈

中  
国

## Biotechnology Market in China

- Biotech in China started in 1984
- Initially concentrated on agribio - food security
- Medical biotech has developed gradually



Source:ArgosBiotech, 2003

- In 2000, China's biotech market is approx \$2.4bn
- Participation in the Human Genome (HGP) & International Rice Genome Sequencing Project (IRGSP)
- Now a major biotech player in Asia
- Science Parks and Innovation Centres +++++

# Potential of China

China Healthcare has more than

- 320,000 healthcare institutions
- 75,000 hospitals

Over 20 biotech parks covering

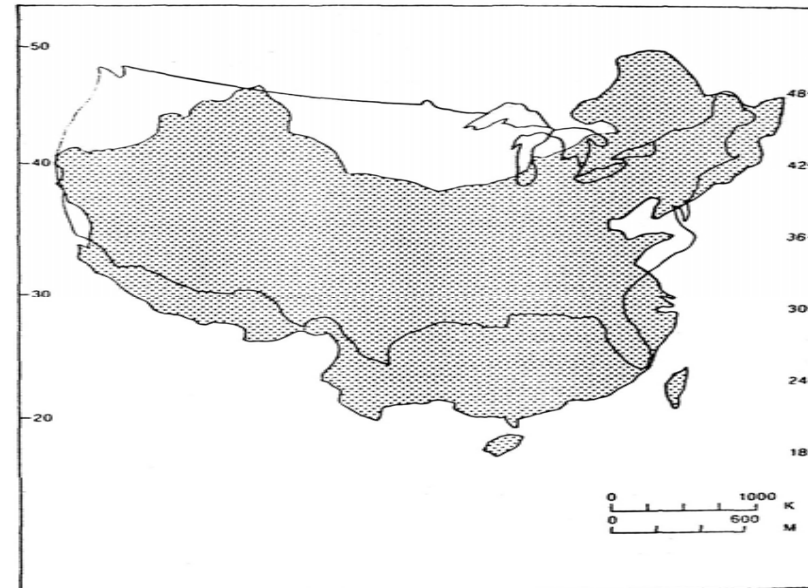
- **Shanghai**
- **Beijing**
- **Guangzhou**
- **Shenzhen**
- Chengdu
- Wuhan

Further examples Biotech/Pharma

Production facilities development in

- Pudong, Shanghai; Hangzhou, Zhejiang Province

China is one of the world's largest supplier of raw materials to pharma



- Land area comparable to US
- Huge population as consumers
- Major economic giant
- Major internal market

## Key Geographical Areas



## Key Factors Shaping the Market

- Biotechnology regarded as one of the 6 key industrial technologies to fuel growth in China's economy
- Supported by the Government - wants to see the value of biotechnology market rise to \$36bn in 2010
- Government funding will increase to \$600m by 2005
- A need to improve the health & well-being of the Chinese people
- Ageing population
- Demands of the younger population for high quality healthcare products - take control of own health
- Growing affluence and spending power
- Commercialisation of scientific research
- A keen eye on World Market Opportunities
- Rapid and major progress in I.P. protection

# China's National Programs

- National High Technology Research and Development Program (863 Program) - budget of €2.3bn
- National New Products Program - priority fields include bioengineering, biomedical - preferential treatment in the form of tax reduction or exemption while state provides financial subsidy
- Torch Program - develop new high tech industries in China
- National Key Basic Research Program (973 Program) - high level research for social economic benefit such as health improvement by 2010. Budget of €263m
- The Tenth Five-Year Plan (2001-2005). Scientific and technological priorities such innovative medicines. Budget of €2.1bn
- Innovation Funds for SME Science & Tech Enterprises - low interests, loans, subsidies and equity investments aimed at supporting and encouraging innovation
- To be released soon - the Eleventh Five year plan 2005-2010



## **Year of the Monkey....**

***what does it have in common with biotechnology?***

- The Monkey's natural talent for learning and advancement
- Everything will be workable this year
- The Monkey will not give up without trying every angle
- There will be success even in impossible ventures
- There will be inventions and improvisations galore
- As the Monkey is one who can laugh off his mistakes the Monkey can improve his bargaining prowess in the next round
- The Monkey who rules this year will urge us to gamble, speculate and exploit risky but ingenious options. If you are quick on the draw, this year will yield huge dividends.

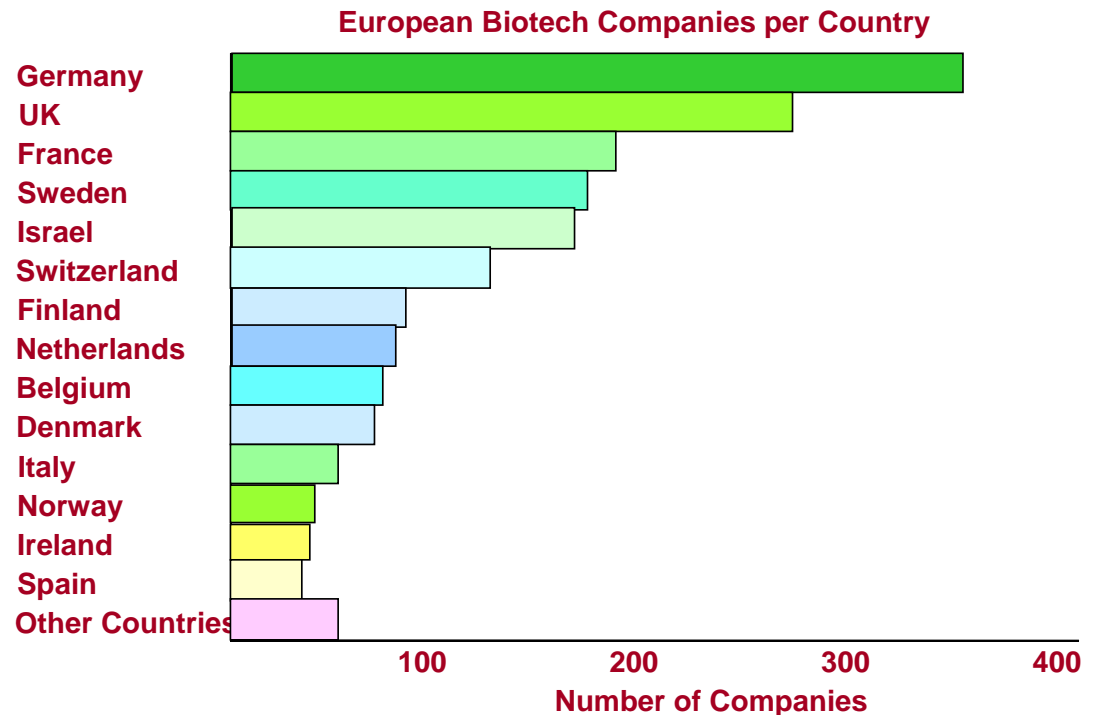
***.....So take a look at China..the sleeping dragon is awake***

## Bioconvergence -The Future – Some Key Issues

- Investment in the Science Base – Long term Game – Public Policy Issues
- Competitiveness and Critical Mass
- Potential for Partnership
- From Laboratory to Application – Funding Issues
- Ownership and Intellectual property
- Prioritisation and Focus
- Human Capital - Talent

## Integration - through alliances

- Alliances increased by 55% in 2000-2003
- need for companies to expand by co-development, co-operation and partnering their technology
- More biotech-biotech deals
  - less out licensing
- Pharma responded by creating their own set of biotech companies radically reorganising R&D

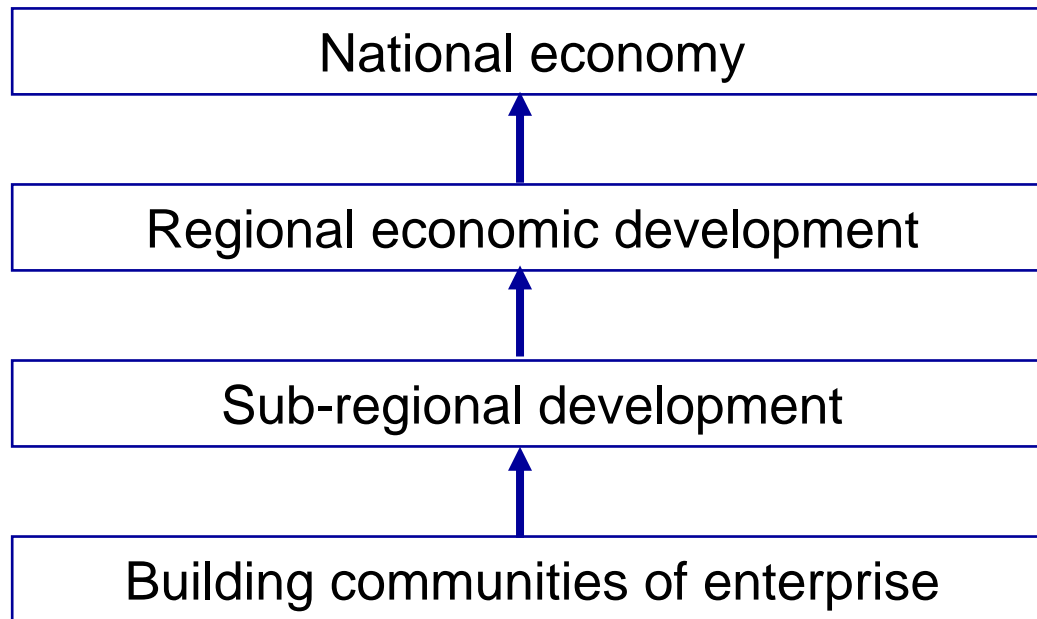


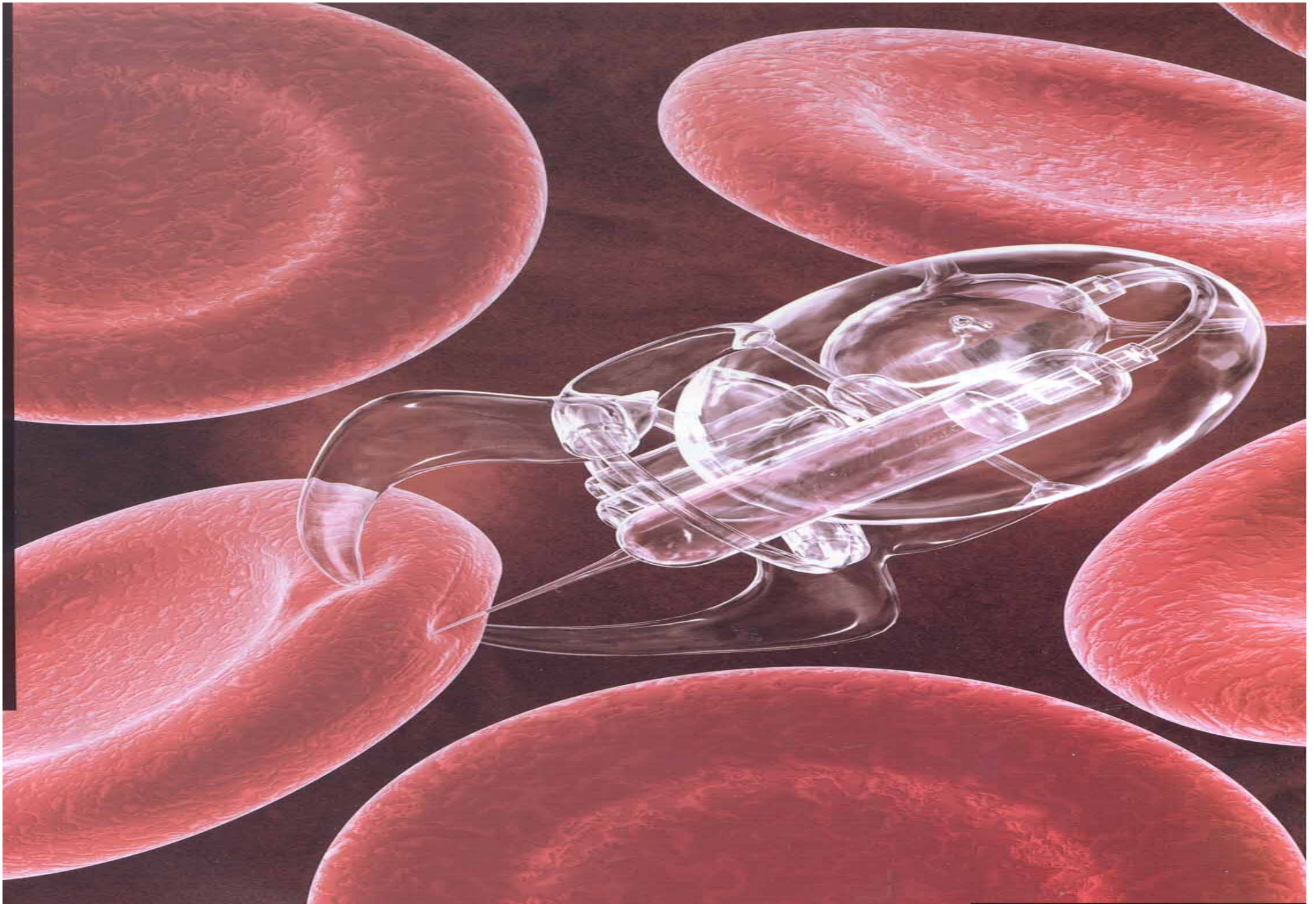
Source: Ernst & Young

## Bioscientists of The Future

- Expansive thinkers
- Embracing converging technologies
- Broader based Knowledge and Skills base
- Definitely “Inspired”
- Partners and Collaborators – rather than Competitors
- No single “model” – Discoverers, Discoverers / Exploiters – Entrepreneurs
- Implications for Educational processes – Innovation – example – Masters in Bioscience Enterprise

# Bioscience and Building an Enterprise Society







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