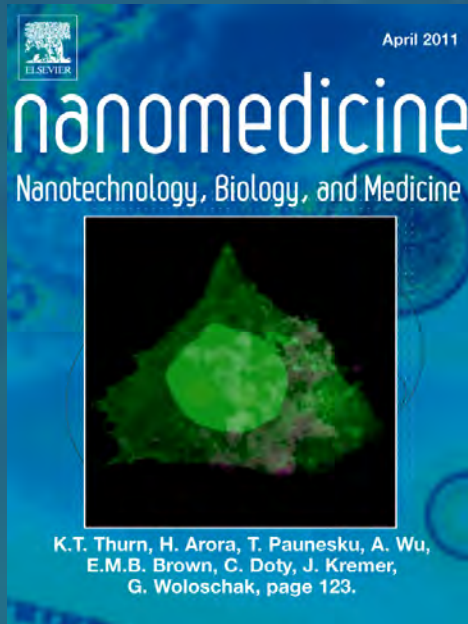


nanomedicine:

Nanotechnology, Biology and Medicine (Elsevier)



Publishes the latest experimental and theoretical advances in basic, translational and clinical nanomedicine at www.nanomedjournal.com

Impact Factor for 2009 = 5.44, h-index: 21

- **8th** of 92 in the “**Medicine, Research & Experimental**” category
- **11th** out of 59 journals in the “**Nanoscience and Nanotechnology**”
- Indexed in Medline and Journal Citation Reports within one week after publication on the web. Average publication time is 60 days, rejection rate: 75-80%

Top downloaded articles include:

- Antimicrobial effects of silver nanoparticles
- Nanostructure-mediated drug delivery
- What is nanomedicine?
- Role of nanotechnology in targeted drug delivery and imaging
- Nanomedicine and nanotoxicology: two sides of the same coin
- Translational nanomedicine: status assessment and opportunities, etc.

***Department of Pharmaceutical Sciences
at Northeastern University
Overview***

Lajos P. Balogh

Editor-in-Chief: Nanomedicine: Nanotechnology, Biology and Medicine

Scientific Advisor and CEO, AA Nanomedicine and Nanotechnology Consulting

Adjunct Professor of Pharmacology, Northeastern University, Boston, MA

Member, US Technical Advisory Group to ISO TC229 Nanotechnology, ASTM E56 Nanotechnology

Executive Board, American Society for Nanomedicine

balogh1@prodigy.net, baloghlp@gmail.com



<http://www.pharmsci.neu.edu>

Department Structure

Bouve College of Health Sciences

Dean Stephen Zoloth

School of Pharmacy

Dean Jack Reynolds

Department of Pharmaceutical Sciences

Prof Mansoor Amiji, Chair

Research Areas

Medicinal Chemistry

Pharmacology and Toxicology

Pharmaceutics and Delivery

Translational Imaging

Bio-Analytical Chem

Centers

Center for Drug Discovery

New England Inflammation Institute

Center for Pharmaceutical Biotech and Nanomedicine

Center for Translational Imaging

Barnett Institute

Department Profile

Faculty (20)

Full Prof.	10
Associate Prof.	6
Assistant Prof.	2
Instructor	2

[13 Tenured, 5 Tenure Track, and
2 Non-tenure Track]

Staff (25)

- Professional/Research	20
- Advisors	2
- Administrative	3

Co-op/Internship Model of Education

- 2.25 Coordinators for PharmD and Biotechnology MS students
- 400+ PharmD placements and 20+ MS placements per year
- Internship for PhD and MS students in local companies

Undergraduate Students

PharmD - ~800 (0-6 model)

Graduate Students - 155

PhD	45
MS	110

Stipended Doctoral Students

Teaching	15
Research	30

Research Centers

- Center for Drug Discovery** (*Director: Prof Alex Makriyannis*)
- New England Inflammation and Tissue Protection Institute** (*Director: Prof Misha Sitkovsky*)
- Center for Pharmaceutical Biotechnology and Nanomedicine** (*Director: Prof Vladimir Torchilin*)
- Center for Translational Neuro-Imaging** (*Director: Prof Craig Ferris*)

Faculty members are also affiliated with the:

- Biotechnology Program**
- Bioengineering Program**
- Nanomedicine Consortium**
- Barnett Institute**

Faculty Highlights

Mansoor Amiji – Distinguished Professor and Chairman

Research Interest: Polymeric biomaterials, drug/gene delivery systems, and nanomedical technologies

Research Funding: Grants from NIH and private companies



Vladimir Torchilin – Distinguished Professor and Director of Center for Pharmaceutical Biotechnology and Nanomedicine

Research Interests: Targeted drug delivery, cancer immunology, and nanomedicine

Research Funding: NIH grants including the \$13.5 M Center for Cancer Nanotechnology Excellence (CCNE) award from NCI



Faculty Highlights – Cont'd

Barbara Waszczak – Professor of Pharmacology

Research Interests: Molecular signaling, pharmacology, and therapy for Parkinson's disease

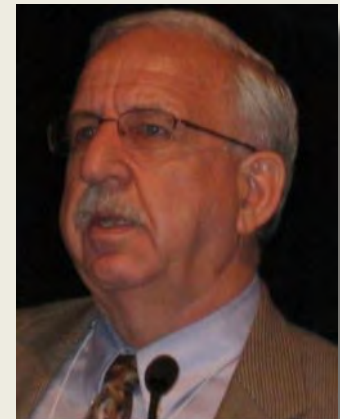
Research Funding: The Michael J. Fox Foundation for Parkinson's Research



Richard Deth – Professor of Pharmacology

Research Interests: Role of oxidative stress in neuro-psychiatric disorders

Research Funding: NIH and private foundations



Faculty Highlights – Cont'd

Craig Ferris – Professor of Psychology and Pharmaceutical Sciences and Director of Center for Translational Neuro-Imaging

Research Interests: Neuro-psychiatric disorders imaging systems in drug discovery and R&D

Research Funding: Grants from NIH and private companies



Heather Clark – Associate Professor of Pharmaceutical Sciences

Research Interests: Nano-sensors for *in vitro* and *in vivo* analyte measurements

Research Funding: NIH and DARPA grants



Faculty Highlights – Cont'd

Lajos Balogh – Professor of Pharmaceutical Sciences and Editor-in-Chief of Nanomedicine: NBM (Elsevier)

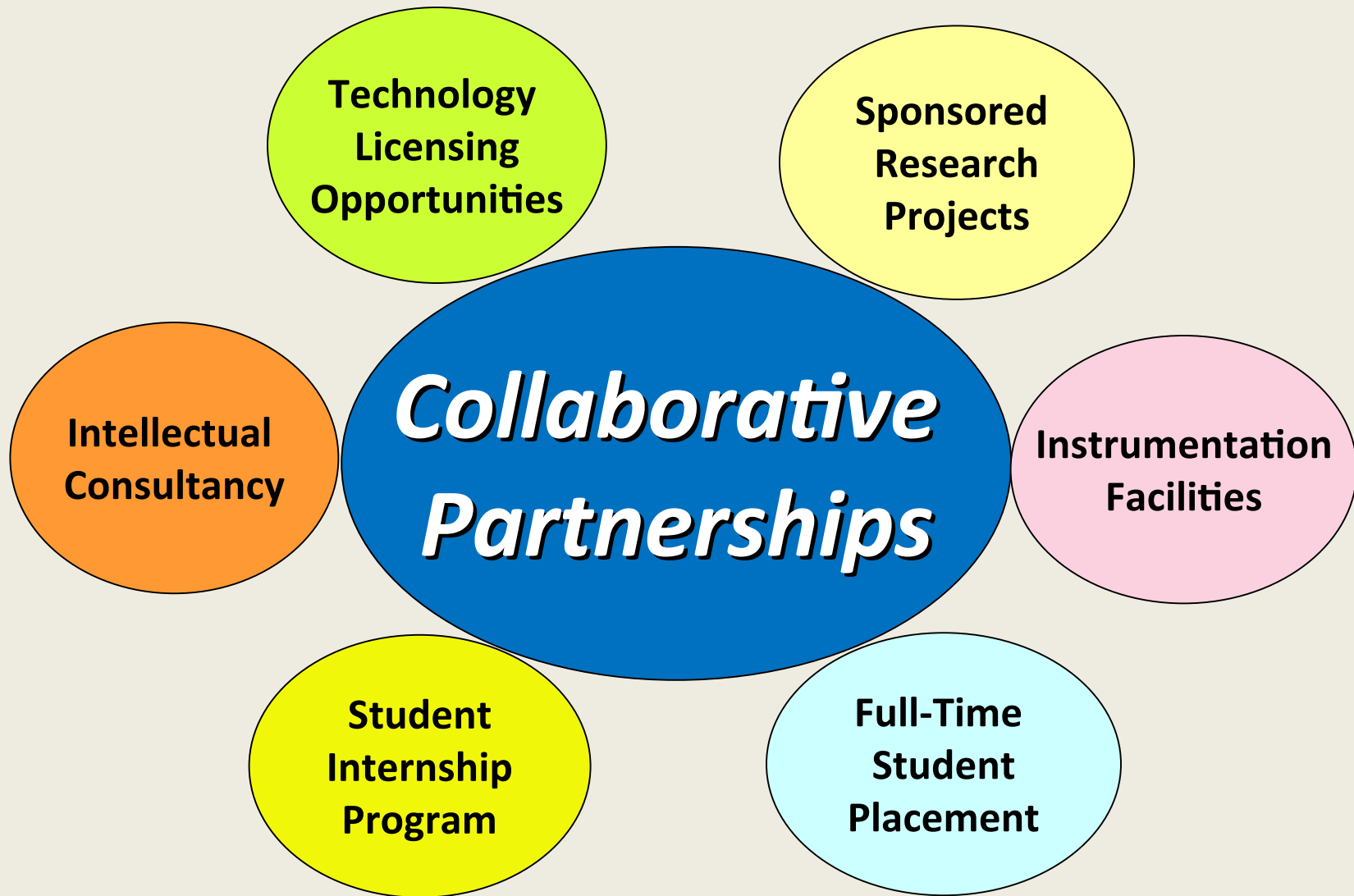
Research Interests: Cancer imaging and therapeutic systems, targeted drug discovery and R&D, dendrimers and dendrimer nanocomposites

Research Funding: Grants from NIH and private companies

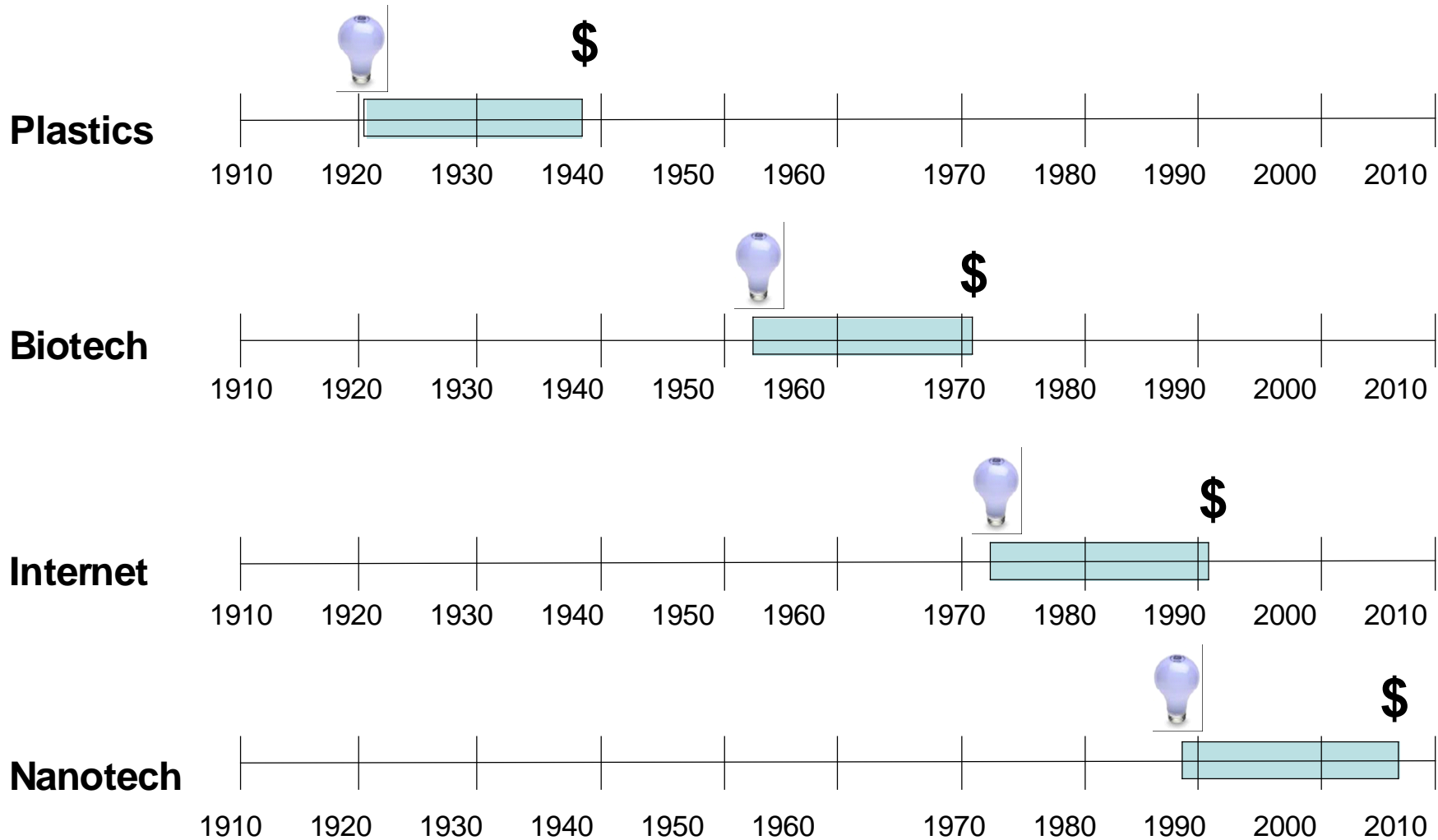
Nanomedicine and Nanotechnology Consulting



Partnership Opportunities



Nanotechnology fits a commercialization pattern

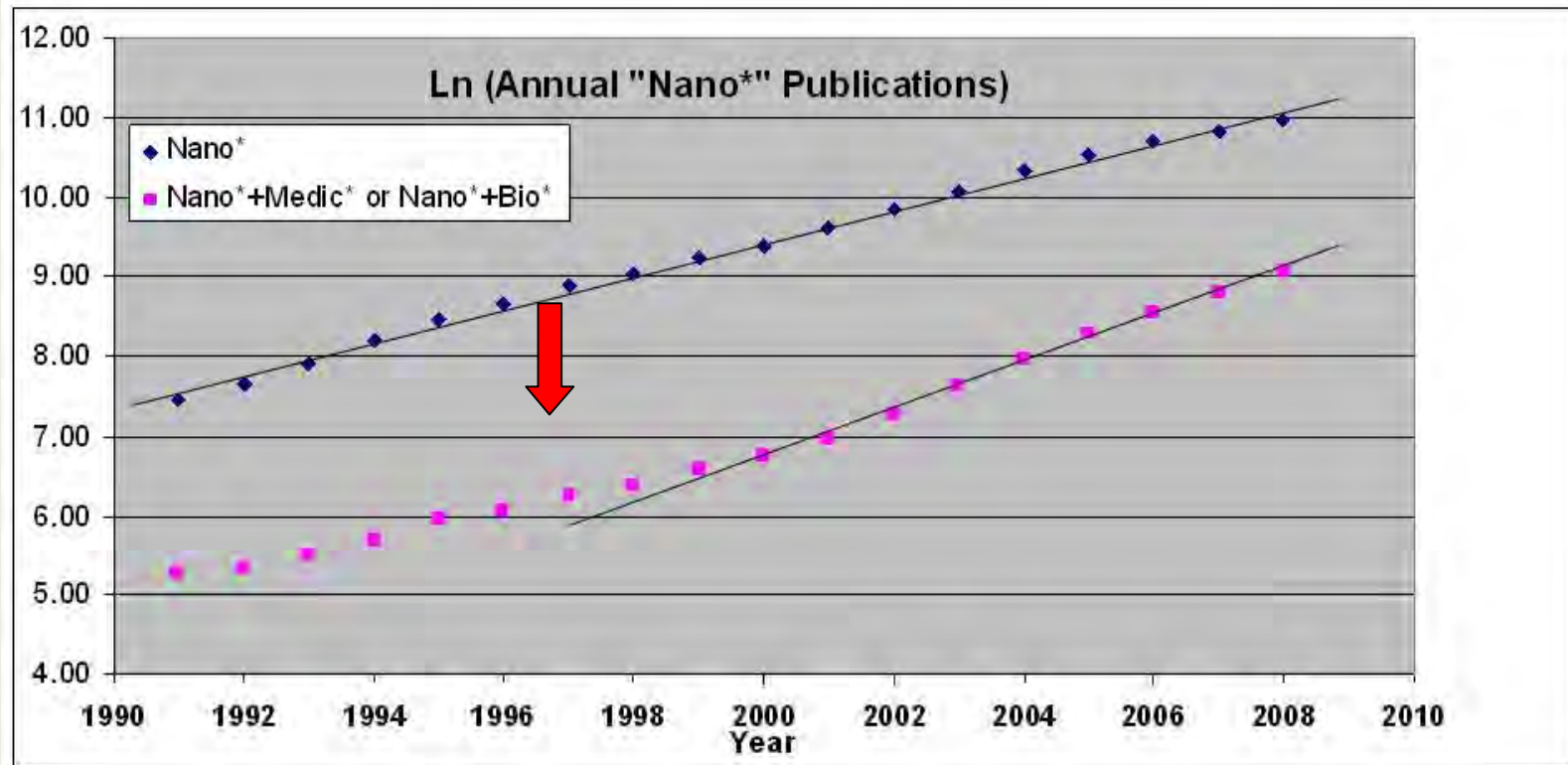


Time required for maturation of science discoveries into commercial products.

Courtesy Lux Research Inc. 140 East 45th Street, 30th Floor New York, NY 10017

J. Murday et al Nanomedicine NBM, 2009, Vol.5(3),251-273

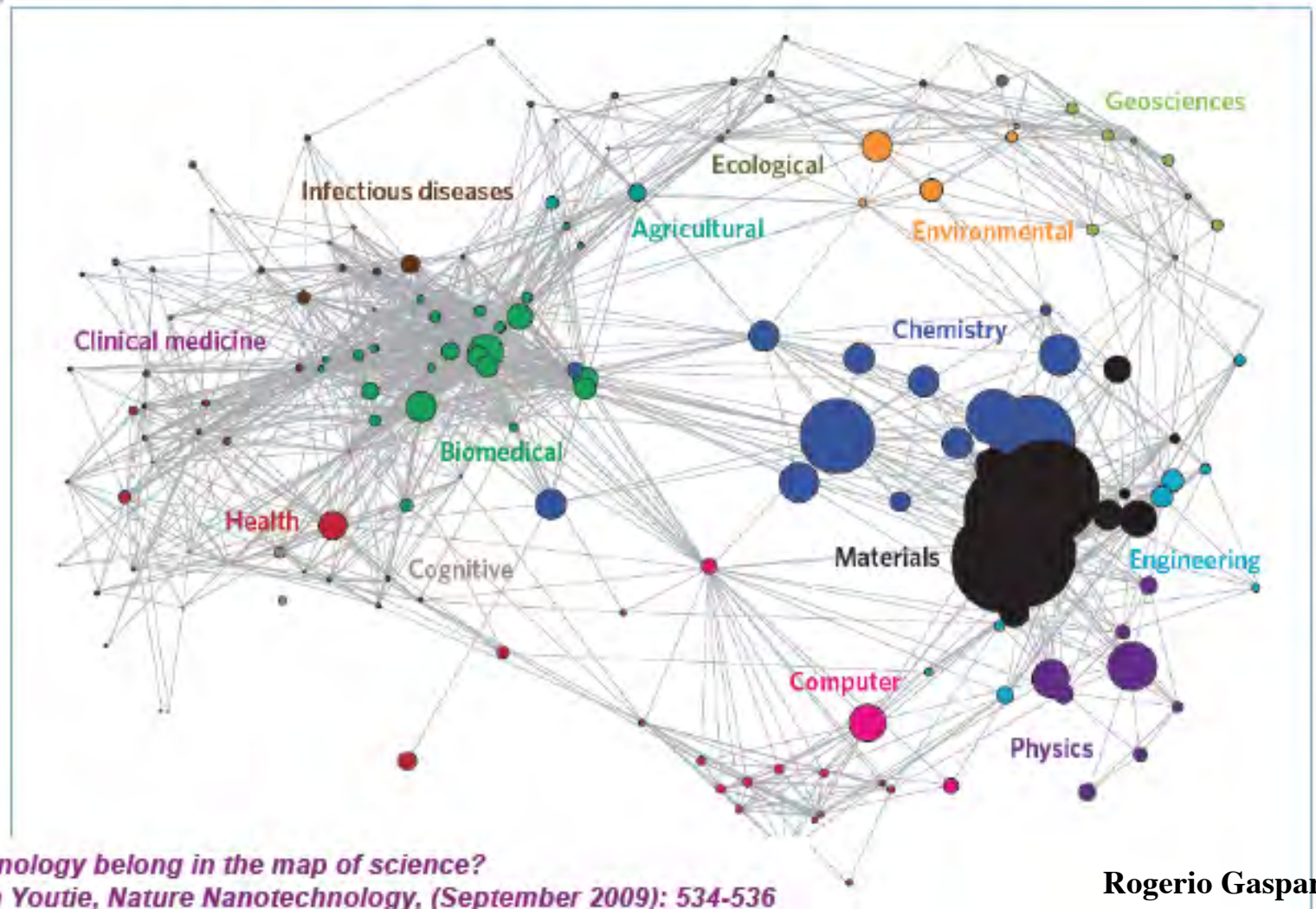
Nanomedicine research is intensifying



Publication counts derived from the Thompson ISI database on 1/2/2009 using the indicated keywords. The vertical axis is the natural logarithm of the number of publications. There is a clear change in slope for the publications associated with biology and medicine around the year 2000.

What is the present position of nanoscience in science?

The position of nanoscience and nanotechnology over a base map of science. Each node in this map¹⁵ is one of the 175 subject categories in the SCI. The size of each node is proportional to the number of nanopapers published in journals in each subject category during the period January–July 2008. Location on the axes in this Kamada–Kawai algorithm representation has no inherent meaning: the connecting arcs and proximity reflect similarity based on cross-citation patterns, reinforced by colouring to reflect the clustering of subject categories into macrodisciplines



Where does nanotechnology belong in the map of science?
Alan L. Porter and Jan Youtie, *Nature Nanotechnology*, (September 2009): 534-536

Rogério Gaspar

Demanding challenges for “nano” development are not presented by S&T, but social and business aspects:

1. *Nanotechnology is developing in a fast-paced and multilingual global theater*
2. *Conflicting self-interests of participants*
3. *Research and traditional drug development is going to the opposite directions*
4. *Improve communication to make IP, Patent, and Standardization activities more effective*
5. *Accelerate commercialization (IP, safety, environment and regulatory) activities, educate stakeholders and the public*
6. *Nanomedicine must become a successful business*

ISO definition of nanotechnology

- “Application of scientific knowledge to manipulate and control matter in the **nanoscale** in order to make use of size- and structure-dependent properties and phenomena, as distinct from those associated with individual atoms or molecules or with bulk materials.
- **Note:** Manipulation and control includes material synthesis.”

- **ISO/TS 80004-1 -- Nanotechnologies -- Vocabulary -- Part 1: Core terms**

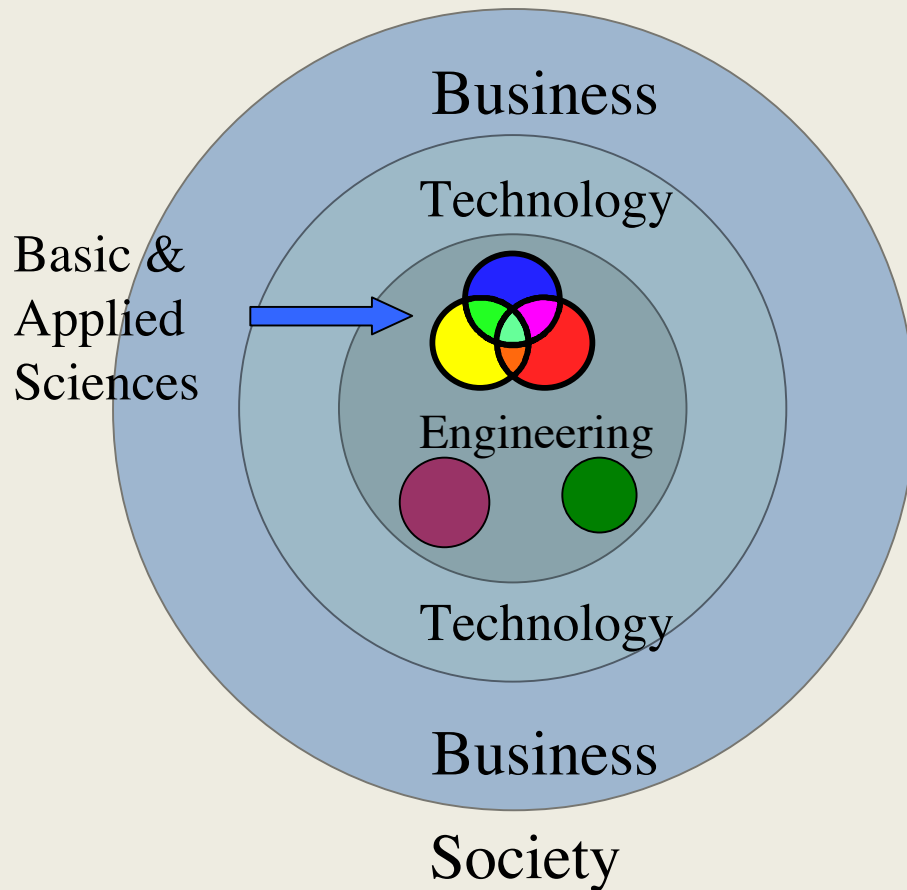
has now been published and is available on the ISO Website:

http://www.iso.org/iso/iso_catalogue/catalogue_tc/catalogue_detail.htm?csnumber=51240&commid=381983

Definitions in this Core Terms document are also available for review on the ISO Concept Database: <http://cdb.iso.org>

Science, Engineering, Technology, Business, Society

The way this hierarchy works is not going to change by adding “nano”.

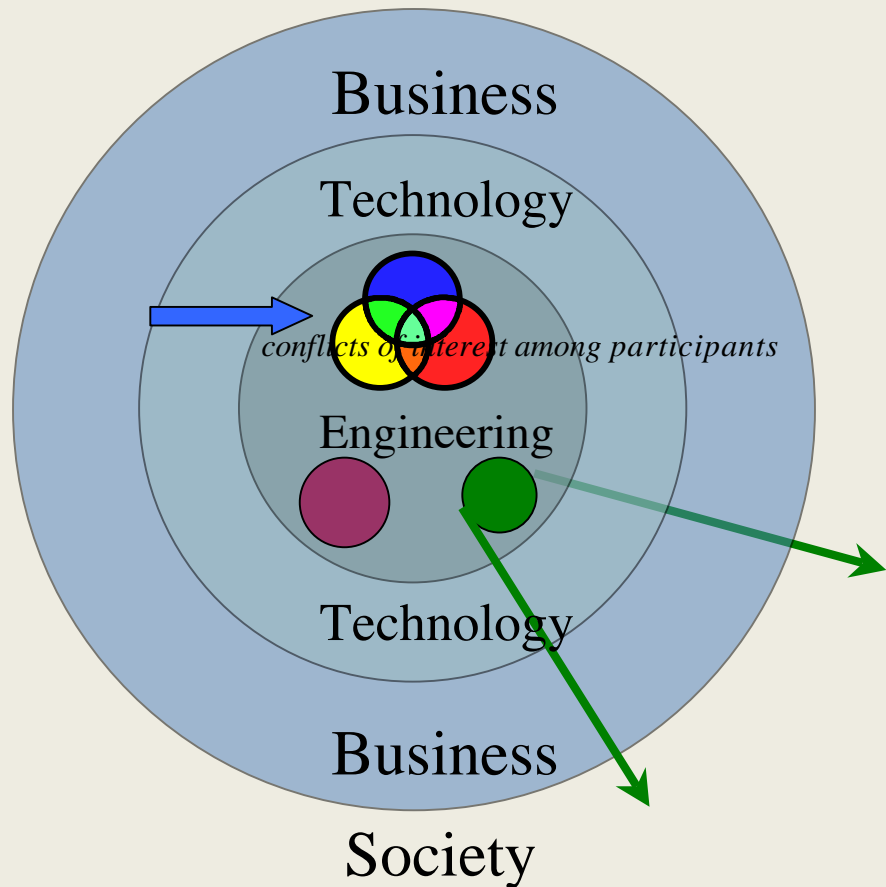


Development drivers:

1. Societal need
2. Scientific interest
3. Business opportunity

Development of new nanoscience/technology based applications must be treated as a **system**, consisting of good science, creative engineering, and **goal-oriented activity that provides a solid profit for business**

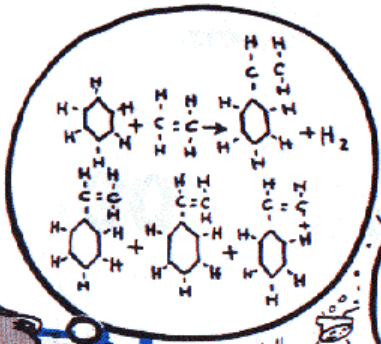
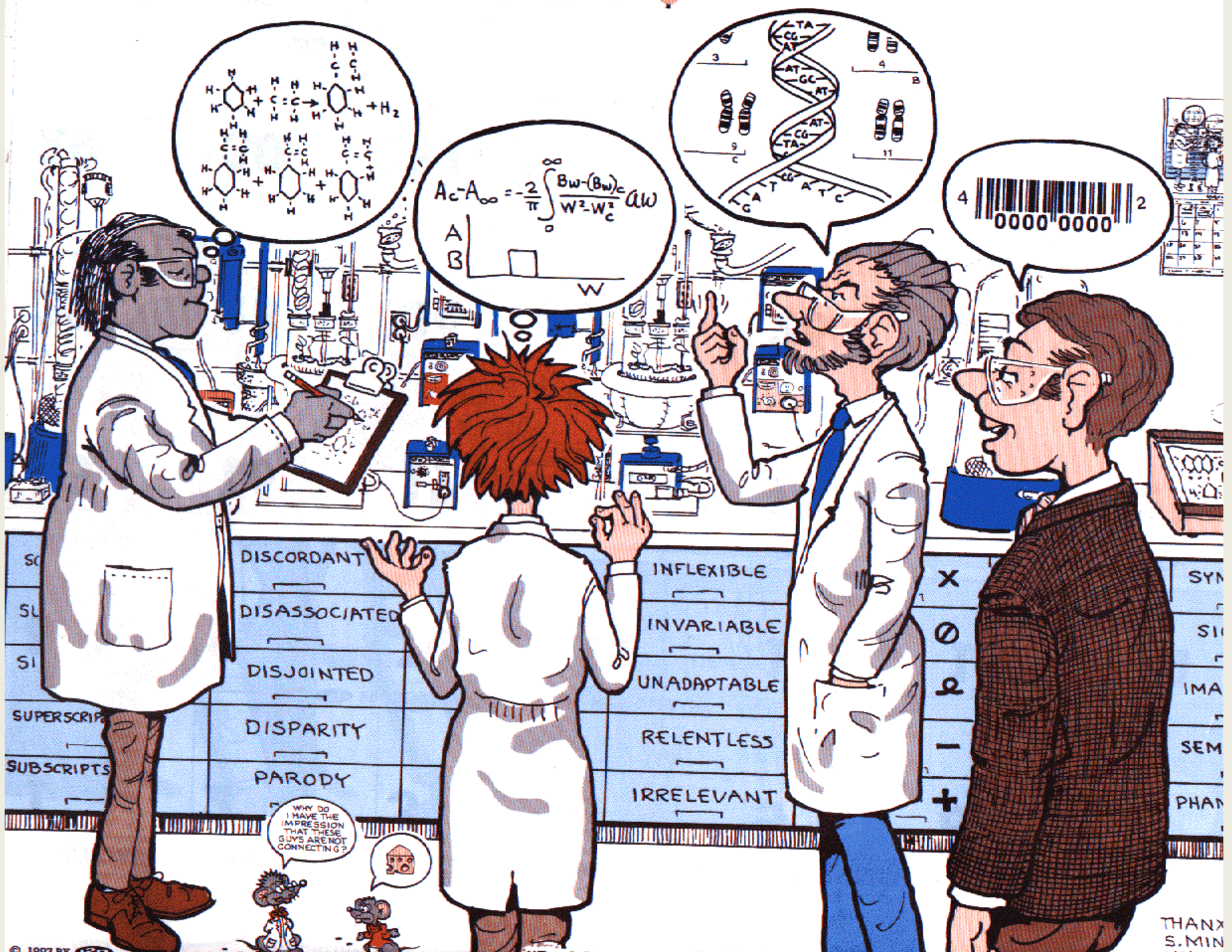
Conflicts among participants' interests



Motifs of participants differ:

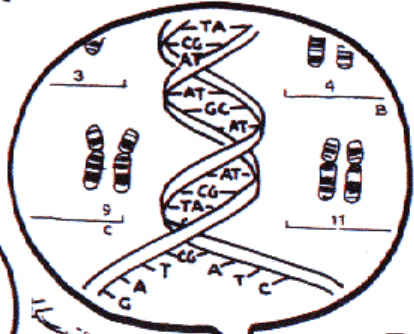
- scientists want to study, publish, and invent;
- engineers want to develop processes and technology;
- companies want to own IP and markets;
- businessmen and inventors want to make profit
- society wants better (and less expensive) healthcare

and many of them is trying to stay in his/her comfort zone...



$$A_c - A_\infty = -\frac{2}{\pi} \int_0^\infty \frac{Bw - (Bw)_c}{W^2 - W_c^2} dW$$

A
B
W



WHY DO I HAVE THE IMPRESSION THAT THESE GUYS ARE NOT CONNECTING?

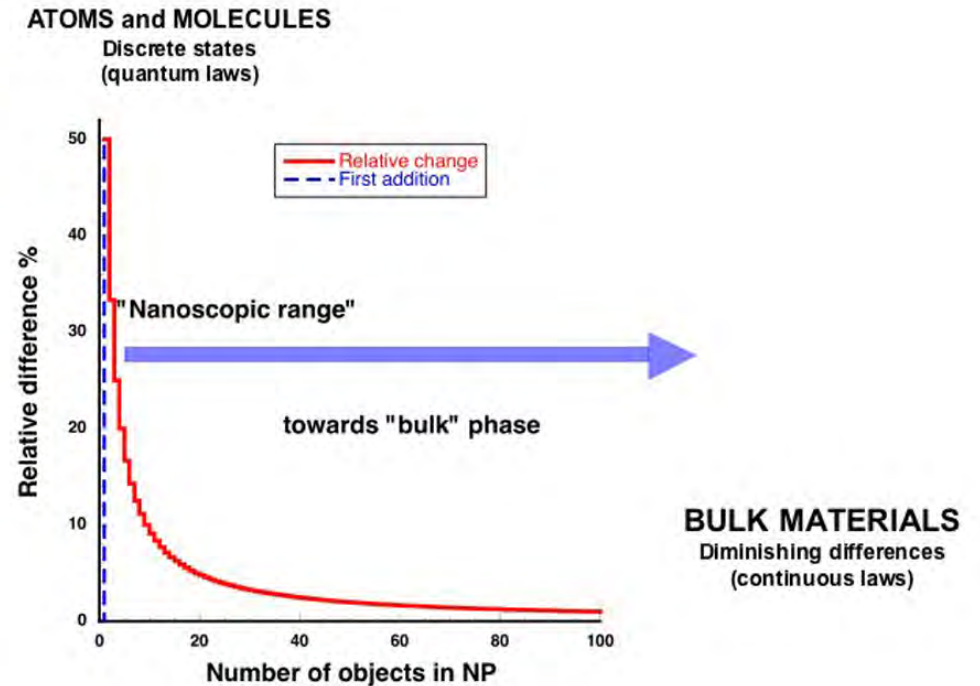
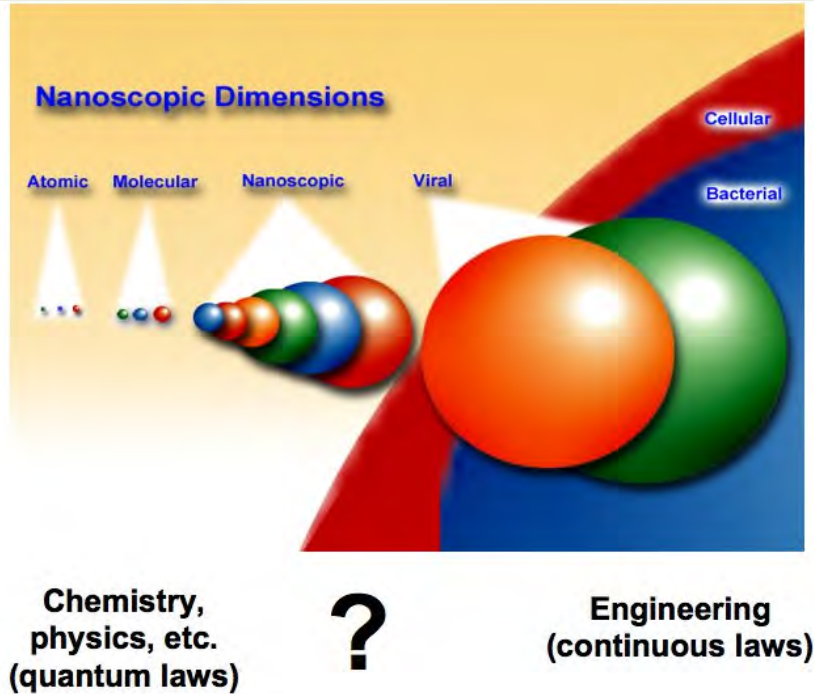
THANK S. MIN

Scientific, Decision-making, and Public definitions of “nano”

- In scientific term “nano” equals 10^{-9} (of something, e.g., meter, or ampere, or any dimension).
- The reason for trying to set (1-100 nm or other limits) of nanotechnology is that decision-makers and regulators in agencies (NIH, EPA, FDA, etc.) need precise terms and draw clear guidelines. These definitions are always influenced by specific intentions and interests. **Definitions based on properties in a size-range lead to a circular logic - properties are NEVER based on one single parameter.**
- Public definitions are created by journalists trying to describe their understanding of a scientific achievement to the general public. Translating knowledge for the public is really important, but may be imprecise (e.g., shape-related words vs. action words).

THE HUMAN MIND WORKS WITH USING CATEGORIES, ANALOGIES AND ASSOCIATIONS!

The properties of “nanoscale” objects



- are **transitional** between **molecular** and **bulk** due to the **emerging collective / cooperative behavior** of the components as a system.
- present **chemical** and **materials properties simultaneously**,
- **surface contribution** is prominent

Commercialization must-haves (safety, environment and regulation) can't keep pace with nanomedicine research, which is accelerating exponentially

Example: Personalized medicine may be:

- (A) the application of existing drugs to personal genetic and biologic characters of the patient, or
- (B) (B) a drug/ nanomedicine designed and synthesized to the characteristics of the specific illness of a specific person)

Personalized medicines of group B, are impossible to commercialize under the present regulatory procedures, they will not be reimbursed by insurance companies, therefore cannot enter the clinic (MD's liability insurance is also a question).



Early Phase

Seed

Novel Dx/BM

IPO

Genomics

FIPCO

**Disease
Management**

Late Phase

Series A/B/C

Accepted BM

+ROI

Product

VIPCO

**Health
Management**



CROSSING THE VALLEY OF DEATH

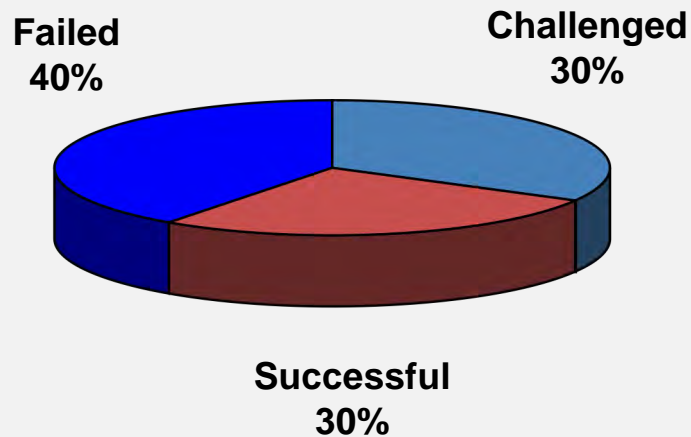
So, what to do?

We have to:

- keep working on nomenclature and terminology, and educate to improve communication between all involved
- Explain “nano” to people to avoid public fear and rejection based on prejudice
- support responsible commercialization by all means
- Take the initiative, but be patient - these are transformational programs!
- keep transforming education
- teach academic researchers about required industrial knowledge, and government officials about nano S&T
- Involve more and more students and small companies

Transformational Programs always encounter endemic time and budget delivery issues

Large Scale Project Delivery Success Ratios ⁽¹⁾



“Failure” is defined as:

- Schedules not met
- Over budget
- Expected value not realized

Why Projects Fail ⁽²⁾

- Poor planning
- Constituents never had buy in
- Deliverables changed without notification
- Inadequate training
- Scope creep
- Lack of communication
- Inadequate dependency management
- Lack of skilled resources
- Competing objectives
- Incomplete/changing requirements
- Change in upper management
- Lack of commitment from project team, users, management
- Lack of leadership
- Lack of explicit focus on business value

To prevent failure, it is critical to understand some root cause issues

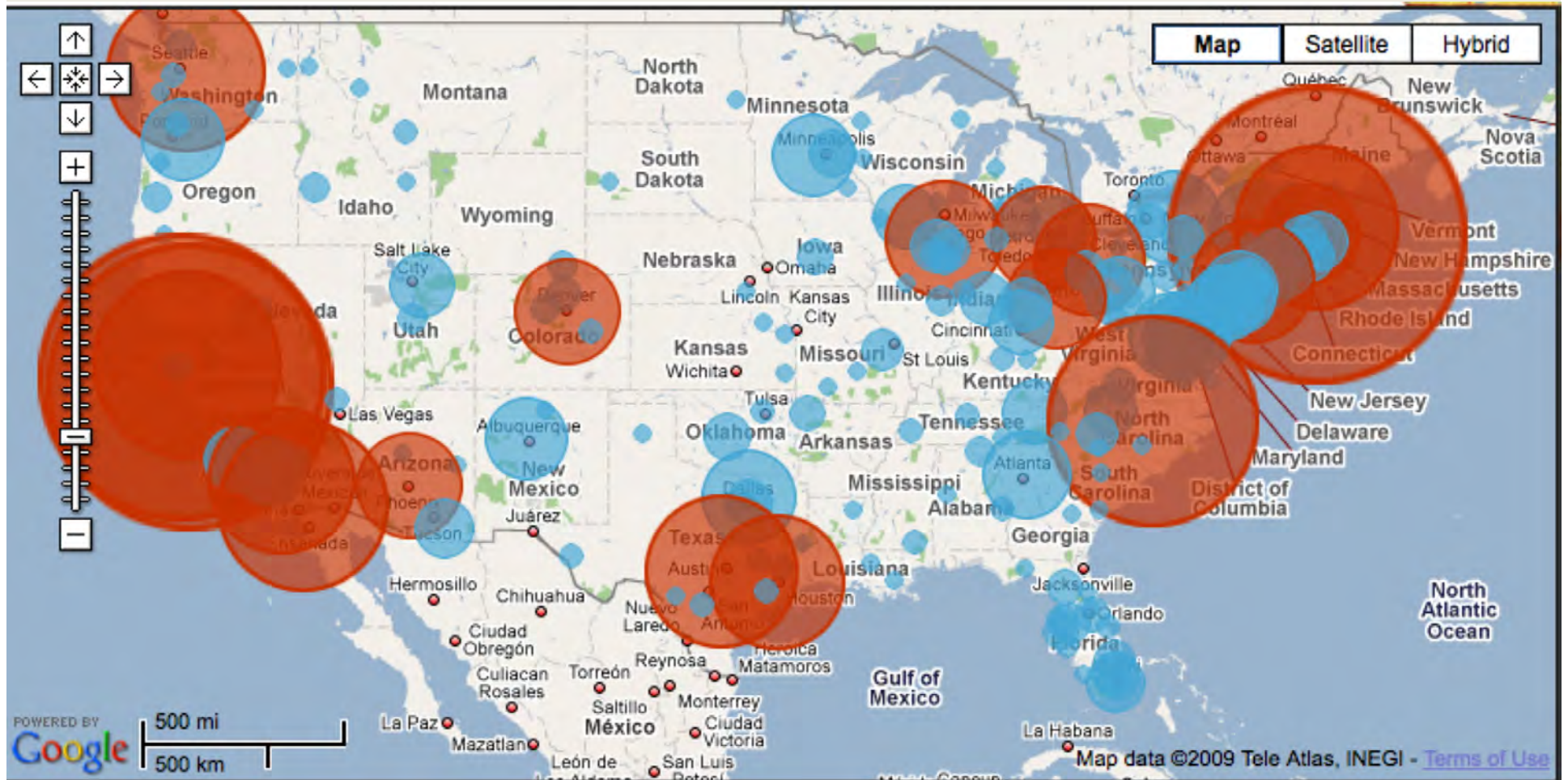
Sources:

(1) The Standish Group, based on Fortune 1000 Corporate Interviews

(2) DiamondCluster Value Management analysis

US NanoMetro Map

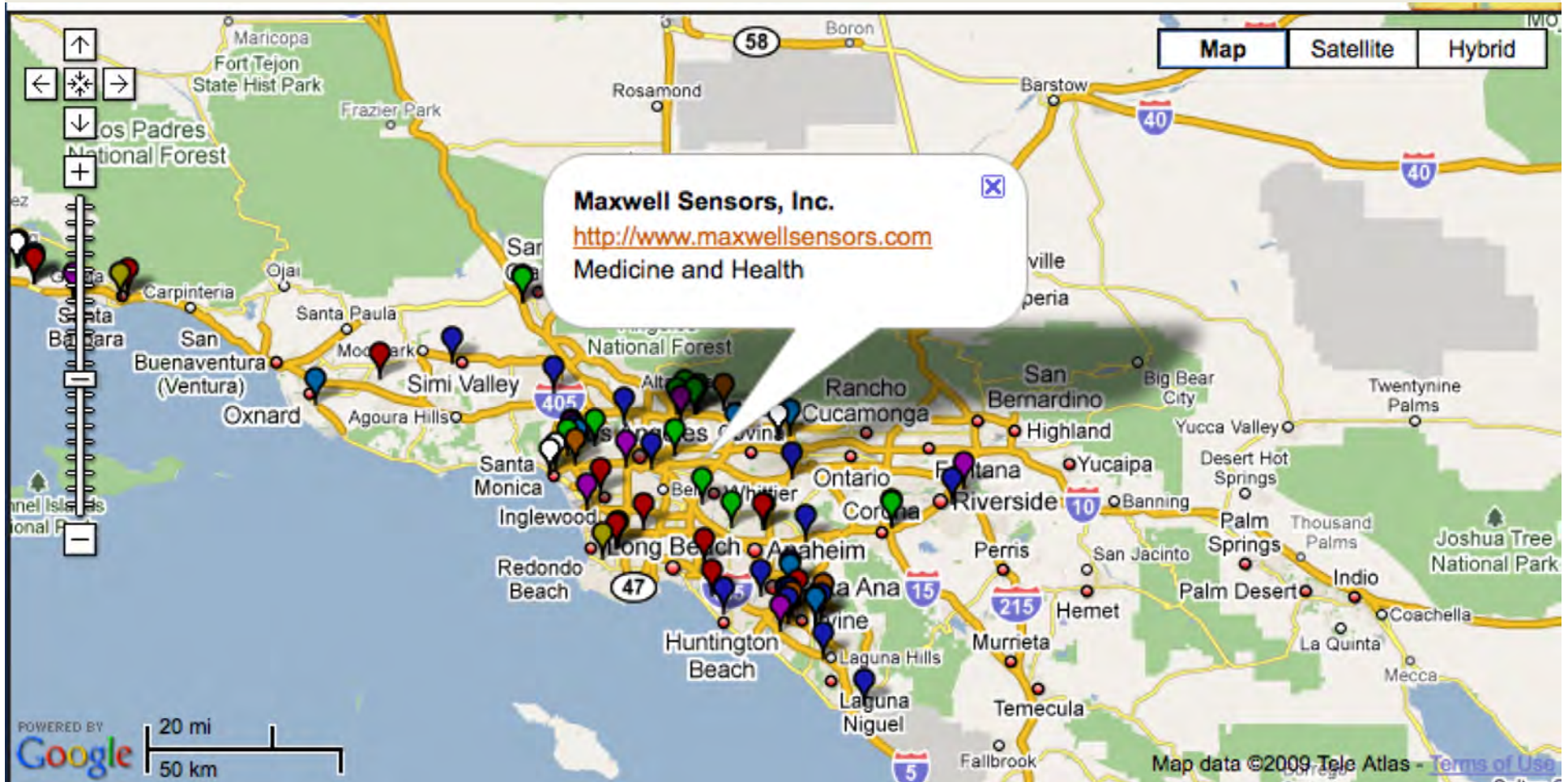
Total in 2009: 1200



This map shows the locations (by zip code) of companies, universities, government laboratories, and organizations working in nanotechnology around the United States.

<http://www.nanotechproject.org>

US NanoMetro Map



Once you zoom in, the circles on the map will be replaced by pins, indicating individual companies, universities, government laboratories, or organizations in each area. Click on a pin to see more information about that entry

	Company/Organization Name	City	3-Digit Zip Code	Sector	Website
AL	California Molecular Electronics Corporation	Huntsville	358	Electronics	http://www.calmec.com
	CFD Research Corporation	Huntsville	358	Tools and Instruments	http://www.cfdrc.com
	CytoViva, Inc.	Auburn	368	Imaging and Microscopy	http://www.cytoviva.com
	The AEGIS Technologies Group, Inc.	Huntsville	358	Tools and Instruments	http://www.aegistg.com
	University of Alabama	Tuscaloosa	354	Academic and Government Research	http://www.ua.edu
	University of Auburn	Auburn	368	Academic and Government Research	http://www.auburn.edu/
AK	University of Alaska - Fairbanks	Fairbanks	997	Academic and Government Research	http://www.uaf.edu/
AZ	AmerElite Solutions, Inc.	Phoenix	850	Medicine and Health	http://www.amerelitesolutions.com
	Amtech Systems, Inc.	Tempe	852	Tools and Instruments	http://www.amtechsystems.com/
	Arizona Microsystems	Tucson	857	Electronics	http://www.azmicrosystems.com
	Arizona State University	Tempe	852	Academic and Government Research	http://www.asu.edu
	Climax Engineered Materials	Sahuarita	856	Materials	http://www.climaxengineeredmaterials.com
	DA NanoMaterials, LLC	Tempe	852	Materials	http://www.nanoslurry.com
	Dainty Footings	Tucson	857	Materials	http://www.daintyfootings.com/
	Entrepix, Inc.	Tempe	852	Tools and Instruments	http://www.entrepix.com
	Fullerene International Corporation	Tucson	857	Materials	http://www.fullereneinternational.com
	ImaRX Therapeutics, Inc.	Tucson	857	Medicine and Health	http://www.imarx.com
	MaatShop, LLC	Sedona	863	Medicine and Health	http://www.netmar.com/~maat/maatshop/
	MER Corporation	Tucson	857	Energy and Environmental Applications	http://www.mercorp.com
	Microchip Technology, Inc.	Chandler	852	Electronics	http://www.microchip.com
	Nano and Giga Solutions, Inc.	Gilbert	852	Tools and Instruments	http://www.nanoandgiga.com
NanoLight Technology	Pinetop	859	Imaging and Microscopy	http://www.nanolight.com	



A small body of determined
spirits fired by an unquenchable
faith in their mission can alter
the course of history.

— Mohandas Gandhi