Business Week 2010

April 12 - 16

The Innovation Economy with Particular Emphasis on the 'Business' of Nanotechnology

NANO 101
Introduction to Nanotechnology
for Business Students

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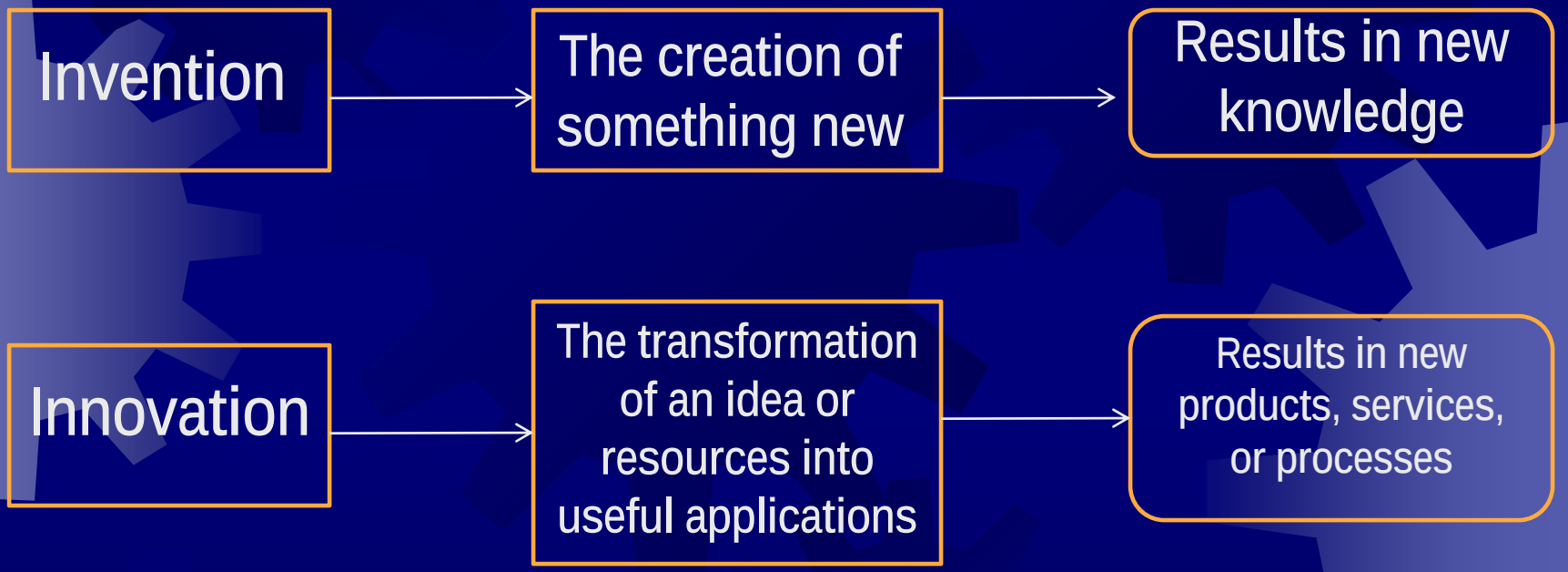
Objectives of NANO 101

- Introduce business students to nanotechnology.
- Provide an example of UT Arlington nanotechnology business formation.
- Encourage business student interest/involvement in UT Arlington nanotechnology business opportunities.

Invention vs. Innovation



Innovations

- Ideas and inventions are not innovations
  - Ideas are free and last forever
  - Most inventions are never commercialized
- Change results not from coming up with good ideas or clever inventions, but making them work technologically (i.e. consistently) and commercially (profitably).
- Commercial success requires
  - Customer/user adoption
  - Profitability for continuing operation

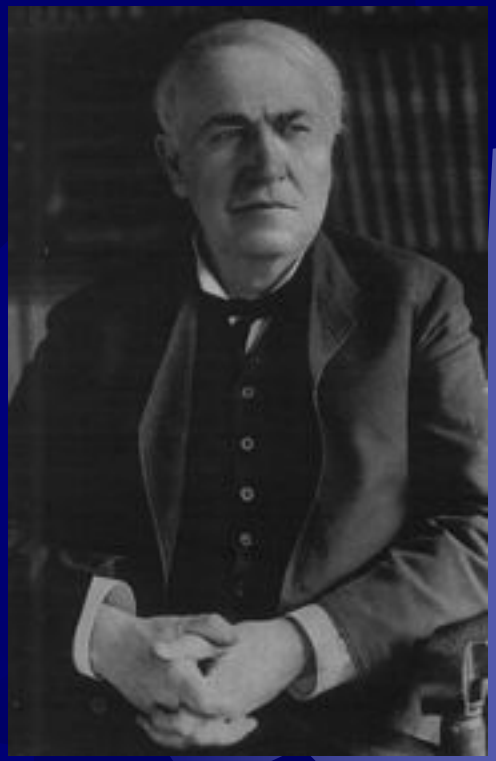
Inventor-Innovator-Entrepreneur

Thomas Edison

- More than 1000 patents

…but was an appalling inventor say his colleagues…

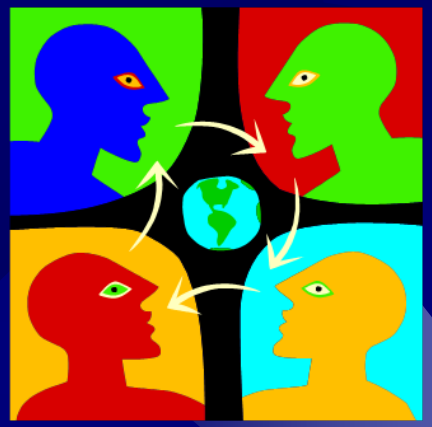
…however he was a fantastic innovator and entrepreneur



- Had technical and entrepreneurial skills
- Built teams to complement his strengths
- Inspired them with vision of what is possible
- Managed the innovation process
- Promoted himself and innovations ceaselessly

Social Reality of innovation

- Innovation is fundamentally a social process.
  - Very few succeed in innovation as the lonely only.
  - Most successful innovations are implemented by teams.



Innovation is a Social Process

- Which technology wins out depends
  - The dynamics of competition between alternatives that are initiated and promoted by entrepreneurs, competitors, alliances, government, investors, etc.

Innovation and Technology

Innovation is positive change or improvement in a product, process, procedure, or system resulting from the application of technology. There are two general types of innovation:

- Product – Change in product or service
  - New material and/or new use
  - High quality and/or fewer defects
- Process – Changes that affect the way outputs are produced
  - Flexible, agile, and/or just-in-time
  - Mass customization

World's Most Innovative Companies

Fast Company, March 2010

Huawei [5]
Hulu [11]
BYD [16]
Indian Premier League [22]
HJC [31]
PG&E [7]
Spotify [15]
Gilt Groupe [21]
Grey New York [24]
Aldi Sud [40]

World's Most Innovative Companies (cont)

Fast Company, March 2010

Facebook [1]
Apple [2]
Novartis [8]
HP [10]
Intel [14]
IBM [18]

Amazon [2]
Google [2]
WalMart [9]
Nike [13]
Cisco System [17]
GE [19]

Nano What?

- Nanoscience is the study of structures that are smaller than about 100 nanometers; these are known as nanostructures.
- A nanometer is a billionth of a meter (or less than one millionth of an inch).
- Nanotechnology is the application of nanostructures in nanoscale devices (circuits and sensors).
- At the single atom and molecular level nanoscience and nanotechnology involve the bringing together of chemical, physical, and biological properties of various systems.

Advantages of Nanotechnology

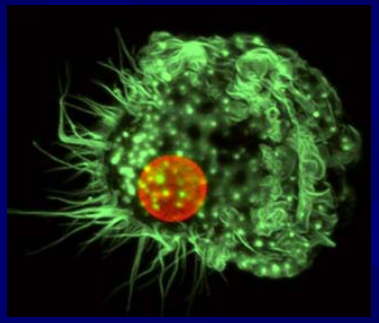
- There are also great advantages to being small:
  - The progression of semiconductor technology is dependent on ever diminishing size scales
  - Nanoscale devices are invisible to the human eye, and thus can potentially perform many functions without disruption to human activity
  - By building devices molecule by molecule or atom by atom, engineers will have unprecedented control over the design and fabrication of new devices
  - New nano-based fabrication technology yields new devices and systems and new business opportunities

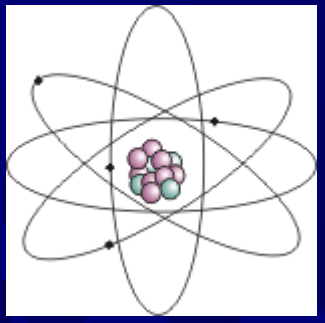
Nanomeasurement – Size Approximation

Ant (length)	12,000,000 nm (~ ½ inch)
Pollen	40,000 nm (~1/1000 inch)
Smallest thing visible by human eye	10,000 nm
Virus	100 nm
DNA	1 nm
Carbon nanotube	1 nm
Hydrogen atom	1/10 nm
Human hair	50,000 nm

Logarithmic Length Scale

Human 

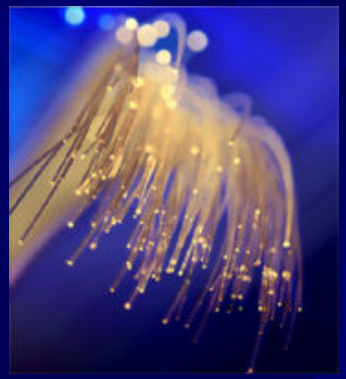
Cell 

 Atom

Meter (m) | Millimeter (mm) | Micrometer (μm) | *Nanometer (nm)* | Picometer (pm)

Larger ← → *Smaller*

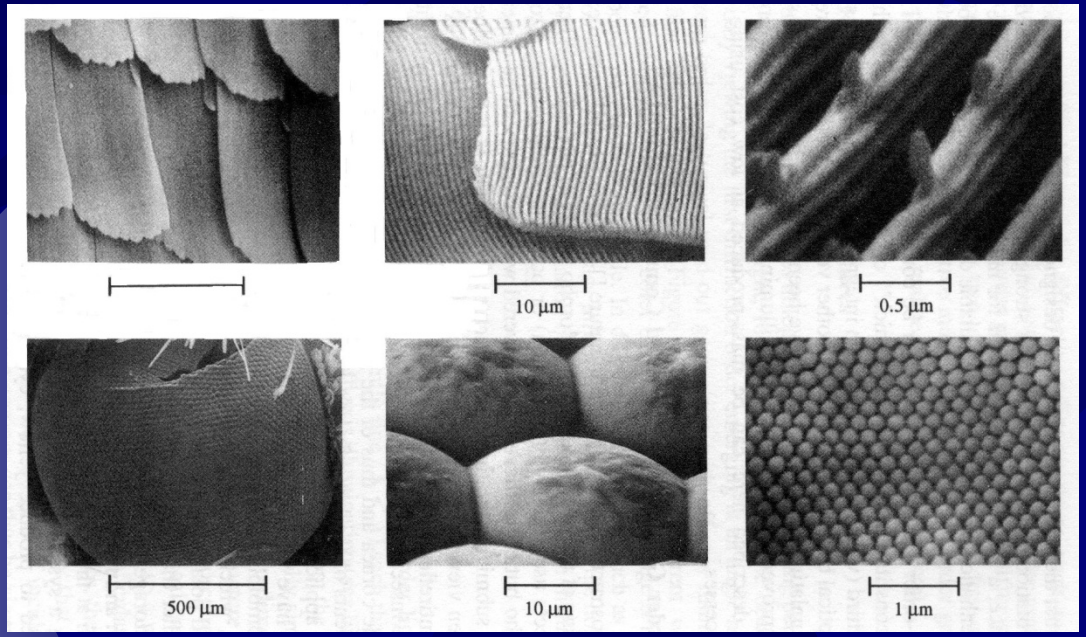
10^{0} m | 10^{-3} m | 10^{-6} m | 10^{-9} m | 10^{-12} m

Optical Fiber 

 Protein

Nature: The ultimate nanotechnologist

NATURAL PERIODIC MICROSTRUCTURES



Butterfly
(morpho family)

Moth's eye

Nano-scale patterns cause colors of many insects:

Nanotech Products

- Hanjo Chemical – golf balls and the ‘nano’ driver
- Envirosystems EcoTru – nanosilver wound dressing
- Easton – nano softball bats
- BASF – superhydrophobia spray
- Aspen Aerogels – foot warmers
- 3M – dental adhesive
- Surf Nano Products – board enhancer
- Wilson – tennis rackets and balls

Additional Nano Facts

- Nanotech products and services could easily surpass $1 trillion by 2015.
- U.S. government funding for nanotech research has increased from about $400 million ten years ago to approximately $4 billion today.
- Private capital (or venture capital) in the U.S. is funding in excess of $1 billion a year into early stage nano-based businesses.
- Japan, China, South Korea, Canada, Germany, and Russia are rapidly emerging as close rivals to the U.S. in nanotech programs – global trade competitiveness will soon be greatly determined by nanotech competency.

Nanotechnology at UT Arlington

Since 2001, $17,500,000 received from external resources for nanotechnology research.

Since 2001, 300 disclosures and 36 patents issued, roughly one-third relate to nano.

Nanotech Researchers at UT Arlington

- Robert Magnusson, Electrical Engineering--Nanophotonics, nanofabrication, nanoscale biosensors
- Samir Iqbal, Electrical Engineering--Biosensors and Bio-Inspired Fabrication
- Seong Jin Koh, Materials Science and Engineering--Nano-electronic devices, sensors for molecular level detection
- Wei Chen, Physics--Nanoparticle-based therapeutics for cancer treatment
- Peter Kroll, Chemistry--Embedded nanocrystals and nanostructured materials

Resonant Sensors, Inc.

High-Growth, Multi-billion Opportunity in the Drug Development, and Medical Analysis Industries

Debra Wawro, Founder/CEO

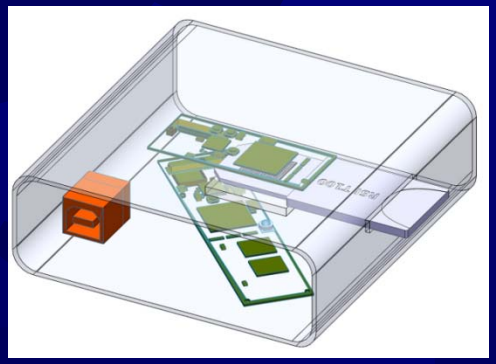
Dr. Robert Magnusson, Founder/CTO

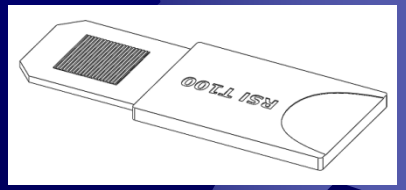
Our Products

Label-free biosensor systems that test biochemical interactions in real-time with outstanding accuracy

Vides Bioassay System for high throughput screening in drug development

Compact biochip systems for rapid biomarker screening in cancer diagnostics





Razor and razor blade model

RSI Technology Solves the Problems of Tag-Based Analysis & Reduces Time by Factor of 15-100.

Features	Current label-based approaches	RSI label-free sensor system
Time to measure a biochemical reaction	4-24 hours (typical)	<15 minutes (typical)
Chemical processing to detect biochemical reaction	2-3 incubation steps and 10-15 washing steps before readout.	Real-time, direct monitoring of biochemical reaction.
Sensitivity	pM range (commercial benchtop plate readers).	pM range
Binding kinetics	Not capable	Yes
Robust to sample variations and environmental changes	sample-to-sample variations can decrease accuracy.	Yes – dual peak detection provides the ability to distinguish surface changes from background.

Executive Team and Plan

RSI was founded in 2004 by the inventors

- Based on many years UT Arlington Electrical Engineering faculty/student research

RSI has exclusive rights to biosensor IP portfolio through a license agreement with UT Arlington.

RSI team includes several highly skilled employees plus the founders:

Debra Wawro, Founder/Inventor/CEO. Previously held Commodity Management and Engineering positions at Tellabs and Marconi Networks. Prior research faculty at UTSW Medical Center.

Dr. Robert Magnusson, Founder/Inventor/CTO. Recognized pioneer in guided-mode resonance technology. Recently appointed Texas Instruments Distinguished University Chair in Nanoelectronics.

Commercialization Efforts

2006	2007-2008	2009-2010	2011-2012
-IP license -Feasibility -Phase I SBIR grant	-Seed investors -More grants -Solidify core team -Business Plan -Build customer relationships -File more patents	-Commercial product -Initial revenues -Strategic partners -Establish branding and marketing path -Series A funding -More patents…	-Product ramp up -Profitability -More product development -Expand marketing/sales -Fill out management staff -More patents…

Funding and Plans

- RSI has received funding from:
- -NSF, NIH and DARPA for Phase I and II Small Business Innovative Research
- -State of Texas Emerging Technology Fund
- -Angel investors
- -Expected revenue generation this year

Manufacturing and distribution channels via strategic partners

Addressing rapid growth, near term $3B market for benchtop system

Projected financial forecast for RSI: $250M in 5 yrs

Knowledge/Experience/Perspectives/ Skills Necessary to Work in Nanotechnology Business Firms

- Expertise in some key business function
- Business and market development
- Some technical knowledge of nanoscience
- Business plan and budgeting
- Oral, written, and interpersonal communication
- Patent and intellectual property law
- Understanding of the dynamics of a rapidly emerging nanotechnology industry
- Capitalization (and monetization) of early stage nano product/service development
- Product characteristics and uses
- Think globally

Are you interested in the “business” of nanotechnology?

- ✓ Sign up for an information session
- ✓ New course 41xx Engineering Fall 2010
- ✓ Additional questions