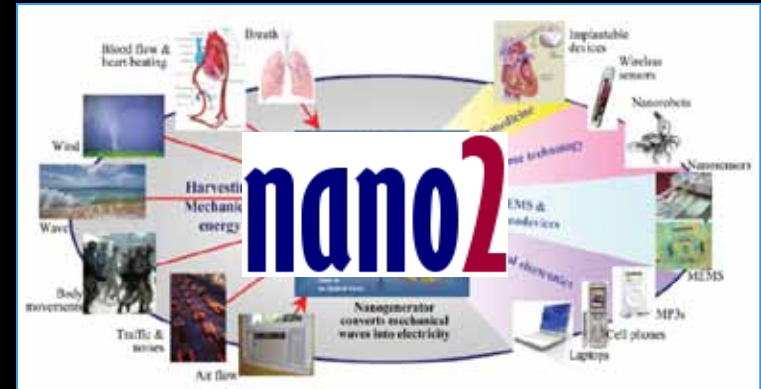


2000



2010



2020

NNI framework and long view

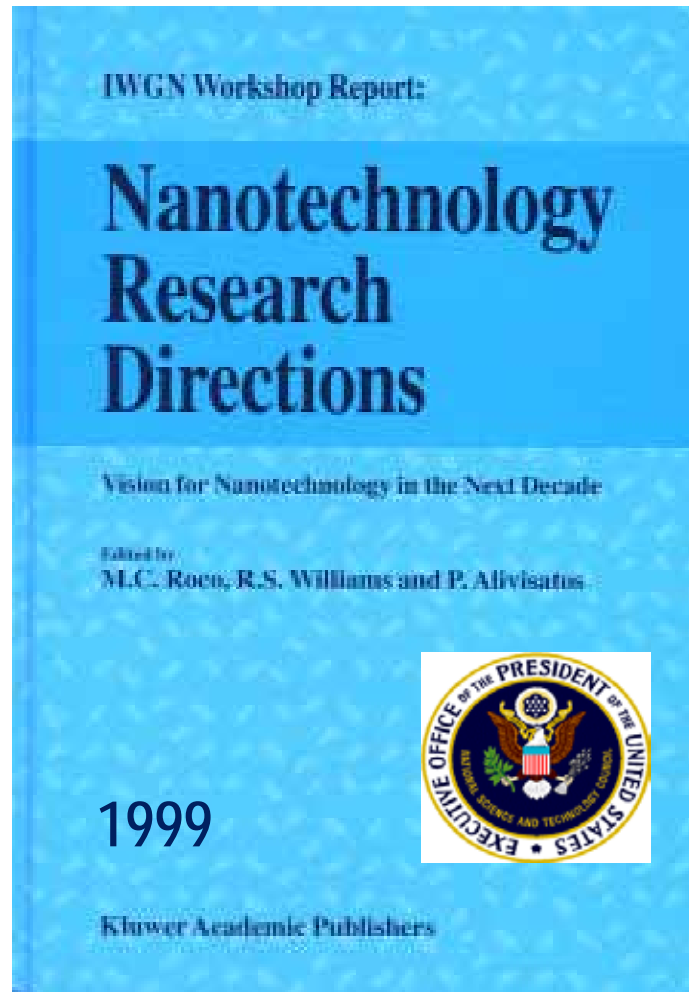
Mike Roco

NSF and NNI

*NSF-NNI Workshop: Design and Manufacturing of Integrated Nanosystems
March 2-3, 2011*

Long-term nanotechnology research directions (2000-2020)

nano1

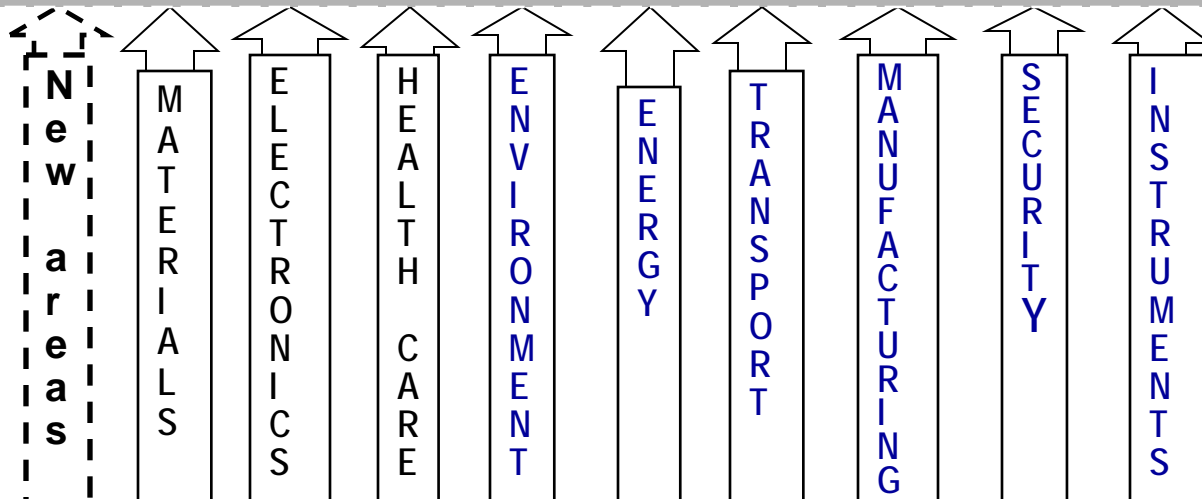


nano2

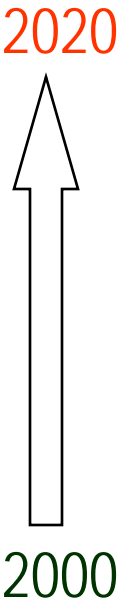


NSF/WTEC, www.wtec.org/nano2/ ; Springer 2010

Mass Application of Nanotechnology after ~ 2020



**CREATING A NEW
FIELD AND
COMMUNITY IN TWO
FOUNDATIONAL
STEPS (2000~2020)**



NS&E integration for general purpose technology
 ~ 2011 ← **nano2** → ~ 2020
 Direct measurements; Science-based design and processes;
 Collective effects; Create nanosystems by technology integration

- New disciplines*
- New industries*
- Societal impact*

Foundational interdisciplinary research at nanoscale
 ~ 2001 ← **nano1** → ~ 2010
 Indirect measurements, Empirical correlations; Single principles,
 phenomena, tools; Create nanocomponents by empirical design

- Infrastructure*
- Workforce*
- Partnerships*

Beginning of nanomanufacturing in NNI

Grand Challenge on Nanomanufacturing added in FY 2002

NSF, DOC/NIST, DOD, DOE, NASA, USDA, NIH

Series of workshops with a NNI report

Nanomanufacturing Program at NSF (2002-)

National Nanomanufacturing Network (2004-)

NNI nanomanufacturing budget

FY 2010 (actual):

\$84.5M (4.4% of NNI budget)

FY 2012 (WH request):

\$122.5M (10.0% of NNI budget)

*Note: FY 2012 Request is \$2.13 B,
20% increase over FY 2011 Request \$1.76 B*

Nanomanufacturing, Industry Liaison, and Innovation (NILI) working group

- | **Purpose:** advance and accelerate the creation of new products and manufacturing processes derived from discovery at the nanoscale.
- | **Goals:**
 1. Facilitate nanotechnology innovation, nanomanufacturing advancement, and technology transfer in and by Federal agencies
 2. Exchange information and stimulate interactions relating to nanotechnology among Federal agencies, academe, industry, professional societies, and State and local organizations
 3. Create innovative methods for transferring techn. to industry

Planning NNI “signature initiatives” with nanomanufacturing components in FY 2012

Sustainable Nanomanufacturing

\$ 84M (NSF \$35.4M; DOE \$35.3M; NIST \$7.4M; NASA \$5M; USDA/FS \$0.9M)

Nanoelectronics for 2020 and Beyond

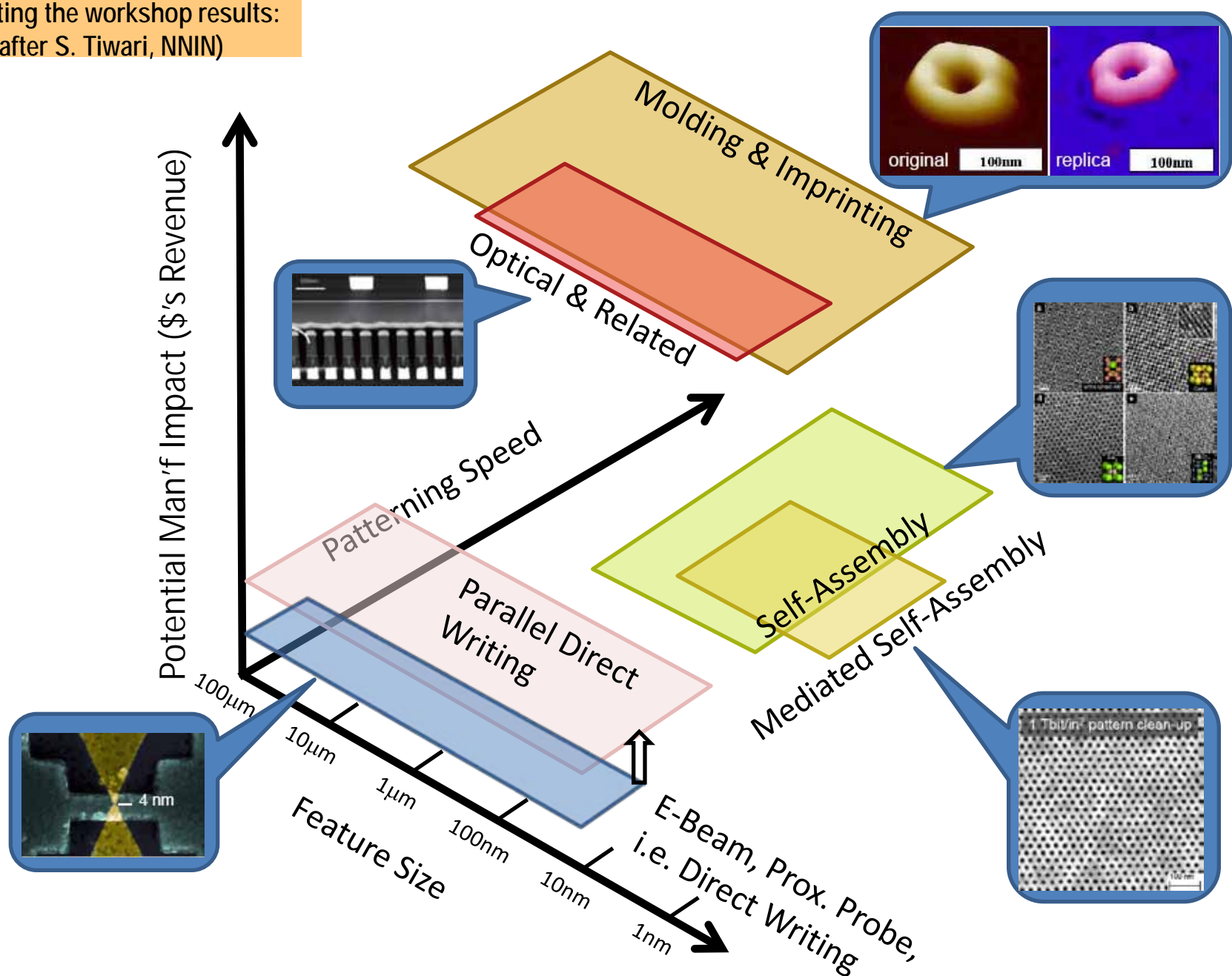
\$ 98.5M (NSF \$50M, DOE \$33.8M; NIST \$11.7M; NASA \$3M)

Nanotechnology for Solar Energy

\$ 125.7M (DOE \$79.2M; NSF \$32M; NIST \$11.5M; NASA \$2M; USDA/NIFA \$1M)

In FY 2012 Request: a new system oriented nano centers

- First group of three
Nanosystems Engineering Centers (~\$4M/y)
provided that funds are available
- Tentative date for the **announcement by April 2011**;
full proposals in August 2011;
awards to be made in 2012
- Address major topics **from discovery to innovation**



Nanopatterning on surfaces

Need for nanomanufacturing in the U.S.

- “Service work” alone is not sufficient in a modern economy
- Nano - broad based technology to enhance or replace mature technologies in order to maintaining high paying jobs
- Better opportunities for nanomanufacturing in U.S. when:
 - Use of advanced infrastructure and multidisciplinary teams
 - Highly automated processes
 - Links to other “emerging technologies”
 - Requiring a culture of innovation