NSF SES 0938099

Nanoscale Science and Engineering Center

at University of California, Santa Barbara

Year 3 (8) Annual Report

March 16, 2012 – March 15, 2013

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3. PROJECT SUMMARY

The Center addresses questions of nanotech-related societal change through research and education that encompasses three main areas: **IRG-1: Origins, Institutions, and Communities** produces and integrates a diverse range of historical sources and research tools in order to understand specific facets of the nano-enterprise's history; **IRG-2: Globalization and Nanotechnology** addresses global industrial policy and development of nanotechnology, with a particular focus on China, Japan & India as well as Latin America and pathways to the use of nanotechnologies to spur equitable development; and **IRG-3: Nanotech Risk Perception and Social Response** conducts social research on formative nanotech risk and benefit perceptions in the US and abroad aimed at studying perceptions of emerging nanotechnologies by multiple stakeholders in the nano-enterprise. Strategic topic projects (solar energy, California industry, media coverage of nano) extend and integrate the three IRGs' work. In combination, these efforts address a linked set of issues regarding the domestic US and global creation, development, commercialization, production, consumption, and control of specific kinds of nanoscale technologies. Important features of CNS' approach are commitment to issues of *socially and environmentally sustainable innovation*, participatory research with nanoscientists; a focus on specific nanotechnologies and comprehensive consideration of their applications in industries like electronics, energy, food, environmental, and health; and employment of a global framework for analysis with attention to equitable development. **IRG 3** studies cross-national modes of enhancing public participation. The Center's three IRGs combine expertise in many fields: technology, innovation, culture, health, energy, global industrial development, gender and race, environment, space/location, and science and engineering. Core collaborators are drawn in the US from UC Davis and UCLA, Arizona State Univ., Chemical Heritage Foundation, Decision Research, Duke Univ., Lehigh Univ., Long Island Univ., Rice Univ., and SUNY New Paltz, and internationally from Beijing Institute of Technology (China), Cardiff Univ. (UK), Seoul National University (S. Korea), Univ. of British Columbia (Canada), and University of Nottingham (UK). CNS has served as a leader in the NSF Network for Nanotechnology in Society and is co-founder of the international scholarly organization S.NET, which is successfully forging an international community of nano and emerging technology scholars from nations around the globe. CNS-UCSB is a research partner in the NSF/EPA-funded UC Center for Environmental Implications of Nanotechnology at UCLA/UCSB.

Education and Outreach programs at CNS-UCSB aim to nurture an interdisciplinary community of nano scientists, social scientists, humanists, and educators who collaborate in CNS IRGs and achieve *broader impacts* through informed engagement of diverse audiences in dialogue about nano and society. CNS-UCSB provides 3-5 postdoctoral research scholar positions each year. Graduate Fellowships and researcher postions for social science and NSE grads enable them to participate jointly in CNS IRG research and education. A hallmark of CNS-UCSB education is the introduction of scientists- and engineers-in-training into the methods and practices of societal research and through them to key issues of responsible development. A CNS 8-week intensive summer undergraduate internship program run for the 7th time in 2012 integrates diverse California community college students into CNS research. Through a year-round bi-weekly seminar program, a speakers series, conferences, visiting scholars, informal science education events for the public, electronic dissemination of a popular nano and society-related News Clips service to about 500, over a couple dozen public events with community members, and accelerating outreach to key sectors of government and industry, the CNS maintains a solid following of campus, local, and national and international media, as well as interest by government, industry, NGOs, and the general public.

In 2012-13 CNS-UCSB continued substantial progress in research on pathways and impediments to socially and environmentally sustainable futures for nanotechnologies, producing 52 new publications in the past year, bringing total publications since our renewal 2.5 yrs ago to 212, with another 49 in the publication stream, and making 80 presentations this year at academic venues. Applebaum, Block, Harthorn, and Pidgeon each provided critical input to national policymaking bodies in the US and UK, and CNS researchers made over 72 presentations to key audiences in government, industry, NSE, and the public.

4. PARTICIPANTS

4A. CENTER PARTICIPANTS

Bold *indicates active in Year 8*

*UCSB (*co-funded)*

Name	Title	Department	Organization
***Peter Alagona**	**Assistant Professor**	**History & Environmental Studies**	UC Santa Barbara
Richard Appelbaum	**Professor**	**Sociology, Global & International Studies**	UC Santa Barbara
David Awschalom	Professor	Physics	UC Santa Barbara
Edwina Barvosa	**Associate Professor**	**Chicana/o Studies, Feminist Studies**	UC Santa Barbara
Bruce Bimber	**Professor**	**Political Science, Communication**	UC Santa Barbara
Tim Cheng	Professor	Electrical and Computer Engineering	UC Santa Barbara
Brad Chmelka	Professor	Chemical Engineering	UC Santa Barbara
Julie Dillemuth	Education Director	CNS-UCSB	UC Santa Barbara
Jennifer Earl	Professor	Sociology	UC Santa Barbara
William Freudenburg	Professor (deceased)	Environmental Studies	UC Santa Barbara
Fiona Goodchild	Education Director (Retired)	California NanoSystems Institute	UC Santa Barbara
Michael Goodchild	**Professor (Retired)**	**Geography**	UC Santa Barbara
Barbara Herr Harthorn	**Professor/Director**	**Feminist Studies, Anthropology, Sociology/CNS-UCSB**	UC Santa Barbara
Craig Hawker	**Professor/Director**	**Chemical Engineering/Materials Research Laboratory, MRSEC**	UC Santa Barbara
Patricia Holden	**Professor**	**Microbiology, Environmental Studies**	UC Santa Barbara
W. Patrick McCray	**Professor**	**History of Science**	UC Santa Barbara
Aashish Mehta	**Assistant Professor**	**Global & International Studies**	UC Santa Barbara
Miriam Metzger	**Professor**	**Communication**	UC Santa Barbara
John Mohr	**Professor**	**Sociology**	UC Santa Barbara
Meredith Murr	Director	Research Development	UC Santa Barbara
Christopher Newfield	**Professor**	**English**	UC Santa Barbara
Casey Walsh	**Associate Professor**	**Anthropology**	UC Santa Barbara

Sub-Award PIs

Name	Title	Department	Organization
Frederick Block	**Professor Emeritus**	**Sociology**	**Univ of California, Davis**
Joseph Conti	Assistant Professor	Sociology, Law	University of Wisconsin
Sharon Friedman	**Professor**	**Science Journalism, Communication**	**Lehigh University**
Gary Gereffi	**Professor/Director**	**Sociology,CGGC**	**Duke University**
Robin Gregory	**Senior Researcher**	**Psychology**	**Decision Research**
Paul Slovic	**President**	**Psychology**	**Decision Research**
Timothy Lenoir	**Professor**	**History, Data Visualization, Visual Studies**	**Duke University**
Cyrus Mody	**Assistant Professor**	**History, Technology Studies**	**Rice University**
Nicholas Pidgeon	**Professor**	**Applied Psychology**	**Cardiff University, UK**
Terre Satterfield	**Professor**	**Culture, Risk & Env.**	**Univ of British Columbia, CA**

Collaborators

Name	Title	Department	Organization
Nick Arnold	**Professor**	**Physics and Engineering**	**Santa Barbara City College**
Gerald Barnett	Director	University Tech. Transfer	University of Washington
Christian Beaudrie	**Associate**	**Marerials, Risk Analysis**	**Compass Reource Management, CA**
Daryl Boudreaux	**President**	**Commercialization**	**Boudreaux and Associates**
David Brock	**Senior Research Fellow**	**History**	**Chemical Heritage Foundation**
Karl Bryant	**Assistant Professor**	**Sociology, Women's Studies**	**SUNY New Paltz**
Cong Cao	**Associate Professor**	**Sociology**	**University of Nottingham, UK**
Hyungsub Choi	**Assistant Professor**	**History of Science**	**Seoul National University, SO Korea**
Meredith Conroy	Assistant Professor	Politics	Occidental College
Zhu Donghua	Vice Dean	Management and Economics	Beijing Institute of Technology, CN
Jennifer Earl	**Professor**	**Sociology**	**University of Arizona**
Brenda Egolf	**Research Scientist**	**Journalism**	**Lehigh University**
Matthew Eisler	**Lecturer**	**Engineering and Society**	**University of Virginia**

Guillermo Foladori	**Professor**	**Sociology**	**Universidad Autonoma de Zacatecas, MX**
Hillary Haldane	Assistant Professor	Anthropology	Quinnipac University
Patrick Herron	**Researcher**	**Data Mapping and Visualization**	**Duke University**
Noela Invernizzi	**Phd**	**Science & Technology Policy**	**Federal University of Parana, BR**
Jacqueline Isaacs	Professor	Mechanical & Industrial Engr.	Northeastern University
Mikael Johansson	**Lecturer**	**Global Studies**	**Univnersity of Gothenburg, SE**
Ann Johnson	**Associate Professor**	**History of Science and Tech, Mod. Europe**	**University of South Carolina**
Milind Kandlikar	**Associate Professor**	**Science Policy & Regulation**	**University of British Columbia, CA**
Graham Long	**Partner**	**Environmental Technology**	**Compass Resource Management, CA**
Yasuyuki Motoyama	**Senior Scholar**	**City & Regional Planning**	**Ewing Marion Kauffman Foundation**
Joseph November	**Associate Professor**	**History**	**University of South Carolina**
Rachel Parker	**Sr. Research Associate**	**Sociology**	**Science & Technology Policy Institute**
Dorothy Roberts	**Professor**	**Law and Sociology**	**University of Pennsylvania Law School**
Jennifer Rogers-Brown	**Assistant Professor**	**Sociology**	**Long Island University**
Philip Shapira	**Professor**	**Public Policy**	**Georgia Institute of Technology**
Denis Simon	**Vice Provost**	**Political Science**	**Arizona State University**
Marilynn Spaventa	Acting Executive VP	ESL	Santa Barbara City College
Xinyue Ye	**Assistant Professor**	**Geography**	**Bowling Green State Univ.**
Jan Youtie	**Manager, Policy Services**	**Political Science**	**Georgia Institute of Technology**
Edgar Zayago Lau	**Senior Researcher**	**Development Studies**	**Universidad Autonoma de Zacatecas**

UCSB Postdoctoral Researchers (*co-funded)

Name	**Department**	**Co-Funding**
***Mary Collins**	**Environmental Science and Management**	**UC CEIN**
Meredith Conroy	Political Science	
*Gwen D'Arcangelis	Women's Studies	UC CEIN

Matthew Eisler	History	
***Shannon Hanna**	**Environmental Science and Management**	**UC CEIN**
Mikael Johansson	Social Anthropology	
Luciano Kay	**Public Policy**	
Yasuyuki Motoyama	City and Regional Planning	
***Christine Shearer**	**Sociology**	**Harthorn-Deliberation**
James Walsh	**Sociology**	

Non-UCSB Postdoctoral Researchers

Name	Department	Organization
Adam Corner	**Social Psychology**	**Cardiff University**
Christina Demski	**Psychology**	**Cardiff University**
Stacey Frederick	**Textile Management**	**Duke University**
Marian Negoita	**Sociology**	**University of California, Davis**
Anton Pitts	**Risk Science**	**University of British Columbia**

CNS Graduate Fellows

Name	Department	Organization
Peter Burks	**Chemistry, BioChemistry**	**UC Santa Barbara**
Amanda Denes	**Communication**	**UC Santa Barbara**
Roger Eardley-Pryor	**History**	**UC Santa Barbara**
Cassandra Engeman	**Sociology**	**UC Santa Barbara**
Matthew Gebbie	**Materials**	**UC Santa Barbara**
Shirley Han	**Ecology, Evolution and Marine Biology**	**UC Santa Barbara**
Shannon Hanna	**Environmental Science and Management**	**UC Santa Barbara**
Zachary Horton	**English**	**UC Santa Barbara**
Tyronne Martin	**Chemistry**	**UC Santa Barbara**
Galen Stocking	**Political Science**	**UC Santa Barbara**

*UCSB Graduate Student Researchers & Research Assistants (**cofunded)*

Name	Department	Organization
***Lynn Baumgartner**	**Environmental Science and Management**	**UC Santa Barbara**
*Erin Calkins	Chemistry, Biochemistry	UC Santa Barbara
***Benjamin Carr**	**Environmental Science and Management**	**UC Santa Barbara**
***Mary Collins**	**Environmental Science and Management**	**UC Santa Barbara**
Lauren Copeland	**Political Science**	**UC Santa Barbara**
Rachel Cranfill	**Linguistics**	**UC Santa Barbara**
Chloe Diamond-Lenow	**Feminist Studies**	**UC Santa Barbara**
***Allison Fish**	**Environmental Science and Management**	**UC Santa Barbara**
Angus Forbes	Media Arts & Technology	UC Santa Barbara
Sarah Hartigan	Global Studies	UC Santa Barbara
Zachary Horton	**English**	**UC Santa Barbara**
Pehr Hovey	Media Arts & Technology	UC Santa Barbara
Indy Hurt	Geography, Geographic Information Science	UC Santa Barbara
***John Meyerhofer**	**Environmental Science and Management**	**UC Santa Barbara**
Margaret Moody	Education	UC Santa Barbara
Kristen Nation	**UCSC**	**UC Santa Barbara**
Shadi Roshandel	Education	UC Santa Barbara
Elizabeth Sciaky	Education	UC Santa Barbara
Adélaîde Veyre	Political Science	UC Santa Barbara
David Weaver	Political Science	UC Santa Barbara
Anna Walsh	**Global Studies & International Studies**	**UC Santa Barbara**

Non-UCSB Graduate Student Researchers

Name	**Organization**
Jennifer Bayzick	Lehigh University
Christian Beaudrie	**University of British Columbia, CA**
Laura DeVries	University of British Columbia, CA
Lanceton Mark Dsouza	**Duke University**
Aaron McGuire	Duke University
Brittany Shields	University of Pennsylvania

Undergraduate & High School Interns & Researchers (UCSB, Community College [CC], High School [HS])

Name	***Organization***	***Name***	***Organization***
Brent Boone	CC	**Kristen Nation**	**UCSC**
Angla Burger	**UCSB**	**Emily Nightingale**	**UCSB**
Sergio Cardenas	CC	**Bryan Phillips**	**CC**
Cecilia Choi	UCSB	Srijay Rajan	CC
Hannah Cruz	**HS**	William Reynolds	CC
Andi Docktor	UCSB	Nicholas Santos	CC
Andi Diaz	UCSB	**Andreea Larisa Sandu**	**UCSB**
Gianna Haro	**CC**	**Eddie Triste**	**CC**
Katherine He	**UCSB**	Julie Whirlow	UCSB
Simone Jackson	CC	Sabrina Wuu	UCSB
Kelly Landers	CC	**Maria Yepez**	**UCSB**
Alexandra Lyte	CC		

Non-UCSB Undergraduate Researchers

Name	**Organization**
Sean Becker	Univ of WI Madison
Rachel Bowley	Duke University
Christine McLaren	**Lehigh University**
Ryan White	Lehigh University
Alexander Zook	**Lehigh University**

CNS-UCSB Staff

Name	Title	Department	Organization
Shawn Barcelona	**Financial Analyst**	**CNS-UCSB**	**UC Santa Barbara**
Cathy Boggs	**Education Coordinator**	**CNS-UCSB**	**UC Santa Barbara**
Sage Briggs	Purchasing & Travel Coordinator	CNS-UCSB	UC Santa Barbara
Joshua Dean	Education and Outreach Assistant	CNS-UCSB	UC Santa Barbara
Barbara Gilkes	Assistant Director	CNS-UCSB	UC Santa Barbara
Cory Jones	**Media Assistant**	**CNS-UCSB**	**UC Santa Barbara**
Monica Koegler-Blaha	**ISBER Payroll Analyst**	**ISBER**	**UC Santa Barbara**
Valerie Kuan	**Purchasing & Travel Coordinator**	**CNS-UCSB**	**UC Santa Barbara**
Diane Laflamme-McCauley	Artist	CNS-UCSB	UC Santa Barbara
Brendy Lim	**ISBER IT Support**	**ISBER**	**UC Santa Barbara**
Enrique Macias (Rick)	**IT Support**	**CNS-UCSB/ISBER**	**UC Santa Barbara**
Bonnie Molitor	**Assistant Director**	**CNS-UCSB**	**UC Santa Barbara**
Stacy Rebich Hespanha	Education Coordinator	CNS-UCSB	UC Santa Barbara
Andreea Larisa Sandu	**Education and Outreach Intern**	**CNS-UCSB**	**UC Santa Barbara**
David Weaver	**Outreach / Web Assistant**	**CNS-UCSB**	**UC Santa Barbara**
Maria Yepez	**Admin Assistant**	**CNS-UCSB**	**UC Santa Barbara**

*Non-CNS-UCSB Staff (*Unfunded)*

Name	*Organization*
Edgar Arteaga	**Universidad Autonoma de Zacatecas, MX**
Jordan Herman	**Duke University**
Kate North-Lewis	**Cardiff University**
***Jan Pachon, unfunded**	**Duke University**
Lesley Strabel	**Cardiff University**
Ben Weiss	**Duke University**

Affiliated Participants (Not receiving Center support)

Name	Title	Department	Organization
UCSB:			
Kevin Almeroth	**Professor**	**Computer Science**	UC Santa Barbara
Andrew Flanagin	**Professor**	**Communication**	UC Santa Barbara
Arturo Keller	**Professor**	**Biogeochemistry, Mechanical & Enviro. Eng.**	UC Santa Barbara
Lubi Lenaburg	**Evaluation Coordinator**	**CNSI Center for Science and Eng. Partnerships**	UC Santa Barbara
Miriam Metzger	Associate Professor	Communication	UC Santa Barbara
Lisa Parks	**Professor**	**Film and Media Studies**	UC Santa Barbara
	Director	**CITS**	UC Santa Barbara
Mark Rodwell	Professor, Director	Electrical and Computer Engineering, NNIN	UC Santa Barbara
Ram Seshadri	Professor	Materials, Chemistry and Biochemistry	UC Santa Barbara
Sangwon Suh	Associate Professor	Environmental Science and Management	UC Santa Barbara
Other Institutions			
Francesca Bray	**Professor**	**Gender and Technology**	**Edinburgh University, UK**
Meredith Conroy	**Assistant Professor**	**Politics**	**Occidental College**
Brian Davison	**Associate Professor**	**Computer Science & Engr.**	**Lehigh University**
Magali Delmas	**Associate Professor**	**Corp. Environmental Mgmt.**	**Univ of CA, Los Angeles**
Sarah Kaplan	**Associate Professor**	**Business**	**Univ of Toronto**
Matthew Keller	**Assistant Professor**	**Sociology**	**Southern Methodist Univ**
Sharon Ku	Postdoc. Researcher	History & Phil. of Science	Univ of Southern Indiana
Jens-Uwe Kuhn	Assistant Professor	Global and International Studies	SB City College
Erica Lively	Associate	Electrical Engineering	Exponent
Ephraim Massawe	Assistant Professor	Computer Science, Industrial Technology	Southeastern Louisiana University
Mara Mills	Assistant Professor	Media, Culture & Communication	New York University
André Nel	**Professor, Director, Physician**	**UCLA Medical School, UCLA CEIN**	**Univ of CA, Los Angeles**
Mathieu O'Neil	Associate Professor	Computer Science, Sociology	Australian National Univ
Takushi Otani	**Associate Professor**	**History and Philosophy of Technology**	**Kibi International Univ, JP**
Ismael Rafols	Researcher	Science Policy	Sussex University
Gurumurthy Ramachandran	Professor	Environmental Science and Engineering	Univ of Minnesota
Shyama Ramani	Researcher	Dev. Economics	Ecole Polytechnique,

			INRA, FR
Alain Rieu	Professor	Philosophy	Université Lyon 3, FR
Kalpana Sastry	Principal Scientist	Agriculture	Nt'l Academy of Agricultural Research Management, IN
Joseph Summers	Test Dev. Engineer	Electrical Engineering	Infinera
Tim Wilson	**Associate**		**Compass Resource Management, CA**
Stephen Zehr	**Professor**	**Sociology**	**Univ of Southern Indiana**

Visiting Scholars

Karl Bryant	**Assistant Professor**	**Sociology, Women's Studies**	**SUNY New Paltz**
Jacqueline Isaacs	Professor	Mech. & Industrial Eng.	Northeastern University
Sharon Ku	**Postdoctoral Scholar**	**History & Phil. of Science**	**Univ of Southern Indiana**
Kalpana Sastry	Principal Scientist	Agriculture	Nt'l Academy of Agricultural Research Management, IN
Edgar Zayago Lau	**Senior Researcher**	**Development Studies**	**Univ Autonoma de Zacatecas, MX**
Vivek Wadhwa	**Vice President**	**Academic and Innovation**	**Singularity University**

Nanotechnology in Society Network Lead Partners

Davis Baird	**Provost & VP for Academic Affairs**	**Philosophy**	**Clark University**
Chris Bosso	**Professor**	**Political Science**	**Northeastern University**
David Guston	**Director & Professor**	**Politics & Global Studies**	**CNS-ASU, Arizona**
Alfred Nordmann	**Professor**	**Philosophy**	**Darmstadt University, GE**

Affiliated Participants (S.NET 2012 Travel Support)

Name	Title	Department	Organization
Indrani Barpujari	Researcher	Science and Technology	The Energy & Resource Institute, India
Sean Becker	Undergrad	Sociology	University of Wisconsin-Madison
Rodrigo Cortes-Lobos	PhD Candidate	Public Policy	Georgia Tech
Rider Foley	PhD Candidate	School of Sustainability	Arizona State University
Maryse de la Giroday	Independent Scholar		Canada
Nachshon Goltz	PhD Candidate		York University, Canada
Julia Guivant	Professor	Sociology and Political Science	Federal University of Santa Catarina, Brazil
Thanate Kitisriworaphan	Lecturer	Demography	Bangkok Thonburi University, Thailand

Anna Lamprou	PhD Candidate	Science and Technology Studies	Rensselaer Polytechnic Institute, New York
Mathieu Quet	Postdoctoral Scholar		IRD-IFRIS, France
Trust Saidi	PhD Candidate		Maastricht University, Zimbabwe
Pankaj Sekhsaria	PhD Candidate		Maastricht University, India

4B. EXTERNAL ADVISORY BOARD

Name	*Title*
John Seely Brown (Board Co-Chair)	Visiting Professor at University of Southern California and former Chief Scientist of Xerox Corporation and the director of its Palo Alto Research Center (PARC)
Ann Bostrom (Board Co-Chair)	Professor and Dean in School of Public Policy at University of Washington, Seattle
Craig Calhoun	Director of the London School of Economics and Political Science, UK
Vicki Colvin	Professor of Chemistry and Executive Director of the Center for Biological and Environmental Nanotechnology at Rice University
Ruth Schwartz Cowan	Professor in the History and Sociology of Science Department at the University of Pennsylvania
Susan Hackwood	Executive Director of the California Council on Science and Technology, Professor of Engineering ar UC Riverside
Thomas Kalil (Board Chair Emeritus, 2007-2008)	Deputy Director of the White House Office of Science and Technology Policy and Technology at UC Berkeley
Julia Moore (Board Chair Emeritas)	2006-2009 Director of Research for the Pew Health Group, Pew Charitable Trusts; former Deputy Director of Foresight and Governance Project at the Woodrow Wilson International Center for Scholars
Willie Pearson, Jr.	Chair of History, Technology and Society at Georgia Institute of Technology
Robert Westervelt	Director of the Nanoscale Science and Engineering Center-NSEC at Harvard University, & Professor of Applied Physics & Physics

4C. PARTICIPATING ACADEMIC INSTITUTIONS

Allan Hancock Community College
Arizona State University
Bangkok Thonburi University
Beijing Institute of Technology, China
Bowling Green State
California Polytechnic State University, San Luis Obispo
Cardiff University, Wales, UK
Centre National de la Recherche Scientifique (CNRS), France
Clark University
College of the Canyons
Cornell University
Cuesta Community College
Darmstadt University, GE
Duke University
Ecole Polytechnique, France
Edinburgh University, UK
Federal University of Parana, BR
Federal University of Santa Catarina, Brazil
Georgia Institute of Technology
IRD-IFRIS, France
Jackson State University
Kibi International University, Japan
Lehigh University
Long Island University
Maastricht University, India
Maastricht University, Zimbabwe
Moorpark College
National Academy of Agricultural Research Management, India
New York University
Northeastern University
Occidental College
Oxnard Community College
Quinnipiac University
Rensselaer Polytechnic Institute, New York
Rice University (William Marsh)
Santa Barbara City College
Singularity University
Seoul National University, South Korea
Southeastern Louisiana University
Southern Methodist University
State University of New York, Levin Institute
State University of New York (SUNY), New Paltz
Sussex University, UK

Universidad Autónoma de Zacatecas, Mexico
Université de Lyon 2, France
Université de Lyon 3, France
University of Arizona
University of British Columbia, Canada
University of California, Berkeley
University of California, Davis
University of California, Los Angeles
University of Exeter, UK
University of Gothenburg, Sweden
University of Minnesota-Twin Cities
University of Nottingham, UK
University of Pennsylvania Law School
University of South Carolina
University of Southern Indiana
University of Toronto, Canada
University of Twente, Netherlands
University of Virginia
University of Washington
University of Wisconsin-Madison
Ventura College
York University, Canada

4D. PARTICIPATING NON-ACADEMIC INSTITUTIONS

American Bar Foundation
American Institute of Physics
Boudreaux and Associates
Chemical Heritage Foundation
Compass Resource Management, Canada
Decision Research Corporation
Energy & Resource Institute, India
Environmental Defense Fund
International Council on Nanotechnology (ICON), Rice University
International Risk Governance Council, Switzerland
Kauffman Foundation
Knowledge Networks
Latin American Network of Nanotechnology and Society (ReLANS), Mexico
Meridian Institute
Nanoscale Informal Science Education Network (NISE)
Santa Monica Public Library
Santa Barbara Museum of Natural History
Science and Technology Policy Institute
Woodrow Wilson International Center, Project on Emerging Nanotechnologies
YouGov America Inc.

Table 1: Quantifiable Outputs				
Outputs	**Reporting Year -2 2011**	**Reporting Year -1 2012**	**Reporting Year 2013**	**Total**
Publications that acknowledge NSF NSEC Support				
In Peer-Reviewed Technical Journals: Primary	24	17	13	54
In Peer-Reviewed Technical Journals: Leverage	0	7	13	20
Books / Chapters or sections in books: Primary	61	36	22	119
Books / Chapters or sections in books: Leverage	0	6	4	10
Other: Primary	9	0	0	9
Other: Leverage	0	0	0	0
Total Publications	***94***	***66***	***52***	***212***
With Multiple Authors	36	54	30	120
Multiple Authors: Co-Authored with NSEC Faculty	33	50	26	109
Publications that do not acknowledge NSF NSEC Support				
In Peer-Reviewed Technical Journals	0	0	1	1
NSEC Technology Transfer				
Inventions Disclosed	0	0	0	0
Patents Filed	0	0	0	0
Patents Awarded	0	0	0	0
Patents Licensed	0	0	0	0
Software Licensed	0	0	0	0
Spin-off Companies Started (if applicable)	0	0	0	0
Degrees to NSEC Students				
Bachelor's Degrees Granted	0	3	1	4
Master's Degrees Granted	5	0	1	6
Doctoral Degrees Granted	8	2	3	13
NSEC Graduates Hired by				
Industry	0	1	0	1
NSEC Participating Firms	0	0	0	0
Other U.S. Firms	0	1	0	1
Government	1	0	0	1
Academic Institutions	5	1	6	12
Other	1	0	0	1
Unknown	0	3	0	3
NSEC Influence on Curriculum (if applicable)				0
New Courses Based on NSEC Research	8	9	0	17
Courses Modified to Include NSEC Research	10	13	14	37
New Textbooks Based on NSEC Research	2	16	11	29
Free-Standing Course Modules or Instructional CDs	0	0	0	0
New Full Degree Programs	0	0	0	0
New Degree Minors or Minor Emphases	0	0	0	0
New Certificate	0	0	0	0
Information Dissemination/Educational Outreach				
Workshops, Short Courses to Industry	6	6	5	17
Workshops, Short Courses to Others	15	21	16	52
Seminars, Colloquia, etc.	137	165	131	433
World Wide Web courses	1	1	1	3

6. MISSION, SIGNIFICANT ADVANCES, AND BROADER IMPACTS

Nanotechnology Origins, Innovations, and Perceptions in a Global Society

The global vision for nanotechnology to mature into a transformative technology that furthers social as well as economic aims depends on an array of complex and interconnected factors situated within a rapidly changing international economic, political, and cultural environment. The NSF Center for Nanotechnology in Society at UCSB pursues an integrated portfolio of interdisciplinary societal research on the challenges to the successful, responsible development of nanotechnology in the US, Europe, Asia, and Latin America at a time of sustained technological innovation. The Center incorporates education for a new generation of social science and nanoscience professionals as it fosters research on the innovation and development systems for nanoscale technoscience across space and time, in conjunction with analysis of the societal meanings attributed to such emergent technologies by diverse stakeholders. CNS-UCSB contributes to responsible development by engaging with those key stakeholders: scientists, toxicologists, policymakers and regulators, EH&S personnel, the nanomaterials industry, public and public interest groups, and journalists in the global North and South.

Broader Impact

CNS-UCSB's education and outreach programs, which are central to its mission, include a diverse range of students and participants. The Center provides novel interdisciplinary educational opportunities for a new generation of social science, humanities and nanoscience professionals via graduate fellowships (7 in the past year, 4 social science/humanities and 3 science and engineering, for a total of 10 social science/humanities fellows and 8 NSE fellows to date in the renewal, 32 total since 2006); graduate research assistantships (35 at UCSB and 10 w/ external collaborators); undergraduate summer research internships to regional community college students (4 in the past year, 19 since inception) and UCSB undergrads (5 in 2012-2013, 15 total since 2006) who are mentored by UCSB graduate students (19 mentorships to date), and 1-3 interdisciplinary social science/humanities postdocs per year (10 in 2012-13, 5 of them co-funded, 5 at other institutions). CNS shows its commitment to educating a new generation of socially attuned researchers by convening a year-round graduate research seminar for credit that includes scholarly discussion, professional training and development, research colloquia, and other activities, along with participation by postdocs, undergrads, visitors, faculty researchers and others. CNS integrates content based on Center research into courses for undergraduate and graduate students in science and technology studies, has contributed to online course materials in the UC CEIN and the NSF NACK center at Penn State, and has developed and piloted a model curriculum for community college science and society education, a primary population for nano workforce development.

CNS aims to disseminate both technological and social scientific findings related to nanotechnology in society to the wider public and to facilitate public participation in the nanotechnological enterprise through public engagement in dialogue with academic researchers from diverse disciplines. In 2012 and 2013 we held 2 annual 2-day NanoDays in Santa Barbara (Apr 2012 and March 2013) with 1300 adults and children participating in 2013. In addition, CNS also participated in NanoDays at the Science Center of LA. CNS-UCSB commits significant resources to conferences and workshops for diverse audiences, alternating smaller, more specialized meetings for researchers (Nanotech risk perception 2010, Nanotech innovation systems 2010) with larger-scale international conferences and workshops (co-hosted/co-sponsored with CNS-ASU the 3rd annual S.NET conference in Tempe, AZ in Nov 2011 for 200 scholars, scientists, industry representatives, journalists, and NGO members from 20 countries; co-organized & raised and administered international travel awards for the 4th annual S.NET

2012 conference in Enschede, Netherlands at Twente University). In addition to its co-founding role in S.NET, CNS serves as a key connection hub in the growing nano in society network, via speaker series, short- and medium-term visiting scholars, and as a dissemination point for research results (as requested by Chemical Heritage Foundation, UC Center for the Environmental Implications of Nanotechnology, and others). Outreach to still wider publics and interested parties takes place via electronic forms such as our popular "CNS-UCSB News Clips," contributions to leading blogs such as *Science Progress*, *2020 Science*, and *Huffington Post*, podcasts of interviews with researchers, and media briefings, and exploration of possible new media methods to be used in the future such as online deliberation, currently piloted in an undergraduate course and through a community-based organization. The CNS also engages and informs policymakers and governmental agencies (e.g., Appelbaum with OECD on global economic development, Block to Congress on similar issues, Harthorn to the NPEC working group of the NNI and NNCO personnel as well as NAS, NIOSH and California's DTSC; Pidgeon on an ongoing basis to the UK House of Commons Science & Technology Select Committee inquiry on the Regulation of Geoengineering (in which he draws on CNS nano research)*;* and Newfield in prominent blogs such as *The Huffington Post*). CNS researchers contribute to the UC CEIN evidence-based knowledge of the public, emerging views of nanotechnologies, and past risk controversies for use in developing risk reduction and risk management advice to regulators and industry. Results of CNS research are being disseminated to wider audiences via traditional media as well as through concerted efforts to use new media (e.g., posts to the prominent blog, *Science Progress*, and *The Blog --Huffington Post*; development of online course materials; interviews with nano journalism (e.g., the *New Haven Independent*), and contributions of research and commentary to high impact science journals that reach a wide array of industry, policy, and academic audiences).

Synthesis of CNS-UCSB research has culminated in 4 volumes now in print or in progress. First is a book for a wider public audience developed from the CNS-UCSB NanoEquity conference in Washington DC, *Can Emerging Technologies Make a Difference in Development?* edited by Parker and Appelbaum, Routledge, 2012. *The Social Life of Nanotechnology,* edited by Harthorn & Mohr with a foreword by Board co-Chair John Seely Brown, was published by Routledge in July 2012 and draws from and integrates all three research groups' work in a social science analysis of innovation, public perception, and governance. Seely Brown describes the volume as: **"**An encompassing collection of scholarly works touching nearly every aspect of the social currents underlying the launching of this field, its radically cross-disciplinary nature, and the crucial issue of how to engage the public in a meaningful dialogue about the risks and opportunities that this promising field might produce." In addition IRG 3 leaders Pidgeon, Harthorn & Satterfield co-edited a special issue of the leading journal, *Risk Analysis (Nov 2011)* composed of new research from the IRG 3 nanotech risk perception specialist meeting in Santa Barbara, CA in Jan 2010. And *Can Rich Countries Still Invent?,* edited by Newfield and Boudreaux, is being developed from the *States of Innovation* international conference in Lyon, France in April 2010, which explores the critical dimensions of a post-linear model of innovation that will integrate with the public. CNS-UCSB also has initiated as a summative activity development of a series of *policy briefs* to extend the implications of the maturing research mission. CNS-UCSB's distinguished National Advisory Board provides us with strategic advice from leaders of stakeholder constituencies at all phases of research and dissemination

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SES 0938099

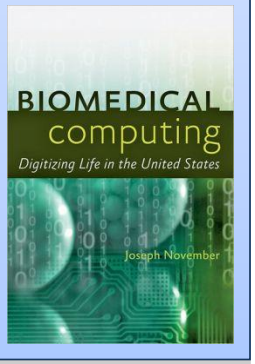
Innovation and Research at the Nanotechnology-Biology Interface

Summary: This project investigates the historical roots of federal agencies' recent efforts to foster innovation at the bio-nano interface.

Aim: To clarify the roles of individuals and institutions in a process that has made nanotechnology and biomedicine increasingly important to each other.

Analysis: A case study comparison of two attempts by the NIH to implement '"bioengineering":

1) Efforts in the 1960s to rationalize biomedicine via digital computing techniques
2) Attempts in the 21st century to harness nanotechnology in life science research



Analysis builds on prior work by J. November.[2]

Approach:

- Archival research at NIH, National Archives, NSF
- Recorded interviews (ongoing research continuing through 2013)

Preliminary findings[1]:
NIH and NARA archival documents show:

1) Motives of those—within NIH, NSF, and IEEE's early community of biomedical engineers—who sought to bring engineering practices into medicine, as well as the immediate consequences of their efforts;
2) How the appropriation of engineering methods by medical researchers blurred the scientific disciplinary boundaries within which they had traditionally worked and how it problematized the goals they were trying to achieve.

Future Research: Extend analysis to synthetic biology, DNA nanotechnology

[1]Joseph A. November, "Engineering a Better Medicine," The Society for the History of Technology (SHOT), Copenhagen, Denmark, October 6, 2012.
[2]Joseph A. November, *Biomedical Computing: Digitizing Life in the United States* (Baltimore: Johns Hopkins University Press, 2012).

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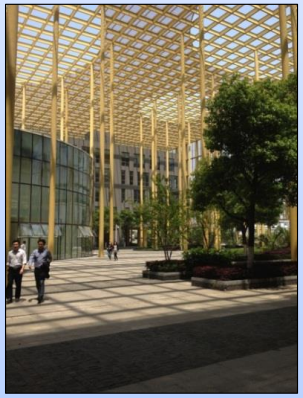
Globalization and Commercialization of Nanotechnology

Can China Become a Nano-Innovator?

Thirteen interviews were conducted with small business owners, low-level government officials, and researchers in Shanghai and Suzhou, China in April of 2012 to investigate the various factors that either help or hinder the development of nanotechnology communities in China.

"People would rather stay in the United States if given the choice, but with current economic conditions and decreased funding opportunities, increased numbers of Chinese nationals are deciding to go back to China"

--Small business owner/entrepreneur, April 2012



Suzhou Industrial Park

Future Research:

The results from this work will be utilized to aid in the development of a comparative framework to analyze the role of nanotechnology in emerging economies, including: Brazil, China, and Mexico.

Key findings:

- Nearly half of interviewees were returnees.
- Several believed China lacks true innovation.
- China's innovation model emphasizes government's role in simulating market mechanisms and shielding companies from risk yet tends to favor products over basic research.

- Academics stated that funding for basic research is discouraged in favor of applied research yet still felt intense pressure to publish in top-ranked scientific journals to secure funding.
- National and regional governments publish annual lists of products and commission companies to create these goods.
- Several interviewees believe companies receiving government funding are neither innovative nor "hungry" for success.

Stocking, G., Han, X., Gebbie, M., Appelbaum R.P. 2013 "Can China become a nano innovator? An investigation into the Chinese nanotechnology communities in Shanghai and Suzhou Industrial Parks," In Preparation.

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Corporate Strategies in Nanotechnology and Its Applications

Country-Level Technology Studies

Methods & Data: Natural Language Processing (NLP) and Principal Component Analysis of patent databases to extract, visualize, and analyze topical phrases and tech focus.

Selected findings:

- Nanotechnology has a range of energy storage applications, yet foci emerge, e.g. China: Lithium-ion batteries and U.S.: fuel cells.
- Weak Chinese performance of China and still incipient application of nanotechnology in energy storage compared to front-runners (U.S., Japan, South Korea).

China-U.S. nano-focus in energy storage showing topics of country-level corporate patenting activity (1990-2010)

a) China (4.6% share of patents in the field)

b) U.S. (24.1% share of patents in the field)

*Figures show only main patenting focus of companies in each country (center of the topic maps); bubble size proportional to patent counts.

Company Patent Portfolio Studies

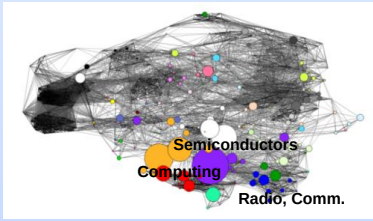
Method & data: Selected company case studies (44 Chinese firms) using website data and patent overlay developed in collaboration with Georgia Tech.

Selected findings:

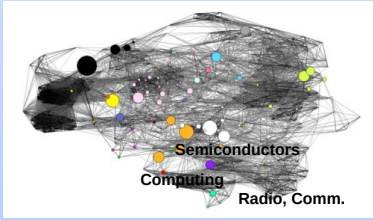
1. Incumbent firms (benefit from nanotechnology at core business level;
2. Incumbent firms challenged by lack of control over new tech;
3. New nano-specific firms with segment focus and novel applications;
4. New "green firms" focused on environmentally-friendly versions of existing technologies.

Hong Fujin Precision Industry (China) showing the company's patent portfolio & nanopatents

a) Patent portfolio (5,166 patents)*



*b) Nanotechnology patents (242 patents)**



*Figures show company patent portfolio and nanopatents in relation with global innovation map. Node size proportional to patent counts in each technology area. Labels shown for main technology areas.

Kay, L, Appelbaum, R. (2012) *How do companies embrace emerging technologies? The case of nanotechnology and energy storage applications in China* (In Progress); Kay, L., Youtie, J. (2012) *Emerging technologies and corporate strategies: The case of nanotechnology for energy storage solutions in China* (In Progress); Kay, K., Newman, N., Youtie, J., Porter, A. L., Rafols, I. (2012) *Patent Overlay Mapping: Visualizing Technological Distance.* arXiv:1208.4380 (Under Review)

CNS-UCSB Center for Nanotechnology in Society

CARDIFF UNIVERSITY / PRIFYSGOL CAERDYDD

UNDERSTANDING RISK

IAGP Integrated Assessment of Geoengineering Proposals

NSF

SES 0938099

Climate Geoengineering and the SPICE project

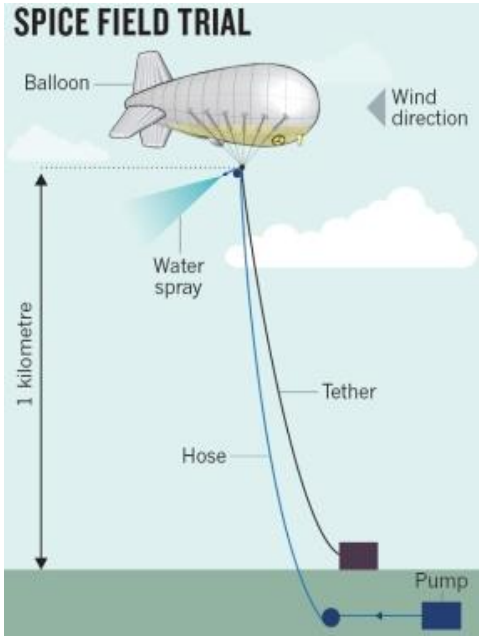
Geoengineering

Geoengineering is defined as the "deliberate large-scale manipulation of the planetary environment to counteract anthropogenic climate change." Early public engagement has been recommended.

Responsible Innovation

Charged by UK Research Councils, public deliberative research was conducted using methods pioneered in 2007. The objective was to gauge public views on the acceptability of the SPICE test-bed after providing participants with technical, ethical, and societal information about stratospheric aerosols and test-bed proposals. Results were used as evidence at a responsible innovation evaluation of the SPICE test-bed held in July 2011.

The UK SPICE Case Study This project investigates the means, efficacy, impacts, and modes for stratospheric particle delivery—a climate engineering effort involving the construction of a 20km pipe suspended by a balloon. For testing purposes, researchers sought to scale-down the 20km pipe and balloon to a **1km test-bed** (see figure), exploring related *engineering* challenges and computer modelling accuracies and efficacies.



Methodology Three one-and-a-half day deliberative workshops were conducted in the UK (Cardiff, Norwich and Nottingham). Each workshop had 8-12 participants, whose gender, age, socio-economic status, educational level, ethnicity and location, were noted. Participants discussed climate change, mitigation, and adaptation responses, in the context of specific geoengineering approaches and then in terms of the SPICE proposal more specifically.

Results While almost all participants were accepting of the field trial, few endorsed the use of stratospheric aerosols for climate change mitigation, citing that the strategy failed to address main drivers (emissions). Also, a key concern for participants was the early developmental phase of related international governance/regulatory regimes used to shape future geoengineering research/deployment.

Pidgeon, N,F., Parkhill, K.A., Corner, A. & Vaughan, N. (2013) Deliberating stratospheric aerosols for climate geoengineering and the SPICE project. *Nature Climate Change*, v3.

Corner, A., Pidgeon, N. & Parkhill, K.A. (2012). Perceptions of geoengineering: Public attitudes, stakeholder perspectives & the challenge of 'upstream' engagement. *Wiley Interdisciplinary Reviews – Climate Change.*

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Shifting public perceptions of nanotechnology: implications for policy dialogue

Perceptions of nanotechnology

Surveys indicate high benefit ratings about nanotechnologies, but also a lack of familiarity, which may mean such views are malleable.

Communicating with the public

Unlike other technologies, no risk event has occurred with nanotechnology, so perceptions are easily influenced. We report these mobile perceptions and argue that science-policy dialogues need to accommodate this uncertainty. A key question addressed is: How is acceptability by the public impacted by the order of information presented?

Methodology Data collection: US national phone survey in English (N= 1,100) designed to assess public perceptions of nanotechnology; it took 20-25 minutes to complete. The protocol included examination of how specific risk/benefit and risk management information, under varying conditions, influenced acceptability of nano-enabled applications.

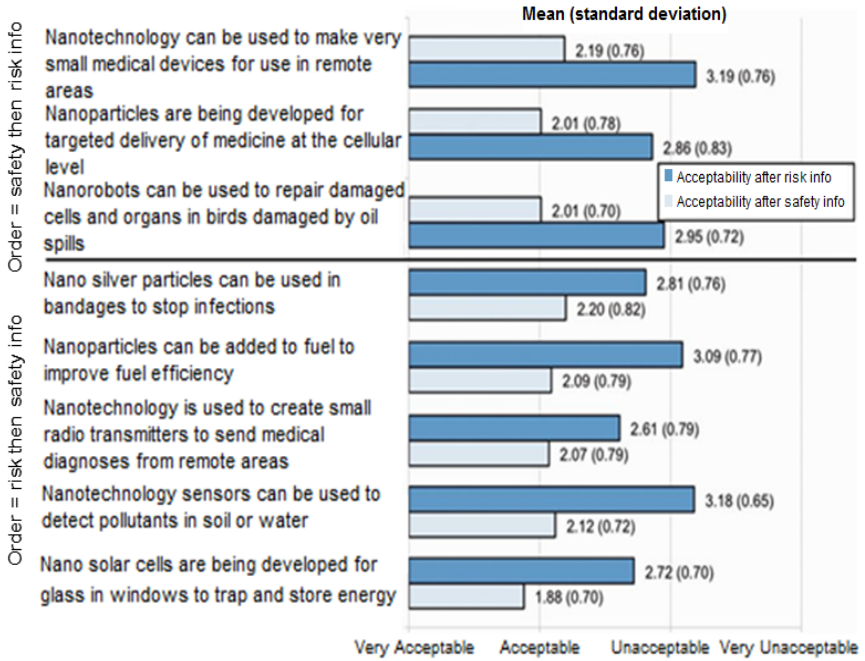
Results

1)Presenting *risk info after benefit* info significantly impacted acceptability ratings vs. the reverse order

2) Risk descriptions linked to predictors of perceived risk produced *high reversals* of acceptability *when benefit preceded risk info*

3) Those positively inclined toward nanotechnologies were significantly *more* likely to *increase trust* when presented with positive regulatory actions

4) Those negatively inclined *increased distrust* only very slightly when presented with negative regulatory actions.



Satterfield T, Conti J, Harthorn BH, Pidgeon N, Pitts A. (2012) Understanding shifting perceptions of nanotechnologies and their implications for policy dialogues about emerging technologies. *Science and Public Policy*.

Satterfield T, Kandlikar M, Beaudrie CEH, Conti J, Harthorn BH. (2009). Anticipating the perceived risk of nanotechnologies. *Nature Nanotechnology.*

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IRG 3 Social Movement Organizations and Nanotechnology Safety, Governance, and Responsible Development

How do social movement organizations (SMOs) understand and mobilize around nanotechnology-related issues?

This project is compiling and analyzing the webpages, press releases, publications, and other written statements authored by over 140 SMOs globally from 1999 to present.

Preliminary findings are based on examination of written statements of 18 organizations particularly active around nano-related issues.

Concerns specific to nanomaterial (NM) type:

- Nanosilver and titanium dioxide
- However, most statements reference nanotechnology generally

Concerns specific to NM application:

- Military
- Food, agriculture
- Sunscreen

Range of stated goals:

- Increased environmental health and safety research
- Public participation in science and technology development
- Regulation (e.g. labeling), government oversight
- Moratorium on NM use and production

Tactics:

- Organize forums
- Issue reports, public statements, press releases
- Lesser extent: litigate; collaborate with industry

Engeman, Cassandra and Barbara Herr Harthorn (*Research in Progress)*

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California in the Nano Economy: www.CaliforniaNanoEconomy.org

Introduction: California in the Nano Economy is a new industry and education-focused website for the nanotechnology community that presents California's footprint in nanotechnology. The website represents an interactive, web-based version of applying a value chain research approach to a specific location while highlighting the parts of a variety of industries that are impacted by a particular technology (nano).

Website Highlights

- Educational and Workforce Development Organizations & Programs
- Public Policy and Economic Development Initiatives
- California Firm and Supporting Organization Location Pages, Profiles & Maps
- Total firm locations: 375 (Fig. 2)/Total supporting organizations: 155 (as of March 2013)
- Profiles of the firm & supporting organization most-cited as being involved with nano
- Select variables available: value chain positions, products, focus areas & value-adding activities
- Interactive, value chain diagram (Fig.1)
- Interactive, geographic maps of locations by key variables

Dr. Stacey Frederick/Center on Globalization, Governance, & Competitiveness (CGGC) Duke University/CNS-UCSB.

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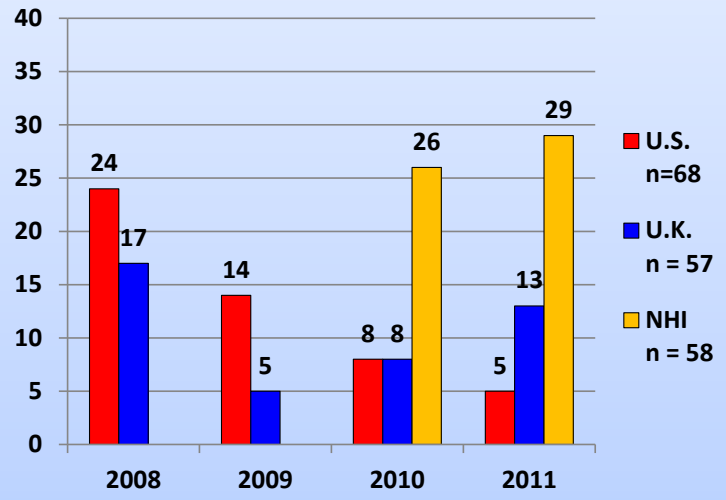
Key Finding: An Online Newspaper Reported More About Nanotechnology Risks Than Did Traditional Newspapers

Number of Articles Discussing Nanotechnology Health Risks



More nano articles on health risks appeared in the online *New Haven Independent* (NHI) than in U.S. and U.K newspapers and wire services. The total number of risk articles for 2008 - 2011 for each category is on the right.

The *New Haven Independent* (NHI), an online newspaper, discussed more health, environmental, and societal risks in 2010 and 2011 compared to 33 U.S. and U.K. newspapers and two U.S. wire services. All sources were searched systematically for nanotechnology risk information.

During the study time frame (2010 and 2011), health risks dominated the NHI's coverage, appearing in 94.8% of articles that discussed risks (see the chart to the left).

Actually, from 2008-2011, health risks were covered most frequently by all news sources, appearing in 81.4% of articles that discussed risks. Other risks included: societal (63.9%) and environmental risks (62.8%). The most prevalent individual risks covered in each category were:

- Health: risk to lungs
- Societal: risk to safety
- Environment: risk to water sources

Sharon M. Friedman and Brenda P. Egolf, "Tracking Media and Internet Coverage of Nanotechnology Risks over the Years." Paper presented at the Society for Risk Analysis Annual Meeting, San Francisco, CA, December 12, 2012.

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Solar Futures: Science and Business Life in the Race Against Climate Change

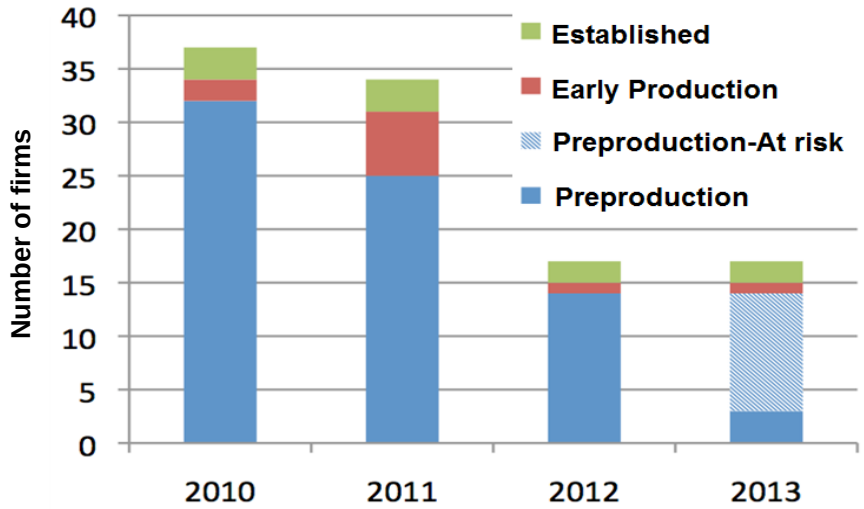
Introduction

Second and third generation nano-enabled photovoltaics (PV) are seen as important technological advances for replacement of 60 year old silicon PV. However, the high profile bankruptcy of Solyndra and Evergreen caused investors and customers to flee. Now, venture capitalists see this technology as mature and unlikely to yield high return while government sees it as too immature to fund.

Methods

- Analysed impact of silicon dominance in solar market
- Developed Alternative Innovation Model (previously Lyon Model) with emphasis on solar nanotechnological innovation
- Conducted interviews with ~ 90% (n=50) of post-silicon PV manufacturers in US, UK, Germany, France, and Spain on the fate of solar.

Photovoltaic Firms in Decline



Results

- Current economic environment poses threat to all second and third generation PV manufacturers
- Key linear innovation model features – strong intellectual property rights and trade secrecy—are not working
- Private capital will no longer wait for technological maturation
- Public capital is not being sought (or legitimated) by an ambivalent industry, even when near death
- The West is on track to lose the manufacture of a vital nanoscale technology – next generation of PV will be manufactured in Asia and R&D will follow

Newfield & Boudreaux, "Learning From Solyndra: Changing Paradigms in the US Innovation System," in *Nanotechnology and Development* (Cambridge UP, forthcoming)

Newfield, "Does Solar Energy Need a New Innovation Model? The Case of Germany," in *Little by Little: Expansions of Nanoscience and Emerging Technologies*

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Faculty Seed Grants Awarded 2013: Focusing on Societal Issues for New Technologies

Aims:
1. Generate new research/engagement projects
2. Involve new faculty participants
3. Further the mission of the CNS

Details:
1. Projects funded up to $60,000 (direct costs) for 12-months
2. A second call for additional seed grant proposals planned for Fall 2013

Awards:
1. Reviewed/considered Fourteen applications
2. Four awards made at a total of $240,706

IRG 1: Contemporary History

- **Public Sentiment and the Performance of Protest in Japan's Antinuclear Movement—***Research examining the role of music and performance in generating social discourse about risk and government response to the Fukushima disaster.*
- David Novak, Assistant Professor of Ethnomusicology

IRG 2: Innovation and Globalization

- **Filtering out the Social: Nanotechnology and Water Treatment in Mexico—***Research examining the role that nanotechnology plays in Mexico's water quality management infrastructure.*
- Casey Walsh, Associate Professor of Anthropology

IRG 3: Risk Perception

- **Characterization of Uncertainties in the Life Cycle Assessments and Risk Assessments of Nanotechnology—** *Research characterizing location, nature, and level of uncertainty in existing nanotechnology life cycle and risk assessments.*
- Sarah Anderson, Assistant Professor of Environmental Politics

Public Outreach and Engagement

- **Bringing Science to Life: CNS Engagement Seed Grant—***A scientist-artist collaboration aimed at transforming the public's museum experience into a living laboratory of scientific creation.*
- George Legrady, Professor of Media Arts and Technology

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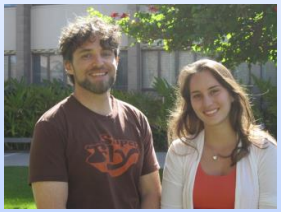
CNS-UCSB INSET Summer Internship Program 2012

The Internships in Nanosystems Science, Engineering and Technology (INSET) program brings community college students to UCSB for a first-hand research experience in a collaborative academic environment. Interns assist with research, participate in seminars, and present project findings in both a public talk and poster presentation. CNS-UCSB trained four interns in 2012.

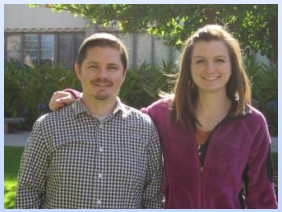
IRG-1: Green Nanovisions & their Policy Consequences



Intern: Gianna Haro,
Santa Barbara City College
Mentor: Roger Eardley-Pryor

Haro analyzed utopian expectations about nanotechnology's environmental applications in order to construct a historical narrative of policy consequences related the technology's environmental health and safety impacts.

IRG-2: Identifying the Role of California in the Nanotechnology Economy



Intern: Kelly Landers,
Santa Barbara City College
Mentor: Galen Stocking

Landers researched information on companies from across the value chain and conducted phone interviews with suppliers. Findings were integrated into an interactive nanotechnology economy website focusing on California.

IRG-3: Nano Regulatory Policy & NGOs: A Global View

Intern: Eddie Triste,
Allan Hancock College
Mentor: Cassandra Engeman

Triste contributed to a growing global database of over 90 NGOs that mobilize around nanotechnology-related concerns and compiled NGO written statements for analysis in a project investigating how NGOs communicate nano issues.

IRG-X: Open Innovation & its Role in a Nano-Enabled Solar Industry

Intern: Bryan Phillips,
Santa Barbara City College
Mentor: Zach Horton

Phillips studied collaboration and development within open source software and hardware communities, analyzing a series of interviews with nano-solar entrepreneurs to understand challenges for innovative nano-solar startups.

CNS-UCSB participates in the NSF-funded program in partnership with the California NanoSystems Institute at UCSB. CNSI

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Webinar: Societal Dimensions of Responsible Innovation for Nanotechnology

NACK Webinar - Societal & Ethical Issues in Nanotechnology

Barbara Harthorn, Director CNS-UCSB

December 14, 2012

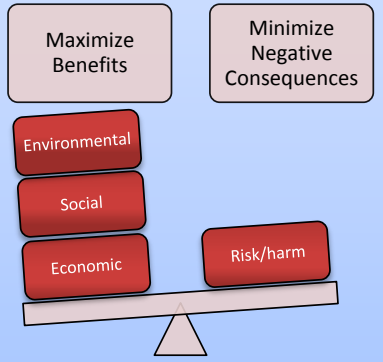
Societal And Ethical Issues In Nanotechnology
Webinar Objectives:

- What is responsible development of nanotechnology (and why you should care)?
- Will the public accept these new technologies?
- How can public participation lead to better outcomes?
- What about the experts?
- Governance challenges

Engaging Audiences Around The World With CNS-UCSB:

- Webinar highlighted CNS research across all IRGs 2006-2012
- 83 registrants from 23 states plus District of Columbia and Puerto Rico, and from 13 countries outside the U.S., including in Europe, North and South America, Australia, and Asia
- 13 additional webinar views in the first quarter of 2013
- Webinar participants come from 2- and 4-year higher education colleges and universities, K12 and STEM educators, industry, national laboratories, state and federal government, scientific societies, NGOs, and entrepreneurs.
- Interactive format with chat feature enabled public participation and engagement

"How am I supposed to think about consequences before they happen!"



NACK NETWORK
WWW.NANO4ME.ORG

PENNSTATE 1855

The National ATE Center for Nanotechnology Applications and Career Knowledge (NACK) Network
Aims to create a nanotechnology-knowledgeable citizenry by providing resource sharing, course materials, and stressing broad student preparation to help create and sustain economically viable nanotechnology education at 2- and 4-year colleges and universities across the U.S.

8. STRATEGIC RESEARCH PLAN

The Center's research program is designed as a systematic analysis of historical and contemporary aspects of nanoscale science and engineering (NSE) policy and innovation systems for successful commercialization, globalization as a key factor in comparative economic development in the United States, China, Korea, Japan, Europe,and Latin America, and emerging perceptions of and regulatory actions on nanotechnologies as media and diverse publics become aware of them. The critical organizing frame for CNS-UCSB is that of *socially and environmentally sustainable innovation*, in which we integrate historical, global economic, and social and psychological factors in formative analysis of the nano-enterprise in relation to these goals. Research in the current award has been organized into three interdisciplinary research groups (IRGs): **IRG 1** – *Origins, Innovations, and Institutions* seeks to develop a rich understanding of the historical underpinnings of the current landscape of the nano-enterprise; **IRG 2** – *Globalization and Nanotechnology* examines nanotechnology development under differing governmental approaches in China, Japan, and Korea, the United States, and more recently in Latin America, to ask how different industrial policies and investment strategies, in combination with international cooperation and collaboration among researchers, shape distinctive nanoscience and industry outcomes across nations; **IRG 3** – *Risk Perception and Social Response*--focuses on understanding the dynamic nature of publics' and experts' perceptions and social intelligence about nanotechnologies, social amplification and attenuation of risk, and methods for effective and equitable public engagement and deliberation. In addition, **X-IRG projects** address strategic topics that span and integrate IRGs (e.g., nano solar energy, Nano in California global value chain project on nano industry, media framing of nanotech, nano lab ethnography). Together these provide a comprehensive understanding of current processes and societal interactions for economically successful and socially responsible development, commercialization, and global distribution of nanotechnologies. CNS-UCSB uses a strategic mixture of social, cultural, economic, political, bibliographic, and historical methods to address these issues at different scales, temporal frames, and resolutions. The composite picture of the emerging and growing nano-enterprise rendered by CNS-UCSB's research portfolio identifies and analyzes the critical issues for the safe, successful, *responsible and sustainable development* of nanotechnologies in the global society. Important features of our collective approach are an integrated, participatory relationship with nanoscientists and engineers; a focus on specific nanotechnologies such as nanoelectronics, nanoparticles such as quantum dots, thin films, and nanoporous materials; comprehensive consideration of their applications in industries like electronics, energy, environmental, food, and health; developing understanding of views of multiple stakeholders as critical to societal outcomes and public participation; employment of advanced spatial analytic methods and a global framework for analysis.

CNS-UCSB views our linked set of foci on the scientific invention and economic development aspects of new nanotechnologies (IRGs 1 & 2), the meanings for risks and benefits that accrue on the societal side through media, expert & public processes (IRG 3, X-IRG), and the historical grounding of these in social, institutional, and policy contexts (IRG 1) as a highly productive, intersectional yet distinct mode of organizing a center's collaborative interdisciplinary research and education. The 3 IRGs that form the core of our research are connected by numerous threads of common interests and some shared personnel, as well as the processes for integration that CNS-UCSB, as a centralized, single campus center, provides and continues to refine and develop. IRG 1 & 2 combine expertise in examining industrial policies and their effects on nano development in East Asia; IRG 2 & 3 plan future work together on the nanotech workforce, agricultural nano in the developing world, and global NGO actions; and IRG 1 & 3 share interests in nano EH&S policy, public imaginaries of technological futures, and NGO activities. IRG 1, for example, is looking at the policy history of both energy and EH&S issues with regard to nanotech. IRG 2 is engaged in a comparative study of national policies aimed at promoting nanotechnology research, development and commercialization in the previously mentioned countries. It is also centrally concerned with workplace health and safety issues, an area it plans to pursue in connection with IRG 2 leader

Appelbaum's MacArthur Chair, which is focused on labor conditions. IRG 3's research is moving further into experimental design modes to conduct multifactorial analysis of the drivers of emerging nanotech risk perceptions, looking specifically at the construction of (and reversals of) judgments of benefits *and* risks, counterintuitive findings, and behavioral patterns that are of particular import to policy makers. New deliberative work by Harthorn's group in collaboration with Pidgeon in the UK will extend the group's consideration of gender as a factor in risk perception and interactions in small group deliberative settings by looking more closely at race and ethnicity as well as policy-relevant energy applications. The MacArthur Chair awarded in 2010 to IRG 2 leader Appelbaum enhances CNS focus for 5 years on jobs, job creation, and workplace safety issues that are also a focus of IRG 3 research. Funding to Harthorn, Satterfield & Kandlikar from the UC Center for Environmental Implications of Nanotechnology, 2008-2013, is producing new work on industry, scientist, regulatory, and public views of environmental risks of nano. Altogether, CNS-UCSB's work encompasses issues of globalization, innovation, and risk, with central themes of inequality, vulnerability, product stigma, environment, and the production of policy-relevant results. Our research teams use a variety of comparative case analyses across specific nations and regions (US, EU, E Asia, Latin America), across applications for energy, environment, health, food, and water, and varying institutional practices (e.g., IP regimes) to highlight US nanotech R&D and public views, and situate them in their comparative global context.

CNS-UCSB's extensive collaborations with the UCSB Materials Research Laboratory (MRSEC), the College of Engineering and the Institute for Energy Efficiency, the California NanoSystems Institute, the Bren School of Environmental Science and Management, NSE participation on our National Advisory Board and Executive Committee, our unique interdisciplinary graduate fellows program that co-educates NSE and social science grads, and the funded collaboration of the CNS-UCSB with the UC CEIN and its large global network of nanoscientists and ecotoxicologists provide us with a strong web of connections to the NSE, nanotoxicology and materials research communities. The years ahead will serve to further develop and strengthen these ties, through joint activities such as collaborative summer internship programs; public, community and campus events and programming; community college and on-line course development; and many other means. These connections, and the highly interdisciplinary exchanges that result from them are absolutely essential to the fulfillment of the CNS-UCSB research and education missions. Science and society work of the sort that is expected of the CNS-UCSB requires the development of mutual regard and understanding across very wide disciplinary divides, a process we as social scientists and humanists know needs to grow and develop organically to produce lasting institutional change. UCSB provides a particularly opportune context for this experiment with its renowned interdisciplinarity and its position on the Pacific Rim.

The integration, aggregation and synthesis of research results in the CNS-UCSB take a number of forms. Years 1-7.5 have culminated with the production of numerous publications, reports, and other materials contributing to cutting edge theoretical and substantive issues in disciplinary research, alongside the interdisciplinary space constructed by a highly multi-disciplinary national center such as CNS-UCSB. Center funding, with its longer horizons and IRG collaborative enterprise, enable a focused synthesis of research that is not possible at the individual project level. At the IRG level, this includes state of the art analyses based on cumulative knowledge developed over 7.5 years of research. For example, IRG 2 (Appelbaum & Parker), with IRG 3, took the lead in organizing a large scale CNS-UCSB wide international conference in Nov 2009 in Washington DC focused on impediments to using nanotechnologies for water, energy, health and food to help the world's poor, and developed the results into an edited volume, *Can Emerging Technologies Make a Difference in Development?*, published by Routledge (Parker & Appelbaum 2012), intended to respond to CNS-UCSB members' deep commitment to ensuring that equity issues are addressed as a key aspect of responsible development of nanotechnologies. IRG 3 produced a special issue of the leading risk analysis journal on nanotechnology risk perception (Pidgeon, Harthorn & Satterfield, Nov 2011), based on its Jan 2010 specialist meeting in Santa Barbara that convened an international group of leading scholars to assess the state of knowledge about nanotech risk perception. IRG 3 has also produced a synthesis piece on nanotechnology upstream and midstream deliberation (Corner & Pidgeon, 2012), based on what they have learned from conceptual work by Pidgeon in the UK, from two sets of deliberative workshops in 2007 and 2009 by the full team (Harthorn, Pidgeon, et al.), and from meta-analysis of the published literatures (Satterfield et al. 2009), as well as pioneering new work on another upstream technology, geoengineering. Newfield's innovation X-IRG group hosted a workshop on global nano solar innovation in April 2010 in France that convened over a dozen leading innovation system analysts from North America, Europe, Asia and Africa, from which they are developing an edited volume focused on the pressing economic development issue of *Can Rich Countries Still Innovate?* (Newfield & Boudreaux). And IRG 1 has been planning a specialist meeting to be held in Santa Barbara in June 2013 that engages in critical reflection on emerging technologies and their societal characteristics and footprints, past and present.

In addition to the prolific production and dissemination of research results from individual IRGs and projects via peer-reviewed journals, book chapters and pieces to many different kinds of audiences, CNS-UCSB also has produced an edited volume entitled *The Social Life of Nanotechnologies*, edited by Harthorn and sociologist Mohr, published by Routledge in July 2012. The volume brings together original work from all three IRGs, probing the interactions and tensions between the modernist nanotechnology development enterprise with its focus on economic progress for the US and a postmodern social world concerned with issues of social progress and equitable development around the globe. CNS-UCSB Board Co-Chair John Seely Brown (author of *The Social Life of Information*, Harvard, 2000) authored a foreword to the book, which like his earlier volume on IT, aims to remind scientists, technologists, business and government that the social contexts of technologies demand close and careful attention and understanding.

As CNS-UCSB actively develops a robust set of empirical data, we have stepped up plans for interaction with and dissemination to diverse audiences, including from NSE researchers and students, policy makers, nanotech industries, and the diverse publics we study in our research. In the changing media environment, it is a challenge to create a thoughtful and effective approach to reaching key government, industry, labor, environmental, social group, and public audiences with the implications of our research. CNS-UCSB research has much to offer such audiences. For example, IRG 2's comparative work suggests US government investment in private sector early stage development may be necessary to effectively launch nano-enabled commercial developments in the current economy. IRG 3's survey research provides experimental evidence that it may be harmful to public acceptance to focus exclusively on the benefits of new nanotechnologies, something many in both science and industry assume as the preferred approach. Meanwhile IRG-1's work shows a trajectory of nanotechnology over a timespan that encompasses the Cold War, post Cold War and

immediate post-9/11 era. And CNS-UCSB equitable development work provides a strong basis for promoting open source development strategies for humanitarian technological development. All CNS-UCSB IRGs use center resources to develop and consolidate policy relevant results that the Center's outreach infrastructure in turn will enable us to disseminate effectively to the audiences that can benefit from them.

9. RESEARCH PROGRAM, ACCOMPLISHMENTS, AND PLANS
Mar 16, 2012 – Mar 15, 2013

IRG 1: Origins, Institutions, and Communities

W. Patrick McCray, lead	History	UC Santa Barbara
David Brock	History	Chemical Heritage Foundation
Hyungsub Choi	History	Seoul National University
Cyrus Mody	History	Rice University
Joseph November	History	Univ. of South Carolina

Affiliates

Matthew Eisler	History	Univ. of Virginia
Ann Johnson	History	Univ. of South Carolina
Sarah Kaplan	Business	University of Toronto
Takushi Otani	History	Seoul National University
Amy Slaton	History	Drexel Univ.

2 Grads, and 3 Undergrads

Graduate students: **Social science/humanities**
Roger Eardley-Pryor, History

Undergraduate students: UCSB: Angela Burger
Community college: Gianna Haro

1. Introduction

The **Origins, Institutions, and Communities** group (**IRG 1**) establishes the historical contexts for the emergence of nanotechnology as a research field, a component of US science policy, and an element in popular imaginings of future technologies. Together with funded colleagues at Rice University, the University of South Carolina, the Chemical Heritage Foundation, the University of Toronto, and Seoul National University, IRG-1 explores topics related to nanotech's history, including research policies for micro/nanoelectronics, what the historical context is for interdisciplinary research in American nanotech labs, how federal research policies have helped foster new areas of research that bridge the physical and life sciences, and the mergence of new research areas such as DNA nanotechnology.

2. Goals

Reliable knowledge about nanotechnology's contemporary social, economic, and policy implications must be based on a comprehensive and robust understanding of its historical contexts. Nanotechnology borrows heavily from people, organizations, and methods that pre-date the founding of the National Nanotechnology Initiative. Scientists, policymakers, and the public borrow on long-standing viewpoints in evaluating nano's potential. Those borrowings shape how nanotechnology is done, perceived, and regulated. Our work examines these historical underpinnings at multiple levels – scientists' careers, institutions, research communities, instrumentation, national and state policy, and the public's evolving perception of nanotechnology. Investigating the "deep history" of a broad set of communities and institutions will help us understand the resources available to the early nano-proponents, and ultimately allow us to understand how those resources constrained and enabled particular aspects of the nano-enterprise.

This research group in the period March 2012-March 2013 was composed of: W. Patrick McCray (Professor of History, UCSB); Cyrus Mody (Asst. Professor of History, Rice University); Joseph November (Assoc. Professor of History, University of South Carolina) and Hyungsub Choi (Seoul National University) and David Brock (Chemical Heritage Foundation). We had the participation of CNS Graduate Research Fellow Roger Eardley-Pryor. We also had contributions from three unfunded collaborators: Sarah Kaplan and Ann Johnson. We also recently added Amy Slaton (Drexel University) for a new project on the nano workforce. So far as growth, we feel the size of the group is near-ideal and brings together a group of researchers whose diverse research interests overlap in keys ways with regard to nanotechnology.

3. Rationale, Approach and Organization of IRG 1

In the last several years, IRG 1 has emerged as the largest and most active groups devoted to the historical and humanistic study of nanotechnology in the world. This kind of team-oriented research is extremely rare in the humanities. In fact, this alone stands out as one of the major achievements of the CNS in that the sort of team-oriented research IRG 1 does would not have been possible outside of the CNS framework.

Our group this past year continued its focus on three interrelated themes: origins, institutions, and communities. We see these as the resources from which scientists, businesspeople, and policy makers fashioned today's nano-enterprise. Broadly defined, these resources included not only scientific and technical knowledge, but also scientific communities and institutions, visionary scientists, organizational practices in universities, corporations, and government agencies, and broader context such as international security threats and industrial competition. We have investigated a broad range of questions within these three themes including: How have the research policies for micro/nanoelectronics in the U.S. compare with those of other Pacific Rim nations? What is the historical context for interdisciplinary research in U.S. research institutions and to what degree is it manifested? How do visionary technologists have an impact on the public perception and policy aspects of emerging technologies?

IRG 1, due to the high geographic dispersal of its members, functions in a semi-autonomous manner. Group leader McCray maintained oversight of all research projects via regular email and phone exchanges with project leaders as well as mentorship of IRG 1 grad fellows and postdocs. We freely shared information/research resources and met as a group at least once a year, typically in conjunction with one of the annual professional society meetings. IRG 1's methods combine qualitative and quantitative research. These include: exhaustive searches for sources of information, especially primary sources typically found through archival research; the study of the information in those sources; the critical evaluation of the information, an active process to comprehend motives and judge actions; the final synthesizing of material and recasting it according to personal judgment in a narrative. British historian Lord Acton said, "Method makes the historian." History is a science in a broad, qualified sense, though not an exact science. Its empirical method makes history a social science, and its critical narrative aligns history with the humanities. Academics view history as a dynamic process and interpret history as a story of the past that remains in constant dialogue with the present.

One major accomplishment for the IRG in the past year has been the expansion of the team. We have successfully brought Amy Slaton (Drexel University) on board and are anticipating her starting a new project that deals with the training of the nano-workforce starting later in 2013. Another addition is Sarah Kaplan (U. Toronto) who joined CNS as an unfunded participant.

During the past year, McCray, Mody, and Johnson have successfully laid the framework for holding a workshop at UCSB in June 2013. It is titled "Emerging Technologies, Past and

Present" and will bring about 2 dozen historians and STS scholars together for a 2-day meeting. The workshop's goal is to develop a historical framework in which to understand the often-problematic category of "emerging technologies." We see emerging technologies as those which are described (now or in the past) as technologies or technological systems that will "change the game," driving new markets, requiring new regulatory paradigms, and having broad and difficult to anticipate social "impacts." They are often associated with risk, speculation, uncertainty, and the possibility of financial reward. We particularly want the workshop to complicate the notion of emerging technologies by highlighting technologies which have already emerged, failed to emerge, or matured without ever being proclaimed as "emerging." By examining the history of several specific once-emerging technologies, we want this workshop to both clarify and elaborate on the entire category. Attendees will write and pre-circulate article-length essays which address some aspect of emerging technologies. We have recruited papers that move beyond the traditional U.S. and late 20th century-centric focus. Thus far, Ron Kline (Cornell), Steve Usselman (Georgia Tech), Amy Slaton (Drexel), Bill Leslie (Johns Hopkins), and Sarah Kaplan (U. Toronto) have agreed to serve as commentators and overall "synthesizers" for the meeting.

4. Major IRG 1 Research Accomplishments in the Center

IRG 1-1: Nanotechnology and the Pacific Rim; Hyungsub Choi, Takushi Otani

This project is an investigation of the formation of the South Korean nanotechnology enterprise and the historical precedents that contributed to its rapid ascendance. Toward this goal, Choi conducted field research at the National Nano Fabrication Center in 2011 and has continued to network with South Korean practitioners and observers of nanotechnology.

The aim of this project is to develop case studies in the development of nanoscale science and technology in South Korea. In particular, Choi has identified a university laboratory in South Korea, in the Department of Materials Science and Engineering, Seoul National University (SNU), that had made a transition from semiconductor processing to nanotechnology (more specifically, nano-pores) since the early 2000s. In order to place the transition within a proper historical context, he will also examine the history of engineering education and research at SNU, beginning with the Minnesota Project in the late 1950s and early 60s.

The project has evolved into an interesting direction. While digging into the recent history of the South Korean university laboratory that made the transition from semiconductor processing to nanotechnology in the early 2000s, Choi discovered that the PI (Ki-Bum Kim) was involved in an research institute called the SNU Nanoelectronics Institute (SNI), established in 1995 (and fizzled around 1999). During this reporting period, Choi sought as much information as possible on the SNI, with an aim to write a history of the development. The SNI participants later went on to play critical roles in the KNNI in 2001, and were influential in setting the agenda of nanotechnology research in South Korea in the 21st century. The plan is to use this story to examine the "emerging technology" rhetoric in a country that is mounting a catch-up campaign.

During this time Choi conducted oral history interviews with SNU faculty members and former graduate students that have participated in SNI project (8 subjects). He also collected primary documents from interviewees, including the first proposal, progress reports, etc. He also started documentary research on the history of engineering education and research at SNU, focusing on curricular changes, faculty career trajectories, and student experiences. This included collecting and analyzing all publications, as well as MS and PhD theses, that came out of this

research group since 1992.Finally, he prepared draft paper (in Korean), which will be expanded to include the "emerging technologies" theme.

Leveraging his position in the Department of Materials Science and Engineering, Choi is continuing to network with key nanotechnology practitioners. One of them is Ki-Bum Kim, who has been the “Mike Roco” figure in South Korean nanotechnology policymaking. Choi plans to use Kim as an entry point to the Korean nanotechnology community.

IRG 1-2: Pioneers of Nanotechnology *(Oral History Project);* David Brock, Patrick McCray

The development of nanotechnology in the late twentieth and early twenty-first centuries has left very few traces of the sort that historians have relied upon: paper manuscripts and documents. Communications have increasingly taken ephemeral electronic forms, as have reports, data, and other documentation. To help remedy this, since 2005 IRG 1 has been documenting the nano-enterprise with oral histories.

In this reporting period, Brock has formulated a list of nanoscientists he wishes to interview between now and 2015, pending contract negotiations and IRB approval.

IRG 1-3: Institutions of Interdisciplinarity; Cyrus Mody, Hyungsub Choi, Sarah Kaplan

This research stream of IRG 1 examines how U.S. institutional forms from the distant past shaped current nano policies. Our starting point is the sociological observation that new institutions copy from older institutions rather than inventing structures and protocols from scratch. Research focuses on institutions promoting interdisciplinary collaboration.

Members of this project were largely working separately during this reporting period. Mody submitted a prospectus and two chapters of his second book, *The Long Arm of Moore's Law*, to Palgrave-MacMillan for consideration. This book will draw heavily on IRG 1 research. Choi conducted research at several universities (MIT, Penn State, Princeton, Penn, Stanford) in the US and Korea. Kaplan and collaborators Ruth Schwartz Cowan and Jonathon Milde submitted a paper based on a field study of the Nano-Bio Interface Center at the University of Pennsylvania to Social Studies of Science. This paper examines interdisciplinary research in practice.

Several members of IRG 1 were together at the Society for the History of Technology meeting in Copenhagen in October. Mody has been working with McCray and Johnson on the Emerging Technologies conference to be held in Santa Barbara next year, in which Kaplan and Choi are also participating. Choi invited Mody to give a talk at Seoul National University, during which they also took the opportunity to plan a future collaborative article on the Mansfield Amendment.

In addition to the above two projects, Kaplan is conducting research (funded by NSF in the NSEC DMR and the Canadian Social Sciences and Humanities Research Council) on practices of interdisciplinary research in nanotechnology. Convinced that the nature of today’s scientific and technological problems demand interdisciplinary solutions, research policy makers and funders are increasingly demanding coordination among academic disciplines. This has been particularly true in the field of nanotechnology, where patrons demand interdisciplinary research, not just across different scientific or engineering areas but also including the social sciences and humanities. Yet, studies attempting to document the degree of interdisciplinarity in nanoscience and technology outcomes (such as publications) have provided mixed results. Further, research on interdisciplinarity has with few exceptions treated it monolithically as a style of research or

research outcome rather than considering the coordination as it happens. It is thus difficult to identify mechanisms of coordination and the consequent policy implications.

Kaplan's project traces the day-to-day activities of researchers in the Nano/Bio Interface Center at the University of Pennsylvania (an NSF-funded NSEC) using ethnographic techniques such as observation, interviews and collection of a wide range of documentary evidence (such as grant applications and instrument signup sheets). Specifically, it explores how interdisciplinary coordination takes place both on the cognitive plane and in the political economy of research, being neither wholly about the generation of creative ideas across disciplines nor about the breaking down of barriers across departments. Drawing from the history and sociology of science literature on interdisciplinarity and matching it with organizational theories about coordination, this project has identified the objects (instruments) and boundary spanners (primarily students) who operate at the nexus of disciplines. Kaplan intends this mapping of the research process to provide a framework for understanding tensions in interdisciplinary work and identifying the micro- mechanisms by which change in the management of scientific research occurs. A further extension of this project is examining how these changes in research practices map onto changes in publication patterns, examining the degree of interdisciplinarity in publications by NBIC researchers before and after the creation of the NBIC, and also comparing NBIC-funded projects from other projects (and publications) completed by NBIC-affiliated researchers during the time of the NSF grant.

IRG 1-4: Innovation and Research at the Nanotechnology-Biology Interface; Joseph November, Patrick McCray

The main focus of this project aims to elucidate the roots of federal agencies' recent efforts to foster innovation and research at the bio-nano interface, will compare early 1960s efforts to rationalize biomedicine via digital computer techniques and 21st century attempts to harness nanotechnology in life science research. Included in this aim, the project will investigate two attempts by the NIH to implement "bioengineering," one launched around 1960 and centered on the then-emerging technology of digital computing, the other launched around 2000 and grounded in today's emerging nanotechnology. Despite such different means, both varieties of bioengineering cast living systems as artifacts and cast those working with such systems as manageable engineers rather than scientists dependent on serendipitous breakthroughs. By historicizing the relations between technology development and the study of life, this case study aims to clarify the roles individuals and institutions in process that has made nanotechnology and biomedicine increasingly important to each other.

November has visited archives at the National Institutes of Health and the National Archives. He completed his archival research at the National Archives in April 2012 and will be making a final trip to the NIH to conduct archival work and possibly interviews in May 2013.

Drawing from archival material gathered during the past two years, November is preparing an article "Engineering a Better Medicine" for publication. A preliminary version of this article has been presented as a professional talk (of the same name) for the Society for the History of Technology (SHOT) annual meeting, which was held in October 2012 in Copenhagen, Denmark.

During the 2013-2014 academic year, November will be on sabbatical leave. To help support the research he will conduct on 1970s biomedical computing during his leave he has won competitive travel grants from the Association for Computing Machinery (ACM) and the Charles Babbage Institute (CBI). These grants will allow him to travel to the Stanford University Archives

and the CBI's archive at the University of Minnesota; the information gained from this archival work is highly relevant to the bio-nano interface project.

In addition to November's work on bio-nano, McCray continued to work on a new project called "From Blueprints to Bricks." The goal is to explore the establishment of a research community in the U.S. that does DNA nanotechnology. During this reporting period, McCray made multiple research trips to Caltech during the reporting period and also was a visiting professor at Caltech for part of 2012. He met regularly with people active in the field of "DNA nanotechnology" (a form of nano-engineering that treats DNA not as an information-containing molecule but as a building material).

IRG 1-5: (Nano)Technological Enthusiasm and the Public Imagination; Patrick McCray

This project utilized historical case studies to explore how public perceptions of nanotechnology were influenced by its connections with earlier expressions and advocacy of technological enthusiasm in the 1970s and expressions of technological utopias, and how public imaginings of future technologies have intersected with public policy. By examining the political and social context of several exploratory or even fringe technologies–the distinction often rests with the beholder– and the communities of the scientists, technologists, and futurists who advocated them, this project explicated a clearer understanding of how modern technological utopias emerge, which clearly carries implications for the contemporary nanotechnology regime.

The primary result of this project was the completion and publication of production of McCray's book *The Visioneers: How a Group of Elite Scientists Pursued Space Colonies, Nanotechnologies, and a Limitless Future* (Princeton, 2013). With the publication of the book – and with the exception of travel to give talks related to it – this line of research is largely closed.

IRG 1-6: Nanotechnology Narratives and U.S. Environmental, Health, & Safety (EHS) Policies
Roger Eardley-Pryor, Patrick McCray, Giana Haro

This research project examines how perceptions of concern over nanotechnology's environmental, health, and safety (EHS) developed in the United States, and how those perceptions influenced regulatory policy formation. One strand of this project focuses on popular utopian and dystopian narratives about nanotechnology as they relate to EHS policies. Another strand analyzes how various stakeholders have deployed analogies between prior technologies and particular nanotechnologies as a possible guide to nanotechnology's anticipatory governance.

During this reporting period, Eardley-Pryor presented nanoEHS research at conferences abroad; continued participation in CNS graduate seminars; served as a graduate mentor for an undergraduate research project on the policy implications of utopian environmental visions for nanotechnology; designed another summer undergraduate research project on nanotechnology in food; and participated in several educational and public outreach events, including delivery of invited lectures at various institutions and volunteering at NISENet's NanoDays events.

During the summer of 2012, in addition to his on-going participation in the CNS Graduate Seminar, Eardley-Pryor served as a graduate mentor to a community college undergraduate student as part of the summer 2012 Internships in Nanosystems Science, Engineering and Technology (INSET) program. For the 2012 INSET program, Eardley-Pryor designed a research curriculum that explored how visions about nanotechnology's beneficial environmental applications in the 1980s through the early 2000s reflected previous utopian thinking about

technology reshaping and enhancing the natural world. While placing celebratory environmental and health visions of nanotechnology in broader and deeper historical contexts, this research also revealed the more recent political influences and implications that such visions had on contemporary American policy-makers and government agencies. To complete this project, Eardley-Pryor selected and oversaw the work of Giana Haro, a undergraduate community college student in marine biology, originally from the Galapagos Islands off Ecuador, and now a student at Santa Barbara City College. Eardley-Pryor and Haro produced a research poster titled, "Green Nano-Visions and their Policy Consequences." In the fall of 2012, Haro presented her poster at the 2012 SACNAS National Conference, a society of scientists dedicated to advancing Hispanics and Native Americans in science.

In 2013, Eardley-Pryor designed another summer undergraduate research project that he will oversee in UCSB's 2013 INSET program. This new mentorship project explores the use of nanotechnology in food by examining its social and environmental implications, as well as newly developing similarities between nanofoods and genetically modified organisms (GMOs).

In October 2012, Eardley-Pryor traveled to the University of Twente in the Netherlands to present his research at the fourth annual meeting of S.NET, the Society for the Study of Nanoscience and Emerging Technologies. The title of his talk was, ""Planet Nano-topia: Nanotechnology and Nature in a Techno-Utopia." In April 2013, Eardley-Pryor presented a related research poster titled, "How Ecotopian Visions of Nanotechnology Influenced U.S. Environmental Health and Safety," at the annual meeting of the American Society of Environmental History held in Toronto, Canada. In hopes of presenting in November 2013 at the annual meeting of the Society for the History of Technology (SHOT), Eardley-Pryor and Patrick McCray submitted a paper proposal titled, "Regulating Innovation Via Analogy: The Case of Nanotechnology."

In this reporting period, Eardley-Pryor also represented CNS in various educational and public outreach events. In May 2012, he delivered an invited lecture in UCSB's Ethics In Engineering course on the societal implications of emerging technologies. In March 2013, Eardley-Pryor volunteered in the annual NanoDays event, organized by NISEnet and held at the Santa Barbara Museum of Natural History, which engaged over one thousand parents and children visit in nanotechnology demonstrations. Also in March 2013, he led a three-hour introductory seminar on the societal implications of nanotechnology at the Institute of World Culture in Santa Barbara as part of the Institute's theme on the Global Frontiers of Science and Society. His seminar titled, "Considering Nanotechnology: Large Societal Implications of the Very Small," was filmed and will soon be available online for further public outreach.

5. Broader Impacts of IRG 1: Understanding nanotech's societal implications is predicated on possessing a clear and comprehensive understanding of its historical context. The research IRG 1 does contributes to the larger social history of nanotechnology and its ancillary institutional, instrumental, and intellectual adjuncts. Work done in the past 12 months contributes to a more comprehensive and holistic narrative of nanotech's trajectory. This history will ultimately trace the 50+ year arc of nanotechnology's history from its origins in the materials science community in the 1950s and 1960s. It will then follow through new instrumental developments at places like Bell Labs and IBM in the 1970s to major discoveries in the 1980s like the invention of the buckyball and the STM and, eventually, the creation of a vast transnational infrastructure for doing interdisciplinary research in the 21st century. This history will be accessible, valuable and relevant not only to our historian colleagues but also to scientists, engineers, and policy makers. All of the IRG 1 members who teach graduate or undergraduate courses incorporate their CNS-based research in various ways. Mody, November, and Choi all offered instruction in the past

year on the history/sociology of technology which included some nano-themed topics. Finally, during this past year, McCray's *Visioneers* book was released. This was accompanied by interviews on NPR, several public book talks, on-line essays on CNN.com and the Huffington Post etc.

IRG 1 Publications 2012-2013

Primary Publications: Journals

1. Mody, Cyrus C.M., & Choi, Hyungsub. (forthcoming). From Materials Science to Nanotechnology: Institutions, Communities, and Disciplines at Cornell University, 1960-2000. *Historical Studies in the Natural Sciences*.

Primary Publications: Books, Chapters, Reports and other Publications

2. McCray, Patrick. (2012, June 10). "A pioneer in space and on Earth," editorial. *CNN.com*.
3. McCray, Patrick. (2012, November 26). "We May Not Have Flying Cars Yet, But Visioneers are Inventing a New Future," opinion piece. *Forbes.com*.
4. McCray, W. Patrick. (2012). California Dreamin': Visioneering the Technological Future. In V. Janssen (Ed.), *Minds and Matters: Technology in California and the West* (pp. 347-378). Berkeley, CA: University of California Press.
5. McCray, W. Patrick. (2012). From L-5 to X-Prize. In P. J. Westwick & W. Deverell (Eds.), *Blue Sky Metropolis: Aerospace and Southern California* (pp. 171-193). Berkeley, CA: University of California Press.
6. McCray, W. Patrick. (2012). When Space Travel and Nanotechnology Met at the Fountains of Paradise. In B. H. Harthorn & J. W. Mohr (Eds.), *The Social Life of Nanotechnology* (pp. 37-51). New York: Routledge.
7. McCray, W. Patrick. (2013). *The Visioneers: How a Group of Elite Scientists Pursued Space Colonies, Nanotechnologies, and a Limitless Future, Histories of Our Technological Future: How Space Colonies, Nanotechnology, and Transhumanism Challenged the Idea of Limits*. Princeton, NJ: Princeton University Press.
8. Mody, Cyrus. (2013). Limits Be Damned: How a Group of Elite Scientists Pursued Space Colonies, Nanotechnologies, and a Limitless Future. Book review/commentary. *Nature, 493*, 24-25.
9. Mody, Cyrus C.M. (2012). Conferences and the Emergence of Nanoscience. In B. H. Harthorn & J. Mohr (Eds.), *The Social Life of Nanotechnology*. London: Routledge.

Leveraged Publications: Journals

10. Mody, Cyrus C.M., & Nelson, Andrew J. (forthcoming). 'A Towering Virtue of Necessity': Computer Music at Vietnam-Era Stanford. *Osiris, 28*.

Leveraged Publications: Books, Chapters, Reports and Other Publications

Submitted or in preparation publications: primary

11. Mody, Cyrus C.M. (under review). Exemplary Cases and Accounting for Research. In C. Newfield & D. Boudreaux (Eds.), *Can Rich Countries Still Invent? Towards a New Model of International Innovation*.

Submitted or in preparation publications: leveraged

12. Kaplan, Sarah, Milde, Jonathan, & Cowan, Ruth Schwartz. (under review). Interdisciplinarity in practice.
13. Kelly, Kevin, & Mody, Cyrus. (under review). Molecular Electronics: Catching up with Its Promise? *IEEE Spectrum*.

14. Mody, Cyrus C.M. (under review). Essential Tensions and Representational Strategies. In M. Lynch, S. Woolgar, J. Vertesi & C. Coopmans (Eds.), *Representation in Scientific Practice II*. Cambridge, Mass: MIT Press.
15. Mody, Cyrus C.M. (under review). University in a Garage: Instrumentation and Innovation from UC Santa Barbara. In M. Kenney, D. Mowery & M. Walshok (Eds.), *The Role of the University of California in Building Regional Economies through Knowledge Creation and Transfer*. Stanford: Stanford University Press.
16. Shah, Sonali K., & Mody, Cyrus. (under review). Creating a Context for Entrepreneurship: Examining How Users' Technological & Organizational Innovations Set the State for Entrepreneurial Activity. In B. Frischmann, M. Madiosn & K. Strandburg (Eds.), *Commons in the Cultural Environment*. New York: Oxford University Press.
17. Shah, Sonali K., & Mody, Cyrus C.M. (under review). Innovation, Social Structure, and the Creation of New Industries. *Academy of Management Journal*.

IRG 1 Presentations 2012-2013

1. McCray, Patrick. (March 2012). "How California Invented Nanotechnology." Invited talk, University of California, Los Angeles: Los Angeles, CA.
2. Mody, Cyrus. (March 30, 2012). "University in a Garage: Instrumentation and Innovation from UC Santa Barbara." Workshop for edited volume on innovation in the UC system: Berkeley, CA.
3. Mody, Cyrus. (March 31, 2012). "Commentator for panel on Emerging Technology: The Coevolution of Performances, Regulations, and Markets." Business History Conference: Philadelphia.
4. Kaplan, Sarah. (April 2012). "Interdisciplinarity in Practice: a case study of a Nanotechnology Research Center." Queen's University, Strategy Seminar: Kingston, ON.
5. McCray, Patrick. (April 2012). "Gerard O'Neill's Visioneering of the 'High Frontier'" Envisioning Limits: Outer Space and the End of Utopia conference: Berlin, Germany.
6. Kaplan, Sarah. (June 2012). "Interdisciplinarity in Practice: a case study of a Nanotechnology Research Center." DRUID conference: Copenhagen, Denmark.
7. Kaplan, Sarah. (August 2012). "Interdisciplinarity in Practice: a case study of a Nanotechnology Research Center." American Sociological Association: Denver, CO.
8. McCray, Patrick. (September 2012). "Visioneers and their Pursuit of Space Colonies, Nanotechnologies, and a Limitless Future." Invited talk, Korea Advanced Institute of Science and Technology: South Korea.
9. Mody, Cyrus. (September 14, 2012). "Replication and Evolution of Research Organizations: The Case of US Academic Microfabrication Facilities." International Conference on Intellectual and Institutional Innovation in Science: Berlin.
10. Mody, Cyrus. (October 6, 2012). "The Interdisciplinary Imaginary: Computer Music at Vietnam-Era Stanford." Annual meeting of the Society for the History of Technology: Copenhagen.
11. November, Joseph. (October 6, 2012). "Engineering a Better Medicine." The Society for the History of Technology (SHOT): Copenhagen, Denmark.
12. McCray, Patrick. (December 2012). "California Dreaming: The Golden State's Influence on Imaginings, Policies, and Narratives of Nanotechnology" Invited talk, Reilly Center, University of Notre Dame: South Bend, IN.
13 . Mody, Cyrus. (December 7, 2012). "What Do Scientists and Engineers Do All Day? On the Structure of Normal Science." MIT-Harvard symposium on Thomas Kuhn's Structure of Scientific Revolutions, 50 Years Later: Reflections on the History, Philosophy, and Sociology of Science: Cambridge, MA.

14. McCray, Patrick. (January 2013). "Visioneering: From Space Colonies to Nanotechnologies in Pursuit of a Limitless Future." Skeptics Society Distinguished Lecture Series, Cal Tech: Pasadena, CA.
15. Kaplan, Sarah. (February 2013). "Interdisciplinarity in Practice: a case study of a Nanotechnology Research Center." University of Virginia, Darden/McIntire research seminar: Charlottesville, VA.
16. Kaplan, Sarah. (February, 2013). "Interdisciplinarity in Practice: a case study of a Nanotechnology Research Center." AAAS Annual Meeting: Boston, MA.
17. Mody, Cyrus. (March 1, 2013). "The Market and the Garden: Civilianization and the Commercialization of Research in the Long 1970s." Seoul National University, History of Science and technology colloquium: Seoul, South Korea.
18. Kaplan, Sarah. (March 2013). "Interdisciplinarity in Practice: a case study of a Nanotechnology Research Center." UC Davis Conference on Qualitative Research: Davis, CA.

IRG 1 Outreach Activities

1. McCray, Patrick and Eardley-Pryor, Roger, "Take a Little Risk: Historical Analogies for the Regulation of Nanotechnology," 2012 Business History Conference, March 2012, Philadelphia, PA.
2. Mody, Cyrus, "Safety, Disaster, and Innovation on the High Seas before and after the Titanic," Houston Museum of Natural Sciences, April 12, 2012, Houston, TX.
3. Mody, Cyrus, "Safety, Disaster, and Innovation on the High Seas before and after the Titanic," Houston Maritime Museum, April 17, 2012, Houston, TX.
4. Mody, Cyrus, "Safety, Disaster, and Innovation on the High Seas before and after the Titanic," Rice University, Glasscock School of Continuing Studies, Titanic Course, April 19, 2012, Houston TX.
5. Haro, Gianna, "Green Nanovisions and their Policy Consequences," paper presentation Internships in Nanosystems Science, Engineering, and Technology (INSET) public presentations, August 1, 2012, Santa Barbara, CA.
6. Haro, Gianna, "Green Nanovisions and their Policy Consequences," (poster), Internships in Nanosystems Science, Engineering, and Technology (INSET), poster colloquium, August 8, 2012, Santa Barbara, CA.
7. Gordin, Michael, "The Pseudoscience Wars: Immanuel Velikovsky and the Birth of the Scientific Fringe," 2012 Badash Memorial Lecture, University of California, Santa Barbara, October 29, 2012, Santa Barbara, CA.
8. McCray, Patrick, ""Visioneering: From Space Colonies to Nanotechnologies in Pursuit of a Limitless Future," Microsoft, February 2013, Seattle, WA.
9. McCray, Patrick, ""Visioneering: From Space Colonies to Nanotechnologies in Pursuit of a Limitless Future," Seattle Town Hall Series, February 2013, Seattle, WA.
10. McCray, Patrick, ""Visioneering: From Space Colonies to Nanotechnologies in Pursuit of a Limitless Future," San Jose Technology Museum, February 2013, San Jose, CA.
11. McCray, Patrick, ""Visioneering: From Space Colonies to Nanotechnologies in Pursuit of a Limitless Future," Politics and Prose, February 2013, Washington DC.
12. McCray, Patrick, ""Visioneering: From Space Colonies to Nanotechnologies in Pursuit of a Limitless Future," DC Science Café, February 2013, Washington DC.
13. McCray, Patrick, ""Visioneering: From Space Colonies to Nanotechnologies in Pursuit of a Limitless Future," Noblis, February 2013, Washington DC.
14. Eardley-Pryor, Roger, "Considering Nanotechnology: Large Societal Impacts of the Very Small" Institute of World Cultures, March 16, 2013, Santa Barbara, CA.

IRG 2 Progress Report: Globalization and Nanotechnology

R. Appelbaum, Leader	Sociology, Glob. & Int'l Stud.	UC Santa Barbara
T. Lenoir	History	Duke University
A. Mehta	Global & International Studies	UC Santa Barbara
F. Block	Sociology	UC Davis
C. Cao	Contemp. Chinese Studies	Univ. of Nottingham
H. Choi	History	Seoul Nat'l U.
D. Simon	Political Science	Arizona State University
X. Yeu	Geography	Bowling Green State University

Affiliates

G. Gereffi	Sociology	Duke University
R. Parker	Sociology, Sci Policy	Research Staff Member Science & Tech. Policy Inst.
P. Herron	Computer Science	Duke University
G. Folodari	Sociology	Univ. Autónoma de Zacatecas
N. Invernizzi	Anthropology	Univ. of Parana, Brazil
Y. Motoyama	Regional Planning	Kaufmann Foundation
P. Shapira	Management	Georgia Inst of Technology
J. Youtie	Science policy	Georgia Inst of Technology
E. Záyago Lau	Development studies	Latin Amer. Nanotech & Society Network (ReLANS)

3 postdocs, 7 grads, 1 undergrad

Postdoctoral scholar Luciano Kay, CNS Postdoc
Stacey Frederick, GIS Postdoc [X-IRG]
James Walsh, CNS Postdoc [X-IRG]

Graduate students: Science and Engineering:
Matthew Gebbie, Materials, UCSB
Shirley Han, Ecology, Evolution, and Marine Biology, UCSB
Social Science:
Galen Stocking, Political Science, UCSB
Lanceton Mark Dsouza, Duke

Undergraduate Students: Emily Nightingale, UCSB

Technical staff: Ben Weiss, Duke
Jordan Herman, Duke
Jan Pachon, Duke

1. Introduction: The overarching goal of IRG2 is to better understand the importance of both state policies and international collaboration in fostering research, development, and commercialization of nanotechnology, through a comparative study of the U.S., China, Japan, India, Korea, and selected Latin American countries.

2. Goals: Since 2000, when the U.S. officially launched its National Nanotechnology Initiative, global public spending on nanotechnology has exceeded $70 billion. If one includes corporate research and private funding more generally, the total of public and private spending is predicted to reach as much as a quarter of a trillion dollars by 2015 (Cientifica, 2011). Clearly,

pubic officials across the world have come to see nanotechnology as the next technological revolution; firms and investors – no doubt in part attracted by the availability of public funding – have followed suit. Does this nanoscale "race to the bottom" – investing significant public resources in nanotechnology research, development, and commercialization – constitute industrial policy? How successful is it likely to be?

In his classic work, *MITI and the Japanese Miracle: the Growth of Industrial Policy*, Chalmers Johnson (1982) made the now-classic distinction between "plan-rational," "market-rational," and "plan-ideological" state approaches to industrial policy. Johnson's tripartite distinction of policy making was based on two interacting dimensions: the principal type of economic governance (market-driven v. state planning), and the principal type of decision-making (ideologically driven v. what might be today called "evidence-based"). In addition to the crudeness of the resulting binary distinctions, Johnson's framework is missing a logical fourth category: "market-ideological." As Henderson and Appelbaum (1992: 19) reformulated Johnson's original typology, in "*market-ideological* political economies…public policy is oriented above all toward assuring free market operations." Ha-Joon Chang subsequently emphasized the state's engagement in "institutional adaptation and innovation to achieve goals of long-term growth and structural change" (1994), while Meredith Woo-Cumings incorporated similar notions in characterizing industrial policy as "the ability of the state sector both to accommodate itself to the changing requirements for remaining competitive in the global market place and to provide support for educational infrastructure and for research and development" (1999: 27).

Sean O'Riain (2004: 29) pointed out a facilitating role played by the states of Israel, Ireland, and Taiwan, such as fostering international networks, and establishing venture capital funding and innovation centers. In the area of technology, industrial policy can take the form of what have been termed "horizontal technology policies" (HTPs) – policies that involve a class of subsidies that employ market mechanisms and self-selection to advance particular technologies (see, e.g., Hall and Rosenberg, 2010; Teubal, 1997; Breznitz (2007). In an effort to narrow the concept and adapt it to current conditions, economist Dani Rodrik (2004: 38) proposes that a "twenty-first century industrial policy" would involve "strategic collaboration between the private sector and government with the aim of uncovering where the most likely obstacles to restructuring lie and what types of interventions are most likely to remove them." In Rodrik's formulation, the government does not pick particular sectors; rather, it provides support for activities that seem likely to enhance economic advancement – for example, promising frontier technologies. For IRG-2 collaborator Fred Block (2008: 172), this suggests that industrial policy should involve "four distinct but overlapping tasks – targeted resourcing, opening windows, brokering, and facilitation."

By the same token, bibliometric studies have been very nearly unanimous in concluding that science has globalized in two distinct ways. First, there is significant evidence that it has become more internationally interconnected. These interconnections are evident in the growth of international conferences, cross-border funding (Shapira and Wang, 2010), and in the share of peer-reviewed scientific publications involving authors from multiple countries. Second, research activity has become more evenly spread across countries, eroding national concentrations of scientific productivity. This diffusion of scientific activity is apparent in the growing shares of emerging scientific powers in research publications, on editorial boards of journals (Braun *et al*, 2007) and in global patent filings (Dang *et al*, 2010). In fact, the diffusion model, which connotes flows from center to periphery, may not adequately capture this process. As a result of increasing rates of international collaboration and the global flow of scientific talent, significant scientific advances may begin simultaneously in center and periphery through collaborative endeavors that transcend national borders – or may begin in what is

conventionally thought of as the periphery and diffuse to the center. Nanotechnology research is of significant interest in this regard because the field is nascent, has seen major growth in the last twenty years, and, as noted above, has been accorded high priority by governments around the world.

Building on these distinctions, where do efforts to develop nanotechnology – and, by inference, other emerging technologies that hold the promise of fostering significant economic gains – fall in terms of industrial policy? How can the study of international nanotechnology research collaborations shed light on the connections between national policies and the evolution of international scientific networks? The principal goals of IRG-2 – since the beginning of CNS, and throughout this review period – have been to answer these questions.

To accomplish these overarching goals, IRG-2 has engaged in a number of interrelated projects and activities that draw on field interviews, documentary analysis, and quantitative bibliometric studies. Our specific goals and accomplishments have included:

1. Develop a comparative framework for understanding innovation policies in different countries through an extensive review of the literature on industrial policy, reflected in presentations and publications during this period
2. Expand our previous work on Chinese industrial policy, focusing on China's emphasis on indigenous innovation and its impact on nanotechnology R&D and commercialization, particularly in Shanghai and Suzhou Industrial park (SIP)
3. Complete our research project on the development of nanotechnology into Mexico, through a supporting grant obtained through UC-MEXUS and CONACYT
4. Establish relations with ReLANS (the Latin American Network for Nanotechnology and Society)
5. Publish the book from our "Emerging Economies/Emerging Technologies" conference (November 4-6, 2009, Washington, D.C.): *Can Emerging Technologies Make a Difference in Development?* (Routledge, 2012)
6. Gauge the contributions of foreign-born scientists and engineers to the development of nanotechnology ion the United States through a study of recent PhD's in nanotechnology
7. Gain a better understanding of how nanotechnology diffuses, both within a country (focusing on China) as well as globally
8. Build a nano-firm and organization database incorporating a global value-chain approach, using it to populate a "California in the Nano Economy" website
9. Continue development of "GLOBONANO," a large scale database including all nanotechnology-related scientific literature, patents, and eventually products, for nearly 60 countries (including the US, China, South Korea, Japan, India, Singapore, and EU countries), and – using this database – begin research on nanotechnology commercialization and international collaboration in nanotechnology research
10. Develop our internal capability to conduct bibliometric and patent analysis, through the work of postdoc Luciano Kay
11. Establish a working relationship/collaboration with Phil Shapira and Jan Youtie at Georgia Tech, to advance our joint efforts in bibliometric and patent analysis
12. Develop a global value chain website on nanotechnology in California, through the work of postdoc Stacey Frederick
13. Conduct preliminary research on foreign graduate students in STEM departments at UCSB ("open doors" project)

3. Organization and approach of the IRG: The activities of IRG-2 are, as indicated above, designed to assess the role of state policy and international collaboration on the development

and diffusion of nanotechnology – from basic research to commercialization. With regard to state policy, we are especially interested in understanding how state policy at all levels – can enable an early-stage technology (such as nano) navigate through the "valley of death" – the inevitable funding gap between a promising idea and successful commercialization. With regard to international collaboration, we are focused on first chronicling the extent of such collaboration, then examining its direction and impact. These efforts are organized into a group of interrelated collaborative projects:

IRG 2-1: China's Developmental State: Becoming a 21st Century Nanotech Leader: Appelbaum, Parker, Cao, Stocking, Gebbie, Han

IRG 2-2: Comparative Study of State Nanotechnology Policy: U.S., China, Japan: Appelbaum, Parker, Motoyama, Choi, Block

IRG 2-3: Drivers of Nanotechnology Commercialization in China – Suzhou Industrial Park: Parker, Appelbaum, Cao, Han, Gebbie, Stocking, Nightingale

IRG 2-4: Development of GLOBONANO database of publications, patents, products: Lenoir, Herron, Weiss, Dsouza, Pachon

IRG 2-5: Global Value Chain Analysis: Frederick, Appelbaum, Harthorn, Herman

IRG 2-6: International Collaboration in Nanotech Research and Publication: Mehta, Lenoir, Herron, Cao, Han

IRG 2-7: Contributions of Foreign-Born Scientists to Nanotechnology Innovation: Walsh

IRG 2-8: UCMEXUS/CONACYT Binational Collaboration (USA-Mexico) in the Development of Nanotechnology (Foladori, Záyago Lau, Parker, Appelbaum)

IRG 2-9 Establish connection with ReLANS, conduct additional research on Mexico: Foladori, Záyago Lau, Appelbaum, Parker, Frederick

IRG 2-10: Bibliometric and Patent Analysis/Mapping (Kay)

IRG 2-11: Open Doors: Chinese (and other foreign) students studying in the U.S. (Appelbaum, Han, Stocking, Gebbie)

IRG 2-12: Will Nanotechnology Prove to be Disruptive? Effects on the Workforce of an Emerging Technology (Appelbaum, Foladori, Zayago Lau, Parker**)**

IRG-2's core efforts are located at UCSB, where Appelbaum meets weekly or biweekly with his new graduate fellows (Stocking, Gebbie, and Han) and UCSB's development economist Mehta. Integration is facilitated through regular meetings, reading and writing assignments, publications, and conference participation (for example, at SNET in Twente, Nethwerlands, October 2012, where IRG-2 organized and our graduate students presented on a panel on nanotechnology in China). IRG-2 (Appelbaum, Stocking, Gebbie, Han, parker, and Cao) also conducted research in Shanghai and Suzhou Industrial Park (SIP) in April 2012, and Appelbaum and Parker attended the Chinano Exhibition and Conference at SIP in September 2012.

A number of the core IRG-2 participants are not in Santa Barbara. Parker (at STPI in D.C.) and Cao (at the University of Nottingham, U.K.) were looped in via conference calls during most of IRG-2's meetings. Motoyama, who completed his postdoc a year ago and relocated to the Kaufmann foundation in Kansas City, has continued collaboration through the publication of a co-authored paper. Luciano Kay joined IRG-2 as a new post-doc on June 1, 2012; he was

previously working as a post-doc at Georgia Tech, a key collaborator in their bibliometric and field studies nanotechnology research.

Kay's relocation to UCSB has fostered future collaboration between CNS-UCSB and CNS-ASU via CNS-ASU's Georgia Tech partnership: Phil Shapira and Jan Youtie visited CNS-UCSB for an IRG2 summit meeting in December 2012, giving a public presentation and meeting with IRG-2 to discuss future collaborations. Currently, three coordinated writing projects are planned for presentation at the Atlanta Conference on Science and Innovation Policy (September 2013), with Appelbaum, Kay, and Shapira-Youtie taking the lead on each. Shapira has also organized a workshop at the University of Manchester, England, for June 2012, at which Appelbaum will give a keynote presentation on China. Kay is being provided with a high-powered workstation that will enable him to run all patent and publication data locally, using Vantage Point (the software he used at Georgia Tech to conduct his analysis); this will enable us to conduct our own bibliometric and patent analysis in house. Additionally, Frederick, Shapira and Youtie submitted a proposal to NSF to conduct a collaborative project on value chain mapping that draws on Frederick's firm-level data and Shapira-Youtie's patent and publication data.

Our other Duke University partners (Lenoir, Herron) have completed their development of the GLOBONANO database, and are completing several publications based on their research. Frederick (also at Duke) has completed her California in the global nanotechnology value chain project, and is now working with Parker on an examination of labor issues in the global nanotechnology value chain. These efforts are coordinated through frequent telephone conversations.

Our partnership with Foladori and Zayago Lau in Mexico, supported in part by a separate grant from UC-MEXUS/CONACyT, was facilitated by face-to-face meetings the December 2012 IRG2 summit involving Shapira and Youtie; Zayago subsequently joined us in September 2012 as a post-doc (fully funded by CONACyT). Our work with ReLANS (the Latin American Nanotechnology Network, headed up by Zayago) continues; we will be co-sponsoring and participating in a conference on nanotech and labor in Curitiba, Brazil (September 2013) in conjunction with the annual meeting of ReLANS.

Finally, we added two affiliates to our IRG: Denis Simon, Vice Provost for International Exchange Initiatives at ASU and a leading expert on China's high-tech turn (Simon visited UCSB-CNS and gave a public talk in February 2013), and Xinyue Ye, an Assistant Professor of Geography at Bowling Green State University, who specializes in regional (GIS-based) analysis of economic development in China.

4. Major IRG-2 accomplishments in the Center

IRG-2's focus, a comparative-historical and quantitative analysis of the development of nanotechnology, cross-cuts with a number of other CNS initiatives and projects. IRG-2 and IRG-1 share an interest in the historical development of national innovation policies focused on nanotechnology. Choi participates in the work of both IRGs, focusing on Korean nanotech innovation systems. Published research by IRG-2 researchers Motoyama, Parker, and Appelbaum examines the historical origins of the U.S. National Nanotechnology Initiative. IRG 2 and 3 also collaborate in development of the X-IRG work by Frederick at Duke on the US and global nano industry, and are currently jointly planning a 2014 conference on "Democratizing Technologies: A role for NGOs in mediating technologies futures?" Finally, Foladori and Invernizzi's publication, *Social and Environmental Implications of Nnotechnology Develolpment in Latin America and the Caribbean* (2012), directly addressed the EHS concerns of IRG-3 (this

pamphlet was initially written in Spanish; IRG-2 translated it and adapted it to the English-speaking population of the Caribbean; it has now also been adapted to Africa). As noted ahove, the planned Septmeber 2013 conference on nanotech and labor in Curitiba, Brazil will also contribute to the work of IRG-3. In addition**,** Mehta extended IRG 2 scope by producing a study for the Asian Development Bank (an intergovernmental organization) on education and export diversification, using across-country and across-industry data to examine how education and industrial policy complement each other in countries seeking market share in technologically sophisticated products.

IRG 2-1: China's Developmental State: Becoming a 21st Century Nanotech Leader: Appelbaum, Parker, Cao, Stocking, Gebbie, Han

This research stream aims at understanding where China stands in terms of innovation, R&D, and commercialization of nanotechnology, examining the degree to which China has a more centralized approach to funding for nanotechnology along the value chain, particularly towards the commercialization end. China is convinced that manufacturing prowess alone is insufficient to becoming a leading economic power in the 21st century. China's overarching goal is to become an "innovation-oriented" society by the year 2020. Since the Third National Conference on Science and Technology in 1995 when "The Decision on Accelerating Scientific and Technological Progress" was announced, "indigenous innovation" (or *zizhu chuangxin*) has been heralded as the source of China's future development, and science, technology and education were identified as the tools that will create national prosperity and reduce the inequality that currently threatens China's rapid development. This approach has been challenged in the literature on industrial policy – most notably in Breznitz and Murphree (2011), who argue that China's strengths lie not in leading-edge innovation, but in second-tier innovations that secure prominent placement in globally fragmented supply chains. Our research addresses these issues, seeking to better understand whether China's relatively government-centered approach toward science and technology policy can succeed in creating the bases for genuine innovation, in light of its distinctive approach to technological leapfrogging, the institutional features of its innovation system, and nanotechnology's status as an early stage emerging technology. This is an ongoing project assessing China's transition from an economy based on low-wage exports to one based on high-tech innovation and manufacturing. Thus far the principal research has been fieldwork - interviews with scientists, engineers, pubic officials, and entrepreneurs in China.

I also made a trip to Beijing, Nanjing, Suzhou-SIP and Shanghai with Rachel Parker (January 19-25, 2013) as part of a STPI evaluation of overseas NSF centers; while much of the information I gathered is destined for the confidential report, some of the interviews and observations will be useful for my CNS research (this trip was paid for by STPI-IDA).

A number of publications have resulted from this research during the past year:

- Appelbaum, Richard and Rachel Parker (2012) "China's Move to High-Tech Innovation: Some Regional Policy Implications," in Christopher Dent and Joern Dosch (eds.), *The Asia-Pacific, Regionalism and the Global System*. Cheltenham, England: Edward Elgar
- Cao, Cong, Richard Appelbaum, Rachel Parker, "Research Is High and the Market Is Far Away: Commercialization of Nanotechnology in China," *Technology in Society* (forthcoming)
- Mehta, Aashish, Herron, Patrick Patrick, Yasuyuki Motoyama, Richard Appelbaum, and Tim Lenoir, Timothy (2012) "Globalization and De-globalization in Nanotechnology Research: The Role of China," *Scientometrics* 93:2: 439-458

- Motoyama, Yasuyuki, Richard Appelbaum, and Cong Cao (forthcoming) "Observing Regional Divergence of Chinese Nanotechnology Centers," *Technological Forecasting and Social Change* (accepted)

IRG 2-2: Comparative Study of State Nanotechnology Policy: U.S., China, Japan: Appelbaum, Parker, Simon, Choi, Block

As previously noted, a central theme of our research is the role of public investment as a driver for nanotechnology R&D and eventual commercialization. To what extent do government-funded national nanotechnology initiatives constitute industrial policy? What are the results of different governmental approaches, in terms of publications, patents, and commercialization? Much of our research to date has focused on China, where government efforts appear to reach further into the commercial end of the value chain than in the U.S. Our China research concludes that China's substantial investment in nanotechnology – one of four "science megaprojects" under the Medium and Long-Term Plan (for high technology) – has paid large dividends at the research stage, but has yet to result in significant commercial payoff. While this is true in other countries as well, China faces the additional challenges of having a risk-averse state sector, an SME sector that is growing but undeveloped, and a university and science academy-based research sector that lacks entrepreneurial experience.

This research stream builds on the previous research done in China, and seeks to better understand the role of state policy as a driver of nanotechnology R&D and commercialization by looking comparatively at the U.S., China, and Japan. The first step has been to focus on the U.S. NNI in an effort to better understand funding allocations across agencies, especially programs such as SBIR and STTR, two federal programs that effectively constitute seed grant programs for promising high-tech ventures that seem likely to successfully commercialize.

We are just beginning this project; there is no significant progress to report at this point. This will be the capstone effort of IRG2, hopefully coming up with a book that looks at comparative innovation policies. Our partnering with ReLans through Edgar and Guillermo (and now Luciano) give us access to Latin America; Hyngsub Choy is working in Korea (although we have had too little contact this year); Yas did work on Japan which will be useful; and Rachel and I have written and published on the US in previous reporting periods (for example, our chapter in *Social Life of Nanotechnology*).

There is one publication during this period:

- Appelbaum, Richard (2013 forthcoming) "Innovative and Responsible Governance of Converging Technologies," appears in ch. 10 of Mihail Roco, Innovative and Responsible Governance of Converging Technologies (OECD Workshop Report on Bridging the Divide Between Policy, Practice and Research on Public Engagement on Nanotechnologies)

IRG 2-3: Drivers of Nanotechnology Commercialization in China – Suzhou Industrial Park: Parker, Appelbaum, Cao, Han, Gebbie, Stocking, Nightingale

Suzhou Industrial Park (SIP) – one of China's showcase high-tech parks – is only fifty miles (and 30 minutes by high-speed train) west of Shanghai. SIP is jockeying to propel Jiangsu Province ahead of its neighbors to become the Silicon Valley of China. One rapidly growing sector of SIP, dubbed Nanopolis (a play on Singapore's successful Biopolis) is home to some of China's rising nanotechnology startups. Promising nanotech firms are provided support for business plan development, legal and incubation services, and significant rent subsidies, among

other perks. In parallel with China's efforts to strengthen its research capacity through science parks such as SIP, the country is increasingly leveraging its large stores of overseas Chinese scientists and engineers to elevate the status of Chinese nanotechnology. China's plan is to establish itself as a knowledge economy through ties with its Diaspora community trained in the US, Europe, Australia, and elsewhere.

During this reporting period we therefore focused on Suzhou Industrial Park (SIP), seen as "China's Silicon Valley," focusing on commercialization. (We also conducted research in Shanghai.) The research this past year has primarily consisted of interviews, although we are beginning to work with Luciano to analyze publications and patents. We conducted two field trips: April 16-26, 2012, to Shanghai and SIP (with Matt, Galen, Shirley, Cong, and Rachel); and September 9-12, 2012, to the SIP-Chinano Exhibition and Conference (with Shirley). Dozens of interviews conducted during each visit.

Xinyue Ye, who recently joined our IRG, is contributing to the effort by conducting a spatial analysis of patent-related data in China. He has completed an initial review of methods regarding High-Tech Innovation and industrial park studies, which rely on data that is spatially referenced in the temporal context. Despite the paucity of recent studies, he notes that research in the fields of GIS and spatial econometrics has generated new space-time methods, although he also notes that spatial spillover effects pose numerous challenges for the application of spatially explicit policies and their evaluations in the comparative context. Recent theoretical work on regional economic growth has suggested a number of fascinating constructs such as convergence clubs and spatial regimes that reflect a growing awareness of the potential importance of the spatial dimension of economic development structure. Much of this remains theoretical, he notes; his work is intended to test these spatial effects issues by considering the nature of space-time patterns and trends of high-tech innovation in China. His next step will be to apply these novel methods of space time analysis to an improved understanding of the agents of change determining differential nanotechnology commercialization spatial patterns in China, identifying the different drivers of commercialization. By introducing a spatially focused set of methods for use in the modeling of spillover effects it will also advance the field of economic geography and regional science. The methods proposed in this research will enable a more comprehensive analysis of high technology growth and change.

Some preliminary conclusions: China is poised to achieve some success in its efforts at "indigenous innovation," but is challenged by a research culture that stifles innovative thinking while over-emphasizing quantity over quality; a business culture that is risk-averse and partly hamstrung by excessive government interference; and a lack of venture capital for SMEs. At the same time, there have been enormous investments in infrastructure, so facilities are excellent.

Parker and Appelbaum have had a paper accepted for the annual SASE (Society for the Advancement of Socioeconomics) conference in Milan (June 2013), "Nanopolis, the Suzhou Industrial Park, and China's Silicon Valley." This paper will critically examine how China's techno-nationalistic approach to development is in fact succeeding in creating a new regional economic advantage that is based on innovation in high technology areas such as nanotechnology, rather than relying on the manufacture and export of low-value goods. In addition, Ye has two papers under preparation (both leveraged by CNS support), "Space, Time, and Innovation: A Review," and "Space-Time Dynamics of Innovators and Intra-provincial Inequality: A Case Study of Zhejiang Province." Ye lists the following as additional CNS leverage activities:

- 2013 Ye, X. and A. Dang (eds.) Special Issue: Spatial Analysis and Modeling on Urban and Regional Development, *Annals of GIS*
- 2013 Ye, X. and Y. Mansury (eds.) Special Issue: Behavior-Driven Agent-Based Models of Spatial Systems, *Annals of Regional Science*
- 2013 Wang, J., Hartmann, R., Ye, X., and Ye, T. (eds.) *A Comparative Geography of China and the U. S.* Publisher: Springer.
- 2013 Proceeding Publication Co-Chair (EI) and Program Committee Member, 21th International Conference on Geoinformatics
- 2012- Editorial Board Member, English and Chinese Book Series on Geospatial Technologies, China Higher Education Press

IRG 2-4: Development of GLOBONANO database of publications, patents, products: Lenoir, Mehta, Motoyama, Herron, Weiss, Dsouza, Pachon

This project has two objectives: to continue development of "GLOBONANO," a large scale database to support quantitative research on the development of scientific literature, patents, and products in all fields of nanotechnology for more than 40 countries, including the US, China, South Korea, Japan, India, Singapore, and EU countries; and to develop research on nanotechnology commercialization and international collaboration in nanotechnology research using the above tools. A key goal of this work is to identify and create an automatically updatable database of commercial firms worldwide developing nano-enabled products. The new data set now includes full sets for 68 countries, up from 43 in the previous version. The GLOBONANO database has been migrated to a new server, and work has been completed on a tool for producing patent output in Vantage Point-compliant XML to assist the work of Luciano Kay in Group 2. Herron also developed a real-time USPTO data extraction tool. Herron continues in his efforts with Jan Pachon, a new hire funded by the Jenkins Lab, to develop a nanoproducts and nanofirms database component for GLOBONANO. During the most recent funding period we continued and expanded our efforts with firm data by working on the development of tools that crawl financial sites, such as EDGAR and the filings of the SEC to update the company database in an automated fashion. Jan Pachon began in June 2012 to code the spidering and extraction of financial records. A large number of candidate firms (~50,000) have been programmatically identified by Pachon as participants in the nanomaterials research, manufacturing and market worldwide. During the present funding period specifications and models for automatic gathering of corporate data in nano and population of a comprehensive nanomaterials and nanofirm database was completed. Testing and revision are presently underway. Other research groups (Darby and Zucker, Roco, and others) currently focus on NSF-funded work in nano. Our dataset now incorporates NIH funding data as well. During the present funding period Herron completed work on incorporating NIH RePORTER data, which contains funding of NIH-supported projects, PI information, publications, and patents produced with support of the grant. We plan to do this same thing for NSF projects next. In the interest of accelerating the advancement of this development Herron and Lenoir hired a computer engineering graduate student with Jenkins Chair research funds, Lanceton Mark Dsouza, who began work with our group in 2012. Dsouza began to develop a web-based social network visualization application designed to interact with users and the GLOBONANO database. In August 2012 Dsouza completed the first draft of the social network web tool, which takes already-generated social network data and renders both dynamic and static social network graphs of coauthorship within the nanotechnology research literature. Dsouza finished a second draft of the software in early September 2012 that incorporates a web interface. Through November and December Dsouza continued to work on a third version of the social network graph which connects with the live GLOBONANO database and has a fully featured

interactive web interface designed for those without programming skills. The first working prototype of this web-based social network visualization of globonano was completed in January 2013. A refinement and extension of features of the tool into a more user-friendly web interface is in currently in development.

During November 2010 Herron began work with Aashish Mehta on performing a global-level study of international collaboration trends in the nanotechnology research literature. Herron generated aggregate data on East Asia, the US, Russia, the EU from the GLOBONANO database after significant enhancements were performed on the db construction process in March 2011. The data were used by Mehta, Herron and Motoyama in late March 2011 to analyze trends in internationalization revealing significant fluctuations in Chinese nanotechnology publications along the lines of international collaboration. Further a global trend of globalization and de-globalization was revealed to be a significant factor in global international collaboration over the last decade. Mehta, Herron, Motoyama, Lenoir and Appelbaum co-authored a paper from March through October 2011; Mehta sent the paper out in October 2011 for review. The paper was accepted with revisions and published in Scientometrics, Online First, in March 2012.

Herron and Lenoir began new work with Mehta and Cong Cao, extending the analysis of the original paper to look at specific country pairings in international collaborations. Herron produced a data set for Mehta in early September 2012. A rough draft of the paper, "Measuring the Impact of International Collaboration in Nanotechnology Research," is now in place and work is continuing. Three additional papers are also in preparation and/or under submission (Lenoir is the leading author on all three):

- "The National Cancer Institute and the Takeoff of Nanomedicine," submitted to *Research Policy*
- "Star Scientists, Federal Funding and the Takeoff of Bionanotechnology and Nanomedicine," under preparation
- "The Takeoff of Nanomedicine: The Importance of the NCI Alliance for Nanotechnology in Cancer," submitted to Katy Börner (ed.), *Science Maps Showing Trends and Dynamics 2013*

IRG 2-5: Global Value Chain Analysis: Frederick, Appelbaum, Harthorn, Herman

This project entails value chain mapping of California and the United States in the global nanotechnology economy. Objectives include identifying firms working in each stage of the supply chain from nanomaterials through end-markets, analyzing the impact of value chain dynamics in each stage such as policies, risk, perception, and competitiveness factors, and evaluating how these are linked together in California and how California compares to competing geographies. Outcomes will include a California in the Nanotechnology Global Economy website. The website and database are complete, although development has continued through the addition of over 70 company and supporting organization profiles. Additionally, Frederick collected and cleaned bibliometric data on nanotechnology in Mexico for Zayago Lasu and Foladori, and began the process of value chain mapping their list of companies in Mexico to facilate their ongoing projects on Latin America. She also worked with Han, in support of IRG-2's China research, by collecting data and initial mapping of nanotechnology companies in China. One final project involves mapping the nanotechnology workforce by collecting basic data on all existing nano-related educational programs in the United States.

IRG 2-6: International Collaboration in Nanotech Research and Publication: Mehta, Lenoir, Herron, Cao, Han

Most countries engaged in nanotech research encourage international research collaborations. As noted above, the role of international collaboration in affecting the diffusion and impact of nanotechnology research, particularly in emerging economies, is a central concern of IRG-2. Two papers are under preparation as a result of this research. The first paper gauges a nation's scientific influence and its changes over time by the share of all citations to nanotech papers published in a given year that are to papers involving that nation. It then develops a decomposition of these trends to examine whether countries are making progress in the quantity or quality of their output. Key results are that: the US is losing relative influence due to a reduction in both dimensions (quality and quantity), the EU and Japan are falling behind on quantity but making progress on quality; Korea is gaining in quantity terms while losing in quality terms; and China, Taiwan and (especially Singapore) are making gains in both quantity and quality. The second paper uses regression analysis to examine the relationship between international collaboration and citation rates, mindful of the possibility that the benefits of international collaboration may vary depending upon the identity of the collaborators. Key results so far are that papers involving collaborations between scientists from some given country and US and German scientists enjoy higher citation rates than papers involving only that country; that papers involving collaborations with Russian scientists are cited less often than single-country papers; and that the citation advantage of collaborations Chinese scientists have gone from negative to positive over the last decade.

Both papers were presented at the SNET conference in Twente, the Netherlands, in October 2012. The first paper is nearing completion and will be submitted to journals in the next two months. The second paper should be submitted before summer 2013.

One publication has resulted:

- Mehta, Aashish, Patrick Herron, Yasuyuki Motoyama, Richard Appelbaum, and Timothy Lenoir, "Globalization and Deglobalization of Nanotechnology Research - The role of China," *Sociometrics* 93 (2012): 439-458

IRG 2-7: Contributions of Foreign-Born Scientists to Nanotechnology Innovation: Walsh

This research employs an original dataset to examine the nativity of scientists making significant contributions to nanotechnology research and innovation. In addition to identifying individuals central in nano-innovation, the research highlights the internal globalization of the American scientific community and informs intellectual and policy debates on immigration and its impacts on the American knowledge economy. Kotoff's bibliometric methods were used to collect all journal articles on nanotechnology between 1999-2009. These were ranked by number of citations; the top 1%- or high-impact- articles were included in the study, which recorded the names of both corresponding and non-corresponding authors. Sources such as the biographical reference work *American Men and Women of Science*, department and faculty web pages, and Linked-In were used to determine the nativity of the population. Aggregate and yearly figures were benchmarked against the prevalence of the foreign-born in both the American scientific labor force and general population.

This research finds that the prevalence of the foreign-born significantly exceeds that of the general population and American Scientific community. Several trends are also apparent. First,

both the number of nanotechnology related articles and the number of foreign-born contributions increased each year. While the United States contributed the largest share of corresponding authors China, India and Germany also made significant contributions. A related study of all nanotechnology-related Ph.D. dissertations at US institutions between 1999-2009 (a total of 4,616 individuals) was used to generate a random sample of all Ph.D.'s; the sample was then used to conduct a survey that provides basic demographic information, as well as information concerning place of birth, citizenship and migration history. This will permit some insights into the career trajectories of foreign-born recipients of U.S. Ph.D.'s in nanotechnology. This project has thus far resulted in paper in progress ("The Impact of Foreign -Born Scientists and Engineers on American Nanoscience Research"), and one publication:

- Walsh, James and Claron Ridge, "Knowledge Production and Nanotechnology: Characterizing American Dissertation Research, 1999-2009," *Technology in Society* 34:2 (May 2012): 127-137

IRG 2-8: UCMEXUS/CONACYT Binational Collaboration (USA-Mexico) in the Development of Nanotechnology; Establish connection with ReLANS: Foladori, Záyago Lau, Parker, Appelbaum

This joint project, with the Doctoral Program on Development Studies at the University of Zacatecas (Mexico), analyzes the development trajectory of nanotechnology in Mexico, with special attention to scientific collaboration and productive agreements between U.S. and Mexican institutions. The project was completed summer 2012 (the final report was filed September 29, 2012). Follow-up work continues – most notably the previously mentioned September 2013 conference on labor and nanotech in Curitaba, Brazil, hosted jointly with ReLans (and funded in part by my MacArthur Chair funds), the purpose of which is to evaluate the drivers of nanotech development in Mexico and other Latin American countries, as well as and assess nanotech's impact on the workforce. Also, as noted previously, Zayago Lau has joined IRG-2 as a postdoc. Among his papers in preparation/under review are:

- Nanotech Education in Mexico (in preparation)
- "Empresas Nanotecnológicas en México: Hace un Primer Inventario" (under review at *Estudios Sociales*)
- "Politica de Ciencia y Tecnología en México; El Caso de las Nanotecnologías (co-authored with Guillermo Foladori and Eduardo Robles-Belmont; under review at Argumentos Magazine-UAM)

A number of publications have resulted since March 2012:

- Foladori, Guillermo, Lau, Edgar Záyago, Appelbaum, Richard, and Parker, Rachel. "Mexico-U.S. scientific collaboration in nanotechnology." Revista Frontera Norte (English edition) 27(47): 2012
- Foladori, Guillermo and Noela Invernizzi, *Social and Environmental Implications of Nanotechnology Development in Latin America and the Caribbean*. Texcoco, Mexico: Impresas Gama, 2012
- Foladori, Guillermo, Edgar Záyago Lau, Remberto Sandoval, Richard Appelbaum, and Rachel Parker (2012) "Mexico-U.S. Collaboration in MEMS/NEMS," *NanoEthics*
- Zayago Lau, Edga, "Pertinencia Social de la Nanotecnología en México," forthcoming in Miguel Ángel Porrúa y la Universdad Autónoma de Zavatecas (eds.), *Estudios Críticos del Desarrollo*

- Zayago Lau, Edgar; Foladori, Guillermo & Arteaga, Ramón (2013). Toward an Inventory of Nanotechnology Companies in Mexico, *Nanotechnology, Law and Business Journa*l, 9.3 (Winter 2012-2013) pp.283-292

IRG 2-9: Extend connection with ReLANS; conduct additional research on Mexico: Foladori, Záyago Lau, Appelbaum, Parker, Frederick

This project continues the collaboration with ReLANS (headed by Zayago Lau) that was initiated in IRG 2-8; it is intended deepen our understanding of nanotechnology in Mexico, as well as provide a comparative analysis of nanotechnology programs and policies in Latin America. One result will be the CNS UCSB-sponsored conference on nanotechnology and labor, held in conjunction with the ReLANS meeting in Curitiba, Brazil (September 2012). In terms of Mexico, a key objective is to uncover how nanotechnology research, production and consumption are integrated; as a leader in Latin America, second only to Brazil, Mexico stands out for its infrastructure, resources and activities related to nanotechnology R&D. There are three main components of this project: (1) Identifying the main actors doing nanotechnology research, including universities, research centers, and laboratories. Zayago Lau has completed most of this stage, including an extensive literature review, as well as an extensive web-research and review of most universities, research centers and laboratories in Mexico. It also involved on-line questionnaires to the directors or research leaders of the institutions. He is currently completing a database with all the publication records of these institutions in order to review what areas of nanotechnology research are these universities covering. (2) Creating a database with all the Mexican enterprises that conduct research in and/or produce nanotechnology in Mexico (completed by January 2013). Information was obtained via a variety of sources: Internet search (making use of identifiers such as nano+Mexico, enterprise+nano+Mexico, product+nano+Mexico); scientific articles and out-reach publications; presentations at conferences, forums and congresses; interviews with researchers who work in nanotechnology; archival review of the main newspapers in Mexico (*La Jornada*, *Reforma*, *Milenio*, *el Universal*, *El Economista*); media advertising; and companies located in the Nuevo León Nanotechnology Cluster. Once it was determined that a given company worked in NT, confirmation was obtained through by employing the following criteria: the information appears on the company's website, and/or was part of the company's official advertising, and or was made public by spokespersons for the company. (3) Creating a database of Mexican nanotechnology based/enabled products. This stage is currently being developed.

These results allowed for an estimated, verifiable quantity of enterprises that work in nanotechnology in Mexico, a spatial distribution of those companies determined by the location of the headquarters of each business, and a classification of companies by productive sector. The results have been published in NLBJ, Vol 9, 283 (Winter 2012-2013). We identified some 101 companies that research and/or produce with nanotechnology. These enterprises are concentrated in two geographic areas within the country: the Distrito Federal (Mexico City) and the state of Nuevo León. This article shows the concentration of enterprises by economic branch. It is worth noting, however, that a number of difficulties had to be overcome in the compilation of this inventory. In some cases, it was not possible to determine whether a given company was a reseller of imported products or if they produced nanomaterials that were incorporated into the productive process. Companies were classified according to the sectors in which their end-products were sold

In addition, Zayago Lau has been exploring the social sustainability of nanotechnology in Mexico. This issue is related to the developmental platform and the nanotechnology public policy that is currently being implemented in the country. The aim is to understand how the

areas of nanotechnology that are being developed in Mexico relate to the developmental problematic of the nation (i.e. poverty, inequality, underemployment, etc.). This was explored in a chapter of a book that already has been accepted for publication.

IRG 2-10: Bibliometric and Patent Analysis/Mapping, Kay

SA first objective is the exploitation of scientific publication and patent databases. This involves research article development, conference presentations and international journal submissions. Most of the work developed thus far is based on the application of data mining and visualization techniques to databases of scientific publications and patents in the field of nanotechnology. Current research thrusts include two lines of research started in previous reporting period, a) nanotechnology development in Asia and b) nanotechnology development in Latin America, and new work in the area of scientometrics, aimed at developing methods for scientific and patent literature analysis and topic discovery. Research aims in this reporting period included further development of at least one publishable research output in each research thrust and presentation of preliminary and final research results at key conferences. As of the reporting date, most of the work developed for this project has drawn on scientific publication and patent databases created by colleagues from Georgia Institute of Technology who collaborate with IRG 2 team on a number of projects. This allows access to reliable data and time to further develop own data sources. Some accomplishments relevant to this first objective:

Development of nanotechnology in Asia:

- "Corporate strategies and emerging technologies: the case of environment-related nanotechnologies and energy storage applications in Chinese firms" continued in collaboration with Youtie. A work meeting and conference paper presentation took place at the S.NET Conference 2012, Henschede, Netherlands, on October 23-25, 2012. After conference presentation this paper has been accepted for a peer-reviewed conference volume publication (book chapter) and work is being done for its completion. This paper uses patent data and other document analysis (company websites and industry report) to investigate case studies of Chinese companies in the field of nanotechnology and the application of this technology to develop energy storage products. The work draws on patent data provided by Georgia Tech.

- "An analysis of nanotechnology content in patent portfolios of companies in the energy storage sector" continued after poster presentation at the "Conference on Patent Statistics for Decision Makers 2012. Knowledge Assets and Economic Growth" held in Paris, France on 28-29 November, 2012. This work seeks to develop patent portfolio analysis techniques to understand commercialization of nanotechnology by companies from China and other leading countries in the energy storage industry sector. A research paper was prepared for the conference too, in collaboration with Appelbaum. The analysis draws on a dataset created to investigate the development of nanotechnology-enabled energy storage solutions (paper co-authored with Youtie) and previous research on patent visualization by Kay, L. et al. "Patent Overlay Mapping: Visualizing Technological Distance", submitted to the Journal of the American Society for Information Science and Technology (JASIST) (paper under review

Development of nanotechnology in Latin America:

- A new research project on "Nanotechnology development in Latin America" with focus on Argentina and Brazil has been started. This work involves a) bibliometric and patent

analysis at the country level to identify leading organizations, collaborations and areas of research and development of nanotechnology, b) country-level case studies and embedded company case studies based on interviews and document analysis to complement the quantitative analysis and better understand nanotechnology commercialization and corporate strategies in Latin America. Recent meeting with officials of Fundacion Argentina de Nanotecnologia in Buenos Aires, Argentina (August 6, 2012) provided key insights for research design and developed contact with key informants for further data gathering. This work is undertaken in collaboration with Appelbaum, Shapira, and Youtie. An outline for research paper and conference presentation abstract have been prepared for submission to the Atlanta S&T Conference 2013 to be held in Atlanta, GA, on September 26-28, 2013. IRB application and approval for interview protocols are pending (project research design needs further work before this can be done).

Scientometrics:

- New work on conference paper “A method for text network analysis: testing, development and application to the investigation of patent portfolios” has been started for submission to the 14th International Society of Scientometrics and Informetrics Conference, to be held in Vienna, Austria, on July 15-19, 2013. This ongoing work seeks to develop a method based on the text network analysis technique and explores its application of the analysis of scientific and patent literature. This has involved the development of a set of software routines that work with the software VantagePoint for text mining and data analysis and scripts based on open source visualization libraries to visualize outputs. A conference paper has been already submitted by Kay. Further work seeks to improve the method, explore its application to other projects of the IRG 2 group, and produce a publishable article

A second objective is to develop our own databases of scientific publication and patents in the field of nanotechnology. For this, IRG-2 has undertaken actions to acquire hardware, software and data licenses that will help to accomplish this goal. This ongoing work started on June 2012 has evolved to adopt the most effective data development strategy by partnering with colleagues of the Georgia Institute of Technology to have access to high quality data in the short term and develop own databases in the longer term. Planned actions aimed at developing own databases include, chronologically: the acquisition of IT hardware to host databases and process big datasets with software for text mining and data analysis and visualization (started in this reporting period); Vantage Point and other software installation and patent database creation using raw patent data (already acquired from the European Patent Office); development of an interface to enable database search by members of CNS-UCSB and colleagues from other institutions with no technical background; and download of raw data and creation of scientific publication database. Next steps involve the selection of the best offer for hardware and software purchase and proceed with deployment and implementation

A third objective has been to maintain and further develop collaborations with colleagues from other institutions, most notably Phil Shapira and Jan Youtie (Georgia Institute of Technology). Collaborations are expected in the form of article co-authorship, joint presentation at conferences (articles and panels,) and data/tools sharing. Shapira and Youtie visited the IRG 2 team in Santa Barbara, CA to initiate new projects and start a closer collaboration that involves data sharing, co-authorships in research articles, and joint panel presentations in conferences. We met and discussed (in person at the IRG 2 summit held on December 7-9, 2012, Santa Barbara, CA and via conference call in other two opportunities) data and research collaboration

plans. The purpose of these meetings has been to plan, implement and initiate data sharing strategies and start new collaborative projects. Three new projects have been started, including one on the development of nanotechnology in Latin America led by Kay.

Papers under preparation and under review include:

- Corporate strategies and emerging technologies: the case of environment-related nanotechnologies and energy storage applications in Chinese firms (Luciano Kay and Jan Youtie; under preparation)

- An analysis of nanotechnology content in patent portfolios of companies in the energy storage sector (Luciano Kay and Richard Appelbaum; under preparation)

- A method for text network analysis: testing, development and application to the investigation of patent portfolios (Luciano Kay; under preparation)

- Corporate strategies of Latin American companies in the field of nanotechnology (Luciano Kay, Richard Appelbaum, Philip Shapira, Jan Youtie; under preparation)

- ay, L. with Newman, N., Youtie, J., Porter, A. and Rafols, I. “Patent Overlay Mapping: Visualizing Technological Distance”, submitted to be considered for publication in the *Journal of the American Society for Information Science and Technology* (JASIST; under review).

- Kay, L. with Youtie, J. and Shapira, P. "Signs of Things to Come? What Intellectual Property Submissions Say About Corporate Strategies in Emerging Technologies”, submitted to be considered for publication in the Special issue of *Technology Forecasting and Social Change* (TFSC) from IM2012 conference; under review.

IRG 2-11: Open Doors: Chinese (and other foreign) students studying in the U.S. (Appelbaum, Han, Stocking, Gebbie)

We will be conducting a web-based survey of all foreign STREM graduate students and post-docs on student visas in UCSB's College of Engineering and NLPS Division, with the aim of getting some comparative data on why they came to the US/UCSB, why they didn't study in their home country, and what their post-graduation plans are. It will be instructive to compare Chinese with other foreign students. Since the repatriation of top STEM grads and postdocs is a major thrust of Chinese policy (the so-called "Thousand Telnts" and "Thousand Young Talents" Programs), this should shed light on some of the relative strengths and weaknesses of China and other countries' educational systems, as well as the push-pull factors that inform the decision to repatriate (or not to repatriate). We have acquired the list of students, and are putting the survey together. We hope to conduct the survey in the spring. If successful, we may do this onother campuses. There is a similar study being done at ASU, and we are incontact with the student who is conducting it. This also ties in with James Walsh's research on immigration policies.

IRG2-12: Will Nanotechnology Prove to be Disruptive? Effects on the Workforce of an Emerging Technology: Appelbaum, Foladori, Zayago Lau, Parker)

This project examines the current and likely future impact of nanotechnology on the workforce, globally by examining such issues as job creation and destruction, brain drain and brain circulation, the types and quality of jobs that are likely to result, training and retraining programs that will be required, and workplace health and safety issues. It examines these issues throughout the nanotechnology global value chain, from the production of raw nanomaterials such as carbon nanotubes (typically the most potentially toxic stage, and one that is most likely to occur in emerging economies) to the incorporation of nanomaterials into final products.

Nanotechnology also has the potential of becoming a transformative technology, much in the way that IT has proven transformative. Breakthroughs are anticipated in such diverse fields as low-cost hybrid (carbon, silicon) solar cells, targeted drug delivery, "labs-on-a-chip," ultra high-speed computing, and nanoporous filtration. While t**he U.S. National Science Foundation anticipates** a commercial revolution worth trillions of dollars within the next decade, with millions workers engaged directly in nanotechnology-related enterprises by 2015, along with many additional millions in supporting jobs, none of these studies have examined how many jobs will be lost as a result of productivity gains in these industries, from the circulation of knowledge workers back to their home countries, or from enterprises that cannot compete with nano-enabled products. This project seeks to examine the nanotechnology workforce and the many challenges faced not only by brain circulation in a knowledge-based economy, but also, challenges to workers producing nano-enabled products in a global economy.

These issues will be examined in a series of papers presented at a CNS UCSB-organized session at the June 2013 SASE meetings in Milan (Appelbaum organized and will chair the session; presenters include Parker and Frederick, Walsh, Zayago Lau, and Kulinowski, as well as a discussant (Gallo). This topic will also be discussed at the Curitiba, Brazil conference (September 2013)

5. Broader Impacts of IRG-2: As detailed throughout this report, IRG-2 has addressed two of the key issues resulting from the globalization of nanotechnology (and, indeed, emerging technologies generally): the extent to which national, state-driven policies can make a difference in advancing national goals with regard to R&D and commercialization of nano-enabled products, and – conversely – the extent to which the cosmopolitan nature of science, which increasingly depends and indeed thrives on cross-border collaborations, can enable advances to transcend national boundaries. Indeed, one of the emerging conclusions from this research is than national ambitions and global collaborations do not necessarily coincide. Another overarching concern of IRG-2 (indeed, of CNS in general) is the use of nanotechnology and other emerging technologies to foster more equitable and sustainable development; this concern is addressed throughout our research.

A further conclusion – which we draw in a preliminary way, since our comparative research is not yet complete – is that international collaboration notwithstanding, state policies can indeed make a difference in the rate of advance of nanotechnology research and commercialization. China, with its vast resources in foreign reserves and long tradition of state planning, has emerged as a strong global player in nanotechnology. While its overall capacity for innovation remains behind that of the U.S. and other advanced industrial economies, China's trajectory is unmistakable. *Ceteris paribus*, as a growing number of Chinese expat scientists and engineers return to China, attracted both by China's growing global prominence and generous incentives provided by national and local governments, we expect this gap to narrow. By way of comparison, Mexico – which lacks a central nanotechnology policy – is highly dependent on the research interests of its foreign collaborators, which may or may not coincide with Mexico's desire to advance its economic growth through high-tech development.

IRG-2 Publications 2012-2013

Primary Publications: Journals

1. Cao, Cong, Appelbaum, Richard, & Parker, Rachel. (forthcoming). Research is High and the Market is Far Away - Commercialization of Nanotechnology in China. *Technology in Society*.
2. Foladori, Guillermo, Figueroa, Santiago, Lau, Edgar Záyago, & Invernizzi, Noela. (2012). Características distintivas del desarrollo de las nanotecnologías en América Latina. *Sociológicas, 14*(30), 330-363.
3. Foladori, G., Figueroa, S., Záyago, E., & Invernizzi, N. (2012). Nanotechnology: Distinctive Features in Latin America *Nanotechnology Law & Business, 9*(1).
4. Foladori, Guillermo, Lau, Edgar Záyago, Appelbaum, Richard, & Parker, Rachel. (2012). Mexico-U.S. scientific collaboration in nanotechnology. *Revista Frontera Norte (English edition) 24*(48).
5. Mehta, Aashish, Herron, Patrick, Motoyama, Yasuyuki, Appelbaum, Richard, & Lenoir, Timothy. (2012). Globalization and De-globalization in Nanotechnology Research: The Role of China. *Scientometrics, 93*(2), 439-458. doi: 10.1007/s11192-012-0687-8
6. Motoyama, Yasuyuki, Con, Cao & Appelbaum, Richard. (forthcoming). Observing Regional Divergence in Chinese Nanotechnology Centers *Technological Forecasting and Social Change*.
7. Walsh, James, & Ridge, Claron. (2012). Knowledge Production and Nanotechnology: Characterizing American Dissertation Research, 1999-2009. *Technology in Society, 34*(2), 127-137.

Primary Publications: Books, Chapters, Reports and other Publications

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Submitted or in preparation publications: primary

11. Appelbaum, Richard. (in preparation). Intellectual property submissions and corporate strategies in emerging technologies: The case of nanotechnology for energy storage solutions in China.
12. Kay, Luciano. (in preparation). A method for text network analysis: testing, development and application to the investigation of patent portfolios.
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14. Kay, Luciano, Appelbaum, Richard, Shapira, Philip, & Youtie, Jan. (in preparation). Corporate strategies of Latin American companies in the field of nanotechnology.

15. Lenoir, Timothy, Herron, Patrick, Wiess, Ben, McGuire, Aaron, Pachon, Jan, & Dsousa, Lanceton. (in preparation). Star Scientists, Federal Funding and the Takeoff of Bionanotechnology and Nanomedicine.
16. Lenoir, Timothy, Herron, Patrick, Wiess, Ben, McGuire, Aaron, Pachon, Jan, & Dsousa, Lanceton. (under review). The Takeoff of Nanomedicine: The Importance of NCI Alliance for Nanotechnology in Cancer. In K. Börner (Ed.), *Science Maps Showing Trends and Dynamics*, *2013*.
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24. Kay, Luciano, Newman, N., Youtie, Jan, Porter, A., & Rafols, I. (under review). Patent Overlay Mapping: Visualizing Technological Distance. *Journal of the American Society for Information Science and Technology*.
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26. Ye, Xinyue. (in preparation). Space, time, and innovation: a review.
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28. Záyago, E. (under review). Pertinencia social de la nanotecnologia en Mexico. In M. Á. Porrúa (Ed.), *Estudios Críticos del Desarrollo*.
29. Záyago Lau, Edgar, Foladori, Guillermo, Appelbaum, Richard, & Figueroa, Edgar. (under review). Empresas nanotecnológicas en México: hacia un primer inventario. *CIAD Estudios Sociales Magazine*.

IRG 2 Presentations 2012-2013

1. Appelbaum, Richard. (March 29-31, 2012). Presenting a paper on labor-related issues that draws on China research. Penn State Conference on global workers' rights: University Park, PA.
2. Appelbaum, Richard. (April 1-3, 2012). "Making Blue the Next Green: Can CSR Help Improve Working Conditions in Global Supply Chains?" International Studies Association conference: San Diego, CA.

3. Appelbaum, Richard. (August, 2012). panel discussant, "Author Meets Critics: Unveiling Inequality: A World-Historical Perspective by Timothy Patrick Moran and Robert Patricio Korzeniewicz." American Sociological Association annual meeting Denver, CO.
4. Block, Fred. (September 2012). "Internal Tensions in the U.S. Model for Financing Innovation." Science Policy Research Unit, University of Sussex: Sussex, UK.
5. Kay, Luciano. (October, 2012). "Acquiring Nanotechnology Capabilities: Role of Mergers and Acquisitions in the Nanotechnology Ecosystem." Fourth Annual Conference of the Society for the Study of Nanoscience and Emerging Technologies (S.Net): Enschede, Netherlands.
6. Kay, Luciano. (October, 2012). "Emerging technologies and corporate strategies: The case of the nanotechnology for energy storage solutions in China." Fourth Annual Conference of the Society for the Study of Nanoscience and Emerging Technologies (S.Net): Enschede, Netherlands.
7. Mehta, Aashish. (October 2012). "The Scientific Influence of Nations: Quantity, Impact and the Role of International Collaboration in Nanotechnology." Fourth Annual Conference of the Society for the Study of Nanoscience and Emerging Technologies (S.Net): Enschede, Netherlands.
8. Parker, Rachel, & Appelbaum, Richard. (October, 2012). "China's Developmental State: Can China Become a Global Nanotech Innovator in the 21st Century?" Annual Meeting of the Society for the Social Study of Science (4S): Copenhagen, Denmark.
9. Stocking, Galen, Han, Shirley, & Matt, Gebbie. (October 2012). "Can China Become a Nano Innovator? An investigation into the Chinese nanotechnology communities in Shanghai and Suzhou Industrial Park." Fourth Annual Conference of the Society for the Study of Nanoscience and Emerging Technologies (S.Net): Enschede, Netherlands.
10. Zayago Lau, Edgar. (October 2012). "Developmental Implications of Nanotechnology." Fourth Annual Conference of the Society for the Study of Nanoscience and Emerging Technologies (S.Net): Enschede, Netherlands.
11. Zayago Lau, Edgar. (October 2012). "Nanotechnology and Development in Latin America: Rationales and Challenges." Annual Meeting of the Society for the Social Study of Science (4S): Copenhagen, Denmark.
12. Lenoir, Timothy. (November 27, 2012). "Federal Funding and the Takeoff of Nanomedicine." University of California, Davis: Davis, CA.
13. Kay, Luciano. (November 28-29, 2012). "How do companies embrace emerging technologies? The case of nanotechnology and energy storage applications in China" (poster). Conference on Patent Statistics for Decision Makers (PSDM): Paris, France.
14. Appelbaum, Richard. (February 23, 2013). Discussant on conference panel. UCSB Orfalea Center Global Studies Conference: Santa Barbara, CA.
15. Mehta, Aashish. (February 2013). "Globalization and deglobalization of nanotechnology research - the role of China." University of California, Santa Barbara, Global Studies Conference: Santa Barbara, CA.

IRG 2 Outreach activities

1. Block, Fred, "Research that Pays Off: Benefits of Federal R&D", Congressional Briefing organized by University Corporation for Atmospheric Research, March, 16, 2012.
2. Appelbaum, Richard, "Assessing the Economic Impact of Nanotech Conference" NSF-OECD meeting, March 26-28, 2012, Washington, DC.
3. Frederick, Stacey, attended International Symposium on Accessing the Economic Impact of Nanotechnology, March 27-28, 2012, Washington, DC.
4. Kay, Luciano, "Using Bibliometric and Patent Analysis to Map Global Innovation Pathways in Nanotechnology," CNS Seminar, CNS-UCSB, June 27, 2012, Santa Barbara, CA.
5. Appelbaum, Richard, video dialogue with Nanotechnology (GIN), Working Group, GIN is the

working group of the nanoscale Science, Engineering, and Technology Subcommittee, the interagency body responsible for coordinating the U.S. National Nanotechnology Initiative, which is the Federal program that oversees nanotechnology R&D, July 12, 2012.

6. Appelbaum, Richard, "WW Norton video shoot for introductory co-authored textbook (*Sociology 9e*)" July 22-24, 2012, New York City, NY.
7. Landers, Kelly, "Identifying the Role of California in the Nanotechnology Economy," paper presentation, Internships in Nanosystems Science, Engineering, and Technology (INSET) public presentations, August 1, 2012, Santa Barbara, CA.
8. Landers, Kelly, "Identifying the Role of California in the Nanotechnology Economy," (poster), Internships in Nanosystems Science, Engineering, and Technology (INSET), poster colloquium, August 9, 2012, Santa Barbara, CA,
9. Kay, Luciano, "Nanotecnología: de la ciencia aplicada al progreso social," Universidad Nacional del Litoral, Facultad de Ingeniería Química, August 23, 2012, Santa Fe, Argentina.
10. Block, Fred, "The Peculiarities of the U.S. Innovation System, Guanghua Leadership Institute organized by Cisco, September 2012, Mountain View, CA.
11. Gebbie, Matt, Han, Shirley, & Stocking, Galen, "Can China Become a nano Innovator: An investigation into the Chinese Nanotechnology Communities in Shanghai and Suzhou Industrial Park," CNS Seminar, CNS-UCSB, October 10, 2012, Santa Barbara, CA.
12. Zayago Lau, Edgar, "Developmental Implications of Nanotechnology," CNS Seminar, CNS-UCSB, October 10, 2012, Santa Barbara, CA.
12. Zayago, Lau, Edgar, "Developmental Implications of Nanotechnology, Seminar Speaker Series," Saint Marys University, November 2012, Halifax, NS.
13. Youtie, Jan & Shapiro, Phillip, "Is there a nanotechnology paradox? Interpreting trajectories of nanotechnology and innovation," CNS Seminar, CNS-UCSB, December 7, 2012, Santa Barbara, CA.

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IRG 3 Progress Report: Risk Perception and Social Response

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N. Pidgeon, Co-leader	Applied Psychology	Cardiff University, UK
T. Satterfield, Co-Leader	Env anthropology	University of British Columbia, CA
E. Barvosa	Chicana/o Studies	UC Santa Barbara
B. Bimber	Political Science	UC Santa Barbara
K. Bryant	Sociology	SUNY New Paltz
S. Friedman [X-IRG]	Science Journalism	Lehigh Univ, Bethlehem, PA
R. Gregory	Env Risk	Decision Research, OR
M. Kandlikar	Science policy	University of British Columbia, CA
J. Rogers-Brown	Sociology	Long Island University, NY
P. Slovic	Psychology	Decision Research, OR

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J. Conti	Sociology, Law	University of Wisconsin, Madison
J. Earl	Sociology	UC Santa Barbara
B. Egolf	Sci Journalism	Lehigh Univ
P. Holden	Microbiology, Eng	UC Santa Barbara
G. Long	Engineering	Compass Resource Management
M. Metzger	Communication	UC Santa Barbara

.5 [+5*] Postdocs, 4 [+5*] Grads, 2 Undergrads, 1 HS student

Postdoctoral researchers:
*Mary Collins, Env Sociology (UC CEIN, beg Oct 2012)
Shannon Hanna, Ecotoxicology, Biostats (0.5 FTE Jan-Mar 2013)
*Christine Shearer, Sociology (0.5 CNS Educ & Outreach)
International: *Adam Corner, Social Psych (Cardiff UK)
*Christina Demski, Social Psych (Cardiff UK)
International: *Anton Pitt, Env Risk (UBC)

Graduate students:
Social science/humanities:
*Mary Collins, Environmental Soc (UC CEIN Mar-Sept 2012)
Lauren Copeland, Poli Sci
*Rachel Cranfill, Linguistics (unfunded)
*Amanda Denes, Communication (unfunded)
Cassandra Engeman, Sociology
Chloe Lenow-Diamond, Feminist Studies
*Ariel Hassell, Communication

Nanoscience/Ecotox/EnvSci:
Shannon Hanna, Environmental Science (Mar–Dec 2012)
International: *Christian Beaudrie, Environmental Risk (UBC)

Undergraduate students:
UCSB: Maria Yepez, Biochemistry
Community college: Eddie Triste

High school student: Hannah Cruz, DPHS

**partially or fully co-funded from another source*

1. Introduction: The overarching goals of IRG 3 are to generate new knowledge about the perceived risks and benefits of nanotechnology and related social action among multiple stakeholders in the nanoenterprise, to explore methods for public engagement in the US context, and to contribute to work in the CNS to disseminate the knowledge gained to an array of critical stakeholders, including diverse US publics, the engineered nanomaterials industry, and policy makers/regulators.

2. Goals: Will nanotechnologies experience public backlash and stigma when they are developed and disseminated that could limit the realization of their potential economic and/or social benefits? This question and its attendant uncertainties have arguably driven US federal investment in research on the societal implications of nanotechnologies, including the CNS at UCSB. The answer to this deceptively simple question hinges on a complex and dynamic set of social, political, economic, and cultural factors that past research has identified as likely to drive sustainability and acceptance or controversy and failure of these new technologies. In addition to economic issues such as job creation or loss, we anticipate primary focal points of public concern to be risk, benefit, regulation, trust, responsibility, and justice, and the degree to which experts share, anticipate, and address these concerns is a powerful predictor of the likelihood of ensuing controversy. IRG 3 thus conducts novel social research on formative nanotech risk and benefit perceptions over time through a well calibrated set of mixed qualitative and quantitative social science research methods aimed at studying the views and beliefs about emerging nanotechnologies by multiple parties. By 'multiple parties' we mean people in numerous social locations and positions—nanoscale scientists and engineers, nano risk assessment experts, regulators, industry leaders, NGOs or other social action and special interest groups, journalists, and members of the public who differ by gender, race/ethnicity, class, occupation, education, and age, as well as nation. An important aspect of our work is to investigate the diversity and nuances of views both within and across these categories of difference, which we pursue because of the demonstrated importance of democratic participation to the success of the innovation system (cf., Dietz and Stern, NRC, 2008), the ethical imperatives, and the challenges to full participation posed by a large and complex multicultural society such as the US.

The theoretical framework for this suite of research projects at inception of the CNS in 2006 was the Social Amplification of Risk Framework (e.g., Kasperson, Pidgeon, & Slovic, 2003), which has been useful in understanding the evolution of past risk controversies. However, thus far, as our work has shown (Satterfield et al., 2009, *Nature Nanotech*), nano R&D has evolved with only modest evidence of significant public awareness, amplified risk perception, or media attention, and as a result, IRG 3 research has moved progressively into more experimental research modes in the context of such continuing low ("upstream") public awareness and low risk signal amplification even as the technologies themselves are moving downstream into wider commercial production and dissemination. Regulatory action has the potential to impact perceived risk quickly and hence is also a vital component of research. This unprecedented lengthy opportunity to study emergent attitudes, beliefs and perceptions is a particular attraction of the nano context for risk analysis, although it brings unique challenges as well. As the work progresses, analysis also focuses on comparative analysis of other emerging technologies with analytically or socially and politically useful similarities and/or differences.

The projects and activities in IRG 3 are organized around the main information and action nodes in the risk amplification framework: scientists, regulators, industry, general publics and more specialized public interest groups, and the media. Specifically, the activities within IRG 3 are designed to foster a greater understanding of the factors that contribute to the perceptions of different stakeholders regarding the social and physical risks (and benefits) of nanotechnologies, of how risk perceptions impact critical behavior, such as industrial EHS

practices, and the importance of equitable distribution of both benefit and harm in the development and application of nanotechnologies. As a result, we have conducted ongoing research on critical stakeholder groups – including the everyday public, organized groups, scientists, industry, environmental health and safety professionals, and regulators.

Quantitative methods used in IRG 3 include: standard, psychometric, consumer, and experimental decision pathway phone and web surveys of demographically diverse US (and other) public and a range of experts including scientists and engineers, regulators, and industry leaders; experimental research on factors driving group polarization in emerging nanotech debate, and tracking of print and internet media coverage of nanotechnologies; qualitative methods provide a substantive basis for and validation of quantitative results and include mental models interviewing, expert interviews, ethnographic interviews, and deliberative public engagement workshops and focus groups regarding the risks and benefits of specific applications of nanotechnologies, in addition to media report analysis. In the past year, researchers in IRG-3 performed work in the main areas detailed below.

Our major goals and accomplishments to date have been to:

- Develop new knowledge about key factors likely to drive critical stakeholder groups' *perceptions of risks and benefits* of specific applications of nanotechnologies, with a particular focus on applications for health and energy. We have pursued this work through a range of studies and methodological approaches and now have a unique body of longitudinal data.
- Examine emergent perceptions, attitudes and beliefs of the US (and comparative other) publics. In particular, we have experimentally examined effects on risk versus benefit judgments and acceptability judgments of application characteristics, risk signal effects, knowledge of nano, affective response, vulnerability and other individual characteristics, and conditions under which reversal of preferences take place.
    - A two-stage survey examines environmental risk perception, looking at risk signal sensitivity in relation to application domain and particular engineered nanomaterials, and develops a novel new measure of perceived environmental resilience of air, water and soil.
    - Midstream/downstream effects are being explored in this survey by examining nano risk perception in relation to consumer product safety attitudes.
    - Another survey examines political consumerism and how perceptions of nanotechnology affect consumers' decisions to avoid or purchase products with nanomaterials.
- Conduct a series of cross-national and US-focused deliberative workshops focused on depth understanding of emergent public views on nanotech applications in the health and energy. The more recent set of US workshops focus on gender dynamics in technological knowledge production in the deliberative setting; current work focuses on expanding the gender focus to look at race and ethnicity and incorporating political theories on participatory democracy. Planning has begun for a possible new series of workshops in both the US & UK that will compare upstream risk concerns between nanotech and fracking, using the attuned understandings of gender and race developed in our earlier work.
- Study nanoscientist, nanotoxicologist, and nano regulator judgments on risk across applications and types of nanomaterials used through mixed methods approaches that provide both depth understanding of the processes through which judgments are formed and broader evidence of the variance in aggregate views of different expert populations.
- Develop a state-of-the-art structured decision making workshop to engage with a select group of elite scientific experts on nano risk pathways for specific high use applications (carbon nanotubes, nano silver).
- Study regulatory challenges across the product life cycle.

- Analyze how the international nanomaterials industry's perceptions of risk and regulation impact their environmental stewardship & workplace safety practices and their receptivity to the regulation of engineered nanomaterials.
- Gain understanding of the international landscape for nano-focused collective action. Develop a database and specific organizational profiles with particular focus on environmental, consumer product safety, agricultural, and labor issues. Link research to a large NGO-engagement event.
- Through X-IRG researcher Friedman, continue tracking of nano media coverage in print and online sources in the US and UK.
- Convene an international specialist meeting of leading researchers in the field and consolidate that new original research into an edited special issue of the leading risk journal, *Risk Analysis.*
- Hands on engagement with the nano risk assessment enterprise through direct participation at the leadership level in the UC CEIN. In particular contribute to reflexive practice in the UC CEIN around issues of responsible innovation, ethics, public engagement, and risk communication.
- Seed new projects that can extend the aims of the group.

3. Rationale, Approach and Organization: The activities in IRG 3 are designed to comprehensively examine the *situated knowledge, perceptions, and beliefs* of the main actors in the nanoenterprise. By "situated knowledge" we draw on social theory to indicate that knowledge (and imagination) are both shaped and conditioned (but not necessarily determined) by social location and position, and that social values, perception and knowledge production are socially organized and co-produced through dialogue (Stoetzler & Yuval-Davis 2002: 315-16). IRG 3 is organized into a set of linked collaborative projects - collaborating teams, lead listed first:

IRG 3-1: Expert studies - UBC, UCSB, Decision Research, Compass Resource Management

IRG 3-2: Emergent Public Perceptions of Benefits and Risks - UBC, Cardiff, UCSB, Decision Research

IRG 3-3: Upstream Public Engagement and Deliberation Research – UCSB, Cardiff, Long Island University, SUNY New Paltz

IRG 3-4: Nanomaterials Industry Risk Perception and Practices – UCSB, UBC

IRG 3-5: Framing of Nano in the Media (X-IRG) – Lehigh Univ

IRG 3-6: Priming Effects in Judgments about Public Policy - UCSB

IRG 3-7: The Politics of Consumer Choice - UCSB

IRG 3-8: NonGovernmental Organizations and Tomorrow's Nanotechnologies – UCSB, Univ of AZ, Long Island Univ., UC Irvine

IRG 3-seed project: Characterization of uncertainties in the life cycle assessments and risk assessments of nanotechnology – UCSB, see seed project program report, below X-IRG 6

Integration and synthesis of effort

IRG 3 effort takes place within a large, complex group, and integration is accomplished through frequent interactions, phone conferences, and meetings among the lead researchers and their teams. Individual project meetings occur on an approximately weekly basis; Harthorn, Pidgeon and Satterfield hold regular monthly teleconferences. In spite of this frequent interchange, the team has found that face-to-face meetings by IRG 3 leaders at least 1-2 times per year are essential to harmonize goals, assess progress across the different research projects, and

advance planning for new projects. In the past year, this has included a full-day IRG 3 meeting before the SRA-E meetings in Zurich in June 2012, and a half-day meeting at the 4S conference in Copenhagen in Oct 2012. IRG 3 organized full sessions of CNS-related research at both SRA-E (Zurich, Jun 2012; organized and chaired by Harthorn, Pidgeon & Satterfield), 4S (Copenhagen Oct 2012; organized and chaired by Collins & Engeman), and S.NET 2012 (Enschede, Netherlands Oct 2012; organized and chaired by Engeman). The group also organized sessions for the Society for Applied Anthropology meetings in Denver, March 2013 (Collins, chair), as well as proposed sessions at 4S (Oct 2013; Collins, Harthorn & Pidgeon chair), and the American Anthropological Association (Nov 2013, Harthorn, invited SMA/CASTAC panel). Additional sessions are planned for S.NET 2013 and SNO 2013. Harthorn, with collaborator Mohr**,** published *The Social Life of Nanotechnology*, Routledge, in July 2012. This volume integrates IRG 3 risk research (chapters by Pidgeon's group, Harthorn's deliberation group, Johansson's lab ethnographic work, Bimber's media framing group, and a theoretical contribution by Freudenburg & Collins) with other CNS work.

4. Major IRG 3 research accomplishments in the Center

The risk perception research within IRG 3 develops new knowledge on emergent perceptions, preferences, and practices in societal engagement with new technologies across an array of participants in the nanoenterprise. This effort contributes to scholarship in a large range of disciplines: anthropology, communication, environmental studies, feminist studies, linguistics, materials science, political science, psychology, risk analysis, science and technology studies, and sociology, as well as science and engineering fields. IRG 3 also contributes to the educational and outreach accomplishments of the CNS in a number of ways.

IRG 3-1: Expert Judgments about Nanotechnologies' Benefits and Risks**:** Harthorn, Kandlikar, Satterfield (leaders), Beaudrie, Conti, Gregory, Johansson, Long, Bryant

This work has strong synergies with IRG 3's public perception work and with our partners in the UC CEIN. In general we anticipate this work will allow us to better understand disciplinary and other contextual differences among the emergent risk assessment community and their counterparts in basic and applied NSE, as well as anticipating points of disjuncture with other stakeholders' views. This work builds on the foundational work of CNS collaborator, Paul Slovic, on the comparative toxicological assumptions of experts and lay persons.

IRG 3-1a*: Expert Studies-Regulatory Challenges*
One component of CNS-UCSB expert study, now complete, was conducted by Conti, an Asst Prof. of Sociology, affiliated in the Law School, at UW Madison, and focused on ***nano regulators and policymakers.*** His prior work with IRG 3 as a key collaborator on both the 2008 public risk perception survey and the 2006 industry EHS survey attuned him to the protocols and risk perception issues of interest, and his unique background as an expert on international governance provides an extremely useful comparative framework. In 2010-2011 he conducted an extensive series of interviews with US nano environmental regulators in which he explored their views on issues of regulating nanomaterials and nano-enabled technologies, particularly in the context of significant risk uncertainty and jurisdictional constraints that provoke "relational regulation" (Huising and Silbey 2011). This work connects directly to the expert web survey project (**IRG 3-1b**). The publication in preparation on this work aims to better understand how regulators think about risk, the way precaution and analogical references by regulators partially overcome what Beck has called "the ultimate deadlock of modern society," that is, the need to make decisions about oversight under conditions of uncertainty, and the way regulatory risk

judgment works as an inevitable form of discretion and informs risk management. A student on the project has also recently published an article (Becker 2013).

The UBC team's analytic work on ***regulation across the life cycle*** highlights the regulatory challenges in the nano case and links well to our collaborative work in the UC CEIN (Beaudrie, Kandlikar and Satterfield, in press 2013, *ES&T*). This publication is based on Beaudrie's Chemical Heritage Foundation commissioned study of regulatory gaps across the life cycle of nanomaterials (Beaudrie 2010). This work identifies critical gaps in US regulatory coverage across the life cycle of emerging nanotechnologies. They argue that these gaps create a regulatory "no-man's land" and make it difficult for regulatory agencies to collect risk relevant data, and conduct risk analyses for emerging nanomaterials at each stage of their life cycle. The focus on LCA (life cycle analysis) in this work aligns well with rising interests in the nano eco-toxicology world in the UC CEIN and elsewhere.

Closely connected to this, the UBC team (Kandlikar, Satterfield & Beaudrie) completed work with Decision Research structured decision making expert, Gregory, and collaborator Long, in developing and implementing a framework for expert elicitation of ranking nanomaterial risks in a 2-day expert workshop Vancouver held in in May 2012. The goal of the workshop was to understand the process of expert judgment formation in the context of high uncertainty about risks. They sought to develop generalized risk influence diagrams to track nano risk pathways (specific to carbon nanotubes & nano silver), identify measureable attributes for key risk factors, and test the feasibility of weighting risk concerns in light of attribute thresholds. This work is the culmination of several years work, in which they have argued that decision-analytic tools (such as risk-ranking, multi-criteria decision analysis, and control banding) can be adapted to help make decisions about emerging nanotechnologies and nanomaterials. Yet, they have found that decision analytic research and tool development is lagging and will require targeted funding mechanisms (Beaudrie & Kandlikar 2011). The workshop has yielded presentations by Beaudrie at SRA 2012, the Conference on Environmental Effects of Nanoparticles and Nanomaterials (Banff, Alberta, Sept 2012), a report, and funding proposals, with more results in preparation.

IRG 3-1b*: Expert Survey—NSE, Nanotox, NanoReg*

Building on interviews conducted by Harthorn and Bryant in 2006-2007 in California, UBC researchers Satterfield, Kandlikar & Beaudrie, with Harthorn, developed a systematic web-based survey of 3 samples of nano experts in 2010. The survey was delivered to 2130 nano-experts with 424 responses from nanoscientists and engineers (NSE), nano-EHS researchers (NanoTox), and nanotechnology regulators (NanoReg). Data analysis is now complete and papers are in final preparation for publication. In the reporting year, aspects of the findings were presented at UC CEIN (May 2012), CNS (May 2012), 4S (Oct 2012), SNET (Oct 2012) and SRA (Dec 2012), and 2 key publications nearing readiness to submit (Beaudrie, Satterfield**,** Kandlikar & Harthorn 2013 in preparation). The study explores experts' views on physical or technological risks, societal risks and benefits, laboratory practices (where appropriate), and regulatory challenges for engineered nanomaterials (ENMs) and nanoenabled products.

Results:

- The expert survey found consistent patterns in risk ranking of nanomaterial release scenarios and product applications across the three nano expert groups, suggesting a general trend and agreement in relative ranking of potential risks. Occupational exposures and environmental releases from production facilities were deemed most risky compared to other release scenarios and specific nano-applications.

- Nonetheless, they also found significant differences in risk perceptions across nano-expert groups, and across demographics including gender and race. They argue that these small but consistent differences in risk judgment, once identified, should be taken into consideration and controlled when utilizing expert judgment under conditions of high uncertainty, such as when conducting risk analysis for emerging nanomaterials.
- Experts in regulatory agencies judge risks across a range of nano-application categories to be significantly higher than corresponding judgments of NSE and nano-EHS researchers. Somewhat surprisingly, regulators in this study are also *more* likely than the other two groups to agree that US regulatory agencies are inadequately prepared for controlling risks from nanotechnologies across application categories.

See X-IRG section below for an update on ethnographic laboratory studies by Johansson.

IRG 3-2: Emergent Public Perceptions of Benefits and Risks (survey research): Satterfield, Pidgeon, Harthorn, Conti, Collins, Corner, Hanna, Pitts

IRG 3-2a: Public perceptions, emergent preferences
Since 2009, the team has continued analysis and write up of data from the 2008 national survey, preparing a series of papers from this work, focusing on key contextual, experiential, affective, and demographic factors that seem to be driving nanotech perceived risk, perceived benefit, reversals of judgments about risk vs. benefit, and construction of preference. The first of these on vulnerability and inequality as factors in risk perception was published in *Risk Analysis* (Conti et al. 2011), 1 on judgment reversals was published in *Science and Public Policy* (Satterfield**,** Conti et al., 2012), and another on affect and ambivalence response is in final steps of revision for resubmission (Satterfield, Corner et al., 2013).

The UK team led by Pidgeon has been vital to every step of this research, from conception to fielding to data analysis and write up and dissemination, as well as contributing key effort to the deliberation research, other public attitude survey studies, including environmental risk perception survey research, and research planning for IRG 3. Pidgeon has extended CNS-based upstream work into climate geoengineering, incl. his 2nd *Nature Climate Change* piece recently (Pidgeon et al. 2013) on deliberating stratospheric aerosols. IRG 3 plans for the next 2 years include possible new deliberation research in the US and UK.

IRG 3-2b: Environmental Risk Perception Survey; Satterfield, Harthorn, Collins, Hanna, Pitts

Leverage: The CNS IRG 3 collaboration with researchers in the UC CEIN offers an unprecedented opportunity for co-production of risk knowledge by scientists and societal researchers. Primarily funded through the UC CEIN Theme 7, the team has conducted research on environmental risk perception in a dually novel area (specific engineered nanomaterials—ENMs-- as nested in distinct perceptions of different environmental media). In order to accomplish this, the group has completed 2 public perception surveys: an initial study of public perceptions of air, water, and soil alone and in interaction with ENMs based on a series of mental models interviews. Papers on these findings are in final preparation for submission. Selective findings from this pilot survey on environmental risk perceptions of ENMs of US public (n=750) include:

- Reporting that ENMs are present in air, soil, and/or water leads to respondents scoring the ENMs as more difficult to detect and/or measure in the environment (i.e., to touch, feel, see, describe, measure, sample and test). Those who see ENMs as highly intangible are more likely to have higher risk ratings for some materials.

- Respondents who rated the environmental media of air, water, and soil as more resilient (i.e., recovering easily from human impacts, self-cleaning over time, mostly pure, easy to control) also tended to see the benefits of various technologies as outweighing the risks, to accept specific nanotechnologies, and to agree with reassuring statements about environmental toxicology (Satterfield, Collins, Hanna, Pitts and Harthorn, in preparation 2012).

A stage 2 web survey of a larger and more representative sample (n=2500, with oversamples of 250 Latina/os and 250 African Americans) was completed by YouGov in Nov 2012. Data analysis is well under way (Satterfield, Collins, Hanna, & Harthorn), and a series of papers is planned for completion in 2013.

IRG 3-2c: Decision Pathway Survey: Satterfield, Gregory, Pidgeon, Corner, Demski, Pitts

In the reporting year, the UBC-Decision Research-Cardiff team has developed a novel dialogic survey using decision pathway structures to gain an understanding about public views on environmental technologies including nanotechnologies and geoengineering. The survey is out for bid and will be run in parallel web survey modes by YouGov in the UK and US simultaneously in Spring 2013.

IRG 3-3: Public Participation in Nanotechnology R&D: Upstream Engagement and Deliberation Research: Harthorn, Pidgeon, Barvosa, Bryant, Rogers-Brown, Corner, Cranfill, Demski, Denes, Hanna, Nation, Shearer

The work in the past year has neared conclusion on analysis of the 2009 gender focused deliberations, with 3 more papers completed and currently under review, and 4 more in preparation. Meanwhile regular meetings and discussion w/ Harthorn, Bryant and Barvosa have advanced plans for new analysis focused on intersectional effects of gender and race. In general, the work supports findings from survey work on the highly gendered nature of technological risk perception but is aiming to explicate how, why and through what kinds of narratives and group dynamics such views are produced in public dialogue, as well as the kinds of responses they generate. These are important questions for participatory democracy. The Cardiff team (Corner & Pidgeon) took on a key writing task for *The Social Life of Nano* edited volume, producing an overview/synthesis of nano public engagement entitled: "Nanotechnologies and upstream public engagement: dilemmas, debates and prospects?" For this work, they created a comprehensive and up-to-date database of all (global) public engagement projects that were documented by either peer-reviewed publications or reports that reflected on data and methodology. The chapter argues that upstream engagement, though challenging in a number of respects, is an important aspect of responsible development. The database is included as part of the chapter and serves as an anchor for CNS discussions in the volume and other venues of the debates around upstream engagement.

Looking ahead, Harthorn's and Bryant's collaboration with UCSB feminist political theorist, Edwina Barvosa, has led to 2 papers and a possible book in preparation by Barvosa, and discussion of a possible future set of US/UK deliberations in 2014 that will incorporate a focus on racial/ethnic identity and multiple identities as factors in risk and benefit perception and deliberative outcomes with a proposed comparative focus on nano and new energy technologies such as fracking.

In addition the Cardiff team under Pidgeon has worked with UK House of Commons Science & Technology Select Committee inquiry on the Regulation of Geoengineering, arguing that any

investment in the physical science of geoengineering should be pre-empted by investment in social science too – so that public engagement on geoengineering can be as upstream and effective as possible. Their current work draws explicitly on CNS funded deliberative work and protocols (Pidgeon**,** Harthorn et al., 2009: *Nature Nanotechnology* publication) and the field of upstream engagement in nanotechnology more broadly. This work demonstrates the applicability of NNI-funded upstream nano research to other emerging technologies and its potential contributions to regulatory decision making and responsible innovation. The team's recent high impact publications in *Nature Climate Change* are excellent examples of CNS IRG 3 leverage.

IRG 3-4: Industry risk perception study (International survey)—Project completed Mar 2013; Harthorn**,** Holden**,** Satterfield**,** Engeman

This project, funded jointly with the UC CEIN IRG 7 (led by Harthorn), aimed to assess changes in industry EH&S views and practices, first studied in our 2006 international survey (Conti et al. 2008) and also add a new dimension of focused risk perception data on industry leaders in order to investigate links between perceived risk and behaviors such as company attention to and following of guidance documents for safe handling of nanomaterials, compliance with voluntary regulatory programs, attention to worker and environmental safety, waste management practices, and consumer safety. The phone and web survey concluded data collection in June 2010 (*n*=78 companies in 14 countries). The first publication (Engeman et al. 2012) demonstrated that industry leaders combine moderate to high risk perception or risk uncertainty about the nanomaterials they handle while holding a number of views inconsistent with risk and uncertainty that we interpret as indicating the need for regulatory oversight, such as a 'go it alone' attitude about risk management, the view that workers are responsible for their own safety, and lack of adherence to now widely available guidance document recommendations for safe handling. A second publication (Engeman et al. 2013 in press) focuses on the implications for worker safety of these findings for a US subsample (n=45) and is published in a leading industrial hygiene journal.

The industry survey project has been of significant interest to NSE, industry and regulators, as well as NGOs and publics, and the team has made numerous presentations outside of social science venues, for example CNS Grad Fellow Engeman's plenary keynote address in the NanoSafe conference, Grenoble, France, Nov 2012. As of Mar 2013, this project is completed.

IRG 3-5: Framing of Nano in the Media (X-IRG); Friedman, Egolf

The work on media framing of nano and analysis of news trends over time in coverage of nanotechnology led by Bimber in the first 5 years is concluded with one publication in press (Lively et al, forthcoming, 2012). Former grad researcher in this project Weaver is continuing his work in media analysis for CNS by producing the Weekly Clips publication for the CNS-UCSB. The study of media framing of nano, a critical issue in public opinion formation, has now shifted fully to collaborator Friedman at Lehigh University and her team, reported below under X-IRG initiatives. Friedman and Egolf have developed an extensive coding system for analyzing print media coverage of nano and will be exploring methods for studying on-line coverage in a valid and reliable fashion. Friedman supplements the print media report analysis with depth interviews with journalists to provide depth understanding of the changing media environment for risk reporting and communication of scientific uncertainty (Friedman & Egolf 2011; Friedman and Egolf 2012).

IRG 3-6: Priming Effects in Judgments about Public Policy (concluded). Bimber, Conroy**,** Lively

This project, led by political scientist Bimber, has examined the effects of issue framing on how the US public forms opinions about nano. The group developed a theoretical framework combining research in psychology on cognitive biases with theories of framing in political science and communication and completed an experimental web survey with about 700 subjects in 2010. The results show substantial contrast effects: that is, subjects primed first to think about a technological issue or other public problems tend to view a second, target issue or problem in contrast to the priming issue. They have investigated the effects on certain comparisons of an issue priming effect, in which conspicuous comparison evokes a process of mental contrast, resulting in audiences seeing the target issue as different rather than similar to the issue being compared. These final results of this project are under journal review (Bimber, Conroy and Lively, under review 2013).

IRG 3-7: The Politics of Consumer Choice; Copeland, Bimber, Hasell

Rising interest in consumer response to nano products makes a critical examination of likely response patterns timely. This project addresses three main research questions. First, how should political consumerism be conceptualized as a form of political behavior? Second, does political consumerism represent an alternative form of participation or a broadening of the conventional participation repertoire? Finally, what motivates people to engage in political consumerism? The work incorporates nano products in its design.

Copeland designed an extensive web survey administered by YouGov to a nationally-representative sample of 2200 U.S. adults. In contrast to other scholars who treat political consumerism as a singular act, Copeland theorized and found key differences between boycotting and buycotting. She hypothesized that boycotting should be more strongly associated with dutiful citizenship norms because it is punishment-oriented and has several key features in common with traditional, interest-based politics. Buycotting, conversely, should be associated with engaged citizenship norms because it is reward-oriented and has more features in common with civic engagement. The findings confirm these distinctions, and the work is in press with *Political Studies*.

Next, Copeland tackles the question of whether boycotting and buycotting represent alternative forms of participation or a broadening of the conventional participation repertoire. In contrast to scholars who conceptualize political consumerism as a reaction against representative political systems, and as an activity that appeals to people who feel marginalized and alienated from formal political settings, the project finds that boycotters are significantly more likely than non-political consumers to engage in electoral, individualized, and civic participation. In contrast, buycotters are only somewhat more likely than non-political consumers to engage in individualized and civic participation. These findings demonstrate that boycotting represents an expansion of conventional participation repertoires.

Most of the literature attributes the expansion of political consumerism to the rise of postmaterialist values, but has offered limited empirical evidence to support this supposition. This research finds that people with postmaterialist values are significantly more likely to engage in both boycotting and buycotting. However, people with pro-environmental beliefs are only significantly more likely to engage in buycotting. These findings demonstrate that the rise in postmaterialism and political consumerism in the U.S. is indeed linked. They also demonstrate the need to differentiate among postmaterialist values in future research. This research is currently under review by *American Politics Research*. These findings provide a solid foundation for the following article manuscript (in preparation): "Reactions to Nanotechnologies in the Marketplace: Risk vs. Benefit Frames and Political Consumerism," with Bimber, and Hassell.

IRG 3-8: NonGovernmental Organizations and Tomorrow's Nanotechnologies: Harthorn, Earl**,** Appelbaum, Rogers-Brown, Engeman, Shearer, Triste, Cruz

IRG 3-8a: NonGovernmental Organizations and Tomorrow's Nanotechnologies: Harthorn, Earl**,** Engeman, Triste, Cruz

This project focuses on an important and often ignored type of public – the non-governmental, self-identified representatives of and advocates for the public. Examples of such organizations in the nanotech context include: Greenpeace, Environmental Defense Fund, and Friends of the Earth Australia. This research began in summer 2011 and continued in 2012 by mapping the NGO *field* by developing an exhaustive, global matrix of more than 144 NGOs engaging in nano-specific environmental, workplace, and consumer safety issues. The work asks why have some NGOs coalesced concern with nanotechnology as opposed other issues? The summer 2012 work (with community college intern Triste and high school intern Cruz) built the nano-focused organization database and further developed a database and systematic summaries of comparative NGOs primarily concerned with other, non-nano environmental and human health issues, following the protocol developed and refined in other projects by collaborator Earl. Harthorn's interview for the August 2012 publication in *Nature* of an article on NGO possible roles in spurring eco-terrorist action against nanotech labs in Mexico has stimulated examination of the full range of NGOs, and a response article on this topic is in preparation. This work in turn contributes to CNS's planned public engagement efforts that include plans for a large international conference/workshop with NGO leaders in Spring 2014. Grad Engeman is the lead project coordinator for the conference, and a large group of interested campus scholars has been engaged to collaborate in shaping the conference.

IRG 3-8b: Civil Society Responses to Emerging Technologies in Mexican and Brazilian Agriculture and Food: Rogers-Brown, Shearer

This project newly initiated in 2012 provides a strong link between IRG 3 work on NGOs, risk perception and action and IRG 2's Latin American focus. Sociologist Rogers-Brown interviewed 32 farmers activists, and biotech and nano-experts in Mexico in summer 2012 about their perceptions of biotechnology and nanotechnology in food and agriculture, and then, with sociologist CNS postdoc Shearer, conducted interviews with 8 farmers, activists, and biotech nano-experts in Brazil a similar range of issues and views. They have begun data analysis and have presented preliminary results at the Society for Applied Anthropology, Mar 2013, in Denver (outside this reporting period).

Rogers-Brown's recent election as a representative for Sociologists for Women in Society to the UN Dept of Public Information provides CNS an excellent link to UN DPI meetings and resources.

IRG 3 Co-funding:
Leverage:
1) Nel, Andre et al. (NSF DBI-0830117), UCSB subk $8.7M (1.3M in CNS direct leverage funds in Theme 7) UC Center for Environmental Implications of Nanotechnology, Harthorn is Theme 7 ("Environmental Risk Perception, Regulation and Outreach") co-leader, Co-PI of the UCSB subcontract, and a member of the UC CEIN Executive Committee, 2008-2013; Satterfield and Kandlikar are Theme 7 senior personnel. The Theme 7 UC CEIN funding has allowed CNS IRG 3 to extend its research on expert views and public perceptions to more specifically environmental issues and to enhance participatory collaboration with NSE and ecotoxicology

researchers. UC CEIN has provided funds for a two-stage public survey on nano environmental risk perception, the 2009-2010 international industry survey (Engeman et al. 2012, Engeman et al. 2013); partial support of the expert survey (Beaudrie et al, report); lead support of the expert decision making under uncertainty workshop; and the Collins nanoremediation study. This support will draw to a close in 2013 at the conclusion of the first 5 years of funding of the UC CEIN.
2) Pidgeon, $525,000 UK Engineering and Physical Sciences Research Council. Integrated assessment of geoengineering proposals. October 2010 – September 2014 (EP/I014721/1). This work has used protocols developed in the CNS deliberative work to extend to public engagement regarding another new technology with very low public awareness and potential high impacts, geoengineering.
3) Harthorn, with UCSB Film & Media Studies colleague Janet Walker, was awarded an intramural ISBER C-RIG grant, Sept 2012-Aug 2013 ($4,000) for a project to develop funding for public participation in climate change risk discussions, as part of the:
4) UCSB Critical Issues in America program for 2012-13 on Figuring Sea Level Rise in which Harthorn is a participating faculty member (grant total, $25,000).
5) Harthorn is senior personnel in the renewal proposal for the UC CEIN, 2013-2018, at UCLA pending at NSF & EPA, $24,000,000. If funded she will continue her involvement in Theme 7 where she helps foster incorporation into UC CEIN work of current risk perception, risk communication, and public participation work.

5. Broader Impacts of IRG 3: Through the activities in IRG 3, we have demonstrated the importance of surveying critical stakeholders about their perceptions and beliefs, conducting research to understand the factors that contribute to those perceptions and beliefs, and acting upon the insights generated from those studies in the context of developing a large class of new technologies that government and investors wish to be both successful and sustainable. Through risk perception research in the center, we now have a better understanding of the priorities of critical stakeholders when it comes to both the regulation and deployment of nanotechnology, as well as how to engage with the general public in a way that builds trust both for academic researchers and for nanotechnology.

IRG 3 has contributed to CNS broader impacts through research on, education of, and outreach to key stakeholders in the nanoenterprise, sharing nano ELSI research and implications with: NSE (through partners in the CNS at UCSB, through numerous publication and professional presentation venues, and by incorporating NSE scientists-in-training into our ongoing societal research, education and outreach programs); with nano ecotoxicologists (through our research about their views on risk and regulation, and through a deep and mutually impactful collaboration with the NSF- and EPA-funded UC CEIN); with regulators (through qualitative and quantitative research, and analysis and synthesis of regulatory gaps; through leading the ELSI component of the UC CEIN in its work on safe development of engineered nanomaterials-ENMs; through engagement with California state, national and international regulators and policymakers on responsible development; through dissemination to NPEC, NNCO, PCAST, NAS and other key regulatory actors); with industry (through our novel survey research on the international ENM industry; through outreach and engagement with industry personnel in ours and UC CEIN's national advisory boards; through travel and dissemination of the research to industry audiences in the US, Japan, and Europe); through work with NIOSH on worker safety issues and methods for extending CNS/UC CEIN research on workplace safety; and to lay audiences through an array of formal and informal events and activities (CNS seminars and visiting lectures; 2 years of participation in UCSB Critical Issues programs--Speculative Futures, 2011-2012 and Figuring Sea Level Rise, 2012-2013; IRG 3 deliberative forums; social media use; Weekly Clips service; website development).

IRG 3, along with the rest of CNS, has had highly successful educational outcomes as measured by achieved employment of former fellows (nanoscience and social science) and postdocs in academia, industry, science policy, and NGOs. This contribution to the rising societal implications workforce is substantial and growing.

IRG 3 work also intersects with that in IRGs 1 & 2 and X-IRG projects in ways that both draw on and contribute to those efforts. In the past year that has included continued extensive interactions with IRG 1 graduate fellow Eardley-Pryor as his historical work on nano EH&S develops and draws on the extensive networks and knowledge of IRG 3 researchers working on EH&S risk issues, particularly in conjunction with the risk assessment efforts in the UC CEIN. IRG 1 leader McCray's book length work on US public imaginaries and early nano development published in 2012 provides temporal and cultural depth to the public delilberation work in IRG 3 as well. IRG 1 work on nano medicine (November) also contributes to IRG 3 focus on nano health applications, one of the main threads that connects our survey and deliberative work. IRGs 2 & 3 have shared interests in issues of equitable development that have brought them together in a number of research lines, a past large scale conference (2009), and the current work by Harthorn, Appelbaum & Engeman on a large scale NGO conference for 2014. IRG 3 researchers Rogers-Brown and Shearer are pursuing new CNS research in Mexico and Brazil in collaboration with IRG 2 collaborators Folodari, Invernizzi, and Lau. IRG 2 and 3 also collaborate in development of the X-IRG work by Fredericks at Duke on the US and global nano industry.

As indicated below, IRG 3 researchers have been active contributors to CNS education and outreach efforts in the past year.

IRG 3 publications 2012-2013

Primary Publications: Journals

1. Beaudrie, Christian E.H., Kandlikar, Milind, & Satterfield, Terre. (forthcoming). From Cradle-to-Grave at the Nanoscale: Gaps in US Regulatory Oversight along the Nanomaterial Life Cycle. *Environmental Science & Technology*.
2. Becker, Sean. (2013). Nanotechnology in the marketplace: how the nanotechnology industry views risk. *Journal of Nanopartical Research, 15*(1426), 1-13. doi: 10.1007/s11051-013-1426-7
3. Copeland, Lauren. (forthcoming). Conceptualizing Political Consumerism: How Citizenship Norms Shape Boycotting and Buycotting. *Political Studies*.
4. Copeland, Lauren, Zúñiga, H.G.Z., & Bimber, B. (forthcoming). Political Consumerism: Civic Engagement and the Social Media Connection. *New Media & Society*.
5. Satterfield, T., Conti, J., Harthorn, B.H., Pidgeon, N.F., & Pitts, A. (2012). Understanding shifting perceptions of nanotechnologies and their implications for policy dialogues about emerging technologies. *Science and Public Policy*. doi: 10.1093/scippol/scs084

Primary Publications: Books, Chapters, Reports and other Publications

6. Beaudrie, Christian, Kandlikar, Milind, & Satterfield, Terre. (forthcoming). "Nanomaterial Risks Expert Workshop Summary."
7. Copeland, Lauren, & Smith, Eric. R.A.N. (forthcoming). Political Consumerism: Citizen Activism in Response to Climate Change and other Environmental Problems. In Y. Wolinsky-Nahmias (Ed.), *Climate Change Policy and the Role of Society*. Washington, D.C: CQ Press.

8. Corner, Adam, & Pidgeon, Nick. (2012). Nanotechnologies and Upstream Public Engagement: Dilemmas, Debates and Prospects? In B. H. Harthorn & J. Mohr (Eds.), *The Social Life of Nanotechnology* (pp. 247-283). New York: Routledge.
9. Harthorn, Barbara Herr, & Mohr, John. (2012). Introduction: The Social Scientific View of Nanotechnologies. In B. H. Harthorn & J. Mohr (Eds.), *The Social Life of Nanotechnology* (pp. 1-15). New York: Routledge.
10. Harthorn, Barbara Herr, & Mohr, John W. (Eds.). (2012). *The Social Life of Nanotechnology*. New York: Routledge.
11. Pidgeon, Nick. (2012). Opinion: Shale gas and public acceptability. *Ingenia*(52), 10-11.
12. Randles, Sally, Youtie, Jan, Guston, David, Harthorn, Barbara, Newfield, Christopher, Shapira, Philip, Wickson, Fern, Rip, Arie, vonSchomberg, René, Pidgeon, Nick. (2012). A Trans-Atlantic Conversation on Responsible Innovation and Responsible Governance. In H. van Lente, C. Coenen, T. Fleischer, K. Konrad, L. Krabbenborg, C. Milburn, F. Thoreau & T. B. Zülsdorf (Eds.), *Little by Little: Expansions of nanoscience and Emerging Technologies*. (pp. 169-180) Heidelberg: Akademische Verlagsgesellschaft.
13. Rogers-Brown, Jennifer, Shearer, Christine, Harthorn, Barbara Herr, & Martin, Tyronne. (2012). Different Uses, Different Responses: Exploring Emergent Cultural Values through Public Deliberation. In B. H. Harthorn & J. Mohr (Eds.), *The Social Life of Nanotechnology* (pp. 195-222). New York: Routledge.

Leveraged Publications: Journals

14. Engeman, Cassandra, Baumgartner, Lynn, Carr, Benjamin, Fish, Allison, Meyerhofer, John, Satterfield, Theresa, Holden, Patricia, Harthorn, Barbara Herr* (*corresponding author). (in press). The hierarchy of environmental, health, and safety practices, in the US nanotechnology workplace. *Journal of Occupational and Environmental Hygiene.*
15. Corner, Adam, Pidgeon, Nick, & Parkhill, K. (2012). Perceptions of geoengineering: Public attitudes, stakeholder perspectives & the challenge of 'upstream' engagement. *Wiley Interdisciplinary Reviews (WIRES) Climate Change*. doi: 10.1002/wcc.176.
16. Maldonado, Julie, Shearer, Christine, & Bronen, Robin. (forthcoming). Climate Change, Displacement and Tribal Communities: Road Map for Adaptation Policies. *Climactic Change*.
17. Pidgeon, Nick , Corner, Adam, Parkhill, K, Spence, A, Butler, C, & Poortinga, W (2012). Exploring early responses to geoengineering. *Philosophical Transactions of the Royal Society (A), 307*, 4176-4196.
18. Pidgeon, N.F., Parkhill, K.A., Corner, A., & Vaughan, N. (forthcoming). Deliberating Stratospheric Aerosols for Climate Geoengineering and the SPICE Project. *Nature Climate Change*.
19. Rayner, S., C., Heyward, Kruger, T., Pidgeon, N.F., Redgwell, K., & Savulescu, J. (2013). The Oxford Principles. *Climactic Change*. doi: 10.1007/s10584-012-0675-2.
20. Shearer, Christine. (2012). Book Reviews: Kari Marie Norgaard's Living in Denial: Climate Change, Emotions, and Everyday Life. *Race, Gender, and Class, 10*(1-2).
21. Shearer, Christine. (2012). The Political Ecology of Adaptation Assistance: Alaska Natives, Displacement, and Relocation. *The Journal of Political Ecology, 19*.
22. Shearer, Christine. (2012). The Social Construction of Alaska Native Vulnerability to Climate Change. *Race, Gender, and Class, 19*(1-2).
23. Simakova, Elena. (2012). Making nano matter: An inquiry into the discourses of governable science. *Science, Technology, & Human Values, 37*(6), 604-626.
24. Xia, Tian, et al. (2012). Implementation of a Multidisciplinary Approach to Solve Complex Nano EHS problems by the UC Center for the Environmental Implications of Nanotechnology. *Small*. doi: 10.1002/smll.201201700.

Leveraged Publications: Books, Chapters, Reports and Other Publications

25. Parkhill, K., Pidgeon, N.F., Corner, A., & Vaughan, N. (forthcoming). Deliberation and responsible innovation: a geoengineering case study. In R. Owen, J. Bessant & M. Heintz (Eds.), *Responsible Innovation*. London: Wiley.
26. Shearer, Christine. (2012). The Human Face of Global Warming. In S. Bannerjee (Ed.), *Arctic Voices: Resistance at the Tipping Point*. New York: Seven Stories Press.

Submitted or in preparation publications: primary

27. Barvosa, Edwina. (in preparation). Ambivalence as Asset: Mapping Meaning & Epistemic Diversity in Public Engagement with Nanotechnology.
28. Beaudrie, Christian, Kandlikar, Milind, Satterfield, Terre, Robin, Gregory, Long, Graham, & Wilon, Tim. (in preparation). Expert Judgment-based Risk Screening for Emerging Nanotechnologies: A Collaborative Approach.
29. Beaudrie, C.E.H, Satterfield, T, Kandlikar, M, & Harthorn, B. H. (in preparation). Nanotechnology and Regulation: Experts views on regulator preparedness for managing risks from engineered nanomaterials. *Nature Nanotechnology*.
30. Beaudrie, C.E.H, Satterfield, T, Kandlikar, M, & Harthorn, B. H (in preparation). Scientists vs Bureaucrats: Precaution, Novelty, & Politics as predictors of perceived risk of ENMs. *Risk Analysis*.
31. Bimber, B, Conroy, M, & Lively, E. (under review). Ordinal Priming.
32. Bryant, Karl, Harthorn, Barbara Herr, Rogers-Brown, Jennifer, & Shearer, Christine. (in preparation). Gender and risk perception in deliberation of new technologies: Differences that matter. *Risk Analysis*.
33. Copeland, Lauren. (in preparation). Political Consumerism: Boycotting, Buycotting, and the Expansion of Political Participation Repertoires in the United States.
34. Copeland, Lauren. (in preparation). To What Extent is Political Consumerism Political? How Political Consumers' Motivations Inform our Understanding of Lifestyle Politics.
35. Copeland, Lauren. (under review). Value Change and Political Action: Postmaterialism, Environmentalism, and Political Consumerism. *American Politics Research*.
36. Copeland, Lauren, & Bimber, Bruce. (in preparation). Reactions to Nanotechnology in the Marketplace: Frames and Political Consumerism.
37. Copeland, Lauren, Bimber, Bruce, & Earl, Jennifer. (in preparation). Political Consumerism, Political Communication, and Political Organization.
38. Cranfill, Rachel, Bryant, Karl, Shearer, Christine, & Harthorn, Barbara Herr. (under review). What Kinds of Lay Expertise Matter? Public Science Deliberation and the Linguistic Construction of Traditional and Novel Expertise. *Public Understanding of Science*.
39. Denes, Amanda, Whirlow, Julie, Cranfill, Rachel, Hanna, Shannon, Shearer, Christine, Rogers-Brown, Jennifer, & Herr Harthorn, Barbara. (in preparation). Gender, talk and group dynamics in nanotechnology public deliberation.
40. Satterfield, Terre, Corner, Adam, Pidgeon, Nick, Conti, Joseph and Harthorn, Barbara Herr. (under review). Affective Ambivalence and Nanotechnologies. *Journal of Risk Research*.
41. Shearer, Christine, Rogers-Brown, Jennifer, Harthorn, Barbara Herr, & Bryant, Karl. (under review). Conservative White Men and Risk: Contextualizing "Low Risk" Views of Environmental and Health Hazards.
42. Satterfield, Terre, DeVries, Laura, Pitts, Anton, & Harthorn, Barbara Herr. (in preparation). "Crude Proxies," Racializing Narrative: Reporting biases and citation errors attributed to the white male effect.

Submitted or in preparation publications: leveraged

43. Barvosa, Edwina. (in preparation). At the Crossroad of Agonistic Democracy and Planned Public Deliberation: Innovation and Continuity in Contemporary Science Governance.
44. Barvosa, Edwina. (in preparation). *Decentering Democracy*.
45. Corner, A., Parkhill, K., & Vaughan, N. (under review). Messing with Nature: Exploring public perceptions of geoengineering in the UK.
46. Satterfield, Terre, Collins, Mary, Hanna, Shannon, Harthorn, Barbara, & Pitts, Anton. (in preparation). Resilience as a Primary Factor in the Perceived Environmental Risk. *Ecology and Society*.

IRG 3 Presentations 2012-2013

1. Parkhill, K., Pidgeon, Nick, & Corner, Adam. (March 2012). "Deliberating Geoengineering: Stratospheric Aerosols" (poster). Under Pressure Conference: London, England.
2. Beaudrie, C.E.H., Satterfield, T., Kandlikar, M., & Herr Harthorn, B. (April 2-4, 2012). "Nanomaterials and Expert Judgment: Risk Perceptions, Regulatory Preparedness, and Screening-Level Assessment." National Science Foundation (NSF) site visit to the UCLA Center for Environmental Implications of Nanotechnology: Los Angeles, CA.
3. Corner, Adam. (May 2012). "Public Perceptions of Geoengineering." IMPLICC Meeting: Mainz, Germany.
4. Beaudrie, C.E.H., Satterfield, T., Kandlikar, M., & Herr Harthorn, B. (May 7-8, 2012). "Nanomaterials and Expert Judgment: Risk Perceptions, Regulatory Preparedness, and Screening-Level Assessment." National Science Foundation (NSF) site visit to the UCSB Center for Nanotechnology in Society: Santa Barbara, CA.
5. Zuniga, H.G.D., Copeland, L., & Bimber, B. (May 2012). "Political Consumerism and Political Communication: The Social Media Connection." Annual meeting of the International Communication Association: Phoenix, AZ.
6. Engeman, Cassandra. (May 7, 2012). "Non-governmental Organizations and Nanotechnologies' Futures" (poster). National Science Foundation (NSF) site visit to the UCSB Center for Nanotechnology in Society: Santa Barbara, CA.
7. Shearer, Christine. (May 14, 2012). "The political-economy of risk perception: A socio-historical look at the climate change lawsuit Native Village of Kivalina v. ExxonMobil et al." UCSB Sociology colloquium: Santa Barbara, CA.
8. Collins, Mary, Harthorn, Barbara Herr, & Satterfield, Terre. (May 17, 2012). "A Nanotechnology Risk Judgment Analysis: Consumer Product Safety and Environmental Attitudes" (poster). Annual meeting of the Southern California Society for Risk Analysis: Los Angeles, CA.
9. Corner, Adam, Pidgeon, Nick, & Parkhill, K. (June 2012). "Moving Upstream from Nano to Geo - Public Perceptions and Geoengineering Proposals." Society for Risk Analysis Conference: Zurich, Switzerland.

10 Bryant, Karl, & Harthorn, Barbara Herr. (June 17-21, 2012). "Inequality, Risk, and Difference in Deliberations about New Technologies." Society for Risk Analysis: Zurich, Switzerland.

11. Harthorn, Barbara Herr, Pidgeon, Nick, & Satterfield, Terre. (June 17-21, 2012). Chairs and co-organizers of the symposium "Nanotechnology Risks - Intersections across the Social Sciences." Society for Risk Analysis: Zurich, Switzerland.
12. Satterfield, Terre, Harthorn, Barbara Herr, & Pitts, Anton. (June 17-21, 2012). "Intuition, Resilience and Perceived Environmental Qualities in the Case of Engineered Nanomaterials." Society for Risk Analysis -- Europe: Zurich, Switzerland.

13. Collins, Mary, Harthorn, Barbara Herr, & Satterfield, Terre. (June 18-20,. 2012). "Nanoremediation: Are there equity concerns?" (poster). SRA-E meeting: Zurich, Switzerland.
14. Pidgeon, Nick. (August 2012). "Public Perceptions of Geoengineering." Oxford Geoengineering Summer School: Oxford, UK.
15. Rogers-Brown, Jennifer. (August 2, 2012). "Participatory democracy and emerging technologies: A Feminist methodological analysis of public deliberations on nanotechnology." International Sociological Association: Buenos Aires, Argentina.
16. Beaudrie, C.E.H., Satterfield, T., Long, G., Gregory, R., Wilson, T., & Satterfield, T. (September 10-12, 2012). "Expert Judgment-Based Risk Screening for Emerging Nanotechnologies: A Collaborative Approach." 7th International Conference on the Environmental Effects of Nanoparticles and Nanomaterials: Banff, Alberta.
17. Corner, Adam. (September 12, 2012). "Messing with Nature: Exploring public perceptions of geoengineering" (poster). Tyndall Assembly, Cardiff University: Cardiff, UK.
18. Beaudrie, C.E.H., Satterfield, T., Kandlikar, M., & Harthorn, B. H. (October 17-20, 2012). "Nanotechnology Expert Perceptions: Benefits, Risks, Bias, and Regulation." Annual Meeting of the Society for Social Studies of Science (4S): Copenhagen, Denmark.
19. Collins, Mary, & Engeman, Cassandra. (October 17-20, 2012). Organizers and Chairs of the Panel, "Social Location and Nanotechology Risk Perception." Annual Meeting of the Society for Social Studies and Science (4S): Copenhagen, Denmark.
20. Collins, Mary, Hanna, Shannon, Harthorn, Barbara Herr, & Satterfield, Terre. (October 17-20, 2012). "People, Products and Nanotechnology: A Risk Judgment Analysis." Annual Meeting of the Society for Social Studies of Science (4S): Copenhagen, Denmark.
21. Cortes-Lobo, Rodrigo, & Engeman, Cassandra. (October 17-20, 2012). Organizers and Chairs for the panel "Public Interest Groups: The Role of Organizational Participation in Nanotechnology." Annual Meeting of the Society for Social Studies and Science (4s): Copenhagen, Denmark.
22. Engeman, Cassandra, Lynn, Baumgartner, Carr, Benjamin, Fish, Allison, Meyerhofer, John, Satterfield, Terre, Holden, Patricia, Harthorn, Barbara Herr. (October 17-20). "Voluntary Regulations in the International Nanomaterials Industry: Perceptions, Practices and Problems for Workers." Annual Meeting of the Society for the Social Study of Science (4S): Copenhagen, Denmark.
23. Harthorn, Barbara Herr and Bryant, Karl. (October 17-20, 2012). "Designing Deliberation: Social Location and the Politics of Difference in US Public Deliberations about New Technologies." Society for the Study of Social Science (4S): Copenhagen, Denmark (talk accepted, prepared and disseminated but not presented due to illness).
24. Pidgeon, Nick. (October 17-20, 2012). Organizer of symposium "Climate Engineering as a Societal Design Problem." Annual Meeting of the Society for Social Studies of Science (4S)/EASST Conference: Copenhagen, Denmark.
25. Satterfield, Terre. (October 17-20). "Intuitive Cognition in the Perception of Air, Water and Soil as They Interact With Engineered Nanomaterials: A Study of US Public Views." Annual Meeting of the Society for Social Studies of Science (4S): Copenhagen, Denmark.
26. Barvosa, Edwina. (October 19, 2012). "Ambivalence as Asset: Mapping Meaning & Epistemic Diversity in Upstream Public Engagement with Nanotechnology." Annual Meeting of the Society for Social Studies of Science (4S): Copenhagen, Denmark.
27. Beaudrie, C.E.H., Kandlikar, M., Long, G., Gregory, R., Wilson, T., & Satterfield, T. (October 22-25, 2012). "Governing the Uncertain: Expert Judgment Based Risk Screening for Emerging Nanotechnologies." Fourth Annual Conference of the Society for the Study of Nanoscience and Emerging Technologies (S.Net): Enschede, Netherlands.

28. Engeman, Cassandra. (October 22-25, 2012). "Non-Governmental Organizations and Nanotechnologies Futures." Fourth Annual Conference of the Society for the Study of Nanoscience and Emerging Technologies (S.Net): Enschede, Netherlands.
29. Engeman, Cassandra. (October 22-25, 2012). panel co-chair and co-organizer for "Public Interest Groups: The Role of Organized Participation and Activism in Nanotechnology Development." Fourth Annual Conference of the Society for the Study of Nanoscience and Emerging Technologies (S.Net): Enschede, Netherlands.
30. Harthorn, Barbara Herr. (November 20-24, 2012). co-organizer, SMA-CASTAC invited panel. American Anthropological Association: Chicago, IL.
31. Beaudrie, C.E.H., Kandlikar, M., Long, G., Gregory, R., Wilson, T., & Satterfield, T. (December 9-12, 2012). "Judgment-Based Risk Screening for Emerging Nanotechnologies: A Collaborative Approach." Society for Risk Analysis Annual Meeting: San Francisco, California.
32. Copeland, Lauren. (November 16-17, 2012). "Conceptualizing Political Consumerism: How Citizenship Norms and Values Shape Boycotting and Buycotting." Annual meeting of the Midwest Association of Public Opinion Research: Chicago, IL.
33. Satterfield, Terre, & Harthorn, Barbara Herr. (December 2-4, 2012). Invited presentation, "Environmental attitudes towards ENMs." NSF nano grantees meeting: Arlington, VA.
34. Pidgeon, Nick. (December 9-12, 2012). "Deliberating Geoengineering Risks: The Case of Stratospheric Aerosols and the SPICE Project" (poster). Society for Risk Analysis Annual Conference: San Francisco, CA.
35. Copeland, Lauren. (January 3-5, 2013). "Value Change and Political Action: Postmaterialism, Environmentalism, and Political Consumerism." Annual meeting of the Southern Political Science Association: Orlando, FL.

IRG 3 Outreach activities

1. Harthorn, Barbara Herr, Program Committee, SNET 2012, University of Twente October 22-24,2012, service January through October, 2012.
2. Harthorn, Barbara Herr. "Theme 7: Risk Perception, Regulation and Outreach" presentation to the NSF External Site Review Team, UC CEIN,UCLA, CNSI, April 2-4, 2012, Los Angeles, CA.
3. Harthorn, Barbara Herr, presenter in workshop on "Interdisciplinary Collaborative Research: How to Develop and Manage a Successful Program," ISBER UCSB, April 10, 2012, Santa Barbara, CA.
4. Engeman, Cassandra, volunteered for NanoDays, a family event held at the Santa Barbara Museum of Natural History to educate the public about nanotechnology, its applications and implications for society, April 14, 2012, Santa Barbara, CA.
5. Harthorn, Barbara Herr, Invited guest Consultant, NPEC (NNI NSET committee on public engagement), April 13, 2012, phone meeting.
6. Engeman, Cassandra, and Harthorn, Barbara Herr, teleconference presentation on industry survey to NAIHA (National American Industrial Hygiene Association), Nanotechnology Working Groups, April 18, 2012.
7. Harthorn, Barbara Herr, Invited testimony, NAS Review Panel of the NNI for OSTP, Beckman Center, May 15-16, 2012, Irvine, CA.
8. Corner, Adam, invited public lecture, 2012 Hay literature festival: http://www.hayfestival.com/p-4537-adam-corner.aspx , June 1, 2012.
9. Rogers-Brown, Jennifer, "Got Nanotechnology? It's here and transforming our lives" by Christina Mulligan, http://www.thirteen.org/metrofoucs/2012/06/got-nanotechnology-its-here-and-transforming-our-lives/, June 26. 2012.
10. Pidgeon, Nick appeared on BBC Radio 4 science programs, "Does Science Need the People" discussing deliberative work on emerging technologies

http://www.bbc.co.uk/programmes/b0117x3r, July, 2012.

11. Harthorn, Barbara Herr, media interview by Leigh Phillips reporter for article on nano NGOs and terrorism in Mexico, *Nature*, 388: 576-579, August 2012.
12. Triste, Eddie, "Nano Regulatory Policy and NGOs: A Global View," paper presentation, Internships in Nanosystems Science, Engineering, and Technology (INSET) public presentations, August 2, 2012, Santa Barbara, CA.
13. Triste, Eddie, "Nano Regulatory Policy and NGOs: A Global View," (poster), Internships in Nanosystems Science, Engineering, and Technology (INSET), poster colloquium, August 9, 2012, Santa Barbara, CA.
14. Pidgeon, Nick asked to forward and discuss with UK Science Minister (RT Hon David Willetts), CNS papers Pidgeon et al. (2009) and Satterfield et al. (2009), discussed factors influencing public attitudes to emerging technologies, September 2012.
15. Harthorn, Barbara Herr, "The Future of Responsible Development for Converging Technologies, Converging Technologies EU-US Workshop, September 20-21, 2012, Leuven, Belgium
16. Harthorn, Barbara Herr, delegate, EC-US Taskforce on Converging Technologies and Responsible Development, September 21-22, 2012, Leuven, Belgium.
17. Harthorn, Barbara Herr, US delegate, EU-US Workshop on Converging Nano-Bio-Info-Cognitive S&T for Responsible Innovation and Society, September 20-21, Leuven, Belgium.
18. Harthorn, Barbara Herr, "Public perceptions of Nanotechnology Risks and Benefits," CalNIN (California Nano Industry organization) meeting, University of California, Los Angeles, CNSI, September 25, 2012, Los Angeles, CA.
19. Collins, Mary, "Public Responses to Nanotechnology: Risks to the Social Fabric?" CNS Seminar, CNS-UCSB, October 10, 2012, Santa Barbara, CA.
20. Rogers-Brown, Jennifer, "No Alibis, "KCSB Radio interview regarding food security in Mexico, free trade, and issues of technology in agriculture and food production, November 2012.
21. Harthorn, Barbara Herr, US co-chair, Ne3LS Network International Conference 2012 on the Responsible Development of Nanotechnology: Challenges and Perspectives, November 1-2, 2012, Montreal , Canada.
22. Harthorn, Barbara Herr, Exec Committee of the AG-CENMs Project, Notre Dame, University, November 12-13, 2012, South Bend, IN.
23. Engemen, Cassandra, "Regulation, Risk, and the Global Nanotechnology Industrial Workplace,"invited opening plenary presentation, NanoSafe 2012, organized by the CEA/LITEN, French government-funded technological and renewable energy research organizations, November 13-15, 2012, Grenoble, France.
24. Collins, Mary & Hanna, Shannon, "Nanotechnology, Risk, and Consumer Products," CNS Seminar, CNS-UCSB, IRG3 panel presentation, November 28, 2012, Santa Barbara, CA.
25. Harthorn, Barbara Herr, Moderator, "Societal Dimensions of Nano & Environment," 2012 NSF Nano Grantees Meeting, December 3, 2012, Arlington, VA.
26. Harthorn, Barbara Herr, Co-Chair/Co-organizer, 2012 NSF Nano Grantees Meeting, December 3-4, 2012, Arlington, VA.
27. Harthorn, Barbara Herr, "Societal Dimensions of Responsible Innovation for Nanotechnology," National Webinar for the NACK (Nanotechnology Applications and Career Knowledge), Center at Pennsylvania State University, http://nano4me.org/webinars.php, December 14, 2012, University Park, PA.
28. Harthorn, Barbara, Herr, phone meeting with James Boiano, NIOSH feasibility study on nanomaterials in industry, March 4, 2013.

29. Harthorn, Barbara Herr and Collins, Mary, "Inspiring Science: Women in Nanotechnology," Santa Monica Public Library, March 17, 2013, Santa Monica, CA.
30. Collins, Mary, “Implementation: Environmental and Economic Justice,” guest lecture in, Environmental Science and Management (ESM) 241: Environmental Politics, UCSB, February 4, 2013, Santa Barbara, CA.

References cited

Dietz, Thomas, and Stern, Paul C., Eds. (2008). *Public Participation in Environmental Assessment and Decision Making.* Washington DC: National Research Council, National Academies Press. Available for download at: http://www.nap.edu/catalog.php?record_id=12434

Huising, R, and Silbey, S. (2011) Governing the Gap: Forging Safe Science Through Relational Regulation. *Regulation & Governance* 5, 15–43.

Gregory, R., L. Failing, M. Harstone, G. Long, T. McDaniels, & D. Ohlson. 2012. *Structured Decision Making: A Practice Guide to Environmental Management Choices.* W. Sussex, UK: Wiley-Blackwell.

Pidgeon, Nick, Kasperson, Roger & Slovic, Paul, Eds. (2003). *The Social Amplification of Risk*. London: Oxford Univ Press.

Stoetzler, Marcel & Yuval-Davis, Nira (2002). Standpoint theory, situated knowledge and the situtated imagination. *Feminist Theory* 3:315-333.

CNS X-IRG projects and Special Projects

B. Harthorn	Feminist Studies/Anthro	UC Santa Barbara
J. Mohr	Sociology	UC Santa Barbara
C. Newfield, Project leader	English/American Studies	UC Santa Barbara
D. Boudreaux	Commercialisation	Boudreaux and Associates
G. Gereffi, PI subk	Sociology	Duke Univ
M. Goodchild (retired Jun 2012)	Geography	UC Santa Barbara
S. Friedman, PI subk	Science journalism	Lehigh Univ
B. Egolf	Science journalism	Lehigh Univ
M. Johansson	Anthropology	Gothenburg Univ
S. Anderson, Seed project leader	Environmental politics	UC Santa Barbara
G. Legrady, Seed project leader	Media Arts & Tech	UC Santa Barbara
D. Novak, Seed project leader	Ethnomusicology	UC Santa Barbara
C. Walsh, Seed project leader	Anthropology	UC Santa Barbara

Affiliates

B. Davison	Computer Science & Eng	Lehigh Univ

1 Postdoc

Stacey Frederick	Business, GVC, GIS	Duke Univ

1 Grad, 2 Undergrads, 1 Technical staff

Graduate students:	Zach Horton, English, UCSB
Undergraduate students:	Christine McLaren, Sci & Env Writing, Lehigh
	Alexander Zook, Env Eng, Lehigh
Technical staff:	Jordan Herman, Duke Univ

CNS X-IRG and Special topic projects

In addition to the main body of research work in the CNS conducted within the IRGs, a number of strategic projects have been initiated in this renewal award period that span two or more IRGs or represent special initiatives designed to respond to rapidly emerging issues of interest in technology and society or develop tools and resources for the CNS. These “Cross-IRG” (X-IRG) projects contribute to the integration of efforts across the IRGs and to the synthesis of key interests

In the reporting year, these projects include:

X-IRG 1: The Social Life of Nanotechnology

X-IRG 2: Solar Futures: Science and Business Life in the Race against Climate Change

X-IRG 3: Spatial Analysis and the Global Value Chain for Nanotechnology/Nano in California

X-IRG 4: Nanotech in the Media

X-IRG 5: Ethnographic Explorations of Nanoscience and Nanotoxicology Laboratories

X-IRG 6: CNS Faculty Seed Grants on Societal Issues for New Technologies

X-IRG 1: *The Social Life of Nanotechnology:* Barbara Harthorn, John Mohr

The Social Life of Nanotechnology is an edited volume published by Routledge in July 2012, edited by anthropologist Harthorn and sociologist and cultural theorists Mohr, a collaborator in the CNS. CNS Board Co-Chair, John Seely Brown authored a foreword for the volume. *The Social Life of Nanotechnology* starts from the basic premise, developed throughout the text, that nanotechnologies have an under-theorized and often invisible social life that starts with the very concept of "nanotechnology" itself which, as we show in the volume, takes on a wide range of socio-historically specific meanings around the globe, across multiple localities, institutions and collaborations, through diverse industries, research labs, and government agencies and on into a variety of discussions within the public sphere itself. The volume looks at this process through the lenses of the social and cultural sciences, revealing a surprisingly complicated social milieu where a series of traditionally modernist scientific projects have been (and are continuously being) re-assembled into new configurations that are sharply marked by their emergence within a rapidly changing, increasingly globalized, and decidedly postmodern world. As the authors in this volume explain, this results in a series of unique contradictions, tensions and unexpected developments. We highlight three dimensions of this process in the papers: the early origins of nanotechnologies, questions about the social (and political) organization of the field, and studies concerned with the cultural and subjective meanings ascribed to nanotechnologies in social settings. With the publication, this project is concluded except for work by the editors to enhance dissemination of the book to diverse audiences. Harthorn has included reference to the volume in presentations to the NSF Nano PI meeting (Dec 2012), and all IRG 3 presentations.

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X-IRG 2: Solar Futures: Science and Business Life in the Race against Climate Change; Christopher Newfield, Daryl Boudreaux, Zach Horton

Newfield's project has posited that NST would not achieve the promised technical acceleration under status quo research conditions, but would require positive *deviations from norms of existing scientific and policy practice.* When the group looked for these deviations, the findings were predominantly negative. Indeed, one of our papers recommended that nanotechnology be officially redefined as "normal science" (Newfield 2012). This would help policymakers and the public see that positive deviations from normal science are rare and thus in need of active, systematic support. This year's research extends past findings in the solar sector, with special emphasis on the nano-enabled leading edge. They are identifying and describing elements they think could improve the overall innovation environment, including addressing some deeper cultural issues.

In 2012-13, the team has focused on three principal activities:
(1) Analysis of the impact of Si dominance in the solar cell market and its impact on the development and commercialization of Generation II and Generation III solar devices. This includes analysis of post-2008 decline of nano-solar sector.
(2) Finalization of the alternative innovation model (previously described as the Lyon Model) with particular emphasis on solar nanotechnological innovation, and completion of Lyon conference volume.
(3) Fate of solar: Interviews with laboratories, researchers, and companies in the US and Europe that may have an unusual set of innovation practices and therefore the capability of resisting the general difficulties of the nano-enabled Gen II & III solar sector.

Results: First, the group has continued ongoing development of a large database of corporate and scientific news and scholarly articles, compiled in Zotero and publicly available at Newfield's site, www.innovate.org, and linked from www.cns.ucsb.edu

Second, we refined our alternative innovation model and renamed Social Innovation of Technology; we elaborated it in two publications and a new drafted chapter of the Lyon conference volume. Our critique of the "linear model" still in widespread use attracted significant interest among German solar practitioners, was cited pre-publication by one of the country's leading thin-film scientists at a major conference in late September, and is proving its value as an analysis of the innovation crisis in a socially and environmentally-crucial nano-enabled technology sector. The team completed editing on *Can Rich Countries Still Innovate* volume

We continued to refine the model through our discussions with industry practitioners who are – unfortunately -- living through troubles we had anticipated as a likely outcome of the linear innovation model's outdated features: premature curtailing of government/public involvement with technology development, and overreliance on strong IPR and private capital investment in strategic technologies.

We have conducted an additional 25 formal interviews in the United States and Germany with the sectors of solar manufacturing, building integrated photovoltaics design, solar park and solar building construction, and government. Many informal meetings and conversations also conducted to accumulate detailed, real-time information about the current state of the sector. Newfield was involved with multiple actors in the German photovoltaic (PV) community during a period of bankruptcy and research reorientation. Horton filmed half a dozen interviews with thin-film practitioners at Intersolar-San Francisco, and made the material into a 15-minute rough cut film. Boudreaux provided scientific intelligence, innovation model analysis, and many back-channel interview prospects. Remarkably, our group has now had at least one contact with 80 - 90 percent of the universe of thin-film photovoltaic firms still in operation. With the exception of one new projected chapter in the book on solar futures, we are nearing completion of its research.

Thus, we now have a case study of the rise and fall of a major cleantech industrial sector in the West, and an explanation of why that sector is declining. The combination of a major technology story and an explanatory structure is potentially very significant, and the results will figure in two major book publications in progress.

Broader Impacts: The group's analysis supports the creation of programs that will develop a *public innovation ecosystem*, and *technocultural innovation education*, which would require cross-training in STEM and socio-cultural fields. Newfield has taught elements of the latter in W 2012 and F 2012 in English 197, "Creativity, College, Corporation.' The course identified the current paradigm of innovation, explored cultural variables that complicate this paradigm and suggest its incompleteness, and developed ideas for using cultural study to go beyond the current national innovation system. In W 2013 he offered a graduate seminar on "The Future of General Theory: The Case of Critical University Studies," which builds on the CNS tech transfer studies. Newfield also gave KCSB radio interviews on "Innovation Decline and the Leadership Crisis," in July, 2012 and on the wider issues of higher education as the context for innovation and change in "Higher Education and Innovation," in October, 2012. And he has been an invited speaker on innovation theory and the humanities in a broad range of contexts in N Europe as well as in California at UC Irvine and at Michigan Tech University, Indiana University and the

Pratt Institute in the past year. Horton has given presentations on the project's work and its film products in a number of venues.

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X-IRG 3: Spatial Analysis and the Global Value Chain for Nanotechnology/Nano in California: Stacey Frederick (supervised by Gereffi, Appelbaum, Harthorn & Goodchild)**,** Jordan Herman

This project entails value chain mapping of California and the United States in the global nanotechnology economy. Objectives include (1) identifying firms working in each stage of the supply chain from nanomaterials through end-markets, (2) analyzing the impact of value chain dynamics in each stage such as policies, risk, perception, and competitiveness factors, and (3) evaluating how these are linked together in California and how California compares to competing geographies. Aims include developing and making available the California in the Nano Economy website and developing a global database of nano-related firms and organizations.

In the past year, the goals have been: 1) to launch and develop the California in the Nano Economy website; 2) to continue to build the national and global nano firm database; 3) to identify the nanotechnology workforce; and 4) to help other working group members in IRG 2 with ongoing projects on Mexico and China.

The California in the Nano Economy website is a continuing working in progress, but is now available to the public at www.californiananoeconomy.org, and has a total of 370 company locations and 157 supporting organization locations at this reporting. Additional state-level information is continually added to the firm and supporting organization database to facilitate the development of the website and to aid in estimating the size and characteristics of the nanotechnology workforce in the United States. Toward the latter end, postdoc Frederick has collected basic data on all existing nano-related educational programs in the US. In addition, she has collected and cleaned bibliometric data on nanotechnology in Mexico for Zayago Lau and Foladori and has initiated value chain mapping their list of companies in Mexico to facilitate their ongoing projects on Latin America. She has also worked with Appelbaum and Han to initiate a new project to map nanotech companies in China.

In addition, instigated by a CNS IRG 2 meeting at UCSB in Dec 2012, Frederick has submitted a NSF proposal with CNS-ASU collaborators Shapira and Youtie at Georgia Tech to conduct a collaborative project on value chain mapping a subset of the global nanotechnology economy using data she has collected on firms and data they have on patents and publications. This would begin in September 2013 if the proposal is funded.

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X-IRG 4: Nanotech in the Media; Sharon Friedman, Brenda Egolf, Christine McLaren, Alexander Zook

This research contributes substantive data on areas of news coverage relevant to all 3 IRGs and other special projects. In the reporting year, X-IRG collaborator Friedman and her Lehigh colleague Egolf et al. continued their systematic longitudinal study of nano news coverage in print media in the US and UK (begun in collaboration with Harvard and UCLA in 2005), and also continued exploration of new media nano coverage by analysis of on-line articles and blogs at the *New Haven Independent*.

In 2012-13 they coded data on articles from a sample of 41 newspapers and 2 wire services that discussed environmental, health and social risks and regulation issues for 2011. Numbers for 2010 and 2011 continue very low: a total of 25 articles (12 US, 13 UK) in 2010, and 23 for 2011 (7 US, 16 UK). They have found that online articles and blogs trend in the opposite direction—from this one source studied in depth, 2010 produced 26 articles or blogs, and 2011 33 articles on the same topics. The move to analysis of blogosphere production has entailed extensive revision of the coding document; the incorporation of online search data in general necessitates extensive modification of the computer news collection program as both Google, Google News and Lexis Nexis have changed their protocols over the time of this project, and web crawling tools rapidly generate massive databases that in turn generate additional problems. Data analysis for this project is under way. Preliminary analysis was presented at the 2012 SRA meetings in San Francisco, and a publication is in preparation based on these findings. Discussion at Lehigh of comparison of risk issues between nanotechnology and hydrofracturing (fracking) will contribute to possible IRG 3 deliberation project in development.

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X-IRG 5: Ethnographic Explorations of Nanoscience and Nanotoxicology Laboratories: Mikael Johansson

During 2012, while reentering his professional obligations in Sweden at the Gothenburg University, Johansson continued analysis of the extensive ethnographic field data collected the during his postdoc at CNS 2009-2010 where he worked in affiliation with IRGs 1 & 3. He is in progress writing a book about the life worlds of nanoscientists and toxicologists studying the adverse effects of nano particles. During the year he completed revisions on several chapters and presented on the work at the 4S/EASST conference in Copenhagen in Oct 2012. Based on his CNS research he has initiated a new collaboration with anthropologist Åsa Boholm (Professor in Social Anthropology, Dept. of Global Studies at Gothenborg University, Sweden) and with her applied for money from the Swedish Research Council. Although the project was denied it received good reviews, and the reviewers wanted more ethnography in the project. They plan to reapply to the Swedish Research Council again with the revised project in April 2013.

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X-IRG 6: CNS Faculty Seed Grants on Societal Issues for New Technologies: Sarah Anderson, George Legrady, David Novak, Casey Walsh.

In order to generate new research and/or engagement projects that will involve new UCSB faculty participants in the CNS who will contribute to furthering the mission of the CNS, PI Harthorn applied to the NSF for a supplement in 2012 to fund a new seed grant program at UCSB. The NSF awarded $187,300 for this purpose in Sept 2012. CNS issued the 1st call for proposals in Fall 2012, generated an impressive applicant pool of 14 strong proposals, and through a rigorous peer review process by an interdisciplinary committee of 5 faculty reviewers selected 4 projects that most closely met the aims of the program, for a total of $240,706, including indirect costs. The funded projects are summarized below. CNS plans to make an additional call in Fall 2013. Project faculty and students and personnel on the projects are all encouraged to become active CNS participants, and they will be presenting on their work in progress in the CNS seminar and other activities.

X-IRG-6-1: Characterization of uncertainties in the life cycle assessments and risk assessments of nanotechnology; *Sarah Anderson*, Assistant Professor of Environmental Politics, Bren School of Environmental Science and Management, UCSB

Transparent communication of uncertainty helps to facilitate public trust in the motives of regulators and scientists. Scientific assessments of nanotechnology serve as the basis for mass media accounts of risk and benefits, yet little is known about how uncertainty is characterized as part of these assessments. This project characterizes the location, nature, and level of uncertainty in existing life cycle assessments and risk assessments on nanotechnology and in the mass media. This seed grant will contribute to CNS IRG 3 on Risk Perception.

X-IRG-6-2: Bringing Science to Life: CNS Engagement Seed Grant; *George Legrady*, Professor of Media Arts and Technology, Colleges of L&S & Engineering

This project positions scientific research into the public domain by transforming the museum into a living lab, allowing the public to see the methods and processes by which scientists develop their work. The project will feature 5 to 10 UCSB Lab-based scientific projects that will use this opportunity to engage the public to contribute to the research in direct and tangential ways. Each sub-theme will be assigned to one or more scientific research project, and be situated in contrast, comparison, or collaboration with one or more artistic research work, or a scientist and artist may decide to explore a particular theme together. This seed grant will contribute to the Public Outreach and Engagement program at CNS.

X-IRG-6-3: Public Sentiment and the Performance of Protest in Japan's Antinuclear Movement David Novak, Assistant Professor of Ethnomusicology, Division of Humanities & Fine Arts, L&S

This seed project will conduct ethnographic fieldwork on the perception of risk and responsibility around the use of nuclear power in contemporary Japan, as articulated by the emerging antinuclear protest movement since the Fukushima disaster. In particular, it will document the activities of musicians and artists in Tokyo and Fukushima and analyze the role of music and performance in generating social discourse about the risks of nuclear energy and government responses. This project will work closely with CNS IRG 1 on the contemporary history of new technology.

X-IRG-6-4: Filtering out the Social: Nanotechnology and Water Treatment in Mexico: Casey Walsh, Associate Professor of Anthropology, Division of Social Sciences, L&S

This project investigates the role of nanotechnology in infrastructures that manage water quality in Mexico. Faced with serious contamination problems in both surface and subsoil water sources, and extreme economic and technical difficulties in assuring water quality through conventional means, water service providers have placed their hopes on new technologies that 1) treat water at a much smaller (micro and nano) scale, and 2) treat water much closer to the point of consumption. Research will focus on a landfill in Tlaquepaque, Jalisco, where nanotech is being used to purify leachate. The project will contribute to CNS IRG 2's work on nanotechnology innovation and globalization in Mexico and Latin America.

X-IRG: Publications 2012-2013

Primary Publications: Journals

Primary Publications: Books, Chapters, Reports and other Publications

1. Newfield, Christopher. (2012). Does Solar Energy Need a New Innovation Model? The Case of Germany. In H. van Lente, C. Coenen, T. Fleischer, K. Konrad, L. Krabbenborg, C. Milburn, F. Siefert & F. Thoreau (Eds.), *Little by Little: Expansions of Nanoscience and Emerging Technologies*. Dordrecht: AKA-Verlag/IOS Press.
2. Newfield, Chris. (2012). Is Nanoscale Collaboration Meeting Nanotechnology's Social Challenge? A Call for Nano-Normalcy. In B. H. Harthorn & J. Mohr (Eds.), *The Social Life of Nanotechnology*. New York: Routledge.
3. Newfield, Chris, & Boudreaux, Daryl. (forthcoming 2013). Learning From Solyndra: Filling Gaps in the US Innovation System. In S. Ramani, V. (Ed.), *What's In It for Emerging Countries*. Cambridge: Cambridge University Press.
4. Newfield, Christopher. (2012). Can Selective Immigration Help the Innovation Crisis? *Huffington Post*.

Leveraged Publications: Journals

Leveraged Publications: Books, Chapters, Reports and Other Publications

5. Newfield, Christopher. (2012). Apple's Attack on the Knowledge Economy. *Huffington Post*.

6. Newfield, Christopher. (2012). A Transatlantic Conversation on Responsible Innovation and Responsible Governance. In H. van Lente, C. Coenen, T. Fleischer, K. Konrad, L. Krabbenborg, C. Milburn, F. Siefert & F. Thoreau (Eds.), *Little by Little: Expansions of Nanoscience and Emerging Technologies*. Dordrecht: AKA-Verlag/IOS Press.

Submitted or in preparation publications: primary

7. Friedman, Sharon. (in preparation). Nano regulation coverage in the mass media and NHI.
8. Newfield, Christopher. (in preparation). The Crisis of American Innovation.
9. Newfield, Chris, & Boudreaux, Daryl (Eds.). (in preparation). *Can Rich Countries Still Innovate? (Lyon volume)*.

Submitted or in preparation publications: leveraged

X-IRG Presentations 2012-2013

1. Newfield, Christopher. (March 2012). "The Technological University We Need." University of California, Irvine: Irvine, CA.
2. Newfield, Christopher. (April 2012). "Does Cultural Study Need Innovation Theory?" JFK Institute, Free University of Berlin: Berlin, Germany.
3. Newfield, Christopher. (May 2012). "Does Innovation Theory Need Cultural Study?" University of Freiburg: Freiburg, Germany.
4. Newfield, Christopher. (May 2012). "Does Innovation Theory Need the Humanities?" HUMLab, University of Umea: Umea, Sweden.
5. Newfield, Christopher. (May 2012). "The Future University." Arts Center Inaugural, University of Umea: Umea, Sweden.
6. Friedman, Sharon, & Egolf, Brenda. (June 18, 2012). "Examining Nano Risks and Regulation in Traditional Media and a Web Newspaper." Society of Risk Analysis-Europe: Zurich, Switzerland.

7. Newfield, Christopher. (September, 2012). "American Studies and Knowledge Ecologies." University of Bonn: Bonn, Germany.
8. Johansson, Mikael. (October 2012). "Different labs different dangers: How scientists working with nanomaterials perceive risk." Annual Meeting of the Society for the Social Study of Science (4S): Copenhagen, Denmark.
9. Newfield, Christopher. (October, 2012). "It's Not a STEM World After ALL: Notes on the Liberal and Practical Arts." Michigan Technological University: Houghton, MI.
10. Friedman, Sharon, & Egolf, Brenda. (December 12, 2012). "Tracking Media and Internet Coverage of Nanotechnology's Risks over the Years." Society of Risk Analysis Annual meeting: San Francisco, CA.
11. Newfield, Christopher. (February 2013). "It's Not a STEM World After All: Notes on the Liberal and Practical Arts." College of Arts and Humanities Institute, Indianan University: Bloomington, IN.
12. Newfield, Christopher. (March 2013). "The Destruction of Creativity? Literary vs. Innovation Theory." Pratt Institute: Brooklyn, NY

X-IRG outreach activities

1. Horton, Zachary, "Filming Nano-Futures: Collaborative Narrative Making in an Academic Context," CNS Seminar, CNS-UCSB, July 11, 2012, Santa Barbara, CA.
2. Newfield, Christopher, "Innovation Decline and the Leadership Crisis", KCSB radio, July 25, 2012.
3. Phillips, Bryan, "Open Innovation and its Role in a nano-Enabled Solar Industry," paper presentation Internships in Nanosystems Science, Engineering, and Technology (INSET) public presentations, August 2, 2012, Santa Barbara, CA.
4. Phillips, Bryan, "Open Innovation and its Role in a nano-Enabled Solar Industry," (poster), Internships in Nanosystems Science, Engineering, and Technology (INSET), poster colloquium, August 9, 2012, Santa Barbara, CA.
5. Newfield, Christopher, "Higher Education and Innovation," KCSB radio, October, 3, 2012.

10. CNS-UCSB DIVERSITY PLAN

The CNS-UCSB community recognizes from experience that diversity strengthens the quality of research and the capacity to disseminate results to a wide range of audiences. Our diversity mission is focused on creating a community comprised of outstanding researchers, staff, and advisors from different gender, racial, ethnic, disciplinary, family, and educational backgrounds that represent and reflect the communities we serve in our research mission. Additionally, the Center has broadened participation by seeking out researchers in other countries across North America, Europe, Asia and Africa, including increasing numbers in the Global South.

(i) Current status and progress this reporting year and since 2010

Undergraduates
Undergraduate interns for our 8-week Summer Internship Program were recruited in years 6-8 (years 1-3 of the current award) through a partnership with UCSB's California NanoSystems Institute's (CNSI) INSET summer program, an institutional REU program funded by NSF that recruits students from California community colleges with an emphasis on diversity. In Year 6, additional summer interns were recruited from among UCSB undergraduates through a broad, campus-wide call, with email announcements and flyers distributed to all academic departments. Additional announcements were sent to our contacts in the SACNAS and Los Ingenieros student organizations.

For the current reporting year, we hosted 4 summer undergraduate interns through the INSET program, 2 male and 2 female, 1 of whom identifies as both Native American and Latino, and another as Pacific Islander and Latino. The 3 interns hosted during summer 2011 were all males (1 of whom was Latino). The four interns hosted during summer 2010 included 3 males (including 1 Asian and 1 Mixed White and Pacific Islander) and 1 female who was both African-American and Latina. Cumulative data for interns from underrepresented groups for the three reporting years is noted in Table 10-1. Of the 11 interns, 9 were participants in the INSET program, and two were UCSB undergrads. Four of them will be the first members of their family to graduate from college. These interns also contributed to the academic diversity of CNS, with majors in Biological Sciences, Chemistry, Engineering, Economics, Geology, Math, Physics, Sociology, and Statistics.

Table 10-1: Diversity information, **Summer Undergraduate Interns**, Years 6, 7 & 8 (n=11)

Female	African-American	Asian	Latina/o Ethnicity	Native American	Pacific Islander	Mixed racial origins
3	1	1	3	1	2	1

[*Summer 2010: We received applications from 24 UCSB students for 2 intramural internship positions. Applicant pool statistics: 8 female, 10 Caucasian, 1 mixed race (including Pacific Islander), 1 Asian, 6 Latino/a. Applicants represented 15 different majors. Applicant information is not available from CNSI for the extramural INSET program applicants for Years 6, 7 or 8.*]

In addition to the summer internship program, CNS-UCSB engages UCSB undergraduates throughout the year directly in the research process and/or in research administration. This growing pool of undergraduates is exposed to cross-disciplinary investigation and research methodologies. Although not always selected via an open recruitment, these students contributed to the Center's diversity, as indicated in Table 10-2. A total of 14 UCSB students

participated in the Center in Years 6, 7, & 8, ten of whom were active during two or more reporting years (Year 6 undergraduate research assistants n=8, Year 7 n=10, Year 8 n=5). Of these 14 students, 86% are female, and 57% are part of other under-represented categories.

Table 10-2: Diversity Information, **undergraduate researcher assistants**, Yrs 6, 7 & 8 (n=14)

Female	African-American	Asian	Latino/a Ethnicity	Native American	Pacific Islander	Mixed racial origin
12	0	4	2	1	0	1

Academic Disciplines of current year UG research assistants: Biology, Biochemistry, Chemistry, Chinese, Environmental Studies, Geography, Global Studies, History, Linguistics, Psychology, Women's Studies

Graduate Students

The CNS-UCSB Graduate Research Fellowship program recruits doctoral student participants through an open, competitive application process. During the reporting year, we ran open recruitments to hire both Social Science/Humanities and Science/Engineering Graduate Fellows. The search was publicized through email announcements, including a diversity statement, sent multiple times to graduate advisors in all academic departments on campus; by posting flyers on campus kiosks and in academic departments; and by posting the job announcements on the Center website front page during the application period.

For Years 6, 7, and 8, 18 students participated in the Center as Graduate Fellows, 7 of whom were funded during Yr 8 with an additional 2 no longer funded but active in continuing work on publications on which they are co-authors. In Year 6, there were 13 Graduate Fellows: 8 in Social Sciences and Humanities and 5 in Science and Engineering. Twelve Graduate Fellows were active during the reporting Year 7: 6 each in Social Sciences/Humanities and Science/ Engineering; and Year 8 had 7 funded, 4 in Social sciences/Humanities and 3 in Science/ Engineering. Table 10-3 shows diversity information for the 18 Graduate Fellows: 47% were Female, and 24% were from under-represented groups. In addition, 2 were the first in their families to graduate from college, and 4 will be the first to receive a graduate degree.

Table 10-3: Diversity information, **Graduate Research Fellows**, Years 6, 7, & 8 (n=18)

Female	African-American	Asian	Latino/a Ethnicity	Native American	Pacific Islander	Mixed racial origin
9	1	2	2	0	0	1

[Current reporting year: In Yr 8, all Fellow were continuing from Yr 7, so no new recruitments took place.]

CNS-UCSB engages an increasing number of graduate students beyond the fellowship program. These students serve as Graduate Student Researchers, research assistants, and in a variety of other data collection and analysis functions. Twenty-one students from UCSB participated in the Center in these roles during years 6-8: 15 from doctoral and 6 from masters' or professional degree programs. As indicated in Table 10-4, 67% are females, and 24% were from underrepresented categories.

10-4: Diversity information, Other **Graduate Student Researchers**, Years 6, 7 & 8 (n=21)

Female	African-American	Asian	Latino/a Ethnicity	Native American	Pacific Islander	Mixed racial origin
14	1	4	0	0	0	0

Academic Disciplines of year 6 to 8 graduate student researchers (non-fellows) at UCSB and partner institutions: Biochemistry, Chemistry, Computer Science; English; Education; Environmental Science & Management; Feminist Studies; Geography/GIS; Global & International Studies; Linguistics; Materials/Risk Science; Political Science; and Science Journalism.

Postdoctoral Scholars and Researchers

CNS-UCSB began its postdoctoral program in Fall 2008. As in our other programs, we strive for a diverse and excellent applicant pool through an open, competitive recruitment process. Positions are broadly advertised nationally to achieve this aim; one example is sending announcements to professional society specialty groups that are geared toward diversity. During our most recent search for open postdoctoral positions with the 3 IRGs in Fall 2011, we advertised the positions at S.NET and through the on-line listservs of the American Anthropological Association's Science, Technology, and Society interest group and the National Communication Associations CRTNet. We also listed position announcements online in the Chronicle of Higher Education online, on Linked-In, and on the National Postdoctoral Association's Postdoctoral Forum and distributed them through our partner organization, CNS-ASU's listserv. We also distributed announcements at the S.NET conference and sent notices through their listserv.

The ten CNS-UCSB funded postdocs in year 8 at all sites include 5 at UCSB, of whom two are females, one is Hispanic ethnicity, and another is of mixed-race and Latina origin, and one is a non-US Citizen (S. American). Of five additional, non-UCSB-based postdoctoral scholars in the reporting year, two are female, and two are based in the UK and one in Canada.

With the departure of three postdocs in summer and fall, 2011 to full-time professional employment, we ran an open recruitment in 2012 to hire 1-2 new Postdoctoral Scholars. The resulting applicant pool of 13 candidates was internationally diverse, including applicants from Western Europe, Southern and Central Asia, and Latin America. The pool included 4 women and 3 Latinos. We hired a Latino researcher and non-U.S. citizen who joined CNS-UCSB in June, 2012. In Fall 2012, Postdoc Shearer moved from her position as a part-time postdoc in IRG 3 working on the deliberation project to a new position working with CNS Outreach on development of a policy briefs program.

In addition, a female who was a graduate student researcher from the UC CEIN completed her PhD and assumed a postdoctoral position there starting in Fall, 2012; she is housed in and participates extensively in CNS-UCSB research and center-wide activities. Also, a CNS Science Fellow completed his PhD in Dec 2012 and moved into a part-time postdoctoral researcher position in CNS in Jan 2013. We additionally have hosted a visiting postdoctoral scholar from Mexico since summer, 2012, and will begin 2 searches in spring, 2013 for postdoctoral scholars to participate in IRG 3 public deliberation research and IRG 1 work.

Disciplinary backgrounds of CNS-UCSB's reporting year postdoctoral scholars include Biostatistics & Risk Science, Ecotoxicology, Environmental Sociology, Management & Textiles, Public Policy, Social Psychology, and Sociology.

Leadership: PIs, Advisory Board, Senior Personnel
At all junctures in its development, CNS-UCSB has recruited staff and participants with attention to diversity of ethnicity, gender, and experience. The Center Director and PI is a woman, a professor of Feminist Studies, a past longtime member of the governing boards of the UCSB Institute for Chicano Studies and the UCSB Center for Black Studies, a current member of the Advisory Committee for the new Center for Latina/o Health, Education & Research as well as the AAAS' Committee on Opportunities in Science (COOS), whose role is to enhance the participation nationally in Science and Engineering of women, people of color, and people with diverse disabilities, sexual orientations, and other needs. The CNS-UCSB Executive Committee has a strong record of gender balance. Three of the seven current members are women (Harthorn, Holden and Metzger). In addition, Assistant Director Molitor and Education Coordinator Boggs serve as *ex officio* members, adding additional gender diversity. As noted in prior reports, we have been less successful in maintaining ethnic diversity in the leadership, although one of the founding PIs was Asian, and one ex-officio member identifies as mixed race heritage. We have been and continue to actively recruit Senior Personnel of diverse gender, racial and ethnic backgrounds from within the UCSB research community to increase the range of inputs into our programs and to create the basis for increased future leadership diversity.

The CNS-UCSB staff also reflects a commitment to diversity. In the reporting year, seven of the eleven UCSB staff members were female. Two identified as Asian, 3 as Mixed Race, 2 as American Indian, and 3 as of Hispanic ethnicity.

In addition to racial, ethnic and gender diversity, disciplinary diversity is a hallmark of CNS-UCSB, as shown above by the backgrounds of our student and postdoctoral participants. Our participants represent a wide breadth of educational backgrounds and disciplinary experience. Departments represented by members of our Executive Committee, including those with which they hold affiliate positions, include Anthropology, the Bren School of Environmental Science & Management, Chemistry/Biochemistry and Materials, Communication, Feminist Studies, Global and International Studies, History, Political Science, and Sociology. Senior Personnel at UCSB expand that list to include: Chicana & Chicano Studies, Engineering, Environmental Studies, Ethnomusicology, Geography, Global Economics, Media Arts & Technology, Microbiology, and Physics. And our collaborators at other universities and settings add Asian Studies, Business, Economics, Science Journalism, Law, Risk Studies, Social Psychology, Science Policy, and Visual Studies.

The CNS National Advisory Board was recruited with attention to diversity by gender, ethnicity, and interest in the equity issues that are likely to accompany emerging nanotechnologies. The Board is nearly 50% women, including the Board Co-Chair who is professor and associate dean for research at Evans School of Public Affairs, University of Washington (Ann Bostrom), a Chemistry professor and the executive director of the Center for Biological and Environmental Nanotechnology at Rice University (Vicki Colvin), the executive director of the California Council on Science and Technology (Susan Hackwood), and a professor in the History and Sociology of Science department at the University of Pennsylvania (Ruth Schwartz Cowan) who is a leading scholar on the gendered history of science and technology. Board member Willie Pearson is African-American, a very active participant in NSF EHR and also contributes strongly to CNS goals of improving diversity.

Senior personnel from CNS-UCSB's collaborating institutions, many of them international, have contributed to the cultural diversity of the CNS; and contribute to gender/ethnic/racial diversity, as 9 collaborators are female, 5 are of Asian heritage, and 1 identifies as Hispanic and 2 more are Latin American. Increasing our diversity in these areas is a central goal as we recruit new Center participants.

Visiting Researchers
The CNS Visiting Researcher program has attracted scholars that contribute to the Center's diversity. Recent visiting scholars include 1 female, 3 junior scholars, two Asians, and 1 Mexican. As noted above, we are hosting a Mexican postdoctoral researcher during 2012-2013 and he is seeking to extend this arrangement for an additional year.

(ii) Plans for the next reporting period

As noted throughout this report, members of the CNS-UCSB community consider our diversity to be one of our major strengths. As such, it is a primary goal of the Center's leadership to continue building and increasing our diversity at all levels of participation in areas such as gender, racial origins, ethnicity, family background, and disciplinary training. Below we describe some of the strategies we are using to accomplish this goal.

Undergraduate and Graduate Student Participants

One primary strategy for maintaining and improving diversity is to start with a large and diverse pool of strong applicants for our programs. Fortunately, UCSB and the California Central Coast area in which it is located are highly diverse, particularly reflecting the growing Latina/o population, but also in having significant Native American, Asian American, and African American population bases. As a rising Research 1 campus in a beautiful coastal setting, UCSB is successful in recruiting a diverse student body and is itself projected to become a Hispanic Serving Institution (HSI) imminently. California currently has 112 schools in the community college and state university system with 81 emerging HSIs (including UCSB), and CNS has been successful in drawing students from such neighboring organizations into its popular undergraduate summer intern program.

Strategies:
- Open recruitment process

A competitive, open recruitment process for our undergraduate internship, graduate fellowship, and postdoctoral programs has allowed us to attract a broad range of applicants. For internal programs (graduate and UCSB undergrad internship positions), information has been disseminated to students by sending email and fliers to all pertinent UCSB departments. These have been augmented by announcements to the UCSB Women's Center, campus organizations including Women in Science and Engineering (WiSE), SACNAS (Society for the Advancement of Chicanos and Native Americans in Science), and Los Ingenieros, to ensure that students from underrepresented groups learn about our opportunities. For community college interns in the INSET program, CNS-UCSB staff work closely with campus partners in CNSI's CSEP (Center for Science and Engineering Partnerships), which recruits widely through established networks in area community colleges to recruit a diverse, talented pool of applicants.

- Collaborations with NSF diversity programs and campus organizations

CNS-UCSB has in the past, and will in the future, work with a variety of on-campus programs and organizations promoting diversity. From its inception to dissolution in 2009, CNS-UCSB

collaborated with the AGEP (Alliance for Graduate Education in the Professoriate) program, including a very well received invited talk on the CNS Education program by CNS Director Harthorn at the NSF SBES AGEP meeting (May 2008) at UCSB. CNS-UCSB has had one NSE fellow who is a veteran of the AGEP program, and who continues to be involved in Center activities following the end of his fellowship.

The UC-DIGSS program (Diversity Internships for Graduate Study in the Social Sciences) supported UC recruitment of minority students in the social sciences, and this collaboration allowed us to successfully recruit a new incoming Latina sociology student who worked with us from 2007-2010 first as an Associate Fellow and then a CNS Social Science Graduate Research Fellow.

The NSF-funded Bridges to the Doctorate program in CNSI aims to connect students to NSF funded opportunities. CNS-UCSB has the opportunity to participate in this network of programs that seek to recruit and retain excellent scholars from underserved populations.

In addition, CNS-UCSB researchers and former Education staff have developed ties with student organizations that serve underrepresented groups, including Los Ingenieros, SACNAS, and Women in Science and Engineering (WiSE). These groups address a wide variety of interests within the student community, and CNS research that focuses on environmental and social impacts has resonated with these groups' members. Presentations to these organizations by education staff, graduate research fellows and postdocs have informed participants about nanotechnology and society issues and current research, as well as described opportunities for students in CNS-UCSSB. The Education staff reach out to these groups to increase their involvement with our work as opportunities arise. We also collaborate with UCSB-wide diversity programs at UCSB as they are developed, by maintaining close communication with key administrators in the College of Letter and Science, Graduate Division, and the Graduate School of Education.

- Partnership with the California Nanosystems Institute's INSET REU Program

For the past 7 summers, CNS-UCSB has hosted and funded participation by California community college STEM students participating in CNSI's Internships in Nanosystems Science, Engineering and Technology (INSET) REU program. INSET's participants annually include high percentage of students from underrepresented racial and ethnic groups. Since 2006, almost two-thirds of all of our undergraduate summer interns (19 out of 31) have been in the INSET program. Between 2002 and 2010, the entire group of CNSI INSET interns was 45% minority, 42% female and 3% disabled (diversity data are not available for individuals over this full period). Tapping into this recruitment network has been useful in increasing CNS-UCSB's diversity. We will host three interns through this program during Summer, 2013.

- Promoting Opportunities for Involvement through Reputation

We at CNS-UCSB have found that diversity reproduces itself. Diversity in our Graduate Fellowship Program helps to make CNS a welcoming context for undergraduates of diverse backgrounds as well. In a regional program such as ours, word of mouth and reputation are important factors in successful recruitment and retention, as is leadership dedicated to achieving a diverse organization that welcomes and supports a wide range of talents, experiences, and interests. We have and continue to make it a priority to create a climate of cross-cultural and cross-ethnic acceptance at all levels. Our record of multi-year participation by graduate and undergraduate student and postdoctoral researchers who are female and/or from underrepresented communities is evidence of success in these areas.

The institutional context for thoughtful commitment to diversity at UCSB is excellent, with an upper administration that is prepared to walk the walk, a McNair scholar's program, 3 ethnic studies programs and departments and both feminist studies and Chican@Studies departments both offering a doctorate. Additional resources that contribute to the climate on campus include the recently funded UC-wide Multi-campus Research Unit based at UCSB, The Center for New Racial Studies, directed by eminent racial formation scholar Howard Winant, and, like CNS, housed in the Institute for Social, Behavioral, & Economic Research.

Postdoctoral Researchers

CNS-UCSB full-time multi-year postdoctoral positions are recruited in an open, competitive process, some of which was described above. We aim our postdoctoral scholars recruitment at a national and international audience through extensive advertising in topical nano, STS, disciplinary, and other listservs, professional organizations, bulletin boards and other avenues. In recruiting for open or new positions, we have worked with the UCSB Office of Equal Opportunity, and in addition to the traditional networks, listservs, and professional organizations (above) we have sent our advertisements to specialty groups serving women and minorities. We will use these approaches in our upcoming search for 1-2 postdoctoral positions during spring, 2013, and continue to broaden our reach to expand our connections with as diverse a group of potential applicants as possible.

Leadership: PIs, Advisory Board, Senior Personnel

To enhance diversity on the faculty level, we have been mindful of our commitment to diversity, recognizing its contribution to research excellence and the broader impact a diverse group can have on the climate and culture of our Center. One of the ways we have been and continue to promote diversity in our leadership is by recruiting new senior personnel representing underserved gender, racial, and ethnic communities. We also have expressly sought to include faculty earlier in their careers and during years 6 and 7 added two assistant and associate level professors at UCSB (one of whom is Chicana and the other Asian), and another junior faculty member at the University of Wisconsin. In Year 8 we have added through the new Seed Grant program 2 assistant professors and 1 associate professor, and we have participated in the successful recruitment to UCSB of a new female S. American junior faculty member with nano in society research experience whom we hope to affiliate to CNS. We also continue to add disciplinary diversity and expand our expertise by adding UCSB faculty from Chicana and Chicano studies, communication, economics, environmental politics, environmental studies, Japanese studies/ethnomusicology, Latin American studies, and media arts & technology.

The majority of Advisory Board members from the Center's first five years continue to serve on the board, except for two (Kalil and Moore) who took on new jobs that precluded continued service. It is not expected that the same Board will serve all ten years, and we are in discussion about how to modify the Board composition for the new challenges ahead as the Center nears the anticipated sunset of NSF support at the end of Year 10. Replacing members will allow us to continue to pursue diversity goals in recruitment.

Engaging Diverse Publics

Expanding public engagement is one of the core goals of CNS-UCSB's outreach plans as we move forward, which are discussed in more detail in Section 12 of this report. We continue to connect with the public by participating in informal science education activities such as NanoDays, which in both 2012 and 2013 (both in the reporting year) was held over two days at the Santa Barbara Museum of Natural History and drew 1300 participants in 2013. We publicize events in our Speakers Series to 100s of individuals from on-campus and the regional

community, and plan public activities with a goal of reaching members of Central California's diverse population. We hope to contribute new understandings of ways to create effective upstream public engagement with emerging technologies through our IRG 3 public deliberation research, which is conducted with panels whose participants reproduce the socio-demographic diversity of the communities in which we conduct them (Santa Barbara, Vancouver, and Cardiff, UK). Another round of research in this arena is planned for 2014. And plans for a major international NGO conference/workshop in 2014, now in depth planning, will contribute a novel scholarly engagement with these selective, self selected publics about their roles in democratizing science.

11. EDUCATION

CNS-UCSB's Education Program continued its successful record of accomplishments in Year 8. CNS-UCSB brings together researchers and students in the social sciences, humanities, engineering, and science to create new, critically-needed collaborative education programs. The Program's leadership team is headed by a senior Communication scholar with expertise in new media, interdisciplinary collaborations between social researchers and scientists, and mediated education and outreach, with the assistance of a staff education program coordinator, and a student assistant who was added to the team in January 2013. The following pages provide an overview of CNS-UCSB's Educational Program components and objectives; discuss the leadership; report on the progress of our ongoing programs for postdoctoral scholars, graduate students, and summer interns; highlight some of our curricular contributions to teaching the ethical, legal, and societal implications (ELSI) of nanotechnologies in multiple educational environments during this reporting period; and discuss personnel and organization changes over the period.

CNS-UCSB Education Program Objectives & Key Programs

CNS-UCSB brings together researchers and students in the social sciences, humanities, engineering, and sciences to create new, critically-needed collaborative education programs. It sponsors graduate fellowships, graduate student researchers, undergraduate internships, and new curricula. The Education Program provides mentorship and educational opportunities to postdoctoral scholars working with the Center's Interdisciplinary Research Groups (IRGs). CNS staff also collaborates with education staff from the California NanoSystems Institute (CNSI) and the Bren School of Environmental Science and Management (the institutional home for the main UCSB portion of the UC Center for Environmental Implications of Nanotechnology-UC CEIN) to develop and implement joint education materials and activities. The diagram below summarizes the four main components of the Program and their objectives.

Program Summary
The Education Program's primary objectives during Year 8 were as follows:

Training the next generation of interdisciplinary scholars:
- 6-8 graduate research fellowships/year
- 3-5 graduate research assistantships/year
- 3-4 undergrad internships/year, with emphasis on community college students from lesser-served communities
- Expand postdoctoral scholars program beyond the 6 active in years 2006-10
- Hold Research Seminar meetings year-round
- 1-2 visiting speakers per quarter (3-6 per year)
- Professional development in communication, research methods, and academic job practices
- At least one major public engagement event annually where Fellows and Postdocs take the lead role
- Funding and professional preparation for conference travel for Program participants
- Ongoing formative and summative evaluation

Creating a diverse community of scholars within CNS:
- Continue to cultivate diversity among student participants, maintaining or increasing previous levels

Curricula Development and Dissemination:
- Annually increase the number of new or modified courses incorporating CNS-UCSB research

Creating a community across the disciplines (SS, Hum, NSE):
- Invite researchers representing multiple disciplines to speak in the CNS Research Seminar
- Invite participants from departments across campus to attend CNS public lectures and events across campus
- Track the home departments of participants attending the CNS Seminars
- Track the continuing participation of graduate students and postdocs after their funding ends
- Track CNS-UCSB participants' presentations both on and off the UCSB campus and at professional meetings and conferences

In the current reporting year we met or exceeded all of our objectives but one of the above categories. The exception was that we did not increase the number of new or modified courses incorporating CNS-UCSB research, although we have maintained previous levels of incorporation. We do anticipate that the addition of new Seed Grant faculty PIs into the CNS will expand the introduction of nano content into the UCSB curriculum in the coming year and beyond. In addition, budget constrictions across the state of California, and more specifically at both the University of California and most community colleges, reduced the number of courses being offered at these institutions, which has impacted our ability to infuse CNS curriculum in new courses. New faculty recruitment has resumed in the past year (including one hire on campus of a nano in society researcher we have already recruited to join the CNS), and we are hopeful this situation will turn around.

Program Leadership

Education is a core goal of all Center activities, including research and outreach efforts. As measured by formal and informal feedback from participating students and postdocs, some of

which will be reported in the following pages, CNS-UCSB has been very successful in training the next generation of scholars to conduct and understand high quality interdisciplinary research on the societal implications of science and technology.

In Year 8, the Program was overseen by the Director of Education, Miriam Metzger, who is a senior faculty member in the Department of Communication at UCSB. She brings expertise in interdisciplinary collaboration, new media, and in communicating social science research findings about the societal implications of science and technology in various education contexts. Professor Metzger has been assisted in this work by the Education Program academic coordinator, Dr. Cathy Boggs. Since the unanticipated medical leave of absence by Dr. Cathy Boggs, in October 2012, CNS has expanded its Education Program staff with the hire of Joshua Dean, a PhD Candidate in Political Science at UCSB, as the Education and Outreach Assistant to provide additional support within the CNS Education and Outreach program. Joshua works on a part-time basis at CNS, reporting to the Education Director and CNS Assistant Director Molitor.

Education Programs Overview

CNS-UCSB's Education programs are key components for fulfilling our mission to prepare the next generation of scholars to engage in collaborative interdisciplinary research addressing emerging technologies' societal implications. Building on the essential research training received in the IRGs and at partner institutions, the Education programs are designed to expand participants' skills by integrating them into the larger Center community through a series of structured programs and activities.

All of our education programs are cross-disciplinary and provide opportunities for participants to interact with a mix of social scientists, humanists, scientists, and engineers at the faculty, postdoctoral, graduate, and undergraduate levels. Our Education programs serve postdocs, graduate students, and undergraduates.

CNS-UCSB Postdoctoral Scholars and Researchers Program

CNS-UCSB provides research and training opportunities for postdoctoral scholars based at UCSB and elsewhere in collaborating institutions. During the past year, postdoctoral scholars and researchers have made important contributions to the success of CNS-UCSB programs and activities, including the NanoDays informal science education program at the Santa Barbara Museum of Natural History and at the California Science Center in Los Angeles; the CNS Research Seminar in Emerging Technologies & Society (research presentations by Luciano Kay, Shannon Hanna, and Mary Collins); workshop on Nanoscience and Emerging Technologies in Society: Sharing Research and Learning Tools (NETS); and the Society for the Study of Nanoscience and Emerging Technologies annual conference (S.NET 2012) in The Netherlands. They have also played key roles in mentoring graduate and undergraduate students in the CNS Graduate Fellows and INSET Summer Internship programs.

CNS has sponsored 15 postdoctoral scholars since 2008. Those active in Year 8 are listed in the following table. Their work, CNS-UCSB's postdoctoral mentorship program, and program evaluation findings are described below.

CNS Postdoctoral Scholars and Researchers Active in Year 8

Postdoctoral Scholars	**PhD Field; Granting Institution**	**Affiliation**
Mary Collins*	Environmental Science & Management, UCSB	IRG 3, UC CEIN
Shannon Hanna	Environmental Science & Management, UCSB	IRG3, UC CEIN
Luciano Kay	Public Policy, Georgia Institute of Technology	IRG2
Christine Shearer*	Sociology; UCSB	IRG 3, NSF Delib., E&O
James Walsh	Sociology; UCSB	IRG 2
Non-UCSB Based Postdoctoral Researchers	**PhD Field; Current Campus**	**Affiliation**
Adam Corner*	Social Psychology; Cardiff U.	IRG 3* GeoEng
Christina Demski	Psychology; Cardiff University	IRG 3
Stacey Frederick	Textile Mgmt.; Duke University	X-IRG, IRG 2
Marian Negoita*	Sociology; U. of California, Davis	IRG 2
Anton Pitts*	Risk Science; U. of British Columbia	IRG 3, UC CEIN

* indicates postdocs funded partially or in full through other awards, but housed and collaborating in CNS-UCSB

Postdoctoral Scholars Program: Starting in 2008, the UCSB-based Postdoctoral Scholars Program has recruited outstanding postdoctoral scholars from the U.S. and around the globe to spend one to three years as members of IRGs or X-IRG initiatives at UCSB. Participants in this program have come from the U.S., Sweden, Japan, Argentina, and Canada, in disciplines including City & Regional Planning, History, Political Science, Public Policy, Science & Technology Studies, Sociology, Social Anthropology, and Women's Studies. Several former postdoctoral scholars have gone on to faculty positions (Gwen D'Arcangelis at Scripps College and Cal State Pomona; Mikael Johansson at Sweden's University of Gothenburg; Philip McCarty at UCSB; and Jennifer Rogers-Brown at Long Island University); Yasuyuki Motoyama is a senior program manager with the Kauffman Foundation; Matt Eisler is a visiting faculty member at the University of Virginia, and Christine Shearer is in a new Postdoctoral Research position at UC Irvine (Feb 2013). Since leaving UCSB, five of these scholars (Eisler, Johansson, Motoyama, Rogers-Brown, and Shearer) have continued to work on CNS-UCSB research projects as external affiliates.

After an open recruitment, Luciano Kay joined IRG2 in residence at UCSB in June 2012. Luciano is an Argentine citizen who received his PhD from Georgia Tech in Public Policy, where he worked with CNS-ASU collaborators Philip Shapira and Jan Youtie. He possesses considerable expertise in Latin American nanotechology policy and in bibliometric research methods. Upon completion of her PhD in the Bren School, graduate student researcher Mary Collins assumed a full-time UC CEIN-funded postdoc position (leverage) in summer 2012 to continue collaborative research with Harthorn and Satterfield on environmental risk perception and the spatial analysis of nano-remediation environmental justice. She has been participating as a CNS postdoc in all CNS IRG 3 and center-wide activities this year. Beginning June 2013, Mary will move on to a full-time position as a postdoctoral fellow at the National Socio-Ecological Synthesis Center (SESYNC) in Annapolis. SESYNC's mission is to bring together different disciplines and stakeholders to increase knowledge on the complex interactions between human and ecological systems. Collins will continue active collaboration with IRG 3.

Several former CNS-UCSB Graduate Fellows who finished their PhD studies are working with their IRGs as postdoctoral researchers to complete research projects begun as students. The three scholars who did this in Year 8 work on projects dealing with the role of gender in public deliberations (Shearer), migration and international collaboration in nanoscience innovation (Walsh) and environmental risk perception and intuitive toxicology (Hanna). Shearer, a sociologist and published writer with expertise in environmental policy issues, is also contributing to the development of CNS-UCSB website materials and public policy briefs for our Outreach Program, discussed in Section 12. Hanna and Collins volunteered to present nanotechnology and society materials at NanoDays at the California Science Center in Los Angeles on April 14, 2012, and participated with Harthorn and 2 other UC CEIN women scientists in a Women in Nanoscience public outreach event at the Santa Monica Public Library, April 17, 2013.

Postdoctoral Researchers at Other Campuses: CNS-UCSB also supports postdoctoral researchers who work with our external collaborators. We fund a full-time postdoctoral researcher at Duke University (Stacey Frederick) who works with sociologist Gary Gereffi and heads a Cross-Interdisciplinary Research Group (X-IRG) spatial analysis project examining the impact of California nanotechnology in the global economy, working with both IRG 2 and IRG 3. We partially support the work of two postdoctoral researchers conducting public deliberations research with Nick Pidgeon at Cardiff University (Adam Corner and Christina Demski), a researcher examining industrial policy and new technologies at UC Davis with Fred Block (Marian Nagoita), and a researcher studying risk perceptions with Terre Satterfield at the University of British Columbia (Anton Pitts). We integrate off-site postdoctoral researchers with other Center personnel and activities whenever possible. For instance, Stacey Frederick served as a mentor for the INSET summer internship program in the past, and did so again in summer 2012 for IRG 2, partnering with UCSB Graduate Fellow Galen Stocking. We also invite all postdocs to CNS Research Summits and other conferences and to face-to-face IRG meetings that take place 2-3 times per year.

Postdoctoral Mentoring: CNS-UCSB postdoctoral scholars based at UCSB and other campuses participate in a variety of mentoring and professional development opportunities through our research, education, and outreach programs. Principal Investigators (PIs) of the Interdisciplinary Research Groups (IRGs) are the primary research mentors for the postdocs who work with them. In addition to communicating with their postdocs by email and phone, the PIs meet regularly with their UCSB-based postdocs, both individually and at meetings of their IRGs. Off-campus-based postdocs participate in IRG team meetings via phone or Skype. In addition to funding their research, CNS-UCSB provides postdocs with financial and mentoring support to submit and present papers and research posters at professional conferences, workshops, and meetings (15 this year). Postdocs also participate in all-CNS-UCSB research and advisory board meetings, where they are encouraged to discuss their research with CNS-UCSB's external collaborators and board members to expand their professional networks with leading nanotechnology researchers and science policy experts. They take an active role in the annual NSF site visits as well.

The Education Program supports postdocs by providing them with professional and personal development opportunities. Postdocs, including alumni and those based at other campuses, are invited to give public presentations about their research at CNS-UCSB Seminar meetings attended by CNS-UCSB faculty, postdocs and graduate fellows, along with other members of the campus and Santa Barbara communities. In 2012-2013, UCSB Postdoctoral Scholars Luciano Kay, Shannon Hanna, and Mary Collins presented their research to the Research

Seminar. Postdocs also participate in Seminar meetings focusing on professional development topics such as presentation skills, the academic publishing process, job hunting and networking tips, and research methods for quantitative and qualitative studies. Postdocs based off-site are encouraged to participate in Seminar meetings via conference call or Skype. Project meetings take place as frequently as weekly by skype video conference with postdocs reporting on work in progress and getting feedback on data analyses, publications in preparation and other collaborative work.

In addition, the Education Program provides postdocs and their mentors with the Individual Development Plan for Postdoctoral Fellows (IDP) developed by the Federation of American Societies for Experimental Biology (FASEB), a document utilized in many universities to identify and meet professional development needs and career objectives. Campus programs available to CNS-UCSB postdocs include the California Nanosystems Institute's Professional Development Program for Postdocs and Graduate Students, as well as the UCSB Society of Postdoctoral Scholars, which provides training and other development opportunities for campus postdocs. UCSBs Graduate Division provides extensive postdoc mentoring and career development materials at (http://www.graddiv.ucsb.edu/postdoctoralscholars/careers.htm, and at http://www.graddiv.ucsb.edu/postdoctoralscholars/mentoring.htm). Indeed, former CNS postdoc Mikael Johansson, a labor scholar, served as president of the then-fledgling UCSB Society of Postdoctoral Scholars during his tenure in Years 5 & 6.

CNS-UCSB postdocs are kept informed about conference, publication, and professional opportunities sponsored by NSF, the NNI, and other entities addressing the societal implications of nanotech and science policy through daily CNS-UCSB listserv announcements. The listservs also include frequent announcements about CNS-UCSB activities, and those for lectures, events, and visitors to UCSB from NSE departments, the Bren School of Environmental Science and Management, the UCSB UC CEIN, the Center for Information Technology and Society (CITS), the Interdisciplinary Humanities Center, and social science and humanities departments.

Evaluation:
We evaluate the postdoctoral program through a confidential annual survey in which our current and former postdoctoral scholars are asked to assess their experience and ratings of program components including their overall experience, their interactions with CNS group leaders and fellow CNS participants, their experience with interdisciplinary research, and their professional development and networking on a 5-point scale. For the Year 8 survey, conducted in March, 2013, we received responses from six of the twelve current and former postdocs contacted.

Overall, responses to the survey were quite positive. Responses measuring the usefulness of the CNS experience as a whole averaged 4.66 on a 5-point scale, with 5 being excellent. Quantitative measures of the quality of their interactions with various members of the CNS-UCSB community, including their IRG leader and fellow researchers were also strong (average response scores between 4 and 4.6). In particular, CNS postdocs noted a very positive experience with the leadership of their IRG groups (average 4.83). Former postdocs also noted that their experiences at CNS have had a positive impact on the their career development (average of 4.66), in particular regarding professional development and training for presentations and conferences, professional writing skills and research experience. Open-ended responses were also positive. One respondent noted that involvement as a postdoc provided "more freedom to organize research plans and explore new research topics." All respondents appreciated the value of their interdisciplinary research experience, noting that access to different perspectives on similar topics introduces new research insights. However,

respondents also noted some communication difficulties associated with bringing together researchers from a wide range of disciplines, which is a common challenge in interdisciplinary research settings. Some postdocs commented that improved communication within CNS would further improve their experience. One former participant was bothered by a lack of timely feedback on draft work submitted to the IRG leader, while another noted a more structured communication and announcement system would be beneficial. Education program staff members are planning to meet to discuss this feedback with IRG leaders and postdocs to develop strategies for addressing these internal communication issues.

Throughout the year, postdoctoral scholars also provide input to the Research Seminar about possible topics and suggestions for improvements. Postdocs are also encouraged to meet with CNS-UCSB's Education Director Metzger and other program staff regularly to discuss their suggestions for program improvements, to seek advice about professional matters such as job hunting tips and publication processes, and to discuss confidential issues such as handling workloads and interpersonal conflicts with other researchers.

CNS Graduate Fellows and Graduate Student Researchers

One of CNS-UCSB's most successful features is its integration of graduate students from a range of social science, humanities, science, and engineering disciplines into every facet of our research, education, and outreach programs. Graduate students participate in IRG research through our Graduate Fellowship Program and in Graduate Student Researcher positions. The Education Program provides these students with a variety of interdisciplinary professional and personal development opportunities to supplement their research training. A list of the 17 students who were active in Year 8 and descriptions of program activities are provided below.

CNS UCSB Graduate Fellows and Graduate Student Researchers during Year 8

Graduate Fellow	**Department**	**Affiliation**
Roger Eardley-Pryor	History	IRG 1
Cassandra Engeman	Sociology	IRG 2
Matthew Gebbie	Materials	IRG 2
Shirley Yueying Han	Ecology, Evolution & Marine Biology	IRG 2
Shannon Hanna**	Environmental Science & Management	IRG 3
Zachary Horton	English	X-IRG
Galen Stocking	Political Science	IRG 2
Grad Student Researcher	**Department**	**Affiliation**
Lynn Baumgartner*	Environmental Science & Management	IRG 3
Benjamin Carr*	Environmental Science & Management	IRG 3
Mary Collins* ***	Environmental Science & Management	IRG 3
Lauren Copeland	Political Science	IRG 3
Rachel Cranfill	Linguistics	IRG 3
Chloe Diamond-Lenow	Feminist Studies	IRG 3
Allison Fish*	Environmental Science & Management	IRG 3
Zachary Horton	English	X-IRG
John Meyerhofer*	Environmental Science & Management	IRG 3
Anna Walsh	Global Studies & International Studies	IRG 2

*Indicates partial or full co-funding
**Moved to postdoc status in January 2013 ***Moved to postdoc status in October 2012

Research Fellowships in Social Science and Humanities and Science and Engineering: The Graduate Fellows Program is a major component of CNS-UCSB's mission to produce and encourage excellent and innovative scholarship addressing the intersection of nanotechnologies with society and contributing to academic workforce development for future nanotechnology research. Graduate Fellows take lead roles in the Center's research, education, and outreach initiatives, and are trained within the IRGs in a unique joint context of social science and nanoscale science and engineering research and training.

Fellows, in residence at UCSB, work directly with their IRG PI mentors. Outstanding students are selected for the program through a campus-wide open recruitment. Social Science and Humanities Fellows are funded at a 20-hour per week time commitment, comparable to that required of UCSB teaching assistants. Science and Engineering Fellows are funded for a 10-hour per week commitment, allowing them to continue to participate fully in their laboratory-based research opportunities available through their home departments. Both Social Science and Humanities Fellowships and Science and Engineering Fellowships are awarded for one-year terms, with possibilities for renewal of up to two additional years.

Seven students were funded in the Graduate Fellowship Program during the reporting year and another 2 former fellows continued collaboration begun during their fellowships (Denes, Martin). Of the nine Graduate Fellows active during the 2012-2013 academic year, two received their PhDs in 2012 (Denes, Hanna). Six Fellows from 2011-2012 were renewed in 2012-2013 (Roger Eardley-Pryor, Cassandra Engeman, Shannon Hanna, Matthew Gebbie, Shirley Yueying Han, and Galen Stocking). Zachary Horton moved to GSR status in 2013. Upon completing their PhDs, Collins (GSR) and then Hanna (fellow) were both hired as postdoctoral researchers in IRG 3 to continue their work on the environmental risk perception survey. The 9 Fellows active in the reporting year represented nine academic disciplines (four in the sciences, three in the social sciences, and two in the humanities), and include one African-American and three women, one of whom is Asian.

In addition to their IRG research activities, the Education Program provides CNS-UCSB Graduate Fellows with many additional professional and personal development activities during the year. A number of these activities are organized under the auspices of the CNS Research Seminar on Emerging Technologies & Society (Sociology 591), which includes a mix of public and in-house research lectures by visiting scholars and UCSB-based scholars, professional skills training workshops, opportunities to present and discuss their research, and administrative and informational meetings. The Seminar meets 4-5 times each quarter and in summer, beginning the year with an orientation workshop for all new and returning Fellows to introduce them to CNS Fellowship requirements, available Center resources, and each other. The majority of seminar sessions are attended by other members of the CNS-UCSB community in addition to the Graduate Fellows, and, in the case of research lectures, by members of the university and Santa Barbara communities at large.

During the reporting year, Graduate Fellows received funding to attend professional meetings and conferences, including the 2012 S.NET Conference at the University of Twente in The Netherlands as well as other domestic and international meetings. In addition, Graduate Fellows Hanna, Engeman, Stocking, Gebbie, Han presented their own research and received feedback on their presentation skills to the Research Seminar at a rehearsal session prior to the S.NET Conference (October 2012). Graduate Fellows Gebbie, Han, and Stocking from IRG 2 joined senior researcher Rich Appelbaum who travelled to China in April 2012 to conduct research on the emerging Chinese bioengineering industry. They presented their research findings at the 2012 S.NET conference in The Netherlands.

Evaluation
Among the most important indicators of the value placed by Graduate Fellows on their experience is their continued involvement with CNS-UCSB beyond their initial funding periods and following graduation, and their success in obtaining research funding from campus and national funding sources, as well as placement in full-time employment opportunities.

As part of ongoing formative and summative evaluation, we annually ask current and former Fellows to complete a confidential survey describing their expectations, their general level of satisfaction, and perceived benefits resulting from their Fellowships by answering a number of closed (5 point scale) and open ended questions. Of the 32 individuals who have participated in the program since its inception, 16 in this award (since Fall 2010), 8 (50%), completed the 2013 survey. Among all of the current in-house Graduate Fellows this year, the response rate was 100% (2 of 2) of the science fellows, and 75% (3 out of 4) of the social science/humanities fellows. Four alumni/ae fellows responded to the survey: three social science and humanities fellows and one science and engineering fellow. The low response rate among past fellows is explained by them responding that they have no changes to report from the previous year's survey.

Current fellows rated their overall experiences positively, with all fellows rating their interactions with other members of their research group and interaction with their group leaders as "excellent" (5 on a scale of 5), and their overall experience as between "very good" and "excellent" (average score of 4.25 on a scale of 5). Fellows specifically cited benefits from their interdisciplinary experiences, collaborative work, improved academic research, writing and presentations skills, and improved understanding of the social and policy contexts in which scientific and technology development take place as key influences of CNS that aided in their growth as scholars and scientists. One fellow noted that other professors and peers had noticed these changes, claiming that "they can tell I've received unique professional training from my work at the CNS." Primary challenges mentioned focused on improving professional development for the science fellows and improved structure for the CNS seminar. Several Fellows indicated their belief that their experiences had influenced their career goals by demonstrating the value that interdisciplinary training provides both in research interests and potential marketability for academic jobs. One fellow wrote, "CNS enriched my graduate experience in ways I never could have imagined by opening research and career opportunities not otherwise available. Thank you for this exceptional experience!"

The CNS seminar continues to adjust to the needs of the CNS participants and looks forward to continuing to improve its ability to meet the needs of the students. Fellows rated the overall content of the seminar series as "good" (average score of 3 on a 5 point scale). Three of the respondents rated the seminar series as "good" or "very good," with one respondent rating it as "satisfactory." Open-ended comments suggest that a set of core readings at the start of the year would improve the focus of the seminar while others noted that more time should be devoted to professional skills development. Both these suggestions have been employed in prior years, and the program will assess whether a return to these modes is advisable.

The four CNS alumni/ae respondents reported having had positive experiences at CNS-UCSB that benefited their current professional activities. The respondents rated their overall CNS experience as "very good" to "excellent" (average score 4.25 on a 5-point scale) and "agree" to "strongly agree" that participation in CNS has been beneficial to their professional career (average score of 4.25 on a 5 point scale). Furthermore, most respondents have continued to collaborate with other CNS researchers since leaving the program and continued to use their

interdisciplinary training in the progression of their professional careers. One former Fellow noted that “Overall this has been a really great experience and I would recommend it highly to anyone with similar career goals or interests.”

Of the alumni/ae survey respondents, one is a technical consultant for an electrical engineering and a computer science company, while one holds a new graduate fellowship position at UCSB. The remaining alumni did not respond to this question. Past annual surveys also show that former CNS fellows have gone on to careers including academic positions (as faculty or postdocs) and consulting.

Graduate Student Researchers (GSRs): In addition to the Graduate Fellows Program, CNS-UCSB provides graduate students with opportunities for involvement in research projects as GSRs. These students are hired by, and work closely with, IRG leaders on projects for periods of one or more quarters’ duration. GSRs are invited, but not required, to participate in all CNS-UCSB activities, including the Research Seminars and graduate student information meetings, and receive regular announcements of professional development opportunities through Center listservs. Like other Education Program participants, GSRs are encouraged to discuss issues of interest and concern with the Education Director and Director of Education Programs and Communication. Several former GSRs were later awarded Graduate Fellowships through open recruitment processes, including current Year 8 Fellows Eardley-Pryor, Engeman, and Horton.

Ten GSRs worked on research and educational outreach projects during the reporting year; seven of whom were women. Seven current or past GSRs worked on IRG 3 projects: Rachel Cranfill completed and submitted for review a publication on gender and talk in public deliberations about nanotech. Four Bren school MSc students (Baumgartner, Carr, Fish, & Meyerhofer) were co-authors on 2 publications out of Harthorn and Engeman’s industry risk perception and workplace safety survey, Mary Collins, a GSR with the UC Center for the Study of the Environmental Implications of Nanotechnology (UC CEIN) at UCSB, worked with Harthorn and Satterfield on a series of projects on environmental risk perception and justice, and Diamond-Lenow provided research assistance on finding new articles Harthorn’s Risk and Inequality course Lauren Copeland worked with Bruce Bimber and Barbara Harthorn in developing a survey of consumer and political attitudes toward nanotechnology products. Anna Walsh worked with Rich Appelbaum on IRG 2 China research. Zachary Horton worked with Chris Newfield as a GSR conducting research for a book on solar energy policy as part of the X-IRG Nano Solar Project.

In year 8, CNS-UCSB developed a formal program of tracking outcomes for current and former GSRs. Education Program leader Metzger with program staff developed an annual survey that was administered to GSRs in March 2013. They reported satisfaction with their IRG research experience highlighting the support they received from their faculty mentors with regard to their research and how to expand their work to meet the Center’s goals. One GSR noted that her or his time at CNS resulted in multiple projects being accepted for publication and helped to confirm the GSR’s interest in pursuing a research-based academic career. They also benefited from inclusion in the CNS seminar while enjoying their freedom to opt out of participation in activities outside their areas of interest. One GSR communicated their appreciation of CNS by saying “I just wanted to take a moment to thank you and the center for all your support. I wouldn’t be where I am today without CNS.” Another former GSR in a letter of appreciation wrote, “I have been extremely fortunate to be a part of the CEIN and CNS and to learn from the very best in the field. I couldn’t have asked for a better group of people to work with.”

INSET Summer Internship Program

In 2012, CNS-UCSB provided four internships to students participating in the NSF-funded Interns in Science, Engineering and Technology (INSET) REU program at the California Nanosystems Institute (CNSI). This program recruits community college students to participate in an 8-week summer research experience on the UCSB campus. As participants in the INSET program, CNS-UCSB interns participate in weekly meetings and special seminars, and are trained in presentation skills alongside REU interns working on experimental science research projects in CNSI laboratories.

At CNS-UCSB, the interns worked on projects addressing the societal implications of nanotechnology under the mentorship of the Social Science and Humanities Graduate Fellows: examining how nanotechnology-inspired visions about reshaping and enhancing nature shaped policy about environmental health and safety issues (Gianna Haro for IRG1); analyzing value chains in nanotechnology related industries in the State of California (Kelly Landers for IRG2); identification of NGOs risk and benefit perceptions of nanotechnology (Eddie Triste for IRG3); and researching open source cultures and analyzing interviews with nano-solar entrepreneurs (Bryan Phillips for X-IRG Solar Project). In addition to working on individual research projects, the interns participated in IRG meetings, attended CNS Graduate Fellows Seminar meetings, and met weekly with program coordinator Boggs. At the end of the program, they gave oral presentations about their research projects to the CNS-UCSB community and to a session attended by other INSET interns and mentors. They also presented their research at a campus-wide research poster colloquium with UCSB interns from the INSET and other summer research programs.

Two of the four (50%) summer interns were women, and one intern (25%) was Latino. Mentor Roger Eardley-Pryor from CNS-UCSB will present the results of IRG1's 2012 summer INSET project research at the annual meeting of the American Society for Environmental History in Toronto, Canada in April 2013. The title of the paper is "How Ecotopian Visions of Nanotechnology Influenced U.S. Environmental Health and Safety."

Following completion of their internships, Landers matriculated at UCSB as a Math/Statistics major, Triste matriculated at Sacramento State College in Sociology, while Haro and Phillips both returned to Santa Barbara City College on their way to an eventual transfer to UCSB.

2012 INSET Summer Interns

Intern	Home University	Grad Mentor	PI	IRG
Gianna Haro	Santa Barbara City College	Roger Eardley-Pryor	Patrick McCray	1
Kelly Landers	Santa Barbara City College	Galen Stocking	Rich Applebaum	2
Eddie Triste	Allan Hancock College	Cassandra Engeman	Barbara Harthorn	3
Bryan Phillips	Santa Barbara City College	Zach Horton	Chris Newfield	X-IRG

Evaluation

Evaluations completed by both interns and mentors demonstrated the continued success of the INSET program. Interns enjoyed the research process and were satisfied with their final projects. They also reported satisfaction with how much they learned from participation in CNS activities, and interactions with their mentors and other members of the CNS-UCSB community.

As in past years, the 2012 interns reported increased motivation in their own courses, increased confidence in their knowledge, research skills, and, in particular, increased confidence in their communication and presentation skills as a result of participating in the program. Two of the interns commented that the experience opened up potential new career opportunities. Particular challenges they reported include staying motivated while collecting data and making oral presentations. One intern working on a film project noted their biggest challenge was working through differences of (artistic) opinion on the project. Another intern, when asked about challenges during the internship said, “I think the most challenging aspect of CNS was leaving.” The most enjoyable aspects of their internship cited were interacting with CNS-UCSB researchers and the diverse fields of study they bring to the center, and working in a research-based, project-oriented setting. Overall, the interns reported developing a greater appreciation for the issues influencing nanotechnology’s social acceptance and the role of social science research in general. One intern summarized the value of the program as follows, “This internship gave me valuable presenting and networking skills, but most important it showed me how capable I am of things I didn’t know I could do before. I know this internship is just the beginning and first opportunity of many more to come towards building my professional career. Thank you!” She further notes that the internship experience motivated her to go to graduate school in the future.

Mentors evaluated their experience positively stating that, if given the opportunity, they would participate in the program again. Mentors reported enjoying working with their students, noting the enthusiasm with which the interns approached their projects. Mentors enjoyed helping the interns develop their research skills and seeing the growth of their intern’s confidence. While all the mentors noted that the experience took time away from their own research, each commented that the benefits were well worth the time commitment. In addition to the positive experience of witnessing the academic growth of their interns, some mentors also noted benefits to their own research project and their ability to communicate across fields and improve their ability to teach and share knowledge. One mentor summarized the value of the program to mentors and interns as follows: “The INSET program helped improve my ability to mentor undergraduate research projects. The structure of the INSET program provides an outline for how I would construct my own course or program of interdisciplinary research, which I hope to do in the future as a professor. Working with such a dedicated, intelligent, and hard-working intern also helped me clarify the quality of my thinking about my research project. INSET is an excellent program and a pleasure!” Another had this to say: “The program provides an important opportunity for community college students to work in a university research setting and to improve written communication and presentation skills. As a Research Fellow and mentor, I also benefited from the program, learning how to guide students through designing social science research, collecting data, and communicating finds. This is a skill I will take to my future academic positions.”

Curriculum

Graduate Fellows Orientation Meeting: In September 2012, CNS-UCSB started the academic year with a half-day orientation workshop and lunch for the new and returning Graduate Fellows. The orientation was built around an interactive discussion of the Center’s mission, activities, and policies and procedures, as well as specific background on the IRG research programs. In addition, the orientation included an introduction to nanoscale science and engineering concepts, and hands-on exposure to nanoscale materials using some of the exercises developed by the Nanoscale Informal Science Education Network for NanoDays. The

session was followed by a lunch to introduce the new Fellows to CNS-UCSB leadership, faculty, postdocs, and staff.

CNS Research Seminar: As in past years, the CNS-UCSB Research Seminar on Emerging Technologies & Society (offered quarterly as Sociology 591) was the focal point of the Educational Program's internal activities during the reporting year. The quarterly seminar meetings (4-5 per quarter) help develop an interdisciplinary community of scholars with special expertise and help participants learn to communicate effectively across disciplinary boundaries. Seminars address a wide range of issues related to emerging nanotechnologies and society, including social science and NSE research methods and ethics, science and technology studies, professional development topics, and substantive research from the IRGs and strategic projects.

Many of the sessions with outside speakers are open and are advertised to the campus community, generating interest in CNS-UCSB research among departments such as Anthropology, Communication, East Asian Languages and Cultural Studies, Economics, Environmental Studies, Feminist Studies, Global & International Studies, History, Political Science & Sociology.

Seminar speakers this reporting year who were also part of the CNS Speaker Series included the following:

- Jan Youtie & Philip Shapira, "Is there a nanotechnology paradox? Interpreting trajectories of nanotechnology and innovation." Dr. Youtie is Director of Policy Research Services and principal research associate at the Enterprise Innovation Institute at Georgia Institute of Technology. Dr. Shapira is Professor of Policy, Innovation and Management at the Manchester Institute of Innovation Research, Manchester Business School and Professor of Public Policy at Georgia Institute of Technology (Dec 2012)
- Luciano Kay, Postdoctoral Scholar, CNS-UCSB (IRG2), "Using Bibliometric and Patent Analysis to Map Global Innovation Pathways in Nanotechnology" (June 2012)
- Zachary Horton, CNS-UCSB Graduate Fellow, "Filming Nano-Futures: Collaborative Narrative Making in an Academic Context" (July 2012)
- IRG3 panel presentation, "Nanotechnology, Risk, and Consumer Products" by Mary Collins and Shannon Hanna that provided an overview of IRG3 research (Nov 2012)
- Amy Slaton, Professor of History, Drexel University, "New Promise, Old Premise: Workforce Education and Opportunity in American Nanomanufacturing" (Feb 2013)
- Harro van Lente, Associate Professor of Emerging Technologies at Utrecht University and Socrates Professor of Philosophy of Sustainable Development at Maastricht University, "Novelty, Needs and Rights: Anticipating Needs in Society." Professor van Lente is Program Director of Technology Assessment of the NanoNextNL, the leading Dutch research consortium in nanotechnology (Mar 2013)

Seminar professional development sessions included presentations by Miriam Metzger, Bruce Bimber, Trish Holden, and Peter Alagona, who are all faculty in various departments at UCSB, addressing "Secrets of the Temple: The Insiders' Guide to Academic Job Hunting"; Kim DeBacco, Instructional Consultant in the Office of Instructional Development at UCSB led a hands-on workshop on using advanced features of presentation software including Powerpoint, Prezi, and Keynote; Cathy Boggs, CNS-UCSB Education program coordinator, discussing how to create effective poster presentations; Lauren Copeland, Matt Gebbie, Shirley Han, Galen Stocking, Edgar Zayago Lau, and Mary Collins delivered practice conference presentation talks; and practice job talks were given by Mary Collins "Disproportionaltiy, Inequality, and

Vulnerability in Socio-Ecological Systems"; Cassandra Engeman, "Unions, Policy, and Family Values: How Unions Influence State-Level Policy in the U.S."; and Roger Eardley-Pryor, The Global Environmental Moment."

CNS-UCSB students can broaden their formal education in areas related to their IRG research by participating in interdisciplinary doctoral emphases programs offered by UCSB. Three of particular relevance are those in Technology and Society, Feminist Studies, and Global Studies. The interdisciplinary doctoral emphasis program in Technology and Society is organized through the UCSB Center for Information Technology and Society (CITS). CNS-UCSB faculty Bimber, Harthorn, McCray and Metzger are affiliated with CITS, and a close working relationship exists between the two Centers. The doctoral emphasis requires coursework in the areas of culture and history and society and behavior, and a dissertation on a topic concerning technology and society. All CNS faculty and students are kept informed about upcoming events and speakers in the CITS seminar series.

NACK Webinar: On December 14, 2012 CNS Director Barbara Harthorn conducted a webinar on "Societal and Ethical Issues in Nanotechnology" as part of the National ATE Center for Nanotechnology Applications and Career Knowledge (NACK) Network, located at the Penn State College of Engineering. The NSF-funded network aims to create a nanotechnology-knowledgeable citizenry by providing resource sharing, course materials, and stressing broad student preparation to help create and sustain economically viable nanotechnology education at 2- and 4-year colleges and universities across the U.S.

Dr. Harthorn's webinar provided an overview of ELSI (Ethical, Legal, & Social Issues) approaches to the responsible development of nanotechnology. Based on research conducted at CNS from 2006-2013, the talk addressed such questions as: What is meant by "Responsible Development"? Who are the stakeholders in nanotech development, and what are their views on this? What are the main approaches being taken to governance of nanotechnology? Why involve the public? The webinar attracted 83 registrants from 23 states plus District of Columbia and Puerto Rica, and from 13 countries outside the U.S., including in Europe, North and South America, Australia, and Asia, with additional webinar views ongoing (with 13 already in the first quarter of 2013). Webinar participants came from both 2- and 4-year higher education colleges and universities, and also included K12 and STEM educators, as well as participants from industry, national laboratories, state and federal government, scientific societies, NGOs, and entrepreneurs. The webinar featured a chat feature that enabled two-way participation and interaction with participants. To access the webinar content and interactive discussion, please see. http://nano4me.org/webinars.php

Curriculum: CNS-UCSB faculty, external collaborators and former Graduate Fellows incorporated Center research into 14 unique university courses during this reporting period, listed below. (Note that some courses were taught more than once per year, which is not reflected in the overall count of unique courses above.)

Graduate Level Courses:

- English 236, UCSB, *Future of General Theory: The Case of Critical University Studies* (Newfield)
- Feminist Studies 260, UCSB, *Feminist Research Methods* (Harthorn guest lecture W 13)
- Sociology 591BH, UCSB, *CNS Research Seminar in Emerging Technologies and Society*, taught 4 quarters/yr. (Harthorn)

- Environmental Science and Management 241, UCSB, *Environmental Politics* (Collins guest lecture Feb 2013)
- History 201HS, *Advanced Readings in History of Science & Technology* (McCray W13)

Undergraduate Level Courses:

- Anthropology/Environmental Studies 130A (Harthorn guest lecture)
- English 197, UCSB, *American Literature & Business Culture/Creativity* (Newfield)
- Feminist Studies 186HH, UCSB, *Gender and Society: Risk & Inequality* (Harthorn) (offered W 2012 & W 2013).
- Global & International Studies 2, UCSB, *Introduction to Global Studies: Politics and Economics* (Appelbaum)
- Global & International Studies 130, UCSB, *Global Economy and Development* (Appelbaum)
- Civil Engineering 202, University of British Columbia, *Civil Engineering II* (social context of infrastructure, climate change and energy, leadership, and project management and construction), Department of Civil Engineering (Kandlikar, Beaudrie)
- Feminist Studies 186HH, UCSB, *Gender and Society: Risk & Inequality* guest lecture "The Political-Economy of Risk Perception" (Shearer)
- Jour/ES/STS 323: Health and Environmental Controversies, Lehigh University (Friedman)
- Anthropology 195A, *Senior Honors Thesis* (topic "The Politics of Risk Perception"), supervised by Harthorn (W 2013).

In addition to these formal course activities, CNS faculty Timothy Lenoir, Duke University, Department of Art, Art History, & Visual Studies, directed two undergraduate independent studies on recent developments of nanotechnology in China and the effectiveness of new innovation policies in stimulating indigenous innovation in China, and directed a senior honors thesis on this topic as well. Rich Appelbaum advised a Ph.D. candidate in Economics studying the success of internationally trained Chinese venture capitalists, and shot video for an introductory co-authored textbook in sociology (WW Norton, publisher). Cyrus Mody, Rice University, delivered a guest lecture to a course examining the Titanic disaster at the Glasscock School of Continuing Studies.

Master Class with Vivek Wadwha: CNS hosted master class for CNS faculty, graduate fellows, postdocs, GSRs, and leading campus faculty and administrators with Vivek Wadwha, *Washington Post* and *Bloomberg Businessweek* columnist, on Monday, November 19 examining the controversial topic of: "How exponentially advancing technologies will allow us to solve humanity's grand challenges, but will decimate China's manufacturing industry and India's call centers." Vivek Wadhwa is Vice President of Academics and Innovation at Singularity University, Silicon Valley, Fellow at the Arthur & Toni Rembe Rock Center for Corporate Governance, Stanford University, Director of Research at the Center for Entrepreneurship and Research Commercialization at the Pratt School of Engineering, Duke University, and distinguished visiting scholar, Halle Institute of Global Learning, Emory University. In 2012, the U.S. Government awarded him distinguished recognition as an "Outstanding American by Choice" for his "commitment to this country and to the common civic values that unite us as Americans." The master class was attended by 32 participants, who came from a wide range of fields, including Political Science; Economics; History; Communication; English; Sociology; Feminist Studies; Global & International Studies; Chicano/Chicana Studies; Chemistry; Environmental Science & Management; Materials Science; Ecology, Evolution, & Marine Biology; Computer Science, Electrical and Computer Engineering; Development Studies;

Technology Management, and Mechanical Engineering. UCSB's Vice Chancellor for Research also attended the Master Class.

Proposed Nanoecotoxicology Undergraduate Education (NUE) Program: CNS-UCSB Director Harthorn was a Co-PI on a two-year, $200,000 NUE funding proposal to NSF submitted at the end of April, 2012. This undergraduate program was designed to introduce engineering and science students to many applications of nanotechnology, and to provide them with knowledge and hands-on experience that will support careful consideration of potential environmental and societal impacts when choosing nanomaterials to achieve desired design solutions. Lead PI on the proposal was Dr. Arturo Keller, Professor of Biogeochemistry at the Bren School for Environmental Science & Management. This project built on a UC CEIN on-line ecotoxicology course, being disseminated in the US and internationally, for which Harthorn provided one of 15 lectures and the only societal implications content. Although the proposal was unsuccessful in this first attempt, CNS is in discussion w/ UCSB CEIN collaborators about possible next steps for collaborative educational initiatives.

Reports to the National Advisory Board

CNS-UCSB faculty and staff report evidence of progress towards completion of the objectives listed above to the National Advisory Board (NAB). At the most recent NAB's April, 2011 meeting, discussion centered on broad questions related to the Center's future following the end of the second NSF grant period. The Board was especially concerned that CNS-UCSB identify new sources of support to maintain and build on the Education Program's successes in training interdisciplinary graduate student and postdoctoral research scholars. Aware that NSECs that have already sunsetted reported greatest difficulties in obtaining new funding for their education and outreach programs, the NAB advised the Center's leadership to make this a major priority. This issue was discussed further at an all-day Executive Committee planning retreat held in January, 2012, and CNS is working to develop a strategic plan to identify future Education Program activity foci and funding needs. NAB members are providing direct consultation to Director Harthorn and the CNS Executive Committee on an as needed basis. For example, Harthorn had a lengthy discussion w/ Board Co-Chair Bostrom about CNS progress, goals and challenges at the SRA-Europe meetings in Zurich in June 2012; and with Co-Chair Seely Brown in conjunction with his contributions to *The Social Life of Nanotechnology* and his suggestions for possible changes to the NAB membership in the years ahead.

Evaluation Databases

CNS-UCSB maintains databases containing diversity information about all undergraduates, graduate students, and postdoctoral researchers and scholars who participate in the education program. We keep anonymous responses from the annual surveys of postdoctoral researchers and graduate student fellows, and plan to develop future surveys addressing all levels of active participants. We also collect email addresses and department/interests information from attendees who provide this on sign-in sheets at our events. We use this information to identify the nature of the population that is interested in our activities, and it shapes our planning for future education, research, and outreach activities.

Website

The CNS-UCSB website provides information about our Education programs, participants, and resources, at http://www.cns.ucsb.edu/education. Descriptions of the Postdoctoral Scholars, Graduate Fellows, and Summer Internship Programs provide program overviews, application processes, and short profiles of current and former participants. There is also a list of courses at UCSB that address nano and society issues at least in part. Resources for educators include

course materials for the *Nanoscience in Society* community college course and the *Traveling Technologies* internship project. Both the community college course and the internship project were developed by CNS-UCSB in 2011. A “New to Nano” section provides links to resources provided by nano educational organizations such as the Nanoscale Informal Science Education Network (NISE Net), Penn State’s Nanotechnology Applications and Career Knowledge Center (NACK), and the Woodrow Wilson Center’s Project on Emerging Nanotechnologies (PEN). Education Highlights from NSF reports are also posted on the site. News and upcoming events related to the education program are promoted on the website’s front page and archived under the site’s “News” and “Events” tabs. Additional information about Education Program promotion activities can be found below in Section 12: Outreach and Knowledge Transfer.

Table 3a: Education Program Participants - All, irrespective of citizenshi

Student Type	Total	Gender		Race Data								Ethnicity: Hispanic	Disabled
		Male	Female	AI/AN	NH/PI	B/AA	W	A	More than one race reported, AI/AN, B/AA, NH/PI	More than one race reported, W/A	Not Provided		
Enrolled in Full Degree Programs													
Subtotal	**37**	**17**	**20**	**3**	**2**	**1**	**26**	**2**	**0**	**0**	**3**	**6**	**0**
Undergraduate	**15**	5	10	3	2	0	9	0	0	0	1	5	0
Masters	**8**	4	4	0	0	0	6	1	0	0	1	1	0
Doctoral	**14**	8	6	0	0	1	11	1	0	0	1	0	0
Enrolled in NSEC Degree Minors													
Subtotal	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**
Undergraduate	**0**	0	0	0	0	0	0	0	0	0	0	0	0
Masters	**0**	0	0	0	0	0	0	0	0	0	0	0	0
Doctoral	**0**	0	0	0	0	0	0	0	0	0	0	0	0
Enrolled in NSEC Certificate Programs													
Subtotal	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**
Undergraduate	**0**	0	0	0	0	0	0	0	0	0	0	0	0
Masters	**0**	0	0	0	0	0	0	0	0	0	0	0	0
Doctoral	**0**	0	0	0	0	0	0	0	0	0	0	0	0
Practitioners taking courses	**0**	0	0	0	0	0	0	0	0	0	0	0	0
K-12 (Precollege) Education													
Subtotal	**1**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**
Teachers	**0**	0	0	0	0	0	0	0	0	0	0	0	0
Students	**1**	0	0	0	0	0	0	0	0	0	0	0	0
Total	**38**	**17**	**20**	**3**	**2**	**1**	**26**	**2**	**0**	**0**	**3**	**6**	**0**

LEGEND:

AI/AN -	**American Indian or Alaska Native**
NH/PI -	**Native Hawaiian or Other Pacific Islander**
B/AA -	**Black/African American**
W -	**White**
A -	**Asian, e.g., Asian Indian, Chinese, Filipino, Japanese, Korean, Vietnamese, Other Asian**
More than one race reported, AI/AN, B/AA, NH/PI -	**Personnel reporting a) two or more race categories and b) one or more of the reported categories includes American Indian or Alaska Native, Black or African American, or Native Hawaiian or Other Pacific Islander**
More than one race reported, W/A -	**Personnel reporting a) both White and Asian and b) no other categories in addition to White and Asian**
US/Perm -	**U.S. citizens and legal permanent residents**
Non-US -	**Non-U.S. citizens/Non-legal permanent residents**

Table 3b: Education Program Participants - US Citizens and Permanent Residents

Student Type	Total	Gender		Race Data								Ethnicity: Hispanic	Disabled
		Male	Female	AI/AN	NH/PI	B/AA	W	A	More than one race reported, AI/AN, B/AA, NH/PI	More than one race reported, W/A	Not Provided		
Enrolled in Full Degree Programs													
Subtotal	**27**	**11**	**16**	**1**	**0**	**1**	**23**	**1**	**0**	**0**	**1**	**2**	**0**
Undergraduate	**7**	1	6	1	0	0	6	0	0	0	0	1	0
Masters	**7**	3	4	0	0	0	6	0	0	0	1	1	0
Doctoral	**13**	7	6	0	0	1	11	1	0	0	0	0	0
Enrolled in NSEC Degree Minors													
Subtotal	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**
Undergraduate	**0**	0	0	0	0	0	0	0	0	0	0	0	0
Masters	**0**	0	0	0	0	0	0	0	0	0	0	0	0
Doctoral	**0**	0	0	0	0	0	0	0	0	0	0	0	0
Enrolled in NSEC Certificate Programs													
Subtotal	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**
Undergraduate	**0**	0	0	0	0	0	0	0	0	0	0	0	0
Masters	**0**	0	0	0	0	0	0	0	0	0	0	0	0
Doctoral	**0**	0	0	0	0	0	0	0	0	0	0	0	0
Practitioners taking courses	**0**	0	0	0	0	0	0	0	0	0	0	0	0
Total	**27**	**11**	**16**	**1**	**0**	**1**	**23**	**1**	**0**	**0**	**1**	**2**	**0**

LEGEND:

AI/AN -	**American Indian or Alaska Native**
NH/PI -	**Native Hawaiian or Other Pacific Islander**
B/AA -	**Black/African American**
W -	**White**
A -	**Asian, e.g., Asian Indian, Chinese, Filipino, Japanese, Korean, Vietnamese, Other Asian**
More than one race reported, AI/AN, B/AA, NH/PI -	**Personnel reporting a) two or more race categories and b) one or more of the reported categories includes American Indian or Alaska Native, Black or African American, or Native Hawaiian or Other Pacific Islander**
More than one race reported, W/A -	**Personnel reporting a) both White and Asian and b) no other categories in addition to White and Asian**
US/Perm -	**U.S. citizens and legal permanent residents**
Non-US -	**Non-U.S. citizens/Non-legal permanent residents**

12. OUTREACH AND KNOWLEDGE TRANSFER

The overall purpose of CNS-UCSB's Outreach and Knowledge Transfer activities is to create awareness and use of our research findings about the societal implications of nanotechnologies among stakeholders at the local, regional, national and international levels, in order to encouraging conversations during this "upstream" period of nanotechnology development that will lead to their responsible and sustainable development.

As personnel have changed and our research course continues to mature, we have begun a process of evaluating the long-term direction of our outreach activities even as we continue those that have proven successful in the past. In this section, we offer an overview of our approach to public outreach and engagement, and then describe our outreach efforts during the reporting year and some of our future plans for sharing our work with various stakeholder audiences—nanoscientists and engineers, the policy community, other technology and society researchers, and members of the general public—who are affected by the nano-enterprise.

Content and Context: Integrating CNS-UCSB's Research and Outreach Programs

Addressing the challenges of devising and implementing new methods for learning about and engaging with the full range of stakeholders in the nano-enterprise is a critical aspect of the NSEC and NNI mandates for responsible technology development and vital to the economic success of the nano-enterprise as well. The core of CNS-UCSB societal implications research focuses on understanding and conducting comparative analysis of the views of the multiple stakeholders in the nano-enterprise, in order to engage them in mutual analysis, discussion, and, we hope, decision making. To that end, CNS-UCSB pursues a multi-layered outreach and knowledge transfer program designed to integrate our research with our efforts to reach and interact with the multiple stakeholders in the growing nano-enterprise. The term "knowledge transfer" implies a one-way and top-down process of knowledge deposition that is at odds with our views about the importance of two- or even multi-way interaction between the scientific and social communities.

CNS strives to gain the knowledge and lay the foundations necessary to pursue the more difficult mutual, interactive forms of engagement with science and society, including addressing the many interested social actors, as well as those individuals and groups who lack familiarity with nanotechnologies but are *implicated* in nanotechnologies' futures. Ongoing relatively low levels of public awareness of nanotechnologies (see our high impact meta analysis of public attitude and perception surveys, Satterfield et al., *Nature Nanotechnology*, 2009) particularly challenge the project of public engagement, and CNS-UCSB is discussing new approaches to helping improve this situation as we move forward. Harthorn is in active discussion as an informal advisor to the NNI's working group on public engagement, NPEC, so this work has the potential to impact (indeed, we're told it has already impacted) government decision making at the highest levels.

There are no easy answers as to how to create meaningful multi-stakeholder participation. At CNS-UCSB, we see our role in this process as having three dimensions. First, we conduct research that generates necessary new knowledge about the contours and beliefs of upstream perceptions about nanoscale science and technology, and responses to messages about them, held by members of the public and of stakeholder groups, which include nanoscale scientists and engineers, nanotoxicologists, regulators, industry, insurers, public interest groups, the media, and societal implications researchers. Second, we seek to disseminate this knowledge through our outreach activities to these various stakeholders and engage with them about their

views on these matters. Third, we want to use this knowledge to develop replicable models of the type of tailored public participation activities that past studies and our own research have shown to be effective.

The challenges to full engagement are many: the experts are diverse, the industry is global, nanomaterials themselves are an enormous class of technologies and their enabled products equally heterogeneous. There are also many publics—workers, members of communities located near industrial sites, consumers, the environmentally exposed—having varying concerns that may exist at the local, state, national, and even global levels. The nano-enterprise is a complex social and historical reality, and capturing it adequately requires multiple methods, along with a selective, strategic approach. A full-scale, national US deliberation effort would require investment far beyond that reflected in the budgets for the two current nano societal research centers, CNS-UCSB and CNS-ASU, even if they were exclusively devoted to public deliberation research and action (which they are not). Our awareness of this constraint on scale of effort has been particularly acute because of the extensive knowledge and advice provided to us since the Center's beginnings by our UK collaborator, Nick Pidgeon, a veteran and outside evaluator of numerous public deliberation and participation campaigns in the risk controversy-plagued UK and one of the world's leading experts in the field.

To understand the highly distributed and complex global nature of the nano-enterprise and its stakeholders requires research approaches that are collaborative, interdisciplinary, and international in scope. The multiple methods used by CNS-UCSB's researchers to meet these challenges include:

- Qualitative social science—interviews, small group dialogue, on-line forums, participant-observation—for learning about deeper, contextual, cultural domains, values, narratives, identities, and experiences
- Quantitative social science—phone, web, & mail surveys using broad, representative samples, or large-scale experimental studies
- Historical analyses–comparative, descriptive, narrative explorations of the nano-enterprise via in-depth oral histories of leading NSE scientists; content analysis of policy, media and other documents; and archival research.

CNS-UCSB Outreach Activities to Nano Stakeholder Groups

The full range of CNS-UCSB research is thus important and integral to the Center's outreach and knowledge transfer goals. Like our research, we believe that our outreach activities must be premised on the understanding that there is no universal, one-size-fits-all approach; rather outreach much be tailored to each party, based on careful assessment and knowledge of their level of technology awareness and understanding, perceptions (positive, negative, neutral, or indifferent), and interests (environmental, economic, health, social, or political, among others).

We also view engagement with the various stakeholder groups as central not only to CNS-UCSB's Outreach Program, but as a key responsibility shared by all members of the CNS-UCSB community. Below we will describe some of the many successful outreach activities through which we have interacted with key stakeholder groups during the reporting year in the hope of encouraging their increased interest in engaging with the important societal implications shaping the developing nano-enterprise. At the same time, our research and others' has shown that some publics may chose not to engage, and the work documents the problematics of rising demand for mandated public participation, in some cases for purposes at odds with the mutual free flow of knowledge suggested in our preferred approach.

NSE Community

Engagement through participatory research and activities with nanoscientists and engineers is a central and distinctive aim of the CNS-UCSB, as well as one of our most fruitful areas of activity. There are many reasons for this. We seek to understand the nano-enterprise from its participants' points of view; to foster new opportunities for dialogue and engagement between nano scientists and social scientists for mutual benefit; to develop innovative methods to train a new generation of society-minded scientists and science-minded social scientists; to use the research findings of the CNS to enhance two-way communication between nano-science and society, and 3-way communication among nano-science, social science, and society.

Leadership: One important aspect of CNS-UCSB's engagement with the NSE community is in our commitment to the involvement of the NSE community at the very top. Five of the eight members of our National Advisory Board come from science backgrounds, including Co-Chair and Former Xerox PARC chief John Seely Brown**;** CBEN (Rice Univ) leader Vicki Colvin; Harvard nanoscientist and NSEC director Robert Westervelt; and engineer Susan Hackwood, Director of the California Council on Science and Technology Policy. The Center's seven-member Executive Committee includes two scientists: materials scientist Craig Hawker and ecotoxicologist and engineer Patricia Holden**.**

Research: Since our beginnings in 2006, members of all CNS-UCSB research groups have actively engaged members of the science and engineering community in our work. Much of this takes the form of direct engagement – attending meetings and conferences, studying scientific research and research practices, conducting interviews, and conducting ethnographic laboratory studies. CNS-UCSB researchers are engaged in studies across many domains of the nanoscience community.

IRG 1 historians conduct research and engage with the scientific community on a near daily basis in their work. In collaboration with the Chemical Heritage Foundation (CHF), they have conducted structured interviews with important nanoscale scientists and engineers, with the goal of capturing their ephemeral recollections of key meetings, events, discoveries and people. These oral histories are archived at the CHF and made available for others to use. Experts interviewed for this project come from many diverse nano fields, including nanoelectronics, nano solar, nanobio, nanomedicine, nanoecotoxicology, and include individuals from the US and abroad. IRG 1 Leader Patrick McCray returned in summer 2012 to UCSB from a prestigious visiting professorship at Cal Tech for 2011-2012 based on earlier interactions with scientists there, and is developing a new project on the nano-bio interface based on what he learned.

IRG 2 researchers have worked closely with NSE researchers in developing and understanding the contexts for international collaboration in their work. As part of their research on the impacts of the nano-enterprise on international social, economic, and development processes, IRG 2 leader Rich Appelbaum and three Graduate Fellows (Gebbie, Han, and Stocking) traveled to Suzhou, China in April 2012 to interview managers and early-career stage scientists working on bionanotechnology in companies located in BioBay, a nanotechnology center located within Suzhou Industrial Park. IRG 2 researchers have since presented papers on labor-related issues that draw from the China research at Penn State's conference on global workers' rights last spring, and at the Orfalea Center Global Studies Conference this February. In addition, in July 2012 Rich Applebaum advised the Nanotechnology GIN working group. GIN is the working group of the nanoscale Science, Engineering, and Technology Subcommittee, which is the interagency body responsible for coordinating the federal program (NNI) that oversees nanotechnology research and development in the US.

IRG 3 has developed deep and lasting ties with both NSE and nanotoxicologists. CNS-UCSB is a funded partner in the UC Center for Environmental Implications of Nanotechnology at UCLA, in which Director Harthorn leads the only social science IRG and serves on the leadership team, the UC CEIN Executive Committee. This involves extensive participation in all aspects of a 'Big Science' center, including conceptual planning of UC CEIN direction, the challenges of ENM risk assessment, serving as a voice for embedding societal implications issues within the structures and practices of the Center. Harthorn is collaborating with the UC Center for Lab Safety as they seek to develop a risk perception survey of all UC laboratory researchers, based in part on the awareness of the value of risk perception research generating within the UC CEIN community at UCLA. This collaboration has led to collaborative education and outreach activities between UC CEIN and CNS-UCSB, the fostering of new projects-in-planning with the wider societal implications community (e.g. Guston and Eggleson's NSF workshop proposal on which Harthorn is a lead collaborator which was funded in 2012), and the co-production of knowledge through collaborative research with UCSB engineer and microbiologist Patricia Holden, a professor in the Bren school of Environmental Science and Management and also a principal in the UCSB CEIN conducting ecotoxicology research. IRG 3 has collaborated on the 2nd international survey of industry risk perceptions and safe handling practices for nano materials (see Engeman et al., 2012 and 2013; also Conti et al. 2008). This project represents a highly successful integration of social science and nanoscale science expertises and interests and has led to further points of connection, for example, the addition of Holden to the CNS Executive Committee in 2011 and to discussion of new possible collaborations in progress.

Joint Funding Proposals: CNS-UCSB researchers have collaborated with scientists and engineers on numerous joint funding proposals, a majority of them successful. One of the most noteworthy of these was the $24 million award that established the UC Center for the Environmental Implications of Nanotechnology (UC CEIN), for whom CNS-UCSB director Harthorn has been an active IRG leader and researcher in addition to the range of activities noted above. Harthorn is a funded senior personnel on the pending renewal proposal for this national center ($24M). In an extension of the CNS-CEIN partnership, Harthorn also served as Co-PI with Dr. Arturo Keller from the Bren School of Environmental Science & Management on an NSF NUE proposal in 2012 to fund co-development of a new undergraduate curriculum in nanoecotoxicology with significant societal implications content

Publications: In publishing our results, CNS researchers have chosen venues that reach beyond our traditional disciplinary audiences of social scientists, historians and science and technology studies, by disseminating our work to such publications as *Physics Today*, *Chemical Heritage White papers*, *Environmental Science & Technology*, *Journal of Nanoparticle Research*, *Nature*, *Nature Nanotechnology*, and *Nature Climate Change*, and *Chemical Engineering*. Our researchers have been invited to attend and make presentations to meetings and conferences for the semiconductor industry, the NNI and its industry participants, and leading economic industry groups, as well as professional meetings of chemists, physicists, materials scientists, toxicologists, and environmental and occupational health and safety experts. During this reporting period CNS-UCSB Director Harthorn was interviewed in August 2012 for an article that appeared later that month in *Nature* on nanotechnology NGOs and terrorism in Mexico. In 2013, Cyrus Mody also published an article in *Nature* titled, "Limits be Damned: Review of How a Group of Elite Scientists Pursued Space Colonies, Nanotechnologies, and a Limitless Future."

Education: One of the most successful and novel methods by which CNS-UCSB engages scientists and engineers has been to directly involve their graduate students in our work through

our innovative interdisciplinary Graduate Fellowship program. Alongside their peers from the social sciences and humanities (5 in the reporting year), Nanoscale Science and Engineering Graduate Fellows (2 in the reporting year) participate fully in the CNS-UCSB IRGs of which they are members, by attending IRG meetings, helping to design studies, analyzing data and in some instances helping to collect it, as is the case with the two Science and Engineering Fellows who accompanied IRG 2 leader Rich Appelbaum to China in April 2012. The high value that many of them place on their experience with us is demonstrated by the ongoing commitment of past NSE Fellows to CNS-UCSB (including former Science Fellows Burks, Ferguson, Macala, Martin, and Rowe), as shown by their continuing participation in our events and other activities even beyond the time they leave campus. We continue to keep alumni/ae Fellows informed of happenings through our listserv announcements and informal contacts by IRG leaders. We also intend to celebrate their contributions to the Center by reconvening them along with all other Fellows and Postdocs in a meeting at the end of our first 10 years of existence.

CNS-UCSB collaborates with nanoscientists and engineers on other aspects of our education program. Our summer internship program is integrated with CNSI's INSET REU program, in which STEM students from California community colleges spend 8 weeks in residence developing and completing a research project on the societal implications of nanotechnology under the mentorship of our Graduate Fellows and Postdocs. In addition to the proposed nanoecotoxicology course under preparation, still in need of funding, we regularly partner on educational and outreach activities, such as NanoDays, with the faculty and staff of other NSF-funded nano organizations based at UCSB, including the NNIN, the MRSEC housed in the Materials Research Laboratory (MRL), and the UC CEIN, among others. The recent appointment of CNS Executive Committee member Craig Hawker to the Directorship of the CNSI will only enhance this set of connections.

Policy Community: Policymakers, Regulators and NGOs
CNS-UCSB researchers have a strong track record of engaging in dialogue with regulators and policymakers about responsible development and 'moral progress' (see Roco, Harthorn, Guston & Shapira 2011), a term based on Susan Nieman's work (e.g., *Moral Clarity*, 2008) that Harthorn introduced into the societal discussions at the Nano2 meetings in Evanston, IL, Mar 2010). In the past year, CNS researchers have continued to interact with policymakers at the state, federal, and international levels to share their research and its societal implications, including Harthorn's participation in the 2012 Converging Technology discussions in Belgium and her input, along with Appelbaum's, into the publication in press from that series of international and national meetings, led by M. Roco.

Policy Presentations: As the research agenda from the CNS has developed a consolidated set of research results on the *global innovation system* for nanotechnologies (IRGs 1 and 2) and issues regarding the *responsible development* of nanotechnologies (IRGs 2 and 3), CNS is increasingly being called upon and initiating opportunities to disseminate findings to key national (NNI, NNCO, NIOSH, EPA, NSF, US Congressional organizations), international (UK and Canadian governmental organizations) and state level organizations (CCST, DTSC). Some of these presentations during the reporting year are described below.

International: IRG 2 leader Appelbaum participated in NNI-OECD discussion on "assessing the economic impact of nanotechnology" in Washington, DC (March, 2012), and has had discussions with the NNI's Global Issues in Nanotechnology working group. IRG 2 collaborator Fred Block discussed the peculiarities of the US innovation system with the Science Policy Research Unit at the University of Sussex and at the Guanghua Leadership Institute. In that

same month, another IRG 2 collaborator, Stacey Frederick, attended the International Symposium on Assessing the Economic Impact of Nanotechnology. Graduate Fellow Cassandra Engeman (IRG 3) gave the opening plenary keynote presentation at NanoSafe 2012, organized by the CEA/LITEN, French government technological and renewable energy research organizations in Grenoble, France (Nov 2012). CNS-UCSB Director Harthorn served as the US delegate to the EU-US Taskforce on Converging Technologies and Responsible Development and the EU-US Workshop on Converging Nano-Bio-Info-Cognitive S&T for Responsible Innovation and Society in Leuven, Belgium (Sept 2012). She was a co-chair of the Ne3LS Network International Conference 2012 on the responsible development of nanotechnology: Challenges and Perspectives in Montreal, Canada (Nov 2012). IRG 3 collaborator Nick Pidgeon was asked to forward and discuss with UK Science Minister RT Hon. David Willetts research he conducted with Satterfield (IRG 3) and other CNS researchers on factors influencing public attitudes to emerging technologies in September 2012.

National: In 2011, CNS-UCSB Director Harthorn, along with CNS-ASU Co-PI Dietram Scheufele, made a remote presentation to the NPEC NNI working group discussing public participation and communication. Harthorn was also invited as a guest consultant for NPEC, NNI NSET committee on public engagement (April 2012). We have been told that these 2 presentations, along with the resources they shared with the group, made a direct impact at the OSTP level. In May 2012 Harthorn presented invited testimony for the NAS Review Panel of the NNI for OSTP at the Beckman Center in Irvine, California. Harthorn also co-chaired and co-organized the 2012 NSF Grantees Meeting in December 2012 in Arlington, Virginia. There, she was a moderator for a panel on the societal dimensions of nanotechnology and the environment. IRG 2 researchers were also active at the national level. IRG 2 leader Applebaum presented on “Assessing the economic impact of Nanotechnology” at the NSF-OECD meeting (March 2012) in Washington DC. Also, as mentioned earlier, in July 2012 Applebaum engaged in a video dialogue with the Nanotechnology GIN working group, the working group of the Nanoscale Science, Engineering, and Technology Subcommittee. This is the interagency body responsible for coordinating the federal program (NNI) that oversees nanotechnology research and development in the US. Finally, In March, 2012, IRG 2 collaborator Fred Block testified at a Congressional briefing on federal R&D spending organized by the University Corporation for Atmospheric Research.

State: Through her participation in the UC CEIN, Harthorn has been involved in discussions with the State of California Department of Toxic Substance Control (DTSC) regarding their regulatory work with the state’s nanotechology industry; with officials in NIOSH, EPA, FDA and other agencies to plan a workshop for NSE, industry, and policymakers about the risks associated with carbon nanotubes (CNTs); and with the University of California (systemwide) Center for Lab Safety, which is interested in developing a risk perception survey for the UC’s entire population of laboratory researchers. Harthorn also discussed pubic perceptions of nanotechnology risks and benefits as the sole societal implications presenter at the CalNIN industry-university meeting at CNSI-UCLA in September 2012. She also provided detailed consultation to CDC/NIOSH/DSHEFS officer James Boiano in early March 2013 regarding the feasibility and methods for a possible NIOSH study on nanomaterials in industry. NIOSH has asked permission to use the research protocols from CNS/CEIN industry survey.

CNS-UCSB Policy Briefs Program (in development): In a new effort, Education & Outreach Program Director Metzger is working with former CNS-UCSB postdoc Christine Shearer, a professional writer and environmental policy researcher, and Rachel Parker, a former CNS Social Science Graduate Fellow now at the Science and Technology Policy Institute, to develop policy briefs explaining the implications of CNS-UCSB research findings to those involved in the

nanotechnology policymaking process. The first examples of these briefs is close to completion, and we plan to use the mechanism of the Policy Briefs Workshop scheduled for May 2013 to provide readily accessible implications of CNS findings for those making decisions about regulation of various aspects of the nano-enterprise. The morning session of this workshop will provide information about writing for a policy audience, and in the afternoon CNS IRG leaders, postdocs, and fellows will engage in a hands-on writing activity where they translate their CNS-based research into a policy brief, with feedback from workshop leaders, CNS executive committee members, and members of the other IRGs.

NGO Nano Policy Conference (in development): During this reporting period, IRG 3 has conducted research on the role of Non-Governmental Organizations (NGOs) in the nanotechnology governance process, both domestically and internationally. We plan to use the results and implications of this research to aid in the development of a large international conference, planned for Spring 2014 in Santa Barbara. The working title of the conference is "Democratizing Technologies: Evaluating the Role of NGOs in Shaping Technological Futures." This conference will bring together social scientists, science experts, government regulators, and leaders from non-governmental organizations (NGOs) to explore the role of NGOs in the development of new technologies and how these groups can and should influence technological investment, advancement and regulation within a rubric of "responsible development." A central aim of this conference is to provide space for dialogue across these expert groups and to cultivate international networks of organizations with interests in the nexus of technology and society. The focus of this conference will include a range of new technologies as they relate to issues such as worker health and safety, consumer safety, environmental protection, job creation/destruction, equitable development, and environmental and social justice. Central to this conference will be a perspective of NGOs as frequently "uninvited publics" in deliberations about the societal value and implications of technological advancements, as well as the shift of responsibilities from the state to the nonprofit sector. Participants will consider how NGOs – by engaging broader publics, media and policy makers – can and should enhance the participatory framework for sustainable technological development. IRG leaders Harthorn, Applebaum**,** and CNS graduate fellow Cassandra Engeman, as well as Education Director Metzger, have convened a planning committee this year drawing from faculty expertise across the UCSB campus. The committee has begun meeting regularly in winter and spring 2013.

US and International Research Communities

One of CNS-UCSB's primary goals has been to help build networks of relationships among nanotechnology and society researchers from the US and worldwide. We have had a strong international focus from the beginning, and this global, international, and transnational approach is welded into the fabric of the Center. IRG 2 is deeply and theoretically oriented to comparative globalization studies, in which its leader Appelbaum has been a pioneering scholar, and has had a dedicated focus on nano R&D in China and E. Asia from the beginning. International collaborations with Canadian and UK researchers formed the backbone of IRG 3's work, which has been conducted with US/UK/Canada comparative analyses, and the new NGO study is global in scope. IRG 1 has also contributed extensively to the scholarship on scientific and technological advances in East Asia and Europe, as well as in North America. And as will be detailed below, IRG 2 has expanded its research into Latin America with the addition of key personnel and projects.

Building on this robustly international orientation at the core, CNS-UCSB has worked to expand its international impact through involving additional international researchers in our work, by participation in international research networks and conferences, and in our publications.

Expanding CNS-UCSB's Base of International Researchers: During the reporting year, we continued to expand the reach of our IRG research programs through our collaborations with international researchers, some of whom (Pidgeon, Satterfield) we support with international subawards. These collaborations strengthen our ability to access and share data, policy analysis, and research efforts in other countries. The subawards support students and other researchers as well, further expanding the international reach of CNS. Our increased international presence is evinced by our presence at numerous international conference and meetings in the reporting year.

Specific areas in which we have strengthened our international research base include:

Asia: IRG 2 Leader Applebaum and graduate fellows Stocking, Gebbie, and Han traveled to China in April 2012 where they forged ties to nano industry leaders located in BioBay, a nanotechnology center located within Suzhou Industrial Park. IRG1/2 historian and CNS collaborator Choi has moved from the US to a faculty position in S. Korea, where he is studying developments in the Korean nanotechnology industry.

Latin America: Appelbaum is Co-PI on a UC MEXUS/CONACYT grant (with collaborators Foladori & Invernizzi) to develop new research collaborations with Mexican scholars, and by extension, with Latin America scholars, through ReLANS, the Latin American Nanotechnology & Society Network. This project has lead to the year-long appointment of postdoctoral visiting scholar Edgar Zayago Lau. Lau is a full professor in the Development Studies Academic Unit at Universidad Autonoma de Zacatecas, and serves as the technical secretary for the Latin American Network on Nanotechnology & Society (ReLANS/ www.relans.org) headquartered in Zacatecas, Mexico with one coordination office in Curitiba, Brazil. Professor Lau studies emerging technologies and society and the role of science and technology on development. He works in IRG 2, where he is studying the political economy of nanotechnology development in Mexico. Mexico´s National Council of Science and Technology (CONACYT) funds his research at CNS-UCSB. New Seed Grant awardee Walsh brings his expertise on Mexican water systems to a new study on nano water filtration in Mexico that extends IRG 2 work in the area. In addition, IRG 3 researchers Rogers-Brown and Shearer are also collaborating with Foladori and Invernizzi to extend IRG 3 research efforts on risk perception in food studies and NGO action in Brazil and Mexico. Also during the current reporting period, CNS-UCSB hired postdoc Luciano Kay, a citizen of Argentina, who joined the IRG 2 research team.

Globally: IRG 3 researchers Engeman, Earl and Harthorn have continued work on their project to identify NGOs from around the world that are involved in work on nanotechnology's social implications and so far have a database with more than 140 active and linked organizations. This work contributes to the planned large international conference/public engagement activity with global NGOs on new technologies' social and economic development aspects.

Hosting International Research Visitors: CNS-UCSB has in the past hosted visiting international scholars from Canada, China, India, the UK, Germany, France, Spain, Switzerland, The Netherlands, and Sweden, among others. As mentioned above, in 2012-2013, CNS hosted Mexican scholar Edgar Zayago Lau from the Universidad Autonomo de Zacatecas, Mexico**.** Other international visitors in Year 8 include Alfred Nordmann and Harro van Lente. Dr. Nordmann is a Professor of Philosophy at Darmstadt University in Germany. Dr. Nordmann hosted the 2nd annual meeting of the S.NET in 2010; served a co-editor of the IOS volume, *Discovering the Nanoscale* (2004); led one of the sites of the nano public deliberation project DEEPEN led by Phil Macnaghten; and has been an important contributor to discussions of nano ethics. His current research interests are on issues of sustainability and foresight. Dr. Nordmann

is a key representative in discussions about converging technologies in the EU/EC. Dr. van Lente is Associate Professor of Emerging Technologies at Utrecht University and, since 2010, he also is Socrates Professor of Philosophy of Sustainable Development at ICIS, Maastricht University. He is Program Director of Technology Assessment of the NanoNextNL, the leading Dutch research consortium in nanotechnology.

Participation in Developing International Research Networks and Conferences: CNS-UCSB researchers have contributed to the strengthening of existing, and development of new networks among international researchers studying the societal implications of technologies.

Nanotechnology in Society Network (NSN): Along with CNS-ASU's director Guston, Harthorn has played a prominent role in representing societal dimension issues in numerous meetings, conferences and sessions with the NSE community regarding values and mechanisms for fulfilling the aims of "responsible development" of nanotechnologies. They have worked together in the development of the new Anticipatory Governance of Nanotechnologies workshop with K. Eggleson, Notre Dame.

S.NET: Harthorn was a founding executive committee member of S.NET (The Society for the Study of Nanoscience and Emerging Technologies), an international professional society for researchers studying nano societal implications. Harthorn also served on the planning committees for all four annual conferences to date in Seattle, 2009; Darmstadt, Germany, 2010; Tempe, AZ, 2011 (which was co-hosted by CNS-UCSB with CNS-ASU and co-chaired by Guston and Harthorn); and in Enschede, The Netherlands, 2012. For the Darmstadt and Enschede meetings, CNS-UCSB worked with the NSF to obtain, award, and administer travel support funds to enhance participation at the S.NET conferences by students, postdocs and scholars from the developing world. She is involved on a consulting basis with conference hosts for the 2013 conference in Boston, MA.

Canadian Nano Conference: Harthorn was the sole US representative on the scientific organizing committee for a major international conference held in November, 2012 in Montreal, Canada (the Ne^3LS Network International Conference 2012 on *The Responsible Development of Nanotechnology: Challenges and Perspectives*).

European Conferences on Emerging Technologies: CNS-UCSB Director Harthorn was a delegate to the EU-US Taskforce on Converging Technologies and Responsible Development in Leuven, Belgium (September 2012). Research by IRG 3 (Harthorn, Hanna, Engeman) and IRG 2 (Applebaum, Parker, Zayago Lau) as well as CNS collaborators Beaudrie, Pidgeon, Satterfield, Kandlikar, Johansson, Barvosa, postdoc Collins and grad Engeman was presented at the Annual Meeting of the Society for Social Studies of Science (4S) in Copenhagen, Demark (October 2012), and by several other CNS participants at the Society for Risk Analysis in Zurich, Switzerland (June 2012). In addition, Appelbaum is the co-organizer of a major international meeting planned for June 2013 at Bellagio, Lake Como, Italy, on corporate responsibility issues that leverage sustainable development interests of the CNS.

Conference Travel Support for US and International Attendees: In addition to its role in organizing international conferences, CNS-UCSB has supported expanded participation from the Global South and students and early career scholars in Science and Society conferences via travel support and conference coordination. This year, we provided such travel support for CNS-UCSB researchers and collaborators to travel to conferences in France, Germany, South Korea, Denmark, Sweden, Switzerland, and Argentina. We also supported our IRG leaders,

postdocs, and graduate fellows to go to S.NET in 2012 held at the University of Twente, The Netherlands.

Conference Presentations: CNS-UCSB researchers, including postdocs and graduate students, also make numerous public presentations to campus, local, regional, and wider audiences about the work of the CNS-UCSB. In the reporting year these presentations totaled at least 152 and included 72 presentations or sessions in education and outreach and 80 in social science and humanities research contexts. See full listing at the end of this section (12). Additionally, CNS researchers, including graduate students and postdocs organized numerous panels at scholarly conferences. In 2012-2013 this has included taking a leadership role in organizing 5 panels and sessions at 4 conferences in the US, Denmark, The Netherlands, and Switzerland.

Publications Resulting from Conferences: All recent CNS conferences and workshops have had strong international participation and components, and have leveraged these connections into scholarly and outreach contributions.

- The November, 2009 *NanoEquity Conference* in Washington DC was organized by CNS-UCSB's IRG 2 in collaboration with international NGOs interested in development and drew participants from around the globe. This resulted in the publication of a book that circulates those diverse views widely (Parker and Appelbaum, 2012).

- The Jan 2010 international Risk Perception Specialist meeting convened in Santa Barbara by IRG 3 eventuated in the publication, edited by Pidgeon, Harthorn and Satterfield, of a special issue of the international journal, *Risk Analysis* (Nov 2011).

- The April, 2010 *States of Innovation Workshop* organized by X-IRG leader Newfield and researcher Boudreaux was located in, and partially supported by the regional government of Lyon, France April 2010 (with participants from 6 countries around the globe). An edited volume of the proceedings is now well along in preparation (Newfield & Boudreaux, in preparation)

- The 2011 S.NET conference in Tempe, AZ (co-hosted by CNS-UCSB with CNS-ASU) was attended by participants from over 20 countries, and resulted in three different dedicated publications—an edited volume and two special issues of journals.

Hosting Visiting Scholars: CNS-UCSB hosts an active visiting scholars program, providing extensive opportunities for our researchers and students to interact with scholars studying a range of issues on the societal dimensions of nanotechologies. Scholars who visited us during 2012-2013 included

- Karl Bryant (SUNY New Paltz, Sociology & Women's Studies), a former CNS-UCSB Graduate Fellow, visited CNS to work on the IRG 3 gender and deliberation project that he helped launch
- Sharon Ku, a visiting postdoctoral researcher and collaborator with Stephen Zehr from the University of Southern Indiana, spent part of 2011-2012 engaged in the CNS-UCSB community as she studied the challenges and rewards of interdisciplinary collaboration among social scientists/humanists and scientists/engineers engaged in understanding nanotechnologies' social significance.

- Edgar Zayago Lau (Universidad de Automata de Zacatecas in Mexico) has been in residence as a visiting scholar in 2012-2013. Professor Lau is working with IRG 2 leader Applebaum to examine the political economy of nanotechnology development in Mexico.
- Harro van Lente (Utrecht University and Maastricht University, and Program Director of Technology Assessment of the NanoNextNL) visited with CNS in March-April 2013.
- Alfred Nordmann (Professor of Philosophy at Darmstadt University in Germany and host of S.NET 2010) visited CNS IRG3 in February 2013. Dr. Nordmann is a key representative in discussions about converging technologies in the EU/EC.
- Philip Shapira, Professor of Policy, Innovation and Management at the Manchester Institute of Innovation Research, Manchester Business School and Professor of Public Policy at Georgia Institute of Technology and Jan Youtie, Director of Policy Research Services and principal research associate at the Enterprise Innovation Institute at Georgia Institute of Technology visited in December 2012.

UCSB and Santa Barbara Regional Communities
CNS-UCSB and its members engaged members of our local campus and Santa Barbara-area communities through multiple venues during the reporting year. These are described below.

Lectures and Public Events: CNS-UCSB sponsors its own, and co-hosted lectures and special events that were promoted across campus to the humanities, social science, and science and engineering disciplines, and to the larger Santa Barbara community.

CNS-UCSB Speaker Series: During the reporting year, we hosted five public lectures through our speaker series, in addition to the CNS seminars, which are also typically advertised to interested members of the entire UCSB campus. The public lectures were:

- Michael Gordon, Professor of History, Princeton University, "The Pseudoscience Wars: Immanuel Velikovsky and the Birth of the Scientific Fringe" (October 2012) (Badash Memorial Lecture in History)
- Jan Youtie, Director of Policy Research Services and principal research associate at the Enterprise Innovation Institute at Georgia Institute of Technology and Philip Shapira, Professor of Policy, Innovation and Management at the Manchester Institute of Innovation Research, Manchester Business School and Professor of Public Policy at Georgia Institute of Technology, "Is there a nanotechnology paradox? Interpreting trajectories of nanotechnology and innovation" (December 2012)
- Denis Simon, Vice-Provost of International Strategic Initiatives, Arizona State University, "The Next Stage in China's S&T Reforms Post 18th Party Congress" (February 2013)
- Amy Slaton, Professor of History, Drexel University, "New Promise, Old Premise: Workforce Education and Opportunity in American Nanomanufacturing" (February 2013)
- Harro van Lente, Associate Professor of Emerging Technologies at Utrecht University and Socrates Professor of Philosophy of Sustainable Development at Maastricht University, "Novelty, Needs and Rights: Anticipating Needs in Society" (March 2013)

Collaborative Events: CNS-UCSB also co-sponsored a campus-wide, year-long program on risk in postmodern society entitled *Speculative Futures*. This included 12 separate and generally well-attended events, encompassing public lectures, films, workshops, and creative events focused on risk perspectives, nuclear risk, security and catastrophe, conservatives' risk denial, privacy risk, biomedical surveillance, contagion control, and other topics. *Speculative Futures* was the winner of the competitively-awarded UCSB Critical Issues series for 2011-2012 year

(see http://www.criticalissues.ucsb.edu/home.html). McCray and Harthorn were both involved in writing the proposal for this program and in planning meetings, hosting events, providing expert commentary and, along with other CNS participants, introducing societal implications issues from CNS-UCSB research into the wider discourse on campus through these events and activities. Harthorn gave the opening faculty lecture in the program for the year in Fall 2011. Harthorn is also an active participating faculty member in the current year's UCSB Critical Issues in America award, *Figuring Sea Level Rise*, which focuses on climate change and risk. She has served on planning committees throughout the year for a series of events as part of this award, and has helped raise additional funds for it (Harthorn/Walker ISBER C-RIG small grant 2012-3, $4000). In conjunction with the program, CNS is currently co-sponsoring the *Figuring Sea Level Rise* conference to be held in April 2013 in collaboration with the Carsey-Wolf Center at UCSB, and has brought leading risk perception scholar Dan Kahan (Law, Yale University) in as a keynote speaker for the event.

NanoDays: For the past five years, CNS-UCSB has participated in "NanoDays" events, the annual national program coordinated by the Nanoscale Informal Science Education (NISE) Network. Hands-on activities are utilized to engage and promote understanding of nanoscale science and nanotechnology among children and members of the general public. These events are led by CNS-UCSB Graduate Fellows, Postdoctoral Scholars, and additional student volunteers. After hosting events for several years at both campus and community venues, CNS-UCSB began a continuing partnership with CNSI to co-host NanoDays starting in 2009. Additional partners joined the activity in 2010 and 2011, when we co-sponsored a NanoDay event at the Santa Barbara Museum of Natural History in collaboration with the Museum and UCSB's National Nanotechnology Infrastructure Network (NNIN) and UC CEIN, in addition to CNSI. Those events drew audiences of nearly 500 visitors, including families and children.

NanoDays 2012 and 2013 were expanded to a two-day event at the Museum and were held on April 14-15, 2012 and on March 16-17, 2013. CNS Education Director Metzger and five CNS-UCSB Graduate Fellows (Eardley-Pryor, Engeman, Stocking, Han, and Gebbie) as well as former fellow Tyronne Martin, now a researcher in the UCSB CEIN, were on hand to demonstrate a nano sunblock experiment and to explain societal and ethical, implications of nano to interested museum goers using posters supplied by NISE Net covering topics including nano and energy, nano toxicity, nano and safe drinking water, nanosilver in toys, nano surveillance technologies and privacy, in addition to nano sunblock. In 2013, two new activities were added. The first is a game titled "Exploring Nano & Society - You Decide!" is a hands-on activity in which visitors sort and prioritize cards with new nanotechnologies according to their own values and the values of others. Visitors explore how technologies and society influence each other and how people's values shape how nanotechnologies are developed and adopted. The second activity, "Exploring Nano & Society - Space Elevator" is a open-ended conversational experience in which visitors imagine and draw what a space elevator might look like, what support systems would surround it, and what other technologies it might enable. Conversation around the space elevator leads even the youngest visitors to explore how technologies and society influence each other and how people's values shape the ways nanotechnologies are developed and adopted.

In 2012, then CNS graduate fellow Shannon Hanna and then Graduate Student Researcher Mary Collins volunteered with volunteers from UCLA UC CEIN at NanoDays at the California Science Center at the Los Angeles Science Museum, thereby extending to a much larger audience than is possible in Santa Barbara. That said, the 2013 NanoDays 2-day event at the Santa Barbara Museum of Natural History was extremely successful, attracting about 1,300

visitors of all ages and from a diversity of racial backgrounds. This number is nearly three times the number of participants who have taken part in NanoDays Santa Barbara in previous years.

Connecting with community groups. This year, given our personnel constraints, we decided to place less emphasis on creating special outreach events, such as science café type activities, designed to bring the public to us. Instead, we have sought out and responded to invitations from community-based organizations to participate in their events. For instance, CNS-UCSB Director Harthorn and postdoc Collins served as 2 of the 4 panelists presenting on "Inspiring Science: Women in Nanotechnology" at the Santa Monica Library's Women's History Month program in March 2013 in collaboration with UC-CEIN. Also in March 2012, graduate fellow Roger Eardley Pryor (IRG 1) discussed "Considering Nanotechnology: Large Societal Impacts of the Very Small" with the Santa Barbara Institute of World Cultures (IWC). IWC board member Robert Moore wrote to us after the talk describing it as a "perfect example of public education on a difficult scientific and societal issue" that "provided the Santa Barbara community with a valuable opportunity to gain some real understanding of the societal issues and impacts associated with nanotechnology."

In addition to these activities, CNS researchers and collaborators connected with community groups in other ways as well. For example, postdoc Collaborator Adam Corner gave a public talk on geo-engineering at the Hay Festival in Wales on June 1, 2012. This year, CNS IRG 1 researchers Cyrus Mody and Patrick McCray discussed their work publicly at several museum events, including at the San Jose Technology Museum, Houston Museum of Natural Sciences, and the Houston Maritime Museum. McCray gave further public presentations on his work at the DC Science Café, Politics and Prose, Noblis, the Seattle Town Hall Series, and at Microsoft in Seattle in February 2013.

Virtual and Media Outreach to Multiple Stakeholder Communities

The increasingly central role of the Internet in every form of social interaction means that CNS-UCSB must develop sophisticated online resources if we are to participate in the conversations among stakeholders that are influencing the development of nanoscience and technologies. Below are some of the tools we are using to reach these stakeholder audiences.

CNS-UCSB Website: During the past year, we have been making ongoing changes to our website (www.cns.ucsb.edu) both in design and content. The site has been upgraded to the Drupal platform, enabling CNS-UCSB staff to enter content changes to most areas without the need to involve a web designer. During the past year, we employed undergraduate student web assistants to help with making changes and updates to the site's content, including posting links to videos of CNS-UCSB Speakers' Series events, and updating news and events information. We also brought in an undergraduate student intern from UCSB's undergraduate professional writing minor program in Spring, 2012; she received training in public relations writing and promoting public events on the web from outreach staff member Boggs. The upgrade is a large undertaking that has not yet been completed, and progress will continue to be made in the coming year.

In addition to news, event information, and podcasts of selected lectures by CNS-UCS faculty and invited speakers, the website provides visitors with a broad overview of our activities: front-page current news and upcoming event teasers; descriptions of the IRGs and their research projects; profiles of CNS-UCSB's leadership, staff, faculty, postdocs, and graduate fellows; descriptions of our Education programs, as well as course materials and other resources for

educators, mostly at the community college level or above; an events archives; a searchable list of CNS-UCSB publications dating back to 2006; a list of presentations from the current and former reporting years, among other materials; and a news and media section containing a news item archive, links to our videos, and links to current and past CNS-UCSB Clips (see below).

In the coming year, we plan to explore methods for increasing our web presence among our target audiences through social media such as Facebook and Twitter, and determine what resources will be needed to make effective use of these communication channels. One idea we are exploring is the possibility of setting up a social network for NGOs interested in nano and society issues, as part of our planning process for the upcoming conference on this topic.

Webinar: A highlight of CNS-UCSB's outreach and public engagement efforts this reporting year was the webinar conducted by CNS Director Barbara Harthorn conducted on December 14, 2012 which was also described in the Education section (11) of this report. The title of the webinar was "Societal and Ethical Issues in Nanotechnology." The webinar was hosted by the National ATE Center for Nanotechnology Applications and Career Knowledge (NACK) Network, which aims to create a nanotechnology-knowledgeable citizenry by providing resource sharing, course materials, and stressing broad student preparation to help create and sustain economically viable nanotechnology education at 2- and 4-year colleges and universities across the US.

Dr. Harthorn's webinar provided an overview of ELSI (Ethical, Legal, & Social Issues) approaches to the responsible development of nanotechnology. The webinar attracted 83 registrants from 23 states plus District of Columbia and Puerto Rica, and from 13 countries outside the US, including in Europe, North and South America, Australia, and Asia, with additional webinar views during the first quarter of 2013. Webinar participants came from both 2- and 4-year higher education colleges and universities, and also included participants from K12 and STEM educators, industry, national laboratories, state and federal government, scientific societies, NGOs, and entrepreneurs. The webinar featured a chat feature that enabled two-way participation and interaction with and among participants. To access the webinar content and interactive discussion, please see: http://nano4me.org/webinars.php

CNS-UCSB Clips:
Another popular continuing outreach effort reaching a virtual international audience is the CNS-UCSB Clips. Leading breaking news stories on nanotechnology and societal issues are tracked and circulated electronically twice monthly. Bi-monthly Clips compilations were sent out during the reporting period to a national and international list of nearly 500 interested colleagues, students, government and policy people, industry contacts, NGO leaders and members of the general public. The clips are generated by former CNS-UCSB Graduate Fellow David Weaver, one of several former students who continue to be engaged with the Center following completion of their studies.

Traditional Media: Although our focus for the future is on expanding the quality of our web presence, we consider it important to continue using traditional media to reach CNS-UCSB's nano stakeholder audiences. For this purpose, we continue to put out press releases in conjunction with UCSB's public affairs office, as well as online and through our listservs, and we make our researchers available for interviews with reporters from the local, national, and international press. Some examples from this reporting year include:

- *The Social Life of Nanotechnology* (2012, Routledge) by Barbara Harthorn and John Mohr

- *The Visioneers: How a Group of Elite Scientists Pursued Space Colonies, Nanotechnologies, and a Limitless Future* (2012, Princeton University Press) by IRG 1 leader Patrick McCray.
- McCray also had editorials appear in *CNN.com*, "A Pioneer in Space and on Earth" (June 10 2012) and in *Forbes.com* "We May Not Have Flying Cars Yet, But Visioneers are Inventing a New Future" (November 26, 2012).
- *Technological Innovation and Prize Incentives: The Google Lunar X Prize and other Aerospace Competitions* (2012, Edward Elgar Publishing) by IRG 2 postdoctoral scholar Luciano Kay. Luciano was quoted extensively in *Aviation Week's* central article in a special issue on innovation published on March 4, 2013.
- X-IRG solar project leader Chris Newfield, discussed "Innovation Decline and the Leadership Crisis" on KCSB radio on July 25, 2012, and "Higher Education and Innovation," again on KCSB radio, on October 3, 2012.
- Newfield also had two opinion pieces appear in 2012 in the *Huffington Post*, one examining the issue of whether selective immigration can help the innovation crisis, and the other addressing the knowledge economy.
- In July 2012, Nick Pidgeon appeared on the BBC Radio 4 science program, "Does Science Need the People" discussing deliberative work on emerging technologies (http://www.bbc.co.uk/programmes/b0117x3r)
- Jennifer Rogers-Brown, contributed to a story aired on June 26, 2012 by Christina Mulligan of WNET New York Public Media titled, "Got Nanotechnology? It's here and transforming our lives" (http://www.thirteen.org/metrofoucs/2012/06/got-nanotechnology- its-here-and-transforming-our-lives/)
- Rogers-Brown also appeared on "No Alibis, " KCSB Radio interview regarding food security in Mexico, free trade, and issues of technology in agriculture and food production, in November 2012
- Sharon Friedman, conducted media interviews on lack of mass media coverage of nanotechnology in Chemical Week and NHI, reported in Nanowerk.

CNS-UCSB Media Plan for 2013-14: Some of our goals for using traditional and new media in the coming year include:

- Increased networking with regional and national media to secure better placement and promotion of CNS-UCSB news items.
- Continue efforts to post CNS-UCSB op eds and opinion pieces to other prominent blogs (e.g., *Science Progress, The Blog, Miller-McCune*).
- More opportunistic launching and placing of press releases with print, electronic, and online media, in a context of rapidly changing news publishing.
- Continue to improve the CNS-UCSB website for more effective interaction and information retrieval, including showcasing new CNS-UCSB research through written pieces and developing a rotating series of online articles featuring student activities.
- Utilize analytical tools to track traffic patterns to specific areas of our website.
- Conduct a cost/benefit analysis of podcasting CNS-UCSB events of interest to different stakeholder groups.
- Continue to assess requirements for implementing new media tools for engagement (e.g., posting short video clips on research findings of interest to different audiences).
- Develop aims consistent with the resources available and changing media contexts for dissemination and engagement.

Nano and Society Data Archive Project: CNS-UCSB is excited to partner with the University of Massachusetts at Amherst and CNS-ASU on a $48,000 IMLS planning grant, *Nanoscience and Emerging Technologies in Society: Sharing Research and Learning Tools (NETS)*. The purpose of the grant is to explore the opportunities and challenges of establishing a permanent, online repository of nano and society research and data accessible by researchers, policymakers, students, and members of the public who want to learn more about the societal processes influencing nanotechnologies' development and use. The planning grant was used this year to set up a meeting of nano and society researchers to discuss these issues in conjunction with the December, 2012 NSEC meeting in Washington, DC.

The NETS project central activity will be a workshop on June 27-28, 2013 in Amherst, Massachussetts that will gather key researchers in the field together with digital librarians to plan the development of a disciplinary repository of data, curricula, and methodological tools relevant to nanoscience and emerging technologies. Postdoctoral scholar Luciano Kay and other researchers will represent CNS-UCSB at this meeting.

Presentations 2012-2013

A. Education and Outreach (to NSE, industry, government, media, public) (N=72)

McCray, Patrick and Eardley-Pryor, Roger, "Take a Little Risk: Historical Analogies for the Regulation of Nanotechnology," 2012 Business History Conference, March 2012, Philadelphia, PA.

Block, Fred, "Research that Pays Off: Benefits of Federal R&D", Congressional Briefing organized by University Corporation for Atmospheric Research, March, 16, 2012.

Appelbaum, Richard, "Assessing the Economic Impact of Nanotech Conference" NSF-OECD meeting, March 26-28, 2012, Washington, DC.

Frederick, Stacey, attended International Symposium on Accessing the Economic Impact of Nanotechnology, March 27-28, 2012, Washington, DC.

Boggs, Cathy, "Creating Effective Poster Presentations," CNS Seminar, CNS-UCSB, April 2012, Santa Barbara, CA.

Harthorn, Barbara Herr, "Theme 7: Risk Perception, Regulation and Outreach" presentation to the NSF External Site Review Team, UC CEIN, UCLA, CNSI, April 2-4, 2012, Los Angeles, CA.

Harthorn, Barbara Herr, presenter in workshop on "Interdisciplinary Collaborative Research: How to Develop and Manage a Successful Program," ISBER UCSB, April 10, 2012, Santa Barbara, CA.

Mody, Cyrus, "Safety, Disaster, and Innovation on the High Seas before and after the Titanic," Houston Museum of Natural Sciences, April 12, 2012, Houston, TX.

Harthorn, Barbara Herr, Invited guest Consultant, NPEC (NNI NSET committee on public engagement) April 13, 2012, phone meeting.

Engeman, Cassandra, Stocking, Galen, Gebbe Matt, Han, Shirley, and Eardley-Pryor, Roger volunteered for NanoDays, a family event held at the Santa Barbara Museum of Natural History to educate the public about nanotechnology, its applications and implications for society, April 14, 2012, Santa Barbara, CA.

Mody, Cyrus, "Safety, Disaster, and Innovation on the High Seas before and after the Titanic," Houston Maritime Museum, April 17, 2012, Houston, TX.

Engeman, Cassandra, and Harthorn, Barbara Herr, teleconference presentation on industry survey to NAIHA (National American Industrial Hygiene Association), Nanotechnology Working Groups, April 18, 2012.

Mody, Cyrus, "Safety, Disaster, and Innovation on the High Seas before and after the Titanic," Rice University, Glasscock School of Continuing Studies, Titanic Course, April 19, 2012, Houston TX.

Milind Kandlikar, Terre Satterfield, Robin Gregory, Graham Long, and Christian Beaudrie, worked with elite group of nanotoxicology risk experts 2011-2012 to develop expert structured decision making workshop, May 2012, Vancouver, Canada.

Harthorn, Barbara Herr, Invited testimony, NAS Review Panel of the NNI for OSTP, Beckman Center, May 15-16, 2012, Irvine, CA.

Corner, Adam, invited public lecture, "Geo-engineering: Plan B or Pandora's Box?" 2012 Hay literature festival: http://www.hayfestival.com/p-4537-adam-corner.aspx , June 1, 2012

Metzger, Miriam, "Exploring the Societal Implications of Nanotechnology at CNS-UCSB," Introductory lecture to CNS research to the INSET summer interns at the California NanoSystems Institute, UCSB, June 19, 2012, Santa Barbara, CA.

Rogers-Brown, Jennifer, "Got Nanotechnology? It's here and transforming our lives" by Christina Mulligan, http://www.thirteen.org/metrofoucs/2012/06/got-nanotechnology-its-here-and-transforming-our-lives/, June 26, 2012.

Kay, Luciano, “Using Bibliometric and Patent Analysis to Map Global Innovation Pathways in Nanotechnology,” CNS Seminar, CNS-UCSB, June 27, 2012, Santa Barbara, CA.

Pidgeon, Nick, appeared on BBC Radio 4 science programs, “Does Science Need the People” discussing deliberative work on emerging technologies http://www.bbc.co.uk/programmes/b0117x3r, July 2012.

Horton, Zachary, “Filming Nano-Futures: Collaborative Narrative Making in an Academic Context,” CNS Seminar, CNS-UCSB, July 11, 2012, Santa Barbara, CA.

Appelbaum, Richard, video dialogue with Nanotechnology (GIN), Working Group, GIN is the working group of the nanoscale Science, Engineering, and Technology Subcommittee, the interagency body responsible for coordinating the U.S. National Nanotechnology Initiative, which is the Federal program that oversees nanotechnology R&D, July 12, 2012.

Appelbaum, Richard, WW Norton video shoot for introductory co-authored textbook (*Sociology 9e*), July 22-24, 2012, New York City, NY.

Newfield, Christopher, “Innovation Decline and the Leadership Crisis”, KCSB radio, July 25, 2012.

Harthorn, Barbara Herr, media interview by Leigh Phillips reporter for article on nano NGOs and terrorism in Mexico, August 2012, *Nature*, 388: 576-579.

Haro, Gianna, “Green Nanovisions and their Policy Consequences,” paper presentation Internships in Nanosystems Science, Engineering, and Technology (INSET) public presentations, August 1, 2012, Santa Barbara, CA.

Landers, Kelly, “Identifying the Role of California in the Nanotechnology Economy,” paper presentation, Internships in Nanosystems Science, Engineering, and Technology (INSET) public presentations, August 1, 2012, Santa Barbara, CA.

Phillips, Bryan, “Open Innovation and its Role in a nano-Enabled Solar Industry,” paper presentation Internships in Nanosystems Science, Engineering, and Technology (INSET) public presentations, August 2, 2012, Santa Barbara, CA.

Triste, Eddie, “Nano Regulatory Policy and NGOs: A Global View,” Internships in Nanosystems Science, Engineering, and Technology (INSET) public presentations, August 2, 2012. Santa Barbara, CA.

Metzger, Miriam, Bimber, Bruce, Holden, Trish, and Alagona, Peter, “Secrets of the Temple: The Insiders’ Guide to Academic Job Hunting,” CNS Seminar, CNS-UCSB, August 8, 2012, Santa Barbara, CA.

Haro, Gianna, “Green Nanovisions and their Policy Consequences” (poster), Internships in Nanosystems Science, Engineering, and Technology (INSET), poster colloquium, August 9, 2012, Santa Barbara, CA.

Landers, Kelly, “Identifying the Role of California in the Nanotechnology Economy” (poster), Internships in Nanosystems Science, Engineering, and Technology (INSET), poster colloquium, August 9, 2012, Santa Barbara, CA.

Phillips, Bryan, “Open Innovation and its Role in a nano-Enabled Solar Industry” (poster), Internships in Nanosystems Science, Engineering, and Technology (INSET), poster colloquium, August 9, 2012, Santa Barbara, CA.

Triste, Eddie, “Nano Regulatory Policy and NGOs: A Global View” (poster), Internships in Nanosystems Science, Engineering, and Technology (INSET), poster colloquium, August 9, 2012, Santa Barbara, CA.

Kay, Luciano, “Nanotecnología: de la ciencia aplicada al progreso social,” Universidad Nacional del Litoral, Facultad de Ingeniería Química, August 23, 2012, Santa Fe, Argentina.

Block, Fred, “The Peculiarities of the U.S. Innovation System, Guanghua Leadership Institute organized by Cisco, September 2012, Mountain View, CA.

Pidgeon, Nick asked to forward and discuss with UK Science Minister (RT Hon David Willetts),

CNS papers Pidgeon et al. (2009) and Satterfield et al. (2009), discussed factors influencing public attitudes to emerging technologies, September 2012.

Harthorn, Barbara Herr, "The Future of Responsible Development for Converging Technologies, Converging Technologies EU-US Workshop, September 20-21, 2012, Leuven, Belgium.

Harthorn, Barbara Herr, US delegate, EU-US Workshop on Converging Nano-Bio-Info-Cognitive S&T for Responsible Innovation and Society, September 20-21, Leuven, Belgium.

Harthorn, Barbara Herr, "Public perceptions of Nanotechnology Risks and Benefits," CalNIN meeting, University of California, Los Angeles, CNSI, September 25, 2012, Los Angeles, CA.

Newfield, Christopher, "Higher Education and Innovation," KCSB radio, October, 3, 2012.

Collins, Mary, "Public Responses to Nanotechnology: Risks to the Social Fabric?" CNS Seminar, CNS-UCSB, October 10, 2012, Santa Barbara, CA.

Gebbie, Matt, Han, Shirley, & Stocking, Galen, "Can China Become a nano Innovator: An investigation into the Chinese Nanotechnology Communities in Shanghai and Suzhou Industrial Park," CNS Seminar, CNS-UCSB, October 10, 2012, Santa Barbara, CA.

Zayago Lau, Edgar, "Developmental Implications of Nanotechnology," CNS Seminar, CNS-UCSB, October 10, 2012, Santa Barbara, CA.

Harthorn, Barbara Herr, Program Committee, S.NET 2012, University of Twente, October 22-24, 2012, service January through October 22, 2012.

Gordin, Michael, "The Pseudoscience Wars: Immanuel Velikovsky and the Birth of the Scientific Fringe," 2012 Badash Memorial Lecture, University of California, Santa Barbara, October 29, 2012, Santa Barbara, CA.

Rogers-Brown, Jennifer, "No Alibis, " KCSB Radio interview regarding food security in Mexico, free trade, and issues of technology in agriculture and food production, November 2012.

Zayago, Lau, Edgar, "Developmental Implications of Nanotechnology, Seminar Speaker Series," Saint Marys University, Nov. 2012, Halifax, NS.

Harthorn, Barbara Herr, US co-chair, Ne3LS Network International Conference 2012 on the Responsible Development of Nanotechnology: Challenges and Perspectives, November 1-2, 2012, Montreal, Canada.

Harthorn, Barbara Herr, Executive Committee of the AG-CENMs Project, Notre Dame, University, November 12-13, 2012, South Bend, IN.

Engemen, Cassandra, "Regulation, Risk, and the Global Nanotechnology Industrial Workplace," invited opening plenary presentation, NanoSafe 2012, organized by the CEA/LITEN, French government-funded technological and renewable energy research organizations, November 13-15, Grenoble, France.

Wadwha, Vivek, "Master Class with Vivek Wadwha," University of California, Santa Barbara, November 19, 2012, Santa Barbara, CA.

Collins, Mary & Hanna, Shannon, "Nanotechnology, Risk, and Consumer Products," CNS Seminar, CNS-UCSB, IRG3 panel presentation, November 28, 2012, Santa Barbara, CA.

Harthorn, Barbara Herr, Co-Chair/Co-organizer, 2012 NSF Nano Grantees Meeting, December, 3-4, 2012, Arlington, VA.

Harthorn, Barbara Herr, Moderator, "Societal Dimensions of Nano & Environment," 2012 NSF Nano Grantees Meeting, December 3, 2012, Arlington, VA.

Youtie, Jan & Shapiro, Phillip, "Is there a nanotechnology paradox? Interpreting trajectories of nanotechnology and innovation," CNS Seminar, CNS-UCSB, December 7, 2012, Santa Barbara, CA.

Harthorn, Barbara Herr, "Societal Dimensions of Responsible Innovation for Nanotechnology," National Webinar for the NACK (Nanotechnology Applications and Career Knowledge), Center at Pennsylvania State University, http://nano4me.org/webinars.php, December 14, 2012, University Park, PA.

McCray, Patrick, ""Visioneering: From Space Colonies to Nanotechnologies in Pursuit of a Limitless Future," Microsoft, February 2013 Seattle, WA.
McCray, Patrick, ""Visioneering: From Space Colonies to Nanotechnologies in Pursuit of a Limitless Future," Seattle Town Hall Series, February 2013, Seattle, WA.
McCray, Patrick, ""Visioneering: From Space Colonies to Nanotechnologies in Pursuit of a Limitless Future," San Jose Technology Museum, February 2013, San Jose, CA.
McCray, Patrick, ""Visioneering: From Space Colonies to Nanotechnologies in Pursuit of a Limitless Future," Politics and Prose, February 2013, Washington DC.
McCray, Patrick, ""Visioneering: From Space Colonies to Nanotechnologies in Pursuit of a Limitless Future," DC Science Café, February 2013, Washington DC.
McCray, Patrick, ""Visioneering: From Space Colonies to Nanotechnologies in Pursuit of a Limitless Future," Noblis, February 2013, Washington DC.
Collins, Mary, "Implementation: Environmental and Economic Justice," guest lecture in, Environmental Science and Management (ESM) 241: Environmental Politics, UCSB, February 4, 2013, Santa Barbara, CA.
DeBacco Kim, "Workshop on using advanced features of presentation software including Powerpoint, Prezi, and Keynote," CNS Seminar, CNS-UCSB, February 7, 2013, Santa Barbara, CA.
Simon, Denis "The Next Stage in China's S&T Reforms Post-18th Party Congress," University of California, Santa Barbara, February 14, 2013, Santa Barbara, CA.
Slaton, Amy, "New Promise, Old Premise: Workforce Education and Opportunity in American Nanomanufacturing," CNS Seminar, CNS-UCSB, February 21, 2013, Santa Barbara, CA.
Harthorn, Barbara, Herr, phone meeting with James Boiano, NIOSH feasibility study on nanomaterials in industry, March 4, 2013.
van Lente, Harro, "Novelty, Needs and Rights: Anticipating Needs in Society." CNS Seminar, CNS-UCSB, March 7, 2013, Santa Barbara, CA.
Eardley-Pryor, Roger, "Considering Nanotechnology: Large Societal Impacts of the Very Small" Institute of World Cultures, March 16, 2013, Santa Barbara, CA.
Harthon, Barbara Herr, Panelist on "Inspiring Science: Women in Nanotechnology," Santa Monica Public Library, March 17, 2013, Santa Monica, CA.
Collins, Mary, Panelist on "Inspiring Science: Women in Nanotechnology," Santa Monica Public Library, March 17, 2013, Santa Monica, CA.
Friedman, Sharon, Media interviews on lack of mass media coverage of nanotechnology in ChemicalWeek and NHI (New Haven Independent), material reported in Nanowerk.

B. Research Presentations (N=80)

McCray, Patrick. (March 2012). "How California Invented Nanotechnology" (invited talk). University of California, Los Angeles: Los Angeles, CA.
Parkhill, K., Pidgeon, Nick, & Corner, Adam. (March 2012). "Deliberating Geoengineering: Stratospheric Aerosols" (poster). Under Pressure Conference: London, England.
Appelbaum, Richard. (March 29-31, 2012). Presented a paper on labor-related issues that draws on China research. Pennsylvania State Conference on global workers' rights: University Park, PA.
Mody, Cyrus. (March 30, 2012). "University in a Garage: Instrumentation and Innovation from UC Santa Barbara." Workshop for edited volume on innovation in the UC system: Berkeley, CA.

Mody, Cyrus. (March 31, 2012). "Commentator for panel on Emerging Technology: The Coevolution of Performances, Regulations, and Markets." Business History Conference: Philadelphia.

Newfield, Christopher. (March 2012). "The Technological University We Need." University of California, Irvine: Irvine, CA.

Kaplan, Sarah. (April 2012). "Interdisciplinarity in Practice: a case study of a Nanotechnology Research Center." Queen's University, Strategy Seminar: Kingston, ON.

Newfield, Christopher. (April 2012). "Does Cultural Study Need Innovation Theory?" JFK Institute, Free University of Berlin: Berlin, Germany.

Appelbaum, Richard. (April 1-3, 2012). "Making Blue the Next Green: Can CSR Help Improve Working Conditions in Global Supply Chains?" International Studies Association conference: San Diego, CA.

McCray, Patrick. (April 2012). "Gerard O'Neill's Visioneering of the 'High Frontier.'" Envisioning Limits: Outer Space and the End of Utopia conference: Berlin, Germany.

Beaudrie, C.E.H., Satterfield, T., Kandlikar, M., & Herr Harthorn, B. (April 2-4, 2012). "Nanomaterials and Expert Judgment: Risk Perceptions, Regulatory Preparedness, and Screening-Level Assessment." National Science Foundation (NSF) site visit to the UCLA Center for Environmental Implications of Nanotechnology, Los Angeles, CA.

Corner, Adam. (May 2012). "Public Perceptions of Geoengineering." IMPLICC Meeting: Mainz, Germany.

Newfield, Christopher. (May 2012). "Does Innovation Theory Need Cultural Study?" University of Freiburg: Freiburg, Germany.

Newfield, Christopher. (May 2012). "Does Innovation Theory Need the Humanities?" HUMLab, University of Umea: Umea, Sweden.

Newfield, Christopher. (May 2012). "The Future University." Arts Center Inaugural, University of Umea: Umea, Sweden.

Zuniga, H.G.D., Copeland, Lauren, & Bimber, Bruce. (May 2012). "Political Consumerism and Political Communication: The Social Media Connection." Annual meeting of the International Communication Association: Phoenix, AZ.

Engeman, Cassandra. (May 7, 2012). "Non-governmental Organizations and Nanotechnologies' Futures" (poster). National Science Foundation (NSF) site visit to the UCSB Center for Nanotechnology in Society: Santa Barbara, CA.

Beaudrie, Christian, Satterfield, Terre, Kandlikar, M., & Herr Harthorn, B. (May 7-8, 2012). "Nanomaterials and Expert Judgment: Risk Perceptions, Regulatory Preparedness, and Screening-Level Assessment." National Science Foundation (NSF) site visit to the UCSB Center for Nanotechnology in Society: Santa Barbara, CA.

Shearer, Christine. (May 14, 2012). "The political-economy of risk perception: A socio-historical look at the climate change lawsuit Native Village of Kivalina v. ExxonMobil et al." UCSB Sociology colloquium: Santa Barbara, CA.

Collins, Mary, Harthorn, Barbara Herr, & Satterfield, Terre. (May 17, 2012). "A Nanotechnology Risk Judgement Analysis: Consumer Product Safety and Environmental Attitudes" (poster). Annual meeting of the Southern California Society for Risk Analysis: Los Angeles, CA.

Corner, Adam, Pidgeon, Nick, & Parkhill, K. (June 2012). "Moving Upstream from Nano to Geo - Public Perceptions and Geoengineering Proposals." Society for Risk Analysis Conference: Zurich, Switzerland.

Kaplan, Sarah. (June 2012). "Interdisciplinarity in Practice: a case study of a Nanotechnology Research Center." DRUID conference: Copenhagen, Denmark.

Bryant, Karl, & Harthorn, Barbara Herr. (June 17-21, 2012). "Inequality, Risk, and Difference in Deliberations about New Technologies." Society for Risk Analysis: Zurich, Switzerland.

Harthorn, Barbara Herr, Pidgeon, Nick, & Satterfield, Terre. (June 17-21, 2012). Chairs and co-organizers of the symposium "Nanotechnology Risks - Intersections across the Social Sciences." Society for Risk Analysis: Zurich, Switzerland.

Satterfield, Terre, Harthorn, Barbara Herr, & Pitts, Anton. (June 17-21, 2012). "Intuition, Resilience and Perceived Environmental Qualities in the Case of Engineered Nanomaterials." Society for Risk Analysis -- Europe: Zurich, Switzerland.

Collins, Mary, Harthorn, Barbara Herr, & Satterfield, Terre. (June 18-20, 2012). "Nanoremediation: Are there equity concerns?" (poster). SRA-E meeting: Zurich, Switzerland.

Friedman, Sharon, & Egolf, Brenda. (June 18, 2012). "Examining Nano Risks and Regulation in Traditional Media and a Web Newspaper." Society for Risk Analysis-Europe: Zurich, Switzerland.

Appelbaum, Richard. (August, 2012). Panel discussant, "Author Meets Critics: Unveiling Inequality: A World-Historical Perspective by Timothy Patrick Moran and Robert Patricio Korzeniewicz." American Sociological Association: Denver, CO.

Kaplan, Sarah. (August 2012). "Interdisciplinarity in Practice: a case study of a Nanotechnology Research Center." American Sociological Association: Denver, CO.

Pidgeon, Nick. (August 2012). "Public Perceptions of Geoengineering." Oxford Geoengineering Summer School: Oxford, UK.

Rogers-Brown, Jennifer. (August 2, 2012). "Participatory democracy and emerging technologies: A Feminist methodological analysis of public deliberations on nanotechnology." International Sociological Association: Buenos Aires, Argentina.

Block, Fred. (September 2012). "Internal Tensions in the U.S. Model for Financing Innovation." Science Policy Research Unit, University of Sussex: Sussex, UK.

McCray, Patrick. (September 2012). "Visioneers and their Pursuit of Space Colonies, Nanotechnologies, and a Limitless Future" (invited talk). Korea Advanced Institute of Science and Technology: South Korea.

Newfield, Christopher. (September, 2012). "American Studies and Knowledge Ecologies." University of Bonn: Bonn, Germany.

Corner, Adam. (September 12, 2012). "Messing with Nature: Exploring public perceptions of geoengineering" (poster). Tyndall Assembly, Cardiff University: Cardiff, UK.

Beaudrie, C.E.H., Long, G., Gregory, R., Wilson, T., & Satterfield, T. (September 10-12, 2012). "Expert Judgment-Based Risk Screening for Emerging Nanotechnologies: A Collaborative Approach." 7th International Conference on the Environmental Effects of Nanoparticles and Nanomaterials: Banff, Alberta.

Mody, Cyrus. (September 14, 2012). "Replication and Evolution of Research Organizations: The Case of US Academic Microfabrication Facilities." International Conference on Intellectual and Institutional Innovation in Science: Berlin.

Newfield, Christopher. (October, 2012). "It's Not a STEM World After ALL: Notes on the Liberal and Practical Arts." Michigan Technological University: Houghton, MI.

Mody, Cyrus. (October 6, 2012). "The Interdisciplinary Imaginary: Computer Music at Vietnam-Era Stanford." Annual meeting of the Society for the History of Technology: Copenhagen.

November, Joseph. (October 6, 2012). "Engineering a Better Medicine." The Society for the History of Technology (SHOT): Copenhagen, Denmark.

Beaudrie, C.E.H., Satterfield, T., Kandlikar, M., & Harthorn, B. H. (October 17-20, 2012). "Nanotechnology Expert Perceptions: Benefits, Risks, Bias, and Regulation." Annual Meeting of the Society for Social Studies of Science (4S): Copenhagen, Denmark.

Cortes-Lobo, Rodrigo, & Engeman, Cassandra. (October 17-20, 2012). Organizers and Chairs for the panel "Public Interest Groups: The Role of Organizational Participation in

Nanotechnology.” Annual Meeting of the Society for Social Studies and Science (4s): Copenhagen, Denmark.

Collins, Mary, & Engeman, Cassandra. (October 17-20, 2012). Organizers and Chairs of the Panel, "Social Location and Nanotechology Risk Perception." Annual Meeting of the Society for Social Studies and Science (4S): Copenhagen, Denmark.

Collins, Mary, Hanna, Shannon, Harthorn, Barbara Herr, & Satterfield, Terre. (October 17-20, 2012). "People, Products and Nanotechnology: A Risk Judgment Analysis.” Annual Meeting of the Society for the Social Study of Science (4S): Copenhagen, Denmark.

Engeman, Cassandra, Lynn, Baumgartner, Carr, Benjamin, Fish, Allison, Meyerhofer, John, Satterfield, Terre, Holden, Patricia, Harthorn, Barbara Herr. (October 17-20). "Voluntary Regulations in the International Nanomaterials Industry: Perceptions, Practices and Problems for Workers.” Annual Meeting of the Society for the Social Study of Science (4S): Copenhagen, Denmark.

Harthorn, Barbara Herr and Bryant, Karl. (October 17-20, 2012). “Designing Deliberation: Social Location and the Politics of Difference in US Public Deliberations about New Technologies.” Society for the Study of Social Science (4S): Copenhagen, Denmark (talk accepted, prepared and disseminated but not presented due to illness).

Johansson, Mikael. (October 17-20, 2012). "Different labs different dangers: How scientists working with nanomaterials perceive risk.” Annual Meeting of the Society for the Social Study of Science (4S): Copenhagen, Denmark.

Pidgeon, Nick. (October 17-20, 2012). Organizer of symposium "Climate Engineering as a Societal Design Problem.” Annual Meeting of the Society for the Social Study of Science (4S): Copenhagen, Denmark.

Satterfield, Terre. (October 17-20). “Intuitive Cognition in the Perception of Air, Water and Soil as They Interact With Engineered Nanomaterials: A Study of US Public Views.” Annual Meeting of the Society for the Social Study of Science (4S): Copenhagen, Denmark.

Parker, Rachel, & Appelbaum, Richard. (October, 2012). "China's Developmental State: Can China Become a Global Nanotech Innovator in the 21st Century?” Annual Meeting of the Society for the Social Study of Science (4S): Copenhagen, Denmark.

Zayago Lau, Edgar. (October 2012). "Nanotechnology and Development in Latin America: Rationales and Challenges.” Annual Meeting of the Society for the Social Study of Science (4S): Copenhagen, Denmark.

Barvosa, Edwina. (October 19, 2012). "Ambivalence as Asset: Mapping Meaning & Epistemic Diversity in Upstream Public Engagement with Nanotechnology.” Annual Meeting of the Society for the Study of Science in Society (4S): Copenhagen, Denmark.

Beaudrie, C.E.H., Kandlikar, M., Long, G., Gregory, R., Wilson, T., & Satterfield, T. (October 22-25, 2012). "Governing the Uncertain: Expert Judgment Based Risk Screening for Emerging Nanotechnologies.” Fourth Annual Conference of the Society for the Study of Nanoscience and Emerging Technologies (S.NET): Enschede, Netherlands.

Engeman, Cassandra. (October 22-25, 2012). "Non-Governmental Organizations and Nanotechnologies Futures." Fourth Annual Conference of the Society for the Study of Nanoscience and Emerging Technologies (S.NET): Enschede, Netherlands.

Engeman, Cassandra. (October 22-25, 2012). Panel co-chair and co-organizer for "Public Interest Groups: The Role of Organized Participation and Activism in Nanotechnology Development.” Fourth Annual Conference of the Society for the Study of Nanoscience and Emerging Technologies (S.NET): Enschede, Netherlands.

Kay, Luciano. (October 22-25, 2012). "Acquiring Nanotechnology Capabilities: Role of Mergers and Acquisitions in the Nanotechnology Ecosystem.” Fourth Annual Conference of the Society for the Study of Nanoscience and Emerging Technologies (S.NET): Enschede, Netherlands.

Kay, Luciano. (October 22-25, 2012). "Emerging technologies and corporate strategies: The case of the nanotechnology for energy storage solutions in China." Fourth Annual Conference of the Society for the Study of Nanoscience and Emerging Technologies (S.NET): Enschede, Netherlands.

Stocking, Galen, Han, Shirley, & Matt, Gebbie. (October 2012). "Can China Become a Nano Innovator? An investigation into the Chinese nanotechnology communities in Shanghai and Suzhou Industrial Park." Fourth Annual Conference of the Society for the Study of Nanoscience and Emerging Technologies (S.NET): Enschede, Netherlands.

Mehta, Aashish. (October 24, 2012). "The Scientific Influence of Nations: Quantity, Impact and the Role of International Collaboration in Nanotechnology." Fourth Annual Conference of the Society for the Study of Nanoscience and Emerging Technologies (S.NET): Enschede, Netherlands.

Zayago Lau, Edgar. (October 2012). "Developmental Implications of Nanotechnology." Fourth Annual Conference of the Society for the Study of Nanoscience and Emerging Technologies (S.NET): Enschede, Netherlands.

Copeland, Lauren. (November 16-17, 2012). "Conceptualizing Political Consumerism: How Citizenship Norms and Values Shape Boycotting and Buycotting" Annual meeting of the Midwest Association of Public Opinion Research: Chicago, IL.

Harthorn, Barbara Herr. (November 20-24, 2012). Co-organizer, SMA-CASTAC invited panel. American Anthropological Association: Chicago, IL.

Kay, Luciano. (November 28-29, 2012). "How do companies embrace emerging technologies? The case of nanotechnology and energy storage applications in China" (poster). Conference on Patent Statistics for Decision Makers (PSDM): Paris, France.

Lenoir, Timothy. (November 27, 2012). "Federal Funding and the Takeoff of Nanomedicine." University of California, Davis: Davis, CA.

McCray, Patrick. (December 2012). "California Dreaming: The Golden State's Influence on Imaginings, Policies, and Narratives of Nanotechnology" (invited talk). Reilly Center, University of Notre Dame: South Bend, IN.

Satterfield, Terre, & Harthorn, Barbara Herr. (December 2-4, 2012)."Environmental attitudes towards ENMs" (invited presentation). NSF nano grantees meeting: Arlington, VA.

Beaudrie, C.E.H., Kandlikar, M., Long, G., Gregory, R., Wilson, T., & Satterfield, T. (December 9-12, 2012). "Judgment-Based Risk Screening for Emerging Nanotechnologies: A Collaborative Approach." Society for Risk Analysis Annual Meeting: San Francisco, California.

Friedman, Sharon, & Egolf, Brenda. (December 12, 2012). "Tracking Media and Internet Coverage of Nanotechnology's Risks over the Years." Society of Risk Analysis Annual meeting: San Francisco, CA.

Mody, Cyrus. (December 7, 2012). "What Do Scientists and Engineers Do All Day? On the Structure of Normal Science." MIT-Harvard symposium on Thomas Kuhn's Structure of Scientific Revolutions, 50 Years Later: Reflections on the History, Philosophy, and Sociology of Science: Cambridge, MA.

Pidgeon, Nick. (December 9-12, 2012). "Deliberating Geoengineering Risks: The Case of Stratospheric Aerosols and the SPICE Project" (poster). Society for Risk Analysis Annual Conference: San Francisco, CA.

McCray, Patrick. (January 2013). "Visioneering: From Space Colonies to Nanotechnologies in Pursuit of a Limitless Future." Skeptics Society Distinguished Lecture Series, Cal Tech: Pasadena, CA.

Copeland, Lauren. (January 3-5, 2013). "Value Change and Political Action: Postmaterialism, Environmentalism, and Political Consumerism" Annual meeting of the Southern Political Science Association: Orlando, FL.

Kaplan, Sarah. (February, 2013). "Interdisciplinarity in Practice: a case study of a Nanotechnology Research Center." AAAS Annual Meeting: Boston, MA.

Kaplan, Sarah. (February 2013). "Interdisciplinarity in Practice: a case study of a Nanotechnology Research Center." University of Virginia, Darden/McIntire research seminar: Charlottesville, VA.

Appelbaum, Richard. (February 23, 2013). Discussant on conference panel. UCSB Orfalea Center Global Studies Conference: Santa Barbara, CA.

Mehta, Aashish. (February 2013). "Globalization and deglobalization of nanotechnology research - the role of China." University of California, Santa Barbara, Global Studies Conference: Santa Barbara, CA.

Newfield, Christopher. (February 2013). "It's Not a STEM World After All: Notes on the Liberal and Practical Arts." College of Arts and Humanities Institute, Indiana University: Bloomington, IN.

Kaplan, Sarah. (March 2013). "Interdisciplinarity in Practice: a case study of a Nanotechnology Research Center." UC Davis Conference on Qualitative Research: Davis, CA.

Newfield, Christopher. (March 2013). "The Destruction of Creativity? Literary vs. Innovation Theory." Pratt Institute: Brooklyn, NY.

Mody, Cyrus. (March 1, 2013). "The Market and the Garden: Civilianization and the Commercialization of Research in the Long 1970s." Seoul National University, History of Science and technology colloquium: Seoul, South Korea.

13. SHARED AND OTHER RESEARCH FACILITIES

The infrastructure needs for the societal implications research of CNS-UCSB are well met through UCSB and partner organizations.

1) CNS-UCSB
The main facilities for CNS located in a suite of contiguous offices in Girvetz Hall, providing housing for all CNS personnel in proximity among researchers, staff and infrastructure and a suitable conference and meeting space. The CNS site is in a centrally located building on campus that allows effective coordination and communication among all participants. This space commitment by the Executive Vice Chancellor, College of Letters and Science, and Dean of Social Sciences to the CNS on our very space-constrained campus is a strong mark of support for our interdisciplinary research and education efforts. Since 2011, the College of Letters and Science has generously provided an additional contiguous office to accommodate the needs of CNS' numerous visiting scholars and researchers. We continue to have access as needed to additional space for meetings, conferences, seminars, and other gatherings in the **Institute for Social, Behavioral & Economic Research** (ISBER) in North Hall, Global and International Studies, and other campus locations. ISBER additionally provides the organized research infrastructure for CNS through computing network infrastructure for our offices and our work, secure sites on the server for our collaborative sharing of project data, and many forms of research administration support that augment our administrative capacity.

2) California NanoSystems Institute (CNSI)
The UCSB CNSI offers a unique set of resources that contribute to the collaborative, interdisciplinary nature of the Center. Completed early in the first award period, CNSI is a dedicated Institute building that serves as a state-of-the-art laboratory facility and hub for many of the nanoscientists and engineers working on campus. It includes a consolidated 10,000 square foot Materials Characterization Laboratory, equipped with NMR, electron microscopes, scanning probe tools, optical and electrical characterization and surface analysis capability, and trio of shared Nanostructures Laboratories—a 1600 square foot Biological NanoStructures Laboratory for biological synthesis and analysis; a 1200 square foot Chemical NanoStructure Lab for chemical synthesis, and a 8,500 square foot NanoStructures Cleanroom Facility of Class 100/Class 1000 level space. The CNSI building also houses the Allosphere, a 360 degree, 3-story data-visualization space, and extensive exhibition space that accomodates travelling nano science education exhibitions and public engagement events. These spaces are important sites for CNS's partnered education programs with CNSI. Although CNS no longer occupies office space in the CNSI building, the foundation created by our partnerships with CNSI education personnel and co-residence with them for several years endures, and we continue to use CNSI conference and meeting spaces for seminars, lectures, and other events to increase our visibility and engagement with the NSE community. CNS Executive Committee member and MRL Director, Craig Hawker, has just been appointed Director of the CNSI, and this will serve to additionally strengthen our ties with the institute. More information on CNSI, the MRL, and UCSB nanoscale shared research facilities can be found at www.cnsi.ucsb.edu and http://www.cnsi.ucsb.edu/facilities/.

3) Materials Research Laboratory (MRL) (UCSB)
The MRL was established in September 1992 with funding from the National Science Foundation (NSF), and became an NSF Materials Research Science & Engineering Center (MRSEC) in 1996. The research, scientific and engineering activities of the Materials Research Laboratory focus on educational outreach and four major interdisciplinary research groups

(IRGs), as well as six laboratories. MRL also runs the IGERT program ConvEne — Conversion of Energy Through Molecular Platforms, an interdisciplinary approach to graduate education aimed at providing a new generation of Chemical Scientists and Engineers with the technical skills, environmental awareness, business expertise, and teamwork approaches that will be required to address fundamental and applied issues in the generation and conversion of energy in efficient and environmentally-sustainable ways. The Director of MRL, Craig Hawker, is a co-PI of the Center's NSEC award and a member of the CNS Executive Committee. MRL Education staff co-coordinate a campus-wide summer Undergraduate Research Intern Seminar Series, which CNS interns attend and in which CNS Education staff and faculty have presented. http://www.mrl.ucsb.edu

4) Nanotech: The UCSB Nanofabrication Facility, National Nanotechnology Infrastructure Network (NNIN) (UCSB)
UCSB has extensive facilities and research in nanotechnology. Specific UCSB strengths include leading expertise in compound semiconductors, photonics, quantum structures, and expertise with non-standard materials and fabrication processes. The nanofabrication facility has comprehensive and advanced semiconductor and thin film processing equipment and provides access and professional consultation to industrial and internal and external academic users. The facility currently consists of 12,700 sq ft of clean space. Both on-site and remote support of users (including equipment training, process consultation, and remote job processing) is provided by a staff of six engineers supporting facilities and three Ph.D.-trained engineers supporting process. The Nanofabrication Facility has been a resource for CNS ethnographic research of laboratory culture, and new partnerships with Education staff that bring CNS expertise to NNIN Societal and Ethical Issues education programs are expanding our reach to new audiences. http://www.nanotech.ucsb.edu/

5) Center for Spatial Studies (spatial@ucsb)/National Center for Geographic Information and Analysis (NCGIA)/Center for Spatially Integrated Social Science (CSISS) (UCSB)
The Center for Spatial Studies, NCGIA, and CSISS (housed within NCGIA) together form a cluster of internationally renowned knowledge, mapping resources and personnel for spatial analytic scientific work. Given the global scope of CNS' research, the interest in tracking flows (such as the movement of goods services, and ideas through the global value chain), and the attraction of spatial data visualizations as a means of enhancing participation and knowledge exchange, the spatial resources at UCSB, and CNS's close connection to them constitute significant resources. CNS PIs Harthorn and Appelbaum are former executive committee members of CSISS (a NSF-funded social science infrastructure center), and the spatial center's former director, Michael Goodchild, has been a key advisor and resource for the CNS. He retired from campus in June 2012, but current director Don Janelle continues as a key resource for CNS. Spatial@ucsb provides free consulting services on GIS, cartographic and other spatial research. CNS has drawn GSRs (Glennon, Hurt) and a fellow (Hurt) from CSS, and CNS has a firm commitment to incorporating cartographic and spatial analysis in the data analysis and data visualization phases of our research. In our current award, as CNS generates more databases adequate for spatial statistics we anticipate even closer ties with this cutting edge resource and the tools it provides. (See http://www.spatial.ucsb.edu; www.ncgia.ucsb.edu and www.csiss.org.)

6) Social Science Survey Center (SSSC) (ISBER, UCSB)
The SSSC/Benton Survey Research Laboratory at UCSB enhances interdisciplinary collaboration on theoretical and methodological planes. The SSSC is directed by sociologist John Mohr, a senior researcher in the CNS who has worked with both IRG 3 and IRG 2, and Associate Director, sociologist Paolo Gardinali. It is housed in the Humanities and Social

Science Building and administered by ISBER and includes equipment and resources to conduct state-of-the art computer assisted interviewing system (CATI) telephone surveys, sophisticated web-based surveys, and mail and multi-mode surveys on local, regional, or national populations in several languages. The SSSC works in extending traditional data collection methods with the use of online-based questionnaires for quantitative and qualitative data collection, in survey and experimental settings. The SSSC has also pioneered a cutting edge use of mixed data collection modes, using telephone, mail and web for maximum effectiveness. Extensive consulting is available on survey instrument design and development, programming, and data analysis and interpretation, and the SSSC is developing full GIS capability. Data security is a top priority, and multiple backups ensure stable system performance. SSSC provides ongoing support services for CNS deliberative workshops, web and phone surveys, and data analysis consulting. Campus research services infrastructure greatly reduce the cost of such data acquisition while providing a reliable and IRB-safe mode. CNS has used SSSC services for full survey sercies or components of projects. For more information see http://www.survey.ucsb.edu

7) Center for Information and Technology (CITS) (UCSB)
CITS is dedicated to research and education about the cultural transitions and social innovations associated with technology, particularly in the highly dynamic environments that seem so pervasive in organizations and societies today. They also work to improve engineering through infusing social insights into the innovative process. CITS was founded at UC Santa Barbara in 1999, on the thirtieth anniversary of the birth of the Internet, through the efforts of founding director Bruce Bimber, also a senior researcher and executive committee member in the CNS. CITS research initiatives range from ground-breaking research on social computing, to the role and effectiveness of technology in the classroom, to the role of technology in organizing community events. In addition to research, CITS also supports an optional Technology and Society Ph.D. emphasis, which is available to students in participating doctoral programs at UCSB from the College of Engineering, the Social Sciences, and the Humanities and of interest to CNS grads. The emphasis provides interdisciplinary training on the relationships between new media and society with intensive faculty involvement. CITS serves as a close partner on graduate recruiting, shared programming, and other interests in common. CNS PIs Harthorn, and McCray as well as Executive Committee member Bimber are all affiliated faculty in CITS, CNS Education Director Metzger is also the advisor of the CITS graduate emphasis program, collaborator Earl is a former director, and current director Parks confers regularly with the CNS executive committee. Longterm plans under discussion for the CNS include possible collaborative institutionalization with CITS. http://cits.ucsb.edu/

8) Bren School of Environmental Science and Management (UCSB)
The Bren School is among a handful of schools in the United States and the only one in the West that integrates science, management, law, economics, and policy as part of an interdisciplinary approach to environmental problem-solving. The school is housed in what was the "greenest" laboratory facility in the United States when it was completed in 2002, and in 2009 it became the first building to receive a second LEED Platinum certification, this time in recognition of maintenance and operations of an existing building. Bren Hall is home to a collection of superbly equipped laboratories, computer centers, lecture halls, and other teaching and meeting places that support instruction, research, interaction, and the development of tomorrow's most capable scientists and environmental managers. Bren School faculty and colleagues at UCSB (including CNS researchers), UCLA, and other universities are nearing completion on a 5-year, $24 million nanotechnology risk-assessment project funded by the National Science Foundation (NSF) and the U.S. Environmental Protection Agency (EPA), the UC Center for the Environmental Implications of Nanotechnology (UC CEIN). CNS IRG 3

researchers have had an active, funded role in the UC CEIN, and Harthorn serves on the center's executive committee; the UC CEIN's renewal proposal for 2013-2018 funding is pending at the NSF and EPA. is the nation's first such large-scale study of the potential ecological effects of nanomaterial forms. Bren School microbiologist Holden has been a collaborator with CNS IRG 3 since 2006 and joined the Executive Committee in Fall, 2011. New Seed Grant recipient Anderson is an Environmental Politics professor in Bren. http://www.bren.ucsb.edu

9) The University of California Center for Environmental Implications of Nanotechnology (UC CEIN)
The University of California Center for Environmental Implications of Nanotechnology (UC CEIN) was established in 2008 with funding from the National Science Foundation and the U.S. Environmental Protection Agency to explore the impact of engineered nanomaterials on a range of cellular lifeforms, organisms and plants in terrestrial, fresh water and sea water environments. The UC CEIN integrates the expertise of engineers, chemists, colloid and material scientists, ecologists, marine biologists, cell biologists, bacteriologists, toxicologists, computer scientists, and social scientists to create the predictive scientific platform that will inform us about the possible risks and safe design of nanomaterials (NMs) that may come into contact with the environment. Led by Andre Nel, UCLA, CNS-UCSB Director Barbara Harthorn co-leads UC CEIN Theme 7 - Risk Perception, Regulation and Outreach with co-PI chemist Hilary Godwin, UCLA, and serves on the Executive Committee for the Center. The UC CEIN's renewal proposal for an additional 5 years of funding 2013-2018 is pending at the NSF and EPA.

The UC CEIN is housed within the California NanoSystems Institute (CNSI) at UCLA, with a second major hub at the University of California, Santa Barbara, led by Arturo Keller. The Santa Barbara facilities include office, lab, meeting, and classroom space in the UCSB Bren School of Environmental Science and Management, research offices in CNS, and administrative and computing facilities within the Earth Research Institute (ERI) at UCSB. UCSB CEIN provides meetings, seminars, education program activities, and outreach events in which CNS researchers and students collaborate. http://www.cein.ucla.edu/

10) Center on Globalization, Governance, and Competitiveness (CGGC) (Duke University)
This Center, led by CNS IRG 2 collaborator, Gary Gereffi, was created to address one of the key challenges of the contemporary era: to harness the potential advantages of globalization to benefit firms, countries, and organizations of all kinds that are trying to maintain or improve their position in the international arena. It does so by creating a comprehensive research framework that links the global, national, and local levels of analysis, translating research into appropriate organizational strategies and government policies. Its goal is to draw on a widespread, interdisciplinary network of scholars to formulate creative solutions for firms, countries, and organizations that want to improve their competitiveness or forge better development policies. It draws on the experience and expertise of the Rockefeller Foundation's Global Value Chains Initiative, assembling interdisciplinary, international groups of researchers with deep expertise on a broad range of industries affected by globalization. The Center's first three priority areas are China, India, and Mexico. The Center provides essential intellectual contributions to IRG 2's work on nanotechnology, globalization and E. Asia, as well as to the CNS undergraduate education program's project of the Global Value Chain. CNS spatial postdoc Frederick is combining GVC expertise gained in work with the CGGC with spatial analytic approaches to examine nanotech in the US and California (and across the global value chain). See http://www.cggc.duke.edu/

11) Chemical Heritage Foundation (CHF), Philadelphia
The Chemical Heritage Foundation is a library, museum, and center for scholars. Located in Philadelphia, CHF maintains world-class collections, including instruments and apparatus, rare books, fine art, and the personal papers of prominent scientists, all related to the chemical and molecular sciences. CHF also hosts conferences and lectures, supports research, offers fellowships, and produces educational materials. Their programs and publications provide insight on subjects ranging from the social impact of nanotechnology to alchemy's influence on modern science. CHF is the former base of CNS IRG 1 collaborators, Cyrus Mody, Hyungsub Choi, Matt Eisler, and current home to collaborator Brock. CHF is a partner in CNS's production of *oral histories* of leading nanoscientists, hosts key nano in society workshops and conferences, in which CNS has been a welcome participant; CNS has also partnered with CHF in the publication of a series of commissioned research briefs, including some involving CNS researchers (Beaudrie, 2010; Mody, 2010; Parker, 2010). http://www.chemheritage.org/

12) The Jenkins Collaboratory, Duke University is IRG 2 collaborator Tim Lenoir's laboratory for developing technologies in contemporary science, engineering, and medicine, and their social and ethical implications. Their work focuses particularly on the current fusion of biotechnology, nanotechnology, and information technologies, and the transformative possibilities of this fusion for biomedicine, human-machine engineering, cultural production, and civic engagement. The Jenkins Collaboratory has several computer lab spaces and offices/workspaces as well as dedicated server space on the Duke campus. Current database development in IRG 2 is utilizing the professional expertise and infrastructure capabilities of this center to advance analysis of the nano innovation system. http://www.jhfc.duke.edu/jenkins/

13) Science Journalism program/ Lehigh University
Through the Lehigh University's Journalism & Communication department, CNS collaborator Sharon Friedman directs the Science Writing Program, which prepares bachelor's degree students to write for such science fields as engineering, medicine, scientific research and environmental sciences, and contains a media analysis component. Friedman, along with a professional researcher and student researchers, utilize facilities in Coppee Hall on the Lehigh campus in Bethlehem, PA.

14) Decision Research, Eugene, Oregon, is a non-profit research organization investigating human judgment, decision-making, and risk. They conduct both basic and applied research in a variety of areas including aging, aviation, environmental risk, finance, health policy, medicine, and law. Founded in 1976 by the leading international risk perception researcher, Dr. Paul Slovic, Decision Research is dedicated to helping individuals and organizations understand and cope with the complex and often risky decisions of modern life. Their research is based on the premise that "decisions should be guided by an understanding of how people think and how they value the potential outcomes—good and bad—of their decisions." DR's research staff includes CNS collaborator, Dr. Robin Gregory, an expert on stakeholder participation in environmental decision making. DR provides unique expertise on psychometric risk perception and decision risk research. http://www.decisionresearch.org/

International Facilities

15) The Institute for Resources, Environment and Sustainability (IRES) at the University of British Columbia (UBC), Canada
The Institute for Resources, Environment and Sustainability (IRES) is an issue-driven interdisciplinary research institute with interest and expertise in a wide range of environment and sustainability issues. IRG 3 researchers Terre Satterfield and Milind Kandlikar serve as

core faculty in the Institute, and Satterfield currently as its head. The Institute fosters sustainable futures through integrated research and learning about the linkages among human and natural systems, to support decision making for local to global scales. IRES is home to a major interdisciplinary graduate education program (RMES) with 80 doctoral and 40 master students. Located within the Aquatic Ecosystems Research Laboratory (AERL) on the Main Mall of UBC's Vancouver campus, IRES facilities include office space, meeting facilities, classroom space, study space, and computing. http://www.ires.ubc.ca/

16) Understanding Risk Research Group at Cardiff University, UK

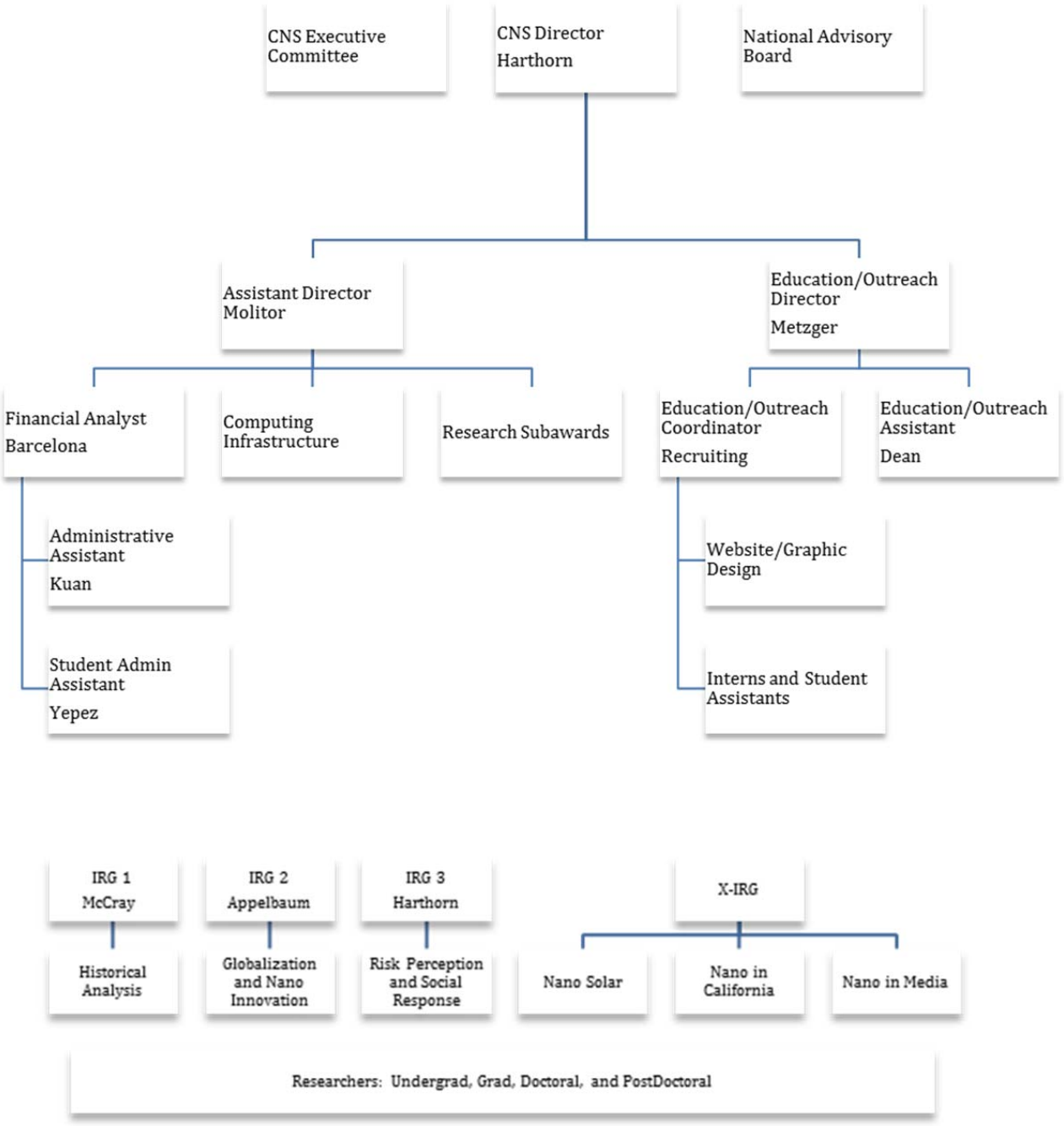
The Understanding Risk group is an interdisciplinary social sciences (psychology, sociology and technology studies, geography) research unit at Cardiff University focusing on the impacts upon individuals and communities, and acceptability to people, of environmental and technological risk within everyday life. The Group provides expertise in: the psychology of climate change; public attitudes towards and acceptability of energy supply systems; sustainable behaviour change and energy demand reduction; social conflicts and sitting of large scale energy technologies; risk perception, communication and public engagement. IRG 3 collaborator Nick Pidgeon is Director of the Understanding Risk Group, which provides a rich set of collaborators and expertise for the CNS students and postdocs working at Cardiff.
http://www.understanding-risk.org/

14. PERSONNEL

CNS-UCSB is a single campus center, based firmly at University of California at Santa Barbara, taking full advantage of its renowned reputation for interdisciplinarity, its stellar materials science and engineering capabilities (MRSEC, top ranking Engineering College and Materials Department #1 in public institutions in the world, California NanoSystems Institute, NNIN site, 2 Nobel laureates in the field), dedicated institutional commitment to diversity at all levels of leadership, and a strong team of interdisciplinary social science and humanities scholars to provide the core for CNS. CNS-UCSB Director Barbara Herr Harthorn is assisted by a a faculty Director of Education (Metzger), an Assistant Director (Molitor, 1.0 FTE), an education program Acadmic Coordinator (Boggs, .75 FTE), a Financial Analyst/Events Coordinator (Barcelona, 1.0 FTE), a Travel and Purchasing Administrative Assistant (Kuan, 1.0 FTE), and a Computing Specialist (Lim, .25 FTE). Harthorn works collaboratively with 3 co-PIs (Appelbaum, McCray, and MRL/MRSEC/CNSI Director Hawker) and an active, engaged CNS Executive Committee, which includes the 4 PI/co-PIs and former co-PI Bimber, Director of Education Metzger, and CEIN collaborator, Holden; CNS Assistant Director Molitor and Academic Coordinator Boggs serve *ex officio.* The 3 IRG leaders (McCray, Appelbaum, and Harthorn) are all based on the UCSB campus, share research space in the CNS, and meet frequently face to face with their on campus IRG research teams and remotely with collaborators. Thus, IRG leaders integrate their research issues and needs through the Executive Committee and senior researcher meetings and seminars.

Director Harthorn is responsible for all official agency contact with the CNS-UCSB, for CNS adherence to campus and agency policies regarding fiscal controls, IRB, and the oversight of all CNS business. She is the primary contact for the CNS to the UCSB upper administration and the CNS' immediate administrative unit, the Institute for Social, Behavioral, and Economic Research (ISBER). In these capacities, she is responsible for oversight of fiscal management, including both cooperative agreement and campus matching funds, CNS subawardees, space allocation, and compliance with UC and UCSB campus policies. As lead PI, Dr. Harthorn also represents the CNS in NSF Nanotechnology in Society Network and NSEC network interaction. The CNS Executive Committee meets monthly on a face-to-face basis, conferencing in those who may be off site, and electronic and face-to-face communication takes place more frequently on matters both practical and intellectual.

CNS Organizational Chart



Personnel changes in the current reporting period

Executive Committee
Dr. Cathy Boggs, who served on the CNS Executive Committee *ex officio* as CNS Education Coordinator since May 2011, took a medical leave in Oct 2012 and stepped down from the position in February 2013. The Education and Outreach programs continue to be represented fully on the CNS Executive Committee by Miriam Metzger, CNS Director of Education and Outreach. The Executive Committee is in discussion about possibly adding yet more members as part of the planning for CNS2 (post-Yr 10).

Staffing
Following significant transition in 2011, as outlined in last year's annual report, we are pleased to report there have been no changes in CNS administrative staffing this reporting period. The current staffing profile provides efficient and effective support of the Center, with expertise in such critical areas as: grants management, fiscal management, project management, travel and events coordination, and general administrative support.

In spring 2013 a search will be conducted to fill the Education and Outreach Coordinator position, left vacant by Boggs' recent departure from UCSB. In the meantime, workload has been shifted to Assistant Director Molitor, Education Director Metzger, Director Harthorn, and UCSB Political Science graduate student Joshua Dean has been hired on a part-time basis to serve as Education and Outreach programs assistant.

CNS leverages NSF and UCSB cash contributions to achieve savings without sacrificing capability. UCSB cash contribution covers a significant portion of CNS staff salaries and fringe benefits. CNS staff draws regularly on the expertise of the staff of CNS' immediate control point, ISBER, for assistance in all aspects of extramural award submissions and administration, human resources/personnel actions, and computer network administration. ISBER's support has enabled CNS to achieve efficiencies in a number of areas, providing backup to CNS' smaller, more specialized staff. In addition, CNS shares computer technology staffing with ISBER, which gives the CNS access to full-time IT staff, without having to commit full-time salary expenditures. CNS has networked and further draws from expertise on the UCSB campus by contracting specific tasks (e.g., re-building the web platform, disseminating press releases, print design) to on-campus specialists.

National Advisory Board
CNS has had since inception an excellent National Advisory Board comprised of leading STS and social science scholars and members from industry, NSE, NGOs, policy, and others (see the full list in Section 4B). Board members John Seely Brown and Ann Bostrom currently serve as Co-Chairs. Since this award began in 2010, the board plans were to meet remotely or face-to-face in biannual meetings with CNS Executive Committee members, staff, researchers, and students to discuss CNS research, education and outreach efforts, assess new opportunities, and consider possible course adjustments in response to them. The board provides informal consultation on an as needed basis to Director Harthorn, and board meetings serve as an informal evaluation mechanism, as a sounding board for brainstorming new ideas and new directions, as a means to elicit elite views from a range of stakeholders in nanotechnology's societal impacts. This has been highly successful to date, and CNS plans no major changes to this basic approach, although some Board members have questioned the need for such regular meetings in the later years of the Center and have urged a shift to consultation. Board members

are willing and available for such consultation by phone and e-mail throughout the year, with serendipitous individual face-to-face meetings as travel schedules allow. In its most recent meeting, the Board discussed possible reconfiguration of the Board in tandem with the CNS' evolving needs, particularly the long range development plans for beyond NSF funding horizons.

Center as Infrastructure for Societal Implications Researchers

The Center has taken a leadership role, with CNS-ASU, in development of the new Society for the Study of Nanoscience and Emerging Technologies (S.NET). As reported last year, the 2 CNS Centers partnered to co-sponsor, co-host the S.NET 2011 conference, held in Tempe, Arizona, in Nov 2011. CNS-UCSB hosted the website for the conference and the conference program committee, which Director Harthorn co-chaired with CNS-ASU Director Guston. CNS-UCSB sought, obtained and administered NSF supplement funds to support researchers traveling to the 2012 S.NET meeting in the Netherlands, and Harthorn served on the program committee for the 2012 meeting as well. The infrastructure investment by NSF in the CNS-UCSB is thus benefiting a much wider community of scholars and researchers, and the multi-agency NNI as well. In collaboration with CNS-ASU, CNS-UCSB is taking a leading role in many structured interactions among NSE and societal dimensions researchers and more are in development in the future. Harthorn and Guston correspond on an approximately weekly basis and schedule regular conference calls as well to encourage a free flow of information among the Centers and their networks.

Management and Operation of Research Program

CNS has established an effective infrastructure for managing its collaborative research efforts. CNS' base on a single campus and consolidated and generous space arrangements in Girvetz Hall simplify these processes.

- Executive Committee meetings on a quasi-monthly basis allow prompt and direct reporting to and consultation with the group on both administrative and research issues
- Research group and/or project meetings take place on a roughly weekly basis at UCSB, often dialing/skyping in collaborators for teleconference participation.
- The CNS Graduate Seminar (Soc 591 BH) meets bi-weekly year-round and provides an established forum for sharing of research issues, regular rotating presentations by senior personnel, postdocs, and grads, for discussion and training on research methods, IRB issues, as well as informal interaction. Summer interns are incorporated into the seminar during the 8-week summer internship program.
- Grad Fellows and Graduate Student Researchers work together in common space, which facilitates information sharing across the groups.
- Postdoctoral Fellows work in shared and adjacent space, which also serves to promote interactions; occasional gatherings for tea or drinks that include all CNS researchers and staff in informal exchange extend these opportunities.
- Visiting Scholar/Lecture Series brings together CNS researchers with extramural visitors for formal and informal interactions. Visitors are selected by grads, researchers, and education program personnel.
- Research Summit meetings are held in Santa Barbara to allow the free flow of ideas among all CNS collaborators, students, and personnel from the 18 institutions actively involved in core CNS research. A Summit is planned for 2013-14.
- Management of projects—CNS requires semi-annual reporting and invoicing from all subawardees, and similar reporting from all IRGs, X-IRG projects and the education

program. This permits ongoing formative evaluation by the director and assistant director of progress toward goals, personnel changes on projects at all sites, and outputs.

- IRB—CNS operates under a blanket human subjects protocol in PI Harthorn's name and individual project approvals for all projects involving human subjects, at UCSB and other campuses are required in addition. Assistant Director Molitor maintains a centralized database to ensure full compliance and to monitor upcoming expirations of existing protocols; the UCSB campus now utilizes an online system to provided notification of approaching deadlines and simplify renewal processes. PI Harthorn provides annual training on research ethics and individual consultation on specific projects, and Harthorn and Molitor provide extensive consultation on individual projects as needed.
- Annual process for IRG budget review and allocation—CNS Director Harthorn solicits annual budget proposals from IRGs, allocates funds based on performance, unexpended funds carried forward, and competing needs. Budgets are then discussed in Executive Committee. Budgets are gauged to different research methods and needs, as well as progress toward goals.
- New postdocs are required to submit a research proposal to the CNS Exec within a month of their arrival and to provide milestones for assessing progress. Postdoc evaluation takes place on an annual basis in conjunction with university and agency protocols and in compliance with the requirements of the union now in place for UC postdoctoral scholars.
- Funder-required annual reporting and site visits provide significant impetus to aggregate and synthesize data within and between research groups
- Annual retreats of the Executive Committee and staff to discuss NSF review results have facilitated group assessment through SWOT analysis, collective decision making and other mechanisms, and will be implemented on an as-needed basis in the future. The most recent retreat was held in Jan, 2012 at the Mosher House and also brought in most of the upper administration of campus and potential future partners to discuss long term prospects for CNS.

Clear and regular communication is essential to the management of any organization. To achieve this end, CNS-UCSB researchers and staff are in regular communication with one another, and this process is greatly facilitated by shared space. Members of the executive committee meet on a regular basis and those not physically present join via conference call. Email provides another forum for the exchange of ideas and information. Finally, the CNS website is continuing development to increase the means for more complex databases to be created, stored, and shared internally with adequate security maintenance and externally when desired and appropriate. We have been successfully using secure sites on the ISBER server for sharing data and resources with collaborators around the world.

Seed Grants program

In addition, in 2012, CNS sought to extend its faculty participants at UCSB as it heads toward sunset by requesting and receiving a supplement from NSF for a Seed Grant program. The first call was initiated in Fall, 2012, and 4 of 14 proposals were selected for funding. The program brings into the CNS 4 new faculty, from all 3 Divisions of the College of Letters and Science and the Bren School and Engineering, 2 of them are assistant professors, 1 is associate, and their projects are just getting under way. Given the success of this recruitment, we anticipate running a 2nd call in Fall 2013 with CNS funds.

B. Evaluation plan for CNS-UCSB

The evaluation plan for the CNS-UCSB is to evaluate performance against our goals in the main functional areas - research, education and public outreach, the network with other nanotechnology in society programs, international collaboration, and the clearinghouse. We evaluate work using formative and summative processes at several levels of aggregation: within each working group on a regular, semi-annual basis (some groups do this quarterly), at the Executive Committee level also on a regular basis, and at the level of the National Advisory Board on a biannual or intermittent basis, depending on need. Annual reporting on established metrics provides an important set of data on the accomplishments of the CNS and highlights any problematic areas. Processes are in place to evaluate and defund projects that are unable to meet goals, as well as to be responsive to newly arising opportunities.

Seek continuous feedback

We begin with efforts to solicit and incorporate continuous feedback. This type of formative evaluation involves a continual quest for information about all areas of our functioning. In the research working groups, the mechanism for this is now standardized 6-month progress reports by the working group project leaders and specific projects within IRGs that are available for review by the full CNS executive committee. All subawardees are required to submit such reports as well. Monthly face-to-face meetings of the Executive Committee have proven invaluable for appraising progress toward goals and identifying areas of concern. Additional meetings among working group personnel are also ongoing, both to coordinate research within groups and to integrate efforts between groups. The education and outreach program is also providing periodic updates, meeting bi-weekly with all graduate fellows and postdocs, and provides extensive programmatic support to undergraduate interns. (See Education section 11 for specific education program evaluation methods, goals, and metrics.)

The CNS Executive Committee is the main formal mechanism through which such formative evaluation takes place, with on-going discussion of possible problems, necessary adjustments to plans or activities, and communication. The meetings are largely face to face (although traveling members may be on conference call) and take place on a monthly basis. The Director maintains oversight of this process. The National Advisory Board (NAB) members are available for consultation on an as needed basis as well, and we confer with them when additional advice is needed. There is a high level of intercommunication among the principals of the CNS, and a very significant circulation of scholarly and practical advice, references, articles, and other knowledge sources among the Executive Committee members, staff, postdocs, and students, primarily by electronic media. We are using online methods to facilitate this process, and we will be conducting ongoing analysis of their effectiveness.

The CNS Assistant Director, Director of Education, and Education Coordinator are involved in the monthly Executive Committee meetings and report to the Director. CNS staff members have recourse for advice and assistance to the experienced and knowledgeable professional staff of the Institute for Social, Behavioral, and Economic Research (ISBER). Regular work performance evaluation is mandated for all UCSB employees.

Budgetary controls within the University of California are very rigorous, and budget oversight of the CNS is maintained by ISBER and the Office of Research. The CNS Assistant Director and Director are in near daily consultation about budget matters, and, as needed, with all personnel, subawardees, and service providers.

Semi-annual reporting is required from all CNS research teams, UCSB and extramural subcontractors. This is a requirement in conjunction with invoicing for subawardee payments, and these documents are circulated to all CNS principals. The Education program also reports semi-annually on accomplishments and any issues of concern. These written records provide systematic detail that our face-to-face meetings cannot cover, and serve to inform everyone about ongoing work of the CNS.

Achieve aims
This kind of summative evaluation takes place primarily on an annual basis. The main mechanisms for achieving this are: annual reporting (for the CNS and for the NSF) and meetings with the NAB if needed. Annual reporting is required for all components of the CNS, and such cumulative records are the subject of focused meeting and discussion. The NAB, in addition, meets biannually in Santa Barbara if needed and is asked to provide detailed commentary, advice, and criticism both in person and, in some cases, in a written report. In the past a key aspect of the NAB process has been an executive session without CNS leadership, aimed at producing candid discussion and appraisal by this distinguished body of people outside CNS but familiar with us. At the most recent meeting (Apr 4 2011) the Board declined to meet without the executive committee and chose instead to have open discussion with us, providing praise for the progress on all fronts and suggestions for long range planning processes.

NSF annual reviews provide the main opportunity for summative evaluation. Preparation for the site visits involves extensive discussion and reflexive analysis by the CNS Executive Committee and staff.

Additional summative measures are drawn at any natural junctures, for example, the completion of a particular research program, or the completion of an iteration of the summer intern program. Entry and exit interviews are conducted with all summer interns and graduate mentors at the start and end of the program, respectively. The annual survey to graduate fellows, both current and past, is conducted in conjunction with the annual report cycle. More details about these measures are available in the Education section (section 11) of this report.

Prepare to meet changing conditions, emerging issues
This challenge of meeting changing conditions is particularly great in the context of studying nanotechnology in society, as the issues are far ranging and many of them still in development. Uncertainty about the economic forecast, technical risks and public reception to these emerging technologies complicates this picture. We are tracking changes, in both the nanoscience, economic, and social worlds, and we will address these issues as they emerge. In particular, IRG 3 is tracking social response and participation in a number of ways (public perception studies, NGO study). Taken together, these data do provide empirical data about the changing economic, political and social worlds in which nanotechnologies are unfolding. CNS has responded to changing conditions by new recruitments of grads and the addition of new collaborators. The CNS postdoctoral researcher program also brings in new scholars and new ideas, and CNS is continually expanding its network of collaborators. As noted above, after extensive discussion in retreat and Executive Committee, CNS initiated a 2-yr Seed Grant program in late 2012 to draw participation of new faculty, especially junior faculty, in CNS research and activities. The initial round of awards was made in January 2013. The CNS Faculty Seed Grant program is a vital step in development toward the long term future of the center.

Table 4a: NSEC Personnel - All, irrespective of Citizenship

Personnel Type	Total	Gender		Race Data								Ethnicity: Hispanic	Disabled	% NSEC Dollars
		Male	Female	AI/AN	NH/PI	B/AA	W	A	More than one race reported, AI/AN, B/AA, NH/PI	More than one race reported, W/A	Not Provided			
Leadership, Administration/Management														
Subtotal	**16**	**8**	**8**	**0**	**0**	**0**	**11**	**2**	**3**	**0**	**0**	**2**	**0**	0%
Director(s) [1]	1	0	1	0	0	0	1	0	0	0	0	0	0	100%
Thrust Leaders [1]	5	4	1	0	0	0	5	0	0	0	0	0	0	100%
Administrative Director and Support Staff	10	4	6	0	0	0	5	2	3	0	0	2	0	86%
Research														
Subtotal	**97**	**60**	**37**	**1**	**0**	**1**	**63**	**9**	**1**	**2**	**20**	**7**	**0**	0%
Senior Faculty [1]	28	19	9	0	0	0	15	3	0	0	10	1	0	57%
Junior Faculty [1]	15	12	3	0	0	0	8	3	0	2	2	1	0	80%
Research Staff	7	3	4	0	0	0	4	0	0	0	3	0	0	86%
Visiting Faculty [1]	3	2	1	0	0	0	1	1	0	0	1	1	0	33%
Industry Researchers	5	5	0	0	0	0	4	0	0	0	1	0	0	100%
Post Docs [1]	10	6	4	0	0	0	8	0	1	0	1	2	0	100%
Doctoral Students [1]	14	8	6	0	0	1	11	1	0	0	1	0	0	71%
Master's Students [1]	8	4	4	0	0	0	6	1	0	0	1	1	0	88%
Undergraduate Students (non-REU) [1]	7	1	6	1	0	0	6	0	0	0	0	1	0	93%
Curriculum Development and Outreach														
Subtotal	**5**	**2**	**3**	**0**	**0**	**0**	**3**	**0**	**0**	**0**	**2**	**0**	**0**	0%
Senior Faculty [1]	3	2	1	0	0	0	2	0	0	0	1	0	0	50%
Junior Faculty [1]	0	0	0	0	0	0	0	0	0	0	0	0	0	0%
Research Staff	2	0	2	0	0	0	1	0	0	0	1	0	0	100%
Visiting Faculty [1]	0	0	0	0	0	0	0	0	0	0	0	0	0	0%
Industry Researchers	0	0	0	0	0	0	0	0	0	0	0	0	0	0%
Post Docs [1]	0	0	0	0	0	0	0	0	0	0	0	0	0	0%
Doctoral Students [1]	0	0	0	0	0	0	0	0	0	0	0	0	0	100%
Master's Students [1]	0	0	0	0	0	0	0	0	0	0	0	0	0	0%
Undergraduate Students (non-REU) [1]	0	0	0	0	0	0	0	0	0	0	0	0	0	0%
High School Students	0	0	0	0	0	0	0	0	0	0	0	0	0	0%
REU Students														
Subtotal	**8**	**4**	**4**	**2**	**2**	**0**	**4**	**0**	**0**	**0**	**0**	**4**	**0**	0%
REU students participating in NSEC Research [1]	4	2	2	1	1	0	2	0	0	0	0	2	0	100%
NSEC Funded REU Students	4	2	2	1	1	0	2	0	0	0	0	2	0	100%
Precollege (K-12)														
Subtotal	**1**	**0**	**1**	**0**	**0**	**0**	**0**	**0**	**0**	**1**	**0**	**0**	**0**	0%
Students	1	0	1	0	0	0	0	0	0	1	0	0	0	-
Teachers—RET	0	0	0	0	0	0	0	0	0	0	0	0	0	-
Teachers—Non-RET	0	0	0	0	0	0	0	0	0	0	0	0	0	-
Total[1]	**127**	**74**	**53**	**3**	**2**	**1**	**81**	**11**	**4**	**3**	**22**	**13**	**0**	**0%**

1 The percentage of people in the personnel category receiving at least some salary or stipend support from NSF NSEC Program must be provided in the far right column, "% NSEC Dollars." Details are described in the Instructions section for this table.

LEGEND:	
AI/AN -	**American Indian or Alaska Native**
NH/PI -	**Native Hawaiian or Other Pacific Islander**
B/AA -	**Black/African American**
W -	**White**
A -	**Asian, e.g., Asian Indian, Chinese, Filipino, Japanese, Korean, Vietnamese, Other Asian**
More than one race reported, AI/AN, B/AA, NH/PI -	**Personnel reporting a) two or more race categories and b) one or more of the reported categories includes American Indian or Alaska Native, Black or African American, or Native Hawaiian or Other Pacific Islander**
More than one race reported, W/A -	**Personnel reporting a) both White and Asian and b) no other categories in addition to White and Asian**
US/Perm -	**U.S. citizens and legal permanent residents**
Non-US -	**Non-U.S. citizens/Non-legal permanent residents**

Table 4b: NSEC Personnel - US Citizens and Permanent Residents

Personnel Type	Total	Gender		Race Data								Ethnicity: Hispanic	Disabled	% NSEC Dollars
		Male	Female	AI/AN	NH/PI	B/AA	W	A	More than one race reported, AI/AN, B/AA, NH/PI	More than one race reported, W/A	Not Provided			
Leadership, Administration/Management														
Subtotal	**0**	**5**	**2**	**0**	**0**	**0**	**7**	**0**	**0**	**0**	**0**	**0**	**0**	0%
Director(s) [1]	0	0	1	0	0	0	1	0	0	0	0	0	0	100%
Thrust Leaders [1]	0	4	1	0	0	0	5	0	0	0	0	0	0	100%
Administrative Director and Support Staff	0	1	0	0	0	0	1	0	0	0	0	0	0	0%
Research														
Subtotal	**2**	**2**	**1**	**1**	**0**	**1**	**10**	**1**	**1**	**0**	**2**	**3**	**0**	0%
Senior Faculty [1]	0	0	1	0	0	0	1	0	0	0	0	0	0	0%
Junior Faculty [1]	0	1	0	0	0	0	1	0	0	0	0	0	0	0%
Research Staff	0	0	0	0	0	0	0	0	0	0	0	0	0	0%
Visiting Faculty [1]	0	1	0	0	0	0	1	0	0	0	0	0	0	0%
Industry Researchers	2	0	0	0	0	0	1	0	0	0	1	0	0	100%
Post Docs [1]	0	0	0	0	0	0	0	0	1	0	0	1	0	-
Doctoral Students [1]	0	0	0	0	0	1	0	1	0	0	0	0	0	-
Master's Students [1]	0	0	0	0	0	0	0	0	0	0	1	1	0	-
Undergraduate Students (non-REU) [1]	0	0	0	1	0	0	6	0	0	0	0	1	0	0%
Curriculum Development and Outreach														
Subtotal	**0**	**0**	**2**	**0**	**0**	**0**	**3**	**0**	**0**	**0**	**2**	**0**	**0**	0%
Senior Faculty [1]	0	0	0	0	0	0	2	0	0	0	1	0	0	0%
Junior Faculty [1]	0	0	0	0	0	0	0	0	0	0	0	0	0	0%
Research Staff	0	0	2	0	0	0	1	0	0	0	1	0	0	100%
Visiting Faculty [1]	0	0	0	0	0	0	0	0	0	0	0	0	0	0%
Industry Researchers	0	0	0	0	0	0	0	0	0	0	0	0	0	0%
Post Docs [1]	0	0	0	0	0	0	0	0	0	0	0	0	0	0%
Doctoral Students [1]	0	0	0	0	0	0	0	0	0	0	0	0	0	100%
Master's Students [1]	0	0	0	0	0	0	0	0	0	0	0	0	0	0%
Undergraduate Students (non-REU) [1]	0	0	0	0	0	0	0	0	0	0	0	0	0	0%
Total[1]	**2**	**7**	**5**	**1**	**0**	**1**	**20**	**1**	**1**	**0**	**4**	**3**	**0**	**0%**

1 The percentage of people in the personnel category receiving at least some salary or stipend support from NSF NSEC Program must be provided in the far right column, "% NSEC Dollars." Details are described in the Instructions section for this table.

LEGEND:	
AI/AN -	**American Indian or Alaska Native**
NH/PI -	**Native Hawaiian or Other Pacific Islander**
B/AA -	**Black/African American**
W -	**White**
A -	**Asian, e.g., Asian Indian, Chinese, Filipino, Japanese, Korean, Vietnamese, Other Asian**
More than one race reported, AI/AN, B/AA, NH/PI -	**Personnel reporting a) two or more race categories and b) one or more of the reported categories includes American Indian or Alaska Native, Black or African American, or Native Hawaiian or Other Pacific Islander**
More than one race reported, W/A -	**Personnel reporting a) both White and Asian and b) no other categories in addition to White and Asian**
US/Perm -	**U.S. citizens and legal permanent residents**
Non-US -	**Non-U.S. citizens/Non-legal permanent residents**

15. PUBLICATIONS AND PATENTS

2012-2013
Primary Publications: 13 Journals; 22 Books, Chapters, Reports, & Other Publications
Leveraged Publications: 13 Journals; 4 Books, Chapters, Reports, & Other Publications
Submitted / In Preparation Publications: 32 Primary; 17 Leveraged
Total: 101

Primary Publications: Journals

Beaudrie, Christian E.H., Kandlikar, Milind, & Satterfield, Terre. (forthcoming). From Cradle-to-Grave at the Nanoscale: Gaps in US Regulatory Oversight along the Nanomaterial Life Cycle. *Environmental Science & Technology*.

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Walsh, James, & Ridge, Claron. (2012). Knowledge Production and Nanotechnology: Characterizing American Dissertation Research, 1999-2009. *Technology in Society, 34*(2), 127-137.

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Appelbaum, Richard, & Parker, Rachel. (2012). China's Move to High Tech Innovation. In C. Dent & J. Dosch (Eds.), *The Asia-Pacific, Regionalism And The Global System* (pp. 201-215). Northampton, MA: Edward Elgar.

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Copeland, Lauren, & Smith, Eric. R.A.N. (forthcoming). Political Consumerism: Citizen Activism in Response to Climate Change and other Environmental Problems. In Y. Wolinsky-Nahmias (Ed.), *Climate Change Policy and the Role of Society*. Washington, D.C: CQ Press.

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McCray, W. Patrick. (2013). *The Visioneers: How a Group of Elite Scientists Pursued Space Colonies, Nanotechnologies, and a Limitless Future, Histories of Our Technological Future: How Space Colonies, Nanotechnology, and Transhumanism Challenged the Idea of Limits*. Princeton, NJ: Princeton University Press.

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Engeman, Cassandra, Baumgartner, Lynn, Carr, Benjamin, Fish, Allison, Meyerhofer, John, Satterfield, Theresa, Holden, Patricia, Harthorn, Barbara Herr* (*corresponding author). (in press). The hierarchy of environmental, health, and safety practices, in the US nanotechnology workplace. *Journal of Occupational and Environmental Hygiene.*

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Barvosa, Edwina. (in preparation). Ambivalence as Asset: Mapping Meaning & Epistemic Diversity in Public Engagement with Nanotechnology.

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Mehta, Aashish, Herron, Patrick, Lenoir, Timothy, & Cao, Cong. (in preparation). Measuring the impact of international collaboration in nanotechnology research.

Mehta, Aashish, Herron, Partick, Lenoir, Tim, & Cao, Cong. (in preparation). The scientific influence of nations - trends in quantity and impact of nanotechnology publications.

Mody, Cyrus C.M. (under review). Exemplary Cases and Accounting for Research. In C. Newfield & D. Boudreaux (Eds.), *Can Rich Countries Still Invent? Towards a New Model of International Innovation*.

Motoyama, Yasuyuki. (under review). Long-Term Collaboration between Universities and Industry: A Case Study of Nanotechnology Development in Japan. *Technology and Society*.

Newfield, Christopher. (in preparation). The Crisis of American Innovation.

Newfield, Chris, & Boudreaux, Daryl (Eds.). (in preparation). *Can Rich Countries Still Innovate? (Lyon volume)*.

Satterfield, Terre, Corner, Adam, Pidgeon, Nick, Conti, Joseph and Harthorn, Barbara Herr. (under review). Affective Ambivalence and Nanotechnologies. *Journal of Risk Research*.

Satterfield, Terre, DeVries, Laura, Pitts, Anton, & Harthorn, Barbara Herr. (in preparation). "Crude Proxies," Racializing Narrative: Reporting biases and citation errors attributed to the white male effect.

Shearer, Christine, Rogers-Brown, Jennifer, Harthorn, Barbara Herr, & Bryant, Karl. (under review). Conservative White Men and Risk: Contextualizing "Low Risk" Views of Environmental and Health Hazards.

Walsh, James. (under review). The Impact of Foreign-Born Scientists and Engineers on American Nanoscience Research.

Submitted or in preparation publications: Leveraged

Barvosa, Edwina. (in preparation). At the Crossroad of Agonistic Democracy and Planned Public Deliberation: Innovation and Continuity in Contemporary Science Governance.

Barvosa, Edwina. (in preparation). *Decentering Democracy*.

Corner, A., Parkhill, K., & Vaughan, N. (under review). Messing with Nature: Exploring public perceptions of geoengineering in the UK.

Foladori, Guillermo, Robles-Belmont, & Záyago Lau, Edgar. (under review). Política de ciencia y tecnología en México: el caso de las nanotecnologías. *Argumentos Magazine-UAM*.

Kaplan, Sarah, Milde, Jonathan, & Cowan, Ruth Schwartz. (under review). Interdisciplinarity in practice.

Kay, Luciano, Newman, N., Youtie, Jan, Porter, A., & Rafols, I. (under review). Patent Overlay Mapping: Visualizing Technological Distance. *Journal of the American Society for Information Science and Technology*.

Kay, Luciano, Youtie, Jan, & Shapira, Philip. (under review). Signs of Things to Come? What Intellectual Property Submissions Say About Corporate Strategies in Emerging Technologies. *Technology Forecasting and Social Change*.

Kelly, Kevin, & Mody, Cyrus. (under review). Molecular Electronics: Catching up with Its Promise? *IEEE Spectrum*.

Mody, Cyrus C.M. (under review). Essential Tensions and Representational Strategies. In M. Lynch, S. Woolgar, J. Vertesi & C. Coopmans (Eds.), *Representation in Scientific Practice II*. Cambridge, Mass: MIT Press.

Mody, Cyrus C.M. (under review). University in a Garage: Instrumentation and Innovation from UC Santa Barbara. In M. Kenney, D. Mowery & M. Walshok (Eds.), *The Role of the*

University of California in Building Regional Economies through Knowledge Creation and Transfer. Stanford: Stanford University Press.

Satterfield, Terre, Collins, Mary, Hanna, Shannon, Harthorn, Barbara, & Pitts, Anton. (in preparation). Resilience as a Primary Factor in the Perceived Environmental Risk. *Ecology and Society*.

Shah, Sonali K., & Mody, Cyrus. (under review). Creating a Context for Entrepreneurship: Examining How Users' Technological & Organizational Innovations Set the State for Entrepreneurial Activity. In B. Frischmann, M. Madiosn & K. Strandburg (Eds.), *Commons in the Cultural Environment*. New York: Oxford University Press.

Shah, Sonali K., & Mody, Cyrus C.M. (under review). Innovation, Social Structure, and the Creation of New Industries. *Academy of Management Journal*.

Ye, Xinyue. (in preparation). Space, time, and innovation: a review.

Ye, Xinyue. (in preparation). Space-Time Dynamics of Innovators and Intra-provincial Inequality: a case study of Zhejiang Province.

Záyago, E. (under review). Pertinencia social de la nanotecnologia en Mexico. In M. Á. Porrúa (Ed.), *Estudios Críticos del Desarrollo*.

Záyago Lau, Edgar, Foladori, Guillermo, Appelbaum, Richard, & Figueroa, Edgar. (under review). Empresas nanotecnológicas en México: hacia un primer inventario. *CIAD Estudios Sociales Magazine*.

16. BIOGRAPHICAL INFORMATION

We are reporting no new CNS-UCSB investigators in this period.

17. HONORS AND AWARDS

Appelbaum, Richard holds the MacArthur Chair through 2015.

Beaudrie, Christian, Student Merit award from the Society for Risk Analysis, Engineered Nanomaterials Specialty Group, 2012.

Beaudrie, Christian, Travel award to 7th International Conference on the Environmental Effects of Nanoparticles and Nanomaterials, Banff, Alberta, September 10-12, 2012.

Beaudrie, Christian, 2nd Place, Best Student Oral Presentation: 7th International Conference on the Environmental Effects of Nanoparticles and Nanomaterials, Banff, Alberta, September 10-12, 2012.

Collins, Mary & Hanna, Shannon, Best Poster award, Society for Risk Analysis Southern California meeting, Spring 2012.

Collins, Mary, Barbara Herr Harthorn & Terre Satterfield, Best Poster award, Society for Risk Analysis Europe conference, Zurich, June 2012.

Collins, Mary, received a 2-year postdoctoral fellowship at SESYNC, NSF national ecology center at University of Maryland, June 2013-June 2015

Copeland, Lauren, Award for Excellence in Teaching, Graduate Student Association, UCSB, 2012.

Copeland, Lauren, Doctoral Fee Fellowship, Department of Political Science, UCSB, 2012.

Copeland, Lauren, Doctoral Student Travel Grant, Academic Senate, UCSB, 2013 ($685.00).

Copeland, Lauren, Conference Travel Grant, Department of Political Science, UCSB, 2013 ($500.00).

Copeland, Lauren, Prestage-Cook Travel Award, Southern Political Science Association, 2013 ($150.00).

Copeland, Lauren, Doctoral Fee Fellowship, Department of Political Science, UCSB, 2013.

Engeman, Cassandra, Doctoral Student Travel Grant from UCSB Academic Senate ($1200).

Engeman, Cassandra, Humanities and Social Sciences Research Grant ($2000) from UCSB Graduate Division for dissertation research.

Engeman, Cassandra, invited keynote opening plenary presentation: “Regulation, Risk, and the Global Nanotechnology Industrial Workplace.” NanoSafe2012, organized by the CEA/LITEN, French government-funded technological and renewable energy research organizations, Grenoble, France, November 13-15, 2012.

Engeman, Cassandra, honors received by Project Lead on dissertation research: invited presentation. “Unions, Policy, and Family Values: How Unions Influence State-level Leave Policy in the United States.” UCSB Department of Sociology Colloquium, Santa Barbara, CA, February 13, 2013.

Engeman, Cassandra, awarded Graduate Associate affiliation with the Broom Center for Demography, UCSB (for dissertation research).

Harthorn, Barbara Herr, Invited testimony, NAS Review panel of the NNI for OSTP, Beckman Center, Irvine, CA, May 15-16, 2012.

Harthorn, Barbara Herr, promotion from Associate Professor to Professor, effective July 2012.

Harthorn, Barbara Herr, US delegate to US-EC Workshop on Responsible Development of Converging Technologies; plenary presenter, Leveun, Belgium, September 2012.

Hawker, Craig, received Centenary Award from the Royal Society of Chemistry, 2012.

Hawker, Craig received American Chemistry Society’s award in Polymer Chemistry, 2012.

Hawker, Craig, Merck-Karl Pfisher Lecturer, MIT, 2012.

Hawker, Craig, Marker Lecturer, Pennsylvania State University, 2012.

Hawker, Craig, Eastman Lecturer, University of Akron, 2012.

Hawker, Craig received American Chemistry Society’s national award for professional advancement, 2013.

Hawker, Craig, Scientific Director of the California Nanosystems Institute, 2013.

Kandlikar, Milind, Reid Visiting Fellowship, Princeton University, 2012 – 2013.

Kaplan, Sarah & Vakili, Keyvan, Best Paper award, DRUID conference (for “Breakthrough Innovations”) 2012.

Landers, Kelly, accepted to give a poster presentation: "Identifying the Role of California in the Nanotechnology Economy," Society for the Advancement of Chicanos and Native Americans in Science (SACNAS) National Conference, October 11-14, 2012, Seattle, WA.

McCray, W. Patrick, Visiting Professorship, California Institute of Technology, Pasadena, 2011-2012

McLaren, Christine, student researcher named a Presidential Scholar and awarded fee fellowship Lehigh University.

November, Joseph, 2013 Arthur L. Norberg Travel Grant Award, Charles Babbage Institute.

November, Joseph, June 2012 promoted to Associate Professor, Department of History, University of South Carolina.

Pidgeon, Nicholas, awarded Honorary Fellowship of the British Science Association (UK equivalent of AAAS), September 2012.

Rogers-Brown, Jennifer, elected as a representative for Sociologists for Women in Society to the United Nations Dept of Public Information, 3-year term 2013-16.

Shearer, Christine, Invited Facilitator, Hazardous Chemicals: Agents of Risk and Change, Rachel Carson Center for Environment and Society Travel Award, Munich, Germany, April 27-29, 2012.

Shearer, Christine, Rachel Carson Environment Book Award (Honorable Mention), October 2012.

Shearer, Christine, Lannan Foundation Writing Residency Fellowship ($5,000), November 2012.

Shearer, Christine, awarded a Postdoctoral Scholar position in the Department of Earth System Science at Univ of California at Irvine on “Innovative Solutions to the Energy-Carbon-Climate Problem” in collaboration with Carnegie/Stanford and Harvard Universities, beginning Feb 2013.

Triste, Eddie, accepted to give a poster presentation: "Nano Regulatory Policy and NGOs: A Global View," Society for the Advancement of Chicanos and Native Americans in Science (SACNAS) National Conference, October 11-14, 2012, Seattle, WA.

Ye, Xinyue, received Bowling Green State University research funds ($10,000) for pursuing Big Data-based Spatiotemporally Integrated Social Sciences over Cyberinfrastructure, Building Strength project, 2013.

Zayago Lau, Edgar, received a Postdoctoral Fellowship from Mexico’s National Council of Science and Technology (CONACYT), August 2012 – June 2013 (USD 24,000).

Table 6: Partnering Institutions									
Institution Type	**Name of Institution**	**Receives Financial Support From Center**	**Contributes Financial Support To Center**	**Minority Serving Institution Partner**	**Female Serving Institution Partner**	**National Lab/ Other Govt. Partner**	**Industry Partner**	**Educ / Museum Partner**	**International Partner**
I. Academic Partnering Institution(s)	**Allan Hancock Community College**			Y				Y	
	Arizona State University	Y							
	Bangkok Thonburi University								Y
	Beijing Institute of Technology	Y							Y
	Bowling Green State University								
	California Polytechnic State University, San Luis Obispo							Y	
	Cardiff University, UK	Y							Y
	Clark University								
	CNRS - France							Y	Y
	College of the Canyons			Y					
	Cornell University							Y	
	Cuesta Community College							Y	
	Darmstadt University, GE								Y
	Duke University	Y							
	Ecole Polytechnique, France								Y
	Federal University of Parana, BR								Y
	Federal University of Santa Catarina, BR								Y
	Georgia Institute of Technology								
	IRD-IFRIS, France								Y
	Jackson State University			Y				Y	
	Kibi International University, Japan								Y
	Lehigh University	Y	Y						
	Long Island University	Y	Y						
	Maastricht University								Y
	Moorpark College							Y	
	Natl Academy of Agricultural Research Management, India	Y							Y
	New York University	Y							
	Northeastern University	Y							
	Occidental College	Y		Y					
	Oxnard Community College			Y					
	Quinnipiac University								
	Rensselaer Polytechnic Institute, New York								
	Rice University								
	Santa Barbara City College	Y						Y	
	Singularity University								
	Seoul National University, South Korea								Y
	Southeastern Louisiana University			Y					
	Southern Methodist University								
	SUNY Levin Institute	Y							
	SUNY New Paltz	Y							
	Universidad Autónoma de Zacatecas, Mexico								Y
	Université de Lyon 2, France								Y
	Université de Lyon 3, France		Y						Y
	University of Arizona	Y							
	University of British Columbia, Vancouver, Canada	Y							Y

	University of California, Berkeley	Y							
	University of California, Davis	Y							
	University of California, Los Angeles		Y						
	University of Edinburgh, UK		Y						
	University of Exeter, UK								
	University of Gothenburg, Sweden								
	University of Minnesota-Twin Cities		Y						
	University of Nottingham, UK		Y						Y
	University of Pennsylvania								
	University of South Carolina	Y							
	University of Southern Indiana								
	University of Sussex, UK								Y
	University of Toronto, Canada		Y						
	University of Twente								Y
	University of Virginia								
	University of Washington	Y							
	University of Wisconsin-Madison	Y							
	Ventura College			Y				Y	
	York University, Canada								
Total Number of Academic Partners	**64**	**20**	**8**	**7**	**0**	**0**	**0**	**9**	**16**

Institution Type	Name of Institution	Receives Financial Support From Center	Contributes Financial Support To Center	Minority Serving Institution Partner	Female Serving Institution Partner	National Lab/ Other Govt. Partner	Industry Partner	Educ / Museum Partner	International Partner
II. Non-academic Partnering Institution(s)	American Bar Foundation								
	American Institute of Physics Incorporated								
	Boudreaux and Associates	Y					Y		
	Chemical Heritage Foundation	Y					Y		
	Compass Resource Management	Y							Y
	Decision Research	Y							
	Energy & Resource Institute, The, India								Y
	Environmental Defense Fund								
	Nanotechnology (ICON), Rice University		Y						Y
	International Risk Governance Council, Switzerland								Y
	Kauffman Foundation						Y		
	Knowledge Networks	Y							
	Latin American Network of Nanotechnology and Society (ReLANS), Mexico								Y
	Meridian Institute	Y							Y
	Nanoscale Informal Science Education (NISE) network							Y	
	Santa Barbara Museum of Natural History							Y	
	Santa Monica Public Library							Y	
	Science and Technology Policy Institute (IDA)								
	Woodrow Wilson International Center	Y	Y						Y
	You Gov America Inc.	Y					Y		Y
Total Number of Non-academic Partners	**20**	**8**	**1**	**0**	**0**	**0**	**4**	**2**	**8**

Current and Pending Support

Investigator: Richard P Appelbaum

Support: ☒ Current ☐ Pending ☐ Submission Planned in Near Future

Project/Proposal Title:
NSEC: Center for Nanotechnology in Society at University of California Santa Barbara

Source of Support: National Science Foundation

Total Award Amount: 6,288,425 (5-yr Award & 2 Supplements) Total Award Period Covered: 9/15/10 – 8/31/2015

Location of Project: UC-Santa Barbara

Person-Months Per Year Committed to the Project: Cal: 0.0 Acad: .45 (match) Sumr: 1.0 (grant)

Current and Pending Support

Investigator: Barbara Herr Harthorn

Support: ☒ Current ☐ Pending ☐ Submission Planned in Near Future

Project/Proposal Title:
NSEC: Center for Nanotechnology in Society at University of California Santa Barbara

Source of Support: National Science Foundation

Total Award Amount: 6,288,425 Total Award Period Covered: 9/15/10 – 8/31/2015
(5-yr Award & 2 Supplements)

Location of Project: UC-Santa Barbara

Person-Months Per Year Committed to the Project: Cal: 0.0 Acad: 3.7 (match) Sumr: 2.0 (grant)

Support: ☒ Current ☐ Pending ☐ Submission Planned in Near Future

Project/Proposal Title:
CEIN-Predictive Toxicological Assessment and Safe Implementation of Nanotechnology in the Environment

Source of Support: NSF and EPA, Subaward from UC-Los Angeles

Total Award Amount: 5,954,530 Total Award Period Covered: 09/01/2008 – 08/31/2013

Location of Project: UC-Santa Barbara

Person-Months Per Year Committed to the Project Cal: 0.0 Acad: 0.18 Sumr: 1.0

Current and Pending Support

Investigator: W. Patrick McCray

Support: ☒ Current ☐ Pending ☐ Submission Planned in Near Future
Project/Proposal Title: NSEC: Center for Nanotechnology in Society at University of California, Santa

Source of Support: National Science Foundation
Total Award Amount: 6,288,425 Total Award Period Covered: 9/15/10 – 8/31/2015
(5-yr Award & 2 Supplements)

Location of Project: UC-Santa Barbara
Person-Months Per Year Committed to the Project: Cal: 0.0 Acad: .55 Sumr: 1.0

Support: ☐ Current ☒ Pending ☐ Submission Planned in Near Future
Project/Proposal Title: From Blueprints to Bricks: Building a Community for DNA Technology

Source of Support: National Nanotechnology Infrastructure Network
Total Award Amount: 20,000 Total Award Period Covered: 09/01/2012 – 08/31/2014
Location of Project: Off-Campus
Person-Months Per Year Committed to the Project Cal: 0.0 Acad: 1.35 Sumr: 1.0