



**NSF SES 0938099**

***Nanoscale Science and Engineering Center***

at University of California, Santa Barbara

Abbreviated

**Year 4 (9) Annual Report**

**March 16, 2013 – March 15, 2014**

## **TABLE OF CONTENTS**

<b>3.</b>	<b>Project Summary</b>	<b>1</b>
<b>4.</b>	<b>Participants</b>	<b>2</b>
<b>4A.</b>	<b>Center Participants</b>	<b>2</b>
<b>4B.</b>	<b>Advisory Board</b>	<b>18</b>
<b>4C.</b>	<b>Participating Academic Institutions</b>	<b>19</b>
<b>4D.</b>	<b>Participating Non-Academic Institutions</b>	<b>21</b>
<b>5.</b>	<b>Quantifiable Outputs</b>	<b>22</b>
<b>6.</b>	<b>Mission, Significant Advances, and Broader Impacts</b>	<b>23</b>
<b>7.</b>	<b>Highlights</b>	<b>25</b>
<b>8.</b>	<b>Strategic Research Plan</b>	<b>36</b>
<b>9.</b>	<b>Research Program, Accomplishments, and Plans</b>	<b>40</b>
	<b>IRG1</b>	<b>40</b>
	<b>IRG2</b>	<b>53</b>
	<b>IRG3</b>	<b>79</b>
	<b>XIRG</b>	<b>99</b>
<b>10.</b>	<b>Center Diversity Progress and Plans</b>	<b>111</b>

<b>11.</b>	<b>Education</b>	<b>117</b>
<b>12.</b>	<b>Outreach and Knowledge Transfer</b>	<b>137</b>
<b>13.</b>	<b>Shared and Other Facilities</b>	<b>163</b>
<b>14.</b>	<b>Personnel</b>	<b>169</b>
<b>15.</b>	<b>Publications and Patents</b>	<b>179</b>
<b>16.</b>	<b>Biographical Information</b>	<b>186</b>
<b>17.</b>	<b>Honors and Awards</b>	<b>194</b>
<b>18.</b>	<b>Fiscal</b>	<b>197</b>
<b>18A.</b>	<b>Statement of Residual Unobligated Funds</b>	<b>197</b>
<b>18B.1</b>	<b>Current Year Actual Expenditures</b>	<b>198</b>
<b>18B.2</b>	<b>Proposed Increment Budget</b>	<b>200</b>
<b>19.</b>	<b>Cost sharing</b>	<b>205</b>
<b>20.</b>	<b>Leverage</b>	<b>206</b>
<b>21.</b>	<b>Current and Pending Support</b>	<b>212</b>

### 3. PROJECT SUMMARY

The Center at UC Santa Barbara 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 by multiple stakeholders in the nano-enterprise and modes of enhancing public participation. Strategic topic projects (solar energy, California industry, media coverage of nano) and Seed Grant projects 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 comparative global framework for analysis with attention to responsible and 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, cognition and perception, 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 Fdn., Decision Research, Duke Univ., Lehigh Univ., Rice Univ., and SUNY New Paltz, and internationally from Beijing Institute of Tech. (China), Cardiff Univ. (UK), Seoul National Univ. (S. Korea), Univ. of British Columbia (Canada), and Univ. of Nottingham (UK). CNS-UCSB 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 researcher positions each year. Graduate Fellowships and researcher positions 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 their use to address responsible development. A CNS 8-week intensive summer undergraduate internship program run for the 8<sup>th</sup> time in 2013 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, new media dissemination, numerous public events with community members, and accelerating outreach to key sectors of government, industry, and NGOs, the CNS maintains a solid following of campus, local, and national and international media, and interest by government, industry, NGOs, and the general public.

In 2013-14 CNS-UCSB continued substantial progress in research on pathways and impediments to socially and environmentally sustainable futures for nanotechnologies, producing 40 new publications in the past year, bringing total publications since our renewal 3.5 years ago to 252, with another 51 in the publication stream, and making 88 presentations this year at academic venues. Appelbaum, Harthorn, Pidgeon, and Simon each provided critical input to national policymaking bodies in the US and UK, and CNS researchers made over 66 presentations to key audiences in government, industry, NSE, and the public.

#### 4. PARTICIPANTS

##### 4A. LIST OF CENTER PARTICIPANTS

**Bold** indicates active in Year 9

<i>University of California, Santa Barbara (*co-funded)</i>			
<b>Name</b>	<b>Title</b>	<b>Department</b>	<b>Organization</b>
<b>*Peter Alagona</b>	<b>Assistant Professor</b>	<b>History &amp; Environmental Studies</b>	<b>UC Santa Barbara</b>
<b>Sarah Anderson</b>	<b>Assistant Professor</b>	<b>Environmental Science &amp; Management</b>	<b>UC Santa Barbara</b>
<b>Richard Appelbaum</b>	<b>Professor</b>	<b>Sociology, Global &amp; International Studies</b>	<b>UC Santa Barbara</b>
David Awschalom	Professor Director	Physics California NanoSystems Institute	UC Santa Barbara
<b>Edwina Barvosa</b>	<b>Associate Professor</b>	<b>Chicana/o Studies, Feminist Studies</b>	<b>UC Santa Barbara</b>
<b>Bruce Bimber</b>	<b>Professor</b>	<b>Political Science, Communication</b>	<b>UC Santa Barbara</b>
Tim Cheng	Professor	Electrical & Computer Engineering	UC Santa Barbara
Brad Chmelka	Professor	Chemical Engineering	UC Santa Barbara
Julie Dillemoth	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
<b>Barbara Herr Harthorn</b>	<b>Professor Director</b>	<b>Anthropology CNS-UCSB</b>	<b>UC Santa Barbara</b>
<b>Craig Hawker</b>	<b>Professor Director</b>	<b>Chemical Engineering Materials Research Laboratory, MRSEC</b>	<b>UC Santa Barbara</b>
<b>Patricia Holden</b>	<b>Professor</b>	<b>Environmental Microbiology</b>	<b>UC Santa Barbara</b>
<b>George Legrady</b>	<b>Professor</b>	<b>Media Arts &amp; Technology Program</b>	<b>UC Santa Barbara</b>

<b>W. Patrick McCray</b>	<b>Professor</b>	<b>History of Science</b>	<b>UC Santa Barbara</b>
<b>Aashish Mehta</b>	<b>Assistant Professor</b>	<b>Global &amp; International Studies</b>	<b>UC Santa Barbara</b>
<b>Miriam Metzger</b>	<b>Professor</b>	<b>Communication</b>	<b>UC Santa Barbara</b>
John Mohr	Professor	Sociology	UC Santa Barbara
Meredith Murr	Director	Research Development	UC Santa Barbara
<b>Christopher Newfield</b>	<b>Professor</b>	<b>English</b>	<b>UC Santa Barbara</b>
<b>David Novak</b>	<b>Associate Professor</b>	<b>Music</b>	<b>UC Santa Barbara</b>
<b>Lisa Parks</b>	<b>Professor Director</b>	<b>Film &amp; Media Studies Center for Information Technology &amp; Society (CITS)</b>	<b>UC Santa Barbara</b>
<b>Casey Walsh</b>	<b>Associate Professor</b>	<b>Anthropology</b>	<b>UC Santa Barbara</b>

<i>Sub-Award Pls</i>			
<b>Name</b>	<b>Title</b>	<b>Department</b>	<b>Organization</b>
<b>Frederick Block</b>	<b>Professor Emeritus</b>	<b>Sociology</b>	<b>UC - Davis</b>
Joseph Conti	Assistant Professor	Sociology & Law	University of Wisconsin
<b>Sharon Friedman</b>	<b>Professor</b>	<b>Science Journalism, Communication</b>	<b>Lehigh University</b>
<b>Gary Gereffi</b>	<b>Professor Director</b>	<b>Sociology, Center for Globalization, Governance &amp; Competitiveness (CGGC)</b>	<b>Duke University</b>
<b>Robin Gregory</b>	<b>Senior Researcher</b>	<b>Psychology</b>	<b>Decision Research</b>
<b>Paul Slovic</b>	<b>President</b>	<b>Psychology</b>	<b>Decision Research</b>
<b>Timothy Lenoir</b>	<b>Professor</b>	<b>New Technologies in Society, Literature &amp; Computer Science</b>	<b>Duke University</b>
	<b>Chair</b>	<b>Kimberly J. Jenkins for New Technologies in Society</b>	
<b>Cyrus Mody</b>	<b>Associate Professor</b>	<b>History &amp; Technology Studies</b>	<b>Rice University</b>

Nicholas Pidgeon	Professor	Applied Psychology	Cardiff University, UK
Terre Satterfield	Professor	Culture, Risk & Environment	University of British Columbia, CA

<b><i>COLLABORATORS &amp; Other Funded Participants</i></b>			
<b><i>Name</i></b>	<b><i>Title</i></b>	<b><i>Department</i></b>	<b><i>Organization</i></b>
Nick Arnold	Professor	Physics & Engineering	Santa Barbara City College
Javiera Barandiaran	Assistant Professor	Global & International Studies	UC Santa Barbara
Indrani Barpujari	Researcher	Science & Technology	The Energy & Resource Institute, India
Gerald Barnett	Director	University Tech. Transfer	University of Washington
Christian Beaudrie	Associate	Resource Management & Environmental Studies	Compass Resource Management, CA
Sean Becker	Undergrad	Sociology	University of Wisconsin-Madison
Daryl Boudreaux	President	Commercialization	Boudreaux & Associates
Francesca Bray	Professor & Chair	Social Anthropology	University of Edinburgh
David Brock	Senior Research Fellow	History	Chemical Heritage Foundation
Karl Bryant	Assistant Professor	Sociology, Women's Studies	SUNY New Paltz
Angelina Callahan	Postdoctoral Scholar	History, Sociology of Technology & Science	Georgia Institute of Technology
Luis Campos	Assistant Professor	History	University of New Mexico
Cong Cao	Associate Professor	Sociology	University of Nottingham, UK
Hyungsub Choi	Assistant Professor	History of Science	Seoul National University, SO Korea

<b>Martin Collins</b>	<b>Curator</b>	<b>History</b>	<b>Smithsonian National Air &amp; Space Museum</b>
<b>Mary Collins</b>	<b>Postdoctoral Scholar</b>	<b>Environmental Studies</b>	<b>University of Maryland</b>
Meredith Conroy	Assistant Professor	Politics	Occidental College
<b>Jonathan Coopersmith</b>	<b>Associate Professor</b>	<b>History</b>	<b>Texas A&amp; M</b>
Rodrigo Cortes-Lobos	PhD Candidate	Public Policy	Georgia Tech
Zhu Donghua	Vice Dean	Management & Economics	Beijing Institute of Technology, CN
<b>Jennifer Earl</b>	<b>Professor</b>	<b>Sociology</b>	<b>University of Arizona</b>
<b>Brenda Egolf</b>	<b>Research Scientist</b>	<b>Journalism</b>	<b>Lehigh University</b>
<b>Matthew Eisler</b>	<b>Lecturer</b>	<b>Engineering &amp; Society</b>	<b>University of Virginia</b>
<b>Guillermo Foladori</b>	<b>Professor</b>	<b>Sociology</b>	<b>Universidad Autonoma de Zacatecas, MX</b>
Rider Foley	PhD Candidate	School of Sustainability	Arizona State University
Maryse de la Giroday	Independent Scholar	Science Communications	Vancouver, Canada
Nachshon Goltz	PhD Candidate	Law / Technology Regulation	York University, Canada
Julia Guivant	Professor	Sociology & Political Science	Federal University of Santa Catarina, Brazil
Hillary Haldane	Associate Professor	Anthropology	Quinnipac University
<b>Jennifer Hawken</b>	<b>Independent Consultant</b>	<b>Transcriber</b>	<b>Irving, Texas</b>
<b>Patrick Herron</b>	<b>Researcher</b>	<b>Data Mapping &amp; Visualization</b>	<b>Duke University</b>
<b>Kenneth Hough</b>	<b>Graduate Student</b>	<b>History</b>	<b>UC Santa Barbara</b>
<b>Noela Invernizzi</b>	<b>Professor</b>	<b>Science &amp; Technology Policy</b>	<b>Federal University of Parana, BR</b>
Jacqueline Isaacs	Professor	Mechanical & Industrial Engineering	Northeastern University



<b>Mikael Johansson</b>	<b>Faculty Program Director</b>	<b>Global Studies</b>	<b>University of Gothenburg, SE</b>
<b>Richard John</b>	<b>Professor</b>	<b>Graduate School of Journalism</b>	<b>Columbia University</b>
<b>Ann Johnson</b>	<b>Associate Professor</b>	<b>History of Science &amp; Technology, Modern Europe</b>	<b>University of South Carolina</b>
<b>Matthew Jones</b>	<b>Associate Professor &amp; Chair</b>	<b>Contemporary Civilization</b>	<b>Columbia University</b>
<b>Dan Kahan</b>	<b>Elizabeth K. Dollard Professor of Law &amp; Professor</b>	<b>Law &amp; Psychology</b>	<b>Yale Law School</b>
<b>Milind Kandlikar</b>	<b>Professor</b>	<b>Science Policy &amp; Regulation</b>	<b>University of British Columbia, CA</b>
<b>Sarah Kaplan</b>	<b>Associate Professor</b>	<b>Strategic Management</b>	<b>University of Toronto</b>
<b>Arturo Keller</b>	<b>Professor</b>	<b>Environmental Science &amp; Management (BREN School)</b>	<b>UC Santa Barbara</b>
<b>Matthew Keller</b>	<b>Assistant Professor</b>	<b>Sociology</b>	<b>Southern Methodist University</b>
Thanate Kitisriworaphan	Lecturer	Demography	Bangkok Thonburi University, Thailand
<b>Gul Karagoz-Kizilca</b>	<b>Assistant Professor</b>	<b>History</b>	<b>Ankara University</b>
<b>David Kirby</b>	<b>Senior Lecturer</b>	<b>Science Communication Studies</b>	<b>University of Manchester</b>
<b>Ronald Kline</b>	<b>Professor</b>	<b>Science &amp; Technology Studies</b>	<b>Cornell University</b>
Anna Lamprou	PhD Candidate	Science & Technology Studies	Rensselaer Polytechnic Institute, New York
<b>Matthew Lavine</b>	<b>Assistant Professor</b>	<b>History</b>	<b>Mississippi State University</b>
Lubi Lenaburg	Evaluation Coordinator	Center for Science & Engineering Partnerships (CNSI)	UC Santa Barbara
<b>Stuart Leslie</b>	<b>Professor</b>	<b>History of Science</b>	<b>John Hopkins University</b>
<b>Nelson Lichtenstein</b>	<b>Professor</b>	<b>History</b>	<b>UC Santa Barbara</b>

<b>Sarah Lowengard</b>	<b>Adjunct Associate Professor</b>	<b>Humanities &amp; Social Sciences</b>	<b>Cooper Union</b>
Graham Long	Partner	Environmental Technology	Compass Resource Management, CA
<b>Michael Lynch</b>	<b>Professor</b>	<b>Science &amp; Technololgy Studies</b>	<b>Cornell University</b>
<b>Maria Teresea Napoli</b>	<b>Evaluation Coordinator</b>	<b>Center for Science &amp; Engineering Partnerships (CNSI)</b>	<b>UC Santa Barbara</b>
<b>Marian Negoita</b>	<b>Researcher</b>	<b>Sociology</b>	<b>Social Policy Research Associates</b>
<b>Yasuyuki Motoyama</b>	<b>Senior Scholar</b>	<b>City &amp; Regional Planning</b>	<b>Kauffman Foundation</b>
<b>Joseph November</b>	<b>Associate Professor</b>	<b>History</b>	<b>University of South Carolina</b>
<b>Rachel Parker</b>	<b>Senior Research Associate</b>	<b>Sociology</b>	<b>Science &amp; Technology Policy Institute</b>
Mathieu Quet	Researcher	Communication	IRD-IFRIS, France
<b>Margaret Rhee</b>	<b>Graduate Student</b>	<b>History</b>	<b>UC Santa Barbara</b>
Dorothy Roberts	Professor	Law & Sociology	University of Pennsylvania Law School
<b>Jennifer Rogers-Brown</b>	<b>Assistant Professor</b>	<b>Sociology</b>	<b>Long Island University</b>
Trust Saidi	PhD Candidate	Traveling Nanotechnologies	Maastricht University, Zimbabwe
Pankaj Sekhsaria	PhD Candidate	Nanotechnology Research	Maastricht University, India
<b>Philip Shapira</b>	<b>Professor</b>	<b>Public Policy</b>	<b>Georgia Institute of Technology / University of Manchester</b>
<b>Asif Siddiqi</b>	<b>Assoc Professor</b>	<b>History</b>	<b>Fordham University</b>
<b>Denis Simon</b>	<b>Vice Provost</b>	<b>Political Science</b>	<b>Arizona State University</b>

<b>Amy Slaton</b>	<b>Professor</b>	<b>History &amp; Politics</b>	<b>Drexel University</b>
Marilynn Spaventa	Acting Executive VP	Sciences/Mathematics/ School of Modern Language	Santa Barbara City College
<b>Kara Swanson</b>	<b>Assoc. Professor</b>	<b>Law</b>	<b>Northeastern University</b>
<b>Steve Usselman</b>	<b>Professor, Chair</b>	<b>School of History</b>	<b>Georgia Institute of Technology</b>
<b>Jeffrey Womack</b>	<b>Masters Student</b>	<b>History</b>	<b>University of Houston</b>
<b>Xinyue Ye</b>	<b>Assistant Professor</b>	<b>Geography</b>	<b>Kent State University</b>
<b>Jan Youtie</b>	<b>Manager, Policy Services</b>	<b>Political Science</b>	<b>Georgia Institute of Technology</b>
<b>Edgar Zayago Lau</b>	<b>Senior Researcher</b>	<b>Development Studies</b>	<b>Universidad Autonoma de Zacatecas</b>

<b>UCSB Postdoctoral Researchers (*co-funded)</b>			
<b>Name</b>	<b>Title</b>	<b>Department</b>	<b>Organization / Co-Funding</b>
<b>*Mary Collins</b>	<b>Postdoctoral Researcher</b>	<b>Environmental Science &amp; Management</b>	<b>UC Santa Barbara / UC-CEIN</b>
Meredith Conroy	Postdoctoral Researcher	Political Science	UC Santa Barbara
<b>*Lauren Copeland</b>	<b>Postdoctoral Researcher</b>	<b>Political Science</b>	<b>UC Santa Barbara / UC-CEIN</b>
<b>*Gwen D'Arcangelis</b>	<b>Postdoctoral Researcher</b>	<b>Women's Studies</b>	<b>UC Santa Barbara / UC-CEIN</b>
Matthew Eisler	Postdoctoral Researcher	History	UC Santa Barbara
<b>Xueying (Shirley) Han</b>	<b>Postdoctoral Researcher</b>	<b>Ecology, Evolution, &amp; Marine Biology</b>	<b>UC Santa Barbara</b>
<b>Shannon Hanna</b>	<b>Postdoctoral Researcher</b>	<b>Environmental Science &amp; Management</b>	<b>UC Santa Barbara</b>
Mikael Johansson	Postdoctoral Researcher	Social Anthropology	UC Santa Barbara
<b>Luciano Kay</b>	<b>Postdoctoral Researcher</b>	<b>Public Policy</b>	<b>UC Santa Barbara</b>
Yasuyuki Motoyama	Postdoctoral Researcher	City & Regional Planning	UC Santa Barbara

*Christine Shearer	Postdoctoral Researcher	Sociology	<b>UC Santa Barbara / Harthorn-Deliberation</b>
James Walsh	Postdoctoral Researcher	Sociology	UC Santa Barbara

<b><i>Non-UCSB Postdoctoral Researchers</i></b>			
<b><i>Name</i></b>	<b><i>Title</i></b>	<b><i>Department</i></b>	<b><i>Organization</i></b>
<b>Adam Corner</b>	<b>Postdoctoral Researcher</b>	<b>Social Psychology</b>	<b>Cardiff University</b>
<b>Christina Demski</b>	<b>Postdoctoral Researcher</b>	<b>Psychology</b>	<b>Cardiff University</b>
<b>Stacey Frederick</b>	<b>Postdoctoral Researcher</b>	<b>Textile Management</b>	<b>Duke University</b>
Matthew Keller	Postdoctoral Researcher	Sociology	UC - Davis
Marian Negoita	Postdoctoral Researcher	Sociology	UC - Davis
<b>Anton Pitts</b>	<b>Postdoctoral Researcher</b>	<b>Risk Science</b>	<b>University of British Columbia</b>
<b>Christine Shearer</b>	<b>Postdoctoral Researcher</b>	<b>Earth Science &amp; Sociology</b>	<b>UC - Irvine</b>
<b>Merryn Thomas</b>	<b>Postdoctoral Researcher</b>	<b>Psychology</b>	<b>Cardiff University</b>
<b>James Walsh</b>	<b>Postdoctoral Researcher</b>	<b>Sociology</b>	<b>University of Pennsylvania</b>

<b><i>UCSB Graduate Fellows</i></b>			
<b><i>Name</i></b>	<b><i>Title</i></b>	<b><i>Department</i></b>	<b><i>Organization</i></b>
Peter Burks	Graduate Fellow	Chemistry, BioChemistry	UC Santa Barbara
Amanda Denes	Graduate Fellow	Communication	UC Santa Barbara
<b>Roger Eardley-Pryor</b>	<b>Graduate Fellow</b>	<b>History</b>	<b>UC Santa Barbara</b>
<b>Cassandra Engeman</b>	<b>Graduate Fellow</b>	<b>Sociology</b>	<b>UC Santa Barbara</b>
<b>Amy Foss</b>	<b>Graduate Fellow</b>	<b>Chicano/a Studies</b>	<b>UC Santa Barbara</b>
<b>Matthew Gebbie</b>	<b>Graduate Fellow</b>	<b>Materials</b>	<b>UC Santa Barbara</b>
<b>Xueying (Shirley) Han</b>	<b>Graduate Fellow</b>	<b>Ecology, Evolution &amp; Marine Biology</b>	<b>UC Santa Barbara</b>
Shannon Hanna	Graduate Fellow	Environmental Science & Management	UC Santa Barbara
<b>Bridget Harr</b>	<b>Graduate Fellow</b>	<b>Sociology</b>	<b>UC Santa Barbara</b>
<b>Ariel Hasell</b>	<b>Graduate Fellow</b>	<b>Communications</b>	<b>UC Santa Barbara</b>

Zachary Horton	Graduate Fellow	English	UC Santa Barbara
Tyronne Martin	Graduate Fellow	Chemistry	UC Santa Barbara
<b>Louise Stevenson</b>	<b>Graduate Fellow</b>	<b>Ecology, Evolution &amp; Marine Biology</b>	<b>UC Santa Barbara</b>
<b>Galen Stocking</b>	<b>Graduate Fellow</b>	<b>Political Science</b>	<b>UC Santa Barbara</b>
<b>Brian Tyrrell</b>	<b>Graduate Fellow</b>	<b>History (Environmental History)</b>	<b>UC Santa Barbara</b>

<b>UCSB Graduate Student Researchers &amp; Research Assistants (*co-funded)</b>			
<b>Name</b>	<b>Title</b>	<b>Department</b>	<b>Organization</b>
*Lynn Baumgartner	Grad Student Researcher	Environmental Science & Management	UC Santa Barbara
*Erin Calkins	Grad Student Researcher	Chemistry, Biochemistry	UC Santa Barbara
*Benjamin Carr	Grad Student Researcher	Environmental Science & Management	UC Santa Barbara
*Mary Collins	Grad Student Researcher	Environmental Science & Management	UC Santa Barbara
<b>Lauren Copeland</b>	<b>Grad Student Researcher</b>	<b>Political Science</b>	<b>UC Santa Barbara</b>
<b>Rachel Cranfill</b>	<b>Grad Student Researcher</b>	<b>Linguistics</b>	<b>UC Santa Barbara</b>
<b>John V. Decemvirale</b>	<b>Grad Student Researcher</b>	<b>History of Art &amp; Architecture</b>	<b>UC Santa Barbara</b>
Chloe Diamond-Lenow	Grad Student Researcher	Feminist Studies	UC Santa Barbara
*Allison Fish	Grad Student Researcher	Environmental Science & Management	UC Santa Barbara
Angus Forbes	Grad Student Researcher	Media Arts & Technology	UC Santa Barbara
<b>Sheetal Gavankar</b>	<b>Grad Student Researcher</b>	<b>Environmental Science &amp; Management</b>	<b>UC Santa Barbara</b>
Sarah Hartigan	Grad Student Researcher	Global & International Studies	UC Santa Barbara
<b>Ariel Hasell</b>	<b>Grad Student Researcher</b>	<b>Communications</b>	<b>UC Santa Barbara</b>
<b>Zachary Horton</b>	<b>Grad Student Researcher</b>	<b>English</b>	<b>UC Santa Barbara</b>
Pehr Hovey	Grad Student Researcher	Media Arts & Technology	UC Santa Barbara
Indy Hurt	Grad Student Researcher	Geography, Geographic Information Science	UC Santa Barbara
*John Meyerhofer	Grad Student Researcher	Environmental Science & Management	UC Santa Barbara

**Quinn McCreight      Grad Student Researcher      Global & International Studies UC Santa Barbara**

Margaret Moody      Grad Student Researcher      Education      UC Santa Barbara

Kristen Nation      Grad Student Researcher      UCSC      UC Santa Barbara

Shadi Roshandel      Grad Student Researcher      Education      UC Santa Barbara

Elizabeth Sciaky      Grad Student Researcher      Education      UC Santa Barbara

**Caitlin Vejby      Grad Student Researcher      Global & International Studies UC Santa Barbara**

Adélaïde Veyre      Grad Student Researcher      Political Science      UC Santa Barbara

Anna Walsh      Grad Student Researcher      Global & International Studies      UC Santa Barbara

David Weaver      Grad Student Researcher      Political Science      UC Santa Barbara

**Christopher Wegemer      Grad Student Researcher      Global & International Studies UC Santa Barbara**

<b><i>Non-UCSB Graduate Student Researchers</i></b>			
<b><i>Name</i></b>	<b><i>Title</i></b>	<b><i>Department</i></b>	<b><i>Organization</i></b>

Jennifer Bayzick      Grad Student Researcher      Journalisim & Communication      Lehigh University

**Parul Baxi      Grad Student Researcher      Sociology      UC - Davis**

**Christian Beaudrie      Grad Student Researcher      Institute for Resources, Environment and Sustainability (IRES)      University of British Columbia, CA**

Laura DeVries      Grad Student Researcher      Institute for Resources, Environment and Sustainability (IRES)      University of British Columbia, CA

**Lanceton Mark Dsouza      Grad Student Researcher      Jenkins Collaboratory      Duke University**

Matthew Keller      Grad Student Researcher      Sociology      UC - Davis

Aaron McGuire      Grad Student Researcher      Jenkins Collaboratory      Duke University

**Miguel Ruiz      Grad Student Researcher      Sociology      UC - Davis**

**Matthew Thomas      Grad Student Researcher      Jenkins Collaboratory      Duke University**

Brittany Shields      Grad Student Researcher      History & Sociology      University of Pennsylvania

<b><i>Undergraduate, High School Interns &amp; Researchers (UCSB, Community Colleges &amp; High Schools)</i></b>			
<b><i>Name</i></b>	<b><i>Title</i></b>	<b><i>Department</i></b>	<b><i>Organization</i></b>

Brent Boone	Undrgrad Student Researcher	CNS-UCSB / IRG3	UC Santa Barbara
<b>Angela Burger</b>	<b>Undrgrad Student Researcher</b>	<b>CNS-UCSB / IRG1</b>	<b>UC Santa Barbara</b>
Sergio Cardenas	Undrgrad Student Researcher	CNS-UCSB / IRG1	College of the Canyons
Cecilia Choi	Undrgrad Student Researcher	CNS-UCSB / IRG3	UC Santa Barbara
Hannah Cruz	Undrgrad Student Researcher	CNS-UCSB / IRG3	Dos Pueblos High School
Andi Docktor	Undrgrad Student Researcher	CNS-UCSB / IRG2	UC Santa Barbara
Andi Diaz	Undrgrad Student Researcher	CNS-UCSB / IRG2	UC Santa Barbara
Gianna Haro	Undrgrad Student Researcher	CNS-UCSB / IRG1	Santa Barbara City College
Katherine He	Undrgrad Student Researcher	CNS-UCSB / XIRG	<b>UC Santa Barbara</b>
Simone Jackson	Undrgrad Student Researcher	CNS-UCSB / IRG3	Allan Hancock College
<b>Paul Kovacs</b>	<b>Undrgrad Student Researcher</b>	<b>CNS-UCSB / IRG1</b>	<b>Santa Barbara City College</b>
<b>Megan Kelley</b>	<b>Undrgrad Student Researcher</b>	<b>CNS-UCSB / IRG1</b>	<b>UC Santa Barbara</b>
Kelly Landers	Undrgrad Student Researcher	CNS-UCSB / IRG2	Santa Barbara City College
Alexander Lyte	Undrgrad Student Researcher	CNS-UCSB / IRG3	Santa Barbara City College
Kristen Nation	Undrgrad Student Researcher	CNS-UCSB / IRG3	<b>UC - Santa Cruz</b>
<b>Emily Nightingale</b>	<b>Undrgrad Student Researcher</b>	<b>CNS-UCSB / IRG2</b>	<b>UC Santa Barbara</b>
Bryan Phillips	Undrgrad Student Researcher	CNS-UCSB / XIRG	Santa Barbara City College
<b>Kelli Pribble</b>	<b>Undrgrad Student Researcher</b>	<b>CNS-UCSB / IRG3</b>	<b>Victor Valley College</b>
Srijay Rajan	Undrgrad Student Researcher	CNS-UCSB / IRG2	Moorpark College
William Reynolds	Undrgrad Student Researcher	CNS-UCSB / IRG3	Ventura College
Nicholas Santos	Undrgrad Student Researcher	CNS-UCSB / IRG1	UC Santa Barbara
Andreea Larisa Sandu	Undrgrad Student Researcher	CNS-UCSB / Education	UC Santa Barbara

<b>Merisa Stacy</b>	<b>Undrgrad Student Researcher</b>	<b>CNS-UCSB / IRG2</b>	<b>Santa Barbara City College</b>
Eddie Triste	Undrgrad Student Researcher	CNS-UCSB / IRG3	Allan Hancock College
Julie Whirlow	Undrgrad Student Researcher	CNS-UCSB / IRG3	UC Santa Barbara
Sabrina Wu	Undrgrad Student Researcher	CNS-UCSB / IRG1	UC Santa Barbara
<b>Maria Yopez</b>	<b>Undrgrad Student Researcher</b>	<b>CNS-UCSB / IRG3</b>	<b>UC Santa Barbara</b>

<b><i>Non-UCSB Undergraduate Researchers</i></b>			
<b>Name</b>	<b>Title</b>	<b>Department</b>	<b>Organization</b>
Sean Becker	Undrgrad Student Researcher	CNS-UCSB / IRG3	University of Wisconsin, Madison
Rachel Bowley	Undrgrad Student Researcher	CNS-UCSB / IRG3	Duke University
<b>Christine McLaren</b>	<b>Undrgrad Student Researcher</b>	<b>CNS-UCSB / IRG3</b>	<b>Lehigh University</b>
<b>Amber Schrum</b>	<b>Undrgrad Student Researcher</b>	<b>CNS-UCSB / IRG3</b>	<b>Lehigh University</b>
Ryan White	Undrgrad Student Researcher	CNS-UCSB / IRG3	Lehigh University
<b>Alexander Zook</b>	<b>Undrgrad Student Researcher</b>	<b>CNS-UCSB / IRG3</b>	<b>Lehigh University</b>

<b><i>UCSB Staff &amp; Technical Support</i></b>			
<b>Name</b>	<b>Title</b>	<b>Department</b>	<b>Organization</b>
<b>Shawn Barcelona</b>	<b>Center Administrator</b>	<b>CNS-UCSB / Admin</b>	<b>UC Santa Barbara</b>
<b>Cathy Boggs</b>	<b>Education Coordinator</b>	<b>CNS-UCSB / Ed &amp; Outreach</b>	<b>UC Santa Barbara</b>
Sage Briggs	Purchasing/Travel Coordinator	CNS-UCSB / Admin	UC Santa Barbara
<b>Joshua Dean</b>	<b>Education Admin Assistant</b>	<b>CNS-UCSB / Ed &amp; Outreach</b>	<b>UC Santa Barbara</b>
<b>Brandon Fastman</b>	<b>Education Coordinator</b>	<b>CNS-UCSB / Ed &amp; Outreach</b>	<b>UC Santa Barbara</b>
Barbara Gilkes	Assistant Director	CNS-UCSB / Admin	UC Santa Barbara
Cory Jones	Education Admin Assistant	CNS-UCSB / Outreach	UC Santa Barbara
<b>Monica Koegler-Blaha</b>	<b>Payroll Support</b>	<b>ISBER / CNS-UCSB / Admin</b>	<b>UC Santa Barbara</b>
<b>Valerie Kuan</b>	<b>Purchasing/Travel Coordinator</b>	<b>CNS-UCSB / Admin</b>	<b>UC Santa Barbara</b>
Diane Laflamme-McCauley	Artist	CNS-UCSB / Admin	UC Santa Barbara
<b>Brendy Lim</b>	<b>IT Support</b>	<b>ISBER / CNS-UCSB / Tech</b>	<b>UC Santa Barbara</b>
<b>Enrique Macias (Rick)</b>	<b>IT Support</b>	<b>ISBER / CNS-UCSB / Tech</b>	<b>UC Santa Barbara</b>



<b>Bonnie Molitor</b>	<b>Assistant Director</b>	<b>CNS-UCSB / Admin</b>	<b>UC Santa Barbara</b>
<b>Kiyomitsu Odai</b>	<b>Staff Reseach Assistant</b>	<b>CNS-UCSB / Seed Grant DN</b>	<b>UC Santa Barbara</b>
Stacy Rebich-Hespanha	Education Coordinator	CNS-UCSB / Education	UC Santa Barbara
<b>Laura Saldivar-Tanaka</b>	<b>Staff Reseach Assistant</b>	<b>CNS-UCSB / Seed Grant CW</b>	<b>UC Santa Barbara</b>
Andreea Larisa Sandu	Admin Assistant	CNS-UCSB / Education	UC Santa Barbara
James Walsh	Staff Research Associate	CNS-UCSB / IRG2	UC Santa Barbara
<b>David Weaver</b>	<b>Web Assistant</b>	<b>CNS-UCSB / Outreach</b>	<b>UC Santa Barbara</b>
<b>Maria Yopez</b>	<b>Admin/Research Assistant</b>	<b>CNS-UCSB / IRG3 Research</b>	<b>UC Santa Barbara</b>

<b><i>Non-CNS-UCSB Staff &amp; Researchers (*Unfunded)</i></b>			
<b><i>Name</i></b>	<b><i>Title</i></b>	<b><i>Department</i></b>	<b><i>Organization</i></b>
Edgar Arteaga	Reseach Assistant	CNS-UCSB / IRG2	Universidad Autonoma de Zacatecas, MX
<b>Evan Donahue</b>	<b>Reseach Assistant</b>	<b>CNS-UCSB / IRG2</b>	<b>Duke University</b>
<b>Jordan Herman</b>	<b>Reseach Assistant</b>	<b>CNS-UCSB / IRG2</b>	<b>Duke University</b>
Kate North-Lewis	Reseach Assistant	CNS-UCSB / IRG3	Cardiff University
<b>Joshua Lynn</b>	<b>Reseach Assistant</b>	<b>CNS-UCSB / IRG3</b>	<b>Lehigh University</b>
<b>Jan Pachon</b>	<b>Reseach Assistant</b>	<b>CNS-UCSB / IRG2</b>	<b>Duke University</b>
Lesley Strabel	Reseach Assistant	CNS-UCSB / IRG3	Cardiff University
Ben Weiss	Reseach Assistant	CNS-UCSB / IRG2	Duke University

<b><i>Affiliated Participants (Not receiving Center support)</i></b>			
<b><i>UCSB</i></b>			
<b><i>Name</i></b>	<b><i>Title</i></b>	<b><i>Department</i></b>	<b><i>Organization</i></b>
<b>Kevin Almeroth</b>	<b>Professor</b>	<b>Computer Science</b>	<b>UC Santa Barbara</b>
Javiera Barandiaran	Assistant Professor	Global Studies	UC Santa Barbara
<b>Andrew Flanagan</b>	<b>Professor</b>	<b>Communication</b>	<b>UC Santa Barbara</b>
Miriam Metzger	Associate Professor	Communication	UC Santa Barbara
Lisa Parks	Professor Director	Film & Media Studies Center for Information Technology & Society (CITS)	UC Santa Barbara

Mark Rodwell	Professor, Director	Electrical & Computer Engineering, NNIN	UC Santa Barbara
Ram Seshadri	Professor	Materials, Chemistry & Biochemistry	UC Santa Barbara
Sangwon Suh	Associate Professor	Environmental Science & Management	UC Santa Barbara
<b>Barbara Walker</b>	<b>Director, Research &amp; Development, Social Science, Humanities &amp; Office of Research</b>	<b>Office of Research</b>	<b>UC Santa Barbara</b>

<b><i>Other Institutions (Unfunded Collaborators &amp; Other Participants)</i></b>			
<b><i>Name</i></b>	<b><i>Title</i></b>	<b><i>Department</i></b>	<b><i>Organization</i></b>
Francesca Bray	Professor	Gender & Technology	Edinburgh University, UK
<b>Meredith Conroy</b>	<b>Assistant Professor</b>	<b>Politics</b>	<b>Occidental College</b>
Brian Davison	Associate Professor	Computer Science & Engineering	Lehigh University
Magali Delmas	Associate Professor	Corporate Environmental Management	UC - Los Angeles
Sarah Kaplan	Associate Professor	Business	Univ of Toronto
Matthew Keller	Assistant Professor	Sociology	Southern Methodist University
<b>Sharon Ku</b>	<b>Assistant Research Professor</b>	<b>History &amp; Politics</b>	<b>Drexel University</b>
<b>Jens-Uwe Kuhn</b>	<b>Assistant Professor</b>	<b>Global &amp; International Studies</b>	<b>Santa Barbara City College</b>
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	UC - Los Angeles
Mathieu O'Neil	Associate Professor	Computer Science & Sociology	Australian National University
Takushi Otani	Associate Professor	History & Philosophy of Technology	Kibi International University, JP

Ismael Rafols	Researcher	Science Policy	Sussex University
Gurumurthy Ramachandran	Professor	Environmental Science & Engineering	University of Minnesota
Shyama Ramani	Researcher	Development 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 Development Engineer	Electrical Engineering	Infinera
<b>Tim Wilson</b>	<b>Associate</b>	<b>Geospatial Analysis</b>	<b>Compass Resource Management, CA</b>
<b>Stephen Zehr</b>	<b>Professor</b>	<b>Sociology</b>	<b>University of Southern Indiana</b>

<i>Visiting Scholars &amp; Event Speakers</i>			
<i>Name</i>	<i>Title</i>	<i>Department</i>	<i>Organization</i>
Xinhe Bao	Professor	Engineering	Dalian Institute of Chemical Physics
Francesca Bray	Professor	Gender & Technology	Edinburgh University, UK
Karl Bryant	Associate Professor	Sociology & Women's Studies	SUNY New Paltz
Martin Collins	Curator	History	Smithsonian Ntl Air & Space Museum
Sarah Davies	Postdoctoral Scholar	Department of Media, Cognition & Communication	University of Copenhagen
Ann Johnson	Associate Professor	History of Science & Tech, Modern Europe	University of South Carolina
Jacqueline Isaacs	Professor	Mechanical & Industrial Engineering	Northeastern University
Dan Kahan	Elizabeth K. Dollard Professor of Law & Professor	Law & Psychology	Yale Law School
Sarah Kaplan	Associate Professor	Strategic Management	University of Toronto

<b>Ronald Kline</b>	<b>Professor</b>	<b>Science &amp; Technology Studies</b>	<b>Cornell University</b>
Sharon Ku	Postdoctoral Scholar	History & Philosophy of Science	University of Southern Indiana
<b>Edgar Zayago Lau</b>	<b>Senior Researcher</b>	<b>Development Studies</b>	<b>Univ Autonoma de Zacatecas, MX</b>
<b>Harro van Lente</b>	<b>Professor</b>	<b>Innovation Studies</b>	<b>Utrecht University, Nld</b>
<b>Stuart Leslie</b>	<b>Professor</b>	<b>History of Science</b>	<b>John Hopkins University</b>
<b>Cyrus Mody</b>	<b>Associate Professor</b>	<b>History, Technology Studies</b>	<b>Rice University</b>
<b>Amy Slaton</b>	Postdoctoral Scholar	<b>History &amp; Politics</b>	<b>Drexel University</b>
Kalpana Sastry	Principal Scientist	Agriculture	Nt'l Academy of Agricultural Research Management, IN
<b>Steve Usselman</b>	<b>Professor, Chair</b>	<b>School of History</b>	<b>Georgia Institute of Technology</b>
Vivek Wadhwa	Vice President	Academic & Innovation	Singularity University
<b>Guoyu Wang</b>	<b>Professor</b>	<b>Philosophy</b>	<b>Dalian University of Technology</b>

<b><i>Nanotechnology in Society Network Lead Partners</i></b>			
<b><i>Name</i></b>	<b><i>Title</i></b>	<b><i>Department</i></b>	<b><i>Organization</i></b>
<b>Davis Baird</b>	<b>Provost &amp; Vice President for Academic Affairs</b>	<b>Philosophy</b>	<b>Clark University</b>
<b>Chris Bosso</b>	<b>Professor</b>	<b>Political Science</b>	<b>Northeastern University</b>
<b>David Guston</b>	<b>Director &amp; Professor</b>	<b>Politics &amp; Global Studies</b>	<b>CNS-ASU, Arizona</b>
<b>Alfred Nordmann</b>	<b>Professor</b>	<b>Philosophy</b>	<b>Darmstadt University, GE</b>

#### 4B. EXTERNAL ADVISORY BOARD

<b><i>Name</i></b>	<b><i>Title</i></b>
<b>John Seely Brown (Board Co-Chair)</b>	Visiting Professor at University of Southern California and former Chief Scientist of Xerox Corporation and the director of its Palo Alto Research Center (PARC)
<b>Ann Bostrom (Board Co-Chair)</b>	Professor and Dean in School of Public Policy at University of Washington, Seattle
<b>Craig Calhoun</b>	Director of the London School of Economics and Political Science, UK
<b>Vicki Colvin</b>	Professor of Chemistry and Executive Director of the Center for Biological and Environmental Nanotechnology at Rice University
<b>Ruth Schwartz Cowan</b>	Professor in the History and Sociology of Science Department at the University of Pennsylvania
<b>Susan Hackwood</b>	Executive Director of the California Council on Science and Technology, Professor of Engineering at UC Riverside
<b>Willie Pearson, Jr.</b>	Chair of History, Technology and Society at Georgia Institute of Technology
<b>Robert Westervelt</b>	Director of the Nanoscale Science and Engineering Center-NSEC at Harvard University, & Professor of Applied Physics & Physics
<b>Former Members:</b>	
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 Emerita)	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

#### **4C. LIST OF PARTICIPATING ACADEMIC INSTITUTIONS**

**Bold** indicates active in Year 9

**Ankara University**

Allan Hancock Community College

**Arizona State University**

Australian National Univ

Bangkok Thonburi University, Thailand

Beijing Institute of Technology, China

**Bowling Green State Univ.**

California Polytechnic State University, San Luis Obispo

Cardiff University, Wales, UK

Centre National de la Recherche Scientifique (CNRS), France

**Chemical Heritage Foundation**

**Clark University**

**CNS-ASU, Arizona**

College of the Canyons

**Columbia University**

**Cooper Union**

**Cornell University**

Cuesta Community College

**Darmstadt University, GE**

**Drexel University**

**Duke University**

Ecole Polytechnique, France

Ecole Polytechnique, INRA, FR

**Edinburgh University, UK**

**Federal University of Parana, BR**

Federal University of Santa Catarina, Brazil

**Fordham University**

**Georgia Institute of Technology**

IRD-IFRIS, France

Jackson State University

**John Hopkins University**

Kauffman Foundation

**Kibi International University, Japan**

**Lehigh University**

**Long Island University**

Maastricht University, India

Maastricht University, Zimbabwe

**Mississippi State**

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**

**Science & Technology Policy Institute**

**Seoul National University, SO Korea**

**Singularity University**

Southeastern Louisiana University

**Southern Methodist Univ**

State University of New York (SUNY), New Paltz

State University of New York, Levin Institute

Sussex University, UK

**Texas A& M**

The Energy & Resource Institute, India

**Universidad Autonoma 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 Edinburgh**

University of Exeter, UK

**University of Gothenburg, Sweden**

**University of Houston**

**University of Manchester**

University of Minnesota-Twin Cities

**University of New Mexico**

**University of Southern Indiana**

**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

**Yale Law School**

York University, Canada

#### **4D. LIST OF PARTICIPATING NON-ACADEMIC INSTITUTIONS**

**Bold** indicates active in Year 9

American Bar Foundation

American Institute of Physics

**Boudreaux and Associates**

**Chemical Heritage Foundation**

**Compass Resource Management, Canada**

**Decision Research Corporation**

**Energy & Resource Institute, The, 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 Barbara Museum of Natural History**

**Santa Monica Public Library**

**Science and Technology Policy Institute**

**Smithsonian Ntl Air & Space Museum**

Woodrow Wilson International Center, Project on Emerging Nanotechnologies

**YouGov America Inc.**



Table 1: Quantifiable Outputs					
Outputs	Reporting Year -3 2011	Reporting Year -2 2012	Reporting Year -1 2013	Reporting Year 2014	Total
<b>Publications that acknowledge NSF NSEC Support</b>					
In Peer-Reviewed Technical Journals: Primary	24	17	13	18	72
In Peer-Reviewed Technical Journals: Leverage	0	7	13	9	29
Books / Chapters or sections in books: Primary	61	36	22	10	129
Books / Chapters or sections in books: Leverage	0	6	4	3	13
Other: Primary	9	0	0	0	9
Other: Leverage	0	0	0	0	0
<b>Total Publications</b>	<b>94</b>	<b>66</b>	<b>52</b>	<b>40</b>	252
With Multiple Authors	36	54	30	24	144
Multiple Authors: Co-Authored with NSEC Faculty	33	50	26	22	131
<b>Publications that do not acknowledge NSF NSEC Support</b>					
In Peer-Reviewed Technical Journals	0	0	1	0	1
<b>NSEC Technology Transfer</b>					
Inventions Disclosed	0	0	0	0	0
Patents Filed	0	0	0	0	0
Patents Awarded	0	0	0	0	0
Patents Licensed	0	0	0	0	0
Software Licensed	0	0	0	0	0
Spin-off Companies Started (if applicable)	0	0	0	0	0
<b>Degrees to NSEC Students</b>					
Bachelor's Degrees Granted	0	3	1	2	6
Master's Degrees Granted	5	0	1	1	7
Doctoral Degrees Granted	8	2	3	5	18
<b>NSEC Graduates Hired by</b>					
Industry	0	1	0	0	1
NSEC Participating Firms	0	0	0	0	0
Other U.S. Firms	0	1	0	0	1
Government	1	0	0	2	3
Academic Institutions	5	1	6	7	19
Other	1	0	0	0	1
Unknown	0	3	0	0	3
<b>NSEC Influence on Curriculum (if applicable)</b>					
New Courses Based on NSEC Research	8	9	0	6	23
Courses Modified to Include NSEC Research	10	13	14	23	60
New Textbooks Based on NSEC Research	2	16	11	13	42
Free-Standing Course Modules or Instructional CDs	0	0	0	1	1
New Full Degree Programs	0	0	0	0	0
New Degree Minors or Minor Emphases	0	0	0	1	1
New Certificate	0	0	0	0	0
<b>Information Dissemination/Educational Outreach</b>					
Workshops, Short Courses to Industry	6	6	5	9	26
Workshops, Short Courses to Others	15	21	16	21	73
Seminars, Colloquia, etc.	137	165	131	125	558
World Wide Web courses	1	1	1	9	12

## **6. MISSION AND IMPACTS**

### **Nanotechnology Origins, Innovations, and Perceptions in a Global Society**

The global vision for nanotechnology to mature into a transformative technology that furthers social aims in tandem with economic goals 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 N America, 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, nanomaterials industries, 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 (10 in the past year, 7 social science/humanities and 3 science and engineering, for a total of 10 social science/humanities fellows and 5 NSE fellows to date in the current award; graduate research assistantships (14 in the current year, 8 UCSB and 6 w/ external collaborators); undergraduate summer research internships to regional community college students (3 in the past year, 11 in the current award) and undergrads at UCSB and partner institutions (7 in 2013-2014, 14 total in the current award) who are mentored at UCSB by graduate students (11 mentorships to date in this award), and 3-5 interdisciplinary social science/humanities postdocs per year (12 in 2013-14, 6 of them co-funded, 7 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 March 2013 we held an annual 2-day NanoDays in the Santa Barbara community with 1300 adults and children participating. In addition, CNS also participates 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 (Emerging Technologies 2013) with larger-scale international conferences and workshops (planning a large international conference for Fall 2014 at UC Santa Barbara on "Democratizing Technologies: Assessing the Roles of NGOs in Shaping Technological Futures," partnered with local and national/international NGOs). 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 the CNS-UCSB webpage [cns.ucsb.edu](http://cns.ucsb.edu), CNS-UCSB Facebook, Twitter, and RSS feeds, contributions to leading blogs such as *Science Progress*, *2020 Science*, and *Huffington Post*, podcasts of interviews with researchers, and media briefings, and research developing new media methods using Twitter, and exploring 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 US Presidential Commission on Bioethics, NNCO/NNI stakeholder meetings, 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 strategies with 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 and other science journalists (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 7 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 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) of new research from the IRG 3 nanotech risk perception specialist meeting in Santa Barbara, CA in Jan 2010. X-IRG project leader Newfield and his collaborator Boudreaux have developed a volume, *Can Rich Countries Still Invent?*, currently under review, from their *States of Innovation* conference in Lyon, France in April 2010 which explores the critical dimensions of a post-linear model of innovation. IRG 1 researchers are planning a linked set of papers from their June 2013 specialist meeting on Emerging Technologies for a special issue of *History and Technology*. Appelbaum and fellow IRG 2 researchers have just signed a book contract for a new volume on *Technology and Innovation in China: China's Evolving Role in the Global Science and Technology System*. And Engeman, Harthorn and Appelbaum plan to develop a collected volume out of the *Democratizing Technologies* conference (Nov 2014) that will integrate scholarly and practitioner perspectives. 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.

## 7. HIGHLIGHTS



# CNS~UCSB

Center for Nanotechnology in Society

## The Rise of the Rest in Nanotechnology Research

### Growing influence newcomer nations

Decomposition Analysis of global nanotechnology publications since 2000

#### Results:

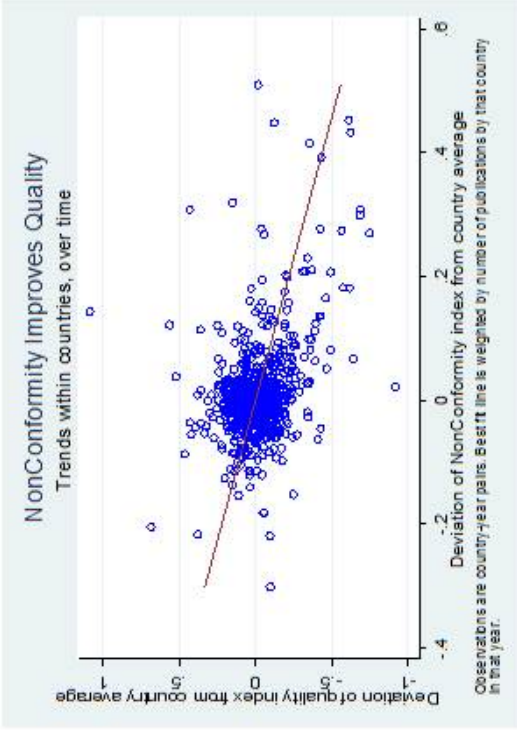
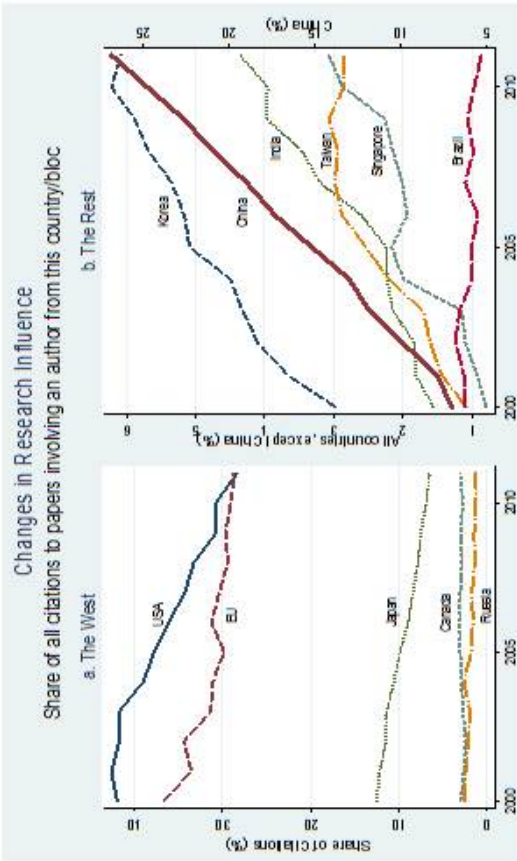
- Share of cited papers from newcomer nations rose.
- This reflects growth in the quantity and impact of their research.

### Newcomer nations should not specialize

Panel data analysis of national research specialization and impact.

#### Results:

For most measures, controls, weighting schemes and subsamples, newcomer nations' impact grew as their research mix became more generic.



Mehta, A., Herron, P.J., Cao, C., & Lenoir, T (2014). The Scientific Influence of Nations: Quantity, Focus and Impact of Nanotechnology Research, *Under Review*.



## The Rise of the Rest in Nanotechnology Research

### Growing influence newcomer nations

Decomposition Analysis of global nanotechnology publications since 2000

#### Results:

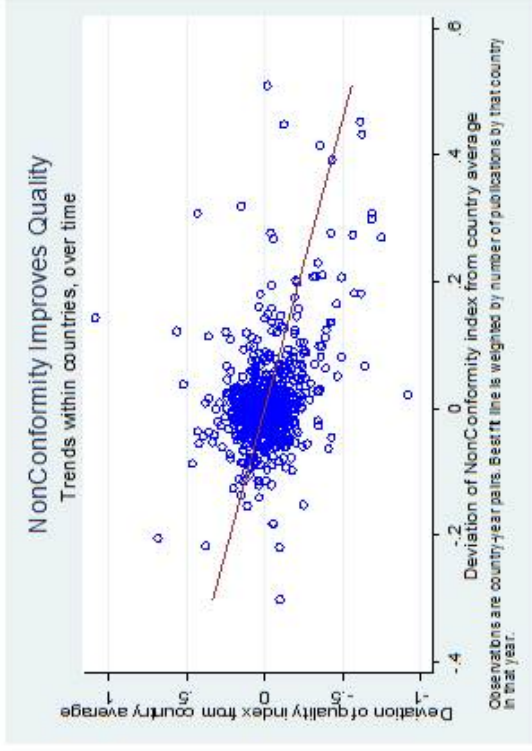
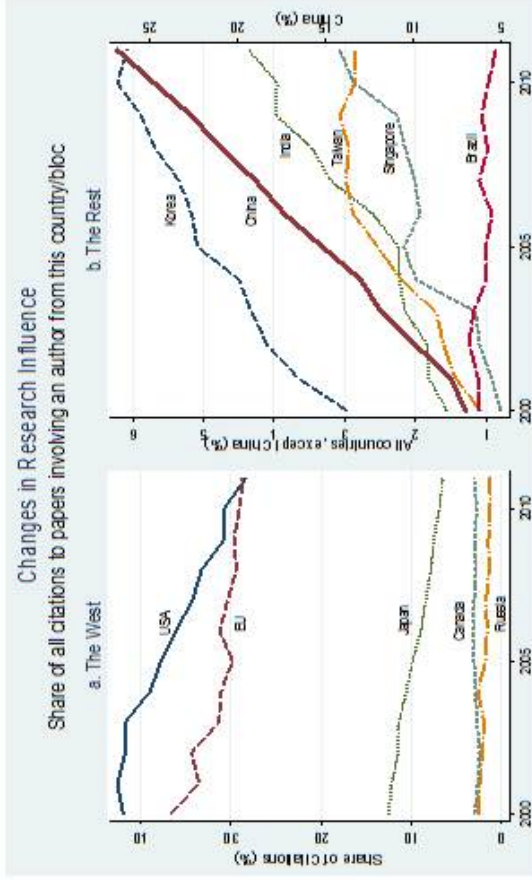
- Share of cited papers from newcomer nations rose.
- This reflects growth in the quantity and impact of their research.

### Newcomer nations should not specialize

Panel data analysis of national research specialization and impact

#### Results:

For most measures, controls, weighting schemes and subsamples, newcomer nations' impact grew as their research mix became more generic.



Mehta, A., Herron, P.J., Cao, C., & Lenoir, T (2014). The Scientific Influence of Nations: Quantity, Focus and Impact of Nanotechnology Research, *Under Review*.

## Innovation pathways of developing countries in emerging technologies: The case of nanotechnology in Argentina and Brazil

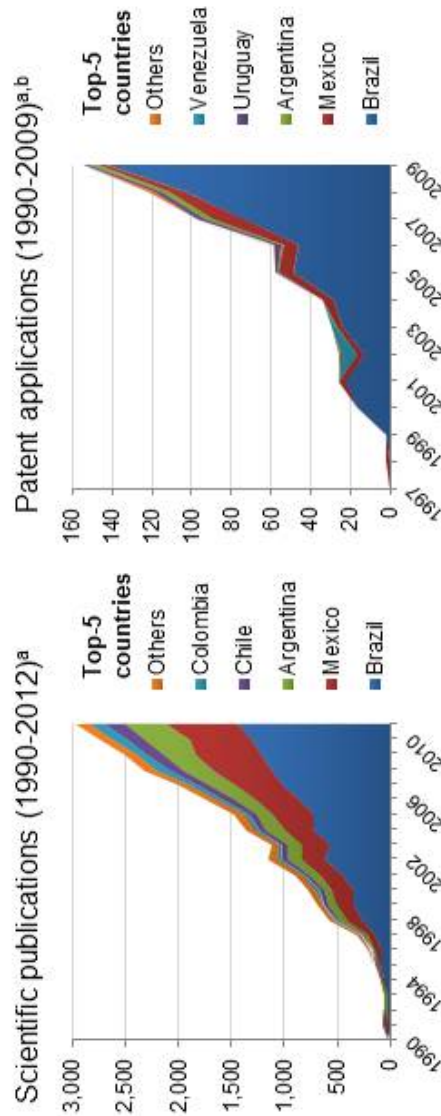
### Research focus:

This research investigates the innovation pathways that developing countries follow in emerging technologies and focuses on nanotechnology in Argentina and Brazil, leaders in this emerging field in Latin America [1]. The project draws mainly on interview and company visits, company website and document analysis. Seventeen interviews were conducted with companies in nanobiotech, new materials, energy storage, among others.

### Preliminary findings:

- Diverse firm trajectories with predominant role of the scientific sector and universities.
- Market focus is generally on mature markets and technology with narrow market definitions.
- There are potential issues in S&T system-industry interactions.
- Policy and economic contexts are generally not conducive for corporate R&D.

### Nanotechnology publications and patents in Argentina, Brazil (1990-2012)



### Corporate activity in nanotechnology in Argentina, Brazil (1990-2012)

	Nanofirms <sup>c</sup>	Corp. publications <sup>a</sup>	Corp. patents <sup>a</sup>
Argentina	41	4 firms 11 publications (2006-2012)	4 firms 5 patent apps. (2003-mid 2010)
Brazil	165	51 firms 312 publications (1991-2012)	73 firms 165 patent apps. (1997-mid 2010)

a. Source: Georgia Tech Global Nanotechnology database. b. All patent offices. c. Based on all sources available to this research.

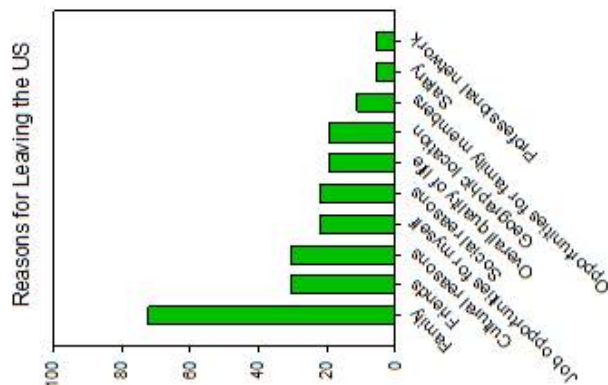
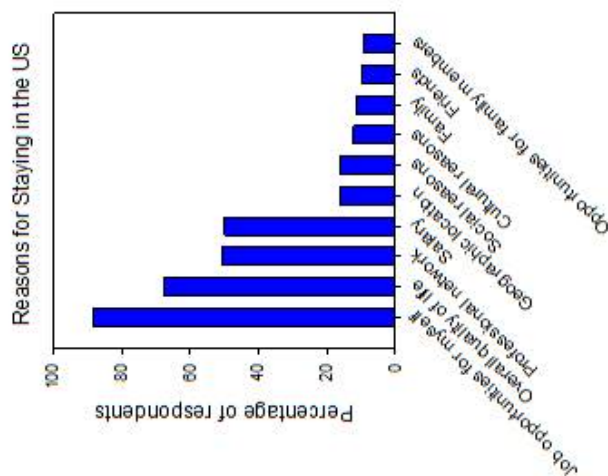
◆ **17 nanotechnology case study firms have been conducted addressing dimensions such as innovation sources, technology focus, partnerships and internationalization.**

**Conference presentations:** Kay, Luciano, "Innovation pathways of developing countries in emerging technologies. The case of nanotechnology in Argentina and Brazil." 5th Annual meeting Society for the Study of Nanoscience and Emerging Technologies (S.NET), Boston, MA - October 27-29, 2013 & 2013 Atlanta Conference on Science and Innovation Policy, Atlanta, GA, September 26-28, 2013. (with Richard Appelbaum, Philip Shapira and Jan Youtie)



## Survey of International STEM Graduate Students

An online survey was administered to international UCSB graduate students from Science, Technology, Engineering, and Mathematics (STEM) fields in 2013 focusing on their motivations for staying or departing the US upon graduation.

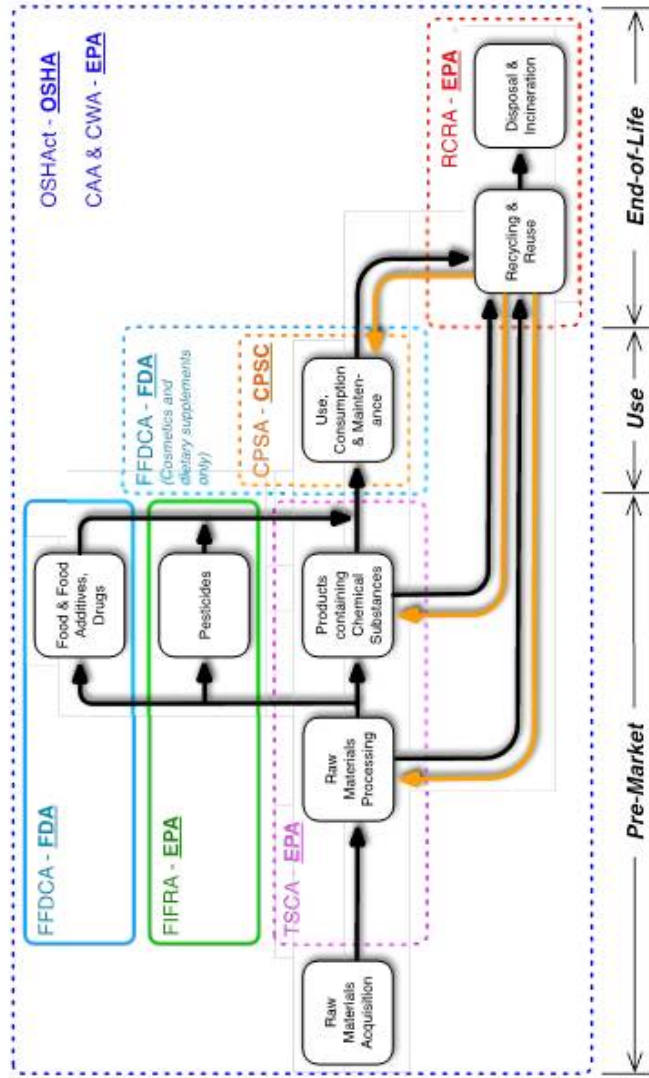


### Results:

- A student's plans for after graduation is the biggest determining factor on whether s/he will remain or leave the US
  - If a student wishes to work in industry, there is a 90% probability that s/he will aspire to stay in the US
  - If a student wishes to work in academia or government, his/her decision to stay/leave is dependent on the interaction of professional, personal, and social factors
- Of those wishing to leave the US, 72% cited "family" as an influential factor
- Of those wishing to stay in the US, 88% cited "job opportunities" as an influential factor, followed by "overall quality of life" (68%)
- Foreign graduate students in STEM still view the US as a top destination country for those wanting to engage in advanced research and innovation.**
- Students view the current immigration process as a hindrance to staying in the US**

Han, X. Stocking, G., Gebbie, M., & Appelbaum, R. (2014). "International Graduate Students in the US: Motivations for Staying and Departing the US Upon Graduation." In Preparation.

## Gaps in Regulation and Oversight



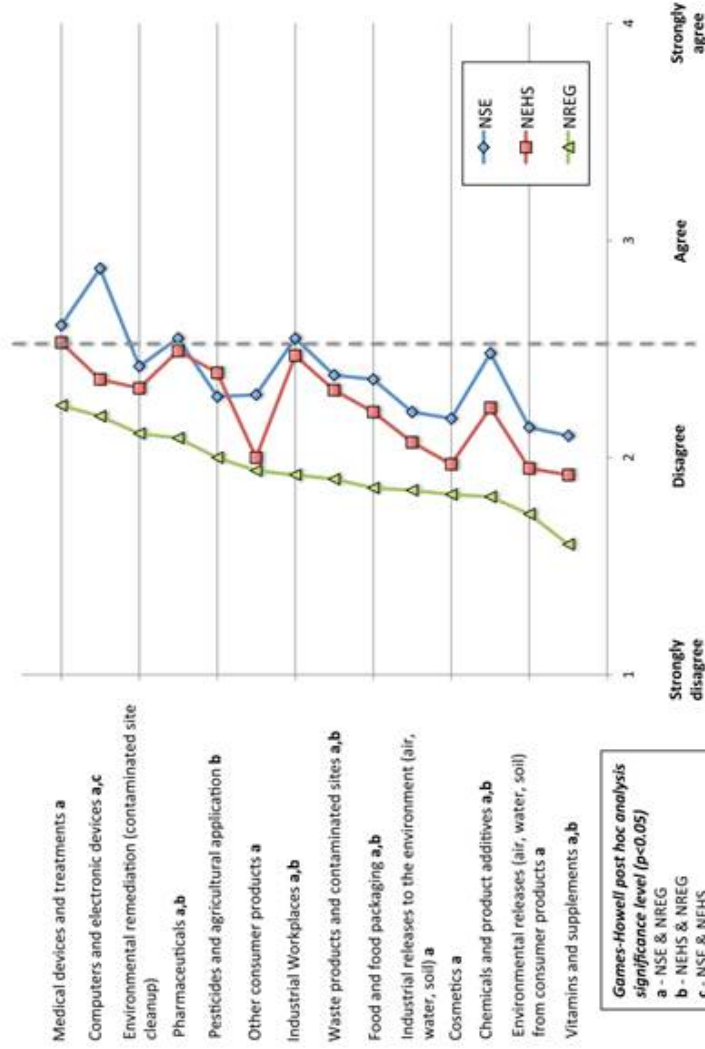
### Key Findings: Improvements needed for nanomaterial regulatory oversight

- High scientific uncertainty, a lack of EHS and product data, make it difficult to manage nanomaterial risks under current regulations
- Inappropriate exemptions and thresholds, confidential business information render many regulations inadequate
- The result: some forms of ENMs may escape federal oversight and risk review at one or more life cycle stages
- Oversight can be improved through regulatory reforms, periodic re-evaluation of ENM risks, and fostering a 'bottom-up' stewardship approach to managing risks

Beaudrie C.E.H., Kandlikar M., Satterfield T. (2013). From Cradle-to-Grave at the Nanoscale: Gaps in U.S. Regulatory Oversight along the Nanomaterial Life Cycle. Environmental Science & Technology. 47, 5524–5534.



## Nanomaterial Risks and Preparedness



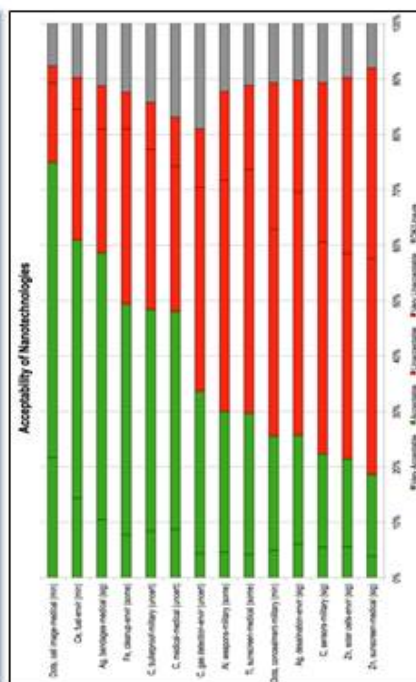
### Key Findings: Regulatory agencies viewed as unprepared for nanotechnologies

- Survey (N=254) of US-based nanoscientists and engineers, environmental health and safety scientists, and regulatory scientists and decision-makers – are 'US government agencies adequately prepared for controlling risks from nanotechnologies?'
- All three expert groups view regulatory agencies as unprepared, with the effect strongest for regulators themselves
- Those who see nanotechnology risks as novel, uncertain, and difficult to assess are most likely to see agencies as unprepared
- Results underscore the need for new tools and methods to enable the assessment of nanomaterial risks and to renew confidence

Beaudrie C.E.H., Satterfield T., Kandlikar M., Harthorn B.H. (2013). Expert Views on Regulatory Preparedness for Managing the Risks of Nanotechnologies. PLoS ONE 8(11), 1-9.

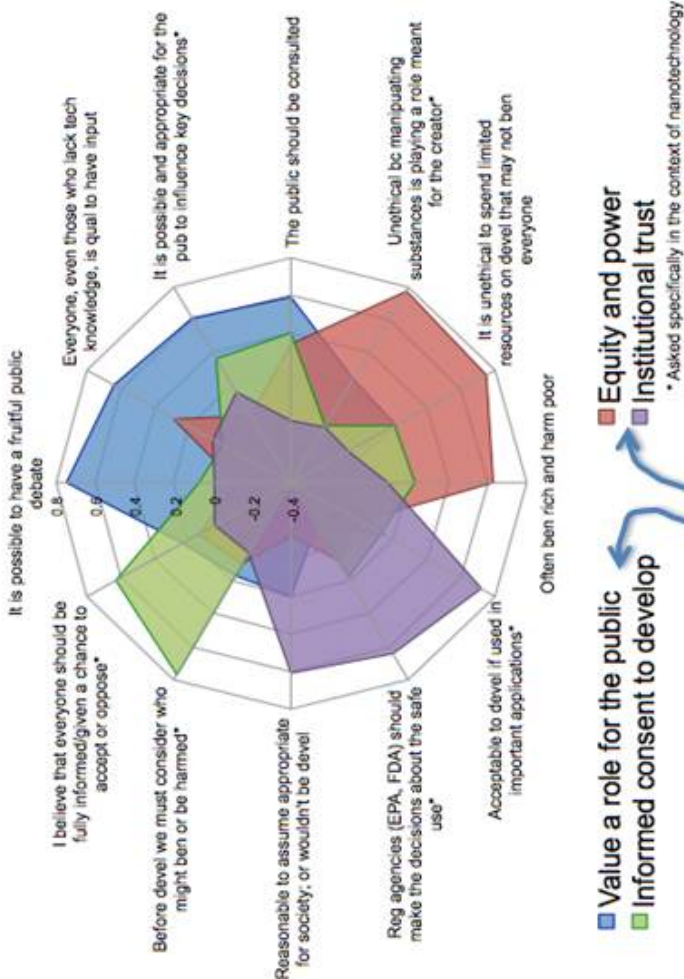
## Ethical Positions and Nanotechnology Acceptance

**Key Findings** → This study shows that there are key responsible development factors that can be identified by US publics. Further, these factors are important and related to the acceptability of nanotechnologies. (US Public Survey Results n=697)



### Logistic Regression Results:

- Dependent Variable:** Nano Acceptability (mean among the 14 variables above)
- Findings:** Those who exhibit lower levels of nano acceptability tend to be:
  - concerned about equity and power;
  - supportive of informed consent;
  - lower trust in institutions;
  - believe in public involvement;
  - older, female, and liberal voters.



- Value a role for the public
- Informed consent to develop

### Four Factor PCA Solution

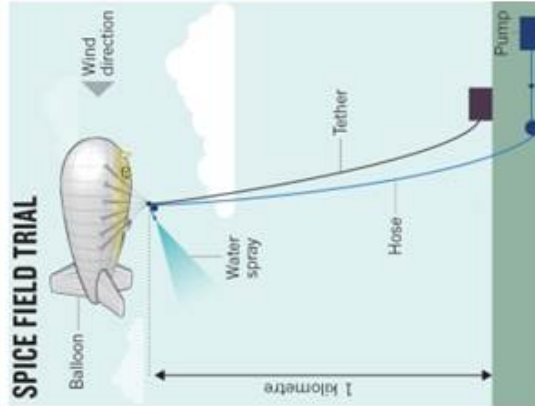
UCCCEIN

Barbara Herr Harthorn, Mary Collins, Terre Satterfield, Shannon Hanna, *In preparation for Journal of Responsible Innovation*



## Deliberating Energy Futures: Geoengineering

**Objective:** compare public perceptions of geoengineering to adaptation and mitigation as alternative responses to climate change



"If you're talking about doing it in the UK, then everybody and their auntie will want ten pennies of their input put in."  
—Barbara, a public deliberation participant predicting inequitable implementation of SRM technologies



**Geoengineering:**  
"deliberate large-scale manipulation of the planetary environment to counteract anthropogenic climate change" (Royal Society, *Geoengineering the Climate: Science, Governance and Uncertainty*)

**UK SPICE Project:** 3.5 year studying the effectiveness of Solar Radiation Management (SRM), offsetting the effects of greenhouse gas increases by causing the Earth to absorb less radiation by the sun

### Deliberation participants voiced:

- concern that commercial interests will override good intentions
- a desire to imagine and prepare for the world that such innovations will bring about
- questions about transboundary impacts and geopolitics
- The importance of being open to a plurality of technologies

### Suggestions based on data:

- Publics be informed of their avenues for engaging with responsible innovation regarding geoengineering
- Developers of geoengineering publish in outlets available to the public
- Responsible innovation framework should increase engagement with invited and uninvited publics from developed *and* developing nations

Parkhill, K., Pidgeon N., Corner, A., & Vaughan, N. (2013). Deliberation and Responsible Innovation: A Geoengineering Case Study. In R. Owen, J. Bessant, Maggy Heintz (Eds.), Responsible Innovation: Managing the Responsible Emergence of Science and Innovation in Society (219-237). West Sussex, UK: Wiley.



## Nano News

Google Alerts published information about nanotechnology risks from a variety of sources, but provided little continuity, making it difficult for readers to put nanotechnology risk news and research developments in context.

- Google Alerts are emails sent to a requester when Google finds new results such as web pages, newspaper articles, or blogs that match a search term. Beginning in March 2010, there were 415 Alerts in 2010 and 2011 that included nano risk information, compared to 58 nano risk articles in the online newspaper, the *New Haven Independent* (NHI), and 17 in U.S. and 27 in U.K. newspapers (Fig. 1).
- Google Alerts drew on 254 different information sources for nano risk news. Of these sources, the most frequent was Marketwatch, followed by Nanowerk, Nanotechnology Now, and Nanotechnology and Development News, which all operate as portals for nanotechnology information.

Figure 1: Number of articles found in 2010 and 2011 in newspapers, NHI and Google Alerts



Figure 2: Number of health, environmental and societal risk articles coded in 2010 and 2011



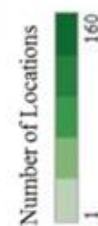
- A random sample of 26 Google Alerts for 2010 and 32 for 2011 showed they followed the same coverage patterns as the NHI and the U.S. and U.K. newspapers, with the most coverage devoted to health risks, followed by societal risks, and environmental risks (Fig. 2).
- While the information in Google Alerts may have reached more people through its wide distribution and subsequent reprinting in numerous news portals, readers would have been better served to look for more in-depth and consistent nanotechnology risk information, such as that in the NHI.

Sharon M. Friedman and Brenda P. Egolf, "Google Information about Nanotechnology Risks." Poster platform presentation at the Society of Risk Analysis Meeting, Baltimore, MD., December 10, 2013.

## Profile of California's Nano Economy: [www.CaliforniaNanoEconomy.org](http://www.CaliforniaNanoEconomy.org)

### Introduction

- **Objective:** Develop methods and estimates of the California's nanotechnology economy
- **Why:** common goal among stakeholders is to track and measure economic, social and/or environmental impacts related to nanotechnology. This includes both positive (return on investment, job creation, revenue generation, energy efficiency) and negative (exposure & risk) impacts.
- **Needed:** Data on key variables: firms, workers, products & geography



### Sample Results

- California accounts for the largest share (nearly one-quarter) of firms and supporting organizations engaged in nanotechnology-related activities in the United States (Fig 1).
- There are 21 educational institutions (universities, community colleges and training centers) in California involved in nanotechnology-related activity via research groups; research centers and labs; degree programs; or other educational opportunities. California is also home to a significant share (22%) of the nano-specific research centers and labs funded by various government agencies through the NNI (Fig 1).
- Largest concentrations of firms and organizations (Fig 2): Santa Clara county (31%) followed by Los Angeles (15%) and Alameda (12%) counties.

Indicator	Number in California	California Share of USA
Firms Engaged in Nano-Related Activity	381	25%
Organizations Engaged in Nano-Related Activity	130	22%
Nano-Related Employment (Firms & Organizations)	47,534	21%
NNI-Funded Centers & Labs (NSF, DOD, DOE, NIH)	22	22%
U.S. Nano-Related Patents with Inventors from California (USPTO Class 977)	1,795	20%
NSF Nano* Awards (1997-Aug. 2013)	1,069	11%
Nano-Related Degree Programs (AS, BS, MS, PhD)	8	9%
Nanotechnology Dissertations: 1999-2007	549	14%

Fig. 2: Locations of California Nano-Related Firms

Fig. 1: Snapshot of California Nano Activity

For more information see: Frederick, Stacey. (2013). California in the Nano Economy at [www.CaliforniaNanoEconomy.org](http://www.CaliforniaNanoEconomy.org)



## Conducting Science, Communicating Science

Educational seminars over the past year have focused on communicating CNS-UCSB research to a broader audience.

### CNS Speaker Series: Science Writers



Ivan Amato: author of NNI brochure *Big Things from a Tiny World*; former editor at *Chemical & Engineering News*



Kathleen Sharp: author of *Blood Medicine: Blowing the Whistle on One of the Deadliest Prescription Drugs Ever*; Atlantic.com



Michael Todd: Social Science Communications Manager at Sage Publications



Matt Kettmann: Senior Editor at *The Santa Barbara Independent*; contributor to *Smithsonian*, *The New York Times*



Visitors to the CNS provided advice on pitching stories, speaking with journalists, and sharing their research results by publishing in popular periodicals.

**Policy Briefs Workshop, May 2013:** Professional writer Christine Shearer, and Science and Technology Policy Institute researcher Rachel Parker (both former CNS-UCSB fellows) led a day-long seminar on writing briefs based on research.

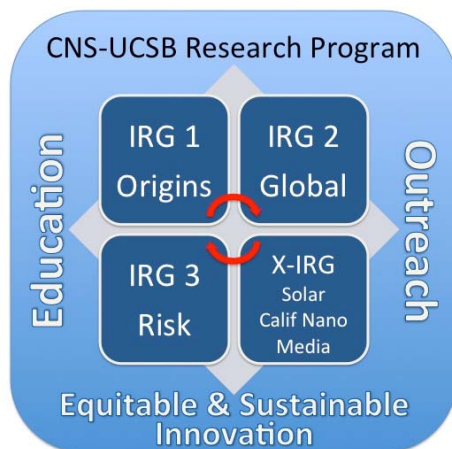
**Op-Ed Workshop, May 2014:** CNS Education Coordinator Brandon Fastman is leading a 3-seminar series that will result in revised essays to be submitted to newspapers and magazines. *Pacific Standard Magazine*, which focuses on social and behavioral science, has agreed to publish its favorite op-ed to come out of the workshop.

## 8. STRATEGIC RESEARCH PLAN

The Center's research program is designed as a systematic analysis of contemporary and historical 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 now robustly in Latin America, to ask how different industrial policies, investment strategies, and labor practices 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, California in the Nano Economy global value chain project on nano industry, media framing of nanotech, nano lab ethnography). New **Seed Projects** bring a new set of societal researchers into dialogue with CNS. Together this integrated research program provides 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 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, has studied the policy history of both energy and EH&S issues with regard to nanotech. IRG 2 is engaged in the 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 pursues in connection with IRG 2 leader Appelbaum's MacArthur Chair, which is focused on labor conditions. IRG 3's research has moved 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, 2008-2014, has produced an award-winning portfolio of 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 and S 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 and resilient web of connections to the NSE, nanotoxicology and materials research communities. The years ahead will 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, most vital, joint program and funding development. 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, its position on the Pacific Rim, its rising Hispanic Serving Institution status, and its rising Carnegie ranking in the Research University/Very High research activity scale.



The integration, aggregation and synthesis of research results in the CNS-UCSB take a number of forms. Years 1-8.5 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 8.5 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, *Risk Analysis*, 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 environmental/energy 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 have developed an edited volume focused on the pressing economic development issue of *Can Rich Countries Still Invent?* (Newfield & Boudreaux, under review). IRG 1 in June 2013 convened a specialist meeting in Santa Barbara in that engaged in critical reflection on emerging technologies and their societal characteristics and footprints, past and present, and they plan to submit a linked set of papers from this meeting for a special issue of *History and Technology*. Appelbaum and fellow IRG 2 researchers have just signed a book contract for a new volume on *Technology and Innovation in China: China's Evolving Role in the Global Science and Technology System* that will synthesize results from their numerous projects on China. And Engeman, Harthorn and Appelbaum plan to develop a collected volume out of the Democratizing Technologies conference (Nov 2014) that will integrate scholarly and NGO practitioner perspectives. 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.

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 and XIRG projects, 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 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 to be 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.

As the CNS at UCSB approaches the final year of NSF funding, we have undertaken focused discussion and planning for the best methods to capture, disseminate, and pass on to future such initiatives the full range of data, knowledge, and learned experience from our societal research program. This was a main topic for discussion at our Jan 31-Feb 1 2014 all-CNS Research Summit, and it is a part of ongoing conversations with our sister center at ASU and other societal researchers in the nanotech research community.

## 9. RESEARCH PROGRAM, ACCOMPLISHMENTS, AND PLANS

### IRG-1: Origins, Institutions, and Communities

#### Faculty and Senior Participants

<a href="#">W. P. McCray</a> , leader	History	UC Santa Barbara
<a href="#">D. Brock</a>	History	Chemical Heritage Foundation
<a href="#">H. Choi</a>	History	Seoul National University
<a href="#">C. Mody</a>	History	Rice University
<a href="#">A. Slaton</a>	History	Drexel University
<a href="#">J. November</a>	History	Univ. of South Carolina

#### Affiliates

<a href="#">M. Eisler</a>	History	Univ. of Virginia
<a href="#">A. Johnson</a>	History	Univ. of South Carolina
<a href="#">S. Kaplan</a>	Business	Univ. of Toronto

#### Graduate Students (2), Undergraduate Students (3)

##### *Graduate Students:*

Roger Eardley-Pryor	Research Fellow	UC Santa Barbara
Brian Tyrrell	Research Fellow	UC Santa Barbara

##### *Undergraduate Students:*

Paul Kovacs	Summer Research Intern	Santa Barbara City College
Megan Kelley	Research Assistant	UC Santa Barbara
Angela Burger	Research Assistant	UC Santa Barbara

## 1. Introduction

The goal of the **Origins, Institutions, and Communities** group (**IRG 1**) is to establish the historical contexts for the emergence of nanotechnology as a research field, a component of US science policy, and as a site for the formation of new research communities. Together with funded colleagues at Rice University, the University of South Carolina, the Chemical Heritage Foundation, and Seoul National University, in Year 9 IRG-1 explored a variety of topics related to nanotech's history. These included research policies for micro/nanoelectronics, what is the historical context 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, the emergence of new research areas such as DNA nanotechnology, and attempts to establish and train a nanotechnology-oriented workforce.

## 2. Goals

As stated in earlier reports, we continue to believe that reliable and usable knowledge about nanotechnology's *contemporary* social, economic, and policy implications must be based on a comprehensive and robust understanding of its *past*. 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 nanotechnology's potential. Those borrowings shape how nanotechnology is done, perceived, and regulated. Our work continues to examine 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.

Our research group in the period March 2013-March 2014 was composed of: W. Patrick McCray (UCSB); Cyrus Mody (Rice University); Joseph November (University of South Carolina); Hyungsub Choi (Seoul National University); David Brock (Chemical Heritage Foundation); and Amy Slaton (Drexel University). We had the participation of two CNS Graduate Research Fellows: Roger Eardley-Pryor (outgoing) and Brian Tyrrell (incoming). We had contributions from two unfunded collaborators: Sarah Kaplan and Ann Johnson, and continued productivity from former IRG 1 postdoc, Matthew Eisler. We believe the current size of the group is near-ideal and brings together a group of researchers whose diverse research interests overlap in key 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. It is the only humanities-oriented working group at either of the two NSF-funded CNSs. 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.

To slightly paraphrase British historian Lord Acton: "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. IRG1'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.

IRG-1, due in part to the high geographic dispersal of its members, functions in a semi-autonomous manner. Group leader McCray maintains 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 share information/research resources and meet as a group at least once a year, typically in conjunction with one of the annual professional society meetings.

One major accomplishment for the IRG in the past year was the holding of an international workshop at UCSB in June 2013. Titled "Emerging Technologies, Past and Present," it brought about 2 dozen historians and STS scholars together for a 2-day specialist meeting. The workshop's goal was to develop a historical framework in which to understand the often-problematic category of "emerging technologies." We see emerging technologies as those that 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 wanted 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 wanted this workshop to both clarify and elaborate on the entire category, which has been central to nanotechnology discourse. Presenters circulated in advance article-length essays that addressed some aspect of emerging technologies. The organizers (McCray, Mody and Johnson) recruited papers that moved beyond the traditional U.S. and late 20th century-centric focus. Ron Kline (Cornell), Steve Usselman (Georgia Tech), Amy Slaton (Drexel), Bill Leslie (Johns Hopkins), and Sarah Kaplan (U. Toronto) served as commentators and overall “synthesizers” for the meeting. As of March 2014, the organizers have selected four of the papers presented at the workshop for submission to a special issue of *History and Technology*.

#### **4. Major IRG1 Research Accomplishments**

##### **IRG 1-1: Nanotechnology and the Pacific Rim; Hyungsub Choi**

Choi’s research in this component has focused on the little-known and short-lived Seoul National University Nanoelectronics Institute (SNI), which operated between 1996 and 1998. The rationale for focusing on the SNI was 1) that it was one of the earliest efforts in South Korean universities to pursue an “emerging technology”; 2) that it consciously adopted an interdisciplinary approach, which was rare in the Korean academic context of the time; and 3) that the research community formed around the SNI served as the core of what later became the South Korean nanotechnology community. Thus, the SNI represents a transformative moment in the history of science and technology in Korea. It is an exemplar of how SNU made the transition from a third-rate teaching university as late as the 1970s to a vibrant research community operating at the global cutting-edge. Thus, the case requires some careful explanation.

To explain the phenomenon, Choi takes several approaches. First, he traces the national policies to foster academic research. During the first few decades after liberation in 1945, the South Korean government paid little attention to scientific and engineering research, and much less to those conducted in universities. The establishment of the Korea Institute of Science and Technology (1966), widely regarded as the beginning of the government’s serious commitment to science and technology, shows that Park Chung Hee and his aides systematically ignored the universities as the main loci of research. How did the government’s attitude toward universities change? Second, Choi has focused on the career trajectories and the acquired capabilities of Korean students studying abroad (mostly in the U.S.) during this period. The students who completed their training in the 1970s largely abandoned their research agenda when they chose to return home. In contrast, those since the 1980s carefully designed their careers so that they could continue their research interests back home. Why and when did the students’ attitude change? Third, the changing state of the South Korean industry, especially the semiconductor industry, needs to be taken into account. As is widely known, the Korea semiconductor companies were marking record profits in the 1980s, which gave them room to consider investing in long-range research in universities. Thus, the case of SNI allows Choi to tie in various strands in the transformation of research practices in South Korea, which in turn formed the basis for the nation’s early plunge into nanotechnology in 2001.

In Choi’s view, the case of SNI allows one to understand the Korean nanotechnology phenomenon from broader perspective. Our understanding of the phenomena, especially in Asia, has focused almost singularly on government policies. The SNI story shows that the formation of a research community was critical for the success of government policies.

Especially for emerging technologies like nano, the existence of a critical mass of experienced researchers ambitious enough to pursue cutting-edge research is indispensable. The initial results of this research were presented to the “Emerging Technologies” workshop in June 2013, and the final paper will be submitted to the special issue organized by Ann Johnson in 2014.

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

The majority of Brock’s involvement with IRG-1 to date has been in the context of a joint oral history effort by the UCSB-CNS and the Chemical Heritage Foundation. This effort was originally conceived as a multi-year program to create a series of in-depth oral histories with significant and representative figures in nanotechnology. The effort proved to be only partially successful, and the effort has concluded. However, Brock was able personally to conduct two useful oral histories, the first with James Von Ehr, an early proponent of and entrepreneur in molecular nanotechnology and the second with Thomas Everhart, an important researcher in the application of electron microscopy to microelectronics. Both interviews address the intersections between the histories of microelectronics and nanotechnology.

**IRG 1-2b:** Technoscientific Re-Emergence and Electronics Uncertainty. David Brock, Patrick McCray; New in this period.

More recently, Brock has worked with McCray to define a new research study in conjunction with IRG-1. This new project continues the theme from the oral histories of the intersection between the histories of microelectronics and nanotechnology.

Brock proposes to study the phenomenon of technoscientific re-emergence at research frontier of today’s nanoelectronics and microelectronics communities. The silicon electronics technologies that have predominated in digital and nanotechnologies for several decades have entered into an age of increased uncertainty. The highly regular pace of change in the ability to reduce the scale of silicon transistors, and to fit more of these transistors onto silicon microchips thereby lowering the cost of digital electronics, is now widely anticipated to end within a decade. Some believe that this regularity has already ended. In response, researchers across university, industrial, and government laboratory settings have initiated investigations into possible nano-scale electronic devices that may be able to supplant the silicon transistor, and microchips of them, and continue to increase the capabilities of electronic systems and lower their cost. Prominent among these diverse research programs are: Ferroelectric FETs (digital logic devices); Ferroelectric RAMs (digital memory devices); spin torque memory and logic devices based on magnetic tunnel junctions; and nanomagnetic logic.

These research programs fall into two categories: ferroelectrics (electrical polarization) and magnetics (magnetic polarization). In this, these research programs are, *prima facie*, examples of technoscientific re-emergence of research programs on novel electronic devices in the 1950s. At the same time that silicon electronics was first investigated, the United States boasted large research communities exploring the use of ferroelectrics and magnetics for new devices and microcircuits for digital logic and memory. These research programs and communities in ferroelectrics and magnetics for digital computing lasted well into the 1960s, after which they fell into relative dormancy and decline in the shadow of the unprecedented growth in the interest in, production of, and deployment of silicon electronics. Today, as the developmental dynamics of silicon electronics appear to be changing, and electronics as a whole is returning to an era of technological uncertainty, ferroelectrics and magnetics are gaining renewed attention for digital computing.

Recently, Brock has been conducting background research on these “More than Moore” research programs and their historical antecedents. Brock will focus efforts in 2014 and 2015 on the case of ferroelectric devices for computer logic and memory. These efforts centered on one predominant *materiality* – the use of Perovskites, materials with a particular crystal structure that exhibit ferroelectric behavior, in particular barium titanate.

The thesis that Brock will explore in the coming months concerns materials-centered and materials-defined communities within electronics research, and the phenomenon of re-emergence. In the next several months, Brock will track down some of the players in the ferroelectric materials community that he believes may exist from the 1950s to the present. He then plans to use IRG-1 support to conduct interviews with these informants in order to look at the connection of the history of nanotechnology to the history of microelectronics through the lens of materials-centered communities. Brock may work with a new UCSB graduate student to explore the role of Carver Mead and Lynn Conway in promoting Very-Large Scale Integration (VLSI). This is the methodology, developed from the late 1950s onward, pioneered by Mead and Conway, and supported heavily by DARPA of putting tens of thousands and then millions of transistors onto a single chip. This may be pursued in Year 10 as a pilot project depending on availability of funds and student interest.

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

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

Members of this project submitted and/or published several articles in this reporting period that connect up their individual research programs into a coherent whole. Mody published three articles on proto-nano interdisciplinary research in the 1970s. One of those articles was co-authored with Choi, who has also submitted an article co-authored with Brittany Shields on interdisciplinary materials research at the University of Pennsylvania in the 1960s. Kaplan and collaborators are close to publishing two or more articles on interdisciplinary nano research at the University of Pennsylvania in the 2000s – research that uses an organizational template drawn directly from the earlier materials program that Choi and Shields have studied. Taken together, recent work by Choi, Kaplan, and Mody offers a half-century arc of interdisciplinarity at some of the leading nodes of US academic nanotechnology.

These synergies between the members of the Institutions of Interdisciplinarity project were greatly aided by the Emerging Technologies workshop organized by McCray, Johnson, and Mody in June 2013. Choi and Kaplan both attended, and Choi presented a paper on an interdisciplinary nano center in 1990s South Korea. Mody and Shields also presented papers on interdisciplinary research of the 1960s and ‘70s at the annual meeting of the American Physical Society.

Choi’s research in this area has focused on a set of academic interdisciplinary research centers on materials science, created in the early 1960s with funds provided by ARPA. He has conducted extensive archival research in university archives, and has collected a sizable amount of documents on the topic. The overall theme of this research project is the introduction of interdisciplinary research in universities, and how various campuses have responded to this challenge.

So far Choi has underscored two themes in this line of research. First, (together with Mody) he traced the historical origin of the “center model” of funding university research, which is ever so prevalent in the National Science Foundation and other funding agencies. We may even call this the hallmark of the NNI, where scores of such centers have been created. Our findings show that the model was conceived by the science policymakers at PSAC during the high Cold War period, and (as former CNS postdoc Matt Eisler showed) was an attempt to bring industrial style R&D to university campuses. No surprise, then, that there was resistance among academics. Second, (together with Penn graduate student Brittany Shields) Choi has focused on the new laboratory buildings and what they represent. The practical meaning of the buildings was the physical reshuffling of researchers to increase interdisciplinary contact. The idea did not yield noticeable outcomes and was constantly questioned by scientists and policymakers. Yet, it proved to be a persistent theme in redesigning spaces for research practices. There seems to be a widespread belief that chance meetings lead to more creative ideas. An initial paper from this work was published in *Historical Studies in the Natural Sciences* in April 2013. A second paper is currently under review at *Minerva*.

In addition to the above two areas, Sarah Kaplan is continuing to conduct research (funded by another source)<sup>1</sup> 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 university interdisciplinary research center) 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.

---

<sup>1</sup> This project is supported by the NBIC through the National Science Foundation NSEC DMR-04-25780 and by the Canadian Social Sciences and Humanities Research Council under grant #410-2010-0219.



#### **IRG 1-4:** Innovation and Research at the Nanotechnology-Biology Interface; Joseph November

This project, which aims to elucidate the roots of federal agencies' recent efforts to foster innovation and research at the bio-nano interface, compares: 1) early 1960s efforts to rationalize biomedicine via digital computer techniques; and 2) 21<sup>st</sup> century attempts to harness nanotechnology in life science research. Included in this aim, the project investigates 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 seeks to clarify the roles of individuals and institutions in generating a process that has made nanotechnology and biomedicine increasingly important to each other.

The increasing mutual importance of nanotechnology and biomedicine has become more pronounced in recent years and months. Since 2005, for instance, the NIH has championed nanotechnology as a key mechanism for realizing translational research. The expressed hope is that nano will serve to catalyze the transformation of molecular biology and biochemistry laboratory findings into drugs and other technologies that could be used in the clinic. In October 2011, the National Cancer Institute (NCI) launched its Translation of Nanotechnology in Cancer (TONIC) partnership, which brings together public and private researchers, engineers, and physicians in order "to accelerate the translation and development of nanotechnology solutions for the early detection, diagnosis, and treatment of cancer." TONIC not only seeks to apply existing nano to medical problems, but also to shape the development of new nano (via incentive programs and direct funding) so that it is useful for medicine.

This project is grounded in extensive archival research at the NIH, the National Archives' collections, and historical materials available via the NSF and the NNI. It will also draw from data gathered in recorded interviews with personnel and grantees connected to agencies where nano-bio research is/was supported.

November has visited archives at the National Institutes of Health and the National Archives and gained extensive access to many important documents that have not been formally archived. November also acquired from the NIH extensive materials related to attempts to develop nanotechnology for biomedical purposes. This mostly comes in the form of slides from research presentations by NIH and NIH-sponsored researchers to the FAES graduate course, Insights into Nanobiotechnology (BIOCH 319 [Nov-Dec 2007]).

Drawing from material gathered during the past two years, he is preparing an article "Engineering a Better Medicine" for submission to *Technology and Culture*. A preliminary version of this article has been presented as a professional talk (of the same name) for The Society for the 2012 History of Technology (SHOT) annual meeting in Copenhagen, Denmark. To complete research for that article, he plans to return to the NIH in 2014 and conduct archival research at the National Academy of Sciences, New York Academy of Science, Charles Babbage Institute (Univ. of Minnesota), and Stanford University.

November plans to formally interview several surviving participants in early federal efforts to create the field of "bioengineering." These include: 1) Daniel M. Fox, who has been active since the 1960s in federal efforts to harness emerging technologies for medicine, and who served as

president of the influential Milbank Foundation; 2) Jerome R. Cox, Jr., former head of Biomedical Computing Laboratory (Washington University); and 3) Wesley A. Clark, Jr., computer architect and lead developer of several important bioengineering-related technologies in the 1960s and 1970s.

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

Project completed prior to this reporting year.

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

The two research aims of this project both examine how perceptions of concern over nanotechnology's environmental, health, and safety (EHS) developed in the United States, and how those perceptions have (or have not) influenced regulatory policy formation on nanotechnology. The first aim of this project explores popular utopian and dystopian narratives about nanotechnology as they relate to EHS policies. The second research aim for this project 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's work included presentation of nanoEHS research, delivery of public lectures and museum volunteering on behalf of CNS, continued participation in CNS graduate seminars, and mentorship of nano-related undergraduate summer research. In Spring 2013, Eardley-Pryor led a 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. He also 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 in nanotechnology demonstrations. In April, he presented a 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. This marked the first CNS-UCSB presentation to environmental historians. In Spring, Eardley-Pryor delivered an invited lecture on the environmental implications of nanotechnology at Lewis and Clark College, in Portland, Oregon. In summer, Eardley-Pryor served as a graduate mentor for an undergraduate research project on nanotechnology in food for the 2013 Internships in Nanosystems Science, Engineering and Technology (INSET) program. Though Eardley-Pryor did not serve officially as a graduate fellow from September through December 2013, his activities in this period included revision of a paper co-written with W. Patrick McCray titled, "Regulating Innovation via Analogy: The Case of Nanotechnology," which was presented by McCray at the workshop on "Pressing Issues: The History of Technology Meets Public Policy," at Colby College, ME. Future work includes revising this paper for submission to an academic journal.

**IRG 1-7:** Divided Labor and Stratified Opportunity in American Nanomanufacturing: The Paradox of the Middle Skilled; Amy E. Slaton; New in this period

This research centers on the study of sub-baccalaureate nanotechnology education in the United States. As part of a larger study of community college and university programming for "nanotechnician" workforce preparation, it considers curricula; educational materials (including instruments, textbooks, lab kits, etc.); and pedagogical exchanges among instructors, publishers, and other stakeholders.

Nanoscale manufacturing, an emerging sector in the United States encompassing biotechnology, pharmaceutical, electronics and other industrial enterprises, has formulated itself along a familiar organization of labor: production operations are minutely divided, with mechanization and automation paramount. From the vantage point of labor history, today's cleanroom technicians fabricate medical devices and semiconductors much in the manner that assembly line workers produced Model-T Fords one hundred years ago.

As Slaton's previous research has shown, outsourcing notwithstanding, American industrial leaders and economic planners project a growing domestic nanosector and excitedly promise many such jobs in production and quality control. The segmented nature of this new nano-related workforce is confirmed by vocal demands by employers and economic policy makers for more "middle skilled" nanoworkers, a stratum seen to possess competencies "above" routine fabrication tasks and "below" expert design or management. Such nanotechnicians are said accordingly to require "more than high school" but "less than college," giving rise to dozens of two-year nanotech degree programs. Thus, employers and educators, often with government support, have together delineated a recipe for workers equipped with cutting-edge, esoteric knowledge. Crucially, however, that knowledge is to be deployed within a system of constrained occupational opportunity.

Of particular importance are exceptional cases in which instructors, local employers, and students have transgressed the strict segmentation of nanomanufacturing labor. In a very few instances, shop-floor workers have been acknowledged to possess dynamic bodies of skill and knowledge. Here, the technicians' experiences of fabrication directly inform the work of product designers and process engineers. The technicians' assigned responsibilities, and in one case even their job descriptions and wages, have expanded as a result. How does such mutability come about and why so rarely? Do these exceptions prove the rule or suggest a way forward to more equitable industrial employment conditions in high-tech manufacturing?

In this reporting period, Slaton continued research centered on promotional and self-assessment documents produced by makers of micro- and nanotech educational materials; study of the materials themselves; and publications by educators involved in the design or use of these materials. She interviewed an industrial liaison to community college manufacturing programs (Philadelphia region) and the director of a MEMS Technician Associate Degree program (Albuquerque). Slaton has also contacted other administrators and instructors to set up additional interviews. Finally, she met with NIST personnel responsible for standards-related education and attended meetings of ISO working groups on nano-scale metrology, instrumentation and nomenclature in high-tech manufacturing (Washington DC).

At Drexel University, Slaton developed and taught a course on "Nanotechnology in Society" for the Master's Program in Science, Technology and Society. In this reporting period she has also published columns on so-called high-tech workforce education in "InsideHigherEd.com" and continued to produce the blog "STEMequity.com" on issues of diversity and educational inclusion in science and engineering.

**IRG 1-8:** Nanotechnology, Aesthetics and Innovation; W. Patrick McCray; new in this period.

With the completion of *The Visioneers*, McCray began to consider another book-length topic related to CNS. One avenue he has explored this year concerns the intersection of art (and artists) with nanotechnology (and engineers). This would build on a recent special issue of the journal *Leonardo* (2012) on art and nanoscience. This may also connect with the work of CNS seed grant recipient, George LeGrady. The main focus is on the formal collaborative efforts

between artists and engineers/scientists and the variable nature of what they produce in terms of art and technology. Given that NSF is interested in putting more (A)rt in its STEM efforts (STEAM), McCray will continue to investigate this as a modest priority over the next year.

**IRG 1-9:** DNA Nanotechnology and Nanotechnologists; Patrick McCray, Brian Tyrrell; New in this period.

This research project examines the historical formation of an international interdisciplinary research community around using DNA molecules as the raw material for constructing active and passive nano-scale structures. One of the strands of the project interrogates the transformation in thinking that allowed DNA nanotechnologists to consider the structural properties of DNA separate from its genetic information. A second focus of this project is funding. Historians have argued that biology surpassed physics as the prestige discipline in American science in the post-Cold-War period. This project examines how DNA nanotechnology emerged as physicists, chemists, and computer scientists responded to the realities of federal funding in the sciences. Given the bio-nano focus of this project, there are strong resonances with November's work in IRG 1-4.

In the reporting year McCray continued work on a project called "From Blueprints to Bricks." The goal is to explore the establishment of a research community in the US that does DNA nanotechnology. During this reporting period, McCray made multiple research trips to Caltech and NYU to do interviews 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.) Brian Tyrrell IRG 1 new CNS Research Fellow, and McCray will work together on this line of work.

In June 2013, Tyrrell attended the CNS-sponsored Emerging Technologies Workshop held in Santa Barbara, California. This workshop introduced him to the work of some of the senior members of CNS including Cyrus Mody and Amy Slaton. The workshop familiarized Tyrrell with the research priorities of CNS before his fellowship began. Throughout the period of his fellowship (September 2013-present), Tyrrell has conducted research on DNA nanotechnology, specifically the technique developed by Paul Rothemund known as "DNA origami." To aid in this process, Tyrrell, under the tutelage of McCray, has been observing oral history interviews and reading old interviews in order to learn the methods associated with conducting interviews in the history of science. As part of his training in oral history, Tyrrell has helped develop questions for recently conducted interviews. Tyrrell is submitting abstracts to two conferences in 2014: the Society for Social Studies of Science (4S) and the Society for the History of Technology (SHOT).

**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 Year 9 contributes to a more comprehensive and holistic narrative of nanotech's trajectory. In terms of direct connections and impacts, consider November's work on the bio-nano interface.

In keeping with the mission of IRG-1 to produce "a comprehensive and holistic narrative of nanotech's trajectory," November's project will demonstrate that one area to which the "deep history" of nanotech extends is a series of federal efforts (some going back more than 50 years) to incorporate engineering into biomedical research and medical practice. Although many of its methods are indeed novel, the use of nanotech in life sciences research represents a

continuation of much work that pursued under the rubrics of molecular biology, cell biology, biochemistry, bioengineering, and medical engineering. In the case of the NIH's massive involvement in nanotech, there is a broad continuum of institutions and personnel stretching from today's nanobio research back to groups established as early as the 1960s. Tracing this history would go a long way towards clarifying the origins of the expertise and technical means required to pursue nano-related endeavors as well as the origins of institutional will to support such activities.

All of the IRG-1 members who teach graduate or undergraduate courses incorporate their CNS-based research in various ways. Slaton, Mody, November, and Choi all offered instruction in the past year on the history/sociology of technology which included some nano-themed topics.

Another means of engagement is the blog *Leaping Robot* maintained by McCray. Although the views expressed here are solely his own and not those of the NSF, the topics McCray writes about frequently address issues related to emerging technologies. In several cases, McCray's blog posts have been picked up by *Physics Today* and rebroadcast, substantially raising their readership. In a similar vein, Amy Slaton also maintains a blog devoted to STEM and education related issues.

Finally, McCray's *Visioneers* book was released late in 2012. This was accompanied by a series of public talks and radio appearances. *The Visioneers* won the Eugene Emme award from the American Astronautical Society in 2013. Mody's 2011 book *Instrumental Community* won the Paul Bunge Award from the German Chemical Society as well as the previously noted Cushing Memorial Prize.

### **IRG 1 Publications 2013-2014**

#### **Primary Publications: Journals**

1. Eisler, Matthew N. (2013). "The Ennobling Unity of Science and Technology": Materials Sciences and Engineering, the Department of Energy, and the Nanotechnology Enigma. *Minerva*. doi: 10.1007/s11024-013-9224-z
2. Mody, Cyrus. (2013). Santa Barbara, Physics, and the Long 1970s. *Physics Today*, 66(9), 31-37.

#### **Primary Publications: Books, Chapters, Reports and other Publications**

3. Mody, Cyrus. (2014). 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* (pp. 153-179). Stanford, CA: Stanford University Press.

#### **Leveraged Publications: Journals**

4. Mody, Cyrus, & Choi, Hyungsub. (2013). From Material Science to Nanotechnology: Institutions, Communities, and Disciplines at Cornell University, 1960-2000. *Historical Studies in Natural Sciences*, 43(2), 121-161.
5. Mody, Cyrus, & Nelson, Andrew J. (2013). 'A Towering Virtue of Necessity': Computer Music at Vietnam-Era Stanford. *Osiris*, 28, 254-277.

#### **Leveraged Publications: Books, Chapters, Reports and other Publications**

6. Mody, Cyrus. (2014). Essential Tensions and Representational Strategies. In M. Lynch, S. Woolgar, J. Vertesi & C. Coopmans (Eds.), *Representation in Scientific Practices Revisited* (pp. 223-248). Cambridge, MA: MIT Press.

**Submitted or in preparation publications: primary**

7. Eardley-Pryor, & McCray, Patrick. (in preparation). Regulating Innovation via Analogy: The Case of nanotechnology.
8. Mody, Cyrus. (under review). The Market and the Garden: Santa Barbara Physicists in the Vietnam Era. In D. Kasier & W. P. McCray (Eds.), *Groovy Science: The Counter-Cultures and Scientific Life, 1955-1975*.

**Submitted or in preparation publications: leveraged**

9. Mody, Cyrus. (under review). What Do Scientists and Engineers Do All Day? On the Structure of Scientific Normalcy. In A. Bokulich & W. Devlin (Eds.), *Kuhn's Structure of Scientific Revolutions: 50 Years On*: Springer.
10. Mody, Cyrus. (under review). Fabricating an Organizational Field for Research: US Academic Microfabrication Facilities in the 1970s and 1980s. In T. Heinze & R. Münch (Eds.), *Intellectual and Organizational Innovation in Science: Historical and Sociological Perspectives*. New York: Palgrave Macmillan.
11. Shah, Sonali K., & Mody, Cyrus. (under review). How Do Users Develop and Diffuse Their Innovations? Resources, new Social Structures, and Scaffolding. *Organization Science*.
12. Shah, Sonali K., & Mody, Cyrus. (under review). Creating a Context for Entrepreneurship: Examining How Users' Technological and Organizational Innovations Set the Stage for Entrepreneurial Activity. In B. Frischmann, M. Madison & K. Strandburg (Eds.), *Commons in the Cultural Environment*. New York: Oxford University Press.

**IRG 1 Presentations 2013-2014**

1. Eardley-Pryor, Roger. "How Ecotopian Visions of Nanotechnology Influenced U.S. Environmental Health and Safety," (poster). American Society for Environmental History (ASEH), Toronto, Canada, April 6, 2013.
2. McCray, Patrick. "Gerard O'Neill's Visioning for the Humanization of Space," invited talk at "Space Exploration and the Human Imagination" conference, Rice University, Houston, TX, April 2013.
3. Choi, Hyungsub. "The Origins of Interdisciplinary Research in Nanotechnology in Korea," Korea History of Science Society Annual Meeting, April 27, 2013.
4. Choi, Hyungsub. "The Origins of Interdisciplinary Research in Nanotechnology in Korea," Post-Catch UP Research Center, KAIST, May 16, 2013.
5. Choi, Hyungsub. "Emerging Technology in an Emerging Research Community: A Story of the SNU Nanoelectronics Institute," "Emerging Technologies" workshop at UCSB, Santa Barbara, CA, June 24-25, 2013.
6. November, Joseph. "The Cochrane Collaboration Beyond Cochrane," International Congress of History of Science, Technology, and Medicine, Manchester, United Kingdom, July 22, 2013.
7. Mody, Cyrus. "An Historical Alternatives Approach to the Materials of Microelectronics," International Congress of History of Science, Technology, and Medicine, Manchester, United Kingdom, July 25, 2013.
8. McCray, Patrick. "Regulating Innovation via Analogy: The Case of Nanotechnology," invited talk presented at "Pressing Issues: The History of Technology meets Public Policy," workshop, Colby College, Waterville, ME, September 2013.
9. McCray, Patrick. "Regulation via Analogy," invited presentation for "Into the Real World: Historians and Public Policy Roundtable," Meeting of Society for History of Technology, Portland, ME, October 10-13, 2013.

10. Choi, Hyungsub. Untitled presentation, East Asian Science, Technology, and Society Meeting, Tokyo Institute of Technology, Tokyo, Japan, November 2013.
11. McCray, Patrick. "Visioneering: From Space Colonies to Nanotechnologies in Pursuit of a Limitless Future," invited talk presented at Arizona State University, Phoenix, AZ, November 2013.
12. Slaton, Amy. Invited speaker on the history of instrumentation in high-tech manufacturing McGill University, Montreal, Canada, February 20, 2014.

### **IRG 1 Outreach Activities 2013-2014**

13. Eardley-Pryor, Roger. "Nanotechnology: The Large Societal Impacts of the Very Small," Institute of World Culture, Santa Barbara, CA, March 16, 2013.
14. Eardley-Pryor, Roger. Participant and Volunteer Nano-Days, Santa Barbara Museum of Natural History, Santa Barbara, CA, March 17, 2013.
15. Mody, Cyrus. "Dad's in the Garage: Santa Barbara Physicists in the Long 1970s," Forum for the History of Physics invited session, American Physical Society meeting, Baltimore, MD, March 20, 2013.
16. Eardley-Pryor, Roger. "Environmental History and Nanotechnology," invited lecture for Environmental Histories of Science and Technology (Dr. Jerry Jessee), Lewis and Clark College, Portland, OR, April 11, 2013.
17. McCray, Patrick. "Visioneering: From Space Colonies to Nanotechnologies in Pursuit of a Limitless Future," invited talk presented at the Smithsonian Institution, Washington, D.C., May 2013.
18. Kovacs, Paul. "Nanotechnology in Food: Lessons from the Industrialization and Enrichment of Bread," Internships in Nanosystems Science, Engineering, and Technology (INSET), public presentation, Santa Barbara, CA, August 7-8, 2013.
19. Mody, Cyrus. Moderator, session on "Social Construction of Technology," American Sociological Association annual meeting, New York, NY, August 10, 2013.
20. Kovacs, Paul. "Nanotechnology in Food: Lessons from the Industrialization and Enrichment of Bread," (poster), Internships in Nanosystems Science, Engineering, and Technology (INSET), poster session, Santa Barbara, CA, August 15, 2013.
21. Mody, Cyrus. Interviewed by Prof. Vicki Colvin and Prof. Dan Mittleman for Rice Smalley Institute web course "Small Talk," October 22, 2013.
22. Slaton, Amy. Invited Keynote Speaker "President's Diversity Breakfast," Colorado School of Mines, Golden, CO, November 6, 2013.
23. Slaton, Amy. Invited seminar speaker NEH Program, "Making Connections: Engaging the Humanities at a College of Technology," New York City College of Technology, New York City, NY, February 28, 2014.

**IRG 2: Globalization and Nanotechnology**  
**March 15, 2013-March 15, 2014**

**Faculty and Senior Participants**

<a href="#">R. Appelbaum</a> , Leader	Sociology, Global & Int'l Studies	UC Santa Barbara
<a href="#">T. Lenoir</a>	History	Duke University
<a href="#">A. Mehta</a>	Global & Int'l Studies	UC Santa Barbara
<a href="#">F. Block</a>	Sociology	UC Davis
<a href="#">C. Cao</a>	Contemporary Chinese Studies	Univ. of Nottingham
<a href="#">H. Choi</a> [also IRG 1]	History	Seoul Nat'l U.
<a href="#">D. Simon</a>	Political Science	Arizona State University
<a href="#">Z. Ye</a>	Geography	Bowling Green State Univ.

**Affiliates**

<a href="#">R. Parker</a>	Research Staff Member	Science & Tech. Policy Inst.
<a href="#">G. Foladori</a>	Sociology	Univ Autónoma de Zacatecas
<a href="#">P. Herron</a>	Computer Sci	Duke University
<a href="#">N. Invernizzi</a>	Anthropology	Federal Univ of Parana Brazil
<a href="#">Y. Motoyama</a>	Regional Planning	Kauffman Foundation
<a href="#">E. Záyago Lau</a>	Development Studies	Latin Amer Nanotech & Society Network (ReLans)

**Postdocs (4), Graduate Students (6), Undergraduate Students (2), and Technical Staff (3)**

*Postdoctoral scholars:*

Luciano Kay	CNS	UC Santa Barbara
Stacey Frederick [XIRG]	CNS	Duke University
*James Walsh	CNS	UC Santa Barbara
Shirley Han	CNS	UC Santa Barbara

*Graduate students:*

Parul Baxi	Sociology	UC Davis
Matthew Gebbie	Materials	UC Santa Barbara
Miguel Ruiz	Sociology	UC Davis
Galen Stocking	Political Science	UC Santa Barbara
Mathew Thomas	Jenkins Collaboratory	Duke University
Lanceton Mark Dsouza	Jenkins Collaboratory	Duke University

*Undergraduate Students:*

Emily Nightingale	Global Studies	UC Santa Barbara
Marisa Stacy	Literature	Santa Barbara City College

*Technical Staff:*

Evan Donahue	Research Asst	Duke University
Jordan Herman [XIRG]	History, German, & Relig Stud	Duke University
Jan Pachon	Research Asst.	Duke University

\* Co-funded or fully funded from another source

**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 the end of 2000, when the U.S. officially launched its National Nanotechnology Initiative, the NNI has invested (including its 2014 request) nearly \$20 billion (NNI 2013). 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). According to one recent estimate, global spending on nanotechnology increased 40-45% annually between 2010 and 2013; revenue from nano-enabled products is now estimated to exceed \$1 trillion, a third in the United States (NNI 2014). Clearly, public 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. This effort will draw on the various projects listed below, but particularly projects 3, 5, and 12, which focus on Mexico, Latin America, and India, as well as former IRG2 postdoc Motoyama's research on Japan (he is currently with the Kauffman Foundation) and Choi (conducting research in Korea).
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. Continue our research on the development of nanotechnology into Mexico through collaborations with Guillermo Foladori and Edgar Zayago Lau (both are faculty at the University of Zacatecas). This relation was initiated through a supporting grant obtained through UC-MEXUS and CONACYT (now completed). We have applied for a second UC-MEXUS/CONACYT grant in order to develop a framework that will be used the U.S., China and Brazil.
4. Deepen relations with ReLANS (the Latin American Network for Nanotechnology and Society), including through sponsoring an international workshop on Nanotechnology and Society in Latin America hosted at the Federal University of Paraná, Curitiba, Brazil.
5. Extend our comparative analysis to Latin American analysis to Latin America, focusing initially on Argentina and Brazil.
6. Gauge the contributions of foreign-born scientists and engineers to the development of nanotechnology in the United States through a study of recent PhD's in nanotechnology

7. Build a nano-firm and organization database incorporating a global value-chain approach, using it to populate a “California in the Nano Economy” website, and develop comparison state databases.
8. Develop our internal capability to conduct bibliometric and patent analysis, through the work of postdoc Luciano Kay.
9. Continue our working relationship/collaboration with Phil Shapira and Jan Youtie at Georgia Tech, to advance our joint efforts in bibliometric and patent analysis.
10. Complete data collection on foreign graduate students in STEM departments at UCSB (“open doors” project).
11. Initiate a survey (in China) of leading nanotech academic researchers, to assess their perceptions of the strengths and weaknesses of China’s approach to innovation.
12. Plan for future, post-CNS research and funding needs to continue the work begun under CNS

### 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, two of which are being conducted in close collaboration with IRG-3:

- IRG 2-1: China’s Developmental State: Becoming a 21<sup>st</sup> Century Nanotech Leader: Appelbaum, Parker, Cao, Stocking, Gebbie, Han
- IRG 2-2: Comparative Study of State Nanotechnology Policy: U.S., China, Japan: Appelbaum, Block, Han, Gebbie, Stocking, Nightingale, Stacy; Foladori, Zayago,, Invernizzi
- 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, International Collaboration in Nanotech Research and Publication: Lenoir, Mehta, Herron, Weiss, Dsouza, Pachon, Donahue
- IRG 2-5: Global Value Chain Analysis (X-IRG): 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: ReLANS, Research in Mexico, Latin America: Foladori, Záyago Lau, Appelbaum, Parker, Kay
- IRG 2-10: Bibliometric and Patent Analysis/Mapping: Kay, Mehta
- 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, Invernizzi
- IRG 2-13: Corporate Strategies of Latin American Nanotech Companies and Their Policy and Institutional Contexts with Focus on Argentina and Brazil: Kay, Appelbaum, Parker, Invernizzi

IRG 2-14 Survey of China Nanotechnology Scholars in Leading Chinese Universities:

Appelbaum, Han, Stocking, Gebbie, Simon

IRG 2-15: Framing Nanotechnology in the Media (X-IRG): Stocking

IRG2's core efforts are located at UCSB, where Appelbaum meets weekly or biweekly with his graduate fellows (Stocking and Gebbie; and Han, formerly a fellow, is now an IRG2 postdoc who assists in overseeing the various projects as well as taking the lead in several, as indicated. Our meetings also include UCSB's development economist in Global & International Studies (Mehta) and IRG2 postdoc Kay, as well as undergraduate researcher Nightingale. Integration is facilitated through regular meetings, reading and writing assignments, publications, and conference participation (for example, SASE in Milan, June 25-29, 2013, where IRG2 organized a panel and presented; S.NET in Boston, October 27-30, 2013, where IRG2 organized a panel and our graduate students and collaborators presented). A number of the core IRG2 participants are not in Santa Barbara. Parker (on loan from STPI to the U.S. Agency for International Development in D.C.) and Cao (at the University of Nottingham, U.K.) were looped in via conference calls during most of IRG2's meetings.

Luciano Kay, who joined IRG-2 as a postdoc on June 1, 2012, has brought IRG2 researchers into collaborations with his former colleagues at Georgia Tech (Phil Shapira and Jan Youtie). Shapira organized a workshop at the University of Manchester, England (June 24-26, 2013), at which Appelbaum and Parker gave a keynote presentation on China; they also attended the CNS Research Summit February 1, 2014, as well as an IRG2 all-day planning and strategy session the day before. Kay has been provided with a high-powered workstation that enables him to run patent and publication data locally, using Vantage Point (the software he used at Georgia Tech to conduct his analysis); this enables 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. While this was not funded, we hope to pursue other funding for this project.

Our other Duke University partners (Lenoir, Herron) have completed their development of the GLOBONANO database, and are finishing publications based on their research, including a collaborative publication with Mehta. Because we now have in-house capability for bibliometric and patent analysis, we will no longer be funding GLOBONANO, although we will continue our collaboration with Lenoir. 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, initially supported in part by a separate grant from UC-MEXUS/CONACyT, was facilitated by face-to-face meetings at research summits and at various conferences (SASE; Curitiba, Brazil, Sept 5-7, 2013); Zayago joined us in September 2012 as a postdoc, remaining until May 2013 (this was fully funded by CONACyT). Our work with ReLANS (the Latin American Nanotechnology Network, headed up by Zayago) continues; we co-sponsored and participated in a conference on nanotech and labor in Curitiba, Brazil in conjunction with the annual meeting of ReLANS (the conference was funded through Appelbaum's MacArthur Foundation Chair funds). This connection also brought Noela Invernizzi into our project. She is on the faculty of the Federal University of Parana, Brazil; her expertise is in Brazilian nanotechnology policy, the social and ethical implications of nanotechnology for developing countries and nanotechnology implications for labor.

Finally, we continue to work with a number of other affiliated faculty members: Rachel Parker, former CNS Fellow (where she focused on nanotechnology in China), currently on leave from STPI to work with USAID for a year on technology issues in developing countries; Denis Simon, Vice Provost of ASU's Office of International Strategic Initiatives and one of the world's leading experts on science, technology and innovation in China; Fred Block, Research Professor in Sociology at UC Davis, whose research focuses on U.S. industrial policy; 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**

IRG2's focus, a comparative-historical and quantitative analysis of the development of nanotechnology, crosscuts with a number of other CNS initiatives and projects. IRG2 and IRG1 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 IRG2 researchers Motoyama, Parker, and Appelbaum examined the historical origins of the U.S. National Nanotechnology Initiative. IRGs2 and 3 also collaborate in development of the X-IRG work by Frederick at Duke on the US and global nano industry and Stocking on framing nano in print and social media. IRGs 2 and 3 are also currently jointly planning a November 13-15, 2014 conference on "Democratizing Technologies: Assessing the roles of NGOs in shaping technological futures." As noted above, the September 5-7, 2013 conference on nanotech and labor in Curitiba, Brazil also contributes to the work of IRG3.

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

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 21<sup>st</sup> 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, public officials, and entrepreneurs in China.

During this review period two articles were published (one in a special issue of *Development and Change* focused on China and co-edited by Appelbaum), and one additional paper has been completed and is ready for submission:

- Motoyama, Yasuyuki, Cong Cao, and Richard Appelbaum, "Observing Regional Divergence of Chinese Nanotechnology Centers," *Technological Forecasting and Social Change*, March 2013
- Jeffrey Henderson, Richard Appelbaum, and Suet Ying Ho, "Globalization With Chinese Characteristics: Externalizations, Dynamics, and Transformations," *Development and Change: Special Issue on Globalization With Chinese Characteristics* (November 2013): 1221-1253
- Jeffrey Henderson, Richard Appelbaum, and Suet Ying Ho (eds.), *Development and Change: Special Issue on Globalization With Chinese Characteristics* (November 2013)
- *Technology and Innovation in China: China's Evolving Role in the Global Science and Technology System* - book proposal to Polity Press (solicited by Polity). Co-authors: Richard Appelbaum, Cong Cao, Rachel Parker, Denis Simon. Contract has been offered and is being signed.

**IRG 2-2:** Comparative Study of State Nanotechnology Policy: U.S., China, Japan: Appelbaum, Block, Han, Gebbie, Stocking, Nightingale, Stacy; Foladori, Zayago, Invernizzi

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.

The overall goal of this project is to develop an understanding of the ways in which governments attempt to manage, nurture, and cultivate nanotechnology research within their country. Understanding which processes are most fruitful will be helpful for policymakers evaluating new directions for nanotechnology policy. To do this, we are gathering information on a subset of these policies and comparing varying facets to develop a framework for analysis. This framework will include funding levels, the development of highly concentrated research regions, regulation analysis, and other relevant areas. When coupled with certain output metrics, including publication and patent information, we aim to use this tool to analyze the effectiveness of nanotechnology policy in each country. Research aims include descriptively analyzing nanotechnology policy in selected countries, developing a framework for evaluating

nanotechnology policy in a subset of these countries, and applying this framework to all countries with significant nanotechnology policy.

Between May and June 2013, our working group developed a set of criteria for selecting countries. In this regard, we sought to include countries at varying levels of technological development, implementation of nanotechnology and other emerging technology policies, as well as overall level of development, system of governance, and power centralization or diffusion. We decided on eventually including EU countries, particularly Germany, as well as Latin American countries like Brazil and Mexico and Asian countries like China and India.

From June to August 2013, an intern (Marisa Stacy) under the umbrella of the Center for Science and Engineering Partnership's Internship in Nanosystems Science, Engineering and Technology (INSET) began gathering policy information on a subset of these countries and doing some preliminary analysis of their funding levels, grant program requirements, and qualitative analysis of nanotechnology regulations. She gathered information on Germany, Russia, France, the United Kingdom (UK), the European Union (EU), and South Africa, although she primarily focused on Germany, Russia, the UK, and the EU. Preliminary analysis of the database she collected has begun. Due to previous research, the IRG already has information on China and several Latin American countries. From June to September 2013, IRG2's undergrad researcher (Emily Nightingale) has worked with us to develop a profile of India's nanotechnology policy and how it has been implemented across the country in anticipation of further research there. Currently, we are in the process of analyzing data gathered by IRG2's undergrad researcher as well as finding new relevant policy information for other countries of interest. We have also submitted a UC-MEXUS/CONACyT proposal, with Foladori, Zayago, and Parker, that would partially support the development of a comparative framework, focusing on work done in Mexico and Latin America.

We also note that Choi, in connection with IRG1, is conducting research into the policies and practices that led to the development of nanotechnology in East Asia since the 1990s. Focusing on South Korea and Japan, this project seeks to place the Asian development within the broader context of global nanotechnology, as well as in its historical context. Going beyond the usual discussions focused on national policies, this project aims to provide detailed case studies involving individual researchers, contributing to an understanding of the specific dynamics among policies, institutions, and individual scientists and engineers in Asian societies, while analyzing the development of national policies for promoting nanotechnology in South Korea. While this year's research has been a case study of the Seoul National University Nanoelectronics Institute, projected future work will more broadly tie in with the work of IRG2, examining the Korean National Nanotechnology Initiative.

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

We are currently focusing on Suzhou Industrial Park (SIP), "China's Silicon Valley," as a case study. Based on interviews and research conducted at the 2012 Chinano Conference and Exposition held at SIP, we have papers in preparation and under submission. This research poses two key questions: "Does SIP function as a Marshallian Industrial District, with regional developmental spillover effects?" "Does SIP result in innovative products with commercial value?"

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.

We did not conduct additional field research during this period, focusing instead on writing papers on SIP. Xinyue Ye, who recently joined our IRG, is contributing to the effort by conducting a spatial analysis of patent-related data in China. 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. His next step will be to apply 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. 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 gave a keynote address (“Nanopolis and Suzhou Industrial Park: China’s Silicon Valley?”) at a conference organized by Phil Shapira at the University of Manchester England (June 24-26), and a paper with the same title at the IRG2-convened panel at the annual SASE (Society for the Advancement of Socioeconomics) conference in Milan (June 27-29). Data were analyzed using Hyper Research (qualitative data analysis and management software). A series of codes were developed in order to iteratively and inductively tease out themes emergent in the interview data collected previously. Codes were grouped by theme in order to situate the work in the context of the literature review explained above. Feedback received at both meetings was incorporated into a paper which has now been completed and will be submitted for peer review. This paper critically examines 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.

- Richard Appelbaum, Rachel Parker, and Cong Cao, “Nanopolis and Suzhou Industrial Park: China’s Silicon Valley?” (in preparation)
- Richard Appelbaum, Matt Gebbie, Shirley Han, and Galen Stocking, “Can China Become a Nanotech Innovator?” (under review)

**IRG 2-4:** Development of GLOBONANO database of publications, patents, products, International Collaboration in Nanotech Research and Publication: Lenoir, Mehta, Herron, Weiss, Dsouza, Pachon, Donahue



During the past reporting period the GLOBONANO database was updated, bringing the records of metadata for worldwide literature in nanotechnology up to date through Fall 2013. The key feature of the work by Patrick Herron, Mathew Thomas, and Lanceton Dsouza was the completion of a second version of an automated record collection application designed to keep up with changes from ISI. During the 2013 summer Mat Thomas, a graduate student at Duke in MIS who joined the Jenkins Collaboratory this year, developed a new process that identifies and extracts explicit relationships between author, author address, and article. This relationship is explicit for all nano records for years 2007 and after. More importantly the new data set now includes full sets for all countries (100), up from 68 countries in the previous version and 43 in the first version. Also being added to the new collection is metadata for all conference proceedings. Additionally the database is being expanded to all years (1974-2013).

During the present reporting period Herron migrated the database to a new server, retiring the older hardware carrying the last versions of the GLOBONANO database. Further, the database is being replicated on a second server to provide maximum uptime and performance. Additionally new equipment was acquired to not only replicate the database but also to maintain two collocated backup copies of all pertinent data. Herron and Pachon completed work on a real-time USPTO data extraction tool for extracting nanotechnology and Bionanotechnology patents. The purpose of such a tool is to fill in US patenting metadata not yet captured by the PATSTAT dataset. Herron continues in his efforts with Evan Donahue, who is picking up on previous work by Jan Pachon, to develop a nanoproducts and nanofirms database component for GLOBONANO.

During the current funding period efforts to extract firm-level data were augmented with the development of tools that crawl financial sites (e.g., EDGAR, SEC filings). A large number of candidate firms (~20,000) have been programmatically identified by Pachon and revised by Herron and Donahue as participants in the nanomaterials research, manufacturing and market worldwide. A second run of collecting Nanowerk was rewritten and executed by Donahue in September 2013. In addition to SEC and Nanowerk data, Herron, Pachon and Donahue together collected nanotechnology-related corporate records (profiles and business-to-business transactions) from the OneSource and Zephyr business databases. Herron, Thomas and Donahue have recently begun merging these disparate data sets into the single revised database model completed in July 2013. The dataset now incorporates NSF, NIH, and NCI RTeporter funding data.

Several research projects involved collaboration with Aashish Mehta. "Specialization, Diversification and the Scientific Influence of Nations" examines the rising scientific influence of new scientific powers in the area of nanotechnology, asking which nation's scientific influence is growing and falling; whether countries are playing a "quantity or quality game," and whether they are specializing in specific sub-fields of nanoscience, or diversifying their mix of research subfields to conform with the global mix of subfields. A related question is whether a country has tended to produce higher quality science when it specializes or when it diversifies its research portfolio. A draft paper has been written and is nearly ready to submit. "International Collaboration and the Impact of Nanotechnology Research" asks whether international collaboration in nanotechnology research enhances its impact. This project seeks to show that with proper controls and methods, the identity of collaborators matters a great deal. Partnerships between pairs of countries can be classified according to whether they are associated with higher impact for both, one or neither countries relative to single-country papers. Changes in country impact characterizations over time shed light on changes in national scientific capacity.

Preliminary findings suggest that the old scientific powers (US, EU, Japan) are ceding scientific influence to the newer, Asian powers. Among the new powers, China and (especially) Singapore, stand alone in achieving higher scientific influence by increasing citation rates per paper. The others (India, Brazil, Taiwan, Korea) are primarily advancing by producing more, lower impact research. The old powers, especially the US, continue to maintain specialized research portfolios with an emphasis on bionano. The newer powers have dramatically diversified their research portfolios in the last decade, and increasingly emulate the research mix of the world as a whole. Tentatively, it appears that, controlling for the identity of the country, specialization is associated with lower research quality. Several robustness tests on question are on-going, including the use of different measures, subsamples of countries, subsamples of journals, weighting schemes and the introduction of appropriate control variables. Other results indicate that collaborations with US and German scientists are associated with the greatest gains in citation rate, collaborations with Russian scientists are associated with reduced citation rates, and, while collaborations with Chinese scientists were associated with lower impact, this has changed dramatically. A variety of robustness tests are pending before we can be sure the results are not spurious.

Papers submitted or under preparation during this review period include:

- Tim Lenoir and Patrick Herron, “The National Cancer Institute and the Takeoff of Nanomedicine,” under review at *Scientometrics*
- Tim Lenoir and Patrick Herron, “Star Scientists, Federal Funding and the Takeoff of Bionanotechnology and Nanomedicine,” revising for resubmission
- Aashish Mehta, Patrick Herron, Tim Lenoir, Cong Cao, “Measuring the Impact of International Collaboration in Nanotechnology Research” (near completion)
- “The Scientific Influence of Nations: Quantity, Focus and Impact in Nanotechnology Research” (under review)
- “Evaluating the Effectiveness of the NCI Alliance for Nanotechnology: Phase II” (in preparation)

**IRG 2-5:** Global Value Chain Analysis (X-IRG): 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 include the California in the Nanotechnology Global Economy website.

During this reporting period, data collection was expanded to encompass firms in all states (~1,500 locations). Data was added for more than 100 products for California companies. Forward and backward linkages were made for all categories for each stage, sector and sub-sector in the nano value chain, and important global/national firms and supporting organizations outside California were also added for each stage, sector & sub-sector. Investor information was added to the website, including affiliated firms with sources of funding (SBIR, Venture Capital, etc.). Work was also done (in collaboration with Edgar Zayago Lao and Guillermo Foladori) on developing a database of publications by authors with an institutional affiliation in Mexico, resulting in a journal article and presentations for S.NET and SNO conferences; additionally, two

short subject pieces for the California Research Bureau were co-authored with Christine Shearer and Jennifer Brown on nanotechnology in California (overview, potential risk, and risk perceptions).

During this period, the following papers have resulted:

- Frederick, Foladori, Zayago, “Twelve Years of Nanoscience and Nanotechnology Publications in Mexico” (published)
- Frederick, Shearer, Brown, “Short Subject: Nanotechnology in California Estimates” (under preparation)
- Frederick, Shearer, Brown, “Quantifying the Nanotechnology Workforce in the US: Methods, Barriers & Estimates” (under preparation)

IRG2-6: International Collaboration in Nanotech Research and Publication: Mehta, Lenoir, Herron, Cao, Han. Project completed prior to this reporting year.

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. Kottoff’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.

During this review period, this project has resulted in one publication:

- James Walsh, “The Impact of Foreign-born Scientists and Engineers on American Nanoscience Research,” *Science and Public Policy* (forthcoming)

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

**IRG 2-9:** ReLANS, Research in Mexico, Latin America: Foladori, Záyago Lau, Appelbaum, Parker, Kay, Invernizzi

This joint project, with the Doctoral Program on Development Studies at the University of Zacatecas (Mexico), analyzes the development trajectory of nanotechnology in Mexico and Latin America, with special attention to scientific collaboration and productive agreements between U.S., Mexican, and other Latin American country institutions. It is intended both to deepen our understanding of nanotechnology in Mexico, as well as provide a comparative analysis of nanotechnology programs and policies in Latin America.

With regard to Mexico, research was conducted primarily by Guillermo Foladori and Edgar Zayago Lau. During this reporting period a database was created consisting of Mexican firms either conducting research or manufacturing with nanotechnologies. The major universities and research centers working with nanotechnology were also identified, and a bibliometric analysis was conducted of major nanoscience and nanotechnology publications. Zayago Lau has also been exploring the social sustainability of nanotechnology in Mexico. 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.), as well as how Mexico's approach to nanotechnology has been shaped by Mexico's relations with the US and EU.

In terms of other Latin American countries, research focused on Argentina and Brazil, and was conducted primarily by Luciano Kay in conjunction with Jan Youtie and Phil Shapira at Georgia Tech. A theoretical framework and corresponding design was developed, in order to better address the issue of innovation pathways in emerging technologies in developing countries. A set of meetings with scholars and policy-makers in Argentina (May-June 2013) helped Kay develop main dimensions of this framework and re-design the data gathering plan to account for company activities that may not be reflected in scientific publication and patent databases. Research protocols for gathering data from multiple sources are currently under development, and bibliometric and patent data collection is now replete. Kay has also completed fieldwork in Argentina, and is currently conducting fieldwork in Brazil, to complement the quantitative data. He has also initiated collection of company website data and policy documents. Some preliminary analysis has been done for purposes of conference presentations (see below).

Publications include:

- Edgar Zayago Lau, Guillermo Foladori, Richard P. Appelbaum, and Edgar Ramon Arteaga Figueroa, "Empresas Nanotecnológicas en México: Hace un Primer Inventario," *Estudios Sociales* 42 (July-December 2013), pp. 9-25
- Zayago Lau, Edgar; Foladori, Guillermo and Arteaga, Ramón (2013). Toward an Inventory of Nanotechnology Companies in Mexico, *Nanotechnology, Law and Business Journal*, 9.3 (Winter 2012-2013) pp.283-292
- Guillermo Foladori, Edgar Záyago Lau, E. Sandóval, Richard Appelbaum, and Rachel Parker, "Colaboración México-Estados Unidos en MEMS / NEMS. *Estudios Críticos del Desarrollo*, 3(4)
- Edgar Zayago Lau, Stacy Frederick, Guillermo Foladori, "Twelve Years of Nanoscience and Nanotechnology Publications in Mexico," *Journal of Nanoparticle Research* (under review)

- Edgar Zayago Lau, “La nanotecnología y su inserción en el desarrollo,” *Observatorio del Desarrollo* 4 (2013 forthcoming)
- “The Social Relevance of Nanotechnology in Mexico,” *Sociologia y Tecnociencia (Sociology and Technoscience)* 3(2) 2013: 48-70

Related publications (but without CNS support) include:

- Guillermo Foladori, “Nanotechnology Policies in Latin America: Risk to Health and Environment,” *Nanoethics* (August 2013)
- M. Guerrero Garcia and Guillermo Foladori, Divulgación de las implicaciones sociales y Ambientales de las nanotecnologías. *Revista Digital Universitaria*, 14(4) (April 1, 2013)
- Guillermo Foladori, F. Bejarano, and Noela Invernizzi, “Nanotecnología: gestión y reglamentación de riesgos pra la salud y el medio ambiente en América Latina y el Caribe. *Trabalho, Educação e Saúde*, 11(1) 2013, 145–167

During this reporting period, IRG2 was directly involved with the previously mentioned September 5-7 conference on labor and nanotech in Curitiba, Brazil, hosted jointly with ReLans (and funded in part by Appelbaum’s MacArthur Chair funds), the purpose of which was 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. Appelbaum, Foladori, and Zayago Lau presented (Foladori and Appelbaum co-organized the conference with Noela Invernizzi). Kay also presented at the 2013 Atlanta Conference on Science and Innovation Policy, September 26-28, and the 2013 S.NET Boston Conference, October 27-29.

#### **IRG 2-10: Bibliometric and Patent Analysis/Mapping (Kay, Mehta)**

A 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: nanotechnology development in Asia and 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 the IRG2 team on a number of projects. This allows access to reliable data and time to further develop own data sources, as described below.

The IRG2 Bibliometric and patent analysis/mapping project also seeks to develop its own databases of scientific publication and patents in the field of nanotechnology. For this, the IRG2 team 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: Acquisition of IT hardware to host databases and process big datasets with software for text mining and data analysis and visualization (accomplished in previous reporting period);

Software installation and patent database creation using raw patent data (started, ongoing in current period using data 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 (planned start for next reporting period); and Download of raw data and creation of scientific publication database (planned start for next reporting period).

During this reporting period, considerable progress was made in database development. The IRG2 group purchased hardware to install the team's scientific publication and patent databases. UCSB's IT department installed this hardware. Galen Stocking installed a Patstat database using data purchased from EPO in 2012. Ongoing efforts will make this database accessible to the rest of the team for the creation of patent datasets. The IRG2 Bibliometric and Patent Analysis/Mapping team has updated the automation scripts for Visualization with Gephi and VantagePoint which allow exporting data from text mining software into visualization software for network and visual analysis. This scripts are used in ongoing work and shared with colleagues (e.g. in this period, Wei Fan, Beijing Institute of Technology, and Brenda Brady, National Research Council Canada). Other related activities aimed at database development involved testing of trial online version of the Chinese patent office (SIPO) database and downloading/exploring alternative data sources such as EEE-PPAT developed by ECOOM-EUROSTAT-EPO PATSTAT. The purpose of these activities is to find alternative data sources that can enhance available dataset by providing better quality data that are key in IRG 2 research (e.g. full address of Chinese patent assignees, harmonized patent assignee names).

The IRG2 Bibliometric and Patent Analysis, Mapping team continued collaborations and interactions (via email, Skype and in person at the Atlanta S&T Conference 2013) with Dr. Jan Youtie and Dr. Philip Shapira, colleagues from Georgia Institute of Technology, as well as with co-authors in other projects. Conversations have been also started to initiate collaborations with colleagues from the U.S. and abroad

Research progress can be categorized as falling into several areas:

1. Development of nanotechnology in Asia

- a. Completion of work on the paper "Corporate Strategies in Emerging Technologies: The Case of Chinese Firms and Energy Storage-Related Nanotechnology Applications" in collaboration with Dr. Jan Youtie, Georgia Institute of Technology. This article is in press, to be published as book chapter in Konrad, Kornelia, Christopher Coenen, Anne Dijkstra, Colin Milburn, and Harro van Lente (eds.). 2013, *Shaping Emerging Technologies: Governance, Innovation, Discourse*, Berlin: IOS Press. This paper investigates 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.
- b. Work on the paper "Two Poles in Global Nano Research: Structure and Evolution of the Global Nano Collaborative Innovation Network" which investigates global scientific collaborations in nanotechnology and draws lessons for China. This research is led by Wei Fan, Yun Liu, and Jinglan Chen from School of Management and Economics, Beijing Institute of Technology, Beijing, China, and has partial support from CNS IRG-2 (Luciano Kay). The paper has been accepted for conference presentation at the Asia Pacific Innovation Conference 2013, December 6-7, 2013, Taiwan.
- c. New project on geo-location of patenting activity in China in collaboration with Dr. Xinyue Ye, Kent State University. This work aims at exploring co-location issues and



dynamics of nanotechnology innovation in China. Initial steps have included exploring alternative patent datasets to gather necessary location data of patent assignees.

2. Development of nanotechnology in Latin America
  - a. A new research project on "Nanotechnology development in Latin America" with focus on Argentina and Brazil has been started and developed to the point of data gathering and preliminary analysis for conference presentation. This work is undertaken in collaboration with Dr. Richard Appelbaum (CNS-UCSB) and Dr. Philip Shapira and Dr. Jan Youtie, colleagues from Georgia Institute of Technology (see previous IRG2-7 project description).
3. Scientometrics and patent analysis
  - a. Finalized research on patent visualization "Patent Overlay Mapping: Visualizing Technological Distance" in collaboration with colleagues from Georgia Tech, Search Technology and Ingenio Spain, and submitted for journal publication (reviewed and accepted). In press in the *Journal of the American Society for Information Science and Technology* (JASIST)
  - b. Started new research "Mapping the Global Race for National Security Technologies" in collaboration with *Dr. Aashish Mehta*. This project investigates the global development of national security technologies and their implications for U.S. security policy, drawing on the method and technique for patent mapping developed by Luciano Kay and colleagues from Georgia Tech and other institutions (see this report). This project has been awarded a \$11,000 research grant from the UC Institute on Global Conflict and Cooperation
  - c. The IRG 2 Bibliometric and Patent Analysis, Mapping team updated the automation scripts for "Visualization with Gephi and VantagePoint" which allow exporting data from text mining software into visualization software for network and visual analysis and "Patent maps and overlays" which allow creating patent maps using VantagePoint and Pajek. These scripts are used in ongoing work and shared with colleagues (e.g. Georgia Tech colleagues) and more broadly disseminated to the policy and research community (e.g. Wei Fan, Beijing Institute of Technology and Brenda Brady, National Research Council Canada)
  - d. Prepared and submitted map visualization "Visualizing R&D topical concentrations through science and patent overlay maps" to the 10<sup>th</sup> Iteration of Places and Spaces: Mapping Science Exhibit on "The Future of Science Mapping" (2014) in collaboration with colleagues from Georgia Tech, Search Technology and Ingenio Spain
  - e. Worked on book chapter on patent mapping, network analysis and visual analytics for new edited volume on Patent Information Retrieval (Springer) with colleagues from Georgia Tech, Search Technology and Ingenio Spain
4. Corporate strategies in emerging technologies
  - a. Worked on and finalized research "Signs of Things to Come? What Patent Submissions by Small and Medium-Sized Enterprises Say About Corporate Strategies in Emerging Technologies" in collaboration with Dr. Jan Youtie and Dr. Phil Shapira (Georgia Tech). The paper was submitted and accepted for journal publication. The paper is published in *Technological Forecasting & Social Change*
  - b. Worked on and finalized research "Acquiring Nanotechnology Capabilities: Role of Mergers and Acquisitions" in collaboration with Dr. Jan Youtie (Georgia Tech). The paper was submitted and accepted for journal publication. This paper is published in *Technology Analysis & Strategic Management*
  - c. Started new work on strategies of Brazilian companies in nanotechnology with Dr. Stacey Frederick and Dr. Noela Invernizzi. This research seeks to further exploit datasets created for other projects

- d. Initiated discussion with Prof. Jennifer Woolley, Leavey School of Business, Santa Clara University to develop collaborations particularly aimed at data sharing to enhance CNS dataset of nanotechnology companies
5. Specialization, Diversification and the Scientific Influence of Nations (with Mehta): This project examines the rising scientific influence of new scientific powers in the area of nanotechnology. We ask four questions: (1) which nation's scientific influence is growing and falling (2) whether countries are playing a "quantity game" or a "quality game" (i.e. producing a lot of scientific ideas, or focusing their resources on producing excellent ones) (3) whether they are specializing in specific sub-fields of nanoscience, or diversifying their mix of research subfields to conform with the global mix of subfields (4) whether a given country has tended to produce higher quality science when it specializes or when it diversifies its research portfolio. The paper is complete, posted on the Social Science Research Network, and under review at the journal *Science*.
6. International Collaboration and the Impact of Nanotechnology Research (with Mehta): This project asks whether international collaboration in nanotechnology research enhances its impact. This question has been examined before, but the methodologies have been crude in several respects: (1) the effect of adding an international collaborator was confused with the effect of simply adding a collaborator; (2) important controls were excluded (field-specific citation rates, table length etc.); and, most importantly, (3) analyses typically ignore the identity of the collaborators. Preliminary research shows that with proper controls and methods, the identity of collaborators matters a great deal. Partnerships between pairs of countries can be classified according to whether they are associated with higher impact for both, one or neither countries relative to single-country papers. Countries can be characterized by the apparent effects of including their scientists on papers. Changes in country characterizations over time shed light on changes in national scientific capacity

Research involving the exploitation of scientific publication and patent databases falls into several areas, resulting in a number of new papers:

- Luciano Kay, Jan Youtie, and Philip Shapira, "Inter-industry knowledge flows and sectoral networks in the economy of Malaysia" (under review)
- Luciano Kay and Jan Youtie, "Corporate Strategies in Emerging Technologies: The Case of Chinese Firms and Energy Storage-Related Nanotechnology Applications," chapter in Kornelia Konrad, Christopher Coenen, Anne Dijkstra, Colin Milburn, and Harro van Lente (eds.), 2013, *Shaping Emerging Technologies: Governance, Innovation, Discourse*. Berlin: IOS Press. This paper investigates 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.
- Wei Fan, Yun Liu, Jinglan Chen (School of Management and Economics, Beijing Institute of Technology), and Luciano Kay, "Two Poles in Global Nano Research: Structure and Evolution of the Global Nano Collaborative Innovation Network" (in preparation; presented at the Asia Pacific Innovation Conference 2013, December 6-7, 2013, Taiwan ). This paper investigates global scientific collaborations in nanotechnology and draws lessons for China.
- Luciano Kay, Nils Newman, Jan Youtie, Alan Porter, and Olisrael Rafols, "Patent Overlay Mapping: Visualizing Technological Distance," *Journal of the American Society for Information Science and Technology* (2013).
- Luciano Kay, Jan Youtie and Phil Shapira , "Signs of Things to Come? What Patent Submissions by Small and Medium-Sized Enterprises Say About Corporate Strategies in Emerging Technologies," *Technological Forecasting & Social Change* (2013)

- Luciano Kay and Jan Youtie, "Acquiring Nanotechnology Capabilities: Role of Mergers and Acquisitions," *Technology Analysis & Strategic Management* (2013)

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

This project seeks to understand why international students pursuing nanotechnology-related degrees in American universities decided to leave their home countries to come to an American university. This involves several related research questions: How does the American research and education culture compares to the cultures that international students experienced in their home countries. What aspects of the American academic culture are perceived as strengths and weaknesses with regard to fostering a collaborative and creative environment? What influences the decision of international students to either stay in America or leave the United States following the completion of their degrees?

Between March 15 and April 15, 2013, IRG2 analyzed the "Open Doors" raw data set (a large collection of demographic information on international students that have come to study in American universities at the undergraduate, masters, and PhD levels) that we obtained from the Institute of International Education during the previous reporting period. This analysis led us to develop initial hypotheses regarding the research questions outlined above. For example, we noticed a dramatic spike in the numbers of undergraduate students that came to America beginning in 2008, which we hypothesized could be tied to the American economic downturn. By April 2013, we had obtained Human Subjects approvals and initiated a pilot survey study among the international graduate student population at UCSB to generate a data set that would address the above 3 aims. The survey officially concluded in June of 2013 and gathered 169 completed responses from students from 17 different countries. A particular success was the 47 completed responses we received from Chinese students, which will allow us to closely tie the findings from this pilot study to our ongoing work on nanotech development and innovation within technology parks in China

The survey data has now been analyzed. Preliminary highlights from the survey include: 88% of the respondents chose to attend an American university for a higher quality of education (Aims 1 and 2), greater than 73% of the respondents chose an American university to boost future career prospects (Aim 1), 77% of the respondents wish to remain in the US immediately following graduation with 88% of these respondents stating job opportunities as motivating this decision and 68% of respondents citing quality of life factors (Aim 3). There is a 90% likelihood that students wish to remain in the US after graduation if they wish to work outside of academia/research. We are now in the process of completing follow-up interviews with willing participants and writing our research paper for publication. We have completed 12 interviews so far and will send out a second round of emails asking for participation before closing this part of the study.

One presentation has been made thus far, by Grad Fellows Shirley Han, Galen Stocking, and Matt Gebbie, "A Global Nanotech Education: A Trend Analysis of Chinese S&T Students in the United States," Society for the Study of Nanoscience and Emerging Technologies annual meeting 10/2/2013.

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

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 the U.S. National Science Foundation anticipates a commercial revolution worth trillions of dollars within the next decade, with millions of 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 were examined in a series of papers presented at a CNS UCSB-organized session at the June 2013 SASE meetings in Milan (Appelbaum organized and chaired the session; presenters included Parker and Frederick, Walsh, Zayago Lau, and Kulinowski, as well as a discussant (Gallo). This topic was also discussed at the Curitiba, Brazil conference (September 2013)

**IRG 2-13:** Corporate Strategies of Latin American Nanotech Companies and Their Policy and Institutional Contexts with Focus on Argentina and Brazil: Kay, Appelbaum, Parker, Invernizzi, Shapira, Youtie. New project in this period.

A research project has been started on "Nanotechnology development in Latin America," with a focus on Argentina and Brazil, has been started and developed to the point of data gathering and preliminary analysis for conference presentation. This work is undertaken in collaboration with Richard Appelbaum, Philip Shapira, Jan Youtie. The purpose of this research project is to investigate the innovation pathways of developing countries in emerging technologies. During the current reporting period IRG2 developed the theoretical framework and corresponding research design to address the issue of innovation pathways in emerging technologies in developing countries, although further revisions will be done.

A set of meetings with scholars and policy-makers in Argentina (May-June) helped to develop main dimensions of theoretical framework (thanks to the identification of potential factors influencing the trajectories of companies in emerging technologies in the country case studies) and enabled a re-design of the data gathering plan to account for company activities that may not be reflected in scientific publication and patent databases. In addition to field research involving interviews with selected companies, this project includes bibliometric and patent analysis for the case studies, and the analysis of websites and company documents.

Research protocols are now complete, although further revisions will be done during the rest of the data gathering process as new insights into the research topic are gained. Firms have been selected based on data sources deemed reliable (databases of publications and patents,

government lists of firms receiving funding for nanotechnology R&D, key informants --scholars and government officials). The firm selection criteria sought to have variation in case studies in the following dimensions: industry, geographic location, size (within the SMEs group). The case selection process has been also affected by managers' willingness to participate in the study and project budget. Data has been gathered, including bibliometric and patent analysis (publication and patent data for Latin American companies based on Georgia Tech databases), and interviews have been completed with companies in Argentina and Brazil.

Some preliminary analysis has been completed for conference presentations (2013 Atlanta Conference on Science and Innovation Policy, Atlanta, GA, September 26-28, 2013 and S.NET Conference 2013, Boston, MA, October 27-29, 2013); the ongoing work involves the coding and analysis of interview transcription data and documentary data. This project now plans to fully exploit company data of the Brazil case studies to produce another journal publication that will incorporate a value chain perspective for company data, and expand the group's collaborations by incorporating Prof. Noela Invernizzi (Federal University of Parana, Brazil) in the team.

Papers under preparation:

- Richard Appelbaum, Philip Shapira, and Jan Youtie , "Nanotechnology development in Latin America" with a focus on Argentina and Brazil (data gathering and preliminary analysis for conference presentation)

**IRG 2-14:** Survey of China Nanotechnology Scholars in Leading Chinese Universities: Appelbaum, Han, Stocking, Gebbie, Simon; new project in this period.

This project has just been started. It will involve a survey of leading nanotech academic researchers in China, to assess their perceptions of the strengths and weaknesses of China's approach to innovation. Thus far we have planned a pilot study of ~2,000 Chinese scientists and engineers at each of the top 100 universities in China, as ranked by Wushulian (a researcher at the Chinese Academy of Management Sciences) for 2013. We have done a web-based survey (Baidu, in Chinese) of all Material Science and Engineering departments in these universities, and plan a second survey of Chemical Engineering departments (we estimate that these should encompass 80% of all nanoscientists and engineers at these universities). We have examined the CVs of all the scientists and engineers in these departments to determine which ones are engaged in nanotech-related research. Thus far some 1,200 scientists and engineers have been identified. The 100 universities were located in 33 different cities around China. Our next step is to develop a brief survey instrument and begin the pilot study.

**IRG 2-15:** Framing Nanotechnology in the Media (X-IRG): Stocking; new project in this period.

Given the powerful effects the media can have on public opinion, how nanotechnology is discussed in the media can shape considerably the attitudes the public has about nanotechnology. However, it is not clear how much of an effect the media has on domains such as nanotechnology and other emerging issues, which are often outside the day-to-day life of the average person. Additionally, changes in the media environment, including the proliferation of new sources as well as the ensuing fragmentation of the audience and the rise of social media, may further limit media effects.

The goal of this study is to measure the relationship between the media and the public as it relates to nanotechnology. It does this through an analysis of media and public attention to nanotechnology. Furthermore, it aims to characterize these responses in terms of their support

or opposition of the technology as well as the knowledge level exhibited by the response. It will begin by collecting media data on nanotechnology from newspapers, online news and blogs, and broadcast news, and analyzing public attention given to nanotechnology from Twitter as well as pre-existing opinion surveys. The overall aim is to analyze frame propagation across media segments.

To date, we have collected news data on nanotechnology, including broadcast transcripts and newspaper articles that discuss nanotechnology and related terms. These data extends to 1998, just before discussion of the NNI began. We have begun acquiring data on social media. After contacting several providers, we are currently in negotiation with Crimson Hexagon, which offers searchable data from Twitter, blogs, prominent websites, and discussion forums. We expect to have this data by the end of the quarter and begin analysis in the Summer.

**5. Broader Impacts of IRG-2:** As detailed throughout this report, IRG2 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 that national ambitions and global collaborations do not necessarily coincide. Another overarching concern of IRG2 (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.

### **Courses/teaching/mentoring that draws on CNS Research**

- Appelbaum uses his China research in large lower- and upper-division undergraduate courses (e.g., Global 2, Global 130) as well as his graduate seminars.
- Lenoir has directed two independent studies by undergraduates on recent developments of nanotechnology in China and the effectiveness of new innovation policies in stimulating indigenous innovation in China.
- Lenoir has directed two independent studies by undergraduates on recent developments of nanotechnology in China and the effectiveness of new innovation policies in stimulating indigenous innovation in China.



- Lenoir directed a senior honors thesis by Hannah Sieber at Duke on the history of “sea turtles” and attitudes of overseas Chinese students and business people in the North Carolina Research Triangle to their economic prospects upon returning to China. The thesis was completed in March 2013 and won the prize for the best honors thesis at graduation in International Comparative Studies.

## **Leverage**

- Appelbaum is the lead evaluator of Florida International University's Global Studies Program, and was a member of a 2-person evaluation team for Occidental College's Public Diplomacy Program, and will be the lead evaluator of the University of British Columbia's Liu Institute for Global Studies. In all of these cases he has the opportunity to use his CNS China work as an example of the importance of understanding China's high-tech turn. His co-authored introductory sociology textbook, published by WW Norton, draws heavily on his CNS-related research, as do a series of the previously mentioned You Tube videos, intended for student and instructors that feature him talking about his research.
- Frederick submitted an NSF proposal in February with Youtie and Shapira at Georgia Tech to conduct a collaborative project on value chain mapping a subset of the global nanotechnology economy using the data she has collected on firms, in conjunction with the data they have on patents and publications. Although the proposal was not funded by the NSF, we plan to seek other sources of funding.
- Mehta is consulting with the Asian Development Bank (an intergovernmental organization) on education and export diversification, using cross-national and cross-industry data to examine how education and industrial policy complement each other in countries seeking market share in technologically sophisticated products.
- The conference in Curitiba resulted in discussions with Flavio Orlando Plentz Filho, Coordinator of the Micro and Nanotechnology Department at MCTI (Brazil's Ministry of Science and Technology) about a possible future CNS collaboration.
- Luciano Kay has been interviewed by Julie Cohen, Public Affairs & Communications, UCSB, to further disseminate the work "Patent Overlay Mapping: Visualizing Technological Distance" in UCSB's news bulletins

## **IRG 2 Publications 2013-2014**

### **Primary Publications: Journals**

1. Cao, Cong, Appelbaum, Richard, & Parker, Rachel. (2013). Research is High and the Market is Far Away - Commercialization of Nanotechnology in China. *Technology in Society*, 35, 55-64.
2. Henderson, Jeffrey, Appelbaum, Richard, & Ho, Suet Ying. (2013). Globalization with Chinese Characteristics: Externalizations, Dynamics, and Transformations. *Development and Change: Special Issue on Globalization With Chinese Characteristics*, 44(6), 1221-1253. doi: 10.1111/dech.12066

3. Motoyama, Yasuyuki. (2014). Long-term collaboration between university and industry: A case study of nanotechnology development in Japan. *Technology and Society*, 36, 39-51.
4. Motoyama, Yasuyuki, Cong, Cao, & Appelbaum, Richard. (2014). Observing regional divergence in Chinese nanotechnology centers. *Technological Forecasting and Social Change*, 81, 11-21.
5. Walsh, James. (forthcoming). The Impact of Foreign-Born Scientists and Engineers on American Nanoscience Research. *Science and Public Policy*.
6. Záyago Lau, Edgar. (2013). The Social Relevance of Nanotechnology in Mexico. *Sociología y tecnociencia/Sociology and Technoscience*.
7. Záyago Lau, Edgar (forthcoming). Empresas nanotecnológicas en México: hacia un primer inventario.
8. Záyago Lau, Edgar, Frederick, Stacey, & Foladori, Guillermo. (2014). Twelve years of nanoscience and nanotechnology publications in Mexico. *Journal of Nanoparticle Research*, 16(2193). doi: 10.1007/s11051-013-2193-1

#### **Primary Publications: Books, Chapters, Reports and other Publications**

9. Kay, Luciano, & Youtie, Jan. (2013). Corporate Strategies in Emerging Technologies: The Case of Chinese Firms and Energy Storage-Related Nanotechnology Applications. In K. Konrad, C. Coenen, A. Dijkstra, C. Milburn & H. van Lente (Eds.), *Shaping Emerging Technologies: Governance, Innovation, Discourse*. Berlin, Germany: IOS Press / AKA.

#### **Leveraged Publications: Journals**

10. Kay, Luciano, & Youtie, Jan. (2014). Acquiring Nanotechnology Capabilities: Role of Mergers and Acquisitions. *Technology Analysis & Strategic Management*. doi: 10.1080/09537325.2013.872773
11. Kay, Luciano, Youtie, Jan, & Shapira, Philip. (2013). Signs of Things to Come? What Patent Submissions by Small and Medium-Sized Enterprises Say About Corporate Strategies in Emerging Technologies. *Technology Forecasting and Social Change*. doi: 10.1016/j.techfore.2013.09.006
12. Kay, Luciano, Youtie, Jan, Newman, Nils, Porter, Alan, & Rafols, Ismael. (forthcoming). Patent Overlay mapping: Visualizing Technological Distance. *Journal of the American Society for Information Science and Technology*.
13. Záyago Lau, Edgar. (2013). La inserción de la nanotecnología en el desarrollo. *Observatorio del Desarrollo*, 2(6).

#### **Leveraged Publications: Books, Chapters, Reports and other Publications**

##### **Submitted or in preparation publications: primary**

14. Appelbaum, Richard, Cao, Cong, Parker, Rachel, & Simon, Denis. (in preparation). *Technology and Innovation in China: China's Evolving Role in the Global Science and Technology System*. Polity Press.
15. Appelbaum, Richard, Gebbie, Matt, Han, Shirley, & Stocking, Galen. (in preparation). Can China Become a Nanotech Innovator?
16. Appelbaum, Richard & Parker, Rachel. (in preparation). Nanopolis and Suzhou Industrial Park: China's Silicon Valley?

17. Kay, Luciano, Appelbaum, Richard, Youtie, Jan, & Shapira, Philip. (in preparation). Innovation pathways of developing countries in emerging technologies: The case of nanotechnology in Argentina and Brazil.
18. Mehta, Aashish, Herron, Patrick, Cao, Cong, & Lenoir, Timothy. (under review). The Scientific Influence of Nations: Quantity, Focus and Impact in Nanotechnology Research.
19. Mehta, Aashish, Herron, Patrick, Lenoir, Timothy, & Cao, Cong. (in preparation). Measuring the impact of international collaboration in nanotechnology research.

#### **Submitted or in preparation publications: leveraged**

20. Fan, Wei, Liu, Yun, Kay, Luciano, & Chen, Jinglan. (in preparation). Two Poles in Global Nano Research: Structure and Evolution of the Global Nano Collaborative Innovation Network.
21. Kay, Luciano, Youtie, Jan, & Shapira, Philip. (under review). Inter-industry knowledge flows and sectoral networks in the economy of Malaysia.
22. Lenoir, Timothy. (in preparation). Evaluating the Effectiveness of the NCI Alliance for Nanotechnology: Phase II.
23. Lenoir, Timothy, Herron, Patrick, Wiess, Ben, McGuire, Aaron, Pachon, Jan, & Dsouza, Lanceton. (under review). The National Cancer Institute and the Takeoff of Nanomedicine. *Scientometrics*.
24. Lenoir, Timothy, Herron, Patrick, Wiess, Ben, McGuire, Aaron, Pachon, Jan, & Dsouza, Lanceton. (in preparation). Star Scientists, Federal Funding and the Takeoff of Bionanotechnology and Nanomedicine.
25. Záyago Lau, Edgar (in preparation). Nanomedicine development in Mexico: hopes and challenges.

#### **IRG 2 Presentations 2013-2014**

1. Appelbaum, Richard. "Nanotechnology as Industrial Policy: China and the United States," Annual Meetings of the International Studies Association, San Francisco, CA, April 4, 2013.
2. Appelbaum, Richard. "Will China Challenge the U.S. as a Technology Superpower? Some Lessons from the U.S. and Chinese Nanotechnology Initiatives," invited lecture at Arizona State University, Tempe, AZ, April 17, 2013.
3. Lenoir, Timothy. "Federal Funding and the Takeoff of Nanotechnology and Nanomedicine," presentation at the University of Chicago, Chicago, IL, May 15, 2013.
4. Appelbaum, Richard. "From 'Made in China' to 'Designed in China': Does China's High Tech Turn Mean an End to the China Sweatshop?" Keynote address Global Studies Association annual conference, Palos Verde, CA, June 7, 2013.
5. Appelbaum, Richard & Parker, Rachel. "Nanopolis and Suzhou Industrial Park: China's Silicon Valley?" Sustaining Growth for Innovative New Enterprises Academic Workshop - Manchester Institute of Innovation Research, Manchester, United Kingdom, June 25, 2013.
6. Appelbaum, Richard, & Parker, Rachel. "Nanopolis and Suzhou Industrial Park: China's Silicon Valley?" Annual Meetings of the Society for the Advancement of Socioeconomics (SASE), Milan, Italy, June 27-28, 2013.
7. Walsh, James. "The Impact of Foreign-Born Scientists and Engineers on American Nanoscience Research," Annual Meetings of the Society for the Advancement of Socioeconomics (SASE), Milan, Italy, June 27-28, 2013.

8. Cao, Cong. "Science, Technology, and Innovation in China: Progress, Problems, and Prospect," Sustaining Growth for Innovative New Enterprises Academic Workshop – Manchester Institute of Innovation Research Manchester Business School, University of Manchester, Manchester, United Kingdom, June 2013.
9. Cao, Cong, & Lü, Jialing. "Trajectory of China's High-Tech Development: The 'Growing Pains/Premature Senility' Thesis Revisited," Suzhou-Silicon Valley-Beijing 2013 International Innovation Conference on Technology Innovation and Diasporas in a Global Era, Suzhou, China, July 2013.
10. Zayago Lau, Edgar "Implications of Nanotechnology for Labor," Society for the Advancement of Socio-Economics, Milan, Italy, July 2013.
11. Appelbaum, Richard. "Making Blue the Green: Achieving Workers' Rights in the Global Economy," Annual Meetings of the American Sociological Association, New York, NY, August 10, 2013.
12. Appelbaum, Richard. "Achieving Workers' Rights in the Global Economy: Report from a Workshop at the Rockefeller Foundation Center, Bellagio, Italy," ASA Mini-conference on Labor and Global Solidarity, New York City, NY, August 12, 2013.
13. Appelbaum, Richard. "Nanotechnology, Labor, and Regulation," International Workshop on Nanotechnology and Society in Latin America, Curitiba, Brazil, September 5, 2013.
14. Foladori, Guillermo. "Global and Brazilian Trends in Nanotechnology," International Workshop on Nanotechnology and Society in Latin America, Curitiba, Brazil, September 5, 2013.
15. Zayago Lau, Edgar. "Advancement of Nanotechnology in Mexico," International Workshop on Nanotechnology and Society in Latin America, Curitiba, Brazil, September 5, 2013.
16. Kay, Luciano. "Innovation pathways of developing countries in emerging technologies: The case of nanotechnology in Argentina and Brazil," 2013 Atlanta S&T Conference, Atlanta, GA, September 26-28, 2013.
17. Kay, Luciano. "Nanotechnology corporate strategies and the influence of policy and institutional contexts: evidence from Latin American countries," Annual meeting of the Society for the Study of Nanoscience and Emerging Technologies (S.NET), Boston, MA, October 26-27. 2013.
18. Han, Shirley, Gebbie, Matthew, Stocking, Galen, & Appelbaum, Richard. "A Global Nanotech Education: A Trend Analysis of Chinese S&T Students in the United States," Society for the Study of Nanoscience and Emerging Technologies (S.NET), Boston, MA, October 27, 2013.
19. Mehta, Aashish. "The employment effects of nanotechnology: Informed speculation, going beyond the R&D sectors," Sustainable Nanotechnology Conference, Santa Barbara, CA, December 2013.

#### **IRG 2 Outreach Activities 2013-2014**

20. Stocking, Galen. Participant and Volunteer Nano-Days, Santa Barbara Museum of Natural History, Santa Barbara, CA, March 17, 2013.
21. Han, Shirley. Participant and Volunteer Nano-Days, Santa Barbara Museum of Natural History, Santa Barbara, CA, March 17, 2013.
22. Gebbie, Matthew. Participant and Volunteer Nano-Days, Santa Barbara Museum of Natural History, Santa Barbara, CA, March 17, 2013.
23. Parker, Rachel. Panelist CNS-UCSB Policy Briefs Workshop, Santa Barbara, CA, May 28, 2013.

24. Appelbaum, Richard & Lichtenstein, Nelson. Co-organizers, workshop on "Achieving Workers' Rights in the Global Economy," Rockefeller Foundation Center, Bellagio, Italy, July 4, 2013.
25. Appelbaum, Richard. "From Made in China to Designed in China: What does China's High-Tech Turn Mean for Chinese Workers?" presentation at workshop on "Achieving Workers' Rights in the Global Economy," Rockefeller Foundation Center Bellagio, Italy, July 4, 2013.
26. Appelbaum, Richard. "Regulation, Risk, and the Global Nanotechnology Workplace," Fielding Graduate University Summer Session Workshop on Global Systems, Santa Barbara, CA, July 16, 2013.
27. Appelbaum, Richard. "From Made in China to Designed in China: What Does China's High-Tech Turn Mean for Chinese Workers?" Fielding Graduate University Summer Session Workshop on Global Systems, Santa Barbara, CA, July 19, 2013.
28. Stacy, Merisa. "Comparative Nanotechnology Policy Analysis," Internships in Nanosystems Science, Engineering, and Technology (INSET), public presentation, Santa Barbara, CA, August 7-8, 2013.
29. Stacy, Merisa. "Comparative Nanotechnology Policy Analysis," (poster), Internships in Nanosystems Science, Engineering, and Technology (INSET), poster session, Santa Barbara, CA, August 15, 2013.
30. Kay, Luciano. Interview with Julie Cohen, Public Affairs & Communications, UCSB to disseminate the work "Patent Overlay Mapping: Visualizing Technological Distance" in UCSB's news bulletins, Santa Barbara, CA, September 19, 2013.
31. Lenoir, Timothy. Presentation on GLOBONANO project and the study of the NCI Alliance, webinar presentation to the National Nanomanufacturing Network's Nanoinformatics 2013 Workshop at the University of Pennsylvania, Philadelphia, PA, October 15, 2014.
32. Kay, Luciano. Interview with Wired UK (via email) to disseminate the work "Patent Overlay Mapping: Visualizing Technological Distance," November 18, 2013.
33. Kay, Luciano, & Han, Shirley. Presentation on strategies for advancing the collection, dissemination, and preservation of social dimensions research about nano and emerging technologies for research and public audiences Nanoscience and Emerging Technologies in Society: Research and Learning Tools (NETS) Workshop, Amherst, MA, December 6, 2013.
34. Kay, Luciano. Presented a short training by Skype on how to use patent mapping tools to Georgia Tech colleagues, December 6, 2013.
35. Kay, Luciano. Interview with UCSB Daily Nexis (via email) to disseminate the work "Patent Overlay Mapping: Visualizing Technological Distance," Santa Barbara, CA, January 16, 2014.
36. Appelbaum, Richard. "China - is public investment paying off?" Paulo Martines video interview for Brazilian TV broadcast, January 21, 2014.
37. Lenoir, Timothy & Herron, Patrick. Presentation on GLOBONANO project and the study of the NCI Alliance, webinar presentation for the National Cancer Institute's Working Group on Nanoinformatics, January 23, 2014.
38. Lenoir, Timothy. Presentation on GLOBONANO project and the study of the NCI Alliance webinar, presentation for the Duke Media Arts + Sciences Rendezvous, January 30, 2014.

## IRG 3 Progress Report: Risk Perception and Social Response

### Faculty and Senior Participants

<a href="#">B. Herr Harthorn</a> , Leader	Med anthropology	UC Santa Barbara
<a href="#">N. Pidgeon</a> , Co-leader	Applied Psychology	Cardiff University, UK
<a href="#">T. Satterfield</a> , Co-Leader	Env anthropology	University of British Columbia, CA
<a href="#">S. Anderson</a> [seed grant]	Env Politics	UC Santa Barbara
<a href="#">C. Beaudrie</a>	Associate	Compass Resource Management
<a href="#">E. Barvosa</a>	Chicana/o Studies	UC Santa Barbara
<a href="#">B. Bimber</a>	Political Science	UC Santa Barbara
<a href="#">K. Bryant</a>	Sociology	SUNY New Paltz
<a href="#">J. Earl</a>	Sociology	UC Santa Barbara
<a href="#">S. Friedman</a> [X-IRG]	Science Journalism	Lehigh Univ, Bethlehem, PA
<a href="#">R. Gregory</a>	Env Risk	Decision Research, OR
<a href="#">P. Holden</a>	Microbiology	UC Santa Barbara
<a href="#">M. Kandlikar</a>	Science policy	University of British Columbia, CA
<a href="#">G. Long</a>	Engineering	Compass Resource Management
<a href="#">D. Novak</a> [seed grant]	Music	UC Santa Barbara
<a href="#">J. Rogers-Brown</a>	Sociology	Long Island University, NY
<a href="#">P. Slovic</a>	Psychology	Decision Research, OR

### Affiliates

<a href="#">F. Bray</a>	Anthropology	Edinburgh University, UK
<a href="#">B. Egolf</a>	Sci Journalism	Lehigh Univ
<a href="#">P. Holden</a>	Microbiology, Eng	UC Santa Barbara
<a href="#">M. Metzger</a>	Communication	UC Santa Barbara

### Postdocs (3 + 5\*), Graduate Students (5), Undergraduate Students (2)

#### Postdoctoral researchers:

*Mary Collins	Env Sociology	Univ. of Maryland
*Lauren Copeland	Poli Sci	UC Santa Barbara
Shannon Hanna	Ecotoxicology	UC Santa Barbara
*Christine Shearer	Env Sociology	UC Irvine

#### International Postdoctoral researchers:

*Adam Corner	Social Psych	Cardiff UK
Christina Demski	Social Psych	Cardiff UK
*Anton Pitts	Env Risk	UBC
Merryn Thomas	Geog	Cardiff UK

#### Graduate students:

Lauren Copeland	Poli Sci	UC Santa Barbara
*Rachel Cranfill	Linguistics	UC Santa Barbara
Cassandra Engeman	Sociology	UC Santa Barbara
Ariel Hasell	Communication	UC Santa Barbara
Amy Foss	Chicano Studies	UC Santa Barbara

#### Undergraduate students:

Maria Yopez	Biochemistry	UC Santa Barbara
Kelly Pribble	Political Science	Victor Valley College

*\*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 develop and document 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 scientists and engineers in the field, diverse US publics and NGOs, the engineered nanomaterials industry, and policymakers/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 different 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, low risk signal amplification, and resultant conditions of attenuation, 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 has also been a vital component of research. This unprecedented lengthy opportunity to study emergent attitudes, beliefs and perceptions is a particular attraction of the nanotechnology 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 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 attention to safety issues 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 public interest groups, scientists and engineers, 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-based surveys of demographically diverse and representative US (and other) publics 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. IRG 3 also employs systematic qualitative research methods that 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 and comparative data.
- Examine emergent perceptions, attitudes and beliefs of the US (and comparative other) publics regarding new technologies. 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 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 deliberately avoid or purchase products with nanomaterials, and how these are related to the other factors driving boycotting and boycotting behavior.
- 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, and developing a new stream of research on

comparative environmental risk perception of energy futures involving unconventional oil and gas development.

- 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 who are critical decision makers about nano regulation.
- 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 as a method of bridging the gap between current uncertainty and available quantitative risk assessment (carbon nanotubes, nano silver).
- Study regulatory challenges across the product life cycle in the US.
- Analyze how the international and US-based nanomaterials industries' perceptions of risk and regulation impact their environmental stewardship & workplace safety practices, potential worker safety, 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 international NGO-engagement event.
- Through X-IRG researcher [Friedman](#), conclude comparative tracking of nano media coverage in print and online sources in the US and UK and final analyses. Work with XIRG researcher Stocking and IRG 3 researchers [Bimber](#) and Hasell to track twitter views on nano and fracking 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.
- Map out new syntheses of the nanotech risk perception field, based on the larger body of our work.
- Plan future fund seeking initiatives to extend the group's work.

### **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 with collaborating teams of researchers, lead institution listed first:

- IRG 3-1: Expert studies - UBC, UCSB, Decision Research, Compass Resource
- 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– Lehigh Univ [see X-IRG report on Friedman project]; UCSB: new project on twitter framing [see X-IRG report on Stocking project]
- IRG 3-6: Priming Effects in Judgments about Nano - 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(s): [see X-IRG Seed project program reports on Anderson and Novak projects]

***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 day and a half long IRG 3 meeting before the CNS Research Summit in Santa Barbara, Feb 1 2014; later in Year 9, the group plans a full meeting of lead personnel in Cardiff, UK Jun 23-25 2014.

IRG 3 organized full sessions of CNS-related research at the Society for Applied Anthropology (Denver, Mar 20-24, 2013); 4S (San Diego, Oct 10-13, 2013; organized and chaired by Harthorn & Collins), and SNET (Boston Oct 2013; co-organized by Copeland & Harthorn). The group also led organizing sessions for SNO (Santa Barbara, Nov 2013; Harthorn & Guston), and the American Anthropological Association meetings in Chicago, Nov 2013 (Harthorn). Harthorn served on the national organizing committee for the NNI's Risk3 Stakeholder Workshop, Washington DC, Sept 2013 where she also gave one of 2 keynote addresses. Pidgeon was an invited speaker at the Sackler Conference in Wash DC on the Science of Science Communication 2. Harthorn gave invited testimony to the US President's Commission on Bioethics in Feb 2014 in relation to the societal aspects of the new BRAIN Initiative. She is also serving on the executive committee for the NSF Workshop on Societal Implications of Synthetic Biology planned for Nov 2014.

#### **4. Major IRG3 research accomplishments**

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 and science, linguistics, materials science, political science, psychology, risk analysis, science and technology studies, science policy, sociology, and women's studies, as well as science and engineering fields. IRG 3 also contributes significant effort to the educational and outreach accomplishments of the CNS.

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

This work has strong synergies with IRG 3's public perception work and with our partners in the UC CEIN. In general this work has contributed to better understanding of 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**

UBC team's analytic work on **regulation across the life cycle** has concluded its work in the past year. In 2013, the UBC team completed a paper (Beaudrie, Kandlikar and Satterfield, 2013, *ES&T*) based on Beaudrie's Chemical Heritage Foundation commissioned study of regulatory gaps across the life cycle of nanomaterials (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. This paper was recently (Mar 2014) awarded First Runner-Up Best Policy Analysis 2013 in *Environmental Science & Technology*, a notable honor and accomplishment.

Closely connected to this study, the UBC team (Kandlikar, Satterfield & Beaudrie) completed work with Decision Research structured decision making expert, Robin Gregory, and collaborator Graham Long, in developing and implementing in a 2-day expert workshop for expert elicitation of ranking nanomaterial risks, held in Vancouver in 2012. The goal of the workshop was to understand the process of expert judgment formation in the context of high uncertainty about risks. This work was 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 in the current condition of gaps in hard risk assessment data. In the past year, the workshop has yielded invited presentations at the UC CEIN Nano EH&S Forum (May 2013), the Environment Department at the University of York (July 2013), the Department of Civil and Environmental Engineering North Dakota State University (Sept 2013), Society for Risk Analysis 2013, and the publication of a report (CNS). The team is pursuing additional funding and possible means to extend the project.

**IRG 3-1b: Expert Survey—NSE, Nanotox, NanoReg;** Satterfield, Kandlikar & Beaudrie, Harthorn

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). 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. Data analysis is now complete and the final key publications were completed in the

reporting year (Beaudrie, Satterfield, Kandlikar & Harthorn, *PLoS One* 2013, and a 2<sup>nd</sup> paper under review).

**IRG 3-2: Emergent Public Perceptions of Benefits and Risks (survey research);** Satterfield, Pidgeon, Harthorn, Collins, Copeland, Corner, Demski, Hanna, Hasell, 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. A final publication on affect and ambivalence response is readying for resubmission (Satterfield, Corner et al., 2014).

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, the decision pathway survey, and ongoing comparative analysis of geoengineering/responsible innovation, as well as research planning for IRG 3. See Pidgeon et al 2014 under review, NAS; Corner, Markowitz & Pidgeon 2014; Corner 2013; Pidgeon et al 2013; Corner et al. 2013; and Randles et al. 2013. In addition, Pidgeon made invited presentations to the Oxford Univ Geoengineering Research Governance Network Conference, the US NAS, Sept 2013; the Sackler Science of Science Communication conf, Sept 2013; Corner convened a symposium at the Science in Public conference (Nottingham, UK July 2013).

IRG 3 plans for the next 2 years include conclusion of the decision pathway analysis in collaboration with Decision Research and an additional cross-national survey of public perceptions in the US and UK if funding permits.

**IRG 3-2b: Environmental Risk Perception Survey;** Satterfield, Harthorn, Collins, Copeland, 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 in 2010. 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:

- 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, readying for submission, 2014).

- Consumer products safety judgments are linked to judgments about nanomaterial safety (Collins, Satterfield, Hanna, and Harthorn, 2014 in prep).
- Public's views on nanoethics indicate 4 robust factors that show responsible development ideals are well distributed in the US public (Harthorn, Collins, Satterfield, and Hanna, 2014 in prep).

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, Copeland, & Harthorn), and a series of papers is planned for completion in 2014.

### **IRG 3-2c: Decision Pathway Survey; Satterfield, Gregory, Pidgeon, Demski, Pitts, Hasell**

In the reporting year, the UBC-Decision Research-Cardiff team put in the field a novel comparative US-UK decision pathway survey to gain an understanding about public views on environmental technologies including nanotechnologies and geoengineering. The survey was run in parallel web survey modes by YouGov in the UK and US and produced a dataset w/ n=800 for each country in Sept 2013. Data analysis has been underway by CNS Fellow Hasell at UCSB under direction of Satterfield, Gregory and Pidgeon. Gregory and Gregory has made preliminary presentations on the methods and findings at University of Calgary, Alberta (Nov, 2013), and Lake Champlain Basin Program in Burlington, VT (Feb 2014)

### **IRG 3-3: Public Participation in Nanotechnology R&D: Upstream Engagement and Deliberation Research; Harthorn, Pidgeon, Barvosa, Bryant, Rogers-Brown, Cranfill, Harr, Shearer, Stevenson, Thomas, Yopez**

**IRG 3-3a.** The work in the past year has neared conclusion on basic analyses of the 2009 gender focused deliberations, with 1 paper in revise and resubmit, and 2 more in preparation. The Pidgeon Cardiff team's 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. Harthorn is working with Harr on planned medical anthropological analysis of nanomedicine deliberations from 2007 and 2009 and is in discussion with several presses about a potential book on this topic.

Building on the 2007 and 2009 nano deliberations, and the UK geoengineering and energy deliberations, the team led by Pidgeon and Harthorn has initiated planning a new set of US-UK deliberations for summer 2014 that will build on the nano energy futures work to explore unconventional oil and gas technologies, another upstream technology involving nanoscale chemicals in a context of significantly greater amplification of risk.

**IRG 3-3b:** In a closely related project UCSB feminist political and social theorist Barvosa, with graduate student Foss, has initiated a project to apply new theoretical analysis to previously collected IRG3 public deliberation research data, and 2) to generate new theory building that relates CNS public deliberation research findings to related scholarly and policy debates on the growing role of public deliberation in American democracy as part of large scale "deliberative systems." The two-fold aim of this research is to draw upon existing IRG3 data to further develop understanding of how public engagement research can contribute to effective policy making in the area of science governance, especially in cases where the implications of public deliberation data are not immediately clear--as when public deliberations reveal public ambivalence. In addition, this research seeks to illuminate the significance of IRG3 deliberation data and practices for broader questions regarding the democratization of science governance,

and the deepening of American democracy more generally. Barvosa is far along in preparation of a book length project on this work, has submitted 1 article for review, and has another in preparation, and Foss has actively participated in 4S, SNET, and other science and technology conferences in the reporting year.

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

This project, funded primarily through the UC CEIN IRG 7 (led by Harthorn), aimed to assess changes in industry EH&S views and practices 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 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. The second and final publication out of the project (Engeman et al. 2013) 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.

Although the research is now concluded on this project, the industry survey project has been of ongoing significant interest to NSE, industry, industrial hygienists, and regulators, as well as NGOs and publics, and the team has made numerous presentations outside of social science venues. In the reporting year, Harthorn provided a half-day workshop and then was a keynote speaker at a NIOSH meeting, webcast to many additional government and industry participants, in Cincinnati in July 2013. This work has contributed knowledge from our survey to assist NIOSH and CDC researchers planning additional industry surveys on health and safety issues. As a result of this successful event, Harthorn was also invited to give a webinar on the industry survey research to the nanotoxicology specialty group of the Society of Toxicology, March 2014.

**IRG 3-5 Framing of Nano in the Media (X-IRG-Friedman; X-IRG Stocking); Friedman, Egolf, McLaren, Zook, Lynn, Schrum; Stocking, Bimber, Hasell**

The study of media framing of nano in the renewal award period has been conducted by 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 have been 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, and new analysis of Google News and an online media source (the New Haven Independent) that has had a particular focus on nano risk issues. Friedman and Egolf have 2 papers in preparation on these results. Friedman presented on the results of the project at SNET (Boston, Oct 2013) and SRA (Baltimore, Dec 2013). Friedman was also honored by appointment to the Council of the AAAS in Jan 2014.

In addition, reported under the X-IRG Stocking project, IRG 3 Fellow Hasell has begun working with IRG 2 Fellow Stocking and faculty researcher Bimber on a newly acquired new media dataset of Twitter data and will extract and analyze comparative framing in the Twitter coverage



of nano and fracking in the US and UK, for use in conjunction with IRG 3-3a (above) and new comparative US-UK survey research under discussion in IRG 3.

**IRG 3-6: Priming Effects in Judgments about Public Policy;** Bimber, Conroy--Project completed in prior year.

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

To increase understanding of political consumerism, 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. For her dissertation in Political Science, Copeland designed and implemented a survey instrument to a nationally-representative sample of 2200 U.S. adults. Copeland theorized and found key differences between boycotting and buycotting that are important to understanding how scholars should conceptualize political consumerism as a form of political behavior. She has published 3 articles from this study and has another 6 in preparation.

Next, she 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. The implications for buycotting, however, are less clear, but the difference between the two acts is apparent.

Finally, 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 study has resulted so far in 3 publications and another 6 are in preparation. In addition, Copeland has extensively disseminated results to political science conferences in the US and Europe and to 4S and SNET conferences. CNS IRG 3 Fellow Hasell is working with Copeland analyzing consumer preferences regarding the nano product data collected.

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

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

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 and 2013 by mapping the NGO *field* by developing an exhaustive, global matrix of more than 182 NGOs engaging in nano-specific environmental, workplace, and consumer safety issues or their allied partners. The work asks why have some NGOs coalesced concern with nanotechnology as

opposed other issues? The summer 2013 work (with community college intern Pribble) 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. In addition to Pribble presentations in the INSET program in summer 2013, Engeman presented a paper on the NGO project work in the UCSB Environmental Politics conference (May 2013) and the ASA (Aug 2013); Harthorn presented for Engeman at the SNET conf (Oct 2013).

This work in turn contributes to CNS's planned public engagement efforts that include plans for a large international conference/workshop with NGO leaders Nov 15-17 2014. Senior Grad Fellow 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 (see sections 11 and 12 for more information).

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

This project began in 2012 and 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 been conducting data analysis and presented preliminary results at the Society for Applied Anthropology, Mar 2013, in Denver and at the SNET conference, Boston Oct 2013.

Rogers-Brown's continued service 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 in Yr 9:***

1) Nel, Andre et al. (NSF DBI 1266377), \$24,000,000. UC Center for Environmental Implications of Nanotechnology renewal, yrs 6-10, Harthorn is Theme 7 senior personnel and a member of the UC CEIN Executive Committee, 2013-2018.

2) 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 (Satterfield et al, 2014, in prep), the 2009-2010 international industry survey (Engeman et al. 2012, Engeman et al. 2013); partial support of the expert survey (Beaudrie et

al., PLoS One 2013; under review); lead support of the expert decision making under uncertainty workshop (Beaudrie et al., report); and the Collins nanoremediation study. This support will draw to a close in August 2014 at the conclusion of the no cost extension of the 1<sup>st</sup> 5 years of funding of the UC CEIN.

3) Pidgeon, £116,280, UK Natural Environment Research Council. “CCS Grand Challenge in Geological Storage.

4) Friedman, \$120,000, Lehigh University seed grants, 2013-14, on risk perception and earthquakes and hydraulic fracturing in Pennsylvania

5) 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.

6) 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:

7) UCSB Critical Issues in America program for July 2012- June 2013 on Figuring Sea Level Rise in which Harthorn was a participating faculty member (grant total, \$25,000).

### **5. Broader Impacts of IRG 3**

*Key impacts on overall goals of the CNS. Include integration with other IRGs, value added, contributions to education and outreach efforts, media impact of work, etc.*

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 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 deliberation 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.

IRG 3 researchers have been active contributors to CNS education and outreach efforts in the past year. See below for the full list of activities, also cited in Sections 11 & 12.

### **IRG 3 Publications 2013-2014**

#### **Primary Publications: Journals**

1. Beaudrie, Christian, Kandlikar, Milind, & Satterfield, Terre. (2013). From Cradle-to-Grave at the Nanoscale: Gaps in US Regulatory Oversight along the Nanomaterial Life Cycle. *Environmental Science & Technology*, 47(11), 5524-5534. doi: 10.1021/es303591x
2. Beaudrie, Christian, Satterfield, Terre, Kandlikar, Milind, & Harthorn, Barbara Herr. (2013). Expert Views on regulatory preparedness for managing the risks of nanotechnologies. *PLOS One*. doi: 10.1371/journal.pone.0080250
3. Copeland, Lauren. (2013). Conceptualizing Political Consumerism: How Citizenship Norms Shape Boycotting and Buycotting. *Political Studies*. doi: 10.1111/1467-9284.12067
4. Copeland, Lauren. (2013). Value Change and Political Action: Postmaterialism, Environmentalism, and Political Consumerism. *American Politics Research*. doi: 10.1177/153267X13494235
5. Engeman, Cassandra, Baumgartner, Lynn, Carr, Benjamin, Fish, Allison, Meyerhofer, John, Satterfield, Terre, Holden, Patricia, & Harthorn, Barbara Herr. (2013). The hierarchy of environmental, health, and safety practices, in the US nanotechnology workplace. *Journal of Occupational and Environmental Hygiene*, 10(9), 487-495. doi: 10.1080/15459624.2013.818231

6. Pidgeon, Nick, Parkhill, Karen, Corner, Adam, & Vaughan, Naomi. (2013). Deliberating Stratospheric Aerosols for Climate Geoengineering and the SPICE Project. *Nature Climate Change*, 3(5), 451-457. doi: 10.1038/NCLIMATE1807
7. Satterfield, Terre, Conti, Joe, Harthorn, Barbara Herr, Pidgeon, Nick, & Pitts, Anton. (2013). Understanding shifting perceptions of nanotechnologies and their implications for policy dialogues about emerging technologies. *Science and Public Policy*, 40(2), 247-260. doi: 10.1093/scippol/scs084

### **Primary Publications: Books, Chapters, Reports and other Publications**

8. Beaudrie, Christian, Kandlikar, Milind, & Satterfield, Terre. (2013). "UBC SDM Risk Workshop summary *CNS Report*," Center for Nanotechnology in Society - UCSB.
9. Copeland, Lauren, & Smith, Eric R.A.N. (forthcoming). Consumer Political Action on Climate Change. In Y. Wolinsky-Nahmias (Ed.), *Climate Change Policy and Civic Society*. Washington, D.C.: CQ Press.
10. Parkhill, Karen, Pidgeon, Nick, Corner, Adam, & Vaughan, Naomi. (2013). Deliberation and responsible innovation: a geoengineering case study. In R. Owen, J. Bessant & M. Heintz (Eds.), *Responsible Innovation* (pp. 219-240). London: Wiley.
11. Randles, S., Youtie, J., Guston, D., Harthorn, B., Newfield, C., Shapira, P., Wickson, F., Rip, A., von Schomberg, R. and Pidgeon, N. (2013) A Trans-Atlantic conversation on responsible innovation and responsible governance. In van Lenet, H. et al (eds) Little by Little; Expansions of Nanoscience and Emerging Technologies (pp. 169-180). IOS Press.
12. Shearer, Christine, Rogers-Brown, Jennifer, Bryant, Karl, Cranfill, Rachel, & Harthorn, Barbara Herr. (2013). Power and Vulnerability: Re-contextualizing 'low risk' views of environmental and health hazards. In S. Maret (Ed.), *Research in Social Problems and Public Policy, Vol 21, William R. Freudenburg, a Life in Social Research* (pp. 235-257). Bingley, UK: Emerald Group Publishing Limited.

### **Leveraged Publications: Journals**

13. Cherry, Catherine, Hopfe, Christina, MacGillivray, Brian, & Pidgeon, Nick. (2013). Media discourses of low carbon housing: The marginalisation of social and behavioural dimensions within the British broadsheet press. *Public Understanding of Science*. doi: 10.1177/0963662513512442
14. Corner, Adam, Parkhill, Karen, & Vaughan, Naomi. (2013). Messing with Nature: Exploring public perceptions of geoengineering in the UK. *Global Environmental Change*, 23(5), 938-947. doi: 10.1016/j.gloenvcha.2013.06.002
15. Corner, Adam, Markowitz, Ezra, & Pidgeon, Nick. (2014). Public engagement with climate change: the role of human values. *WIREs Climate Change*. doi: 10.1002/wcc.269

### **Leveraged Publications: Books, Chapters, Reports and other Publications**

16. Collins, Mary, & Freudenburg, William. (2013). Temporal Myopia: A Case of Promising New Technologies, the Federal Government, and Inherent Conflicts of Interest. In S. Maret (Ed.), *Research in Social Problems and Public Policy* (pp. 259-276). Bingley, England: Emerald.
17. Corner, Adam. (2013). Geoengineering & Green Thought. *Political Science Hosted by the Guardian*, Retrieved from <http://www.theguardian.com/science/political-science/2013/jul/29/messing-nature-geoengineering-green-thought>

### Submitted or in preparation publications: primary

18. Barvosa, Edwina. (in preparation). Officially ambivalent: technocratic commitments in the democratization of science governance.
19. Barvosa, Edwina. (in preparation). *Constructing Deliberative Democracy: Constructivism, Deliberative Systems, and the Diverse Democratic Self*. Cambridge University Press
20. Barvosa, Edwina. (under review). Ambivalence as Asset: Mapping Meaning & Epistemic Diversity in Public Engagement with Nanotechnology.
21. Beaudrie, Christian, Kandlikar, Milind, Satterfield, Terre, Robin, Gregory, & Long, Graham. (in preparation). Nanomaterial Risk Screening: A Structured Decision Making (SDM) Approach.
22. Beaudrie, Christian, Satterfield, Terre, Kandlikar, Milind, & Harthorn, Barbara Herr. (under review). Scientists vs Regulators: Precaution, Novelty and Regulatory Oversight as Predictors of Perceived Risk of Engineered Nanomaterials.
23. Copeland, Lauren. (in preparation ). Political Consumerism and the Expansion of Political Participation in the US.
24. Copeland, Lauren. (in preparation). Putting the Political in Political Consumerism: Towards a Theory of Motivations.
25. Copeland, Lauren. (in preparation). Postmaterialism vs. Engaged Citizenship as Predictors of Non-Electoral Forms of Political Participation.
26. Copeland, Lauren, & Feezell, Jessica T. (in preparation). Citizenship norms and political participation: The mediating role of digital media use.
27. Copeland, Lauren, & Hasell, Ariel. (in preparation). Risky Business? How Risk vs. Benefit Frames Influence Consumer Attitudes toward Nanotechnology Applications.
28. Copeland, Lauren, & Hasell, Ariel. (in preparation). Framing Effects on People's Expressed Willingness to Purchase Nanotechnology Applications in the U.S.
29. Corner, Adam, Satterfield, Terre, Pidgeon, Nick, & Harthorn, Barbara Herr. (in preparation). Affective ambivalence and nanotechnologies.
30. 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.
31. Friedman, Sharon, & Egolf, Brenda. (in preparation). Media coverage of government regulations concerning nanotechnology risks in the United States and United Kingdom.
32. Friedman, Sharon, & Egolf, Brenda. (in preparation). Internet coverage of nanotechnology risks in the New Haven Independent and Google Alerts.
33. Friedman, Sharon, & Egolf, Brenda. (in preparation). Information sources used by journalists to discuss nanotechnology risks in the United States and United Kingdom.
34. Harthorn, Barbara Herr, Collins, Mary, Hanna, Shannon, & Satterfield, Terre. (in preparation). Public Attitudes on Environmental Risk, Trust, and Responsible Development of Nanotechnologies.
35. Satterfield, Terre, Harthorn, Barbara Herr, Collins, Mary, & Pitts, Anton. (in preparation). Resilience and intuitive cognition as predictors of the environmental impacts of engineered nanomaterials.
36. Satterfield, Terre, DeVries, Laura, & Harthorn, Barbara Herr. (in preparation ). Perilous Ideas: Essentialisms in Health Risk Research and the Invisibility of the White Male Effect.
37. Shearer, Christine, & Rogers-Brown, Jennifer. (in preparation). Nanotechnology Risk Perceptions and Assessments *CA Research Bureau Short Subject Publication*.
38. Shearer, Christine, & Rogers-Brown, Jennifer. (under review). Nanotechnology and Society: An Overview *CA Research Bureau Short Subject Publication*.

### Submitted or in preparation publications: leveraged

39. Collins, Mary, Harthorn, Barbara Herr, & Satterfield, Terre. (in preparation). Nanoremediation: Are there equity concerns?
40. Collins, Mary, Hanna, Shannon, Harthorn, Barbara, & Satterfield, Terre. (in preparation). US Public Views on Nanotechnology and Product Safety: So Far So Good?
41. Copeland, Lauren, Bimber, Bruce, & Earl, Jennifer. (in preparation). Contentious Consumers: Political Consumerism, Movement Societies and Self-Directed Political Action.
42. Pidgeon, Nick, Demski, Christina, Butler, Catherine, Parkhill, Karen, & Spence, Alexa. (under review). Communicating and Deliberating Energy System Change for the UK Proceedings of the US National Academy of Sciences.
43. 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 2013-2014

1. Harthorn, Barbara Herr. "US Public Perceptions of Environmental Resilience in the Face of New Technologies in the Americas," presented in the panel "Risk, Perception, and Environmental Hazards of New Technologies in the Americas," Society for Applied Anthropology, Denver, CO, March 21, 2013.
2. Collins, Mary. Session Organizer, "Risk, Perception, and Environmental Hazards of New Technologies in the Americas," Society for Applied Anthropology, Denver, CO, March 22, 2013.
3. Collins, Mary, Harthorn, Barbara Herr, & Satterfield, Terre. "Nanoremediation: Emergent technology and issues of equity," Society for Applied Anthropology, Denver, CO, March 22, 2013.
3. Rogers-Brown, Jennifer & Shearer, Christine. "Reconceptualizing Risk and Regulation for Emerging Technologies in Food and Agriculture," Society for Applied Anthropology, Denver, CO, March 22, 2013.
4. Satterfield, Terre, deVries, Laura, Pitts, Anton, & Harthorn, Barbara Herr. "Crude Proxies and Essentializing Narratives in Risk Research," Society for Applied Anthropology, Denver, CO, March 22, 2013.
5. Copeland, Lauren. "Political Consumerism and the Expansion of Political Participation Repertoires in the United States," Annual meeting of the Western Political Science Association, Hollywood, CA, March 28-30, 2013.
6. Copeland, Lauren. "Political Consumerism: Boycotting, Buycotting, and the Expansion of Political Participation in the United States," Annual meeting of the Midwest Political Science Association Chicago, IL, April 11-14, 2013.
7. Beaudrie, Christian, Kandlikar, Milind, Long, G., Gregory, W., Wilson, T., & Satterfield, Terre. "Expert Judgment-Based Risk Screening for Emerging Nanotechnologies: A Collaborative Approach," UC-CEIN Nano EH&S Forum, UCLA, Los Angeles, CA, May 6-9, 2013.
8. Collins, Mary. "Ecotypes, Risk Perception and New Technologies: The Effect of Environmental Context on Nanotechnology Public Risk Perception," (poster). UC-CEIN Nano EHS Forum: Scientific Advances Toward Reducing Complexity in Nano EHS Decision Making, Los Angeles, CA, May 8, 2013.
9. Hanna, Shannon. "Consequences of Carbon nanotubes in Marine Ecosystems: Accumulation and Toxicity in a Marine Mussel," (poster). UC-CEIN Nano EHS Forum: Scientific



- Advances Towards Reducing Complexity in Nano EHS Decision Making, Los Angeles, CA, May 8, 2013.
10. Copeland, Lauren. "Political Consumerism and Political Participation," Ninth Annual California Graduate Study Conference, Center for the Study of Democracy, University of California, Irvine, Irvine, CA, May 18, 2013.
  11. Copeland, Lauren, & Hasell, Ariel. "Risky Business? How Risk vs. Benefit Frames Influence Consumer Attitudes toward Nanotechnology Applications," Annual conference on Environmental Politics and Policy, Santa Barbara, CA, May 31, 2013.
  12. Engeman, Cassandra, & Harthorn, Barbara Herr. "Mobilizing in the Context of Uncertainty: Social Movement Organizations and Contentious Issues of Nanotechnology Safety, Governance, and Responsible Development," UCSB Environmental Politics Conference, Santa Barbara, CA, May 31, 2013.
  13. Collins, Mary. "Environmental Risk Judgment Analysis: Nanotechnology and Consumer Products," Annual Meeting of the Association for Environmental Studies and Sciences (AESS), Pittsburgh, PA, June 19-22, 2013.
  14. Engeman, Cassandra. "Mobilizing in the Context of Uncertainty: Social Movement Organizations and Contentious Issues of Nanotechnology Safety, Governance, and Responsible Development," Capitalism, the Politics of Inequality, and Historical Change, mini-conference of the Comparative-Historical and Political Sociology sections of the American Sociological Association, New York City, NY, August 14, 2013.
  15. Copeland, Lauren. "Political Consumerism and the Expansion of Political Participation in the U.S." European Consortium for Political Research and the Center for the Study of Democracy at Leuphana University, Luneberg, Germany, September 18, 2013.
  16. Copeland, Lauren. "Political Consumerism and the Changing Citizen," Mannheim Centre for European Social Research, University of Mannheim, Mannheim, Germany, September 23, 2013.
  17. Copeland, Lauren. "Political Consumerism and the Changing Citizen," research presentation to the Department of Political Science, University of California, Santa Barbara, Santa Barbara, CA, September 2013.
  18. Collins, Mary, Hanna, Shannon, Satterfield, Terre, & Harthorn, Barbara Herr. "Ecotypes, Risk Perceptions, and New Technologies," Annual Meeting of the Society for Social Studies of Science (4S), San Diego, CA, October 9-12, 2013.
  19. Copeland, Lauren, & Hasell, Ariel. "Framing Effects on U.S. Consumer's Expressed Willingness to Purchase Nano-enabled Consumer Products," Annual Meeting of the Society for Social Studies of Science (4S), San Diego, CA, October 9-12, 2013.
  20. Collins, Mary, & Harthorn, Barbara Herr. Co-Organizers, "The Politics of Risk & Perception: The Nanotechnology Case" Panel, Society for the Social Study of Science (4S), San Diego, CA, October 10-13, 2013.
  21. Harthorn, Barbara Herr & Bryant, Karl. "Social Location and the Politics of Difference in US Public Deliberations about New Technologies," Society for the Social Study of Science (4S), San Diego, CA, October 11, 2013.
  22. Copeland, Lauren, & Harthorn, Barbara Herr. Co-organizers, "A Matter of Trust: Perceptions of Nanotechnology Risk and Responsibility" Panel, 5th annual meeting of the Society for the Social Study of Nanoscience and Emerging Technologies, Boston, MA, October 27-30, 2013.
  23. Copeland, Lauren, & Hasell, Ariel. "Framing Effects on U.S. Consumers' Expressed Willingness to Purchase Nano-enabled Consumer Products," Annual Meeting of the Society for the Study of Nanoscience and Emerging Technologies, Boston, MA, October 27-30, 2013.

24. Collins, Mary & Harthorn, Barbara Herr. "Public Perception of Nanotechnology Risks and Risk Managers," 5th annual meeting of the Society for the Study of Nanoscience and Emerging Technologies, Boston, MA, October 28, 2013.
25. Harthorn, Barbara Herr. Session Chair, Panel 3-1A 5th annual meeting of the Society for the Social Study of Nanoscience and Emerging Technologies, Boston, MA, October 28, 2013.
26. Harthorn, Barbara Herr, & Engeman, Cassandra. "Mobilizing in the Context of Uncertainty: Social Movement Organizations and the Contentious Issues of Nanotechnology Safety, Governance, and Responsible Development," 5th annual meeting of the Society for the Social Study of Nanoscience and Emerging Technologies, Boston, MA, October, 28, 2013.
27. Friedman, Sharon, & Egolf, Brenda. "A Case Study: Nanotechnology Risk Coverage in the New Haven Independent," Meeting of Society for the Study of Nanoscience and Emerging Technologies, Boston, MA, October 29, 2013.
28. Rogers-Brown, Jennifer, & Shearer, Christine. "Neoliberalism and Emerging Technologies: Measuring Civil Society Responses to New Technologies in Food and Agriculture," Society for the Study of Nanotechnologies and Emerging Technologies (S.NET), Boston, MA, October 29, 2013.
29. Gregory, Robin. Presentation on research methods and initial results of US and UK pathway surveys University of Calgary, Calgary, Canada, November 4, 2013.
30. Hanna, Shannon. "Quantifying Carbon Nanotubes in Biological Samples: Techniques, Applications, and Considerations," Sustainable Nanotechnology Organization Conference, Santa Barbara, CA, November 5, 2013.
31. Harthorn, Barbara Herr. Co-organizer, SMA-CASTAC invited panel, American Anthropological Association, Chicago, IL, November 20-24, 2013.
32. Harthorn, Barbara Herr. "Emergent Perceptions of Risk, Fairness & Trust in Upstream Deliberations re: Nanotechnologies for Health and Human Enhancement," presentation in a joint panel of CASTAC and the SMA on technologies and medicine at the American Anthropological Association meetings, Chicago, IL, November 24, 2013.
33. Beaudrie, Christian, Kandlikar, Milind, Long, G., Gregory, W., Wilson, T., & Satterfield, Terre. "Nanotechnology Risk Screening using a Structured Decision Making (SDM) Approach," Society for Risk Analysis Annual Meeting, Baltimore, MD, December 9-12, 2013.
34. Friedman, Sharon & Egolf, Brenda. "Google Information about Nanotechnology Risks," Meeting of the Society of Risk Analysis, Baltimore, MD, December 10, 2013.
35. Harthorn, Barbara Herr. Organizer and Lead, CNS Research Summit, Santa Barbara, CA, January 31-February 1, 2014.
36. Gregory, Robin. Presentation on research methods and initial results of US and UK pathway surveys Lake Champlain Basin Program, Burlington, VT, February 12, 2014.

### **IRG 3 Outreach Activities 2013-2014**

37. Engeman, Cassandra. Participant and Volunteer Nano-Days, Santa Barbara Museum of Natural History, Santa Barbara, CA, March 17, 2013.
38. Pidgeon, Nick. "Geoengineering as an Emerging Technology: Deliberation and Anticipatory Research Governance," invited talk, Geoengineering Research Governance Network Conference, Oxford University, Oxford, United Kingdom, March 18, 2013.
39. Barvosa, Edwina. Keynote/Public Outreach Address for a public launch of CommON-VC, a web-based program in participatory democracy supporting public engagement in Ventura County, CA SJF/Ventura County Community Foundation Camarillo, CA, March 23, 2013.

40. Barvosa, Edwina. Public outreach presentation to Ventura County Together, a collaborative consortium of 40 nonprofit organizations, public agencies, and community service groups to introduce CommON-VC, a web-based program in participatory democracy supporting public engagement in Ventura County, CA VCCF, Camarillo, CA, March 27, 2013.
41. Harthorn, Barbara Herr. Member, National Organizing Committee, National Nanotechnology Initiative, Risk Stakeholder Meeting, Washington, D.C, September 11-12, 2013; weekly planning meetings March- August 2013; planning meeting, US Department of Agriculture, Washington D.C., June 12, 2013, Washington, D.C., March - August 2013.
42. Harthorn, Barbara Herr. Invited discussant, Faculty Panel on Interdisciplinarity, Anthropology Department Graduate symposium, UCSB, Santa Barbara, CA, May 31, 2013.
43. Harthorn, Barbara Herr. "Ethical, Legal, and Societal Implications of Nanotechnologies," invited plenary presentation, 2013 NNI Strategic Planning Stakeholder Workshop, Washington, D.C., June 11-12, 2013.
44. Beaudrie, Christian, Kandlikar, Milind & Satterfield, Terre. "Nanotechnology Risk Screening using a Structured Decision Making (SDM) Approach," invited lecture, Environment Department, University of York, York, United Kingdom, July 4, 2013.
45. Harthorn, Barbara Herr. "Exploring the Societal Implications of Nanotechnology at CNS-UCSB," presentation in the INSET summer interns program, CNSI, UCSB, Santa Barbara, CA, July 9, 2013.
46. Rogers-Brown, Jennifer. "Public Perceptions of Nanotech and Biotech in the US and Mexico - with a focus on food and agriculture applications," Symposium on Ethical, Legal, and Societal Impacts of Nanotechnology at Stony Brook University's summer NSF-funded Research Experience for Undergraduates Program, Stony Brook, NY, July 17, 2013.
47. Corner, Adam. Convener, "Framing & Perceiving Geoengineering" symposium, Science in Public conference, Nottingham, United Kingdom, July 22-23, 2013.
48. Corner, Adam. "Messing with Nature - Geoengineering & Green Thought," Science in Public conference, Nottingham, United Kingdom, July 22-23, 2013.
49. Harthorn, Barbara Herr. Participant, Half-day expert workshop with NIOSH/CNC Surveillance Research Branch team re: surveying the nanomaterials industry, HIOSH campus, Cincinnati, OH, July 30, 2013.
50. Harthorn, Barbara Herr. "Surveying the nanomaterials industry: Lessons learned & challenges," keynote presentation, NGO and federal stakeholder meeting and webcast of the National Institute of Occupational Safety and Health (NIOSH), Cincinnati, OH, July 31, 2013.
51. Pribble, Kelli. "Mobilizing in the Context of Uncertainty: Social Movement Organizations and their Role in Nanotechnology," Internships in Nanosystems Science, Engineering, and Technology (INSET), public presentation, Santa Barbara, CA, August 7-8, 2013.
52. Pribble, Kelli. Mobilizing in the Context of Uncertainty: Social Movement Organizations and their Role in Nanotechnology," (poster), Internships in Nanosystems Science, Engineering, and Technology (INSET), poster session, Santa Barbara, CA, August 15, 2013.
53. Pidgeon, Nick. Invited Presentation, US National Academies inquiry on climate engineering, Washington, D.C., September 10, 2013.
54. Harthorn, Barbara Herr. "Nanotechnology Multi-Stakeholder Risk Perception: Implications for Risk Analysis, Management, and Communication," Keynote address, 2013 NNI Risk 3 Stakeholder Workshop, Washington, D.C., September 11, 2013.
55. Harthorn, Barbara Herr. Moderator, "Public Risk Perception" Roundtable, 2013 NNI R3 Stakeholder Workshop, Washington, D.C., September 11, 2013.

56. Pidgeon, Nick. "Geoengineering: Public Values, Stakeholder Perspectives and the Challenge of 'Upstream' Engagement," Sackler Science of Science Communication conference, September 22-25, 2013.
57. Beaudrie, Christian. "Emerging Nanotechnologies and Risk: Challenges in Assessing and Regulating Risks Under High Uncertainty," Department of Civil and Environmental Engineering, North Dakota State University, Fargo, ND, September 26, 2013.
58. Pribble, Kelli. "Mobilizing in the Context of Uncertainty: Social Movement Organizations and their Role in Nanotechnology," (poster), SACNAS conference Austin, TX, October 3-6, 2013.
59. Harthorn, Barbara Herr. Session Organizer and Chair, "Societal Implications," 2nd Annual Meeting of the Sustainable Nanotechnology Organization, Santa Barbara, CA, November 3-5, 2013.
60. Collins, Mary, & Harthorn, Barbara Herr. "Ethical Positions and Nanotechnology Acceptance: A Social Component of Environmental Sustainability," 2nd Sustainable Nanotechnology Organization Conference, Santa Barbara, CA, November 4, 2013.
61. Harthorn, Barbara Herr. Guest lecture, "Risk, Risk Perception and Environment," ANES 130 - Cross-listed undergraduate course in Environmental Studies and Anthropology, Santa Barbara, CA, November 7, 2013.
62. Harthorn, Barbara Herr. "Evidence-Based Risk Perception and Communication for Ethical and Socially Sustainable Nanotechnology," Plenary talk, NSF NSE Grantees meeting, Arlington, VA, December 4-6, 2013.
63. Harthorn, Barbara Herr. Expert panelist UCSB Office of Research, Collaborative Research Panel for Faculty, Mosher House, UCSB, Santa Barbara, CA, December 17, 2013.
64. Harthorn, Barbara Herr. "Risk Perception and Communication in Nanotechnology Stakeholder Engagement," Invited presentation in panel organized by the US Environmental Protection Agency on stakeholder engagement, American Association for the Advancement of Science, Chicago, IL, February 15, 2014.
65. Harthorn, Barbara Herr. "Understanding Societal Aspects of Emerging Nano Technologies," invited guest lecture and day-long program visit, Peter Wall Institute, Nano Energy Group, Department of Chemistry, University of British Columbia, Vancouver, Canada, February 27, 2014.
66. Harthorn, Barbara Herr. "Surveying the Nanomaterial Industry: Lessons Learned and Challenges," webinar presentation, Society of Toxicology Nanotoxicology Specialty Section, March 10, 2014.

## CNS X-IRG and Special Projects

### Faculty and Senior Participants (10)

<a href="#">C. Newfield</a> , XIRG project Leader	English/American Studies	UC Santa Barbara
<a href="#">D. Boudreaux</a>	Commercialisation	Boudreaux and Associates
<a href="#">G. Gereffi</a> , PI subk	Sociology	Duke Univ
<a href="#">S. Friedman</a> , PI subk	Science journalism	Lehigh Univ
<a href="#">B. Egolf</a>	Science journalism	Lehigh Univ
<a href="#">M. Johansson</a>	Anthropology	Gothenburg Univ
<a href="#">S. Anderson</a> , Seed project leader	Environmental politics	UC Santa Barbara
<a href="#">G. Legrady</a> , Seed project leader	Media Arts & Tech	UC Santa Barbara
<a href="#">D. Novak</a> , Seed project leader	Ethnomusicology	UC Santa Barbara
<a href="#">C. Walsh</a> , Seed project leader	Anthropology	UC Santa Barbara

### Postdocs (1), Graduate Students (3), Undergraduate Students (2), and Technical Staff (3)

#### *Postdocs:*

Stacey Frederick	Business, GVC, GIS	Duke Univ
------------------	--------------------	-----------

#### *Graduate students:*

Zach Horton	English	UC Santa Barbara
Sheetal Gavankar	Environmental Sci. Mgmt	UC Santa Barbara
John V. Decemvirale	History of Art & Architecture	UCSB

#### *Undergraduate students:*

Christine McLaren	Sci & Env Writing	Lehigh
Alexander Zook	Env Eng	Lehigh
Amber Shrum	Sci & Env Writing	Lehigh

#### *Technical and Research staff:*

Jordan Herman	History, German Studies & Religious Studies	Duke Univ
Kiyomitsu Odai	Ethnomusicology	UC Santa Barbara
Laura Saldivar-Tanaka	Anthropology	UC Santa Barbara

## CNS X-IRG and Special Project areas

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

These projects include:

X-IRG 1: The Social Life of Nanotechnology (completed prior to this reporting period)

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 7: Framing Nanotech in the Media (newly added in this reporting period)

**X-IRG 1:** *The Social Life of Nanotechnology*: Barbara Harthorn, John Mohr: Project completed in prior year.

\* \* \*

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

This project 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.

The group has 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. The group has now had at least one contact with 80 -90 percent of the universe of thin-film photovoltaic firms that were still in operation in 2011-13.

Thus, they 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.

During 2013-14, this project has made slow progress. Boudreaux served as Acting CEO of a renewable energy company in the Philadelphia area, Horton worked as a full-time fellow on a digital humanities project, and Newfield was on research and sabbatical leave in England completing a book on another topic. Horton and Newfield edited filmed material into a rough cut film on States of Nano-scale Solar of approximately one hour in length.

Newfield has been an invited speaker on innovation theory and the humanities in a broad range of contexts in N Europe and N. America. Horton has given presentations on the project's work and its film products in a number of venues as well as his own work at SNET 2013.

\* \* \*

**X-IRG 3:** Spatial Analysis and the Global Value Chain for Nanotechnology/Nano in California: Stacey Frederick (Gereffi, with input from Appelbaum, Harthorn), Jordan 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 include the California in the Nanotechnology Global Economy website.

During this reporting period, data collection was expanded to encompass firms in all states (~1,500 locations). Data was added for more than 100 products for California companies. Forward and backward linkages were made for all categories for each stage, sector and sub-sector in the nano value chain, and important global/national firms and supporting organizations outside California were also added for each stage, sector & sub-sector. Investor information was added to the website, including affiliated firms with sources of funding (SBIR, Venture Capital, etc.). Work was also done (in collaboration with Edgar Zayago Lao and Guillermo Foladori) on developing a database of publications by authors with an institutional affiliation in Mexico, resulting in a journal article and presentations for S.NET and SNO conferences; additionally, two short subject pieces for the California Research Bureau were co-authored with Christine Shearer and Jennifer Brown on nanotechnology in California (overview, potential risk, and risk perceptions). New project development has included co-authoring a NSF grant proposal with GA Tech colleagues, and new seed fund project development with IRG 2 researchers.

\* \* \*

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

1. Randomly sample and code Google Alerts articles saved from 2010 and 2011 on nanotechnology risks for comparison with New Haven Independent (NHI) and traditional newspaper nano risk articles during the same years.
2. Prepare NHI article data and "mine" interview with main writer for an S.NET presentation that uses NHI as a case study for indepth Internet reporting on nanotechnology risks.
3. Do more indepth analysis of nano traditional media and Internet coverage of specific health and environmental risks from 2000 to 2011 to see which ones were covered most frequently and in what depth.
4. Work on analysis of intercoder reliabilities for risk variables in the study.
5. Work on the information sources section of the project.
6. Concentrate on preparing several research papers based on the data gathered and analyzed in the past year.

During the spring 2013, McLaren and Zook, with Friedman's supervision, finished coding 26 (2010) and 32 (2011) Google Alerts risk articles that had been randomly selected. The number of articles selected purposely matched those found for the NHI during the same time period. These were entered into SPSS by Egolf.

During the summer, Schrum developed source categories for the Google Alerts risk articles to track what organizations and types of organizations were publishing this information on the Internet. Also during the summer, Lynn entered intercoder reliability data into SPSS for analysis.

During the summer and fall, Friedman and Egolf did a comparative analysis of the risk data from Google Alerts, NHI and the traditional media from 2010 and 2011. Findings showed that Google drew on 245 sources for providing information about nanotechnology risks for its Alerts and that Google Trends showed a continuous drop in search volumes about nanotechnology from 2004 to 2011. The more specialized online newspaper, the New Haven Independent, provided more information about nano risks than did the Google Alerts and the NHI information gave readers context and continuity. While the Google Alerts provided a wider distribution of articles on nanotechnology risks, these articles had little continuity. If readers were not familiar with nanotechnology or had not been following risk issues, they would have had a hard time getting an overview of the nanotechnology risk situation. This analysis was presented to the Society of Risk Analysis in December 2013.

In the early fall, Friedman and Egolf reviewed the NHI data as well as an in depth interview with the chief writer of the NHI nanotechnology articles and blogs, and used a case study approach to analyze enhanced nano risk coverage on the Internet. Findings showed that NHI had extensive coverage of health risk issues, with attention paid most frequently to issues related to lung damage. Societal risk issues were a second widely covered topic, and here the coverage concentrated on safety issues. Concerns about foundation and government sponsorship of specialized enhanced nano coverage on the Internet, such as that with NHI and The Guardian in the UK, were reviewed, particularly relating to the possible end of this coverage if the foundation and government support stops. These findings were presented at the S.NET conference in October 2013.

During the fall, Egolf started to prepare the massive source data files from the study in order to launch the next part of the study. This aspect continues into spring 2014.

The study of media framing of nano in the renewal award period has been conducted by 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 have been 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, and new analysis of Google News and an online media source (the New Haven Independent) that has had a particular focus on nano risk issues. Friedman and Egolf have 2 papers in preparation on these results. Friedman presented on the results of the project at SNET (Boston, Oct 2013) and SRA (Baltimore, Dec 2013). Friedman was also honored by appointment to the Council of the AAAS in Jan 2014.

\* \* \*

**X-IRG 5:** Ethnographic Explorations of Nanoscience and Nanotoxicology Laboratories: Mikael Johansson. This project is on hiatus.

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. Based on his CNS research he has initiated a new collaboration with anthropologist Åsa Boholm (Professor in Social Anthropology, Dept. of Global Studies at Gothenburg University, Sweden) and with her has applied for money from the Swedish Research Council.

\* \* \*

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

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 has applied to the NSF for two supplements, in 2012 and 2013, to fund a new seed grant program at UCSB. The first round of competition in Fall, 2012, resulted in 4 projects awarded in Spring 2013 that most closely met the aims of the program, for a total of \$240,706, including indirect costs. We anticipate awarding 3-4 seed grants in the 2<sup>nd</sup> round in Spring 2014.

#### **Round 1 CNS Faculty Seed Grant Projects:**

**X-IRG-6-1:** Characterization of uncertainties in the life cycle assessments and risk assessments of nanotechnology; Sarah Anderson, Sheetal Gavankar

In order to assess and improve uncertainty communication in Life Cycle Analyses of emerging technologies, this project aims to:

- 1) Derive criteria for effective communication of uncertainty to public audiences from the social science literature
- 2) Use existing methods to evaluate location and type of uncertainty reported in LCAs of engineered nano-materials
- 3) Design new measures corresponding to criteria from 1) above
- 4) Recommend improvements (including tools) for uncertainty communication
- 5) Prepare manuscript for publication to capture the above 1-4

The project completed aims 1-5 in 2013-14. They have derived criteria for communication of uncertainty, used the Walker-Harremoes framework to evaluate location and degree of uncertainty, and designed a new matrix to evaluate the location of reporting of uncertainty, whether likelihoods were associated with scenario analysis, and the use of subjective researcher evaluation of uncertainty. Findings thus far indicate that while there is much discussion of uncertainty, researchers do not provide likelihoods associated with scenarios or an overall evaluation of uncertainty. Reporting of uncertainty is most often in the text, rather than in locations more accessible to a lay audience. Also, there is no unified way of presenting non-statistical, epistemic uncertainty. Finally, discussion of uncertainty lacks the contextualization necessary to make it accessible. The project is currently in the process of publishing these findings, along with the recommendations for improving uncertainty reporting.

**X-IRG-6-2:** Bringing Science to Life: CNS Engagement Seed Grant; George Legrady, John V. Decemvirale

During this reporting period the main focus for our team has been gaining an overview of all of the scientific research projects currently underway on campus, developing the concept of the exhibition and strategies for approaching scientists through conversations with colleagues on campus and at UC Santa Cruz, developing the Spring symposium which will be the first public

iteration and presentation of our work and ideas, gathering (for eventual publication purposes) a list of previous exhibitions both national and international where science has been exhibited within the museum, researching possible grants to approach for funding and researching exhibition techniques for increasing viewer participation with scientific material.

As of this point, we have gained a thorough overview of the scientific research on campus. We have generated a database with hundreds of scientific projects currently being worked on and from this database have created a shortlist of 20 labs. Starting in October, we will begin visiting these labs to see the research and to speak to scientists about how best to accommodate such an exhibition into their schedules and brainstorming ideas of how their projects could fit inside of a museum context. This first pass will also develop relationships that we hope to build on as we make a final selection of labs which we will include in the exhibition.

We have also begun gathering examples of previous exhibitions that have presented science and scientific research within a museum setting. This has been paired with research into viewer participation strategies and the possible role of citizen science within the exhibition. Currently, we've been looking at methodologies for how best to create an interactive environment whereby participants feel a sense of commitment to what they are learning about and the typically passive museum experience is activated and the viewer motivated to participate. This is still under review and we are looking at possibly working with psychology grad students and science writers.

In an effort to develop and expand the concept of the exhibition, we have been working with several colleagues on campus: Jatila van der Veen, Project Scientists, Experimental Cosmology Group and Education and Public Outreach Project Manager for Planck Mission, JPL / NASA, Bruce Robertson, Professor of Art History and Director of the Art, Design and Architecture Museum and the University's Public Affairs and Communications team working on 93106. The project has also expanded off campus and brought on John Weber, Founding Director of UC Santa Cruz's new Institute for Art and Science as co-curator of the exhibition. Weber has scientists, scientists / artists, science writers, grants writers, and practitioners of new media. These meetings have been incredibly fruitful and we have been in touch with Weber on a weekly basis.

Intending to expand and continue our exploration on presenting science in the museum, we have approached several professors on campus and at UC Santa Cruz to participate in a symposium for April 18-19 2014. Topics include: data visualization (how do we visualize data?), Chaos, Symmetry and Granularization, How does Science ask questions? How do we discover? the current relationship of art and science, strategies for presenting scientific research to the public. This symposium will be a teaser for the upcoming exhibition, as well as an opportunity for our questions and ideas to be discussed and debated in public.

**X-IRG-6-3: Public Sentiment and the Performance of Protest in Japan's Antinuclear Movement**  
David Novak, Kiyomitsu Odai

This project's research aims for this period included two distinct goals: gathering information and background material about the past 2 years of antinuclear activity and arts and culture in response to the Fukushima Daiichi nuclear accident, in order to best understand the range of responses and actions that have taken place, and secondly to discover via ethnographic research how music is used to gather audiences for antinuclear festivals and to galvanize public protest events.

First, the project gathered information on the general activities of the antinuclear movement in Japan over the past two years, including translating and summarizing news reports and government statements on Fukushima Daiichi as well as materials published by activists and musicians about specific antinuclear protest actions and activities. Second, they traveled to Japan for a month-long project to conduct ethnographic fieldwork, including audio and video documentation, of antinuclear events in Fukushima, Tokyo, and Osaka during August 2013, and other environmental music festivals, and interviews with activists and artists. These included Project Fukushima!, a festival in Fukushima City, Hello 816!, a second Project Fukushima related music concert in Koriyama city, weekly protests in front of the Prime Minister's residence in Tokyo, and the Goodbye Nukes antinuclear concert and lecture in Hibiya Park. Third, the project spent the fall translating and preparing notes on documents gathered during fieldwork, as well as continuing to connect to virtual events (such as the Dommune Project Fukushima! Roundtable broadcast on streaming weblink). The main project outcome planned is a book-length publication.

**X-IRG-6-4:** Filtering out the Social: Nanotechnology and Water Treatment in Mexico: Casey Walsh, Laura Saldivar-Tanaka

This reporting period included the entire research period of this seed grant. The goals of the project were to:

1. acquire a general knowledge of the nanotechnology sector in Mexico, including a) research/science, b) government, and c) business. Interview key informants in these three sectors.
2. acquire a detailed knowledge of the application of nanotechnology to the water sector including: a) water quality detection; b) water treatment systems. Interview key informants.
3. acquire a detailed knowledge of the application of nanotechnology to treating the leachates from the landfills operated by Hasar's Grupo Ecologico and the Municipal government of Guadalajara. Understand the social process leading to the adoption of that technology. Interview all involved parties, including: academics from regional universities; environmental activists; government officials; businessmen operating the landfills; local rural dwellers in the area of the landfills.
4. identify other applications of nanotechnology to wastewater treatment, for further research.

Through the employment of ethnographic methods the project aimed to measure the degree to which water systems managers are adopting nanotechnology, whether these systems are more public/social or more private/individual, and the overall balance and relation between nanotech filtration and purification techniques and efforts to decrease the production of contaminants and their intrusion into water commons. To move beyond the local scale of analysis and gain a general perspective on the water sector in Mexico. Research has been conducted in various sites among various social actors (Enterprise, Academics, Government, Non Governmental Organizations, General Public). A summary of activities by location follows.

1. Guadalajara, Jalisco:
  - a. Interviews with academics (CIESAS, Universidad de Guadalajara),
  - b. City government officials (Department of Sanitation),
  - c. Water treatment private enterprises (Hasars Grupo Ecologico; Blue Gold; BioDAF),

- d. 3 landfill site visits; landfill run by Hasars. Interviews with engineer in charge, and technicians of water treatment plant,
  - e. Interviews with rural dwellers in the region, downstream from the landfills,
  - f. Interviews with environmental activists
- 2. Monterrey, Nuevo León:
  - a. Interviews with academics and researchers that develop nanotechnology (Centro de Investigacion en Materiales Avanzadas - CIMAV; Universidad Autonoma de Nuevo Leon - UANL; TSSI; Instituto de Innovacion y Transferencia de Tecnologia - I2T2),
  - b. Interviews with representatives of municipal and private water treatment companies
- 3. San Luis Potosi:
  - a. Interview with academic that develops nanotechnology applications for water treatment (Instituto Potosino de Investigacion en Ciencias y Tecnologia - IPICYT),
  - b. Interview with water scholars at the Colegio de San Luis - COLSAN
- 4. Mexico City
  - a. Interviews with academics that develop nanotechnology (Universidad Nacional Autonoma de Mexico - UNAM; Universidad de la Ciudad de Mexico - UCM; Instituto Politecnico Nacional - IPN),
  - b. Interview at the Instituto Nacional de Ecologia y Cambio Climatico (INECC)
  - c. Interview of Eric Gutierrez, Gerente de Potabilizacion (Director of Potabilization), Comision Nacional de Agua
  - d. Interview at the National Center for Metrics (Centro Nacional de Metrologia - CENAM)
- 5. Guanajuato:
  - a. Interview at the Universidad de Guanajuato (UG), Department of Engineering and Nanotoxicology,
  - b. Interview at the Centro de Inovacion en Tecnologia de Agua (CITAG), collaborating with Rice University
- 6. Puebla:
  - a. Interview at the Benemerita Universidad Autonoma de Puebla (BUAP), Department of Research in Zaeolitas.
- 7. Morelos:
  - a. Interview at the Interview at the Instituto Mexicano de Tecnologia del Agua (IMTA)
- 8. Interview at the Instituto Nacional de Ecologia y Cambio Climatico (INECC)
- 9. On-line survey questionnaires to academics that work on Nanotechnology research and development (in progress).

**XIRG-7:** Framing Nanotechnology in the Media: Galen Stocking, Bruce Bimber, Ariel Hasell

Given the powerful effects the media can have on public opinion, how nanotechnology is discussed in the media can shape considerably the attitudes the public has about nanotechnology. However, it is not clear how much of an effect the media has on domains such as nanotechnology and other emerging issues, which are often outside the day-to-day life of the average person. Additionally, changes in the media environment, including the proliferation of new sources as well as the ensuing fragmentation of the audience and the rise of social media, may further limit media effects.

The goal of this study is to measure the relationship between the media and the public as it relates to nanotechnology. It does this through an analysis of media and public attention to nanotechnology. Furthermore, it aims to characterize these responses in terms of their support or opposition of the technology as well as the knowledge level exhibited by the response. It will begin by collecting media data on nanotechnology from newspapers, online news and blogs, and broadcast news, and analyzing public attention given to nanotechnology from Twitter as well as pre-existing opinion surveys. The overall aim is to analyze frame propagation across media segments.

To date, we have collected news data on nanotechnology, including broadcast transcripts and newspaper articles that discuss nanotechnology and related terms. These data extends to 1998, just before discussion of the NNI began. We have begun acquiring data on social media. After contacting several providers, we are currently in negotiation with Crimson Hexagon, which offers searchable data from Twitter, blogs, prominent websites, and discussion forums. We expect to have this data by the end of the quarter and begin analysis in the Spring. Project intersects with IRG 3 and IRG 2.

### **X-IRG Publications 2013-2014**

#### **Primary Publications: Journals**

1. Frederick, Stacey. (2014). Twelve Years of Nanoscience and Nanotechnology Publications in Mexico.

#### **Primary Publications: Books, Chapters, Reports and other Publications**

2. Horton, Zach. (2013). Collapsing Scale: Nanotechnology and Geoengineering as Speculative Media. In K. Konrad, C. Coenen, A. Dijkstra, C. Milburn & H. van Lente (Eds.), *Studies of New and Emerging Technologies 4* (pp. 203-218). Berlin, Germany: IOS Press.
3. Novak, David. (2013). The Sounds of Japan's Antinuclear Movement, Post. Retrieved from [http://post.at.moma.org/content\\_items/251-podcast-the-sounds-of-japan-s-antinuclear-movement](http://post.at.moma.org/content_items/251-podcast-the-sounds-of-japan-s-antinuclear-movement)
4. Novak, David. (2013). Performing Antinuclear Movements in Post-3.11 Japan, STS Forum on the 2011 Fukushima/ East Japan Disaster. Retrieved from <http://fukushimaforum.wordpress.com/online-forum-2/second-3-11-virtual-conference-2013/performing-antinuclear-movements-in-post-3-11-japan/>

#### **Leveraged Publications: Journals**

#### **Leveraged Publications: Books, Chapters, Reports and other Publications**

#### **Submitted or in preparation publications: primary**

5. Gavankar, Sheetal, Anderson, Sarah, & Keller, Arturo. (under review). Critical components of uncertainty communication in life cycle assessments of emerging technologies: Nanotechnology as a case study. *Journal of Industrial Ecology*.
6. Frederick, Stacey. (under review). Nanotechnology in the California Economy *CA Research Bureau Short Subject Publication*.
7. Frederick, Stacey. (in preparation). Quantifying the Nanotechnology Workforce in the US: Methods, Barriers & Estimates.

8. Newfield, Christopher. (in preparation). The Crisis of American Innovation.
9. Newfield, Christopher. (in preparation). Don't Blame Soloydra, Blame the Solar Rules.
10. Newfield, Chris & Boudreaux, Daryl (Eds.). (in preparation). *Can Rich Countries Still Innovate?* .
11. Novak, David. (in preparation). Project Fukushima! Music, Noise and the Public Perception of Nuclear Power in Japan.

**Submitted or in preparation publications: leveraged**

**X-IRG Presentations 2013-2014**

1. Walsh, Casey. "Filtering out the Social: Nanotechnology and Water Treatment in Mexico," Society for Applied Anthropology Meeting, Albuquerque, NM, March 18-22, 2014.
2. Newfield, Christopher. "The Return of Creativity: Literary vs. Innovation Theory," Grinnel College, Grinnell, IA, April 2013.
3. Novak, David. "Sound Demos and the Politics of Protest in Post-3.11 Japan," Humanities Institute at The Ohio State University, Columbus, OH, April 2013.
4. Walsh, Casey. "Dimensiones sociales de la nanotecnología y el tratamiento de aguas en Mexico," Centro de Investigaciones y Estudios Superiores en Antropología Social (CIESAS), Monterrey, Mexico, June 20, 2013.
5. Gavankar, Sheetal & Anderson, Sarah. "Characterization of uncertainties in the life cycle assessments of emerging technologies: Review and implications for public's risk perception," International Society for Industrial Ecology, Ulsan, South Korea, June 25-28, 2013.
6. Horton, Zach. "Particulate Paranoia: Globalization, Geoengineering, and the Nano-Conspiracy Media," Society for the Study of Nanoscience and Emerging Technologies, Boston, MA, October 28, 2013.
7. Walsh, Casey. "Nanotechnology and Water Treatment in Mexico," Annual Meeting of the Society for Social Studies of Science (4S), San Diego, CA, October 10-13, 2013.
8. Newfield, Christopher. "Can Humanities and Social Science Faculty Collaborate? Notes from a 5-Year NSF Grant," Universities in the Knowledge Economy, Copenhagen, Denmark, October 2013.
9. Novak, David. "Music and the Social Amplification of Risk around Nuclear Power in Japan," Society for Social Studies of Science, San Diego, CA, October 2013.
10. Novak, David. Discussant, "Media and the Regional/Transnational Circulation of Nuclear Politics and Fear" Society for Social Studies of Science, San Diego, CA, October 2013.
11. Novak, David. "Project Fukushima! Music, Sound, Noise and the Public Perception of Nuclear Power in Post-3.11 Japan," meeting of the Society for Ethnomusicology, Indianapolis, IN, November 2013.
12. Novak, David. "Sound Demos and the Performance of Antinuclear Protest in Post-3.11 Japan," meeting of the American Anthropological Association, Chicago, IL, November 2013.
13. Novak, David. Guest lecture, UCSB Ethnography and Cultural Studies Research Focus Group, Santa Barbara, CA, December 2013.
14. Novak, David. "Music, Sound, Noise, and the Antinuclear Movement in Post-3.11 Japan," UCSB Music Department Colloquium, Santa Barbara, CA, January 2014.
15. Novak, David. "Music, Sound, and Affect in Japan's Antinuclear Movement," Bard College, Annandale-on-Hudson, NY, February 2014.

16. Novak, David. "Making Noise to Power: Music and Social Protest in Japan's Antinuclear Movement," Culture, Power, Social Change Interest Group, Department of Anthropology, UCLA, Los Angeles, CA, February 2014.

#### **X-IRG Outreach Activities 2013-2014**

17. Novak, David. Guest lecture, presented at the UCSB Anthropology Graduate Symposium, Santa Barbara, CA, May 31, 2013.
18. Johansson, Mikael, & Rogers-Brown, Jennifer. "Ethical, Legal and Societal Implications of Nanotechnology," Stony Brook University, Stony Brook, NY, July 17, 2013.
19. Walsh, Casey. 5th Encounter of the Researchers of the Nanoscience and Micro-nanotechnology, Instituto Politecnico Nacional (IPN), Mexico City, Mexico, November 5-6, 2013.
20. Walsh, Casey. 2nd Colloquium on the Design and Texture of nanostructures, Guadalajara, Mexico, November, 25-26, 2013.
21. Novak, David. Guest lecture, East Asian Languages & Cultural Studies, undergraduate class, Globalizing Japan, Santa Barbara, CA, December 2013.

## **10. CENTER DIVERSITY PROGRESS AND PLANS**

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. Additionally, the Center has broadened participation by seeking out researchers and participants 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 6-9 (years 1-4 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. 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). Participating in this recruitment network has enhanced CNS-UCSB's 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 3 summer undergraduate interns through the INSET program, 2 female and 1 male. They all identified as white; however, one intern presented her work at the Society for the Advancement of Chicanos and Native Americans in Science (SACNAS) annual conference in San Antonio, TX. SACNAS encourages participation from women of all backgrounds.

In addition to the summer internship program, CNS-UCSB engages 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. A total of 10 undergraduate students participated in the Center in Year 9, 8 (80%) of whom were female, 1 of Native American identity and Hispanic ethnicity. The academic majors of undergraduate participants included Biology, Physics, Global and International Studies, Political Science, and English. Past undergraduates have come from the fields of Biochemistry, Chemistry, Chinese, Environmental Studies, Geography, Global Studies, History, Linguistics, Psychology, and 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 award both Social Science/Humanities and Science/Engineering Graduate Fellows. The search was well publicized and targeted through email announcements, including a diversity statement, sent to graduate advisors in all academic departments on campus; by posting to the UCSB student fellowship opportunities board (new this year); 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.

In the current award, a total of 15 students have participated as CNS Graduate Research Fellows, 10 of whom received funding during year 9. Three of the 10 (30%) were from the Sciences/Engineering, and 7 (70%) from the Social Sciences/Humanities. Six (60%) are female and 4 (40%) are male. One reported being of mixed Native American race and Hispanic ethnicity; another reported Asian identity; and 1 of the 10 reported a disability. Their areas of study are Chicana/o Studies; Communication; Ecology, Evolution, and Marine Biology; History Material Science; Political Science; and Sociology. Diversity among Fellows has varied widely over the course of the CNS award.

### **Non-Fellow Graduate Student Researchers**

CNS-UCSB employs a number of graduate student researchers beyond the fellowship program, as do our partners. Fourteen graduate students from UCSB and partner institutions participated in the Center in these roles during the reporting period. Seven (50%) were female, and 7 (50%) were male. Six (43%) were from underrepresented categories (4 Asian, 2 Hispanic).

Year 6-9 non-fellow graduate students have come from fields including Communication; 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 internal 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. CNS-UCSB full-time multi-year postdoctoral positions are normally recruited in an open, competitive process. We have aimed 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, and have distributed calls through our partner organization, CNS-ASU's listserv. We also have distributed announcements at the S.NET conference and sent notices through their listserv. In recruiting for open or new positions, in addition to the traditional networks, listservs, and professional organizations (above) we have sent our advertisements to specialty groups serving women and minorities. We aim to continue to broaden our reach to expand our connections with as diverse a group of potential applicants as possible.

The 12 CNS-UCSB affiliated and active postdocs in the reporting year include 7 females (70%), 1 Asian (8%), 1 person who reports mixed race identity (8%), and two of Hispanic ethnicity (17%).

### **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 Anthropology, affiliated faculty in Feminist Studies and Sociology, a past longtime member of the governing boards of the UCSB Institute for Chicano Studies and the UCSB Center for Black Studies, a past member of the Advisory Committee for the Center for Latina/o Health, Education & Research as well as a 3-year appointed past member of 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. Four of the eight current members are women (Harthorn, Holden, Metzger, and Parks). In addition, Assistant Director Molitor serves as an *ex officio* member, 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, 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, Film and New Media, Global and International Studies, History, Political Science, and Sociology. Senior Personnel at UCSB, including those in our new Seed Grant program, expand that list to include: American Studies, Chicana/o Studies, Engineering, English, 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, Law, Risk Studies, Science Journalism, Science Policy, Social Psychology, 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 Ann Bostrom, who is the Weyerhaeuser Endowed Professor in Environmental Policy at the Evans School of Public Affairs, University of Washington; Vicki Colvin, the Kenneth S. Pitzer-Schlumberger Professor of Chemistry, Professor of Chemical & Biomolecular Engineering and Materials Science and Nanomaterials Engineering (also former Director of the NSEC, CBEN), at Rice University; Susan Hackwood, the Executive Director of the California Council on Science and Technology and Professor of Electrical Engineering at UC Riverside; and Ruth Schwartz Cowan, Professor in the History and Sociology of Science department at the University of Pennsylvania and 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 2 female, 3 junior scholars, three Asians, and 1 Mexican.

## **(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, race and ethnicity (as defined by the NSF), family educational and income 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 Carnegie Research University/Very High research activity campus in a beautiful coastal setting, UCSB is successful in recruiting a diverse student body and is itself hovering on the brink of become a Hispanic Serving Institution (HSI) (anticipated 2014-15 designation). 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 and regional organizations into its popular undergraduate summer intern program. However, with only one more year of NSF-funding anticipated, CNS-UCSB will necessarily be winding down recruitment activities. We do not anticipate recruiting any additional Graduate Research Fellows in the year ahead, for example, yet we do intend to maintain our diverse set of students.

#### **Strategies:**

- Open recruitment process

A competitive, open recruitment process for our undergraduate internship, graduate research 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 has worked 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. Regrettably, NSF's funding for the CNSI/CNS-UCSB INSET program has ended, also concluding a great training opportunity for a diverse set of future scholars. We do plan to continue taking advantage of our diversity-fostering campus partners when recruiting future interns and planning possible future program development, post-CNS.

- 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. CNS-UCSB collaborated with the AGEP (Alliance for

Graduate Education in the Professoriate) program until it dissolved in 2009, 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, which he leveraged into a position in the UC CEIN. CNS research that focuses on environmental and social impacts and equitable development issues has resonated well 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 recurrent opportunities for students in CNS-UCSB.

The former 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 in IRG 1 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.

- 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 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 as well as feminist studies, and with both feminist studies and Chican@Studies departments 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 with which SEED Grant recipient Casey Walsh is affiliated and that, like CNS, is located institutionally within the Institute for Social, Behavioral, & Economic Research.

Further, CNS-UCSB cultivates an ethos of diversity. For example, Graduate Fellow Matthew Gebbie runs the Dow Foundation Distinguished Lecture Series at UCSB. This series brings prominent scholars in STEM fields to talk both about their research and the topic of diversity in their fields. Students at Cal State campuses are brought to UCSB for these lectures in order to learn about possible avenues for future scholarship. In addition, in March 2013, IRG 3 researcher Edwina Barvosa organized and led a public workshop on participative democracy in nearby Ventura, CA. Such outreach activities are not funded by CNS-UCSB, but they are endorsed and encouraged.

**Leadership: Pls, 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 the past year we added through the new Seed Grant program 2 assistant professors and 1 associate professor, and helped recruit to UCSB a new female South American junior faculty member with nano in society research experience who in Year 9 became active with CNS.

**Engaging Diverse Publics**

Expanding public engagement is one of the core goals of CNS-UCSB's outreach plans, 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. A two-day event held annually at the Santa Barbara Museum of Natural History, in 2013 NanoDays drew 1300 participants. We publicize events in our Speakers Series to hundreds 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. Additionally, CNS-UCSB is actively organizing and planning to host in Fall 2014 a large international NGO conference, "Democratizing Technologies: Assessing the Roles of NGOs in Technological Futures," which 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 went through a transition period in Year 9 while continuing a robust agenda. Most importantly, CNS-UCSB maintained its core mission of bringing together researchers and students in the social sciences, humanities, engineering, and sciences to foster critically needed and truly interdisciplinary collaborations. The Program's leadership team is headed by Professor Miriam Metzger, 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 newly hired Education Coordinator, Dr. Brandon Fastman, who joined the team in September 2013. A part-time coordinator remained on staff to ease the transition. His appointment ended on March 31, 2014. Along with the changeover in staff came an influx of five new Graduate Fellows. The following pages provide an overview of CNS-UCSB's Educational Program components and objectives; discuss Program 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 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 9 were as follows:

### ***Training the next generation of interdisciplinary scholars:***

- Train 6-8 graduate research fellows/year
- Complete 3-4 undergrad internships/year, with emphasis on community college students from lesser-served communities
- Continue postdoctoral scholars program
- Hold CNS research seminar meetings year-round
- Host 1-2 visiting speakers per quarter (3-6 per year)
- Offer professional development in communication, research methods, and academic job practices
- Plan or execute at least one major public engagement event annually where Fellows and Postdocs take a lead role
- Provide funding and professional preparation for conference travel for Program participants
- Continue our 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. After a dip in the number of courses that integrate CNS-UCSB research in Year 8, the number has increased from 14 to 20 in Year 9.

## **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 9, 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. An unanticipated medical leave of absence by former Education Program academic coordinator

Cathy Boggs in October 2012, reported in the Year 8 Annual Report, turned out to be a permanent departure. During the rest of the 2012-2013 academic year and through the summer of 2013, Metzger ran the educational program with the help of Joshua Dean, a PhD candidate in Political Science who was hired into the role of Acting Education and Outreach Assistant, and continued through Fall 2013 and Winter 2014 in a graduate assistant role. Dean has worked on a part-time basis at CNS, reporting to the Education Director and CNS Assistant Director Molitor. His employment ended on March 31, 2014.

Meanwhile, the core day to day duties in the program were taken over by Brandon Fastman, the new Education and Outreach Coordinator who was hired in September 2013 to replace Dr. Boggs. Fastman holds a PhD in English from UCSB and worked the previous three years as a staff writer for a prominent local newspaper, *The Santa Barbara Independent*. His familiarity with scholarly discourse paired with his experience writing for a general audience make him an ideal mediator between CNS-UCSB and the general public. His familiarity with the local and campus community is helpful in organizing outreach events such as the annual Nanodays exhibit and forthcoming science cafes.

### **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 in our 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; the CNS Research Seminar in Emerging Technologies & Society; the national 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 2013) at Northeastern University in Boston. 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 19 postdoctoral researchers since the beginning the current award (2010). Those active in the current reporting period 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 9**

<b>Postdoctoral Scholars</b>	<b>PhD Field; Granting Institution</b>	<b>Affiliation</b>
Mary Collins*	Environmental Science & Management, UCSB	IRG 3, UC CEIN



Lauren Copeland*	Political Science, UCSB	IRG 3, UC CEIN
Shannon Hanna	Ecotoxicology, UCSB	IRG 3
Luciano Kay	Public Policy, Georgia Institute of Technology	IRG 2
Xeuying (Shirley) Lim	Ecology, Evolution and Marine Biology	IRG 2
<b>Non-UCSB Based Postdoctoral Researchers</b>	<b>PhD Field; Current Campus</b>	<b>Affiliation</b>
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
Anton Pitts*	Risk Science; U. of British Columbia	IRG 3*, CEIN
Christine Shearer*	Environmental Sociology; UC Irvine	IRG 3
Merryn Thomas	Geog; Cardiff Univ	IRG 3
James Walsh*	Sociology; Univ of Pennsylvania	IRG 2

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

**Postdoctoral Researcher Program:** Since 2010, the UCSB-based Postdoctoral Researchers Program has recruited 12 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, Ecology, Ecotoxicology, 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). Matt Eisler is a visiting faculty member at the University of Virginia. Others have continued on to new postdoctoral positions (Christine Shearer is in a Postdoctoral Research position at UC Irvine; James Walsh is a Postdoctoral Fellow at the University of Pennsylvania's Social Science & Policy Forum; Mary Collins is a Postdoctoral Fellow at the National Socio-Environmental Synthesis Center at University of Maryland; Shannon Hanna is a Postdoctoral Researcher at the National Institute of Standards and Technology). Others have pursued non-academic careers (Yasuyuki Motoyama is a senior program manager with the Kauffman Foundation). Since leaving UCSB, six of the eight who have completed and left (Eisler, Johansson, Motoyama, Rogers-Brown, Shearer, and Collins) have continued to work on CNS-UCSB research projects as external affiliates.

CNS hired one postdoctoral researcher in the reporting period: Xeuying (Shirley) Han. Formerly a Graduate Science Fellow with IRG 2, Han finished her dissertation in Ecology, Evolution, and Marine Biology in December 2013. Her research investigated how sea urchin population dynamics affect local coral reef community structure in French Polynesia. She will continue her work with IRG 2 investigating the emergence of Nanotechnologies in developing countries, particularly in China where she has specific knowledge and expertise. Currently, Shirley is helping to conduct surveys and interviews of international graduate students in STEM fields that are studying in the United States in order to draw conclusions about the research climate in both the U.S. and the cultures from which these students originate. She is also contributing to a comparative study of state nanotech policy in developing countries.

The other postdoctoral researcher currently housed at CNS-UCSB is Luciano Kay. He joined IRG 2 in residence at UCSB in June 2012. Kay 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. The pioneering work of Kay, Youtie, and Shapira on patent-mapping has received widespread attention this year. It was featured on the NSF homepage as well as the *MIT Technology Review* website and in *Wired UK* magazine. His book, *Technological Innovation and Prize Incentives: The Google Lunar X Prize and Other Aerospace Competitions*, was released in February 2013.

IRG 3 will add a new postdoctoral researcher for an 18 month appointment beginning in Spring 2014. The new postdoc will contribute as a full time researcher and US project coordinator on a project led by CNS Director and IRG 3 leader Harthorn, and UK collaborator Nick Pidgeon. The project builds on a series of prior public deliberations conducted by the group on nanotechnologies' environmental and health risks, on energy futures, and on gender and race in public participation. The project will conduct comparative US-UK deliberations on hydrofracturing (fracking) processes of unconventional oil and gas extraction.

**Postdoctoral Researchers at Other Campuses:** CNS-UCSB also supports postdoctoral researchers who work with our external collaborators, including 7 in the current period. 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) research project examining the impact of California nanotechnology in the global economy, working with both IRG 2 and IRG 3. In the past year we have partially supported the work of two postdoctoral researchers conducting public deliberation research with Nick Pidgeon at Cardiff University (Adam Corner and Christina Demski), and Cardiff recently (Feb 2014) added a new fulltime postdoc to the CNS deliberative work, geographer Merryn Thomas; CNS also partially supported a researcher studying risk perceptions with Terre Satterfield at the University of British Columbia (Anton Pitts). Former Fellows Shearer and Walsh are both postdocs currently who are continuing work on CNS research and publications. 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. In this period, she attended the CNS-UCSB Research Summit in January and participates in regular teleconference meetings with IRG 2. 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. The faculty leaders 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 (19 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/ae 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. Former postdoc Edgar Zayago Lau visited CNS-UCSB in May 2013 to deliver a talk titled “Twelve Years of Nanotechnology Development in China.” Lau is now a professor at Autonomous University of Zacatecas in Mexico. Postdocs also participate in and/or co-lead 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 postdoctoral researchers 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. UCSB’s 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 9 survey, conducted in March, 2014, we received responses from both current full-time in residence postdocs.

Overall, their responses to the survey were quite positive. Responses measuring the usefulness of the CNS experience as a whole averaged 4.5 on a 5-point scale, with 5 being excellent. The postdocs also gave high marks for their interactions with their IRG leaders, other members of their IRGs, and the overall quality of their IRG experience. All of these categories garnered a rating of 4.5. Postdocs indicated slightly less satisfaction with the seminar series. The overall usefulness of the series measured between Good and Very good (3.5 on a 5-point scale).

Both quantitative and qualitative measures of their interactions with other IRG leaders and participants indicated some challenges. “Further interactions across research groups through collaborative projects would be interesting,” wrote one postdoc who rated the quality of interactions with members of IRGs other than your own Good (3 on a 5-point scale). The other answered Very Good (4 on a 5-point scale) for the same question.

The most telling qualitative data address the value of working with scholars from different fields because such cross-pollination is a priority of CNS. “You get to learn other perspectives to the same topics, which sparks new ideas in both method and content of own research,” wrote one postdoc. At the same time, both postdocs indicated that working with researchers from other disciplines requires patience. Communication is sometimes difficult, said one, because different fields use different vocabularies. The other postdoc said that the most challenging aspect of conducting research in an interdisciplinary setting was writing collaborative papers which tend to take a few extra iterations.

In the past, former postdocs have noted that their experiences at CNS have had a positive impact on their career development, in particular regarding professional development and training for presentations and conferences, professional writing skills and research experience. However, in recent years, the response rate of former postdocs has been very low. We hypothesize that this is because they have been issued the same exact survey every year. To remedy this problem, CNS-UCSB issued a separate survey for former postdocs and grad fellows this year. Results of this survey will be addressed below.

Throughout the year, postdoctoral scholars also provide input to the Research Seminar about possible topics and suggestions for improvements. For example, Postdoc Kay suggested a seminar presentation by Jennifer Woolley, a professor of business administration at Santa Clara University. Coordinator Fastman arranged a visit during which Woolley delivered a lecture as part of the Seminar series while also discussing a potential collaboration with IRG 2. Postdocs are also encouraged to meet with CNS-UCSB’s Education Director Metzger or Coordinator Fastman 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 should they arise.

## **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 24 students who were active in Year 9 and descriptions of program activities are provided below.

### **CNS UCSB Graduate Fellows and Graduate Student Researchers during Year 9**

<b>Graduate Fellow</b>	<b>UCSB Department</b>	<b>Affiliation</b>
Roger Eardley-Pryor	History	IRG 1
Brian Tyrrell	History	IRG 1
Matthew Gebbie	Materials	IRG 2

Xueying (Xeu)ing Han**	Ecology, Evolution & Marine Biology	IRG 2
Galen Stocking	Political Science	IRG 2
Cassandra Engeman	Sociology	IRG 3/E&O
Amy Foss	Chicana/o Studies	IRG 3
Ariel Hasell	Communication	IRG 3
Louise Stevenson	Ecology, Evolution & Marine Biology	IRG 3
Bridget Harr	Sociology	IRG 3
<b>Grad Student Researcher</b>	<b>Department/Campus</b>	<b>Affiliation</b>
Parul Baxi	Sociology; UC Davis	IRG 2
Christian Beaudrie*	Risk and Environment; UBC (Int'l)	IRG 3
Lauren Copeland	Political Science; UCSB	IRG 3
Rachel Cranfill*	Linguistics; UCSB	IRG 3
John V. Decemvirale	History of Art and Arch; UCSB	Seed grant
Lanceton Mark Dsouza	Jenkins Collaboratory; Duke	IRG 2
Sheetal Gavankar	Environmental Science & Mgt; UCSB	Seed grant
Ariel Hasell	Communication; UCSB	IRG 3
Zachary Horton	English; UCSB	X-IRG
Quinn McCreight	Global & International Studies; UCSB	IRG 2
Miguel Ruiz	Sociology; UC Davis	IRG 2
Mathew Thomas	Jenkins Collaboratory; Duke	IRG 2
Caitlin Vejby	Global & International Studies; UCSB	IRG 2
Christopher Wegemer	Global & International Studies; UCSB	IRG 2

\*Indicates partial or full co-funding

### Research Fellowships in Social Science and Humanities and Science and Engineering:

The Graduate Research 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.

Ten students were funded in the Graduate Fellowship Program over the course of the reporting year. One of these, Xueying (Shirley) Han, received her PhD in December 2013 and was hired as a postdoctoral scholar for IRG 2 in 2014. After a gap quarter, Roger Eardley-Pryor returned to Graduate Fellow status for the winter quarter 2014 and defended and filed his dissertation at the end of March. In addition to Eardley-Pryor, four fellows from 2012-2013 were renewed in 2013-2014 (Cassandra Engeman, Matthew Gebbie, Xueying (Shirley) Han, and Galen Stocking). Cassandra Engeman was honored with a rare CNS Senior Fellow appointment for

2013-14 for her work leading the planning process for the major public outreach event, the *Democratizing Technologies* NGO conference to be held in Fall 2014 (see below). The 10 Fellows active in the reporting year represented seven academic disciplines (two in the sciences, four in the social sciences, and one in the humanities). This cohort included one Fellow of mixed Native American race and Hispanic ethnicity, one Asian, and one person with a disability; six of the 10 were women.

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 or Communication 595), 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 and encouragement to attend professional meetings and conferences, including the 2013 S.NET Conference at Northeastern University in Boston as well as several other domestic and international meetings. Current Fellow Louise Stevenson and former Fellows Hanna and Collins presented at the Sustainable Nanotechnology Organization annual conference, which was held in Santa Barbara and hosted by UC CEIN.

**Democratizing Technologies:** Senior Graduate Fellow Cassandra Engeman is co-leading with IRG leaders Harthorn and Appelbaum the effort to plan a large international conference that will focus on the nexus between NGOs and emerging technologies. The fundamental question we are asking is: In a globalized world, what role do NGOs play in both propagating the benefits and mitigating the risks of new technologies? This conference will include representatives from NGOs, the humanities and social sciences, physical and social sciences, government, and industry. Education Coordinator Fastman and postdoc Han are also helping.

This conference was originally planned for May 2013, but logistics, primarily the impossibility of securing a suitable venue on the campus of UCSB due to construction projects, necessitated pushing the date back. The conference will now take place November 13-15 in a large and welcome venue in the center of campus. Fellow Engeman and CNS Assistant Director Momlitor have created and placed a website for the conference on the CNS-UCSB server, <http://www.cns.ucsb.edu/demtech2014/welcome>. Working in consultation with a large and highly interdisciplinary group of faculty and graduate students, including a number of CNS fellows and postdocs, the conference leaders have invited some but not all intended participants. Details on the content of the conference will be described later in Section 12 of this report.

### *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 as well as five open-ended questions.

One of two (50%) Science Fellows completed the survey. All six (100%) current Social Science/Humanities Fellows responded.

Current fellows rated their experiences positively, with all fellows rating the overall quality of leadership in their working group as excellent (average score of 5 on a scale of 5). They rated their overall experience as between “very good” and “excellent” (average score of 4.7 on a scale of 5). Fellows specifically cited benefits from their interdisciplinary experiences, collaborative work, improved academic research, networking, 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. Fellows gave very high scores specifically for the impact of CNS-UCSB activities on their research experience (average score of 4.9 on a scale of 5) and specialized research knowledge (average score of 4.7 on a scale of 5).

In describing the most rewarding aspect of their CNS experience, one fellow wrote, “It’s hard to pick out one aspect as most rewarding, but I think just learning how different disciplines approach similar problems has been the most crucial in allowing me to recognize the deficiencies in my own discipline.” Another said, “Cross disciplinary dialogue re: the research process (for example, the recent seminar on research ethics across the disciplines) was quite generative.” Other Fellows said they benefitted from learning how to communicate across disciplines and meeting scholars outside of their home department. If the goal of CNS-UCSB is to train a new generation of interdisciplinary researchers, this feedback is very encouraging.

In Year 8, Fellows had requested the incorporation into the Seminar of additional professional development training. We are pleased to report that the CNS seminar saw an uptick in satisfaction from the previous year’s survey. Fellows rated the overall content of the seminar series as “very good” (average score of 4 on a 5 point scale) whereas they had rated it as good (average score of 3 on a 5 point scale) in the last reporting period. One fellow wrote, “I have seen the CNS seminars really improve. Seminar organizers have incorporated feedback from fellows and oriented many of the seminars toward professional development issues.” No respondents rated the content of the seminar series below a 3. Fellows have informally communicated to the Education and Outreach Coordinator that they appreciate seminars devoted to professional skills development. We will continue to offer opportunities for fellows to improve both their research skills as well as ancillary skills such as delivering presentations, writing publications, designing posters, and learning software.

Quantitative data revealed that one area in which CNS-UCSB could better assist the current cohort of Fellows is in presenting extramural funding opportunities. Regarding CNS-UCSB’s impact on teaching about extramural funding, survey responses yielded an average score of 3.4 on a scale of 5. Although timely announcements of opportunities are circulated to all by email list, we will consider the benefits of keeping a database of STS-related funding opportunities and dedicating a physical bulletin board to posting RFPs, as well as better direction of students than they apparently are receiving in their home departments to the resources for fund searching and proposal writing workshops already available on campus. We note that a seminar on grant writing, which would go far in addressing these issues, has been offered a number of times over the life of the CNS, led by Director Harthorn who has many years of professional

experience in faculty and graduate student research development. It has not yet been presented to this largely new cohort, a limitation we will address in the near future.

### **Former CNS Graduate Fellows, Graduate Student Researchers, and Postdocs**

This period, we administered two separate surveys, one for former CNS-UCSB Fellows and GSRs, and one for current Fellows and GSRs. As mentioned above, the past few cycles, we have received a low response rate from former participants in the Education Program because they had no new information to add from what they provided on prior surveys. Instead of asking them the same questions yet again, we instead asked them to update their employment status and whether their CNS-UCSB experience had impacted their work and/or research over the past year.

Of the 35 individuals who have participated in the program in the past, 10 (29%) completed the new, abridged survey. These ten CNS alumni/ae respondents reported having had positive experiences at CNS-UCSB that benefited their current professional activities. They were asked for an open-ended response on how their CNS-UCSB experience had impacted their work or research over the past year. Respondents listed many benefits of their CNS-UCSB training. Those included working in an interdisciplinary setting, learning to communicate with colleagues from different disciplines, thinking about the policy implications of scientific research, and improving their research design skills. One respondent, an assistant professor said that a manuscript begun while he/she was working at CNS-UCSB had been accepted for publication during the past year. The following response was very representative: “My work with CNS allowed me to expand my knowledge base beyond the physical sciences as well as meet other researchers interested in nanotechnology. My work with CNS also improved my communication skills and allowed me to discuss my work with individuals outside of my discipline.” This respondent went on to attribute her/his obtaining their current job to networking and advice through the Fellowship.

Of the 10 alumni/ae survey respondents, four are either postdocs or professors at Universities, two are working at government agencies (one state and one federal), three are working in industry, and one works for a major foundation. One is an engineer at the Walt Disney Corporation. The rest list their titles as scholars, researchers or scientists in the disciplines of policy, chemistry, microbiology, political science, education, earth science and environmental science.

**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 Year 9 Fellows Eardley-Pryor, and Engeman.

In the current period, fourteen graduate student researchers at UCSB (9) and partner institutions (5) contributed effort on projects in IRG 2, IRG 3, X-IRG and Seed projects. Among many accomplishments in the group, UBC recent PhD Christian Beaudrie is the lead author on an award-winning paper with IRG 3 researchers Satterfield and Kandlikar.



### **INSET Summer Internship Program**

In 2013, CNS-UCSB provided three internships to students participating in the NSF-funded Interns in Science, Engineering and Technology (INSET) Institutional REU program at the California NanoSystems Institute (CNSI). This program recruits community college students from lesser served communities 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 social science and humanities research methods, conduct a research project of their own, and learn presentation skills alongside the other REU interns working on experimental science research projects in CNSI laboratories. Students in the 35-hr/week program are closely mentored by an assigned CNS graduate mentor (and through tiered mentoring by the faculty member directing the graduate mentor).

At CNS-UCSB, the interns worked on projects addressing the societal implications of nanotechnology under the mentorship of the 3 Social Science and Humanities Graduate Fellows: examining how the governments of G20 nations implement policy to spur innovation in nanotechnology research (Merisa Stacy for IRG 2); investigating how social movement organizations mobilize around nanotechnology-related issues (Kelli Pribble for IRG 3); and conducting an applied history of prior technological interventions in bread production in order to contextualize and obtain possible lessons for the new development of nanotechnology in food (Paul Kovacs for IRG 1). In addition to working on individual research projects, the interns participated fully in IRG meetings, attended CNS Graduate Fellows Seminar meetings, and met weekly with program assistant Joshua Dean. 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 public research poster colloquium with UCSB interns from the INSET and other summer research programs.

Two of the three (67%) summer interns were women. Kelli Pribble was invited to share a poster at the Society for the Advancement of Chicano and Native Americans in Science annual conference in October. It was held in San Antonio, Texas. She is now studying Political Science (with an emphasis in International Relations) at UC Riverside. Stacy is studying Literature (with an emphasis in science and nature writing) at UC Santa Cruz. Kovacs holds a B.A. in philosophy from UC Santa Cruz. He continues to take Biology courses at Santa Barbara City College with the intention of pursuing neuroscience.

Mentor Roger Eardley-Pryor from CNS-UCSB presented the results of IRG 1'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 was "How Ecotopian Visions of Nanotechnology Influenced U.S. Environmental Health and Safety."

Funding for the full INSET program was not renewed by the NSF for 2014 after 3 successful multi-year runs with CNS as an active partner. Although CNSI is attempting to continue the program on a more limited basis without the NSF funding, CNS leadership concluded that after 8 consecutive years of running these very demanding summer programs, our time in summer 2014 would be better devoted to future development activities, including those aimed at generating education and outreach program funding. As our second funding cycle heads toward its sunset in 2015, we believe it is important to begin laying the groundwork for an institutional legacy. We do plan, however, on recruiting summer undergraduate interns from within UCSB to learn about interdisciplinary research and work on ongoing research projects.

### 2013 INSET Summer Interns

Intern	Home University	Grad Mentor	PI	IRG
Paul Kovacs	Santa Barbara City College	Roger Eardley-Pryor	Patrick McCray	1
Merisa Stacy	Santa Barbara City College	Galen Stocking	Rich Appelbaum	2
Kelli Pribble	Victor Valley College	Cassandra Engeman	Barbara Harthorn	3

#### *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 2013 interns reported high satisfaction with the program, unanimously giving the maximum ratings on the progress they made on their projects, being happy with how much they learned, feeling positive about their access to and interactions with their mentors, guidance and training. They also felt they liked and understood their projects, and that they felt positive about their interactions with the CNS faculty. Open-ended comments included, “The people at CNS were great. Everyone was extremely helpful and very friendly. My mentor was great and she/he was very easy to interact with” and “I felt I was able to talk to my mentor and the faculty about any questions or concerns I had. Everyone was extremely friendly and knowledgeable!”

As with our interns in previous summers, the 2013 interns felt the experience at CNS increased their motivation in their courses; increased confidence in their knowledge, research skills, and, in particular, their communication and presentation skills, which is a large focus of the program. Open-ended comments noted, “I feel that I have gained a more complete understanding of the effects of technology on society and I know this understanding will benefit me going forward,” “I feel very confident about my presentation skills thanks to this experience,” and one intern mentioned that the internship experience will help in her/his credibility on the job market.

When asked about any challenges they faced during the internship, two interns mentioned the short timeframe to complete the research, especially in light of the time needed to prepare poster and oral presentations of the research—all of which had to be completed in 8 weeks. Another intern mentioned staying focused while doing intensive computer research. One commented that “Public speaking did turn out to be a main focus of this internship, and although the public speaking was difficult, I had many resources at my disposal to prepare. I feel that I made a lot of progress in my public speaking and will be a much better public speaker as a result of this project.” The interns felt the most enjoyable aspects of their experience were the people they worked with (mentors, fellow interns, and CNS faculty and staff) and learning new things about nanotechnology.

Overall, the interns reported gaining important skills and knowledge about the societal aspects of nanotechnology. One said, “I’ve learned a lot during my experience at CNS, I had a lot of fun and am so grateful for all the support and encouragement I received from everyone! It’s been one of my best and most memorable summers!” Another intern noted that the internship cultivated a greater appreciation for the role of social science research as follows, “This was a wonderful experience and opportunity. Social Science research is often overlooked and CNS provides the link between society and advancement in technology that is often forgotten.”

Graduate Fellow Mentors similarly evaluated their experience quite positively, and all three were returning participants in the program, itself a testament to the quality of the experience. Mentors said they most enjoyed working with their students, and helping the interns develop their research and presentation skills. In addition to the positive experience of witnessing the academic growth of their interns, the mentors noted benefits to their own research projects. The only negative comments from the mentors concerned the administration of the program by our partner organization, which this year was perceived to be somewhat less well organized than in prior years. It should be noted that this feeling did not extend to the CNS Education and Outreach team. Mentors all agreed that the program increased their own confidence, skill, and ability to work with students that they would carry with them in their future academic careers.

## **Curriculum**

**Graduate Fellows Orientation Meeting:** In September 2013, CNS-UCSB started the academic year with a half-day orientation workshop and lunch for the new and returning Graduate Fellows. Education Director Metzger led an orientation on the Center's mission, activities, and policies and procedures, as well as specific background on the IRG research programs. Science Fellow Matthew Gebbie presented an introduction to nanoscale science and engineering concepts, and new Fellows engaged in hands-on activities developed by the Nanoscale Informal Science Education Network for NanoDays. The session was followed by a lunch meeting 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 and Communication 595) was the focal point of the Education Program's internal activities during the reporting year. The quarterly seminar meetings (at least 4 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.

Most of our seminars are open to researchers from the other NSF-funded Nano research centers on campus. Many of the sessions with outside speakers 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:

- Sarah Anderson, "Characterization of Uncertainties in the Life Cycle Assessments and Risk Assessment of Nanotechnology." Dr. Sarah Anderson is an Assistant Professor in the Bren School of Environmental Science and Management and Seed Grant recipient.
- Dr. Francesca Bray, "Technology, Gender, and History: The Case of Late Imperial China." Dr. Francesca Bray is Professor of Social Anthropology at the University of Edinburgh and President-elect of The Society for the History of Technology.

- Guoyu Wang, “Nanoethics Based on the Principle of Feasibility” Dr. Guoyu Wang is the Vice Dean of School of Humanities, Director of the Department of Philosophy and director of the Center for EU Studies at Dalian University of Technology.
- Casey Walsh, “Filtering out the Social: Nanotechnology and Water Treatment in Mexico.” Dr. Casey Walsh is Associate Professor of Anthropology at UCSB and a Seed Grant recipient. His research interests include water and commodity production in Mexico and California.
- Jennifer Lynn Woolley, “Origins and Outcomes: Success of Nano Spin-offs from Universities, Firms, and Government Research Centers and Laboratories.” Dr. Jennifer Lynn Woolley is an Associate Professor of Management at Santa Clara University. Her research focuses on the emergence of firms, industries, and technologies around the world.

Seminar professional development sessions included presentations by Miriam Metzger (Communication), Bruce Bimber (Political Science), Aashish Mehta (Global Studies), and Megan Valentine (Mechanical Engineering), who are all UCSB faculty, addressing “Secrets of the Temple II: The Insiders’ Guide to Academic Job Hunting.” In October, Librarian Chuck Huber conducted an introduction to Endnote Web software in order to aid in collaborative writing.

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. The CITS Director, Lisa Parks, is a member of the CNS-UCSB Executive Board, 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. In December 2013, CITS and CNS-UCSB co-sponsored a talk by University of Manchester film scholar and former geneticist David A. Kirby. The lecture was titled, “Darwin on the Cutting Room Floor: Evolutionary Biology and Film Censorship, 1930-1968.”

**Curriculum:** CNS-UCSB faculty, external collaborators and former Graduate Fellows incorporated Center research into 22 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:

- Global & International Studies 292MD, Globalization and Development, UCSB (Appelbaum)
- History 590, *Nanotechnology in Society*, Drexel (Slaton S 2013)
- *Key Topics in Development*, Universidad Autonoma de Zacatecas, Mexico, Guest Lecture (Lau, April 2013)
- Resource Management and Environmental Studies 510, *Social Ecological Systems*, University of British Columbia (Satterfield F 2013)
- Sociology 591 or Communication 595, *CNS Research Seminar in Emerging Technologies and Society*, UCSB, taught 4 quarters/yr. (Harthorn or Metzger)

#### Undergraduate Level Courses:

- ANES 130A, *Environment and Society*, UCSB, (Harthorn Guest Lecture F 2013)
- Anthropology 122, *Anthropology of World Systems*, UCSB (Walsh W 2014)
- Anthropology 195A, *Senior Honors Thesis* (topic “The Politics of Risk Perception”), UCSB, supervised by Harthorn (W and S 2013).
- Chemistry 533, *Nanoscience and Nanotechnology*, Rice University (Mody Guest Lecture)
- Feminist Studies 186HH, *Gender and Society: Risk & Inequality*, UCSB, (Harthorn W 2013).
- Global & International Studies 2, *Introduction to Global Studies: Politics and Economics*, UCSB (Appelbaum)
- Global & International Studies 130, *Global Economy and Development*, UCSB (Appelbaum)
- History 109T, *History of Technology in the US*, UCSB (McCray S 2013)
- History 261, *Environmental History*, Lewis and Clark College (Eardley-Pryor Guest lecture Apr 2013)
- History 451, *History of Medicine in the United States*, University of South Carolina, (November S 2013)
- Jour/ES/STS 323: Health and Environmental Controversies, Lehigh University (Friedman F 2013)
- Journalism 296: Doing Media Research, Lehigh University (Friedman S 2014)
- Global Engineering Ethics, Seoul National University (Choi S 2013 and F 2013)
- Materials 232, *Materials, Ethics, and Society*, Cal Poly SLO (Fastman Guest Lecture Jan 2014)
- Music 175J/Japan 172, *Music in Modern Japan*, UCSB (Novak W 2014)
- Political Science 114/Feminist Studies 186 GD, *Democracy, Diversity & Gender*, UCSB, (Barvosa W 2013)
- Sociology 130, *Sociology of Development*, UCSB (Appelbaum)

In addition to these formal course activities, several CNS participants delivered additional educational talks. October 27, 2013, Fellow Eardley-Pryor prepared and Education Director Metzger delivered a lecture titled, “Nanotechnology’s Societal and Environmental Implications,” at the annual Central Coast Bioneers Conference in San Luis Obispo, CA (<http://www.ecologistics.org/centralcoastbioneers/2013-workshops/Nanotech.html>). Former Postdocs Mikael Johansson and Jennifer Rogers-Brown delivered a lecture titled, “Public Perceptions of Nanotech and Biotech in the US and Mexico—With a Focus on Food and Agriculture Applications” at the Symposium on Ethical, Legal, and Societal Impacts of Nanotechnology at Stony Brook University’s summer NSF-funded Research Experience for Undergraduates Program, July 17, 2013.

**Communications Training:** Over the past year, CNS seminars and education events have focused on communicating research to a wider audience. This goal comes with the secondary benefit of amplifying outreach efforts. In May 2013, former CNS-UCSB postdocs Christine Shearer, a writer and environmental policy researcher, and Rachel Parker, a staffer at the Science and Technology Policy Institute, led a workshop on writing policy briefs in order to communicate the import of CNS-UCSB research to figures engaged in crafting or legislating policy. Shearer and Parker offered instruction on addressing a policy audience and capped the event with a hands-on writing activity where CNS-UCSB participants translated one aspect of their research into a policy brief.

In a May 2013 event, NPR Science Desk correspondent, Richard Harris and The Conservation Fund's Vice President of Marketing and Communications, Kathryn Brown, both visited the CNS. They conducted an informal conversation about communicating to a non-academic audience.

In Fall 2013, new Education and Outreach Coordinator Brandon Fastman began offering a year-long series in CNS on writing for a general audience. Drawing on his experience as a news reporter and professional writer, Fastman initiated the series with a seminar that offered writing tips for explaining technical information or specialized knowledge for an audience without deep education in a specific field. He also taught about the format of an op-ed, the primary vehicle by which researchers reach the broader public.

For the second installment of the series, in Jan 2014 three journalists visited CNS-UCSB to offer advice on pitching stories, interviewing with reporters, and composing op-eds. These journalists were Kathleen Sharp, a book author and regular contributor to both Atlantic.com and Salon.com; Michael Todd, the Social Science Communications Manager at SAGE Publications; and Matt Kettmann, managing editor of The Santa Barbara Independent newspaper, Central Coast stringer for The New York Times, and contributor to magazines such as Smithsonian. Another journalist, Ivan Amato, will visit for a CNS seminar in April. Amato has written extensively about nanotechnology including promotional materials for the National Nanotechnology Initiative.

The last installment of series will be a workshop in Spring 2014 on op-eds that graduate fellows and postdocs have written for submission to magazines and newspapers. Efforts to secure publication of these op-eds has already begun. More on this will be shared in the Outreach section.

### **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). The Board has encouraged CNS-UCSB to 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 graduated have reported having the greatest difficulties in obtaining new funding for their education and outreach programs, CNS leadership has made this a priority and is moving forward on several fronts to build new partnerships and develop funding initiatives. For example, this issue was discussed at length in an all-day CNS Leadership Retreat held at UCSB in Aug 2013. A 2014 NAB meeting is being planned for late Spring 2014, and meanwhile NAB members are providing direct consultation to Director Harthorn and the CNS Executive Committee on an as needed basis. For example, Harthorn and Board Co-Chair Bostrom discussed CNS progress, goals and challenges at the AAAS meetings in Chicago in Feb 2014, and will continue that discussion in a teleconference with her and Board Co-Chair Seely Brown later this month. In addition, Harthorn discussed future horizon and funding strategies for education and outreach at length in Dec 2013 with Board member and former NSEC director Robert Westervelt, who has been generous with time and advice.

### **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 beginning 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.

## 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 encourage conversations during this "upstream" period of nanotechnology development that will lead to their responsible and sustainable development. As the first center of its kind (with CNS-ASU), it also serves as a template for future coordinated societal implications research initiatives.

In this section, we offer an overview of our approach to public outreach and engagement, describe our outreach efforts during the reporting year, and detail some of our future plans for sharing our work with various stakeholder audiences—nanoscientists and engineers, the policy community, industry, other technology and society researchers, organized groups and members of the general public—who are affected by the nano-enterprise. As we look towards the future, however, we are beginning to place the near-decade of research on societal implications of nano into a broader context. Our own outreach events and invited presentations address not just the development of nanotechnology in China for instance, but also examine China's innovation policy more broadly. Similarly, work on nano risk-perception has led to comparative studies of risk perception with regard to other emerging technologies, such as geoengineering and hydro-fracturing.

### **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. CNS-UCSB is unique in that it addresses these challenges through both its research and its outreach activities. The core of CNS-UCSB societal implications research focuses on understanding and conducting comparative analysis of the views of the multiple stakeholders in emerging technology contexts, 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. Although the term "knowledge transfer" implies a one-way and top-down process of knowledge deposition, we strive to facilitate two- or even multi-way interaction between the scientific and social communities.

We ideally want to develop replicable models of the type of tailored public participation activities that past studies and our own research have shown to be effective: mutual, interactive forms of engagement with science and society that address 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 or our media content analysis, Bimber 2012) challenge the project of public engagement; however, much of the research on nanotechnology can teach us lessons about other emerging technologies.

There are other challenges as well: 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.

The multiple methods used by CNS-UCSB's researchers to address 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; new and print media studies of nano
- 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.

While there are limits to the audiences that CNS-UCSB can reach, the collaborative, interdisciplinary, and global nature of our research gives us a leg up. For example, Nick Pidgeon, a veteran and outside evaluator of numerous public deliberation and participation campaigns in the UK and one of the world's leading experts in the field, not only helps us to design effective studies but extends our reach across the Atlantic. Our collaborations with researchers in Asia and Latin America extend our reach even further across the globe.

### **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.

### **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 eight-member Executive Committee includes two physical and life scientists: materials scientist Craig Hawker and microbiologist 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 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 held a prestigious visiting professorship at Cal Tech for 2011-2012 based on earlier interactions with scientists there, and is working on a project focusing on the nano-bio interface based on what he learned in the interviews. His year at Cal Tech also led to new contacts, some of whom have already shared oral histories.

IRG 2 researchers have worked closely with NSE researchers in developing and understanding the contexts for international collaboration in their work. An April 2012 trip that IRG 2 leader Rich Appelbaum and three Graduate Fellows (Gebbie, Han, and Stocking) took to interview managers and early-career stage scientists working on bionanotechnology in companies located in BioBay, a nanotechnology center located within Suzhou Industrial Park, continues to yield papers and presentations in the reporting period. At the Sustaining Growth for Innovative New Enterprises Academic Workshop at the University of Manchester, UK, in June 2013 Appelbaum and former postdoc Rachel Parker gave a talk titled "Nanopolis and Suzhou Industrial Park: China's Silicon Valley?" Furthermore, IRG 2 research examines international Science and Engineering students' career decisions and plans to either remain in the US or return to their home bases once their educations are complete, a key issue for S&E investment and collaboration.

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 has led the sole social science research group 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 has collaborated with the UC Center for Lab Safety as they have sought 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 by NSF 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. IRG 3 has collaborated on the 2<sup>nd</sup> 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.

Harthorn's involvement in UC CEIN has led to several grassroots collaborations between scientists and social scientists, both formal and informal. For example, Holden and UC CEIN collaborator Jorge Gardea-Torresday will address CNS scholars in May about the toxicological implications of nanomaterials used in agriculture. When UC CEIN hosted the second annual Sustainable Nanotechnology Organization conference in Santa Barbara on November 2-5, 2013, CNS-UCSB Director Harthorn and CNS-ASU Director Dave Guston co-chaired a panel on societal and policy considerations to a largely NSE audience. Other CNS-UCSB participants included Seed Grant recipient Casey Walsh, former postdoc Mary Collins, former Graduate Fellow and postdoc researcher Shannon Hanna, and current Graduate Fellow Louise Stevenson.

**Joint Funding Proposals:** CNS-UCSB researchers have collaborated with scientists and engineers on numerous joint funding proposals, a majority of them successful. Among 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. The UC CEIN was renewed in Sept 2013 for an additional \$24M, and Harthorn continues an active role in its renewal.

**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 aerospace 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.

**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 where they are embedded into the social science enterprise. Alongside their peers from the social sciences and humanities (7 in the reporting year), Nanoscale Science and Engineering Graduate Fellows (3 in the reporting year) participate fully in the CNS-UCSB IRGs of which they are members, by attending IRG meetings, helping to design studies, and collecting and analyzing data. In a video interview that Education and Outreach Coordinator Fastman conducted at the 2014 CNS Research Summit, Science and Engineering Fellow Matthew Gebbie explained that his work with IRG 2 has helped

him to understand his bench science within a larger context. The high value that many of the Fellows place on their experience with us (as detailed in Section 11) is demonstrated by the ongoing commitment of past NSE Fellows to CNS-UCSB (including former Science Fellows Burks, Ferguson, Macala, Martin, Rowe, and Hanna), 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 are discussing funding and logistical possibilities for reconvening as many as possible at a concluding meeting of the CNS and its many participants.

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. As discussed in Section 11, CNS-UCSB hosted three interns from community colleges in southern California in summer 2013. We also 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. We also regularly invite scholars from these organizations to our talks and seminars. The recent appointment of CNS Executive Committee member Craig Hawker to the Directorship of the CNSI has enhanced 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, March 2010). Participation in ongoing discussions of EU- and other frameworks for responsible innovation are also central activities of senior CNS researchers (e.g. Pidgeon et al., 2013). 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. IRG 3 researchers have published on media frames and nano consumer attitudes, climate change policy, EHS policy, Nano and Public Participation, and the impact of public perception on nano policy dialogues.

**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, EU, 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 organized (with Nelson Lichtenstein, History, UCSB) a workshop on Workers' Rights at Rockefeller Foundation Center, Bellagio, Italy, in which he also presented on China's high-tech turn and its implications for labor. He was also a key organizer of the ReLANS conference in Brazil, which will be discussed in more detail below. IRG 2 collaborator Denis Simon (Arizona State Univ) was tabbed to assist in the first midterm review of China's 15 Year Medium-to-Long-Term Science and Technology Plan (MLP). One of only 12 foreign experts asked to participate in the review, Simon is helping China to transition from a manufacturing-based economy to a more sustainable knowledge economy.

National: Director Harthorn was invited to address several federal policymaking bodies in the reporting period. These include an invited talk on “Risk Perception and Communication in Nanotechnology Stakeholder Engagement” as part of a panel organized by the US Environmental Protection Agency on stakeholder engagement at the American Association for the Advancement of Science conference in Chicago, IL, February 15, 2014. She also delivered one of 2 keynote addresses at the 2013 National Nanotechnology Initiative’s (NNI) Stakeholder Perspectives on the Perception, Assessment, and Management of the Potential Risks of Nanotechnology workshop in Washington in Sept 2013. The purpose of this two-day workshop was to facilitate stakeholder discussion of key elements needed to assess, manage, and communicate potential risks associated with the use of nanomaterial and nanotechnology-enabled products. The public workshop highlighted practical tools non-Federal decision makers used in their consideration of potential risks, including quantitative and qualitative assessment and methods tools. Dr. Harthorn served on the national organizing committee for the meeting, moderated a roundtable discussion at it, and her talk, “Nanotechnology Multi-Stakeholder Risk Perception: Implications for Risk Analysis Management and Communication” took place on September 11. Earlier in the summer, she was an invited plenary speaker at the 2013 NNI Strategic Planning Stakeholder Workshop in June 2013 in Washington DC.

*EHS:* Harthorn has also forged a strong set of connections in the national EH&S community. As one aspect of this, she was invited in 2013 by the CDC and NIOSH to give the keynote address at NIOSH’s Cincinnati base (also broadcast to a large number of federal agency and industry parties via a webinar) on her CNS/CEIN experiences conducting 2 surveys of the international nanomaterials industry on their EHS practices and risk perception. NIOSH is incorporating many aspects of this work into their own plans to conduct a large survey of US companies.

*SOT Webinar:* As a direct effect of the well received NIOSH keynote, the nanotoxicology specialty section (NTSS) of the US Society of Toxicology invited Harthorn to present a webinar to their full membership. On March 10, 2014, CNS Director Harthorn conducted a webinar on “Surveying the Nanomaterial Industry: Lessons Learned and Challenges.” In this talk Dr. Harthorn discussed the processes used in two surveys of the international nanomaterials industry regarding their knowledge of safe handling practices across the product life cycle, their views on hazards posed by manufactured nanomaterials (MNM), and gaps in knowledge. The talk discussed methods used in the studies, challenges posed to conducting state of the art social science surveys, and lessons learned. The work drew on three published papers and background information on data gathering that is not included in published work.

*Bioethics Testimony:* In February 2014 CNS-UCSB Director Harthorn testified to the Presidential Commission for the Study of Bioethical Issues in Washington DC. At the request of the Commission’s Executive Director, Lisa M. Lee, Harthorn addressed how the National Nanotechnology Initiative employs advisory committees to inform ethics integration into nanotechnology research and development. The purpose of the meeting was to consider ethical issues raised by Brain Research through the Advancing Innovative Neurotechnologies (BRAIN) Initiative.

Harthorn’s presentation addressed the structures of the main NNI advisory committees and how they inform ethics integration into nano R&D; and then she addressed other structures and processes by which vital new knowledge about the social and ethical issues are being incorporated into the R&D enterprise. In her comments, Harthorn explained how the funding of CNS-UCSB and CNS-ASU marked an unprecedented federal investment in ELSI research, and that the precedent of the CNS centers can provide direction for an even stronger integration of

ethical considerations into the BRAIN initiative. Footage of the testimony as well as the proceeding discussion can be watched at the following link:  
<http://www.tvworldwide.com/events/bioethics/140210/>

**State:** Under review are “Short Subject” policy briefs composed by former Postdocs Shearer and Jennifer Rogers-Brown, along with current Postdoc Stacey Frederick for the California Research Bureau. Short Subjects are 800-word papers that report research to the California Legislature, Governor’s office, and the public about pertinent policy topics. CNS-UCSB’s Short Subjects will address nanotechnology’s role in the California economy as well as risk perceptions. They developed from a Policy Briefs workshop held at CNS-UCSB in May 2013 described below.

**CNS-UCSB Policy Briefs Program:** In a new effort, Education & Outreach Program Director Metzger worked 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.

Shearer and Parker led a day-long Policy Briefs Workshop at CNS-UCSB in May 2013. The purpose was 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 provided information about writing for a policy audience, and in the afternoon CNS IRG leaders, postdocs and fellows engaged in a hands-on writing activity where they translated their CNS-based research into a policy brief, with feedback from workshop leaders, CNS executive committee members, and members of the other IRGs. As mentioned above, outcomes from the Policy Briefs workshop highlighting CNS-UCSB research are currently under review as “Short Subject” policy briefs for the California Research Bureau.

**NGO Nano Policy Conference** During this reporting period, significant progress has been made in planning for the upcoming international conference, planned for November 13-15 at UCSB. The title of the conference is “Democratizing Technologies: Assessing the Role of NGOs in Shaping Technological Futures.” This conference will bring together social scientists, physical and biological scientists, 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. We aim to foster discussions that 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.

In the last reporting period, IRG leaders Harthorn, Applebaum, and CNS graduate fellow Cassandra Engeman, as well as Education Director Metzger, convened a planning committee drawing from faculty expertise across the UCSB campus. Education and Outreach Coordinator

Fastman has since joined in the planning process. The conference was originally scheduled for the spring of 2014, but venue constraints forced us to move the date to November. The conference is coming together nicely. A program is in place, a venue secured, guest speakers have been invited, and registrations is open. The conference website can be viewed at [www.cns.ucsb.edu/demtech2014/welcome](http://www.cns.ucsb.edu/demtech2014/welcome). It is being updated regularly.

### **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 United States 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 East Asia from the beginning. And as detailed below, IRG 2 has expanded its research into Latin America with the addition of key personnel and projects. 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.

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, as well as researchers who study issues of nano and other emerging technologies in international contexts, by participating 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: IRG2 has strengthened its based of researchers in Asia in several ways. As noted elsewhere in this report, IRG2 has two partnerships which bring strong research ties into Chinese and Korean research networks (Xinyue Ye in China; Hyungsub Choi in Korea). We continue to work with Cong Cao, whose strong networks among academicians in China have enabled him to emerge as one of the leading experts on China's S&T reforms (see e.g. *Science* 2, August 2013: 460-462); and Denis Simon, a member of the American experts team for the U.S.-China Innovation Dialogue and one of only 12 foreign experts team invited by the Chinese government to participate in the first midterm review of China's 15 Year Medium-to-Long-Term Science and Technology Plan (MLP).

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 led to the year-long appointment of postdoctoral visiting scholar

Edgar Zayago Lau at CNS-UCSB. A full professor in the Development Studies Academic Unit at Universidad Autonoma de Zacatecas, Lau serves as the technical secretary for the Latin American Network on Nanotechnology & Society (ReLANS/ [www.relans.org](http://www.relans.org)) headquartered in Zacatecas, Mexico with one coordination office in Curitiba, Brazil.

This connection bore fruit this past September when CNS-UCSB and ReLANS co-hosted the *First International Nanotechnology & Labor Workshop* in Curitiba, Brazil, on September 5-6, 2013, as part of the ReLANS' annual meeting. Experts on a wide array of issues related to the impacts of nanotechnology on labor presented their research findings in an effort to encourage understanding, analysis, and debate on this important topic. Participants included both academic experts, union leaders from different Latin American countries, and representatives of the Brazilian government. IRG 2 PI Appelbaum was a special guest at the conference, and delivered opening remarks. Among other topics, the conference addressed nano development, environmental risk, and workplace safety. Both scholars and representatives of labor unions played a prominent role in the conference program, which can be viewed here: <http://www.cns.ucsb.edu/sites/www.cns.ucsb.edu/files/events/Nano%20%20Labor%20Program.pdf>.

In addition, CNS-UCSB Seed Grant awardee Casey Walsh brings his expertise on Mexican water systems to a study on nano water filtration in Guadalajara, Mexico that extends IRG 2 work in the region. During the reporting period, he presented his work at the Sustainable Nano Organization (SNO) conference, 4S, the CNS-UCSB Seminar series, and the Centro de Investigaciones y Estudios Superiores en Antropologia Social (CIESAS) in Monterrey, Mexico. 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. CNS-UCSB Postdoc Luciano Kay, a citizen of Argentina, studies development in Latin America, and continued to strengthen CNS-UCSB's knowledge-base in this area.

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 180 active and linked organizations. They presented several papers on this in 2013, and the 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 Brazil, Canada, China, Denmark, France, Germany, India, Mexico, The Netherlands, Spain, Sweden, Switzerland, and the UK, among others.

This January, Chinese Professor of Philosophy Dr. Guoyu Wang spent a month in residence at CNS-UCSB. Dr. Guoyu Wang is from Dalian University of Technology (DUT), where she serves as the Vice Dean of School of Humanities, Director of the Department of Philosophy, and Director of the Center for EU Studies. She conducts research on the philosophy and ethics of emerging science and technology, as well as research on technology policy in the European Union. Dr. Wang also serves as General Secretary of the Committee of Ethics of Sci-Tech and Engineering, the Chinese Society for Dialectics of Nature, and is an executive member of the councils of several associations including the Association for Chinese Environmental Ethics, Association for Bioethics and the Association for Chinese Philosophy of Technology. She has received several grants from the Chinese National Science Foundation and Chinese Social Science Foundation to study the challenges associated with ethics and governance of



nanotechnology. Currently, she is the PI of the Center for Ethics and Management of Technology at DUT and also PI for the National Key Research Project for Humanities and Social Sciences on Ethics of High Technology.

At CNS-UCSB, Wang collaborated with IRG 3 and delivered a talk titled, “Nanoethics Based on the Principle of Feasibility,” which focused on the social acceptability of nanotechnology in China. This talk was co-sponsored by the UCSB Department of Chemistry and thus provided another NSE audience for societal implications research.

**Participation in Developing International Research Networks and Conferences:** CNS-UCSB researchers have been active in 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. Eggleston at Notre Dame University.

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 the first four annual conferences 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); Enschede, The Netherlands, 2012. She consulted extensively for the 2013 conference hosts at Northeastern University in Boston. 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. Every year, including this one, a large contingent of CNS-UCSB faculty and students attend and lead sessions and activities at the S.NET Conference.

Presentations in Europe: IRG 3 collaborators at UBC Christian Beaudrie, Milind Kandlikar, Terre Satterfield gave an invited talk on a Structured Decision Making (SDM) approach to risk screening at the University of York in the UK in July 2013. CNS affiliated UC CEIN postdoc, Lauren Copeland, visited Germany in September 2013 to give talks on her CNS-based work on political consumerism at the European Consortium for Political Research at the Center for the Study of Democracy at Leuphana University and at the Centre for European Social Research at the University of Mannheim. IRG 1 Historian Cyrus Mody presented at the International Congress of History of Science, Technology, and Medicine, held in Manchester UK in July 2013. As mentioned above, Appelbaum organized a meeting at the Rockefeller Foundation’s Bellagio Center in Italy about corporate responsibility that draws on CNS research in sustainable development. In addition, IRG 3 co-leader and UK scholar Pidgeon made international trips to the US for consultation with the US National Academy twice in Sept 2013.

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 2013, including travel from foreign sites to do so.

**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 1154 and included 66 presentations or sessions in education and outreach. See full listing at the end of this section. Additionally, CNS researchers, including graduate students and postdocs organized numerous panels at scholarly conferences. In 2013-2014 this has included taking a leadership role in organizing at least eight panels and sessions at 4 conferences in Italy, UK, and the US.

**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 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. It will be titled *Can Rich Countries Still Innovate?* and is currently under review at a prominent academic press (Newfield & Boudreaux, in preparation).
- The June 2013 Emerging Technologies specialist meeting convened by IRG 1 leader McCray produced a series of white papers, 4 of which the organizers have selected to submit for review in tandem to *History and Technology*.
- The CNS-UCSB NGO conference in advanced planning, *Democratizing Technologies* includes plans to develop a major publication, on the same model at the Routledge volume edited by Parker and Appelbaum out of our 2009 Emerging Economies, Emerging Technologies conference on equitable development in Washington DC. One strength of that publication we plan to emulate in the new volume to be is the inclusion of practitioner as well as scholarly contributions.

## Hosting Visiting Scholars

In addition to the visit in 2014 of Chinese philosopher Guoyu Wang, discussed above, CNS hosted a yearlong visit by Mexican collaborator Edgar Zayago Lau at CNS-UCSB through June 2013. During this period, Lau worked extensively with IRG 2 collaborators and took full advantage of the research resources available at UCSB not available at his home base in Mexico.

We also in Sept 2013 hosted a week-long visit by nano researcher Sarah Davies, now at the Copenhagen School of Business. Her visit to UCSB enabled her to conduct a number of interviews, arranged through contacts with CNS director Harthorn, with nanoscientists and other S&E faculty.

**Workshops:** On top of regularly welcoming visiting scholars to Santa Barbara, CNS-UCSB puts on larger-scale events where entire communities of scholars can coalesce. There were two such happenings in the past year.

Emerging Technologies Past and Present Workshop: On June 24-25, 2013, McCray convened a gathering of scholars think through the concept of “emerging technologies.” This conference envisioned emerging technologies as those which are described (now or in the past) as technologies or technological systems that will ‘change the game,’ drive new markets, require new regulatory paradigms, and have broad and difficult to anticipate social impacts. Such technologies are often associated with risk, speculation, uncertainty, and the possibility of financial reward. The aim of the workshop was 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, the workshop sought to both clarify and elaborate on the entire category.

Twelve visiting scholars attended the workshop. Talks addressed technologies as disparate as weather satellites, textile printing, data mining and x-rays. Contexts discussed included colonialism/postcolonialism, developing countries in Asia, the human body, and the Ottoman Empire. Nanotechnologies were thus considered in comparative context with numerous other technological developments.

The entire program may be seen here:

<http://www.cns.ucsb.edu/events/cns-emerging-technologies-past-present-workshop>

CNS Research Summit 2014: In January 2014, CNS-UCSB brought together the entire international network of CNS-UCSB collaborators, including scholars from institutions all over the US as well as Brazil, Mexico, UK, and Canada. As with past meetings, the ftf interaction allowed for a level of coordination and planning that, even with email and videoconferencing technology, is just not possible when collaborators are dispersed around the globe and working on their own projects, without necessarily being fully aware of others’ work in the CNS. Secondly, it was time to start thinking strategically about the future direction of CNS-UCSB after it is no longer an NSEC Center. This conversation broaches questions about future research agendas, funding sources, data sharing and storage, and culminating outputs.

In addition to those conversations, we have surveyed all participants following the event and hope to present preliminary results at the upcoming reverse site visit in May 2014.

### **UCSB and Santa Barbara Regional Communities**

CNS-UCSB and its affiliates 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 sponsored its own, as well as 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:

- Zorina Kahn, Professor and Chair, Economics, Bowdoin College, “Of Time and Space: Technological Spillovers Among Patents and Unpatented Innovations in Early U.S. Industrialization” (April 2013)
- Francesca Bray, Professor of Social Anthropology, University of Edinburgh, Technology, Gender, and History: The Case of Late Imperial China” (April 2013)

- Sarah R Davies, Department of Media, Cognition and Communication at the University of Copenhagen, "Studying and Practicing Public Engagement: Deficit, Deliberation and Delight" (Sept, 2013)
- David A Kirby, Senior Lecturer of Science and Communication Studies at University of Manchester, "Darwin on the Cutting Room Floor: Evolutionary Biology and Film Censorship, 1930-1968" (December 2013)
- Guoyu Wang, Vice Dean of School of Humanities and Professor of Philosophy, Dalian University of Technology. "Nanoethics Based on the Principle of Feasibility" (January 2014)

**NanoDays:** For the past six 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 NanoDays 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 per day, including families and children.

NanoDays 2013 was expanded to a two-day event at the Museum and were held on March 16-17, 2013 (and was held on April 5-6, 2014). CNS Education Director Metzger and five CNS-UCSB Graduate Fellows (Eardley-Pryor, Engeman, Stocking, Han, and Gebbie) 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!" which is a hands-on activity where 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 2014, the space elevator exercise is replaced with a similar one in which children imagine and draw their own robots. They then are asked to discuss how this robot would change their lives and the lives of people around them.

The 2013 NanoDays two-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. IRG 3 researcher Edwina Barvosa gave a presentation and

keynote address at *Ventura County Together*, a collaborative consortium of 40 nonprofit organizations, public agencies, and community service groups to introduce CommON-VC, a web-based program in participatory democracy. This event took place on March 27, 2013 in Camarillo, CA. On the first day of the reporting period, graduate fellow Roger Eardley-Pryor (IRG 1) delivered a presentation on CNS research to the Institute of World Culture (IWC) in Santa Barbara. After a similar talk the previous year, IWC board member Robert Moore wrote to us 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.” Based on this talk, CNS-UCSB was invited to present on the same issues at the Central Coast Bioneers Conference in October 2013. As well, Appelbaum delivered two talks on the Global Nanotechnology Workplace at a Fielding Graduate University summer workshop in Santa Barbara. Whether inside or outside of Santa Barbara, CNS Researchers continued to seize and create opportunities for informal science education formats. For instance, McCray gave a talk based on his book at the Smithsonian Institution in Washington, DC. (The previous year, McCray gave several talks at museums and public forums following the success of his book, *The Visioneers: How a Group of Elite Scientists Pursued Space Colonies, Nanotechnologies*, 2012.)

In the coming year, we are re-instituting science cafés as an opportunity for the public to engage with both NSE and ELSI researchers. By partnering with existing centers on campus, we hope to create a framework that will be sustainable after CNS-UCSB's existence. Preliminary plans are in place to host the first event at a distinctly Santa Barbara location, a wine tasting-room, this spring.

The main public engagement activity for 2013-14 and 2014-15 is our large-scale NGO conference, however, which includes local NGOs as partners and is expected to draw large audiences.

### **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:** The website is an important clearinghouse of information about CNS-UCSB. An upgrade to the Drupal platform in Year 8 made it much easier for staff to update the site. Over the past year, we have focused on reformatting the website so that CNS-UCSB publications and other information are presented as clearly and accessibly as possible. These efforts, largely via the effort of Dean and our website developer, have been very fruitful. It is now much easier for site viewers to find information about papers that were published by CNS-UCSB participants, and where possible, to read them.

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 CNS-UCSB News Clips.

The CNS-UCSB News Clips bimonthly compilations of breaking news stories on nanotechnology and societal issues 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 were generated by former CNS-UCSB Graduate Fellow David Weaver, one of several former students who continued to be engaged in CNS-UCSB after graduation. Weaver, however, now holds a full-time job in the Political Science department of Boise State University, and can no longer maintain this activity.

**Webinars:** In addition to her web broadcast talks in 2013 for the NNI and NIOSH (Jun, July and Sept 2013), Harthorn, as noted above, also conducted a webinar hosted by the Society of Toxicology (March 2014).

IRG 2 Collaborator Patrick Herron also delivered three webinar presentations. The first was on the GLOBONANO project and their study of the NCI Alliance to the National Nanomanufacturing Network's Nanoinformatics 2013 Workshop at the University of Pennsylvania on October 15, 2013. The second was for the National Cancer Institute's Working Group on Nanoinformatics on January 23, 2014. The last was delivered to the Duke Media Arts + Sciences Rendezvous on January 30, 2014. The NCI has asked permission to include our work as an appendix to their submission in preparation for refunding the NCI Alliance.

**Social Media:** During the reporting period, CNS-UCSB opened a Facebook account and Twitter feed to help disseminate information about CNS-UCSB research as well as more general information about nanotechnology. As with disseminating the news clips, however, finding the time for robust ongoing maintenance without dedicated staff for this purpose has been challenging. Our affiliated scholars also maintain their own social media profiles as well as professional blogs that are not focused on but do sometimes incorporate CNS-UCSB research. Examples include [utotherescue.blogspot.com](http://utotherescue.blogspot.com) co-written by X-IRG researcher Christopher Newfield; [STEMequity.com](http://STEMequity.com), maintained by IRG 1 researcher Amy Slaton; and McCray's Leaping Robot Blog ([www.patrickmccray.com/blog](http://www.patrickmccray.com/blog)).

**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:

- McCray penned an editorial for *The Chronicle of Higher Education* titled "The Technologists' Siren Song" (March 10, 2014)
- Cong Cao and Denis Simon (IRG 3) were used as sources for an article in *Nature Jobs* on reversing brain drain in China. (March 5, 2014).
- Postdoc Luciano Kay's research on patent maps was featured on a two-page spread in *Wired UK* (February 2014).
- The work of Kay and collaborators Jan Youtie and Philip Shapira was featured on the NSF homepage following a story by the Georgia Tech News Center. (January 14, 2014) The same work was also covered in the MIT Technology Review website. (September 2, 2013)

- Harthorn was interviewed for articles yet to be published by *The Santa Barbara Independent* and *Physics Today* on her testimony to the Presidential Commission on Bioethics and on nano consumer products respectively.
- Appelbaum was interviewed by Paulo Martines for Brazilian television. The segment was titled “China: Is the Public Investment Paying Off?” (January 21, 2014)

Because of personnel turnover during the reporting period, we have work to do on meeting the goals of our Media Plan as enumerated in the year ahead. That said, with the hiring of Education and Outreach Coordinator Fastman, we have begun to make headway and some structural changes this year have enabled us to amplify our communications efforts. For instance, we are now using the EurekaAlert! News service operated by AAAS. This is a cost-neutral change because UCSB already subscribes to the service. Another simple change was turning the News section of our website into an RSS feed which gets picked up by the university’s Public Affairs news website.

We expect Fastman’s experience as a journalist will help us to meet one of our primary Outreach goals for Year 10, which is to enhance communication with the general public, NSE, and policy communities CNS-UCSB’s research in a narrative fashion. As CNS-UCSB reaches the end of its award cycle, it is important for us to both synthesize and share our work. This will require press releases and news updates that, rather than publicize a single paper or point out honors and awards, arc across research projects and publications, and that contextualize them for our broad variety of audiences. Fastman plans to meet these goals via his own reporting and writing, as well as through the Education Program as elaborated below.

**Media Training:** Many CNS-UCSB senior researchers are comfortable publishing in the popular press. By leveraging the Education Program to bolster the communication skills of Postdocs and Graduate Fellows, CNS-UCSB can exponentially grow its ability to reach the public. Fastman implemented a three-part series on writing op-eds, the first two installments of which have already taken place. This program, which was described in Section 11, included an introduction to writing about specialized research for a general audience. For the second part of the series, three esteemed journalists visited CNS for a panel discussion that included concrete advice for pitching stories, talking to reporters, and composing opinion pieces.

One of the three visitors was Michael Todd, Social Science Communications Manager at SAGE Publications. He previously worked as a contributing editor at *Pacific Standard* magazine which is operated by the nonprofit Miller-McCune Center for Research, Media and Public Policy. *Pacific Standard* focuses on the behavioral and social sciences, and reaches a monthly audience of nearly 1,000,000 via its website and print edition. Todd agreed to help place a CNS-UCSB Graduate Fellow-composed op-ed in *Pacific Standard*. This op-ed will be chosen by editors at the magazine. In the last installment of the op-ed writing series, students will workshop their op-eds to be submitted to *Pacific Standard*. The ones that are not chosen can then be submitted to other publications. This exercise will yield at least one publication, and hopefully it will make CNS-UCSB Graduate Fellows more comfortable with the process of reaching out to the media.

CNS-UCSB Media Plan for 2014-15: Along with our global strategy of engaging in more storytelling, our discrete media plans, because of personnel turnover, have remained largely the same. These are as follows:

- Increase 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:** Postdocs Luciano Kay and Shirley Han participated on behalf of CNS-UCSB in a *Nanoscience and Emerging Technologies in Society: Sharing Research and Learning Tools (NETS)* workshop in Amherst, MA in June 2013. They presented on strategies for advancing the collection, dissemination, and preservation of social dimensions research about nano and emerging technologies for research and public audiences. The workshop, which included digital librarians, was the consequence of a \$48,000 IMLS planning grant, partnered with CNS-UCSB, 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 as well to set up a follow up meeting of nano and society researchers to discuss these issues in conjunction with the December, 2013 NSEC meeting in Washington DC.

## **Presentations 2013-2014**

### **A. Education and Outreach (to NSE, industry, government, media, public) (N= 66)**

- Eardley-Pryor, Roger. "Nanotechnology: The Large Societal Impacts of the Very Small,"  
Institute of World Culture, Santa Barbara, CA, March 16, 2013.
- Eardley-Pryor, Roger. Participant and Volunteer Nano-Days, Santa Barbara Museum of Natural History, Santa Barbara, CA, March 17, 2013.
- Stocking, Galen. Participant and Volunteer Nano-Days, Santa Barbara Museum of Natural History, Santa Barbara, CA, March 17, 2013.
- Han, Shirley. Participant and Volunteer Nano-Days, Santa Barbara Museum of Natural History, Santa Barbara, CA, March 17, 2013.
- Gebbie, Matthew. Participant and Volunteer Nano-Days, Santa Barbara Museum of Natural History, Santa Barbara, CA, March 17, 2013.
- Engeman, Cassandra. Participant and Volunteer Nano-Days, Santa Barbara Museum of Natural History, Santa Barbara, CA, March 17, 2013.
- Pidgeon, Nick. "Geoengineering as an Emerging Technology: Deliberation and Anticipatory Research Governance," invited talk, Geoengineering Research Governance Network Conference, Oxford University, Oxford, United Kingdom, March 18, 2013.



- Mody, Cyrus. "Dad's in the Garage: Santa Barbara Physicists in the Long 1970s," Forum for the History of Physics invited session, American Physical Society meeting, Baltimore, MD, March 20, 2013.
- Barvosa, Edwina. Keynote/Public Outreach Address for a public launch of CommON-VC, a web-based program in participatory democracy supporting public engagement in Ventura County, CA SJF/Ventura County Community Foundation Camarillo, CA, March 23, 2013.
- Barvosa, Edwina. Public outreach presentation to Ventura County Together, a collaborative consortium of 40 nonprofit organizations, public agencies, and community service groups to introduce CommON-VC, a web-based program in participatory democracy supporting public engagement in Ventura County, CA VCCF, Camarillo, CA, March 27, 2013.
- Harthorn, Barbara Herr. Member, National Organizing Committee, National Nanotechnology Initiative, Risk Stakeholder Meeting, Washington, D.C, September 11-12, 2013; weekly planning meetings March- August 2013; planning meeting, US Department of Agriculture, Washington D.C., June 12, 2013, Washington, D.C., March - August 2013.
- Eardley-Pryor, Roger. "Environmental History and Nanotechnology," invited lecture for Environmental Histories of Science and Technology (Dr. Jerry Jessee), Lewis and Clark College, Portland, OR, April 11, 2013.
- Parker, Rachel. Panelist CNS-UCSB Policy Briefs Workshop, Santa Barbara, CA, May 28, 2013.
- Harthorn, Barbara Herr. Invited discussant, Faculty Panel on Interdisciplinarity, Anthropology Department Graduate symposium, UCSB, Santa Barbara, CA, May 31, 2013.
- Novak, David. Untitled talk covering current research, presented at the UCSB Anthropology Graduate Symposium, Santa Barbara, CA, May 31, 2013.
- McCray, Patrick. "Visioneering: From Space Colonies to Nanotechnologies in Pursuit of a Limitless Future," invited talk presented at the Smithsonian Institution, Washington, D.C., May 2013.
- Harthorn, Barbara Herr. "Ethical, Legal, and Societal Implications of Nanotechnologies," invited plenary presentation, 2013 NNI Strategic Planning Stakeholder Workshop, Washington, D.C., June 11-12, 2013.
- Beaudrie, Christian, Kandlikar, Milind, & Satterfield, Terre. "Nanotechnology Risk Screening using a Structured Decision Making (SDM) Approach," invited lecture, Environment Department, University of York, York, United Kingdom, July 4, 2013.
- Appelbaum, Richard, & Lichtenstein, Nelson. Co-organizers, workshop on "Achieving Workers' Rights in the Global Economy," Rockefeller Foundation Center, Bellagio, Italy, July 4, 2013.
- Appelbaum, Richard. "From Made in China to Designed in China: What does China's High-Tech Turn Mean for Chinese Workers?" presentation at workshop on "Achieving Workers' Rights in the Global Economy," Rockefeller Foundation Center Bellagio, Italy, July 4, 2013.
- Harthorn, Barbara Herr. "Exploring the Societal Implications of Nanotechnology at CNS-UCSB," presentation in the INSET summer interns program, CNSI, UCSB, Santa Barbara, CA, July 9, 2013.
- Appelbaum, Richard. "Regulation, Risk, and the Global Nanotechnology Workplace," Fielding Graduate University Summer Session Workshop on Global Systems, Santa Barbara, CA, July 16, 2013.
- Johansson, Mikael, & Rogers-Brown, Jennifer. "Ethical, Legal and Societal Implications of Nanotechnology," Stony Brook University, Stony Brook, NY, July 17, 2013.
- Rogers-Brown, Jennifer. "Public Perceptions of Nanotech and Biotech in the US and Mexico - with a focus on food and agriculture applications," Symposium on Ethical, Legal, and

Societal Impacts of Nanotechnology at Stony Brook University's summer NSF-funded Research Experience for Undergraduates Program, Stony Brook, NY, July 17, 2013.

Appelbaum, Richard. "From Made in China to Designed in China: What Does China's High-Tech Turn Mean for Chinese Workers?" Fielding Graduate University Summer Session Workshop on Global Systems, Santa Barbara, CA, July 19, 2013.

Corner, Adam. Convener, "Framing & Perceiving Geoengineering" symposium, Science in Public conference, Nottingham, United Kingdom, July 22-23, 2013.

Corner, Adam. "Messing with Nature - Geoengineering & Green Thought," Science in Public conference, Nottingham, United Kingdom, July 22-23, 2013.

Harthorn, Barbara Herr. Participant, Half-day expert workshop with NIOSH/CNC Surveillance Research Branch team re: surveying the nanomaterials industry, HIOSH campus, Cincinnati, OH, July 30, 2013.

Harthorn, Barbara Herr. "Surveying the nanomaterials industry: Lessons learned & challenges," keynote presentation, NGO and federal stakeholder meeting and webcast of the National Institute of Occupational Safety and Health (NIOSH), Cincinnati, OH, July 31, 2013.

Kovacs, Paul. "Nanotechnology in Food: Lessons from the Industrialization and Enrichment of Bread," Internships in Nanosystems Science, Engineering, and Technology (INSET), public presentation, Santa Barbara, CA, August 7-8, 2013.

Pribble, Kelli. "Mobilizing in the Context of Uncertainty: Social Movement Organizations and their Role in Nanotechnology," Internships in Nanosystems Science, Engineering, and Technology (INSET), public presentation, Santa Barbara, CA, August 7-8, 2013.

Stacy, Merisa. "Comparative Nanotechnology Policy Analysis," Internships in Nanosystems Science, Engineering, and Technology (INSET), public presentation, Santa Barbara, CA, August 7-8, 2013.

Mody, Cyrus. Moderator, session on "Social Construction of Technology," American Sociological Association annual meeting, New York, NY, August 10, 2013.

Kovacs, Paul. "Nanotechnology in Food: Lessons from the Industrialization and Enrichment of Bread," (poster), Internships in Nanosystems Science, Engineering, and Technology (INSET), poster session, Santa Barbara, CA, August 15, 2013.

Pribble, Kelli. Mobilizing in the Context of Uncertainty: Social Movement Organizations and their Role in Nanotechnology," (poster), Internships in Nanosystems Science, Engineering, and Technology (INSET), poster session, Santa Barbara, CA, August 15, 2013.

Stacy, Merisa. "Comparative Nanotechnology Policy Analysis," (poster), Internships in Nanosystems Science, Engineering, and Technology (INSET), poster session, Santa Barbara, CA, August 15, 2013.

Pidgeon, Nick. Invited Presentation, US National Academies inquiry on climate engineering, Washington, D.C., September 10, 2013.

Harthorn, Barbara Herr. "Nanotechnology Multi-Stakeholder Risk Perception: Implications for Risk Analysis, Management, and Communication," Key note address, 2013 NNI R3 Stakeholder Workshop, Washington, D.C., September 11, 2013.

Harthorn, Barbara Herr. Moderator, "Public Risk Perception" Roundtable, 2013 NNI R3 Stakeholder Workshop, Washington, D.C., September 11, 2013.

Kay, Luciano. Interview with Julie Cohen, Public Affairs & Communications, UCSB, to disseminate the work "Patent Overlay Mapping: Visualizing Technological Distance" in UCSB's news bulletins, Santa Barbara, CA, September 19, 2013.

Pidgeon, Nick. "Geoengineering: Public Values, Stakeholder Perspectives and the Challenge of 'Upstream' Engagement," Sackler Science of Science Communication conference, September 22-25, 2013.

Beaudrie, Christian. "Emerging Nanotechnologies and Risk: Challenges in Assessing and Regulating Risks Under High Uncertainty," Department of Civil and Environmental Engineering, North Dakota State University, Fargo, ND, September 26, 2013.

Pribble, Kelli. "Mobilizing in the Context of Uncertainty: Social Movement Organizations and their Role in Nanotechnology," (poster), SACNAS conference Austin, TX, October 3-6, 2013.

Lenoir, Timothy. Presentation on GLOBONANO project and the study of the NCI Alliance, webinar presentation to the National Nanomanufacturing Network's Nanoinformatics 2013 Workshop at the University of Pennsylvania, Philadelphia, PA, October 15, 2014.

Mody, Cyrus. Interviewed by Prof. Vicki Colvin and Prof. Dan Mittleman for Rice Smalley Institute web course "Small Talk," October 22, 2013.

Harthorn, Barbara Herr. Session Organizer and Chair, Social Implications, SNO conference, Santa Barbara, CA, November 3-5, 2013.

Harthorn, Barbara Herr. Session Organizer and Chair, "Societal Implications," 2nd Annual Meeting of the Sustainable Nanotechnology Organization, Santa Barbara, CA, November 3-5, 2013.

Collins, Mary, & Harthorn, Barbara Herr. "Ethical Positions and Nanotechnology Acceptance: A Social Component of Environmental Sustainability," 2nd Sustainable Nanotechnology Organization Conference, Santa Barbara, CA, November 4, 2013.

Walsh, Casey. untitled presentation, 5th Encounter of the Researchers of the Nanoscience and Micro-nanotechnology, Instituto Politecnico Nacional (IPN), Mexico City, Mexico, November 5-6, 2013.

Slaton, Amy. Invited Keynote Speaker "President's Diversity Breakfast," Colorado School of Mines, Golden, CO, November 6, 2013.

Harthorn, Barbara Herr. Guest lecture, "Risk, Risk Perception and Environment," ANES 130 - Cross-listed undergraduate course in Environmental Studies and Anthropology, Santa Barbara, CA, November 7, 2013.

Kay, Luciano. Interview with Wired UK (via email) to disseminate the work "Patent Overlay Mapping: Visualizing Technological Distance," November 18, 2013.

Walsh, Casey. untitled presentation, 2nd Colloquium on the Design and Texture of nanostructures, Guadalajara, Mexico, November, 25-26, 2013.

Harthorn, Barbara Herr. "Evidence-Based Risk Perception and Communication for Ethical and Socially Sustainable Nanotechnology," Plenary talk, NSF NSE Grantees meeting, Arlington, VA, December 4-6, 2013.

Kay, Luciano, & Han, Shirley. Presentation on strategies for advancing the collection, dissemination, and preservation of social dimensions research about nano and emerging technologies for research and public audiences Nanoscience and Emerging Technologies in Society: Research and Learning Tools (NETS) Workshop, Amherst, MA, December 6, 2013.

Kay, Luciano. Presented a short training by Skype on how to use patent mapping tools to Georgia Tech colleagues, December 6, 2013.

Harthorn, Barbara Herr. Expert panelist UCSB Office of Research, Collaborative Research Panel for Faculty, Mosher House, UCSB, Santa Barbara, CA, December 17, 2013.

Novak, David. Untitled talk presented to EALCS undergraduate class, Globalizing Japan, Santa Barbara, CA, December 2013.

Kay, Luciano. Interview with UCSB Daily Nexus (via email) to disseminate the work "Patent Overlay Mapping: Visualizing Technological Distance," Santa Barbara, CA, January 16, 2014.

Appelbaum, Richard. "China - is public investment paying off?" Paulo Martines video interview for Brazilian TV broadcast, January 21, 2014.

- Lenoir, Timothy, & Herron, Patrick. Presentation on GLOBONANO project and the study of the NCI Alliance, webinar presentation for the National Cancer Institute's Working Group on Nanoinformatics, January 23, 2014.
- Lenoir, Timothy. Presentation on GLOBONANO project and the study of the NCI Alliance, webinar presentation for the Duke Media Arts + Sciences Rendezvous, January 30, 2014.
- Harthorn, Barbara Herr. "Risk Perception and Communication in Nanotechnology Stakeholder Engagement," Invited presentation in panel organized by the US Environmental Protection Agency on stakeholder engagement, American Association for the Advancement of Science, Chicago, IL, February 15, 2014.
- Harthorn, Barbara Herr. "Understanding Societal Aspects of Emerging Nano Technologies," invited guest lecture and day-long program visit, Peter Wall Institute, Nano Energy Group, Department of Chemistry, University of British Columbia, Vancouver, Canada, February 27, 2014.
- Slaton, Amy. Invited seminar speaker NEH Program, "Making Connections: Engaging the Humanities at a College of Technology," New York City College of Technology, New York City, NY, February 28, 2014.
- Harthorn, Barbara Herr. "Surveying the Nanomaterial Industry: Lessons Learned and Challenges," webinar presentation, Society of Toxicology Nanotoxicology Specialty Section, March 10, 2014.

## **B. Research (N= 88)**

- Walsh, Casey. "Filtering out the Social: Nanotechnology and Water Treatment in Mexico," Society for Applied Anthropology Meeting, Albuquerque, NM, March 18-22, 2014.
- Harthorn, Barbara Herr. "US Public Perceptions of Environmental Resilience in the Face of New Technologies in the Americas," presented in the panel "Risk, Perception, and Environmental Hazards of New Technologies in the Americas," Society for Applied Anthropology, Denver, CO, March 21, 2013.
- Collins, Mary. Session Organizer, "Risk, Perception, and Environmental Hazards of New Technologies in the Americas," Society for Applied Anthropology, Denver, CO, March 22, 2013.
- Collins, Mary, Harthorn, Barbara Herr, & Satterfield, Terre. "Nanoremediation: Emergent technology and issues of equity," Society for Applied Anthropology, Denver, CO, March 22, 2013.
- Rogers-Brown, Jennifer, & Shearer, Christine. "Reconceptualizing Risk and Regulation for Emerging Technologies in Food and Agriculture," Society for Applied Anthropology, Denver, CO, March 22, 2013.
- Satterfield, Terre, deVries, Laura, Pitts, Anton, & Harthorn, Barbara Herr. "Crude Proxies and Essentializing Narratives in Risk Research," Society for Applied Anthropology, Denver, CO, March 22, 2013.
- Copeland, Lauren. "Political Consumerism and the Expansion of Political Participation Repertoires in the United States," Annual meeting of the Western Political Science Association, Hollywood, CA, March 28-30, 2013.
- Appelbaum, Richard. "Nanotechnology as Industrial Policy: China and the United States," Annual Meetings of the International Studies Association, San Francisco, CA, April 4, 2013.
- Eardley-Pryor, Roger. "How Ecotopian Visions of Nanotechnology Influenced U.S. Environmental Health and Safety," (poster). American Society for Environmental History (ASEH), Toronto, Canada, April 6, 2013.

- Copeland, Lauren. "Political Consumerism: Boycotting, Buycotting, and the Expansion of Political Participation in the United States," Annual meeting of the Midwest Political Science Association Chicago, IL, April 11-14, 2013.
- Appelbaum, Richard. "Will China Challenge the U.S. as a Technology Superpower? Some Lessons from the U.S. and Chinese Nanotechnology Initiatives," invited lecture at Arizona State University, Tempe, AZ, April 17, 2013.
- Choi, Hyungsub. "The Origins of Interdisciplinary Research in Nanotechnology in Korea," Korea History of Science Society Annual Meeting, April 27, 2013.
- McCray, Patrick. "Gerard O'Neill's Visioning for the Humanization of Space," invited talk at "Space Exploration and the Human Imagination" conference, Rice University, Houston, TX, April 2013.
- Newfield, Christopher. "The Return of Creativity: Literary vs. Innovation Theory," Grinnell College, Grinnell, IA, April 2013.
- Novak, David. "Sound Demos and the Politics of Protest in Post-3.11 Japan," Humanities Institute at The Ohio State University, Columbus, OH, April 2013.
- Beaudrie, Christian, Kandlikar, Milind, Long, G., Gregory, W., Wilson, T., & Satterfield, Terre. "Expert Judgment-Based Risk Screening for Emerging Nanotechnologies: A Collaborative Approach," UC-CEIN Nano EH&S Forum, UCLA, Los Angeles, CA, May 6-9, 2013.
- Collins, Mary. "Ecotypes, Risk Perception and New Technologies: The Effect of Environmental Context on Nanotechnology Public Risk Perception," (poster). UC-CEIN Nano EHS Forum: Scientific Advances Toward Reducing Complexity in Nano EHS Decision Making, Los Angeles, CA, May 8, 2013.
- Hanna, Shannon. "Consequences of Carbon nanotubes in Marine Ecosystems: Accumulation and Toxicity in a Marine Mussel," (poster). UC-CEIN Nano EHS Forum: Scientific Advances Towards Reducing Complexity in Nano EHS Decision Making, Los Angeles, CA, May 8, 2013.
- Lenoir, Timothy. "Federal Funding and the Takeoff of Nanotechnology and Nanomedicine," presentation at the University of Chicago, Chicago, IL, May 15, 2013.
- Choi, Hyungsub. "The Origins of Interdisciplinary Research in Nanotechnology in Korea," Post-Catch UP Research Center, KAIST, May 16, 2013.
- Copeland, Lauren. "Political Consumerism and Political Participation," Ninth Annual California Graduate Study Conference, Center for the Study of Democracy, University of California, Irvine, Irvine, CA, May 18, 2013.
- Copeland, Lauren, & Hasell, Ariel. "Risky Business? How Risk vs. Benefit Frames Influence Consumer Attitudes toward Nanotechnology Applications," Annual conference on Environmental Politics and Policy, Santa Barbara, CA, May 31, 2013.
- Engeman, Cassandra, & Harthorn, Barbara Herr. "Mobilizing in the Context of Uncertainty: Social Movement Organizations and Contentious Issues of Nanotechnology Safety, Governance, and Responsible Development," UCSB Environmental Politics Conference, Santa Barbara, CA, May 31, 2013.
- Appelbaum, Richard. "From 'Made in China' to 'Designed in China': Does China's High Tech Turn Mean an End to the China Sweatshop?" Keynote address Global Studies Association annual conference, Palos Verde, CA, June 7, 2013.
- Collins, Mary. "Environmental Risk Judgment Analysis: Nanotechnology and Consumer Products," Annual Meeting of the Association for Environmental Studies and Sciences (AEES), Pittsburgh, PA, June 19-22, 2013.
- Walsh, Casey. "Dimensiones sociales de la nanotecnología y el tratamiento de aguas en México," Centro de Investigaciones y Estudios Superiores en Antropología Social (CIESAS), Monterrey, Mexico, June 20, 2013.

- Choi, Hyungsub. "Emerging Technology in an Emerging Research Community: A Story of the SNU Nanoelectronics Institute," "Emerging Technologies" workshop at UCSB, Santa Barbara, CA, June 24-25, 2013.
- Appelbaum, Richard, & Parker, Rachel. "Nanopolis and Suzhou Industrial Park: China's Silicon Valley?" Sustaining Growth for Innovative New Enterprises Academic Workshop - Manchester Institute of Innovation Research, Manchester, United Kingdom, June 25, 2013.
- Gavankar, Sheetal, & Anderson, Sarah. "Characterization of uncertainties in the life cycle assessments of emerging technologies: Review and implications for public's risk perception," International Society for Industrial Ecology, Ulsan, South Korea, June 25-28, 2013.
- Appelbaum, Richard, & Parker, Rachel. "Nanopolis and Suzhou Industrial Park: China's Silicon Valley?" Annual Meetings of the Society for the Advancement of Socioeconomics (SASE), Milan, Italy, June 27-28, 2013.
- Walsh, James. "The Impact of Foreign-Born Scientists and Engineers on American Nanoscience Research," Annual Meetings of the Society for the Advancement of Socioeconomics (SASE), Milan, Italy, June 27-28, 2013.
- Frederick, Stacey, & Parker, Rachel. "Quantifying the Nanotechnology Workforce in the US: Identifying a method and barriers for estimating nanotechnologies," Annual Meetings of the Society for the Advancement of Socioeconomics (SASE), Milan, Italy, June 28, 2013.
- Cao, Cong. "Science, Technology, and Innovation in China: Progress, Problems, and Prospect," Sustaining Growth for Innovative New Enterprises Academic Workshop – Manchester Institute of Innovation Research Manchester Business School, University of Manchester, Manchester, United Kingdom, June 2013.
- November, Joseph. "The Cochrane Collaboration Beyond Cochrane," International Congress of History of Science, Technology, and Medicine, Manchester, United Kingdom, July 22, 2013.
- Mody, Cyrus. "An Historical Alternatives Approach to the Materials of Microelectronics," International Congress of History of Science, Technology, and Medicine, Manchester, United Kingdom, July 25, 2013.
- Cao, Cong, & Lü, Jialing. "Trajectory of China's High-Tech Development: The 'Growing Pains/Premature Senility' Thesis Revisited," Suzhou-Silicon Valley-Beijing 2013 International Innovation Conference on Technology Innovation and Diasporas in a Global Era, Suzhou, China, July 2013.
- Zayago Lau, Edgar "Implications of Nanotechnology for Labor," Society for the Advancement of Socio-Economics, Milan, Italy, July 2013.
- Appelbaum, Richard. "Making Blue the Green: Achieving Workers' Rights in the Global Economy," Annual Meetings of the American Sociological Association, New York, NY, August 10, 2013.
- Appelbaum, Richard. "Achieving Workers' Rights in the Global Economy: Report from a Workshop at the Rockefeller Foundation Center, Bellagio, Italy," ASA Mini-conference on Labor and Global Solidarity, New York City, NY, August 12, 2013.
- Engeman, Cassandra. "Mobilizing in the Context of Uncertainty: Social Movement Organizations and Contentious Issues of Nanotechnology Safety, Governance, and Responsible Development," Capitalism, the Politics of Inequality, and Historical Change, mini-conference of the Comparative-Historical and Political Sociology sections of the American Sociological Association, New York City, NY, August 14, 2013.
- Appelbaum, Richard. "Nanotechnology, Labor, and Regulation," International Workshop on Nanotechnology and Society in Latin America, Curitiba, Brazil, September 5, 2013.
- Foladori, Guillermo. "Global and Brazilian Trends in Nanotechnology," International Workshop on Nanotechnology and Society in Latin America, Curitiba, Brazil, September 5, 2013.

- Zayago Lau, Edgar "Advancement of Nanotechnology in Mexico," International Workshop on Nanotechnology and Society in Latin America, Curitiba, Brazil, September 5, 2013.
- Copeland, Lauren. "Political Consumerism and the Expansion of Political Participation in the U.S." European Consortium for Political Research and the Center for the Study of Democracy at Leuphana University, Luneberg, Germany, September 18, 2013.
- Copeland, Lauren. "Political Consumerism and the Changing Citizen," Mannheim Centre for European Social Research, University of Mannheim, Mannheim, Germany, September 23, 2013.
- Kay, Luciano. "Innovation pathways of developing countries in emerging technologies: The case of nanotechnology in Argentina and Brazil," 2013 Atlanta S&T Conference, Atlanta, GA, September 26-28, 2013.
- Copeland, Lauren. "Political Consumerism and the Changing Citizen," research presentation to the Department of Political Science, University of California, Santa Barbara, Santa Barbara, CA, September 2013.
- McCray, Patrick. "Regulating Innovation via Analogy: The Case of Nanotechnology," invited talk presented at "Pressing Issues: The History of Technology meets Public Policy," workshop, Colby College, Waterville, ME, September 2013.
- Collins, Mary, Hanna, Shannon, Satterfield, Terre, & Harthorn, Barbara Herr. "Ecotypes, Risk Perceptions, and New Technologies," Annual Meeting of the Society for Social Studies of Science (4S), San Diego, CA, October 9-12, 2013.
- Copeland, Lauren, & Hasell, Ariel. "Framing Effects on U.S. Consumer's Expressed Willingness to Purchase Nano-enabled Consumer Products," Annual Meeting of the Society for Social Studies of Science (4S), San Diego, CA, October 9-12, 2013.
- Collins, Mary, & Harthorn, Barbara Herr. Co-Organizers, "The Politics of Risk & Perception: The Nanotechnology Case" Panel, Society for the Social Study of Science (4S), San Diego, CA, October 10-13, 2013.
- McCray, Patrick. "Regulation via Analogy," invited presentation for "Into the Real World: Historians and Public Policy Roundtable," Meeting of Society for History of Technology, Portland, ME, October 10-13, 2013.
- Walsh, Casey. "Nanotechnology and Water Treatment in Mexico," Annual Meeting of the Society for Social Studies of Science (4S), San Diego, CA, October 10-13, 2013.
- Harthorn, Barbara Herr, & Bryant, Karl. "Social Location and the Politics of Difference in US Public Deliberations about New Technologies Society for the Social Study of Science (4S), San Diego, CA, October 11, 2013.
- Kay, Luciano. "Nanotechnology corporate strategies and the influence of policy and institutional contexts: evidence from Latin American countries," Annual meeting of the Society for the Study of Nanoscience and Emerging Technologies (S.NET), Boston, MA, October 26-27, 2013.
- Han, Shirley, Gebbie, Matthew, Stocking, Galen, & Appelbaum, Richard. "A Global Nanotech Education: A Trend Analysis of Chinese S&T Students in the United States," Society for the Study of Nanoscience and Emerging Technologies Boston (S.NET), MA, October 27, 2013.
- Copeland, Lauren, & Hasell, Ariel. "Framing Effects on U.S. Consumers' Expressed Willingness to Purchase Nano-enabled Consumer Products," Annual Meeting of the Society for the Study of Nanoscience and Emerging Technologies (S.NET), Boston, MA, October 27-30, 2013.
- Copeland, Lauren, & Harthorn, Barbara Herr. Co-organizers, "A Matter of Trust: Perceptions of Nanotechnology Risk and Responsibility" Panel, 5th annual meeting of the Society for the Social Study of Nanoscience and Emerging Technologies (S.NET), Boston, MA, October 27-30, 2013.

- Collins, Mary, & Harthorn, Barbara Herr. "Public Perception of Nanotechnology Risks and Risk Managers," 5th annual meeting of the Society for the Study of Nanoscience and Emerging Technologies (S.NET), Boston, MA, October 28, 2013.
- Frederick, Stacey. "Twelve Years of Nanotech Publications & Innovation in Mexico," Society for the Study of Nanoscience and Emerging Technologies (S.NET), Boston, MA, October 28, 2013.
- Frederick, Stacey. "Method and Platform for Identifying Stakeholders in the Nanotechnology Economy," Society for the Study of Nanoscience and Emerging Technologies (S.NET), Boston, MA, October, 28, 2013.
- Harthorn, Barbara Herr. Session Chair, Panel 3-1A 5th annual meeting of the Society for the Social Study of Nanoscience and Emerging Technologies, Boston, MA, October 28, 2013.
- Harthorn, Barbara Herr, & Engeman, Cassandra. "Mobilizing in the Context of Uncertainty: Social Movement Organizations and the Contentious Issues of Nanotechnology Safety, Governance, and Responsible Development," 5th annual meeting of the Society for the Social Study of Nanoscience and Emerging Technologies, Boston, MA, October, 28, 2013.
- Horton, Zach. "Particulate Paranoia: Globalization, Geoengineering, and the Nano-Conspiracy Media," Society for the Study of Nanoscience and Emerging Technologies, Boston, MA, October 28, 2013.
- Friedman, Sharon, & Egolf, Brenda. "A Case Study: Nanotechnology Risk Coverage in the New Haven Independent," Meeting of Society for the Study of Nanoscience and Emerging Technologies, Boston, MA, October 29, 2013.
- Rogers-Brown, Jennifer, & Shearer, Christine. "Neoliberalism and Emerging Technologies: Measuring Civil Society Responses to New Technologies in Food and Agriculture," Society for the Study of Nanotechnologies and Emerging Technologies (S.NET), Boston, MA, October 29, 2013.
- Newfield, Christopher. "Can Humanities and Social Science Faculty Collaborate? Notes from a 5-Year NSF Grant," Universities in the Knowledge Economy, Copenhagen, Denmark, October 2013.
- Novak, David. "Music and the Social Amplification of Risk around Nuclear Power in Japan," Society for Social Studies of Science, San Diego, CA, October 2013.
- Novak, David. Discussant, "Media and the Regional/Transnational Circulation of Nuclear Politics and Fear" Society for Social Studies of Science, San Diego, CA, October 2013.
- Gregory, Robin. Presentation on research methods and initial results of US and UK pathway surveys University of Calgary, Calgary, Canada, November 4, 2013.
- Frederick, Stacey. "Who is the Nanotechnology Economy? Obstacles and Methods for Identifying and Estimates of U.S. Nano Firms & Workers," Second Sustainable Nanotechnology Organization Conference, Santa Barbara, CA, November 4, 2013.
- Hanna, Shannon. "Quantifying Carbon Nanotubes in Biological Samples: Techniques, Applications, and Considerations," Sustainable Nanotechnology Organization Conference, Santa Barbara, CA, November 5, 2013.
- Harthorn, Barbara Herr. Co-organizer, SMA-CASTAC invited panel, American Anthropological Association, Chicago, IL, November 20-24, 2013.
- Harthorn, Barbara Herr. "Emergent Perceptions of Risk, Fairness & Trust in Upstream Deliberations re: Nanotechnologies for Health and Human Enhancement," presentation in a joint panel of CASTAC and the SMA on technologies and medicine at the American Anthropological Association meetings, Chicago, IL, November 24, 2013.
- Choi, Hyungsub. Untitled presentation, East Asian Science, Technology, and Society Meeting, Tokyo Institute of Technology, Tokyo, Japan, November 2013.



- McCray, Patrick. "Vioneering: From Space Colonies to Nanotechnologies in Pursuit of a Limitless Future," invited talk presented at Arizona State University, Phoenix, AZ, November 2013.
- Novak, David. "Sound Demos and the Performance of Antinuclear Protest in Post-3.11 Japan," meeting of the American Anthropological Association, Chicago, IL, November 2013.
- Novak, David. "Project Fukushima! Music, Sound, Noise and the Public Perception of Nuclear Power in Post-3.11 Japan," meeting of the Society for Ethnomusicology, Indianapolis, IN, November 2013.
- Beaudrie, Christian, Kandlikar, Milind, Long, G., Gregory, W., Wilson, T., & Satterfield, Terre. "Nanotechnology Risk Screening using a Structured Decision Making (SDM) Approach," Society for Risk Analysis Annual Meeting, Baltimore, MD, December 9-12, 2013.
- Friedman, Sharon, & Egolf, Brenda. "Google Information about Nanotechnology Risks," Meeting of the Society of Risk Analysis, Baltimore, MD, December 10, 2013.
- Mehta, Aashish. "The employment effects of nanotechnology: Informed speculation, going beyond the R&D sectors," Sustainable Nanotechnology Conference, Santa Barbara, CA, December 2013.
- Novak, David. Untitled talk covering current research, UCSB Ethnography and Cultural Studies Research Focus Group, Santa Barbara, CA, December 2013.
- Novak, David. "Music, Sound, Noise, and the Antinuclear Movement in Post-3.11 Japan," UCSB Music Department Colloquium, Santa Barbara, CA, January 2014.
- Harthorn, Barbara Herr. Organizer and Lead, CNS Research Summit, Santa Barbara, CA, January 31-February 1, 2014.
- Gregory, Robin. Presentation on research methods and initial results of US and UK pathway surveys Lake Champlain Basin Program, Burlington, VT, February 12, 2014.
- Slaton, Amy. Invited speaker on the history of instrumentation in high-tech manufacturing McGill University, Montreal, Canada, February 20, 2014.
- Novak, David. "Music, Sound, and Affect in Japan's Antinuclear Movement," Bard College, Annandale-on-Hudson, NY, February 2014.
- Novak, David. "Making Noise to Power: Music and Social Protest in Japan's Antinuclear Movement," Culture, Power, Social Change Interest Group, Department of Anthropology, UCLA, Los Angeles, CA, February 2014.

### 13. SHARED AND OTHER RESEARCH FACILITIES

CNS-UCSB's infrastructure needs for the societal implications research are well met through UCSB and partner organizations.

#### 1) CNS-UCSB

CNS is housed in a centrally located building on campus that allows effective coordination and communication among all participants. The main facilities for CNS are a suite of contiguous offices in Girvetz Hall, providing space for all CNS personnel in proximity among researchers, staff, and infrastructure, with ample conference and meeting space. The commitment of this space (by the Executive Vice Chancellor, College of Letters and Science, and Dean of Social Sciences) to the CNS on a continually 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 larger 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, 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) (UCSB)

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, was appointed Director of the CNSI in April 2013, and this has reaffirmed 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](http://www.cnsi.ucsb.edu) and [www.cnsi.ucsb.edu/facilities/](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. [www.mrl.ucsb.edu](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' 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 director Don Janelle has continued 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 [spatial.ucsb.edu/](http://spatial.ucsb.edu/); [www.ncgia.ucsb.edu](http://www.ncgia.ucsb.edu) and [www.csiss.org](http://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 has been 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 services or components of projects. For more information see [www.survey.ucsb.edu](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 joined the CNS executive committee in 2013. Longterm plans under discussion for the CNS include possible collaborative interactions with CITS. [www.cits.ucsb.edu/](http://www.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 have completed the 1st 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 for 2013-2018 was awarded in September 2013 for an additional \$24M, bringing the total funding over 10 years to \$48M. It 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 and IRG 2 since 2006 and joined the Executive Committee in Fall, 2011. Seed Grant recipient Anderson is an Environmental Politics professor in Bren. [www.bren.ucsb.edu](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 NSF and EPA funding 2013-2018 was awarded in September 2013.

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. [www.cein.ucla.edu/](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 [www.cggc.duke.edu/](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). [www.chemheritage.org/](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. [jenkins.duke.edu/](http://jenkins.duke.edu/)

### **13) Science Journalism program/ Lehigh University**

Through 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. [journalism.cas2.lehigh.edu/](http://journalism.cas2.lehigh.edu/)

**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. [www.decisionresearch.org/](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. [ires.ubc.ca/](http://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 siting 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. [www.understanding-risk.org/](http://www.understanding-risk.org/)

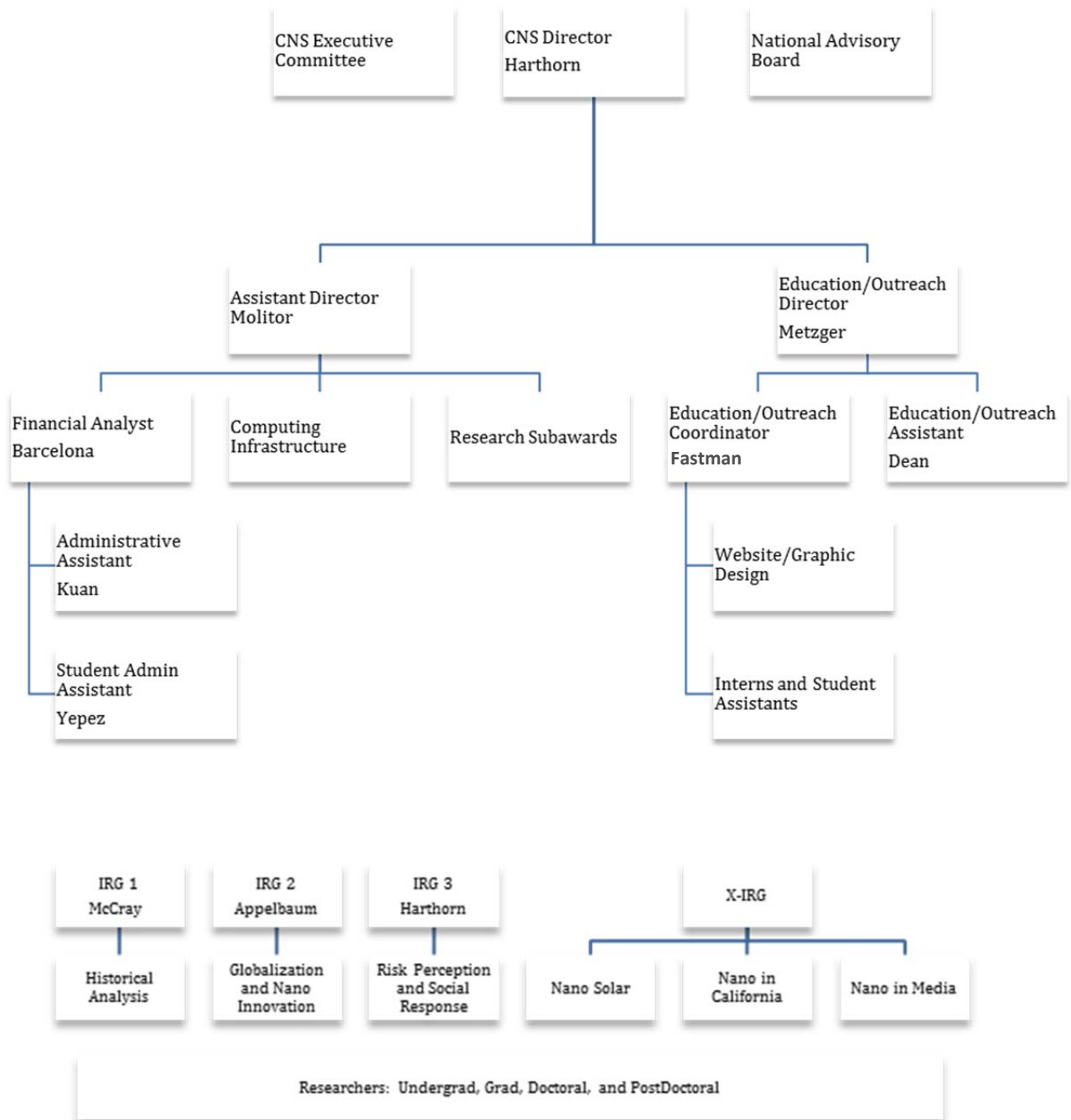
## 14. PERSONNEL

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 faculty Director of Education (Metzger), an Assistant Director (Molitor, 1.0 FTE), an education program Academic Coordinator (Fastman, .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 (Macias, .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, CEIN collaborator Holden, and CITS Director Parks; CNS Assistant Director Molitor and Academic Coordinator Fastman serve *ex officio*. The 3 IRG leaders (Appelbaum, Harthorn, and McCray) 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 quasi-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***

In June 2013 Lisa Parks, UCSB Professor of Film and Media Studies and Director of the Center for Information and Technology in Society (CITS) joined the CNS Executive Committee. As a leading campus Science and Technology Studies scholar, this role enables CNS and CITS to better consider our mutually engaged futures.

Dr. Brandon Fastman accepted the position of Academic Coordinator in September 2013, vacated by Dr. Cathy Boggs earlier in the reporting year. Fastman now serves on the CNS Executive Committee *ex officio*. Education and Outreach programs continue to be represented fully on the CNS Executive Committee by Professor Miriam Metzger, CNS Director of Education and Outreach.

### ***Staffing***

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 administration 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 September 2013 Brandon Fastman accepted the Education and Outreach Coordinator position, left vacant by Boggs' departure from UCSB. In the interim, workload was shifted to Assistant Director Molitor, Education Director Metzger, Director Harthorn, and UCSB Political Science graduate student Joshua Dean, who was 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 many 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 1.50 FTE 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. CNS is in the process of scheduling a 2014 Board meeting for late Spring 2014 to discuss plans beyond the current expected limits of NSF NSEC funding.

### **Center as Infrastructure for Societal Implications Researchers**

The Center has taken a leadership role, with CNS-ASU, in development of the Society for the Study of Nanoscience and Emerging Technologies (S.NET), which recently completed its 5<sup>th</sup> year. In addition to co-organizing and co-hosting of the 2011 S.NET meeting in Tempe, CNS-UCSB has once again sought, obtained and administered NSF supplement funds to support junior and developing world researchers traveling to the 2012 S.NET meeting in the Netherlands, and Harthorn served on the program committee for the 2012 meeting as well, and provided extensive consultation for the Boston hosts in 2013. 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 a regular basis and schedule conference calls as needed to encourage a free flow of information among the Centers and their networks. This dual center relationship has developing into a collaborative enterprise.

### **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 for most projects on a roughly weekly basis at UCSB, often dialing/skyping in off-site collaborators for teleconference participation.
- The CNS Graduate Seminar (Soc 591 or Comm 595) 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 or other project activities.
- Grad Fellows and Graduate Student Researchers work together in common space, which facilitates information sharing across the groups.
- Postdoctoral researchers 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, postdocs, researchers, and education program personnel.

- Research Summit meetings are held in Santa Barbara (most recently in Jan/Feb 2014) to allow the free flow of ideas among all CNS collaborators, students, and personnel from the institutions actively involved in core CNS research.
- Management of projects - CNS requires semi-annual reporting and invoicing from all subawardees, and similar reporting from all IRG researchers, 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; 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 provide 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. Project reporting includes required IRB status reporting.
- Annual process for IRG budget review and allocation - CNS Director Harthorn solicits annual budget proposals from IRG leaders, 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 postdoctoral researchers are required to submit a research proposal to the CNS Executive Committee within a month of their arrival and to provide milestones for assessing progress. Postdoctoral researcher evaluation by mentors 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 those appointed as 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, senior personnel, and staff to discuss NSF review results and assess other challenges and opportunities facing the Center 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 August 2013 at the Mosher House and focused on project development and 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 that cannot be hosted in the cloud.

## **Seed Grants program**

As it heads toward sunset, CNS has developed an institutional means to extend its UCSB faculty participants. The center pursued and received two supplements (in 2012 and 2013) from the NSF for the 1<sup>st</sup> and 2<sup>nd</sup> rounds of a UCSB Faculty Seed Grant program. The first call for proposals was initiated in Fall 2012, and 4 of 14 proposals were selected for funding. This first call brought 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 nearing completion as this reporting period concludes. In Fall 2013 a second call for proposals was issued; we anticipate awarding 3-4 additional Faculty Seed Grants, with projected start dates of May 2014, in response to this call. Seed grant researchers have been invited to join in numerous CNS events and activities, and have presented their research in progress to the CNS seminar.

## **B. Evaluation plan for CNS-UCSB**

The 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, 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 all 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 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, senior personnel, 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 may be 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, although the Board has not seen the need for this in recent meetings. A NAB teleconference meeting with the CNS Executive Committee is planned for late Spring 2014 to discuss post-funding horizon futures.

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 strengthening its network of collaborators. As detailed above, the CNS Faculty Seed Grant program is a vital step in development toward the long term future of the Center.

## 15. PUBLICATIONS AND PATENTS

2013-2014

Primary Publications: 18 Journals; 10 Books, Chapters, Reports and Other Publications

Leveraged Publications: 9 Journals; 3 Books, Chapters, Reports and Other Publications

Submitted/In Preparation Publications: 36 Primary; 15 Leverage

**Total: 91**

### **Primary Publications: Journals**

Beaudrie, Christian, Kandlikar, Milind, & Satterfield, Terre. (2013). From Cradle-to-Grave at the Nanoscale: Gaps in US Regulatory Oversight along the Nanomaterial Life Cycle. *Environmental Science & Technology*, 47(11), 5524-5534. doi: 10.1021/es303591x

Beaudrie, Christian, Satterfield, Terre, Kandlikar, Milind, & Harthorn, Barbara Herr. (2013). Expert Views on regulatory preparedness for managing the risks of nanotechnologies. *PLOS One*. doi: 10.1371/journal.pone.0080250

Cao, Cong, Appelbaum, Richard, & Parker, Rachel. (2013). Research is High and the Market is Far Away - Commercialization of Nanotechnology in China. *Technology in Society*, 35, 55-64.

Copeland, Lauren. (2013). Conceptualizing Political Consumerism: How Citizenship Norms Shape Boycotting and Buycotting. *Political Studies*. doi: 10.1111/1467-9284.12067

Copeland, Lauren. (2013). Value Change and Political Action: Postmaterialism, Environmentalism, and Political Consumerism. *American Politics Research*. doi: 10.1177/153267X13494235

Eisler, Matthew N. (2013). "The Ennobling Unity of Science and Technology": Materials Sciences and Engineering, the Department of Energy, and the Nanotechnology Enigma. *Minerva*. doi: 10.1007/s11024-013-9224-z

Engeman, Cassandra, Baumgartner, Lynn, Carr, Benjamin, Fish, Allison, Meyerhofer, John, Satterfield, Terre, Holden, Patricia, & Harthorn, Barbara Herr. (2013). The hierarchy of environmental, health, and safety practices, in the US nanotechnology workplace. *Journal of Occupational and Environmental Hygiene*, 10(9), 487-495. doi: 10.1080/15459624.2013.818231

Frederick, Stacey. (2014). Twelve Years of Nanoscience and Nanotechnology Publications in Mexico.

Henderson, Jeffrey, Appelbaum, Richard, & Ho, Suet Ying. (2013). Globalization with Chinese Characteristics: Externalizations, Dynamics, and Transformations. *Development and Change: Special Issue on Globalization With Chinese Characteristics*, 44(6), 1221-1253. doi: 10.1111/dech.12066

Mody, Cyrus. (2013). Santa Barbara, Physics, and the Long 1970s. *Physics Today*, 66(9), 31-37.



Motoyama, Yasuyuki. (2014). Long-term collaboration between university and industry: A case study of nanotechnology development in Japan. *Technology and Society*, 36, 39-51.

Motoyama, Yasuyuki, Cong, Cao, & Appelbaum, Richard. (2014). Observing regional divergence in Chinese nanotechnology centers. *Technological Forecasting and Social Change*, 81, 11-21.

Pidgeon, Nick, Parkhill, Karen, Corner, Adam, & Vaughan, Naomi. (2013). Deliberating Stratospheric Aerosols for Climate Geoengineering and the SPICE Project. *Nature Climate Change*, 3(5), 451-457. doi: 10.1038/NCLIMATE1807

Satterfield, Terre, Conti, Joe, Harthorn, Barbara Herr, Pidgeon, Nick, & Pitts, Anton. (2013). Understanding shifting perceptions of nanotechnologies and their implications for policy dialogues about emerging technologies. *Science and Public Policy*, 40(2), 247-260. doi: 10.1093/scippol/scs084

Walsh, James. (forthcoming). The Impact of Foreign-Born Scientists and Engineers on American Nanoscience Research. *Science and Public Policy*.

Záyago Lau, Edgar. (2013). The Social Relevance of Nanotechnology in Mexico. *Sociología y tecnociencia/Sociology and Technoscience*.

Záyago Lau, Edgar (forthcoming). Empresas nanotecnológicas en México: hacia un primer inventario.

Záyago Lau, Edgar, Frederick, Stacey, & Foladori, Guillermo. (2014). Twelve years of nanoscience and nanotechnology publications in Mexico. *Journal of Nanoparticle Research*, 16(2193). doi: 10.1007/s11051-013-2193-1

### **Primary Publications: Books, Chapters, Reports, and Other Publications**

Beaudrie, Christian, Kandlikar, Milind, & Satterfield, Terre. (2013). "UBC SDM Risk Workshop summary *CNS Report*," Center for Nanotechnology in Society - UCSB.

Copeland, Lauren, & Smith, Eric R.A.N. (forthcoming). Consumer Political Action on Climate Change. In Y. Wolinsky-Nahmias (Ed.), *Climate Change Policy and Civic Society*. Washington, D.C.: CQ Press.

Horton, Zach. (2013). Collapsing Scale: Nanotechnology and Geoengineering as Speculative Media. In K. Konrad, C. Coenen, A. Dijkstra, C. Milburn & H. van Lente (Eds.), *Studies of New and Emerging Technologies 4* (pp. 203-218). Berlin, Germany: IOS Press.

Kay, Luciano, & Youtie, Jan. (2013). Corporate Strategies in Emerging Technologies: The Case of Chinese Firms and Energy Storage-Related Nanotechnology Applications. In K. Konrad, C. Coenen, A. Dijkstra, C. Milburn & H. van Lente (Eds.), *Shaping Emerging Technologies: Governance, Innovation, Discourse*. Berlin, Germany: IOS Press / AKA.

Mody, Cyrus. (2014). 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* (pp. 153-179). Stanford, CA: Stanford University Press.

Novak, David. (2013). The Sounds of Japan's Antinuclear Movement, Post. Retrieved from [http://post.at.moma.org/content\\_items/251-podcast-the-sounds-of-japan-s-antinuclear-movement](http://post.at.moma.org/content_items/251-podcast-the-sounds-of-japan-s-antinuclear-movement)

Novak, David. (2013). Performing Antinuclear Movements in Post-3.11 Japan, STS Forum on the 2011 Fukushima/ East Japan Disaster. Retrieved from <http://fukushimaforum.wordpress.com/online-forum-2/second-3-11-virtual-conference-2013/performing-antinuclear-movements-in-post-3-11-japan/>

Parkhill, Karen, Pidgeon, Nick, Corner, Adam, & Vaughan, Naomi. (2013). Deliberation and responsible innovation: a geoengineering case study. In R. Owen, J. Bessant & M. Heintz (Eds.), *Responsible Innovation* (pp. 219-240). London: Wiley.

Randles, S., Youtie, J., Guston, D., Harthorn, B., Newfield, C., Shapira, P., Wickson, F., Rip, A., von Schomberg, R. and Pidgeon, N. (2013) A Trans-Atlantic conversation on responsible innovation and responsible governance. In van Lenet, H. et al (eds) Little by Little; Expansions of Nanoscience and Emerging Technologies (pp. 169-180). IOS Press.

Shearer, Christine, Rogers-Brown, Jennifer, Bryant, Karl, Cranfill, Rachel, & Harthorn, Barbara Herr. (2013). Power and Vulnerability: Re-contextualizing 'low risk' views of environmental and health hazards. In S. Maret (Ed.), *Research in Social Problems and Public Policy, Vol 21, William R. Freudenburg, a Life in Social Research* (pp. 235-257). Bingley, UK: Emerald Group Publishing Limited.

### **Leveraged Publications: Journals**

Cherry, Catherine, Hopfe, Christina, MacGillivray, Brian, & Pidgeon, Nick. (2013). Media discourses of low carbon housing: The marginalisation of social and behavioural dimensions within the British broadsheet press. *Public Understanding of Science*. doi: 10.1177/0963662513512442

Corner, Adam, Parkhill, Karen, & Vaughan, Naomi. (2013). Messing with Nature: Exploring public perceptions of geoengineering in the UK. *Global Environmental Change*, 23(5), 938-947. doi: 10.1016/j.gloenvcha.2013.06.002

Corner, Adam, Markowitz, Ezra, & Pidgeon, Nick. (2014). Public engagement with climate change: the role of human values. *WIREs Climate Change*. doi: 10.1002/wcc.269

Kay, Luciano, & Youtie, Jan. (2014). Acquiring Nanotechnology Capabilities: Role of Mergers and Acquisitions. *Technology Analysis & Strategic Management*. doi: 10.1080/09537325.2013.872773

Kay, Luciano, Youtie, Jan, & Shapira, Philip. (2013). Signs of Things to Come? What Patent Submissions by Small and Medium-Sized Enterprises Say About Corporate Strategies in Emerging Technologies. *Technology Forecasting and Social Change*. doi: 10.1016/j.techfore.2013.09.006

Kay, Luciano, Youtie, Jan, Newman, Nils, Porter, Alan, & Rafols, Ismael. (forthcoming). Patent Overlay mapping: Visualizing Technological Distance. *Journal of the American Society for Information Science and Technology*.

Mody, Cyrus, & Choi, Hyungsub. (2013). From Material Science to Nanotechnology: Institutions, Communities, and Disciplines at Cornell University, 1960-2000. *Historical Studies in Natural Sciences*, 43(2), 121-161.

Mody, Cyrus, & Nelson, Andrew J. (2013). 'A Towering Virtue of Necessity': Computer Music at Vietnam-Era Stanford. *Osiris*, 28, 254-277.

Záyago Lau, Edgar. (2013). La inserción de la nanotecnología en el desarrollo. *Observatorio del Desarrollo*, 2(6).

### **Leveraged Publications: Books, Chapters, Reports, and Other Publications**

Collins, Mary, & Freudenburg, William. (2013). Temporal Myopia: A Case of Promising New Technologies, the Federal Government, and Inherent Conflicts of Interest. In S. Maret (Ed.), *Research in Social Problems and Public Policy* (pp. 259-276). Bingley, England: Emerald.

Corner, Adam. (2013). Geoengineering & Green Thought. *Political Science Hosted by the Guardian*, Retrieved from <http://www.theguardian.com/science/political-science/2013/jul/29/messing-nature-geoengineering-green-thought>

Mody, Cyrus. (2014). Essential Tensions and Representational Strategies. In M. Lynch, S. Woolgar, J. Vertesi & C. Coopmans (Eds.), *Representation in Scientific Practices Revisited* (pp. 223-248). Cambridge, MA: MIT Press.

### **Submitted or in preparation publications: Primary**

Appelbaum, Richard, Cao, Cong, Parker, Rachel, & Simon, Denis. (in preparation). *Technology and Innovation in China: China's Evolving Role in the Global Science and Technology System*. Polity Press.

Appelbaum, Richard, Gebbie, Matt, Han, Shirley, & Stocking, Galen. (in preparation). Can China Become a Nanotech Innovator?

Appelbaum, Richard, & Parker, Rachel. (in preparation). Nanopolis and Suzhou Industrial Park: China's Silicon Valley?

Barvosa, Edwina. (under review). Ambivalence as Asset: Mapping Meaning & Epistemic Diversity in Public Engagement with Nanotechnology.

Barvosa, Edwina. (in preparation). Officially ambivalent: technocratic commitments in the democratization of science governance.

Barvosa, Edwina. (in preparation). *Constructing Deliberative Democracy: Constructivism, Deliberative Systems, and the Diverse Democratic Self*. Cambridge University Press.

- Beaudrie, Christian, Kandlikar, Milind, Satterfield, Terre, Robin, Gregory, & Long, Graham. (in preparation). Nanomaterial Risk Screening: A Structured Decision Making (SDM) Approach.
- Beaudrie, Christian, Satterfield, Terre, Kandlikar, Milind, & Harthorn, Barbara Herr. (under review). Scientists vs Regulators: Precaution, Novelty and Regulatory Oversight as Predictors of Perceived Risk of Engineered Nanomaterials.
- Copeland, Lauren. (in preparation ). Political Consumerism and the Expansion of Political Participation in the US.
- Copeland, Lauren. (in preparation). Putting the Political in Political Consumerism: Towards a Theory of Motivations.
- Copeland, Lauren. (in preparation). Postmaterialism vs. Engaged Citizenship as Predictors of Non-Electoral Forms of Political Participation.
- Copeland, Lauren, & Feezell, Jessica T. (in preparation). Citizenship norms and political participation: The mediating role of digital media use.
- Copeland, Lauren, & Hasell, Ariel. (in preparation). Risky Business? How Risk vs. Benefit Frames Influence Consumer Attitudes toward Nanotechnology Applications.
- Copeland, Lauren, & Hasell, Ariel. (in preparation). Framing Effects on People's Expressed Willingness to Purchase Nanotechnology Applications in the U.S.
- Corner, Adam, Satterfield, Terre, Pidgeon, Nick, & Harthorn, Barbara Herr. (in preparation). Affective ambivalence and nanotechnologies.
- 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.
- Eardley-Pryor, Roger, & McCray, Patrick. (in preparation). Regulating Innovation via Analogy: The Case of nanotechnology.
- Frederick, Stacey. (in preparation). Quantifying the Nanotechnology Workforce in the US: Methods, Barriers & Estimates.
- Frederick, Stacey. (under review). Nanotechnology in the California Economy *CA Research Bureau Short Subject Publication*.
- Friedman, Sharon, & Egolf, Brenda. (in preparation). Media coverage of government regulations concerning nanotechnology risks in the United States and United Kingdom.
- Friedman, Sharon, & Egolf, Brenda. (in preparation). Internet coverage of nanotechnology risks in the New Haven Independent and Google Alerts.
- Friedman, Sharon, & Egolf, Brenda. (in preparation). Information sources used by journalists to discuss nanotechnology risks in the United States and United Kingdom.

Gavankar, Sheetal, Anderson, Sarah, & Keller, Arturo. (under review). Critical components of uncertainty communication in life cycle assessments of emerging technologies: Nanotechnology as a case study. *Journal of Industrial Ecology*.

Harthorn, Barbara Herr, Collins, Mary, Hanna, Shannon, & Satterfield, Terre. (in preparation). Public Attitudes on Environmental Risk, Trust, and Responsible Development of Nanotechnologies.

Kay, Luciano, Appelbaum, Richard, Youtie, Jan, & Shapira, Philip. (in preparation). Innovation pathways of developing countries in emerging technologies: The case of nanotechnology in Argentina and Brazil.

Mehta, Aashish, Herron, Patrick, Cao, Cong, & Lenoir, Timothy. (under review). The Scientific Influence of Nations: Quantity, Focus and Impact in Nanotechnology Research.

Mehta, Aashish, Herron, Patrick, Lenoir, Timothy, & Cao, Cong. (in preparation). Measuring the impact of international collaboration in nanotechnology research.

Mody, Cyrus. (under review). The Market and the Garden: Santa Barbara Physicists in the Vietnam Era. In D. Kaiser & W. P. McCray (Eds.), *Groovy Science: The Counter-Cultures and Scientific Life, 1955-1975*.

Newfield, Christopher. (in preparation). The Crisis of American Innovation.

Newfield, Christopher. (in preparation). Don't Blame Soloydra, Blame the Solar Rules.

Newfield, Chris, & Boudreaux, Daryl (Eds.). (under review). *Can Rich Countries Still Innovate?* Book manuscript currently under review.

Novak, David. (in preparation). Project Fukushima! Music, Noise and the Public Perception of Nuclear Power in Japan.

Satterfield, Terre, DeVries, Laura, & Harthorn, Barbara Herr. (in preparation ). Perilous Ideas: Essentialisms in Health Risk Research and the Invisibility of the White Male Effect.

Satterfield, Terre, Harthorn, Barbara Herr, Collins, Mary, & Pitts, Anton. (in preparation). Resilience and intuitive cognition as predictors of the environmental impacts of engineered nanomaterials.

Shearer, Christine, & Rogers-Brown, Jennifer. (in preparation). Nanotechnology Risk Perceptions and Assessments *CA Research Bureau Short Subject Publication*.

Shearer, Christine, & Rogers-Brown, Jennifer. (under review). Nanotechnology and Society: An Overview *CA Research Bureau Short Subject Publication*.

#### **Submitted or in preparation publications: Leveraged**

Collins, Mary, Hanna, Shannon, Harthorn, Barbara, & Satterfield, Terre. (in preparation). US Public Views on Nanotechnology and Product Safety: So Far So Good?

## 17. HONORS AND AWARDS\*

Appelbaum, Richard, Keynote address at Global Studies Association Annual Meeting, Palo Alto, CA, June 7, 2013.

Barvosa, Edwina, Excellence in Education Award, Student Life, UCSB, Spring 2013.

Beaudrie, Christian, Kandlikar, Milind, & Satterfield, Theresa, paper awarded First Runner-Up Best Policy Analysis 2013 in *Environmental Science & Technology*, "From Cradle-to-Grave at the Nanoscale: Gaps in US Regulatory Oversight along the Nanomaterial Life Cycle." March, 2014.

Collins, Mary, Awarded Postdoctoral Fellowship, National Socio-Environmental Synthesis Center (SESYNC), 2013-2015.

Copeland, Lauren, Received National Science Foundation Workshop Support Grant (SES 1343126), September 2013 (\$1250).

Copeland, Lauren, Received German Academic Exchange Service Grant, September 2013 (\$1200).

Copeland, Lauren, Received Graduate Division Dissertation Fellowship, UCSB, Summer 2013 (\$7500).

Copeland, Lauren, Received Colin Reed – Robert G. Wesson Award for Best Paper Presented at a Professional Meeting, Department of Political Science, UCSB, June 2013 (\$250).

Copeland, Lauren, Received Doctoral Student Travel Grant, Academic Senate, UCSB, April 2013 (\$685).

Foladori, Guillermo, Granted Membership to the National System of Researchers-Tier II, The National Council of Science and Technology (CONACYT, Mexico).

Engeman, Cassandra, Awarded Graduate Associate Fellowship, UCSB Broom Center for Demography for 2013-2014.

Engeman, Cassandra, Awarded Graduate Research and Training Grant, UCSB Broom Center for Demography (\$2000).

Friedman, Sharon, Elected to three-year term on the Council of the American Association for the Advancement of Science in January 2014.

Harthorn, Barbara Herr, Keynote address, NGO and federal stakeholder meeting and webcast of the National Institute of Occupational Safety and Health (NIOSH), Cincinnati, OH, July 31, 2013.

Harthorn, Barbara Herr, Keynote address, NNI R3 Risk Stakeholder Workshop, Washington DC, September 11, 2013

\* Note this list omits all awards reported in Leverage

Harthorn, Barbara Herr, Invited testimony. UC Presidential Commission on Bioethics, Washington D.C. February 10-11, 2014.

Hawker, Craig, ACS Award in Polymer Chemistry, American Chemical Society, 2013.

Hawker, Craig, Otto Warburg Lecturer, University of Bayreuth, Germany, 2013.

Hawker, Craig, Gassman Lecturer, University of Minnesota, 2013.

Hawker, Craig, MacLean Lecturer, McMaster University, 2013.

Hawker, Craig, McGavock Lectureship, Trinity University, 2014.

Hawker, Craig, Peter Timms Lecturer, University of Bristol, UK, 2014.

McCray, W. Patrick, received Eugene M. Emme Astronautical Literature Award for *The Visioneers: How A Group of Elite Scientists Pursued Space Colonies, Nanotechnologies, and a Limitless Future* (published 2012 Princeton University Press), 2013.

Mody, Cyrus, Promoted to Associate Professor, Rice University, 2014.

Mody, Cyrus, Awarded Cushing Memorial Prize, University of Notre Dame Program in History and Philosophy of Science, 2013.

Mody, Cyrus, (with Sonali Shah), Received Industry Studies Association "Rising Stars" Best Paper Award, "Do Users Develop and Diffuse Their Innovations Independent of Firms? Resources, New Social Structures, and Scaffolding," 2013.

Mody, Cyrus, Awarded Paul Bunge Prize, Hans-R.-Jenemann-Stiftung, 2014.

Novak, David, Promoted to Associate Professor, UC Santa Barbara, 2013.

November, Joseph, Received Computer History Museum Book Prize for *Biomedical Computing: Digitizing Life in the United States* (published 2012). Awarded by Special Interest Group for Computers, Information and Society (SIGCIS) and funded by the estate of computing pioneer Paul Baran (\$1,000). Bestowed at the Society for History of Technology (SHOT) Annual Meeting, October 2013.

November, Joseph, Received Association for Computing Machinery History Fellowship, 2013.

Parks, Lisa, Awarded FlowNet grant: Internet freedom and free flow information through socially informed, censor-resistant online social networks." U.S. Department of State, The Bureau of Democracy Human Rights and Labor (DRL). Awarded, \$2,786,600, 2014.

Pribble, Kelli, Accepted poster presentation at the Society for Advancement of Chicanos and Native Americans in Science (SACNAS) National Conference. "Mobilizing Around Nanotechnology: The Role Of Non-Governmental Organizations," San Antonio, Texas, Oct 2013.

Sieber, Hannah, awarded the prize for the best honors thesis at graduation in International Comparative Studies, Duke University, May 2013 (project directed by Timothy Lenoir). Thesis was on the history of “sea turtles” and attitudes of overseas Chinese students and business people in the North Carolina Research Triangle to their economic prospects upon returning to China.

Walsh, Casey, Received Public Anthropology’s Paul Farmer Global Citizenship Award, 2013.



## 20. LEVERAGE

CNS continued its successful record in securing significant leverage in the reporting year 9, using the CNS base to secure additional funding and resources far beyond NSF NSEC investment. Reported Leverage is as follows:

### IRG1

- No new IRG1 leverage was received in this reporting period

### IRG2

- IRG 2 leader Appelbaum was awarded a prestigious 5-year MacArthur Foundation Chair in Global and International Studies in April 2010, which contributes \$200,000 per year for 5 years to extend IRG 2 research efforts.
- IRG 2 faculty researcher Mehta and IRG 2 Postdoctoral scholar Kay received a \$11,000 grant from the UC Institute on Global Conflict and Cooperation in 2013 for IRG 2 related project "Mapping the Global Race for National Security Technologies"
- Mehta also received a UCSB Social Science Research Grant for \$8,000, "How interconnected are global labor markets?"

### IRG3

- IRG 3 Collaborator/Subaward Personnel, Kandlikar (University of British Columbia) obtained a \$150,000 2-year AUTO21 Network of Centres of Excellence grant (University of Windsor, Ontario) "Assessing the Life cycle Benefits and Impacts of Emerging Automotive Technologies, now in its second funding year. CNS support helped win this award, which draws on and contributes to nanotech life cycle analysis.
- Satterfield and Kandlikar also were awarded a Peter Wall Thematic Grant (April 2012, now in the second year of a two-year award) for \$500,000 from the UBC Foundation.
- UC CEIN received a 5-year renewal award from NSF/EPA in September 2013. This award provides a large (~\$6M) subaward to the UCSB CEIN, including CNS Director Harthorn in collaboration with other CNS IRG3 researchers Satterfield and Kandlikar at UBC. For 2013 we are reporting 1 year of this support or \$1,190,906 as leverage to CNS.
- Pidgeon, CNS Subaward PI at Cardiff University in the UK, obtained a \$525,000, 4-year grant in October 2010 from the UK Engineering and Physical Sciences Research Council. Pidgeon's work under this project, "Integrated Assessment of Geoengineering proposals," involves using CNS-generated comparative US-UK public deliberation protocols to conduct comparative emerging technology deliberations in another case with very low public awareness, potentially significant health, safety and environmental risks that are largely unknown, and a UK public that is risk averse and has experienced eroding trust in regulatory bodies. This work provides many useful comparisons for helping advance understanding of emergent risk perceptions. For 2013 we are reporting 1 year of this support or \$131,250 as leverage to CNS.
- IRG 3 Researcher Edwina Barvosa was awarded \$7626 for "Decentering Democracy Rethinking Collective Will Formation in the Pursuit of Justice Diverse Democracies" from the UCSB ISBER Social Science Research Grants program, August 2013.

## **X-IRG**

- Sharon Friedman, X-IRG and IRG 3 researcher and subaward PI, received a \$60,000 CORE grant from Lehigh University on "Cities in the Fall Zone: Earthquake Hazard, Vulnerability and Resiliency in the U.S Mid-Atlantic Region", June 2013.
- Friedman also received a \$60,000 Interdisciplinary CORE grant from Lehigh University, "Impacts of Marcellus Gas Development on Quality of Life Issues in Pennsylvania", December 2013.
- Sarah Anderson, CNS Faculty Seed Grant Recipient and IRG 3 affiliated researcher, received a \$193,000 UCSB Crossroads: Integrating Interdisciplinary Research and Teaching in Graduate Education grant, "Framing Effects in individual and Collective Action on Environmental Politics and Policy", June 2013.

## **Education & Outreach**

- In reporting year 9, CNS continued its role as a lead partner in the CNSI INSET 8-week undergraduate summer internship program (\$417,822 for 2011-2014, reported in Yr 6 and therefore not included in leverage figures this reporting year). This is an intensive NSF institutional REU program for science and technology training of a diverse group of California community college students, many of them from minority-serving institutions.

**Newly-reported** leverage in Year 9 thus totals \$2,436,782, over 200% of CNS' NSF increment for the year of \$1,215,120. Overall, CNS continues to achieve remarkable success in pursuing and receiving funding that extends CNS-related research, education and outreach from a wide array of public and private funders. NSF's investment in the CNS has resulted in a large web of projects connecting to and extending its reach in many directions.

**Table 6: Partnering Institutions - Academic**

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	
	<b>Arizona State University</b>	Y							
	Australian National Univ								Y
	Bangkok Thonburi University								Y
	Beijing Institute of Technology	Y							Y
	Bowling Green State University								
	California Polytechnic State University, San Luis Obispo							Y	
	<b>Cardiff University, UK</b>	Y							Y
	Centre National de la Recherche Scientifique (CNRS), France								
	Clark University								
	College of the Canyons			Y				Y	
	Cornell University								
	Cuesta Community College			Y				Y	
	<b>Dalian Institute of Chemical Physics</b>								Y
	<b>Dalian University of Technology</b>								Y
	<b>Darmstadt University, GE</b>								Y
	<b>Drexel University</b>								
	<b>Duke University</b>	Y							
	Ecole Polytechnique, France								Y
	Ecole Polytechnique, INRA, FR								
	<b>Federal University of Parana, BR</b>								Y
	Federal University of Santa Catarina, BR								Y
	<b>Georgia Institute of Technology</b>								
	IRD-IFRIS, France								Y
	Jackson State University			Y				Y	
	<b>Kent State University</b>								
	Kibi International University, Japan								Y
	<b>Lehigh University</b>	Y	Y						
	<b>Long Island University</b>	Y	Y						
	Maastricht University								Y
	Moorpark College							Y	
	Natl Academy of Agricultural Research Management, India	Y							Y
	New York University	Y							
	<b>Northeastern University</b>	Y							
	Occidental College	Y		Y					
	Oxnard Community College			Y					
	Quinnipiac University								
	Rensselaer Polytechnic Institute, New York								
	<b>Rice University</b>								
	<b>Santa Barbara City College</b>	Y						Y	
	<b>Seoul National University, South Korea</b>								Y
	Singularity University								
	Southeastern Louisiana University			Y					
	<b>Southern Methodist University</b>								
	SUNY Levin Institute	Y							
	<b>SUNY New Paltz</b>	Y							
	Sussex University, UK								
	<b>Universidad Autónoma de Zacatecas, Mexico</b>	Y							Y
	Université de Lyon 3, France		Y						Y
	<b>University of Arizona</b>	Y							
	<b>University of British Columbia, Vancouver, Canada</b>	Y							Y

Table 6: Partnering Institutions - Academic									
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
	University of California, Berkeley	Y							
	University of California, Davis	Y							
	University of California, Irvine							Y	
	University of California, Los Angeles		Y						
	University of Copenhagen								Y
	University of Edinburgh, UK		Y						Y
	University of Exeter, UK								Y
	University of Gothenburg, Sweden								Y
	University of Manchester								Y
	University of Maryland								
	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						Y
	University of Twente								Y
	University of Utrecht								Y
	University of Virginia								
	University of Washington	Y							
	University of Wisconsin-Madison	Y							
	Ventura College			Y				Y	
	Victorville Community College			Y					
	York University, Canada								Y
Total Number of Academic Partners	77	21	8	9	0	0	0	9	29

Table 6: Partnering Institutions - Non-Academic

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		
	<b>Chemical Heritage Foundation</b>	Y					Y		
	<b>Compass Resource Management</b>	Y					Y		Y
	<b>Decision Research</b>	Y							
	<b>Direct Relief International</b>							Y	
	Energy & Resource Institute, The, India								Y
	Environmental Defense Fund								
	<b>Fund for Santa Barbara</b>							Y	
	International Council on Nanotechnology (ICON), Rice University		Y						Y
	International Risk Governance Council, Switzerland								Y
	<b>Kauffman Foundation</b>						Y		
	Knowledge Networks	Y							
	<b>Latin American Network of Nanotechnology and Society (ReLANS), Mexico</b>	Y							Y
	Meridian Institute	Y							Y
	<b>Nanoscale Informal Science Education (NISE) network</b>							Y	
	<b>National Nanotech Coordinating Office (NNCO)</b>					Y			
	<b>National Institute of Occupational Safety &amp; Health (NIOSH)</b>					Y			
	<b>Santa Barbara Museum of Natural History</b>	Y						Y	
	Santa Monica Public Library							Y	
	<b>Science and Technology Policy Institute (IDA)</b>					Y			
	<b>U.S. Environment Protection Agency</b>					Y			
	Woodrow Wilson International Center	Y	Y						
	<b>You Gov America Inc.</b>	Y					Y		Y
<b>Total Number of Non-academic Partners</b>	25	10	2	0	0	4	5	5	7