Innovations emerging from the intersection of the sciences, engineering, arts and design are transforming our economy, culture, and learning contexts. This transformation is emerging through development of products, methods, and questions that are fundamentally hybrid, such as software developed for human play, hardware designed for aesthetic elegance, or the plethora of scientific and cultural information requiring new means of interpretation and expression in order to enable greater understanding of complex dynamics.

As our world undergoes rapid change, we need new ways to create and engage knowledge, drawing from multiple disciplines as we seek to understand the ever-increasing complexity. Collaborators can provide insights into dilemmas that elude understanding through singular inquiry. Global economic interests are at stake: we anticipate industry that will come to dominate our economies in twenty years is just now undergoing invention. New forms of partnership among political, academic and civil sectors of society are required if we are to bring about needed changes intelligently and humanely. Innovation stemming from interdisciplinary creativity is a major contributor to the development of new, sustainable economies and harmonious, cooperating societies.

The National Science Foundation Computer and Information Science and Engineering (CISE) Information & Intelligent Systems (IIS) program sponsored five workshops in 2010-2011, bringing together artists and scientists from across the United States, to address needs of the burgeoning community of groups and individuals engaged in transdisciplinary practice. This effort resulted in the genesis of a new network focusing on advocacy and dissemination of innovative methods for connecting and supporting a distributed community across academia, non-profit organizations, civil society, industry, and funding entities. The network facilitates research community development; collaboration and project matchmaking; expertise referrals; large-scale collaborative teaching; forums to share best practices in lifelong learning; and philanthropic
opportunities for funding organizations. The growing interdisciplinary community continues to face challenges in its efforts to self-organize in the face of constraints imposed by academic systems and historical biases; we continue to seek a dynamic and synergizing research and outreach exchange. We recognize an urgent need for a paradigm shift that can overcome such biases and fully address, in an integrated manner, the documentation needs of the science-art community. To this end, the XSEAD portal will deliver a community platform that will provide a centralized view of this emergent field; fast dissemination of multimodal research outcomes; extensive databases of prior and current research, an informed record of science-art curricula; support structures for science-art careers; and evidence of societal impact of interdisciplinary integration.

The network addresses fundamental challenges including the need to align academic pedagogies with 21st-century thinking skills; to promote diversity of perspectives, approaches, and people in the creative economy; and to benchmark best practices that create critical thinkers and leaders for the ever-changing job market. We are providing a platform to generate and disseminate public dialogue about the intellectual, cultural, and economic potential of creative intersections of art, science and technology.

Network for Sciences, Engineering, Arts and Design (SEAD)

Vision
We will become the leading advocate for collaboration among the sciences, engineering, arts and design, fostering innovation and learning that impact community sustainability and economic growth

Mission
We operate in entrepreneurial, sustainable ways to identify and promote broader impacts for communities and individuals in new areas of practice, research and critical discourse achieving creative excellence and intellectual merit.

Goals
Advocacy for research and creative work
The network facilitates experimentation with new methods, materials, and modes of creative inquiry and understanding in order to spawn groundbreaking discoveries and inventions.

Advocacy for learning and education
The network promotes life-long learning by supporting topics, pedagogies, and evaluation methods that integrate the sciences, engineering, arts and design.

Advocacy for partnerships
The network is a nexus for strategic partnerships among individuals and organizations including government, industry, civic and academic institutions fostering initiatives that bring together diverse disciplines and domains.

Advocacy for culture and economic development
The network champions partnerships that value sustainability, community development and social entrepreneurship, in order to spur economic growth.

Short term objectives overview
Initiatives to July 2013

Research and creative work

White papers working group
Chair, Roger Malina, Distinguished Professor, Arts & Technology, University of Texas, Dallas; Professor, Aix Marseille University; Leonardo/ISAST Chair Emeritus; Leonardo Governing Board Member

Co-Chair Carol Strohecker, Director, Center for Design Innovation, University of North Carolina system; Professor, Winston- Salem State University; Chief Research Officer, Instructor, UNC School of the Arts

Steering Committee
Marjory Blumenthal, Associate Provost, Academic, Georgetown University
Jonas Braasch, XSEAD Co-PI, Assistant Professor, School of Architecture, Communication Acoustics and Aural Architecture Research Laboratory (CA3RL), School of Architecture, Rensselaer Polytechnic Institute, Troy, New York
Shawn Brixey, XSEAD Co-PI, Associate Professor, DXArts, University of Washington
Donna Cox, XSEAD Co-PI, Professor, The National Center for Supercomputing Applications (NCSA), located at the University of Illinois at Urbana-Champaign, Director, Illinois eDREAM Institute
Christo Doherty, Head of Digital Arts, Wits School of the Arts, University of Witwatersrand, Johannesburg, South Africa
Bronac Ferran, Founder, Boundaryobject.org, UK; former Director of Interdisciplinary Arts, Arts Council England
Ken Goldberg, Professor, Industrial Engineering and Operations Research jointly with Electrical Engineering and Computer Science; School of Information, University of California, Berkeley
Christian Jacquemin, Head, La Diagonale, Paris, France; Professor, Computer Sciences, Paris University
Adriene Jenik, XSEAD advisor, Professor and Director, School of Art, Katherine K. Herberger Endowed Chair in Fine Arts, Herberger Institute for Design and the Arts, Arizona State University
Pamela Jennings, Director, Brenda and Earl Shapiro Centers for Research and Collaboration, School of the Art Institute of Chicago
Arantxa Mendiharat, Coordinator, Conexiones Improbables, Bilbao, Spain
Gunalan Nadarajan, Dean and Professor, School of Art and Design, University of Michigan
Oguzhan Ozcan, Professor, Interactive Media Design, Department of Media and Visual Arts Design Lab, Koç University, Istanbul, Turkey
Claudio Rivera-Seguel, Co-founder and Director, Corporación Cultural Arte y Tecnología (ArTeK), Chile
Sundar Sarukkai, Professor and Director, Manipal Centre for Philosophy and Humanities, Manipal University, India
Vicki Sowry, Program Manager, Australian Network for Art and Technology (ANAT)
Nicola Triscott, Founder and Director The Arts Catalyst, United Kingdom; Founder, Project Director, Catalyst Rwanda
Annie Wan, Independent Artist, China

SEAD is generating an overview of the impacts, values, opportunities and challenges of cross-disciplinary research and creative work engaging sciences and engineering with art and design. Following a vision first developed in the 2010 Alexandria workshop cited above, a White Papers Working Group formed to issue an open call for white papers, to result in a published compendium. This compendium will take a form similar to the 2003 publication "Beyond Productivity: Information, Technology, Innovation, and Creativity," edited by William J. Mitchell, Alan S. Inouye, and Marjory S. Blumenthal, Committee on Information Technology and Creativity, National Research Council. White papers will be published online at seadnetwork.wordpress.com and some will be presented at selected conferences.
The White Papers group is also collecting a bibliography of SEAD related, third party reports, to be combined with suggested actions from these White Papers, to gain a meta-view of community needs that will inform future SEAD initiatives.

**SEAD working group on learning, education, innovation, and cultural development**

Coordinator: Lucinda Presley, Executive Director, ICEE (Institute where Creativity Empowers Education)

**Success**

Co-Chairs
Pamela Jennings, Director of the Brenda and Earl Shapiro Centers for Research and Collaboration, School of the Art Institute of Chicago
Katherine Moriwaki, Assistant Professor of Media Design, School of Art, Media and Technology, Parsons the New School for Design
Brian K. Smith, Dean, Continuing Education, Rhode Island School of Design

Assistant: Alicia Gibb, Research and Development Lab Director, BugLabs, New York; Entrepreneur; Tracy Hammond, Director, Sketch Recognition Lab; Associate Professor, Department of Computer Science and Engineering, Texas A&M University

A growing body of research indicates that the ability to innovate will determine a nation’s success in today’s rapidly-changing global economy. In order for a country to remain competitive, today’s workforce and learners of all ages must be trained in innovation thinking skills. Leaders must integrate innovation thinking into learning models and career descriptions in all sectors. Innovation thinking is fundamental to the intersection of the sciences, arts, engineering, and design. Thus, researching, developing, evaluating, and disseminating pedagogies, strategies, technologies, and partnerships to cultivate the inspiring intersections of SEAD will help drive our innovation economy.

Areas of focus include rethinking the distinction between Art and Science in formal and informal learning arenas; designing models for integration of SEAD curriculum; developing and sharing best practices; and involvement in organizational conferences. Others include attending congressional hearings within the Department of Education to address policies, and forging partnerships between universities and community hacker spaces.

Innovation through education involves articulating the impact of transdisciplinary engagement on culture and economic development. There is potential to build a brand with credibility and trust; to identify unique opportunities that merit community support; and to develop "incubator" programs with toolkits and strategies for team building. This can result in workforce development and new models for intellectual property policy and technology transfer. Designed to be accessible to the general public, network activities can foster recognition in the form of awards and challenge projects and can facilitate affinity building in communities. Target support groups would consist of academic policy makers and community leaders joining together to nurture and mentor the next generation.

**Partner enrollment and advocacy in agencies**
Chair, Gunalan Nadarajan, University of Michigan

This objective will serve the goal of identifying partners for the network. There is potential to broker collaborations among members and institutions. This group would become the voice of the network by facilitating and explaining the value of partnerships across communities and disciplines.

SEAD Curatorial Working Group
Chair, Sheldon Brown, Professor of Visual Arts; Director, Arthur C. Clarke Center for Human Imagination; Founder, New Media Arts for the California Institute of Telecommunications and Information Technologies (CalIt2); University of California, San Diego

Co-Chairs
Alicia Gibb, Research and Development Lab Director, BugLabs, New York; Entrepreneur
Pamela Jennings, Director of the Brenda and Earl Shapiro Centers for Research and Collaboration, School of the Art Institute of Chicago

To create crossover linkages among the two separately funded NSF groups NSEAD and XSEAD, three participants will serve on the XSEAD Curatorial Board. This partnership seeks to develop curated sets of high-quality examples of integrative works. Each set will build visual explanations of works representing a perspective on the history and prospects of the field. In developing this content, Sheldon Brown, represents a major academic research facility, Alicia Gibb, represents the “DIY and Maker” community, while Pamela Jennings will contribute a new multimedia representation of the previously curated exhibition “Speculative Data and the Creative Imaginary: shared visions between art and technology.” All three will join a network of distinguished organizations and community leaders working with XSEAD PIs Thanassis Rikakis and Donna Cox, as well as the XSEAD portal development team on this objective.

Acknowledgments
This material is based upon work supported by the National Science Foundation under Grant No. 1142510, Collaborative Research: EAGER: Network for Science, Engineering, Arts and Design (NSEAD) IIS, Human Centered Computing; and Grant 1141631 Collaborative Research: EAGER: Virtual Exchange for Science, Engineering, Arts and Design (XSEAD) IIS, Human Centered Computing. Any opinions, findings, and conclusions or recommendations expressed in this material are those of the authors and do not necessarily reflect the views of the National Science Foundation.

Manuscript received 27 June 2012.