

## **Driving Innovation through Design: Engineering in the 21<sup>st</sup> Century**

*Northwestern University, Evanston, IL, April 15-16, 2010*



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### **Executive Summary**

Sustainable growth in the 21<sup>st</sup> Century requires technological and social innovations that effectively address the complex, interdependent problems that we face as a nation and throughout the world. Design research and education provides the intellectual underpinning and offers knowledge and experience to serve as a foundation for this endeavor. However, establishing interdisciplinary design research and education programs requires institutional transformation to overcome the current system that is structured around traditional disciplines with little cross-connection. This two-day workshop, supported by National Science Foundation (NSF), brought together a group of university administrators, faculty and researchers, and industry practitioners, to discuss the role that Design may play in helping universities transform their educational mission and practices to meet the challenges of the 21<sup>st</sup> Century. The workshop featured invited speakers who shared their views on "Design as a Path to Cross-Connection and Innovation" and "Cultivating Successful Interdisciplinary Programs", together with a "Deans' Panel" consisting of the leaders of both engineering and non-engineering schools who shared their visions and responded to questions. During breakout sessions, participants worked in small teams exploring the role that Design and design education play in innovation. Later, larger groups were formed to discuss five key areas: (1) science of design innovation; (2) interdisciplinary design research; (3) interdisciplinary design pedagogy; (4) nurturing design faculty; and (5) what students will need to know and what we should teach. Several over-arching themes emerged from the discussions. First, Design is the new frontier for sustainable growth and innovation. Second, a unique, transformational opportunity exists and universities should offer new educational strategies and curricular reforms in Design. Third, transforming education and research to emphasize Design will require strong administrative support, financial contributions from research foundations, and multi-institutional collaborative efforts. Recommendations for design research and educational innovations, including the idea of forming a Design Coalition, are detailed in the report.

## 1. Introduction & Motivation for the Workshop

Innovation has been the key to the United States' success [1] and evidence suggests that transformational innovations occur at the intersection of multiple disciplines rather than isolated within them [2]. The innovation process can be accelerated when using integrated design methods and tools [3]. However, there is limited consensus on the constituents of scientific approaches for design innovation, and there are many research questions spanning multiple disciplines in the world of Design. In the current discipline-oriented university system it is equally challenging to create and cultivate an interdisciplinary learning environment that empowers our students and provides the knowledge, skills, and attitudes that they will need to deal with the rapid pace of technological change, the interconnected world, and the complexity of its problems. Solutions will require multidisciplinary approaches and systems thinking.

Building upon the recent successful NSF Design Workshop Series on "Interdisciplinary Design as an Instructional Discipline" [4] and the growing interest from the interdisciplinary design community, we organized a two-day workshop entitled, "Driving Innovation through Design - Engineering in 21<sup>st</sup> Century". The purpose of this workshop was to hold a substantive discussion of the role that Design may have in helping universities achieve their mission in the 21<sup>st</sup> Century and to discuss plans to achieve this objective in both the education and research domains. By bringing together a group of university administrators (deans/department heads), faculty and researchers, and industrial practitioners, the objectives for the workshop were three fold:

1. To reach a deeper understanding of the transdisciplinary issues faced in engineering education and the world of design,
2. To foster interactions and facilitate dialogue between university administrators, design faculty and researchers by collectively sharing experiences of creating, cultivating, and sustaining successful interdisciplinary research and education programs, and
3. To seek synergistic research and educational efforts towards establishing Design as a path to cross-connection and innovation.

An overview of the workshop is given next. Section 3 summarizes the presentations by invited speakers and panelists, and Section 4 reviews the breakout group discussions. Finally, Section 5 gives recommendations based on over-arching themes that emerged from the workshop.

## 2. Overview of the Workshop

The workshop lasted one and an half days, April 15-16, 2010, in the Segal Design Institute on the campus of Northwestern University. The detailed agenda for the workshop is included in Appendix A.

The morning of Day 1 (April 15<sup>th</sup>) featured *Phase I: Design as a Path to Cross-Connection and Innovation*. Four invited talks addressed the need for innovation in the years ahead. Speakers were selected to represent a range of perspectives from the macroeconomic to the pedagogical. The talks were followed by an interactive panel discussion — including questions and comments from participants. In the rest part of Day 1 morning, the participants worked in 10 breakout teams articulating a point-of-view with respect to the role that Design and design education play in innovation.

The afternoon of Day 1 featured *Phase II: Cultivating Successful Interdisciplinary Programs*. Four more invited presentations were given where novel approaches to research and education, featuring Design as a pathway to innovation and transdisciplinary cross-connection, were presented. This was then followed by the "Deans' Panel" during which the leaders of both engineering and non-engineering schools responded to the day's presentations and shared their own visions. Prior to dinner, all attendees were invited to join Design:Chicago, an annual event

that highlights Chicago's vibrant design community, jointly hosted by the Segal Design Institute and the Master in Product Development (MPD) program.

In the morning of Day 2 (April 16), each team from the Day 1 breakout session presented a summary of discussions in the form of a 2-minute “elevator speech”. This was followed by the final activity of the workshop, namely, *Phase III: Identifying Synergistic Research and Education Strategies*. Participants worked in 5 breakout groups, discussed, and reported how we can proactively work together to accomplish our education and research objectives.

All presentation slides and materials are posted online in PDF format on the workshop website: <http://www.segal.northwestern.edu/designworkshop2010/>. The talks in Design:Chicago are archived at <http://www.mpd.northwestern.edu/webcast/DC2010.php>. The team presentations on April 16, including the elevator speeches from 10 breakout teams (Phase I) and the summaries of 5 breakout groups (Phase III) can be viewed at <http://bit.ly/NSF-DesignWorkshop-Segal-NU>.

The workshop drew a diverse group of participants (see Appendix B) from academia, industry, and government agencies. A total of 88 people (including 13 graduate student helpers) attended, representing a wide range of disciplines including Engineering Design (23%), Deans (14%), Business/Marketing/Technology (13%), Human-Centered Design/Design Thinking (12%), Arts, Architecture, and Industrial design (10%), Education Research (7%), Journalism (6%), Organization Theory and Network (6%), Industry (5%), and finally Human Computer Interface (3%). The professional network diagrams among the invited participants based on a pre-workshop survey is provided in Figure 1.



**Figure 1** Professional Network Diagrams of Participants based on Pre-Workshop Survey

### 3. Invited Talks & Deans' Panel

Not counting the speakers in Design:Chicago, the workshop featured eight invited speakers. This section provides brief summaries of each talk. Their presentation slides are posted online in PDF format on the workshop website: <http://www.segal.northwestern.edu/designworkshop2010/>.

#### 3.1. Invited Talks in Phase I: Design as a Path to Cross-Connection and Innovation

Sam Kahan (Senior Economist, Federal Reserve Bank) spoke first on "*Engineers as Innovators*". He suggested that innovation is key to America's success and asserted that "Risk taking is the most defining characteristic of America." Since America's achievements are replicable, we can't rest on our laurels but must continue to produce innovative products and services.

Noshir Contractor's (Professor, School of Communication and the Industrial Engineering Department, Northwestern University) talk was entitled "*Networks by Design for Design*". His research investigates factors that lead to the formation of effective knowledge networks in many different contexts including engineering communities, public health networks, and virtual worlds. In his talk, he brought up the trend towards team science for innovation, creativity and design. He asserted that Design should serve as the main driver for creating knowledge network. He noted the role of technologies in harvesting and enabling knowledge networks in large scale collaborations. A few successful examples of using design as a driver for creating knowledge networks were illustrated in his talk.

The third talk on "*Nothing is Permanent but Change – The Stress on Design and Journalism Schools*" was given by Roger Black (Media Design Consultant, Roger Black Studio, Inc.). For 40 years, Roger Black has been working with multiple magazines, newspapers, and web sites to develop ways to communicate content more effectively. His talk brought up the need in all fields, beyond media industry and engineering, to respond to changing social context. He raised questions such as "How does a university track change?", and "How does the academy help predict the direction of change?", and more. He noted in his talk that Design is a fundamental part of modern life, and it should be part of modern education. He asserted that design courses should be offered throughout the university, and universities should hire professionals who can provide current experiences to enhance the semi-theoretical programs that dominate design and journalism schools. He further noted that some delightful results are happening with collaborative programs that break the usual department divides.

The last talk on "*What Students will Need to Know. What We Teach. What about the Rest?*" by Warren Seering (Professor, Mechanical Engineering, Massachusetts Institute of Technology) provided a strong closure to the session raising many open questions about how university should alter its curriculum to meet the changing needs in education. Seering shared the Mechanical Engineering Department at MIT's process of determining the future needs of university graduates. He presented some interesting and useful insights about what knowledge and skills best serve our graduates and MIT's proposed plans for modifying curriculum. The new curriculum treats undergraduate students as a customer whose product is education; this philosophy led to reevaluation of the importance of traditional engineering coursework. He pointed out that some areas where MIT alumnae felt unprepared: personal skills, teamwork, communication, and independent thinking. These are areas Seering thinks can be addressed by an interdisciplinary design curriculum.

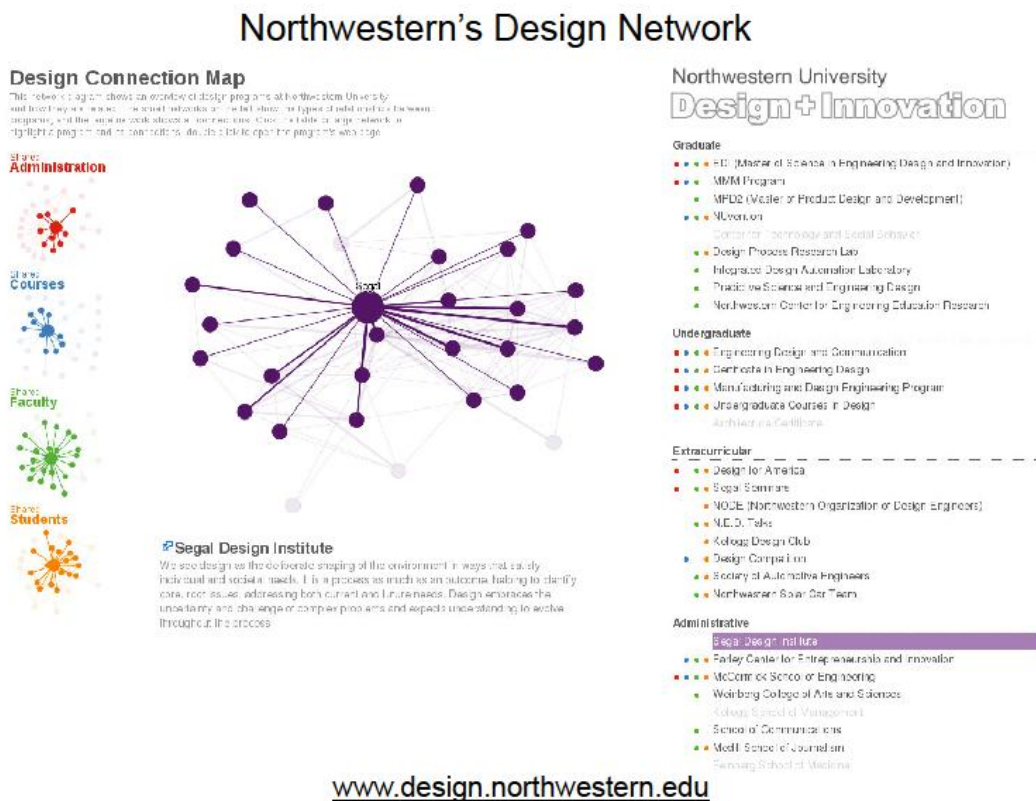
#### 3.2. Invited Talks in Phase II: Cultivating Successful Interdisciplinary Programs

Tim Simpson (Professor, Mechanical and Industrial Engineering, Pennsylvania State University) gave the first talk on "*Recap of the NSF Design Workshop Series: A Closer Look at Successful Interdisciplinary Programs*". A brief review of the NSF Design Workshop Series organized by four



partner institutions (Penn State, Northwestern University, University of Michigan, and Stanford University) was first provided. Professor Simpson then discussed the common barriers that many universities face when trying to implement curricular innovations that are necessary to achieve and sustain interdisciplinary education. These include (1) resources (department buy in, funding, space), (2) faculty (tenure, home department), (3) student (degree name/type, advisor), and (4) curriculum/pedagogy issues (instructional delivery, balance, depth, breadth). He then reviewed five interdisciplinary graduate design programs offered by three different universities—University of Michigan, Northwestern, and Stanford. Shown in the form of morphological matrices, these programs represent “solutions” that span a variety of graduate degree offerings and provide examples of ways to successfully navigate the barriers and hurdles to interdisciplinary design education. More information about the workshop series can be found at <http://www.design.psu.edu/workshops/> and in a published paper [5].

Ed Colgate (Co-Director, Segal Design Institute, Northwestern University) presented a talk on “Northwestern’s Design Network”. Figure 2 provides a snapshot of the front page of the Northwestern Design Network website at [www.design.northwestern.edu](http://www.design.northwestern.edu). The connections among the different programs can be easily understood through the network diagrams where each program’s web page can be reached by clicking the nodes of the network. Professor Colgate discussed the sharing of administration, courses, faculty, and students between various design programs at Northwestern. His talk echoed the need for building effective knowledge networks brought up in Professor Contractor’s talk. Professor Colgate’s talk reinforced the notion that Design lives everywhere in a university and provides a new way of thinking.



**Figure 2.** Northwestern’s Design Network

Panos Papalambros (Director, Design Science Program, University of Michigan) spoke next on “Design Now: Why and How”. Using the interdisciplinary design projects in the Design Science Program at University of Michigan as examples, Professor Papalambros asserted the need to

apply design principles and embrace non-technical issues in design, because the problems of today's world are often poorly defined, uncertain, changing, multifaceted, complex, messy, consequential, beautiful, ethical, innovative, fun, ..., and involve both humans and machines. He stated that quantitative design methods are no longer sufficient to tackle the multifaceted challenges of integrating many disciplines in a large organization. There is a profound need to integrate knowledge from social sciences. Like the other speakers, he reiterated the need for studying, researching, and practicing design throughout all education levels, starting from K-12 and going through both undergraduate and graduate curriculums.

Sheri Sheppard (Professor, Stanford University), an expert on education research, delivered a talk on "*Designing Future Interdisciplinary Design Educators*". In her talk, she first brought up the need for understanding students' learning experience before creating any interdisciplinary program. She discussed the personality traits of "millennials" in today's generation of students, i.e., tolerance, diversity, and personal relationships are more prevalent than in the past. Based on the results obtained from the Academic Pathway Study (APS), an interdisciplinary engineering education research project sponsored by NSF, Dr. Sheppard argued that the profile of the millennial students opens up possibility for design programs and a positive response from students because they are more flexible and ready to embrace innovation. She concluded her talk with recommendations on how to engage millennials in engineering education research, design education, and design research.

### 3.3. Deans' Panel

The Deans' Panel took place in the late afternoon of Day 1 workshop to foster interactions and facilitate dialogue between university administrators and design faculty and researchers. The Dean participants include Don Giddens (Engineering, Georgia Tech), Leah Jamieson (Engineering, Purdue), Barbara Korner (Art & Architecture, Penn State), David Munson (Engineering, U Michigan), Julio Ottino (Engineering, Northwestern), Paul Peercy (Engineering, Wisconsin), Luis Rico-Gutierrez (Design, Iowa State), and David Wormley (Engineering, Penn State). The panel was moderated by Jeremy Gilbert, a faculty member in the School of Journalism and the Segal Design Institute from Northwestern University. The following are some of the questions covered in the panel and the subsequent Q&A session.

1. What is your institution currently doing about design education and research? How would you like to change in the near term?
2. Why do you support design-related work in your institution and how do you support it?
3. For establishing interdisciplinary programs, how do you resolve the usual issues, for example, power only to the disciplines, budget models that do not cross units, faculty hiring? Please tell us your success stories and lessons learned.
4. How are interdisciplinary GRADUATE programs placed under your university structure (e.g., reporting directly to Graduate Dean)? What do you think is the ideal structure?
5. How does the promotion and tenure process differ (if at all) for new faculty working in interdisciplinary programs (e.g., joint appointments)?
6. Do you think Design should have its own department or not?
7. Do you think there is such a thing as design research and what do they think it is?
8. Do you think Design is just hype related to the push for innovation, or is there a deeper intellectual content? Like what?
9. What do you think is the role of the National Science Foundation in supporting design innovation and improving funding opportunities for interdisciplinary design research and educational efforts?

In the opening remarks, each of the Deans discussed the ongoing design programs at their own institutions. Dean Wormley echoed the morning speech of Professor Warren Seering that

alumnae feel unprepared by traditional engineering education in areas of innovation, globalization, and teamwork. Further, a Design curriculum can provide this type of education whereas a traditional one does not. Dean Ottino brought up the issue of cost/funding in forming a design program, and noted that the support from the industry sponsor (Ford Motors) was critical for establishing new design programs such as the EDI (Engineering Design Innovation), a Master degree program at Northwestern. Physical space like the Ford Engineering Design Center provides an avenue to multidisciplinary graduate research. Several Deans mentioned that one strength of an engineering college is to exhibit academic diversity which requires both uni-disciplinary and inter-disciplinary faculty.

**Is Design an intellectual discipline?** The Deans acknowledged that creative achievement rivals technical achievement, even though the measurements of the two are quite different. In engineering technical achievement and scientific research are crucial to faculty success. To establish Design as an intellectual discipline, institutions must find common ground between established disciplines and Design. Throughout this part of the discussion, the Deans acknowledged that proposals from inter-departmental faculty teams are most likely to excite them. Deans see themselves as venture capitalists. A fantastic team and great ideas are both required to get administration support.

**Why is Design interesting to you?** The Deans believe Design adds a new layer of cognitive skills, breadth to the required knowledge base, and captures the essence of engineering: creativity and practicality. Design is also the best way to inspire young potential engineers, for a university to meet its societal responsibilities, and to help with job creation and US competitiveness.

**Where is the research element in Design?** The Deans provided examples of design research opportunities. For example, integrating human and computer problem solving skills and understanding why teamwork works. However, there were questions that were more difficult to answer. e.g., Is Design even science? Or should NSF fund “design” research? These issues bring up the need for the design research community to better define the scientific merits of its research. The exchange between Deans and faculty on this topic led to the discussion about using different channels beyond NSF for funding design research.

Throughout the panel, the Deans provided their overwhelmingly strong support to creating interdisciplinary design programs and showed their enthusiasm and strong interests in understanding the design community. Their responses to the question, “Why are you here?” included: to understand the design community, its vocabulary, its challenges, to learn something, to speak authoritatively to faculty about Design, to gain advice from other design education programs, and to understand the scope of design work.

#### **4. Breakout Sessions**

Two breakout sessions were organized throughout the workshop.

##### 4.1 Breakout session 1 (Phase I)

The first breakout session was organized in Day 1 as a part of *Phase I: Design as a Path to Cross-Connection and Innovation*. The participants were divided into ten teams (see Appendix C), each was asked to articulate a point-of-view about the role that Design and design education should play in innovation. Is Design a pathway to innovation that universities should embrace in the 21<sup>st</sup> century? Why, or why not? Each team was charged to develop an *elevator speech* (1-2 minutes) and a *persuasive visualization* to explain their ideas to key stakeholders (university administrators, funding agencies, employers, potential donors, prospective students, parents,

etc.). Student helpers were assigned to each team to provide technical support (e.g., take notes, shoot/edit video, create visualizations, etc.) and help with brainstorming. The elevator speeches have been recorded and can be viewed at <http://bit.ly/NSF-DesignWorkshop-Segal-NU>. The following is a list of common views emerged from the different breakout teams:

- Design is a learning process.
- Design is a way of thinking and doing.
- Design provides cross-disciplinary interaction space.
- Design serves as a catalyst for innovation that leads to transformation.
- Design provides the inspiration to innovation.
- Design provides a lens to envision and resolve the future of university education.
- Design is the essence of engineering, bringing math, science, and disciplinary knowledge together as problems are solved and innovations are created.
- Design transforms how students see themselves and their future.
- Design contributes to the role of the university in larger society ... providing solutions to real problems.

It is agreed that even though the participants are from different fields, design thinking holds different disciplines together, while “conceptual collisions” across different ways of thinking enable new transformative practices. Throughout the elevator talks, the participants also posed the educational challenges: How are we preparing people to be design thinkers? And how should we train students who have both the depth in disciplinary knowledge and breath in interdisciplinary skills.

#### 4.2 Breakout session 2 (Phase III)

The second breakout session was organized on Day 2 in *Phase III: Identifying Synergistic Research and Education Strategies*. In this phase, participants were divided into the five groups (see participant list in Appendix D) and reflected on the key issues that the interdisciplinary design community collectively faces. Each group was asked to prioritize research and education topics, and identify synergistic efforts towards pursuing new interdisciplinary opportunities.

- Group 1: *Science of Design Innovation* (What is it? What is the impact? What are the key issues and funding opportunities?)
- Group 2: *Interdisciplinary Design Research* (list of prioritized design research topics and funding opportunities)
- Group 3: *Interdisciplinary Design Pedagogy* (list of effective education strategies and prioritized education research topics and funding opportunities)
- Group 4: *Nurturing Design Faculty* (recommendations on career path, faculty appointment, publishing strategies, and ways for seeking support and funding)
- Group 5: *What Students Will Need to Know and What We Should Teach* (a list of knowledge, skills, and attitudes that T-shaped students need and what we should teach)

Key recommendations are summarized next; presentations can be viewed at <http://bit.ly/NSF-DesignWorkshop-Segal-NU>.



## 5. Recommendations and Closing Remarks

*Recommendation 1: Design should be viewed as the new frontier for sustainable growth and innovation.*

Sustainable growth in the 21<sup>st</sup> Century requires technological and social innovations that effectively address the complex, interdependent problems that we face as a nation and throughout the world. Most of today's innovations occur at the boundaries between multiple disciplines [1]. In a globally competitive world economy, organizations that can operate within an interdisciplinary framework will be ideally poised to identify and solve technical and societal challenges in innovative ways while simultaneously preparing the innovators of tomorrow. However, innovation is not well understood [6]. Understanding the process of innovation and its role in the design of products, processes, services, and systems is critical to our nation's future advancement [7]. It has been agreed among the workshop participants that Design is the most promising driver for implementing technological and social innovations. Design is more than just problem solving — it provides a process to channel creativity and foster innovation. While innovation can occur without structure, Design provides a pathway to drive the process of innovation. Given its ubiquitous nature, Design naturally fosters interdisciplinary collaboration leading to innovation.

*Recommendation 2: A unique transformational opportunity exists in which the universities should quickly respond with new educational strategies and curricular reforms in Design.*

While design research uncovers ways to understand and accelerate the process of innovation, the value of design education has received increasing recognition. Universities have recognized the value of Design and related educational strategies, but they have been slow to respond with curricular reform [8]. Thus, a unique transformational opportunity exists. Design thinking allows students to hone their creative abilities by engaging a wide range of knowledge and skills. Design projects empower students to transform the world around them and add value to society by addressing problems in which they are personally vested [9]. Design experiences allow students to take charge of their own learning and instill an innovative mindset within them for life. Building this innovation capacity in our students is the most critical long-term investment we can make as a nation.

*Recommendation 3: Design serves as the driver for implementing technological and social innovations and it will require strong administrative support, financial contributions from research foundations, and multi-institutional collaborative efforts.*

To address the needs brought up in the above recommendations, the workshop participants proposed the idea of creating a coalition of universities that will champion Design (**Design Coalition**) at the national level to educate and inspire the innovators of tomorrow. Collectively, this coalition will help the U.S. research and education agenda transition from a “pure” interpretation of the Vannevar Bush framework that has guided us over half a century [10] to an agenda focused on the need for strong interdisciplinary thinking and innovation [11-13]. A design-driven agenda for sustainable growth and innovation will have a significant impact if it encompasses a coalition of institutions that help train a large percentage of the nation's engineering workforce. The proposed coalition is expected to establish a collaborative ecosystem rooted in design research and education to foster the development of the socio-technical and educational innovations that will advance the nation's capacity to create.

Some recommended topics on design education and research are highlighted as follows.

## **Recommendations on Design Education**

The following education innovations can be accomplished through multiple avenues via either multi-institutional collaborations or adaptation to local conditions of individual institutions.

- Develop a shared set of guiding principles and common practices to nurture and support institutional collaboration;
- Develop a shared curricular vision to support undergraduate and graduate educational experiences that promote design-driven innovation and entrepreneurship;
- Pursue cross-institutional design and pedagogical research that will accelerate the process of innovation and enhance students' lifelong preparation;
- Support organized opportunities for extracurricular, student-generated activities to explore problems beyond the classroom that provide experiences in entrepreneurship, leadership, and globalization first hand;
- Engage K-12 students and teachers to promote talent pipeline development;
- Organize and host workshops and conferences to cross-pollinate exemplary design and innovation research, education, and practices throughout the nation;
- Provide innovation spaces that nurture interdisciplinary collaboration across colleges;
- Develop continuing, distance, and executive education courses to promote new skill sets and thinking for alumni, possibly through cross-institutional collaborations;
- Transform project-based design courses throughout the undergraduate and graduate curriculum to become more interdisciplinary;
- Drive a continuous thread of design innovation from freshman through senior design project courses;
- Educate the educators: Launch masters and doctoral programs that promote interdisciplinary thinking, such as design innovation, design thinking, design science, and advanced design and production techniques, with cross-institutional faculty collaboration;
- Pursue new endowment opportunities to support material, equipment, laboratory, and course activities centered on design; and
- Develop and attract faculty members that thrive in a multidisciplinary environment yet excel in individual disciplinary discourse.

## **Recommendations on Design Research**

A large-scale, sustained education agenda must be supported and complemented by a research agenda that studies the pertinent questions and develops the knowledge and methods to address them. While interdisciplinary education is readily understood, interdisciplinary research is much less so. Rather than perceiving design research as an interdisciplinary area, it is more advantageous to view Design as a discipline in itself that can combine knowledge from other disciplines, akin to our concept of medicine as a discipline. Examples of design research topics include:

- Exploration of the intersection and interaction of people, products, and systems;
- Reconciliation of the creative, holistic thinking of the arts with the analytical, decomposed thinking of the sciences;

- Methods to enhance interdisciplinary communication and collaboration, knowledge capture, and reuse across disciplines;
- Design innovation of complex engineered systems;
- Identification of the characteristics of innovative teams;
- Exploration of the intersection of computing and human systems and how this supports the design process;
- Methodologies for the design of emerging systems, such as medical and health care systems, energy related products and services, and multi-scale devices and systems;
- Design of completely new products, services, and systems yet to be conceived; and
- Interdisciplinary design education including innovation, creativity, teamwork, leadership, entrepreneurship through curricular and extracurricular learning.

In closure, Design provides a foundation to bolster innovation. For the U.S. to continue to lead the world in the development of new products, processes, services, and systems, significant advances in design research and education are imperative. A multi-institutional framework is needed to bring communities of researchers and educators together to advance the nation's innovation agenda. The ideas outlined in this workshop report are just a beginning.

### **Acknowledgments**

This workshop was supported by the Engineering Design and Innovation program of the National Science Foundation, under Grant CMMI-1019226. Any opinions, findings, and conclusions or recommendations in this paper are those of the authors and do not necessarily reflect the views of the National Science Foundation.

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## Appendix A

### Agenda of NSF Workshop Driving Innovation through Design: Engineering in the 21st Century Northwestern University (April 15-16, 2010)

THURSDAY, April 15,

Ford Engineering Design Center (morning)  
James L. Allen Center (afternoon)

- 7:30/7:45 am Walk from Orrington Hotel to Ford Engineering Design Center, 2133 Sheridan Rd. (Hosts: Wei Chen, Jeremy Gilbert, Don Norman)
- 7:45-8:00 am Tour of Ford Engineering Design Center (optional)
- 8:00-8:30 am Continental Breakfast (ITW auditorium, Ford Engineering Design Center)
- 8:30-9:00 am Welcome Wei Chen, Workshop Organizer  
Julio Ottino, Dean, McCormick School of Engineering and Applied Science, Northwestern

#### Phase I: Design as a Path to Cross-Connection and Innovation

Moderator: Ed Colgate, Co-Director of Segal Design Institute

- 9:00-10:30 am Invited Speakers and Q&A
- |   |   |
|---|---|
| Engineers as Innovators   | Sam Kahan, Senior Economist, Federal Reserve Bank   |
| Networks by Design for Design   | Noshir Contractor, Professor, School of Communication and the Industrial Engineering Department, Northwestern |
| Nothing is permanent but change: <i>The stress on design and journalism schools</i> | Roger Black, Media Design Consultant, Roger Black Studio, Inc.  |
| What Students Will Need to Know. What We Teach. What About the Rest?                | Warren Seering, Professor, Mechanical Engineering, MIT  |
- 10:30-10:45 am Coffee break
- 10:45-11:45 am Breakout Sessions
- 11:45-12:00 pm Break (Walk to Allen Center)
- 12:00-1:00 pm Lunch, Atrium Dining Room, James L. Allen Center, 2169 Campus Drive

#### Phase II: Cultivating Successful Interdisciplinary Programs

Moderators: Tim Simpson and Jeremy Gilbert

- 1:00-2:00 pm Invited Talks, Atrium Dining Room Moderator: Tim Simpson
- |   |   |
|---|---|
| Recap of the NSF Design Workshop Series: A Closer Look at Successful Interdisciplinary Programs | Tim Simpson, Professor, Mechanical and Industrial Engineering, Penn State |
|---|---|



	Northwestern's Design Network	Ed Colgate, Co-Director, Segal Design Institute, Northwestern
	Design Now: Why and How	Panos Papalambros, Director, Design Science Program, University of Michigan
	Designing Future Interdisciplinary Design Educators	Sheri Sheppard, Professor, Mechanical Engineering, Stanford University
2:15-3:45	Deans' Panel, Room 140	Moderator: Jeremy Gilbert
	Don Giddens Leah Jamieson Barbara Korner David Munson Julio Ottino Paul Percy Luis Rico-Gutierrez David Wormley	Engineering Dean, Georgia Tech Engineering Dean, Purdue Art and Architecture Dean, Penn State Engineering Dean, University of Michigan Engineering Dean, Northwestern Engineering Dean, University of Wisconsin Dean of the Design School, Iowa State University Engineering Dean, Penn State
3:45-4:00 pm	Break and Seating for Design:Chicago (Auditorium, Allen Center)	
4:00-6:30 pm	<b>Design:Chicago</b> (Optional)	
6:30-7:00 pm	Cocktails	
7:00-8:30 pm	Design:Chicago Dinner (Atrium Dinning Room, Allen Center)	
8:30 pm	Shuttle from Allen Center to Orrington Hotel or walk back with hosts	

**Friday, April 16**

**McCormick Tribune Center**

7:45 am	Walk from Orrington Hotel to the McCormick Tribune Center - Medill School of Journalism, 1870 S. Campus Drive (Hosts: Wei Chen, Jeremy Gilbert, Don Norman)	
8:00-8:30 am	Continental Breakfast/Poster Session (atrium)	
8:30-9:00 am	Preparation for Presentation	
9:00-9:30 am	Elevator Speeches from Day 1 Breakout Teams	

**Phase III: Identifying Synergistic Research and Education Strategies**  
(Moderator: Wei Chen)

9:30-11:00 am	Welcome by Dean John Lavine/Breakout Sessions	Facilitators: Paul Leonardi, Panos Papalambros, Bernie Roth, Tim Simpson, Judy Vance
11:00-11:30 am	Presentations of Group Summaries	
11:30-12:00 noon	Wrap-up	

**Appendix B Participants - NSF Workshop on “Driving Innovation through Design – Engineering in the 21<sup>st</sup> Century”  
Northwestern University (April 15-16, 2010)**

**Invited Participants**

<b>First Name</b>	<b>Last Name</b>	<b>Title</b>	<b>Department/Division</b>	<b>Organization</b>
Robin	Adams	Assistant Professor	Engineering Education	Purdue University
Darlene	Alexander-Houle	Manager/Adjunct Professor	Global Program Manager	Hewlett Packard/University of Phoenix
Roger	Baer	Professor and Chair	Art and Design	Iowa State University
Russell	Barton	Professor	Smeal College of Business	The Pennsylvania State University
Roger	Black	Media Design Consultant		Roger Black Studio, Inc.
Thomas	Bornkessel	Dr.	Chief of Improvement & Quality	Rolls-Royce Germany
David	Celento	Assistant Professor	Architecture	The Pennsylvania State University
Fred	Collopy	Professor and Senior Associate Dean	Weatherhead School of Management	Case Western Reserve University
James	Conley	Clinical Professor	Kellogg School of Management	Northwestern University
Noshir	Contractor	Professor	School of Communication/Industrial Engineering & Management Sciences	Northwestern University
Shanna	Daly	Post-doctoral Fellow	College of Engineering and College of Education	University of Michigan
Dennis	Doordan	Co-Editor	Art, Art History, and Design	Design Issues
Raed	Elaydi	Assistant Professor	Managerial Studies, College of Business	University of Illinois at Chicago
Marcos	Esterman, Jr.	Assistant Professor	Industrial and Systems Engineering	Rochester Institute of Technology
Sebastian	Fixson	Assistant Professor	Technology Operations and Information Management Division	Babson College
Ping	Ge	Program Officer	Division of Graduate Education	National Science Foundation
Richard	Gonzalez	Professor	Psychology	University of Michigan
Rich	Gordon	Associate Professor, Director	Medill School of Journalism, Digital Innovation	Northwestern University
Judith	Gregory	Design Research Faculty	Institute of Design	Illinois Institute of Technology
Rebecca	Henn	Assistant Professor	Architecture	The Pennsylvania State University
Terry	Irwin	Professor, Head	School of Design	Carnegie Mellon University
Ramesh	Jagannathan	Professor	Chemical Engineering	New York University
Sirkka	Jarvenpaa	Professor,	Information, Risk and	University of Texas at Austin

Yan	Jin	Professor	Mechanical Engineering	University of Southern California
Jaewoo	Joo	PhD Candidate	Marketing, Rotman School of Management	University of Toronto
Sam	Kahan	Senior Economist		Federal Reserve Bank of Chicago
Harrison	Kim	Assistant Professor	Industrial and Enterprise Systems Engineering	University of Illinois at Urbana-Champaign
Micah	Lande	PhD Candidate	d.school/Mechanical Engineering	Stanford University
Pierre	Larochelle	Professor, Assistant Dean	Mechanical Engineering, College of Engineering	Florida Institute of Technology
Kemper	Lewis	Professor	Mechanical and Aerospace Engineering	State University of New York at Buffalo
Erin	MacDonald	Assistant Professor	Mechanical Engineering	Iowa State University
Victor	Margolin	Emeritus Professor	Art and Design History	University of Illinois at Chicago
Alison	McKay	Professor of Design Systems	Mechanical Engineering	University of Leeds
Seth	Orsborn	Assistant Professor	Interdisciplinary Engineering	Missouri University of Science and Technology
Matt	Parkinson	Assistant Professor	Mechanical, Industrial and Nuclear Engineering	The Pennsylvania State University
Linda	Pulik	Visiting Professor	Industrial Design	University of Illinois at Chicago
David	Radcliffe	Interim Head	Engineering Education	Purdue University
Karthik	Ramani	Professor	Mechanical Engineering	Purdue University
Jon	Sanford	Director	Center for Assistive Technology and Environmental Access, College of Architecture	Georgia Institute of Technology
Debra	Satterfield	Associate Professor	Art and Design	Iowa State University
Steve	Sawyer	Associate Professor	Center for Technology and Information Policy /School of Information Studies	Syracuse University
Warren	Seering	Professor	Mechanical Engineering	Massachusetts Institute of Technology
Sheri	Sheppard	Professor, Vice Provost	Mechanical Engineering	Stanford University
Mark	Slaven	Managing Director	General Manager, Shanghai	Insight Product Development
David	Stanton	Technology Fellow	College of Journalism and Communications	The Poynter Institute
Mike	Stringer	Managing Partner	Fellow at Kellogg Graduate School of Management	Datasclope Analytics
Janis	Terpenney	Professor	Engineering Education/Mechanical Engineering	Virginia Polytechnic Institute and State University
David	Weightman	Professor	School of Art and Design	University of Illinois at Urbana-Champaign
Maria	Yang	Assistant Professor	Mechanical Engineering	Massachusetts Institute of Technology
Seda	Yilmaz	PhD Candidate	Design Science	University of Michigan

### Deans' Panel

<b>First Name</b>	<b>Last Name</b>	<b>Title</b>	<b>Department/Division</b>	<b>Organization</b>
Don	Giddens	Dean	College of Engineering	Georgia Institute of Technology
Leah	Jamieson	Dean	College of Engineering	Purdue University
Barbara	Korner	Dean	College of Arts and Architecture	The Pennsylvania State University
David	Munson	Dean	College of Engineering	University of Michigan
Julio	Ottino	Dean	College of Engineering	Northwestern University
Paul	Peercy	Dean	College of Engineering	University of Wisconsin-Madison
Luis	Rico-Gutierrez	Dean	College of Design	Iowa State University
David	Wormley	Dean	College of Engineering	The Pennsylvania State University

### Local Organizing Committee and External Steering Committee

<b>First Name</b>	<b>Last Name</b>	<b>Title</b>	<b>Department/Division</b>	<b>Organization</b>
Wei	Chen	Professor	Mechanical Engineering	Northwestern University
Ed	Colgate	Professor, Co-Director of Segal	Mechanical Engineering/Segal Design Institute	Northwestern University
Liz	Gerber	Assistant Professor	Mechanical Engineering/Kellogg School of Management	Northwestern University
Jeremy	Gilbert	Assistant Professor	Medill School of Journalism	Northwestern University
Paul	Leonardi	Assistant Professor	School of Communication/Industrial Engineering and Management Sciences	Northwestern University
Don	Norman	Professor, Co-Director of Segal	Computer Science/Segal Design Institute/ Kellogg School of Management	Northwestern University
Panos	Papalambros	Professor, Director of Design Science	Mechanical Engineering	University of Michigan
Bernie	Roth	Professor, Interim Director of d.school	Mechanical Engineering	Stanford University
Tim	Simpson	Professor	Mechanical, Industrial and Nuclear Engineering	The Pennsylvania State University
Judy	Vance	Professor	Mechanical Engineering	Iowa State University

### Northwestern University Faculty Guest Attendees

First Name	Last Name	Title	Department/Division	Organization
Stephen	Carr	Associate Dean of Undergraduate Engineering	Professor of Materials Science and Engineering	Northwestern University
Walter	Herbst	Professor, Co-director of MPD	Mechanical Engineering	Northwestern University
Greg	Holderfield	Senior Lecturer, Co-Director of MPD	Segal Design Institute/Master of Product Development Program	Northwestern University
John	Lavine	Dean	Medill School of Journalism	Northwestern University
Richard	Lueptow	Professor, Associate Dean for Research, Co-Director of MPD	Mechanical Engineering	Northwestern University

### NU Student Helpers

Scott Aikin  
 Jessica Chen  
 Nicholas Evans  
 Leor Galil  
 Steve Greene  
 Lenore Kaplan  
 Xaver Neumeyer  
 Santiago Padilla  
 Andrew Paley  
 Carolyn Surh  
 Akshay Thakker  
 John Ware  
 Justin Wear

### NU Administrative Support

James Herman



## **Appendix C Teams for Phase I - Design as a Path to Cross-Connection and Innovation**

**10:45-11:45 am, April 15, 2010**

### **Team 1**

#### **2.340 (Unilever Conf)**

##### **Robin Adams (lead)**

Darlene Alexander-Houle  
Roger Baer  
Ed Colgate  
Don Giddens (Dean)  
Harrison Kim  
David Stanton  
Akshay Thakker (helper)

### **Team 2**

#### **2.310 (MPD Conf)**

##### **Dennis Doordan (lead)**

Russell Barton  
Ping Ge  
Rich Gordon  
Leah Jamieson (Dean)  
Sam Kahan  
Panos Papalambros  
Nicholas Evans (helper)

### **Team 3**

#### **1.200 (ITI Conf Rm)**

##### **Matt Parkinson (lead)**

Noshir Contractor  
Judith Gregory  
Jaewoo Joo  
Luis Rico-Gutierrez (Dean)  
Jon Sanford  
Warren Seering  
Justin Wear (helper)

### **Team 4**

#### **1.240 (ITI Student Rm)**

##### **Kemper Lewis (lead)**

David Celento  
James Conley  
John Lavine (Dean)  
Steve Sawyer  
Sheri Sheppard  
Seda Yilmaz  
Lenore Kapla (helper)

### **Team 5**

#### **1.240 (ITI Student Rm)**

##### **Terry Irwin (lead)**

Roger Black  
Marcos Esterman  
Richard Gonzalez  
Julio Ottino (Dean)  
Debra Satterfield  
Tim Simpson  
Scott Aikin (helper)

### **Team 6**

#### **1.330 (MMM Conf)**

##### **David Weightman (lead)**

Shanna Daly  
Raed Elaydi  
Jeremy Gilbert  
Sirkka Jarvenpaa  
Yan Jin  
Paul Peercy (Dean)  
Andrew Paley (helper)

### **Team 7**

#### **1.305 (MMM Lounge)**

##### **Don Norman (lead)**

Thomas Bornkessel  
Sebastian Fixson  
Barbara Korner (Dean)  
Erin MacDonald  
Karthik Ramani  
Mark Slaven  
Jessica Chen (helper)

### **Team 8**

#### **G.330 (Segal Conf Rm)**

##### **Seth Orsborn (lead)**

Stephen Carr (Dean)  
Micah Lande  
Pierre Larochelle  
Alison McKay  
Linda Pulik  
David Radcliffe  
Xaver Neumeyer (helper)

### **Team 9**

#### **G206 (Segal Study Rm)**

##### **Fred Collopy (lead)**

Rebecca Henn  
Richard Lueptow (Dean)  
Bernie Roth  
Mike Stringer  
Maria Yang  
Santiago Padilla (helper)

### **Team 10**

#### **G204 (Segal Study Rm)**

##### **Janis Terpenny (lead)**

Ramesh Jagannathan  
Victor Margolin  
Paul Leonardi  
Judy Vance  
David Wormley (Dean)

**Appendix D Groups for Phase III - Identifying Synergistic Research and Education Strategies**

**9:30-11:00 am, April 16, 2010**

**Group 1 (Forum)**  
**Science of Design**  
**Innovation**

**Tim Simpson (lead)**  
Roger Black  
Thomas Bornkessel  
Fred Collopy (Dean)  
James Conley  
Don Giddens (Dean)  
Judith Gregory  
Ramesh Jagannathan  
Sam Kahan  
Paul Peercy (Dean)  
Karthik Ramani  
Debra Satterfield  
Mark Slaven  
Seda Yilmaz  
Leo Galil (student)

**Group 2 (MTC2101)**  
**Interdisciplinary**  
**Design Research**

**Paul Leonardi (lead)**  
Dennis Doordan  
Raed Elaydi  
Richard Gonzalez  
Rich Gordon  
Greg Holderfield  
Terry Irwin  
Sirkka Jarvenpaa  
Yan Jin  
Harrison Kim  
Kemper Lewis  
Richard Lueptow (Dean)  
Matt Parkinson  
Maria Yang  
Steve Greene (student)

**Group 3 (MTC3107)**  
**Interdisciplinary**  
**Design Pedagogy**

**Judy Vance (lead)**  
Robin Adams  
Ed Colgate  
Sebastian Fixson  
Ping Ge  
Jeremy Gilbert  
Barbara Korner (Dean)  
Victor Margolin  
Linda Pulik  
Luis Rico-Gutierrez  
(Dean)  
Jon Sanford  
Steve Sawyer  
Mike Stringer  
Xaver Neumeyer (student)

**Group 4 (MTC2111)**  
**Nurturing Design**  
**Faculty**

**Panos Papalambros (lead)**  
David Celento  
Marcos Esterman  
Leah Jamieson (Dean)  
Jaewoo Joo  
Micah Lande  
John Lavine (Dean)  
Erin MacDonald  
Seth Orsborn  
Julio Ottino (Dean)  
David Radcliffe  
Janis Terpenney  
Jessica Chen (student)

**Group 5 (MTC2107)**  
**What Students Will**  
**Need to Know and**  
**What We Should**  
**Teach**

**Bernie Roth (lead)**  
Darlene Alexander-Houle  
Roger Baer  
Stephen Carr (Dean)  
Shanna Daly  
Rebecca Henn  
Walter Herbst  
Pierre Larochelle  
Alison McKay  
Don Norman  
Warren Seering  
David Stanton  
David Weightman  
David Wormley (Dean)  
Lenore Kapla (student)