

Exploring Innovation Frontiers Initiative

LAUNCH: EIFI National Dialogue

Georgia Tech Global Learning Center
Atlanta, Georgia
June 9, 2015



A Primer for the EIFI National Launch Dialogue

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Letter from the President

On behalf of the Council on Competitiveness (Council), I am pleased to release *LAUNCH*, a report on the Exploring Innovation Frontiers Initiative (EIFI) national kick-off dialogue held on June 9, 2015 at the Georgia Tech Global Learning Center, in Atlanta.

EIFI is a national, public-private effort to accelerate the over-the-horizon, transformative innovation models that will drive U.S. competitiveness in the coming decades. Sponsored by the National Science Foundation (NSF) Directorate for Engineering, Office of Emerging Frontiers and Multidisciplinary Activities (EFMA), EIFI is a qualitative analysis that will collect, synthesize and disseminate broadly the experiential knowledge of active innovation practitioners. This information will be used to provide academicians with direction for future research in innovation, business leaders and strategists with insights to inform future business models, and policymakers with knowledge to enact public policies that create a supportive environment for sustained innovation-driven growth. More broadly, EIFI is an intensification of the innovation conversation the Council and its members started in 2004 with the National Innovation Initiative (NII) and its report, *Innovate America*—which, in many ways, set the path for U.S. science and technology policy during the following decade.

As we find ourselves at the 10th anniversary of the NII, it is easy to see that the ground has shifted beneath our feet. The proliferation of cost effective research tools once prohibitively expensive (e.g. centrifuges, DNA sequencers, 3-D printers etc.), crowding platforms, and urban do-it-yourself and maker spaces are transforming the



way people and institutions organize to innovate. Profound demographic shifts across the country are dramatically changing the ways in which we engage the pool of potential innovators. And, of course, this is occurring against the backdrop of disappointing economic and productivity growth and increasing wealth, opportunity, and skill disparities among the American people. These trends present both opportunities and challenges. It is up to EIFI partners, participants and stakeholders to characterize this new landscape and set the priorities that will enable the United States to leverage the shared prosperity of the changing nature of innovation—the most important driver of economic growth, productivity and the American standard of living.

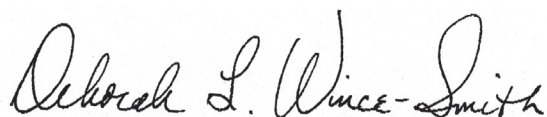
LAUNCH is divided into two sections. The first is a primer developed in advance of the Atlanta-based, national dialogue to enumerate the EIFI vision and goals, detail the Council efforts leading up to and informing this national effort to the boost

U.S. competitiveness, and elucidate the emerging opportunities motivating this initiative. Section two provides a summary, synthesis, and distillation of the proceedings of the June 9, 2015 dialogue held at the Georgia Tech Global Learning Center.

I would like to extend a special thanks to, G.P. “Bud” Peterson, Council Member and President of the Georgia Institute of Technology; C. Michael Cassidy, Council Affiliate and President and CEO of the Georgia Research Alliance; and Hala Modellmog, President and CEO of the Metro Atlanta Chamber, for co-hosting and leading a dynamic, national conversation of 100+ business, academic and national laboratory innovation stakeholders to lay the foundation for and launch the 2-year EIFI dialogue series.

Of course, none of this can happen without the input and support of innovation stakeholders throughout the country. The Council looks forward to continuing to engage national and regional leaders in industry, academia, national laboratories and government as it continues to capture insights and recommendations from this and future dialogues, and sets forward a path of action to increase U.S. competitiveness and meet the goals of the Exploring Innovation Frontier Initiative.

Sincerely,

A handwritten signature in black ink that reads "Deborah L. Wince-Smith". The signature is written in a cursive, flowing style.

Deborah L. Wince-Smith
President & CEO
Council on Competitiveness

Participants

CO-HOSTS

G. P. “Bud” Peterson
President
Georgia Institute of Technology

C. Michael Cassidy
President & CEO
Georgia Research Alliance

Hala Moddelmog
President & CEO
Metro Atlanta Chamber

Deborah L. Wince Smith
President & CEO
Council on Competitiveness

KEYNOTE

France Córdoba
Director
National Science Foundation

ATTENDEES

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Principal Deputy Director
of CDC/ATSDR
Center for Disease Control and
Prevention

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Chair—The Sam Nunn School of
International Affairs
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Advanced Materials Lead, Advanced
Manufacturing
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Chief Technology Officer
United States Steel Corporation

Margaret Brooks
Customer Success
Verizon Enterprise Solutions

Elizabeth Bryant
Director of Corporate Relations
Georgia Institute of Technology

Al Bunshaft
President & CEO
DS Government Solutions

Jasmine Burton
Founder and President
Wish for WASH, LLC
Recent Graduate—Georgia Institute of
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President
The University Financing Foundation

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Nancy Chambers
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G. Wayne Clough
President Emeritus
Georgia Institute of Technology

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Natacha DePaola
Dean, Armour College of Engineering
Illinois Institute of Technology

Tomás Díaz de la Rubia
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Council on Competitiveness

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State Bank Financial Corporation

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Georgia Institute of Technology

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Undergraduate—Georgia Institute of
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Vice President—Information Technology
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Vice President
General Manager of Boeing Research &
Technology
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Chief Technology Officer
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Office of Atlanta City Council Member
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Senior Vice President
Director of GE Global Research
Chief Technology Officer
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President and CEO
Federal Reserve Bank of Atlanta

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Membership Director
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Director, Venture Lab
Georgia Institute of Technology

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David Norton Vice President for Research University of Florida	Mary Snitch Senior Manager University & Industry Relations Lockheed Martin-CETO	Partha Unnava Chief Executive Officer Better Walk Inc.
Phil Paradice Regional Director Economic Development Administration	Diane Souvaine Vice Provost for Research Tufts University	Loren Van Dyke Alumni Booth School of Business The University of Chicago
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Sohi Rastegar Senior Advisor, Directorate for Engineering National Science Foundation	Carolyn Stephens Director, Strategic Marketing and Operations UC Irvine, Institute for Innovation	Kitty Vogt Director, Community Engagement Georgia Research Alliance
Susan Roche Manager—Research Administration Office of the Executive Vice President for Research Georgia Institute of Technology	Angela Strickland Marketing General Manager Southern Company	Grace Wang Deputy Assistant Director Directorate for Engineering National Science Foundation
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Dean, College of Engineering
The Ohio State University

Felicia Winborne
Senior Project Support Specialist
Georgia Institute of Technology

Mohammad Zaidi
Chief Technology Officer (Retired)
Alcoa, Inc.

Agenda

MORNING

7:30 Registration and Continental Breakfast

8:00 Welcome: Exploring Innovation Frontiers Initiative

The Honorable Deborah L. Wince-Smith
President and CEO
Council on Competitiveness

Dr. G. P. “Bud” Peterson
President
Georgia Institute of Technology

8:30 Innovation Keynote

Dr. France A. Córdoba
Director
National Science Foundation

8:50 Exploring Innovation Frontiers Initiative: Vision, Goals and Objectives

Mr. Chad Evans
Executive Vice President
Council on Competitiveness

Preview: “This initiative is fundamentally about the collective act of sensing. For complex systems to survive, adapt, evolve and grow in the face of turbulent change, we must sense the meaningful changes on the horizon and begin to prepare our organizations, institutions, and workforce to leverage these changes for future prosperity.”

9:05 Setting the Stage: Exploring New Models of Innovation

Description: This panel will explore transformative models rooted in the democratization and self-organization of innovation, along with changes in how people perceive and pursue innovation and—more important—how they access the national innovation system.

Guiding Questions

1. Look back over the past decade, what has changed about how your organization thinks about and pursues innovation?
2. What forces and trends—economic, social, and technological, etc.—are driving these changes?
3. Thinking through the lens of innovation, what changes are your organization anticipating, and what are you doing to prepare?

Moderator

Dr. Pramod Khargonekar
Assistant Director, Directorate for Engineering
National Science Foundation

Panelists

Dr. Ileana Arias
Principal Deputy Director of CDC/ATSDR
Center for Disease Control and Prevention

Dr. Paul Hommert
President and Laboratories Director
Sandia National Laboratories

Dr. Mark Little
Senior Vice President
Director of GE Global Research
Chief Technology Officer
GE-Global Research Center

Mr. Rod Makoske
Senior Vice President of
Corporate Engineering, Technology, and Operations
Lockheed Martin

Next Generation Innovator

Ms. Jasmine Burton
Founder and President
Wish for WASH, LLC
Recent Graduate—Georgia Institute of Technology

10:05 Coffee Break**10:20 Untapped Innovation Capacity**

Description: This panel will explore the demographic, socioeconomic, and geographic landscape of the national innovation system, and explore the claim made by science, technology, and innovation policy experts—and its implications—that the U.S. innovation ecosystem is increasingly characterized by exclusion.

Guiding Questions

1. Is the U.S. innovation ecosystem now characterized by exclusion?
2. What impact will changing demographics and rising inequality have on the U.S. innovation ecosystem?
3. How do we create, scale and sustain inclusive communities of innovation in every corner of the country?

Moderator**Dr. Judy Genshaft**

President and CEO/Corporate Secretary
University of South Florida

Panelists**Mr. Al Bunshaft**

President and Chief Executive Officer
DS Government Solutions

Dr. Stephen Cross

Executive Vice President for Research
Georgia Institute of Technology

Dr. Greg Hyslop

Vice President
General Manager of Boeing Research & Technology
The Boeing Company

Mr. Mark Lytle

Vice Chancellor for Economic Development
Board of Regents—University System of Georgia

Next Generation Innovator**Ms. Rachel Ford**

Instructor, Georgia Tech Venture Lab
Undergraduate—Georgia Institute of Technology

11:20 Transition: Pick up lunch and locate breakout room**11:40 Creating and Nurturing New Talent and New Ideas—Working Lunch & First Breakout Session**

Description: This first breakout session will build on the morning plenary sessions. The core function of this session is to break up the participants into smaller groups, to ensure we capture the insights from as many dialogue participants as possible. Each group will reflect on the topics covered in the opening plenary sessions, and begin to discuss what innovation stakeholders can do together across disciplines, sectors, and regions to accelerate the opportunities and overcome the challenges highlighted in the morning sessions.

Guiding Questions

1. Reflecting on the morning session, what do you see as a high-value opportunity to accelerate innovation?
2. What are actionable steps we can take together to leverage these opportunities?
3. What challenges discussed in the morning session resonated with you or your organization?
4. What can we do together to overcome these challenges?

Conversation Lead**Mr. Andrew Garman**

Founder and Managing Partner
New Venture Partners

Facilitator**Mr. Chad Evans**

Executive Vice President
Council on Competitiveness

Scribe**Ms. Gail Spatt**

Program Manager, Office of the Executive Vice President for Research
Georgia Institute of Technology

Conversation Lead**Mr. Alan Taetle**General Partner
Noro-Moseley Partners**Facilitator****Mr. Michael van Ter Sluis**Vice President
Council on Competitiveness**Scribe****Ms. Susan Roche**Manager—Research Administration
Office of the Executive Vice President for Research
Georgia Institute of Technology**Conversation Lead****Dr. Paul Sanberg**President, National Academy of Inventors
Senior Vice President for Research, Innovation, & Economic
Development
University of South Florida**Facilitator****Mr. Joseph Bankoff**School Chair—The Sam Nunn School of International Affairs
Georgia Institute of Technology**Scribe****Ms. Felicia Winborne**Senior Project Support Specialist
Georgia Institute of Technology**AFTERNOON****12:55 Break & Transition back to Plenary****1:15 Innovation for Prosperity**

Description: The panel will explore the process by which innovation diffuses into the economy and how well businesses, entrepreneurs, wage earners, academic institutions, and governments adapt to the structural changes caused by innovation.

Potential Questions

1. Is the U.S. economy (i.e. businesses and workers) becoming less able or willing to absorb new technologies, services, and business models? Does innovation benefit all Americans?
2. How do we improve our ability to absorb increased innovation?
3. How do we do this in a way creates wide-spread prosperity?

Moderator**Dr. James Garrett**Dean, College of Engineering
Carnegie Mellon University**Panelists****The Honorable Kwanza Hall**Council Member, District 2
Atlanta City Council**Dr. Keoki Jackson**Vice President and Chief Technology Officer
Lockheed Martin**Dr. G. Wayne Clough**President Emeritus
Georgia Institute of Technology**Ms. Hala Moddelmog**President & Chief Executive Officer
Metro Atlanta Chamber**Next Generation Innovator****Mr. Partha Unnava**Chief Executive Officer
Better Walk Inc.
Former Undergraduate—Georgia Institute of Technology**2:15 Break Session & Transition**

2:30 Creating New Markets, New Jobs, and Growing the Economy—Second Breakout Session:

Description: This second breakout session will build on the afternoon plenary session. The core function of this session is to break up the participants into smaller groups, to ensure we capture the insights from as many dialogue participants as possible. Each group will reflect on the topics covered in the opening plenary sessions, and begin to discuss what innovation stakeholders can do together across disciplines, sectors, and regions to accelerate the opportunities and overcome the challenges highlighted in the morning sessions.

Guiding Questions

1. Reflecting on the morning session, what do you see as a high-value opportunity to accelerate innovation?
2. What are actionable steps we can take together to leverage these opportunities?
3. What challenges discussed in morning session resonated with you or your organization?
4. What can we do together to overcome these challenges?

Conversation Lead

Dr. David Norton

Vice President for Research
University of Florida

Facilitator

Mr. Chad Evans

Executive Vice President
Council on Competitiveness

Scribe

Ms. Gail Spatt

Program Manager, Office of the Executive Vice President for Research
Georgia Institute of Technology

Conversation Lead

Ms. Dona Crawford

Associate Director for Computation
Lawrence Livermore National Laboratory

Facilitator

Mr. Michael van Ter Sluis

Vice President
Council on Competitiveness

Scribe

Ms. Susan Roche

Manager—Research Administration
Office of the Executive Vice President for Research
Georgia Institute of Technology

Conversation Lead

Dr. Mohammad Zaidi

Chief Technology Officer, Retired
Alcoa, Inc.

Facilitator

Mr. Joseph Bankoff

School Chair—The Sam Nunn School of International Affairs
Georgia Institute of Technology

Scribe

Ms. Felicia Winborne

Senior Project Support Specialist
Georgia Institute of Technology

3:45 Break & Transition back to Plenary

4:00 Breakout Session Read Out

Description: Each breakout session Conversation Lead, or designated representative, will pitch the top recommendations from their respective breakout sessions.

Moderator

Mr. Chad Evans

Executive Vice President
Council on Competitiveness

Respondents

The Honorable Deborah L. Wince-Smith

President and CEO
Council on Competitiveness

Dr. Pramod Khargonekar

Assistant Director, Directorate for Engineering
National Science Foundation

4:45 The Path Forward

Dr. G. P. “Bud” Peterson

President
Georgia Institute of Technology

Dr. Kim Wilcox

Chancellor
University of California, Riverside

The Honorable Deborah L. Wince-Smith

President and CEO
Council on Competitiveness

5:15 Conclude

Part 1:
A Primer for the EIFI National
Launch Dialogue

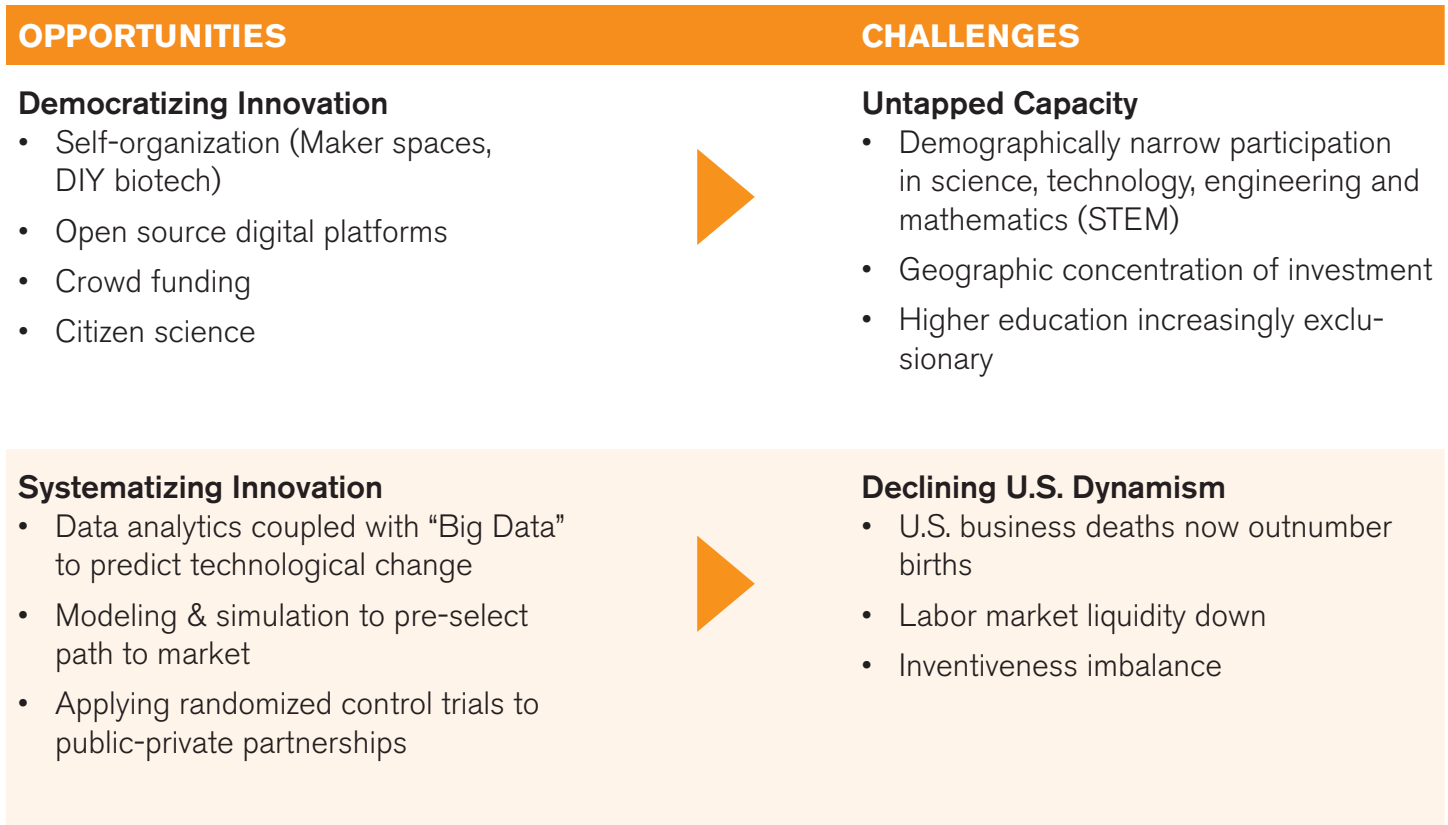
PART 1: A PRIMER FOR THE EIFI NATIONAL LAUNCH DIALOGUE

Setting the Stage: A Decade of Innovation

As the Council on Competitiveness and its members, partners, sponsors and affiliates begin working together on the Exploring Innovation Frontiers Initiative (EIFI), reflecting on what has changed across the innovation landscape since, as a nation, we collectively established national priorities for innovation are critical. A decade has passed since the release of the Council’s cornerstone publication, *Innovate America*, and National Academies *Rising Above the Gathering Storm*, and the authorization of the first bipartisan America COMPETES Act—which has

its foundation in the Council’s National Innovation Initiative. In a sense, these efforts have set the overarching path for science, technology and innovation policy in the United States since the mid-2000s. Yet, the context for innovation in the second decade of the 21st century has changed; the ground has shifted beneath our feet. Models of innovation have continued to evolve, and the environment for American innovation presents new challenges—and also new opportunities.

Figure 1. Why EIFI now?



Opportunity—Democratizing Innovation

In the early 2000s, the open innovation movement emerged in response to the transformation of the global industrial landscape that began in the 1980s. Vertically integrated corporations shed business units (particularly manufacturing) to focus on their core competencies, and shifted research and development (R&D) away from basic research and towards the near-term needs of their respective business units. This ushered in an era in which foundational, technological breakthroughs were as likely to come from universities, national laboratories, and small start-up companies. Thus, businesses today increasingly look as much externally as internally for sources of invention and innovation.

In addition to the ever more outward focus of private sector innovators, the Great Recession of the late 2000s has created new pressures both on academia and legislators. The expectation that universities and community colleges will be active centers for economic development has heightened, and public expenditures on R&D are increasingly justifiable only if they directly boost the economy and create jobs in the near term. As such, the last decade has witnessed the creation by innovation stakeholders of quasi-public institutions (proof-of-concept centers, technology demonstration facilities, innovation hubs, etc.) to bridge the gaps in the innovation ecosystem—be they financial, institutional, or behavioral—widened by the open innovation movement.

Bridging institutions like these, nonetheless, are firmly rooted in Vannevar Bush's 20th century vision of the U.S. STI enterprise. While this model remains the global standard for national systems of innovation, transformational models rooted in the democratization and self-organization of innovation are beginning to emerge across the nation. For example, doctoral students—enabled by the plummeting cost of synthesizing and decoding DNA, by the development of relatively inexpensive tools such as centrifuges, and by the proliferation of crowdfunding platforms—are dropping out of big-budget academic institutions and corporate R&D departments to build their own labs in urban centers across the country.

Manufacturing innovation is following a similar path (i.e. maker spaces)—a path that is now well-worn by the information and communication technology (ICT) community and its “hobbyists” that launched the personal computing revolution in garages across America. ICT—specifically the shrinking, ever cheaper, more powerful and cloud enabled computing tools—in fact underpins the revolutionary changes in fields such as biotechnology and manufacturing. 3-D printers, inexpensive reactors and microfinance websites are what is emerging on the surface.

Less obvious than these surface trends is a fundamental change in how people think about and pursue innovation. It is now possible for someone to imagine, develop and scale a disruptive technology independent of traditional institutions of innovation. The linkages between production and capital are increasing, expanding the financial options well beyond traditional sources. Innovation in one field, sector, or discipline increases the pace of innovation in another. The stage is set for exponential innovation, and we must optimize our nation for this new, unfolding reality.

Challenge—Untapped Innovation Capacity

While we may be experiencing a historical proliferation of democratic models of innovation, it is unwise to conclude that the traditional national system of innovation is not critically important to our nation's well being. Moreover, **leading experts in science, technology, and innovation policy are concerned that the innovation ecosystem is increasingly characterized as exclusionary—as evidenced by concerning trends in demography, higher education, and risk capital.**

Historically, women and people of color have been underrepresented in the U.S. innovation ecosystem. Figure 2 highlights the dismal state of STEM diversity in academia at the middle of the 20th Century—when neither women nor minority groups (individually) could claim more than a seven percent stake in the academic community. Fortunately, after the expenditure of much time, money, and political effort, science and engineering education has

become much more open and diverse over the past half century—particularly for women and temporary residents. Figure 2 reveals that, **today, women are represented roughly proportional to their representation in the U.S. population and the STEM disciplines have benefited from high-skill immigration. Unfortunately, little or no progress has been made to broaden the participation of native-born minority groups.**

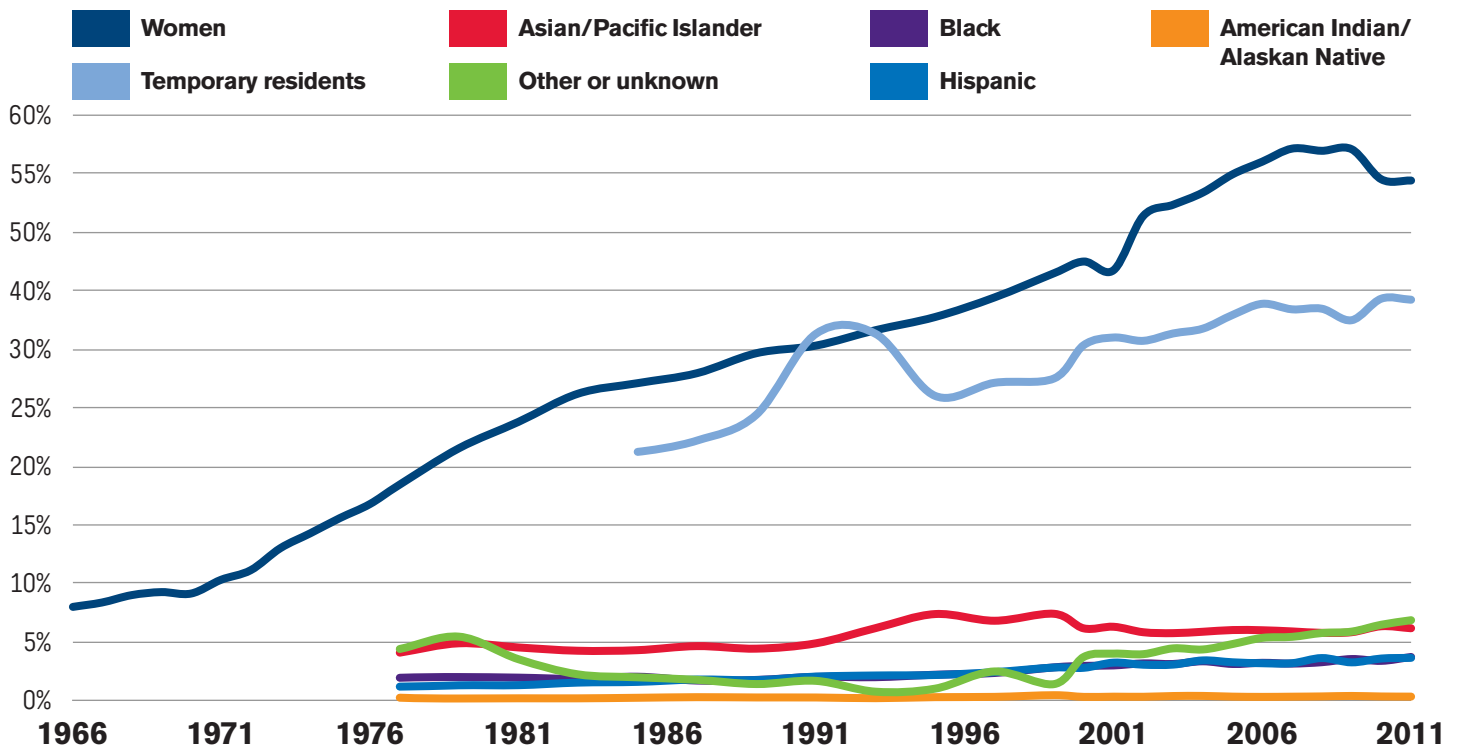
One might suggest that the United States has gotten along quite well with the status quo—as pertains to underrepresented minorities—and, as such, can continue to do so with little risk. However, demographic data suggests otherwise. Census projections reveal that the country's non-Hispanic population will peak at 200 million in 2024, while the multiracial population is projected to more than triple by 2060.

As a result, whites will be in the minority by 2043.¹ Thus, the U.S. innovation ecosystem is out of step with our shifting demographics. The communities in the United States that will soon represent the majority of the U.S. population are the same communities that remain disconnected from the innovation ecosystem.

Not only is the relative size of the pool of potential innovators shrinking, it is becoming increasingly difficult for these college applicants to access the crown jewels of the U.S. innovation ecosystem—research-grade universities. **These institutions are the primary source of knowledge creation and technological innovation that drive American productivity, competitiveness, and prosperity. Yet, the student population at these universities represents a disproportionately small number of U.S. undergraduates.** While there is no formal taxonomy for the nation's top-tier research universi-

Figure 2. Percentage of STEM Doctorates Earned by Demographic

Source: Graph reflects latest available numbers from the NSF's Science and Engineering Indicators. Data before 1976 is from the NSF's Science and Engineering Degrees.



¹ United States Census Bureau, "U.S. Census Bureau Projections Show a Slower Growing, Older, More Diverse Nation a Half Century from Now", December 12, 2012. Accessed June 1, 2015. <https://www.census.gov/newsroom/releases/archives/population/cb12-243.html>

ties, using proxies such membership in the American Association of Universities and *U.S. News & World Report* rankings, the president of the University of Arizona and Council on Competitiveness vice chair, Michael Crow, has estimated that roughly 1 in 10 undergraduates are currently enrolled in first-tier public and private research institutes.² This comes at time when demand for college enrollment is increasing and acceptance rates are falling at research-grade institutions, which will continue to drive down this ratio. For example, between 1989 and 2013 the ratio of freshmen applicants to admitted students at the University of California, Berkeley declined from 40 percent to 16.35 percent.³ Certainly, the “Ivies” are following this trend and more and more state research universities are following suit.

Finally, there remains a long-standing concentration of innovation investment—venture capital, public research and development spending, etc.—in well-established centers of innovation excellence. While there has been an expansion of venture capital into more regions of the country, according to the most recent MoneyTree™ Report by PricewaterhouseCoopers LLP and the National Venture Capital Association, the majority—approximately 65 percent—of venture capital investment remains in just three regions: Silicon Valley, Boston, and New York.⁴ Moreover, according the latest National Science Foundation Survey of Federal Funds for Research and Development, over half of the nation’s public R&D expenditures are concentrated in just eight states—which, not surprisingly, include California, Massachusetts, and New York.⁵

2 Michael M. Crow and William B. Debars, “A New Model for the American Research University,” *Issues in Science and Technology*, Volume XXXI, Issue 3, Spring 2015.

3 Ibid.

4 National Venture Capital Association, “U.S. Venture Capital Investment Spanned 160 Cities in 2014”, January 20, 2015. Accessed June 1, 2015. <http://nvca.org/pressreleases/u-s-venture-capital-investment-spanned-160-cities-2014/>

5 National Science Foundation, “Federal Funds for Research and Development FYs 2012-2014”, Detailed Statistical Table, NSF 14-316, September 30, 2014.

The United States cannot expect to sustain its leadership in innovation when the share of its population that have the opportunities and resources to engage in the innovation process continues to shrink.

Opportunity—Systematizing Innovation

At the same time we have witnessed an increasing awareness of, attention to, and democratization of the innovation process, the development of new methodologies and tools have driven a proliferation of inquiries into the science of the innovation process itself. These efforts have largely focused on reducing the risk and uncertainty in the innovation process through the application of novel technologies, or the novel application of science and technology to innovation management.

Researchers are using the ever-expanding availability of large data sets coupled with data analysis tools to predict technological change, which could provide enormous competitive advantages to organizations that perfect this technology. R&D managers in corporate laboratories, large and small, are using advanced modeling and simulation tools to select innovation pathways with the highest likelihood of success—while avoiding unsuccessful and expensive trials that do not bear fruit. Universities are experimenting with open source software platforms to improve and drive down research infrastructure costs. University campuses are also test beds helping to create the “Internet of Things”. For example, the University of California, San Diego recently began developing its Integrated Digital Infrastructure that will connect all university research equipment to a digital platform and data repository allowing researchers dynamically to generate, analyze and communicate data.⁶ Whether in a corporate laboratory or on a university campus, the overarching trend here is the infusion of computing into every stage of the innovation process. For individuals and organizations that can harness these new capabilities, the benefits and opportunities are practically boundless.

6 The University of California, San Diego, “Integrated Digital Infrastructure (IDI)”, Accessed June 1, 2015. <http://idi.ucsd.edu/>

Researchers are also beginning—in earnest—to apply the scientific method to stages in the innovation process, such as randomized controlled trials (RCTs) targeting bridging institutions (innovation hubs, proof of concept centers, demonstration facilities, university-industry partnerships, etc.). Academics have been contributing for decades to the field of corporate management and just now beginning to focus their attention on these new types of organizational structures—which are the newest tool to accelerate and optimize technology commercialization.

Challenge: Declining U.S. Dynamism

Reving up the U.S. innovation engine does not, per se, translate into American prosperity. Innovation needs to be diffused and scaled in the United States to ensure the economic impact is as far-reaching as possible. This is an active, not passive process undertaken by businesses and people. It is dynamic, inherently disruptive—both destroying and creating new markets, jobs, and opportunities—and lies at the core of American economic and national security. Historically, innovation has been a net positive for the United States, evidenced by a steadily rising standard of living for Americans over the last century. In fact, this is the foundational premise upon which the Council on Competitiveness was built—productivity gains, through innovation, drive up wages. There is, however, a mechanism built into the productivity-prosperity relationship. External forces such as technological disruption change the make-up of the economy by eliminating and replacing low-skill, low-productivity jobs with higher-skill, higher-productivity work. In order for the nation to realize aggregate productivity gains and rising wages, workers need to transition from less productive work to newly created, more productive opportunities. **However, there is evidence that, in recent years, innovation has been more destructive than disruptive.**

In 2008, for the first time in 35 years, U.S. business deaths outnumbered births. While there has been a slight uptick in start-up activities, the overall trend is clear—firm creation has been on the decline since the 1970s.⁷ If new firms are not established, workers are likely to remain locked up in their previous jobs or go on unemployment because there aren't new, higher productivity jobs to which they can be relocated. Data on labor market liquidity confirms this trend. Worker reallocation and churn rate have declined since 2000.⁸ Thus, the coveted new economy jobs are slow to arrive—if they arrive at all—and workers are staying put or dropping out of the workforce.

Moreover, the worker reallocation that is occurring is trending in the wrong direction. The manufacturing sector is a poignant and illustrative example. Millions of well paying low- and middle-skill manufacturing jobs have been lost since 2000. While productivity-enhancing technologies are not the only cause of this job loss, together with international competition, they play a primary role. There has not been, however, a commensurate rise in advanced manufacturing jobs. Figure 3 reveals that between 2000 and 2013, the manufacturing sector lost 5.39 million low- and middle-skill manufacturing jobs. Over that same period, the sector added just 280,000 manufacturing jobs that required at least a college education. So, what has happened to all the manufacturing workers? Largely, they have filled the ranks of low-skill service sector workforce. A recent National Employment Law Project data brief exploring job growth since the 2001 recession, finds that—over the last decade—job growth has been consistently dominated by low-wage service-providing industries, middle skill jobs are disappearing, and high-skill job growth is anemic.⁹ This scenario describes how a large portion of our country has, as a result of technological change, been pushed down the socioeconomic ladder. For many Ameri-

7 U.S. Census Bureau, Business Dynamics Statistics.

8 Steven J. Davis and John Haltiwanger, "Labor Market Fluidity and Economic Performance", National Bureau of Economic Research, September 2014.

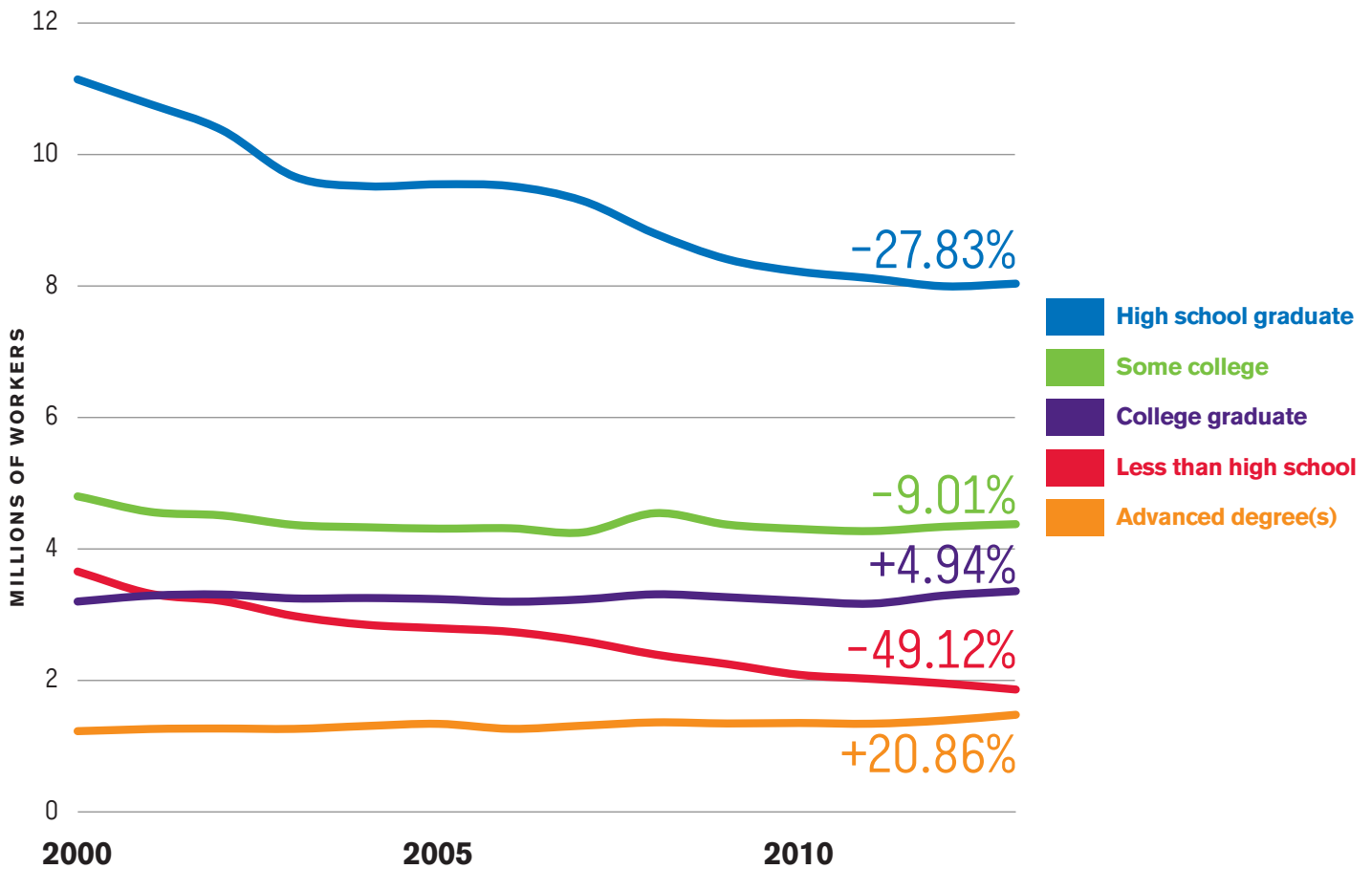
9 The National Employment Law Project, "The Low-Wage Recovery: Industry Employment and Wages Four Years into the Recovery", Data Brief April 2014.

cans, accelerating innovation has yet not translated to more and better opportunities. On the contrary, it is feeding several difficult trends facing our nation: wage stagnation, income inequality, bifurcation of the workforce, and social distrust. All of these trends, independently, threaten are ability to innovate either

directly or indirectly. And, taken together, structural changes tarnish the public opinion of technological innovation in a way that reducing the mandate of policymakers to invest in science, technology, and innovation.

Figure 3. Manufacturing Jobs By Educational Achievement

Source: Steven Ruggles, J. Trent Alexander, Katie Genadek, Ronald Goeken, Matthew B. Schroeder, and Matthew Sobek. Integrated Public Use Microdata Series: Version 5.0 [Machine-readable database]. Minneapolis: University of Minnesota, 2010.



PART 1: A PRIMER FOR THE EIFI NATIONAL LAUNCH DIALOGUE

The Exploring Innovation Frontiers Initiative

The Exploring Innovation Frontiers Initiative (EIFI) is a national, public-private effort to accelerate the over-the-horizon, transformative innovation models that will drive U.S. competitiveness in the coming decades.

Sponsored by NSF Directorate of Engineering, Office of Emerging Frontiers of Research and Innovation (EFRI)—EIFI is a qualitative analysis that will collect, synthesize and disseminate broadly the experiential knowledge of active innovation practitioners. This information will be used to provide academicians with direction for future research in innovation, business leaders and strategists with insights to inform future business models, and policymakers with knowledge to enact public policies that create a supportive environment for sustained innovation-driven growth.

In partnership with our distinctive network of members and affiliates, the Council will host a series of expert dialogues across the United States—underpinned by best-in-class intelligence from reports and initiatives—to make the competitiveness case for strengthening innovation ecosystems. These dialogues will convene a diverse and representative mix of innovation leaders from industry (small, large and entrepreneurial); academia (university presidents, researchers and students); national laboratories and

research institutions; labor leaders; and key influencers (foundation and media leaders). The goals of the EIFI progressive dialogue series are to:

- **Craft** with national and regional stakeholders a transformational innovation action agenda that draws on the strengths of NSF research and positions the United States as a global innovation leader for decades to come;
- **Catalyze** a larger movement to enhance U.S. competitiveness and economic growth by accelerating knowledge creation and the transfer of science and engineering research into market reality; and
- **Expand** and improve public and private sector engagement in the innovation process.

The Council is honored to launch the inaugural EIFI dialogue with the Georgia Institute of Technology, the Georgia Research Alliance and the Metro Atlanta Chamber in Atlanta, GA. This foundational dialogue, national in scope and broad in vision, will set the stage for the EIFI dialogues series—four dialogues over 24 months anchored in regions of the country that embody the transformational changes to the process of innovation occurring in the United States.

The Exploring Innovation Frontiers Initiative



PART 1: A PRIMER FOR THE EIFI NATIONAL LAUNCH DIALOGUE

Leading the Way: The U.S. Council on Competitiveness

With almost three decades of world-class efforts in benchmarking, intellectual leadership, convening and advocating, the Council is a critical leader in the U.S. innovation movement. To sustain this effort, the Council has created a platform for, and given a singular voice to our public and private national innovation leaders.

Key Innovation Initiatives

The National Innovation Initiative: 2003–2005

Led by former Secretary of the Smithsonian and President Emeritus of the Georgia Institute of Technology, G. Wayne Clough, and Samuel J. Palmisano, former Chairman and CEO of IBM Corporation, the National Innovation Initiative (NII) was a CEO-led effort that engaged more than 800 stakeholders across the United States (in dozens of working groups and regional innovation fora), for the first time ever, to define a private sector innovation agenda for the nation. This ground-breaking agenda—the *Innovate America* report released in December 2004 at the National Innovation Summit in Washington, DC—included more than 60 detailed recommendations grouped under three major platforms for action: talent, investment and infrastructure. In August 2007, President George W. Bush signed into law the bipartisan America COMPETES Act, which traces its roots to the Council's National Innovation Initiative.

Technology Leadership & Strategy Initiative: 2009–Present

Now entering its 7th year, the Council's Technology Leadership and Strategy Initiative (TLSI) convenes biannually Chief Technology Officers and their counterparts across the private sector, top research universities, and the national laboratories to make the business case for strategic, prioritized investments in technology-based innovation across the global

economic landscape. Under the leadership of co-chairs Dr. Klaus Hoehn, Vice President of Advanced Technology and Engineering, Deere & Company; Dr. Mark Little, Senior Vice President and Chief Technology Officer, General Electric Company; Dr. John J. Tracy, Senior Vice President of Engineering, Operations, & Technology and Chief Technology Officer, The Boeing Company; and emeritus chair, Dr. Ray O. Johnson; TLSI increases nodes of interconnection within the nation's innovation ecosystem to enable more productive American and global research partnerships, and to preserve and invigorate the nation's technology leadership. The TLSI's leadership and input has, in particular, been a driving force behind the creation of the Department of Energy's Agreement for Commercializing Technology (ACT)—an effort to reduce barriers to collaboration between national laboratories and industry.

The National Engineering Forum: 2012–Present

The competitiveness of the United States requires a workforce of engineers and innovators equipped to design and scale solutions to the nation's most critical needs. But the value-creating engine of American engineering is sputtering. At a time in history when national scientific and technological excellence is more important than ever, the United States must overcome the core challenges facing its engineering enterprise—capacity, capability and competitiveness—to fuel the economy, and ensure prosperity and security. In 2012, the Council launched, in partnership with Lockheed Martin, the National Engineering Forum (NEF; www.nationalengineeringforum.com; @NatlEngForum). The NEF aims to 1) find solutions to the engineering challenges of capacity, capability and competitiveness—the 3Cs—in alignment with the National Academy of Engineering's Grand Challenges for Engineering; 2) identify

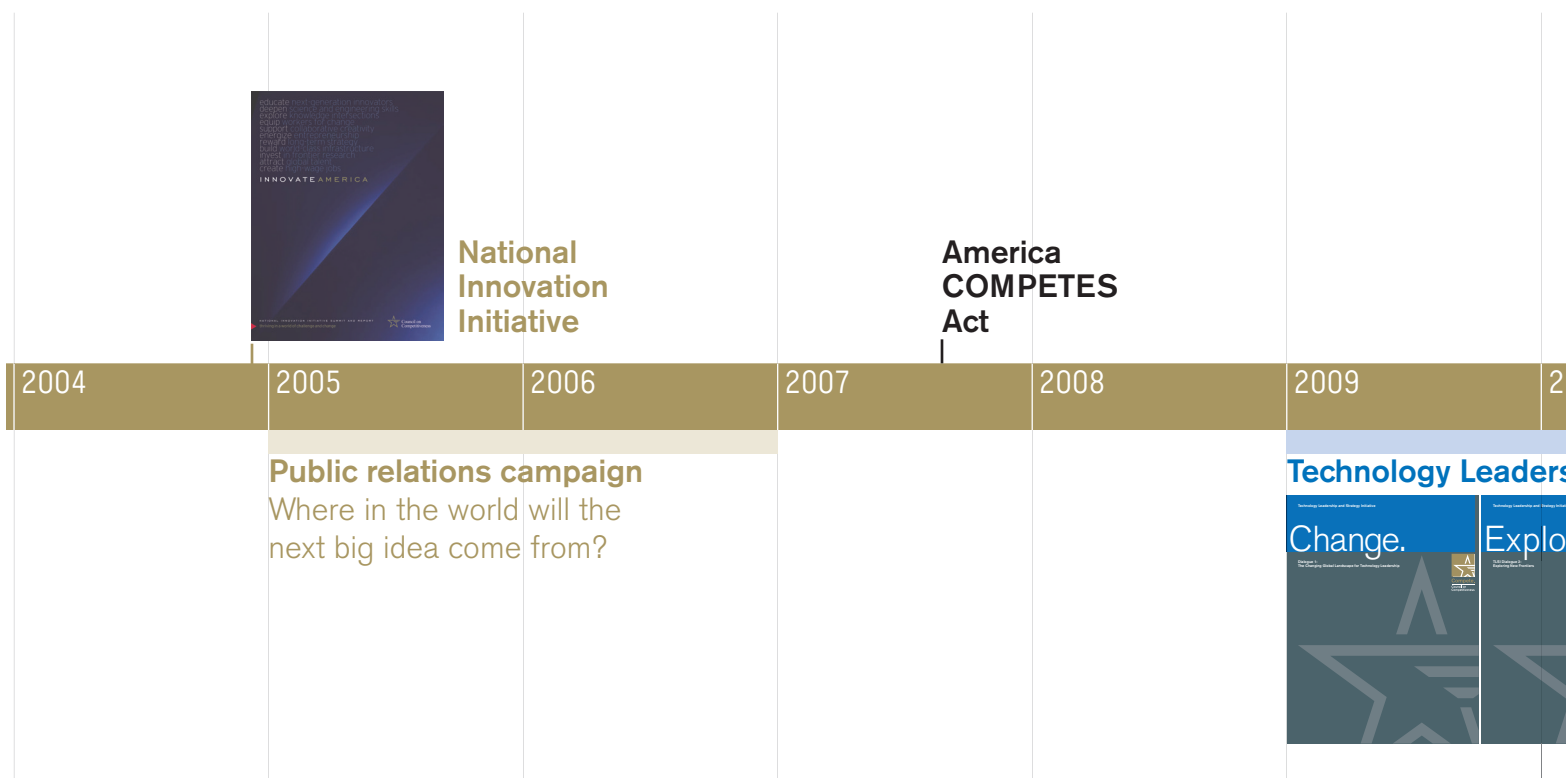
actions the U.S. engineering community can take to ensure our nation’s continued security and prosperity; and, 3) raise awareness of the role of engineers in Americans’ daily lives and chart the future of engineering in the United States. To achieve these goals, NEF is holding regional dialogues across the country and building on their momentum. Since 2014, the National Engineering Forum also has expanded the NEF platform to amplify the voice of engineering students and young professionals—the NEF Generation (NEFGen).

Related Innovation Initiatives

- 1988 and beyond—Our flagship *Competitiveness Index*, pioneered and led by Council on Competitiveness founding member Professor Michael E.

Porter of the Harvard Business School, paints the picture of the entire competitiveness landscape—including comprehensive benchmarking of the U.S. innovation system.

- 1991—Critical Technologies Initiative—one of the first attempts in the United States to identify—from the perspective of the private sector—foundational technologies and pathways to support long-term innovation capacity and national competitiveness.
- 1995-96—The Council maps the state-of-play for the U.S. R&D Enterprise across five critical sectors in, *Endless Frontier, Limited Resources: U.S. R&D Policy for Competitiveness*.
- 1998—Under the leadership of Council Vice

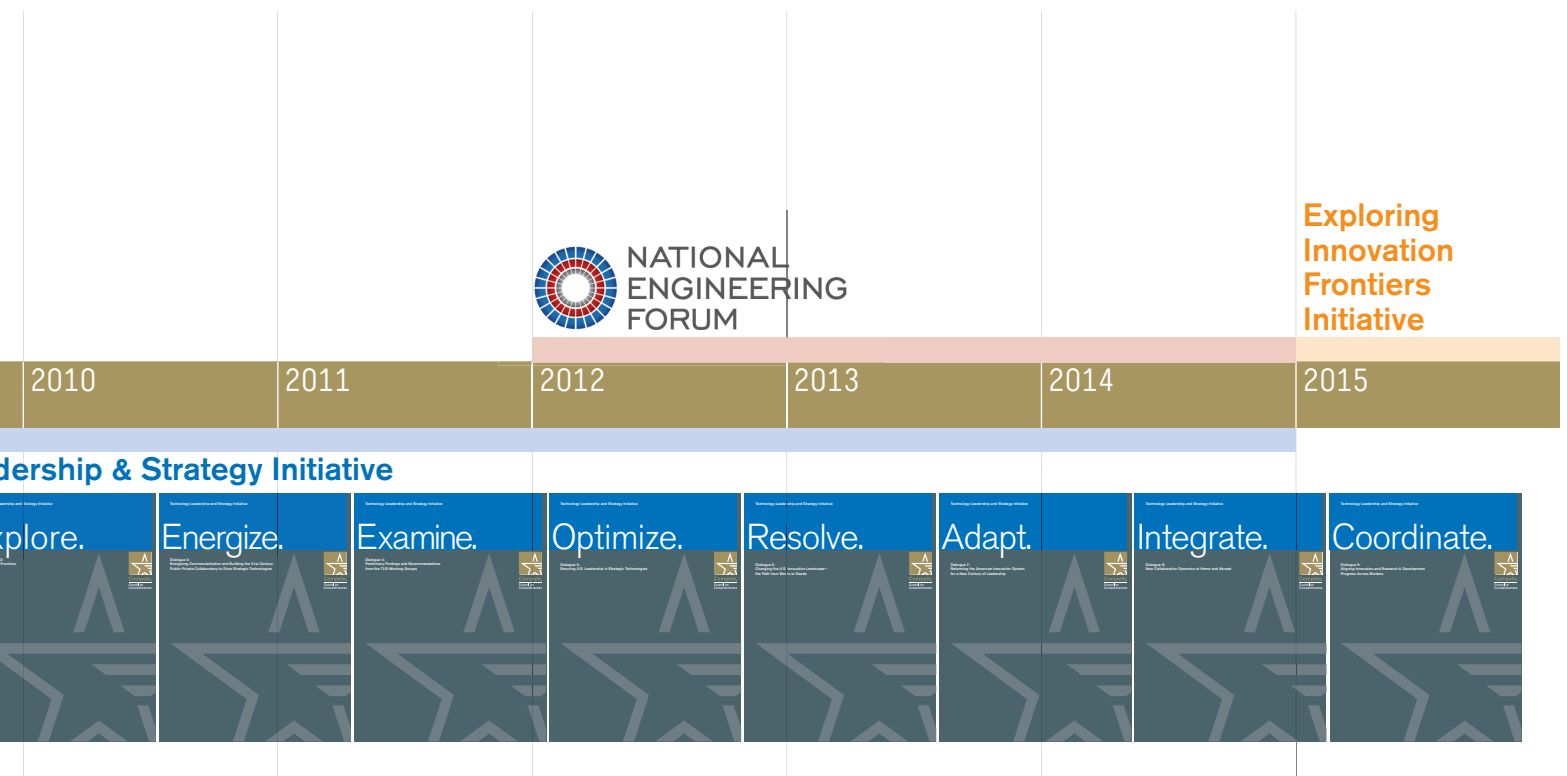


Chairman Charles Vest, the Council convenes the First National Innovation Summit at MIT, Cambridge, MA.

- 1998—The Council releases *Going Global: The New Shape of American Innovation*, articulating for the first time the forces driving the globalization of research and development activities in key industrial sectors.
- 1999—The Council launches, in conjunction with Harvard Business School and MIT Sloan School, the world’s first tool to quantify national innovation capacity, *The New Challenge to America’s Prosperity: Findings from the Innovation Index*.
- 1999-2001—National Clusters of Innovation Initiative is a path-breaking effort to define and

measure regional innovation clusters across the United States, focusing both on success stories and regions that face challenges in catalyzing innovation.

- 2001—National Summit on Regional Innovation Clusters: Washington, DC
- 2001—Second National Innovation Summit: San Diego, CA



PART 1: A PRIMER FOR THE EIFI NATIONAL LAUNCH DIALOGUE

The Path Forward

There is little doubt that the country is immersed in turbulence, transition, and transformation. But it is not completely accurate to claim that we are in an unprecedented time of change. The nation saw similar dynamics in the early 20th century. We can look to economic data to describe the seismic shift from an economy dominated by agriculture to one underpinned by the industrial might of the U.S. manufacturing economy. However, economic data—as well as 100 years of history coupled with a dose of industrial nostalgia—obscures how difficult that transition was for many Americans and, also critically important, the decisions, actions, priorities, and investments made by local, regional, and national public and private sector leaders to ensure this transition moved forward in a way that boosted the standard of living for all Americans. This was active and deliberate process, motivated by the distinctive American drive for progress and global leadership.

The nation is undeniably at another historic inflection point. Pundits and scholars alike are rightfully asking the question; will this economic and social upheaval ultimately lead to broad-based prosperity for all Americans? The Council on Competitiveness suggests this question is largely beside the point. An answer is not necessary for us to define the future for ourselves and take the steps necessary to make this future a reality. Our path does not have to be determined by seeming uncontrollable external forces—

technology with a capital “T”, globalization with a capital “G”. Somehow the public perception of these forces has become something that is amorphous, random, and unyielding. When, in fact, these forces are the result of priorities, decisions, investments, and strategic plans. Just as it was a century ago, these are deliberate choices and deliberate actions.

The Exploring Innovation Frontiers Initiative is where these choices are made and their consequences understood, debated and measured.

Part 2:
Findings from the EIFI National
Launch Dialogue

PART 2: FINDINGS FROM THE EIFI NATIONAL LAUNCH DIALOGUE

Executive Summary

The Council on Competitiveness, with support from the National Science Foundation, launched the Exploring Innovation Frontiers Initiative (EIFI) on June 9, 2015 in Atlanta with a pioneering conference and national dialogue co-hosted with the Georgia Institute of Technology, the Georgia Research Alliance, and the Metro Atlanta Chamber. This foundational dialogue, national in scope and broad in vision, set the stage for the EIFI dialogue series—four to five dialogues anchored in regions of the country that embody the transformational changes to the process of innovation occurring in the United States.

As part of a region successfully cultivating a rich innovation ecosystem, Atlanta was the ideal setting for the national dialogue of the EIFI. Local leaders G.P. “Bud” Peterson, Council Member and President, Georgia Institute of Technology; C. Michael Cassidy, Council Affiliate and President and CEO, Georgia Research Alliance; and Hala Modellmog, President and CEO, Metro Atlanta Chamber, co-hosted a dynamic conversation of 100+ business, academic and national laboratory innovation stakeholders.

The day-long combination of plenary sessions, student interventions and moderated working groups—together with keynote remarks from Dr. France A. Córdoba, Director, National Science Foundation, and Dr. Kim Wilcox, Chancellor, University of California, Riverside—revealed our nation’s top leaders continue to develop new methods and processes to boost innovation for their respective organizations, focusing considerable attention on improving and optimizing strategic partnerships. Public and private sector leaders moved the technology management



The Honorable Deborah L. Wince-Smith, President & CEO, Council on Competitiveness; Mr. C. Michael Cassidy, President, Georgia Research Alliance; Dr. France A. Córdoba, Director, National Science Foundation; Dr. G. P. “Bud” Peterson, President, Georgia Institute of Technology; Ms. Hala Modellmog, President & CEO, Metro Atlanta Chamber.

community forward by sharing best practices in open innovation, and reflected on challenges their organizations face in an environment of decreasing federal investment in basic research.

The national EIFI dialogue also encouraged participants to think more broadly about U.S. competitiveness policy. Attendees reflected on the social and economic context of innovation—directly addressing issues of demographic, socioeconomic, and geographic diversity in the innovation ecosystem—and the impact of innovation on communities across the country, discussing the relationship of innovation and inequality as well as the hollowing out of the middle class. These issues are arguably the defining challenges of this generation and must be part of the country’s overall approach to the innovation ecosystem and U.S. competitiveness.

The structure of the Atlanta dialogue, a combination of plenary and breakout sessions, was developed to elucidate the emerging trends—economic, social, and technology—that Council members, partners and affiliates believe will have a positive or negative impact the U.S. innovation ecosystem. The three plenary sessions focused, respectively, on emerging models of innovation—particularly the democratization of innovation; limited demographic, socioeconomic, and geographic diversity in the U.S. innovation ecosystem; and second and third order effects of innovation on the communities and regions that make up the U.S. economy.

Panel Synopsis—Setting the Stage: New Models of Innovation

During the opening discussion, leaders representing the U.S. innovation ecosystem explored the explanatory trends driving how people and institutions organize themselves to innovate. **Ultimately, there was consensus among the group that competition in the 21st century demands from public and private sector leaders new models of innovation—built on internal and external collaboration.** Adding to the unyielding forces of global competition, two recent trends driving this demand—highlighted by the panelists—are technological convergence, and the work styles and expectations of next generation innovators. **The panel focused largely on how established models of innovation are evolving to accommodate these trends.**

Anchored in the theme of collaboration, panelists explored contemporary models of innovation at the level of the team, organization, region, and nation.

Based on their own professional experiences, the group revealed best practices in open innovation including the importance of geographic proximity and efforts (organizational models, new curriculum, management re-training, etc.) to create the behavioral changes necessary to better leverage strategic partnerships. The group also reflected on barriers to deeper and more multifaceted collaborations including security, validating external inputs, and intellectual property rights. Looking beyond their respective professional roles, panelists suggested best practices in building regional models of innovation including the value of anchoring these ecosystems with research universities as well as inclusive and aggressive regional strategic planning. The group also recognized that teams, institutions, and regions exist in a national innovation ecosystem supported by federal investment in research and development (R&D). More important, the group lamented the historically low levels of federal basic R&D investment, resulting—in part—from competing priorities in Congress, and suggested mechanisms to boost investment.

This opening panel also introduced a foundational theme of the EIFI initiative: the lack of demographic and socioeconomic diversity in the science, technology, and innovation (STI) ecosystem. With input from the young innovators present at the dialogue, the panelists recognized for anyone to thrive in the STI community, having an extensive community of support—family, friends, and mentors—with knowledge of, and ties to the innovation ecosystem is a critical success factor. More important yet, this STI-savvy community of support—according to the group—is precisely what is lacking for women and people of color.

Questions Raised for Future Dialogues

- What are the trends on the horizon that have the potential to transform the way we think about, and pursue innovation?
- How can leaders lever EIFI to support and/or accelerate efforts to develop local and regional systems of innovation—particularly in area where these ecosystems do not yet exist?
- How can leaders use the EIFI to address low levels of federal investment in basic research?
- What are the origins of STI communities of support and how do they function?
- How do we replicate and scale these support systems in communities where they are not available?

Panel Synopsis—Untapped Innovation Capacity

The premise of this second plenary session is that the U.S. innovation ecosystem is increasingly characterized as exclusionary—as evidenced by concerning trends in demography, higher education, and risk capital. The goal of this moderated panel discussion was to bring together national and regional leaders from industry and academia to explore this premise, and begin to develop a strategy to unleash latent innovation capacity. **Panelists agreed that the U.S. innovation ecosystem is not inherently exclusionary. However, the national trends are disturbing, according to the group, and should be seen as a significance risk to national innovation capacity.** Yet, this conversation was largely agnostic—focusing broadly on the importance of getting young people into the science, technology, engineering, and math (STEM) pipeline as early

as possible, peppered with examples of how their respective organizations are driving such efforts. The panelists' comments implied that efforts to broaden participation in the STEM fields tend to be part of larger talent development efforts. Moreover, panelists acknowledged that the data on STEM diversity reveal that distinctive barriers to accessing the innovation ecosystem exist for people of color, women, and low-income students.

This panel also deepened the conversation on regional models of innovation. It was couched in a discussion about diversifying risk capital flows and R&D investment in the United States. While not specifically stated, the panelist's conversation—as well as audience contributions—implied that investment dollars are a lagging indicator; efforts to grow an innovation ecosystem need to come first. According to the panelists, key elements include: regional leadership, marketing/aggressive boosters, building innovation infrastructure, regulatory reform, changing higher education metrics for promotion and tenor, and local congressional support.

Questions Raised for Future Dialogues

- Is the process of building regional innovation ecosystems fundamentally local?
- What are the reasons to transcend this localism and knit together these regions with a national strategy?
- How do regions without research institutions build innovation ecosystems?
- Why are women, minorities and low-income students underrepresented in the STEM fields?
- What are the threats to the innovation ecosystem created by the rising cost of education, and the concomitant increasing in student debt?

Panel Synopsis—Innovation for Prosperity

This final panel was intended to ask academic, industry, and public sector leaders to look beyond their organizational roles and discuss the second and third order effects of innovation. A premise of the discussion was that innovation, in recent years, has become more destructive than disruptive—as evidenced by disturbing data on jobs, business formation, productivity, and economic growth. These trends, beyond the direct challenges they present, are adding to an anti-technology sentiment in the country with the potential to threaten national STI investments. **Supporting unsettling national trends, the group acknowledged technological innovation does not have social standing commensurate with its importance to national prosperity.**

This acknowledgement was accomplished through a deeper explanation of the problem. Linking back to a previous panel, the group discussed the issue of inclusion. Large parts of our population—including many (not all) urban youth, rural Americans, and communities without research institutions—do not see themselves as part of the innovation ecosystem. Furthermore, panelists explained, the United States—still sensing the effects of the dot com bubble—remains weary of the Silicon Valley-style economic development, innovation (specifically proliferation of the “app economy”) is not viewed as a jobs engine, the media emphasizes the negative aspects of technology, and many economic development communities are often still anchored in “old economy” tactics such as attracting large corporations to a region using state and local subsidies. **This explanation of innovation’s relatively low social standing in America—dipping into anti-technology sentiment—as well as the solutions proposed by the**

group, focused largely on the public perception and understanding of science, technology, and innovation (STI).

The best way to boost the public opinion of STI is to ensure all Americans benefit from the changing economy. Building on the idea of innovation infrastructure, participants highlighted entrepreneurship infrastructure (communities of mentors and veteran entrepreneurs, business accelerators, etc.—all knit together with a culture of value creation) as critical to developing an innovation ecosystem that more often translates to broad-based national prosperity.

As was reflected in this conversation, invention, innovation and entrepreneurship flow together in multiple directions, blurring boundaries—all complicated by the fact that the same person or group of people may be performing these activities. While these practitioners find little use in drawing boundaries, it is nonetheless important for STI policy perspective.

Invention, innovation and entrepreneurship are distinct activities; they are unique parts of the broader process that translates an idea to prosperity. Even the phrase “idea to prosperity”, is not commonly used. The STI community often focuses on lab-to-market initiatives or technology readiness levels. Those seem to stop short of what panelists focused on during this discussion—the positive social and economic impacts of innovation and broadening our definition of success.

Questions Raised for Future Dialogues:

- Is the falling social standing of technology and innovation among the American public the result of misperceptions? Or, do these claims have merit?

- What are, if any, the negative or harmful effects of innovation?
- If there are negative or harmful effects, how can we mitigate them? Or, are they a natural element of a health and dynamic innovation driven economy?
- Is public support for investments in science and technology flagging?
- Does the public view science in a different light than technology and innovation?

Working Group Read Out: Participant Priorities

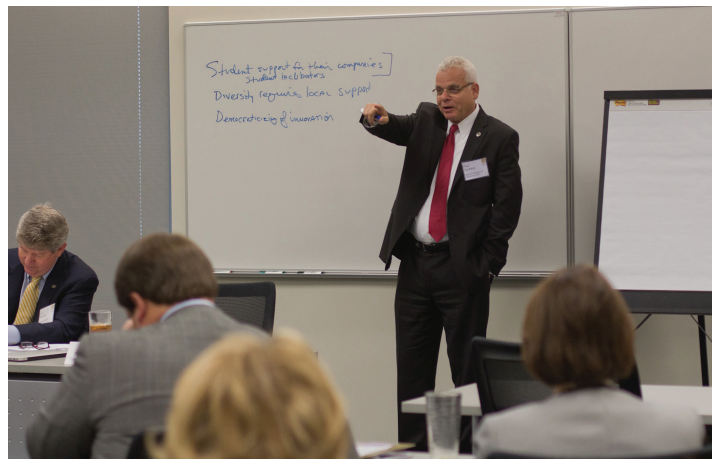
The national launch dialogue was intended to capture the insights of each and every handpicked innovation thought leader, practitioner, and stakeholder participating in the dialogue. To that end, the plenary sessions were complemented with working groups that broke the participants into subsets, more conducive to having a fully inclusive discussion. These facilitated conversations were not designed to introduce new topics, but to dive deeper into the themes developed by the panelists in the plenary sessions and begin to lay the groundwork for the next U.S. innovation strategy. Below is a list, in no particular order, of priorities that participants suggested should underpin an actionable innovation strategy.

Innovation Infrastructure

- Expand and scale the NSF's I-Corps™ program.
- Develop and proliferate across multiple sectors low-cost, easy-to-use tools that promote the self-organization of innovation ecosystems.
- Encourage coordinated, multi-stakeholder (public-private) regional strategic planning to attract resources to communities outside the innovation system.

Entrepreneurship

- Expand entrepreneurship mentorship networks nationally, with a particular focus on the K-12 level within communities disconnected from innovation and entrepreneurial ecosystems.
- Expand entrepreneurship education.



Top: Dr. France A. Córdoba, Director, National Science Foundation.

Bottom: Dr. Paul Sanberg, Senior Vice President for Research, Innovation & Economic Development, University of South Florida.

- Create incentives for financial and human investment in entrepreneurial ecosystems.
- Encourage a culture that tolerates failure when necessary, while ensuring these failures facilitate a learning experience.
- Leverage pop culture figures to encourage non-technical talent to become entrepreneurs.
- Create innovative finance models to boost entrepreneurs' access to risk capital.
- Develop innovative finance models to facilitate the scaling of manufacturing in the United States.



Top: Breakout Group Session: Dr. Greg Hyslop, Vice President, General Manager of Boeing Research & Training, The Boeing Company; Mr. Mark Lytle, Vice Chancellor for Economic Development, Board of Regents—University System of Georgia; Dr. Kim Wilcox, Chancellor, University of California, Riverside.

Bottom: Dr. Ileana Arias, Principal Deputy Director of CDC/ATSDR, Center for Disease Control and Prevention.

Education & Talent

- Reform high-skill immigration policy to ensure foreign-born university graduates remain in the United States.
- Improve STEM metrics—diversity, quality of graduates, graduation rates, retention, etc.
- Reward young inventors with incentives and prizes.
- Establish 21st century shop class in high schools across America.
- Expand and support the pool of STEM-literate teachers.
- Support President Obama's call for free community college.

- Catalyze a culture shift that de-stigmatizes vocational education in the United States.
- Identify and scale education models that bend the cost curve down, allowing more Americans access to higher education, and freeing young people from oppressive debt.
- Invest in programs proven to boost access to the STEM fields for underrepresented communities.

National Investment

- Target federal investments at high-risk, high-payoff opportunities (e.g. DARPA) across all federal agencies.
- Create a non-governmental mechanism for the nation to make strategic investments in critical industries, sectors, and technologies.
- Boost federal support for research and development.

Public Relations

- Highlight the social and non-profit benefits to the nation of innovation and entrepreneurship.

The Path Forward

The Council will continue this national conversation on November 23, 2015 together with Chancellor Kim Wilcox of the University of California, Riverside. The University of California, Riverside offers a distinctive setting for the second EIFI regional dialogue. Riverside—and the surrounding region—is at the leading edge of transformational changes that portend a seismic shift in American innovation. As the country becomes more ethnically diverse and concern grows over underrepresentation in the STEM fields, UCR has embraced and leveraged diversity to boost innovation. Moreover, UCR ranks among the most economically diverse universities in the country. And as college applicants across the nation are finding it increasingly difficult to access research-grade institutions, capturing the experiential knowledge and best practices of first-mover communities like Riverside is essential for the success of Exploring Innovation Frontiers Initiative.

PART 2: FINDINGS FROM THE EIFI NATIONAL LAUNCH DIALOGUE

Innovation Keynote

Dr. France A. Córdoba

Director
National Science Foundation

Dr. Córdoba framed her remarks with a quote from a recent National Academy of Engineering report that she felt encapsulated the goals, themes, and vision of the Exploring Innovation Frontiers Initiative (EIFI): “Innovation is part of the American DNA, but that doesn’t mean that we should take it for granted.” She abstracted further the importance NSF’s support of this nationally significant undertaking:

“Our societal and innovation landscapes are changing rapidly, and we need to thoroughly understand these changes. I think of us as explorers, and exploring is also part of our American DNA. We are a country that first started out exploring and pushing westward, and then pushing up to the heavens in space and beyond. I think of us returning to a place that we once knew well—we thought we understood. We return with a map that was accurate before, but does not describe the landscape as accurately now and needs some re-visioning.”

Fitting for this inaugural dialogue, Dr. Córdoba provided her perspective on an EIFI roadmap to success. She highlighted several established and impactful innovative models and concepts that NSF has been at the forefront of creating, investing, and scaling to rapidly translate discovery to the marketplace, including: the Accelerating Innovation Research (AIR) Program, the Engineering Research



Dr. France A. Córdoba, Director, National Science Foundation.

Center (ERC) Program, the Industry/University Cooperative Research Centers (I/UCRC) Program, the Small Business Innovation Research (SBIR) Program, and the Innovation Corps (I-Corps™) Program. More importantly, she reflected on the elemental characteristics that have determined and defined the success of these programs.

Each innovation focused NSF program, Dr. Córdoba noted, was developed at a time when our needs called for different approaches. For example, the I/UCRCs came along just at the time that places like Bell Labs—a once vital basic R&D enterprise—were winding down. The new model for basic research was for industry to invest directly in universities, and the I/UCRC came along just at the right time. NSF’s innovation programming is heavily leveraged by the private sector, she explained. The integral involve-

ment of industry in the I/UCRCs, for instance, has led to strong support for the program. In fact, the leveraging factor of industry to universities is about ten to one. As a result, Dr. Córdova elaborated, a recent impact study revealed that—in select industry sectors—for each dollar NSF invested, the estimated value of the impact was \$64. The most successful NSF programs are scalable, she reinforced. The first ERC was initiated in 1973, and today it has 80 active centers across the United States with academic partners from 225 universities, and a large number of private companies and government agencies. Another example of scalability is SBIR. At the beginning in 1982, NSF's investment in SBIR was \$1 million and today there are 11 federal agencies with SBIR programs modeled on NSF's, for a total investment is \$2.5 billion. Moreover, in the case of I-Corps™, the model was scaled internationally—recently being adopted by the Country of Mexico.

Dr. Córdova went on to recount the origins of the I-Corps™ model, which—in a sense—is a justification of the EIFI modality of regional dialogues tapping into innovation practitioners and thought leaders across the country. One of the fathers of this program is Steve Blank, she explained, who was a professor at Stanford University and was arguably the first person to think of this model of how to engage his graduate students in translation to the marketplace. He ended up having hundreds of students in his class developing it into a kind of massive open online course (MOOC). Congressman Dan Lipinski, who is on the congressional committee that authorizes NSF, eventually heard about the model and was

so entranced by it he went to the Bay Area to see what was going on and how Steve taught his class. The director of NSF at the time—the current President of Carnegie Mellon and former Dean of MIT, Subra Suresh—was also very familiar with the model. He got his team examining it and developed a kind of NSF model to launch this into a bigger platform.

As the EIFI dialogue series moves across the nation, Dr. Córdova remarks should be kept in mind. If past experience holds true, EIFI should bring together public and private stakeholder to seek out and analyze together the best-in-class models that fill the needs of a changing innovation landscape, can be leveraged by the private sector, and can be scaled across the nation and beyond. As Dr. Córdova explained:

“To remain on the leading edge, we need to anticipate the dynamic nature of the innovation ecosystems, and ask how we can create new approaches and models for the nation’s science and engineering research to create value for everyone.”

PART 2: FINDINGS FROM THE EIFI NATIONAL LAUNCH DIALOGUE

Setting the Stage: Exploring New Models of Innovation

The intent of the first panel was to set the stage for the national launch dialogue, and more broadly, the two-year EIFI Dialogue Series. This foundational panel focused squarely on elucidating how national innovation leaders—representing global technology companies, the national laboratory system, and the federal government—think about and pursue innovation. Dr. Pramod Khargonekar, the Assistant Director for Engineering at the National Science Foundation (NSF), led an insightful conversation, including: Dr. Ileana Arias, Principal Deputy Director of CDC/ATSDR at the Center for Disease Control and Prevention; Dr. Paul Hommert, former President and Laboratories Director of Sandia National Laboratories; Dr. Mark Little, Former Senior Vice President, Chief Technology Officer and Director of GE Global Research; and Mr. Rod Makoske, Senior Vice President of Corporate Engineering, Technology, and Operations at Lockheed Martin. This moderated conversation, engaging the panelists as well as audience members, cut across technologies and disciplines to understand contemporary models of innovation at the level of the team, organization, region, and nation. Ultimately, there was consensus among the group that competition in the 21st century demands from public and private sector leaders new models of innovation—built on internal and external collaboration.

Technology managers have recognized for decades the need for collaboration, yet there is a sense—reflected by the panelists—that new and better models are needed. Aligning the disparate creators and users of new technologies—i.e. strategic partnerships, joint ventures, etc.—became all but necessary in the 1980s to keep pace with accelerating technological progress and global competition. Moreover, public and private collaboration became another tool to help bridge the technology



Dr. Ileana Arias, Principal Deputy Director of CDC/ATSDR, Center for Disease Control and Prevention; Dr. Paul Hommert, Former President and Laboratories Director, Sandia National Laboratories; Dr. Mark Little, Senior Vice President, Director of GE Global Research, Chief Technology Officer, General Electric-Global Research Center; Mr. Rod Makoske, Senior Vice President of Corporate Engineering, Technology, and Operations, Lockheed Martin; Dr. Pramod Khargonekar, Assistant Director for Engineering, National Science Foundation.

valley of death—as the private sector turned increasingly to external sources of innovation and university researchers become more entrepreneurial. Yet, there is another generation of collaborative partnerships on the horizon.

“While partnerships with university are a great strength to Sandia and the nation,” Dr. Hommert explained, “they are not allowing us to sufficiently tap the depth and focus it in a way that leverages our resources more effectively.”

As this emblematic quote highlights, the demand for new and better collaboration is on the rise.

The panelists highlighted two relatively recent trends driving this demand: technological convergence and preferred work styles of next generation innovators.

Technological convergence is transforming interaction among seemingly distinct scientific disciplines, technologies, communities, and domains of human activity to create new competencies, technologies, and knowledge.¹ The most important problems facing our nation, and the world—public health, climate change, energy sustainability, education, etc.—require these distinct domains to work together, increasing their collective power to bring to problems with no clear solution, and where the underlying science may not exist. In such a complex and dynamic environment, Mr. Makoske explained, while technology managers may think they know what field or discipline a solution will come from, they are often wrong. It will come from somewhere else, he goes on: “a totally different technology and totally different ideas.” As a result, external relationships that allow companies to scale competencies quickly are much more important than in the past, and internal stovepipes are being dismantled. In this environment, one might consider the influx into the STEM (science, technology, engineering and math) workforce of young innovators—raised in a hyper-connected, digital and social environment—a complementary development. Dr. Hommert explained, “Early career staff are expecting a highly networked and collaborative environment.” In order for businesses and laboratories to attract top, young talent organization models to need to adapt to the work style of next generation innovators.

Reflecting on current and past collaborative efforts, panelists also shared with the group best practices and success stories—highlighting the importance of structural design as well as culture change. Additionally, the group also highlighted reasons that hinder

external collaboration. Dr. Little explained how the geographic proximity of the GE Munich Research Center to the Technical University of Munich (TUM) improves outcomes. Proximity promotes relatively effortless human capital exchange, highlighted Dr. Little—an important vehicle for knowledge transfer. PhD students from TUM frequently work at GE’s research center, and GE engineers and scientists take advantage of TUM testing facilities run by faculty and students. Moreover, GE is building an industrial commons, explained Dr. Little.

“Rather than building our own research infrastructure, we have invested our own money on top of the resources inside the university to build up their capabilities.”

In many ways, however, proximity is relatively simple to achieve. Not surprisingly then, geography is not the whole story. Dr. Little pointed to the importance of behavior and culture. It is the culture of openness at TUM that underpins the success of this partnership—openness to industry problems as an acceptable academic endeavor, and openness to share resources without significant intellectual property barriers.

The majority of best practices shared by the group focused on this same idea: behavior change.

“We have to create venues that force ourselves out of the traditional, basic to applied thinking. Whether internally or with our external partners, we need to be linking people with different perspectives,” said Dr. Hommert.

¹ “Convergence of Knowledge, Technology, and Society: Beyond Convergence of Nano-Bio-Info-Cognitive Technologies”, World Technology Evaluation Center, Inc., July 2013.

This quote highlights an important goal of innovative multi-organizational models: create a physical space that facilitates the changing of entrenched behaviors and norms, for the goal of realizing a truly collaborative environment. This is easier said than done. While organizational structure supports behavior change, panelists suggest that more is needed. Dr. Khargonekar reflected on the how NSF's I-Corps™ program is transformative for faculty and students, creating a more user-focused, industry relevant way to formulate research questions. Mr. Makoske discussed the importance of training Lockheed Martin leadership to think differently about team dynamics and construction—particularly focusing on building teams with multiple disciplines, multiple generations, and different backgrounds—to get diversity of thought. Moreover, he explained, structuring projects in the form of a challenge—instead of prescribing a technology or solution—drives innovative thinking. Dr. Hommert added to this thought by highlighting the effectiveness of connecting these challenges to discretionary investment, so good ideas can find their way through a competitive budget environment, and team members see the immediate impact of their work.

Even with support from leadership and external pressures driving the need for open innovation, organizations often face significant barriers on the path to a more collaborative environment. This is true for Sandia National Laboratories and the CDC—organizations with significant national security and public safety issues. “For us, the security issues are huge”, explained Dr. Arias. Often this barrier cannot be overcome, she explained. When a choice is made to partner externally, Dr. Arias went on, creating a system for evaluating the quality of the external input becomes critically important—which itself is a barrier. Dr. Hommert seconded these comments, explained that open innovation at Sandia is generally limited to partnerships within the national security community. Mr. Makoske reinforced a point made earlier by Dr. Little: IP negotiations can make a break a successfully partnership.



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Regarding Lockheed Martin's university partnerships, "I think the challenge comes when we start negotiating these deals—finding the win-win solution for all parties," Mr. Makoske explained. "And, frankly, sometimes we can make it quickly, and sometimes we probably spend more time talking about the deal, than we would have spent working on it."

Moving above the level of teams and organizations, panelists focused on models of innovation at the regional level. One of the goals of the Exploring Innovation Frontiers Initiative is to expand and improve public and private sector access and engagement in the innovation process. “We all admire the success of Silicon Valley, the Greater Boston area, and others,” explained Dr. Khargonekar. “Yet, we envision a future where communities across the United States develop their own regional innovation ecosystems that leverage local, distinctive, competitive strength.”

Reflecting on their own experiences, panelists suggested strategies for communities attempting to build innovation-driven local and regional economies.

"The U.S. university system can be an anchor," explained Dr. Little. "I have seen a lot of things around the world, and the U.S. university system is still the best in the class by a large measure."

He reflected on the state-level effort to build New York's innovation economy, anchored at SUNY Polytechnic Institute in Albany, NY. By leveraging resources from industry and government, private and public sector partners established in 2004 the SUNY Colleges of Nanoscale Science and Engineering (CNSE), which according to Dr. Little, has become the best center in the world for semiconductor basic research. The success of CNSE, Dr. Little went on to explain, is based on its ability to become a platform—i.e. innovation infrastructure—upon which the university, government, and hundreds of companies have continued to build. Dr. Hommert reinforced this point and added an insight of his own. Each region will have distinctive obstacles to overcome. In the case of Sandia National Laboratories—and many other national laboratories—that obstacle is geographic isolation. With that particular challenge, Hommert explained:

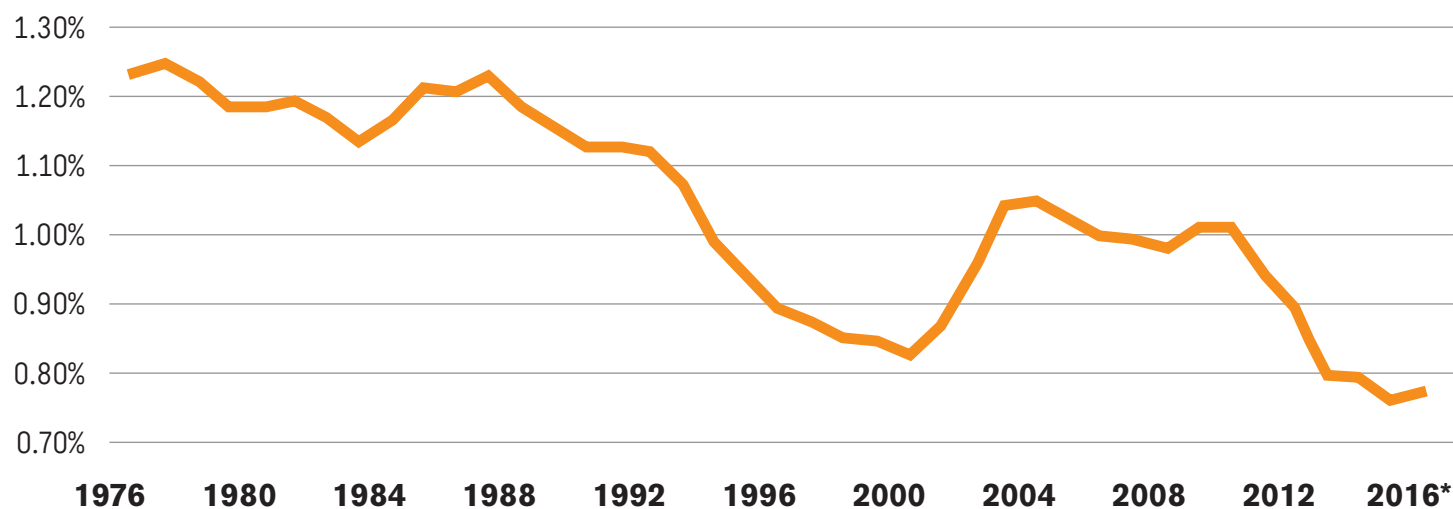
“It is clear that without every component of that ecosystem, the government, the universities, and in this case, research laboratories pulling the oars together, it is very difficult to overcome some of the things that do not work in the favor of that region.”

This point—the importance of concerted regional strategic planning—was reinforced throughout the day.

Whether it is at the team, organization, or regional level, innovation does not occur in a vacuum. An understanding of these models must recognize the national system of innovation underpinned by public investment in the U.S. research enterprise and human capital. At a time when there is bipartisan agreement that an innovation-driven economy is critical to U.S. economic and national security, the United States is failing to provide the necessary fuel for the national innovation engine. The United States has been gradually slipping down the global ranks of research and development (R&D) as a percentage of GDP—a metric of our national R&D “intensity.” Holding the 7th position in 2007, today the United States ranks 10th.² Contributing to this decline, Federal investment in R&D as percentage of GDP has been falling for decades (Figure 1). As a percentage of total U.S. federal discretionary funding, R&D has shrunk to 10.5 percent from its 1965 peak of 17.8 percent.³

Figure 1: Total Federal R&D Investment as a Percentage of GDP: 1979-2016

Source: American Association for the Advancement of Science



*Latest Estimates, FY 2016 is the President Request

² The National Science Foundation, *Science and Engineering Indicators 2014*.

³ AAAS estimates based on Budget of the U.S. Government Historical Tables.

“I really hope the federal government will continue to sponsor basic research, because nobody else will. Foreign governments will, and it is a really core competitive issue for the United States,” explained Dr. Little.

While reinforcing the underlying data on federal R&D investment, this quote points to the symbiotic relationship in the United States of high-tech multinationals and federal-funding science and technology enterprise. Beginning in the 1980’s, vertically integrated corporations shed business units (particularly manufacturing) to focus on other competencies, and they shifted research and development (R&D) away from basic research and toward the near-term needs of their respective business units. This ushered in an era in which foundational, technological breakthroughs were more likely to come from universities, national laboratories, and small start-up companies—all of which are disproportionately supported by federal R&D investments. Thus, while the public role in the innovation ecosystem has increased in importance, funding has decreased.

The challenge, described in comments by NSF Director Córdova and supported by the panelists, is one of competing national priorities. Whether among public or private leaders, democrats or republicans, there is broad agreement that an innovation-driven economy is critical to U.S. economic and national security. However, when business leaders have only a few precious minutes with their congressional representatives, explained Dr. Little, issues such as the reauthorization of the Export-Import Bank, trade agreements, taxation, etc. tend to take priority. Moreover, Dr. Córdova emphasized, our representatives are balancing budgetary pressures from a myriad of other important national investments. The result is the decline of federal R&D investment (Figure 1).

Spotlight: The Senate Competitiveness Caucus

The bipartisan Senate Competitiveness Caucus, co-chaired by Senator Chris Coons of Delaware and Senator Jerry Moran of Kansas, is a forum to bring together Democrats and Republicans to address the most pressing competitiveness issues facing our economy. The Caucus will contribute to an environment of thriving businesses and rising living standards with its focus on a pro-growth, pro-innovation agenda. To promote this agenda, the Senate Competitiveness Caucus will:

- Foster concerted, bipartisan efforts to discuss, develop, and advance policy enhancing U.S. economic competitiveness.
- Convene key leaders from industry, academia, and labor to identify creative solutions.
- Serve as a forum to raise public consciousness about both our competitive strengths and the challenges our economy faces.

In recognition of the need for a new strategy, one that begins to bend the declining funding curve, the Council on Competitiveness is a strategic partner with the newly-formed Senate Competitiveness Caucus. The Council will engage with this platform to amplify the work of our members, affiliates, and partnership as they engage on the Exploring Innovation Frontiers Initiative.



The Honorable Deborah L. Wince-Smith, President & CEO, Council on Competitiveness.

Equally important as financial capital to the health of the U.S. innovation ecosystem, is human capital. In her opening, keynote address at the EIFI national launch, citing the demographic shift in the United States that is creating a historic sense of urgency around STEM diversity, Dr. Córdoba highlighted NSF's commitment to broadening participation in science and engineering—to the tune of \$700 to \$800 million per year. Dr. Córdoba is leading the NSF effort to boost investment to solve this national challenge, and working to ensure these investments are as effective as possible—searching for innovative models or initiatives that truly impact the problem. Ms. Jasmine Burton, next generation innovator, Founder and President of Wish for Wash, LLC and recent graduate of the Georgia Institute of Technology, provided at least one yard stick. Ms. Burton explained that her many achievements can be linked back to an extensive community of support—her family, friends, and mentors—able and willing to plug Jasmine into the science, technology, and innovation community.

“I’ve realized,” she went on, “that this access is a privilege not afforded to everyone, especially people who do not historically have these extensive communities of support. How do we ensure that the pool of future innovators isn’t shrinking as today’s minorities are tomorrow’s majority?”

Ms. Burton identified her personal success factor, a community of support. Using non-profits, non-governmental organizations, etc. to recreate this community of support for minorities underrepresented in the STEM community can be a guiding principle for policy makers re-envisioning their STEM education investment portfolio.

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Untapped Innovation Capacity

The premise of this session is that the U.S. innovation ecosystem is increasingly characterized as exclusionary—as evidenced by concerning trends in demography, higher education, and risk capital. The goal of this moderated panel discussion was to bring together national and regional leaders from industry and academia to explore this premise, and begin to develop a strategy to unleash latent innovation capacity. The panel, led by Dr. Judy Genshaft, President, CEO, and Corporate Secretary for the University of South Florida, was populated by Mr. Al Bunshaft, President and Chief Executive Officer of DS Government Solutions; Dr. Stephen Cross, Executive Vice President for Research at the Georgia Institute of Technology; Dr. Greg Hyslop, Vice President, General Manager of Boeing Research & Technology at The Boeing Company; and Mr. Mark Lytle, Vice Chancellor for Economic Development at the Board of Regents University System of Georgia. Ultimately, panelists agreed that the U.S. innovation ecosystem is not inherently exclusionary. However, the national trends are disturbing, according to the group, and should be seen as a significant risk to national innovation capacity. As Mr. Bunshaft succinctly elaborated:

“We have created a situation where we have a far too narrow band of students who are qualified to enter the system.”

This conversation took EIFI panelists and audience members on a deeper dive into two foundational EIFI themes: diversity in human capital and geographic diversity of financial capital. The human capital conversation highlighted the importance of maintaining a healthy STEM pipeline at all education levels and for all students, with a particular focus on the importance of getting young people into the STEM pipeline as early as possible.



This page and opposite page, panel of speakers: Mr. Mark Lytle, Vice Chancellor for Economic Development at the Board of Regents – University System of Georgia; Dr. Greg Hyslop, Vice President, General Manager of Boeing Research & Training, The Boeing Company; Dr. Stephen Cross, Executive Vice President for Research, Georgia Institute of Technology; Mr. Al Bunshaft, President & CEO, DS Government Solutions, Dassault Systemes; Dr. Judy Genshaft, Chief Executive Officer, USF System, President, University of South Florida.

“It is really a matter of us inspiring people at an earlier age to take the right courses,” explained Mr. Lytle. “We can’t expect someone going into the 11th grade that has not had math for three years and decide suddenly that they want to be an engineer or that they are going to have the skills going forward.”

Mr. Bunshaft supported this view by reflecting on his childhood excitement for the Space Race, and support from his father, as the reason for choosing a career in technology.

Inspiration, however, is just one piece, explained the group. Mr. Bunshaft reflected on his personal experience chairing the board of a high school in the south Bronx of New York.



“These students are not prepared.” Bunshaft explained. “When they reach 6th grade, 7th grade, they’re already off track. They will not be, I am sorry to say, the future innovators.”

These students, he went on, are lacking foundational skills such as numeracy and literacy as well as a core belief in the value of education. Mr. Bunshaft pointed out that the south Bronx is a particularly challenged learning environment, yet these environments—he claimed—present the biggest threat to a healthy and inclusive STEM pipeline.

Big companies are doing what they can to help. To help address these challenges, companies like Boeing and Dassault Systèmes are partnering with educational institutions at all education levels to inspire young people, create high school internships, and support undergraduates and graduate students. Panelists also highlighted specific diversity efforts, such as Boeing’s Mr. Hyslop discussing strategic partnerships with historically black colleges, and affiliations with numerous external groups targeting

Hispanic and African-American participation in the STEM community. However, the panelist’s comments implied that efforts to broaden participation in the STEM fields tend to be part of larger talent development strategy.

The diversity discussion also included a geographic aspect, particularly in reference to flows of risk capital and R&D investment. Reflecting on her experience in the Atlanta region, Rachel Ford—next generation innovator, Georgia Tech undergraduate, and founder of two startups—asked the group, “How can we incentivize the redistribution of this investment money to spur economic development in areas that are identified as non-traditional regions of innovation?” While not specifically stated, the panelists’ conversation—as well as audience contributions—implied that investment dollars are a lagging indicator; efforts to grow an innovation ecosystem need to come first. According to the panelists, key elements include: regional leadership, aggressive marketing, building innovation infrastructure, regulatory reform, changing higher education metrics for promotion and tenure, and congressional support.

To elucidate these elements, Dr. Cross reflected on the Atlanta-based Global Center for Medical Innovation (GCMI). The GCMI, launched in April of 2012, is a comprehensive medical device innovation center, dedicated to accelerating development, building businesses and improving health. In a broader sense, the GCMI is innovation infrastructure. Public and private leaders in Atlanta—Dr. Cross said when highlighting the importance of strong leadership and ecosystem cooperation—recognized a need to fill the gap between invention and the medical device mar-

ket. Local leaders built a network of support from the Economic Development Agenda, the Department of Commerce, the Georgia Research Alliance (GRA), and several universities in the region. Mr. Suresh Sharma of the GRA reinforced the importance of this work:

“The lack of that hardware infrastructure is the kind of a barrier to be able to un-tap huge innovation capacity that does exist in all American cities large and small. Why can't we create next generation products 'Innovation Hubs' next to each Campus or Community College...just like we see a number 'Software Tech Parks' everywhere.”

While this is a great example, Atlanta has a fairly well developed innovation ecosystem. In a sense, there are relatively few barriers for building such innovation infrastructure in Atlanta. Dr. Wayne Clough, President Emeritus of Georgia Tech, explained that this is not necessarily the case across the nation.

“Many of our legislators come from rural places. When we talk about innovation, about investing more money in R&D or you talk about supporting innovation centers and so forth, rural legislators do not see themselves in this.”

If legislators see these innovation efforts as territory of the urban centers and research institutions, he went on, this would remain a considerable barrier to scaling innovation across the nation.

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Innovation for Prosperity

This panel was intended to ask academic, industry, and public sector leaders to look beyond their organizational roles and discuss the second and third order effects of innovation. The motivation for this moderated discussion comes from a distributing public response to slow economic growth and income stagnation. Many pundits, politicians, prominent STI thought leaders, and a considerable portion of the general public believe that accelerating technological disruption is responsible, at least in part, for the nation's economic malaise and the hollowing out of the middle class. A danger of this development is that political leaders lose the public mandate to invest in STI or, worse, see STI as the problem and not the solution to a flagging U.S. economy. Unfortunately, there is already evidence of such a response. At a time when federal investment in R&D are at a historic low, and innovation is more important than ever to boosting and sustaining a high standard of living, the public and its representatives are showing signs of losing faith in technological progress.

The panel, led by Dr. James Garrett, Dean of the College of Engineering at the Carnegie Mellon University, was populated by the Honorable Kwanza Hall, District 2 Council Member of the Atlanta City Council; Dr. Keoki Jackson, Vice President and Chief Technology Officer at Lockheed Martin; Dr. G. Wayne Clough, President Emeritus of the Georgia Institute of Technology; and Ms. Hala Modellmog; President and CEO of the Metro Atlanta Chamber. Supporting the unsettling premise of this conversation, the group acknowledged that technological innovation doesn't have social standing commensurate with its importance to national prosperity. This acknowledgement was accomplished through a deeper explanation of the problem. The conversation also covered



Ms. Hala Modellmog, President & CEO, Metro Atlanta Chamber; Dr. G. Wayne Clough, President Emeritus, Georgia Institute of Technology; Dr. Keoki Jackson, Vice President and Chief Technology Officer, Lockheed Martin; The Honorable Kwanza Hall, Council Member, Atlanta City Council; Dr. James Garrett, Dean – College of Engineering, Carnegie Mellon University.

the importance of entrepreneurship, particularly its role as an essential vehicle to the translation of STI into national, broad-based prosperity.

The conversation began with a deeper explanation of the underlying sources driving the public's opinion of technology and innovation, with Councilman Hall touching on a theme that was raised in a previous plenary session: inclusion.

"I think first and foremost we have to expand our idea of what innovation means and make sure that we are thinking about who does it because often we think it only happens in research institutions."

There are many talented and resourceful problem solvers—young urbanites, rural farmers, etc.—that are not viewed by others, and do not view themselves, as part of an innovation or entrepreneurial ecosystem, Hall explained. Dr. Clough followed by reminding the audience that, to some extent, the nation is

still recovering from the early 2000s dot-com crash. Complicated by the Great Recession, Dr. Clough claimed, the STI community has lost some national credibility as a result.

“In a way, we have gone backwards at a time when technology is ever more pervasive in our lives.”

Dr. Clough added that scientific literacy—or the lack thereof—contributes to the problem. A big challenge, Dr. Clough highlighted, is that the complexity and specification of science is growing and, as a result, scientists have a hard time explaining their work to the general public. Thus, that work remains out of reach to many Americans. Continuing to define the problem, Ms. Modellmog lamented the linkage between innovation and job creation has weakened. Reflecting on her time in the Atlanta region, she noted that many entrepreneurial ventures target, for example, business-to-business software products. While this is certainly a positive development for the region that should be supported and accelerated, these ventures tend to make two to three folks very wealthy, she explained, yet do not create good-paying, long-term employment for the region. Taken together, these elaborations help to explain why many Americans feel STI has a net negative effect on their lives.

The panelists went on to suggest solutions. The explanations provided by the group address both real and perceived effects of innovation, and the potential solutions follow this distinction as well. The decoupling of manufacturing and innovation is a very real, well-documented challenge—so are the news stories of Instagram employing 13 people when it was bought by Facebook for \$1B, compared to

Kodak’s nearly 150,000 workers at its peak. While the evolution of the U.S. economy is complex, Ms. Modellmog pointed to a U.S. education system that has moved away from teaching skills that underpin a manufacturing-driven economy as a both a source of the problem and a solution to tightening the linkage between innovation and jobs. Referring to the high school level in particular, Dr. Jackson added:

“I took shop, and honestly I think that is one of the things that put me on a path to engineering.”

Supporting this approach, Dr. Clough noted the state of Georgia offers a program where high school students can earn two years of technical college credit from a 2-year college during 11th and 12th grade. While these education efforts may seem modest, Ms. Modellmog added, physically building things at an early age can lead to more hardware-focused innovation in the future—and the good-paying manufacturing jobs that support a strong middle class.

The group also focused on combating the negative messaging about technology and innovation often found in popular news sources. The STI community, the panelists implored, needs to be highlighting the benefits of innovation and the power of innovation to solve the world’s most complex and daunting problems. But, Dr. Jackson also reinforced, this needs to be transparent.

“There is going to be disruptions in terms of jobs and in terms of the economy, but ultimately the broader picture is that they enable prosperity in a grander sense.”

In the end, the solution to the poor public opinion of STI is to boost economic security for all Americans. With that in mind, panelists recognized entrepreneur-

ship as the critical “last mile” on the path from idea to prosperity. Dr. Jackson mused on the challenges of getting academic and laboratory researchers to think and act entrepreneurially.

“You may have incredible technical folks and maybe they have very good technical mentors, but they do not have the business acumen to understand what it would take to actually bring their idea to market.”

Dr. Clough seconded this insight from the university perspective. Reflecting on talented research faculty,

“They are people who know their stuff, but they are not necessarily able to talk about the value proposition of, for example, water hydraulics.”

Dr. Garrett pointed out that more and more students and faculty at his and other universities are “engaging in entrepreneurial activity and starting companies with interdisciplinary teams of people, not just engineers and computer scientists. There are increased demands that universities nurture and support this entrepreneurial activity, in addition to the academic mission, with seed funds, facilities and curriculum.” What these quotes highlight is that innovation and entrepreneurship require very different skill sets as well as a different set of resources.

Expanding on the idea of innovation infrastructure, the group reflected on the importance of entrepreneurship infrastructure—particularly the need for a robust community of mentors to impart their rich experiential knowledge on the next generation of entrepreneurs. Reinforcing this conclusion, next generation innovator and recent Georgia Tech graduate, Mr. Partha Unnava, reflected on his experience launching his first company, Better Walk.

“We went through an accelerator, raised a couple rounds [of venture funding], and received orders...and through the whole experience, really none of it would have happened without my mentors and the people around me that molded my value system.”

Reinforcing this point, the group went on to provide some specific examples of efforts focused on building mentorship networks, particularly the Metro Atlanta Chamber Innovation and Entrepreneurship Initiative—targeted at linking Atlanta business schools to the local business community.

As was the case throughout most of the day, this conversation also embodied the themes of inclusivity and diversity. Mr. Hall in particular highlighted the need to include both traditional and non-traditional entrepreneurs in such efforts, and expand these networks beyond our academic centers—where they are typically found today. Speaking to building human capital in Atlanta and other urban spaces, he explained:

“We have [students] at the very top, but the majority do not finish college or even high school. And we are wondering where they are and what they are doing. That is the group we need to think about.”

There is untapped capacity here, said Hall, explaining that these folks are innovative, creative, and resourceful in ways that will benefit the traditional entrepreneurship community. Dr. Jackson followed a similar thread, highlighting the importance of engaging a diverse group of talent.

“It is not just technical folks, but also it is the people who are going to be the bankers and the politicians because those are the skills that you are going to need to ultimately drive something to market.”

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Closing Keynote

Dr. Kim A. Wilcox

Chancellor

University of California, Riverside

I am inclined to think about what the world has been historically and what it is today. To do this, let's go back to the 1950s and '60s. If we had held a similar meeting then, we'd have been talking about infrastructure, roads, bridges and airports. Eisenhower built the Interstate Highway System to move us ahead because our world was bounded by our national borders. We had raw materials in some parts of the country, manufacturing hubs in other parts of the country, and consumption centers in other places. We had to knit these pieces together to make things thrive.

Now jump ahead to today, when we don't often talk about those things. Today we talked about bandwidth. We talked about 3-D printers. But, most of the day we talked about people. It was about talent. It was about management talent and technical talent. It was about anthropologists and biologists. It was about engineers and social scientists. It was about senior professionals and junior professionals. It was about trying to bring people together in new ways, and it was about relationships between and among all those people as well as among the institutions they are a part of. How do we get corporations, universities, development operations and the rest to think differently? How did we make this change from thinking about the nation as disparate hubs around the country that we needed to connect, to a world where we think about people, not things?

Interestingly, we have tied things together. The Internet is now ubiquitous. Every one of us can be in different countries on different weeks of the year and stay connected. We've changed supply chains.



Dr. Kim A. Wilcox, Chancellor, University of California, Riverside.

We have virtual warehouses. We really are a kind of international web. Universities have campuses in other places and around the world. Carnegie Mellon, for example, has a campus in Silicon Valley. We no longer have those clear demarcations regionally that we had 50 years ago. But today, ironically, we've spent much of our time talking about creating regional ecosystems. We're trying now to create our own regional identities in this very diffuse and global milieu. That's an interesting way to think about it, and it brings up two possible solutions to this reality.

One option is that each region is trying to get a competitive advantage. We're trying to find a way to beat Cambridge. We're trying to find a way to beat Austin, Texas. We're trying to find a way to make us special in this new world. Another, more altruistic option, is one in which we're all simultaneously trying to optimize this new world, and we don't know exactly how to do so except in ways that we can achieve locally, where we can look people in the eye and work with them locally. Now, the altruistic solution is a rising

tide that raises all boats; if we can optimize this whole new system, everybody will be better off. But we are Americans. We are capitalists. We all want our region to be a bigger boat, so we're exercising both options at the same time, and not always sure which is which.

The other observation I'd like to make is a tension for which I don't have an easy answer. One of the things that follows from this discussion of trying to create regional ecosystems is the notion of strategic partnerships. We heard a lot of people today talk about strategic partnerships and, for most of us, that means we're not going to try to connect to 30 places; we're going to narrow it down to the ones we think are best for us. So it's really an exclusionary kind of notion. Let's find these strategic partners, and then really bore in on those to optimize our position. That's great if you're in the preferred set. The tension, however, is that right now our stated goal is to diversify and be more inclusive in the world: bring in more women, bring in more students of color, engage underrepresented areas of the country. I am guessing if you went to the top 50 corporations in America and looked at their five, or six, or ten university strategic partners, you'd find Georgia Tech on lots of their lists. You'd find Carnegie Mellon on lots of them. But I'm guessing there are many other universities with very diverse student bodies that are on few lists, or even no lists at all.

If we're really serious about optimizing the talent pool, we have to think about this tension. As an outspoken advocate for strategic partnership and an even more outspoken advocate of inclusion, I'm not sure how to square that circle. But in trying to optimize the entire web, it seems to me that the Council and the NSF and others could help us think about how to do both those things at the same time.

PART 2: FINDINGS FROM THE EIFI NATIONAL LAUNCH DIALOGUE

The Path Forward

The Council will continue this national conversation on November 23, 2015 together with Chancellor Kim A. Wilcox of the University of California, Riverside. The University of California, Riverside offers a distinctive setting for the second EIFI regional dialogue. Riverside—and the surrounding region—is at the leading edge of transformational changes that portend a seismic shift in American innovation. As the country becomes more ethnically diverse and concern grows over underrepresentation in the STEM fields, UCR has embraced and leveraged diversity to boost innovation. Moreover, UCR ranks among the most economically diverse universities in the country. And as college applicants across the nation are finding it increasingly difficult to access research-grade institutions, capturing the experiential knowledge and best practices of first-mover communities like Riverside is essential for the success of Exploring Innovation Frontiers Initiative.

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The Council's mission is to set an action agenda to drive U.S. competitiveness, productivity and leadership in world markets to raise the standard of living of all Americans.

The Council on Competitiveness is the only group of corporate CEOs, university presidents, labor leaders and national laboratory directors committed to ensuring the future prosperity of all Americans and enhanced U.S. competitiveness in the global economy through the creation of high-value economic activity in the United States.

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HOW WE OPERATE

The key to U.S. prosperity in a global economy is to develop the most innovative workforce, educational system and businesses that will maintain the United States' position as the global economic leader.

The Council achieves its mission by:

- Identifying and understanding emerging challenges to competitiveness
- Generating new policy ideas and concepts to shape the competitiveness debate
- Forging public and private partnerships to drive consensus
- Galvanizing stakeholders to translate policy into action and change

