

Coordinate.

Dialogue 9:
Aligning Innovation and Research & Development
Efforts Across Borders



Compete.

Council on
Competitiveness

Dialogue 9: Aligning Innovation and Research & Development Efforts Across Borders

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Dialogue 9:
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Efforts Across Borders

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Dialogue 9: Aligning Innovation and Research & Development Efforts Across Borders

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TLSI DIALOGUE 9

Letter from the President

On behalf of the Council on Competitiveness (Council), it is my pleasure to release *Coordinate*, the report on the ninth dialogue of the Technology Leadership and Strategy Initiative (TLSI). The TLSI brings together American technology leaders from companies, universities and laboratories to set the national agenda for research, technology and commercialization.

I extend special thanks to the co-chairs who make the TLSI possible—Dr. Klaus Hoehn, Vice President, Advanced Technology and Engineering for Deere & Company; Dr. Ray O. Johnson, Senior Vice President and Chief Technology Officer of the Lockheed Martin Corporation; and Dr. Mark Little, Senior Vice President and Chief Technology Officer of the General Electric Company and Director of GE Global Research.

This report presents the agenda, participants list, and the proceedings from the dialogue, held on June 4, 2013 at Georgetown University in Washington, D.C. The ninth dialogue gathered guest speakers, a delegation from Brazil, and TLSI members to align innovation and research and development (R&D) progress within and across national borders. The Council thanks our hosts, Dr. John J. “Jack” DeGioia, President and Dr. Spiros Dimolitsas, Senior Vice President for Research and Chief Technology Officer of Georgetown University for their generosity.

I am grateful to our guest speakers at this dialogue: Dr. José Muñoz, Chief Technology Officer at the National Science Foundation (NSF) and Mr. Roger Kilmer, Chief Manufacturing Officer at the National Institute of Standards and Technology for their participation. I would also like to thank Dr. Mauro Borges Lemos, President of the Brazilian Agency for Industrial Development (ABDI) for leading an



illustrious delegation from Brazil to join the ninth dialogue of the TLSI. By working together and coordinating our efforts, Brazil and the United States have an opportunity to build partnerships and create concrete actions that will lead both countries to increased competitiveness and higher standards of living.

Sincerely,

A handwritten signature in black ink that reads "Deborah L. Wince-Smith". The signature is fluid and cursive.

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

The TLSI dialogues are an open exchange of ideas. The opinions and positions presented in this report are those of the Council or the individual who offered them. The opinions and positions in the report do not reflect official positions of the federal government.

TLSI DIALOGUE 9

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CO-CHAIRS

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Vice President, Advanced Technology and
Engineering
Deere & Company

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Senior Vice President and
Chief Technology Officer
Lockheed Martin Corporation

Dr. Mark M. Little
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Chief Technology Officer
General Electric Corporation and
Director
GE Global Research

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IBM

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Dwight Look College of Engineering
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Associate Laboratory Director for Science and
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Dr. Lawrence Schook
Vice President for Research
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The Honorable Deborah L. Wince-Smith
President and CEO
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BRAZILIAN DELEGATION

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Brazilian Agency for Industrial Development

Ms. Patricia Vicentini
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Mr. Leonardo Santana
Specialist
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Innovation Director
Braskem

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Braskem

Mr. Laercio Aniceto da Silva
Vice President for Business Development
CERTI Foundation

Mr. Luís Gustavo Delmont
Industrial Development Analyst
National Confederation of Industry Brazil

Dr. James Buntaine
Chief Technology Officer
CSEM Brasil

Mr. Gilberto Teixeira
President and CEO
Elo Electronic Systems

Mr. Carlos Berto
Senior Manager
Embraer

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President
Brazilian Patent and Trademark Office

Mr. Marcus Dudkiewicz
International Advisor to the President
Brazilian Patent and Trademark Office

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Secretary of Innovation
Ministry of Development, Industry and Foreign Trade

Mr. Igor Nazareth
Advisor to the Secretary of Innovation
Ministry of Development, Industry and Foreign Trade

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Ms. Ana Takatsu
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Council on Competitiveness

TLSI DIALOGUE 9

Agenda

MORNING

8:00 Registration and Continental Breakfast

8:30 Welcome

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

8:45 Opening Remarks: Globalization and the Role of the “CTO”

The United States and Brazil are the two largest economies in the Western Hemisphere and home to some of the world's most successful companies, prestigious universities and cutting-edge laboratories.

These innovation stakeholders are acting in an ecosystem increasingly characterized by an unrelenting pace of technological change; by deeper and tighter operations spanning national boundaries; and, by the changing nature of innovation itself (more interdisciplinary, collaborative, co-creative).

In this environment, CTOs (whether from industry, academia, national labs or other research institutes) have to create the “bridge” between technological innovation and value creation for their enterprises.

The 9th TLSI dialogue will explore some of the challenges and opportunities facing the “CTO”—and seek insights to understand better and navigate the evolving impacts of globalization and global technological innovation on enterprise strategy.

Dr. Klaus G. Hoehn, TLSI Co-Chair
Vice President
Advanced Technology and Engineering
Deere & Company

Dr. Mark M. Little, TLSI Co-Chair
Senior Vice President and Chief Technology Officer
General Electric Corporation and
Director
GE Global Research

Dr. Ray O. Johnson, TLSI Co-Chair
Senior Vice President and Chief Technology Officer
Lockheed Martin Corporation

9:15 Shaping National and Regional Innovation Agendas

Numerous efforts and opportunities exist at both the national and regional levels for building the innovation commons and infrastructure necessary for a competitive economy.

For instance, in the United States, research centers (like the DOE national laboratories, and public and private universities), as well as initiatives like President Obama's recently announced National Network for Manufacturing Innovation (NNMI), play roles in driving a more competitive U.S. economy. In Brazil, the recently announced *Plano Brasil Maior*, a national innovation agenda set forth by President Rousseff, plays a similar role within the national economy.

Sharing insights and national and regional best practices can stimulate innovation and unearth opportunities to improve and expand upon current efforts.

Introduction and Moderation

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

Kick-off Presentation

Dr. Mauro Borges Lemos
President
Brazilian Agency for Industrial Development (ABDI)

Discussants

Dr. Spiros Dimolitsas
Senior Vice President for Research and Chief Technology Officer
Georgetown University

Mr. Nelson Fujimoto
Secretary of Innovation
Ministry of Development, Industry and Foreign Trade

Dr. José Muñoz
Chief Technology Officer
National Science Foundation

Dr. Mark Peters
Deputy Laboratory Director for Programs
Argonne National Laboratory

Framing Questions

- What are examples of successful policies—at both the national and local levels—that have stimulated sustainable, long-term innovation capacity? What matters most in national and regional policy to catalyze innovation?
- How do countries rich in natural resources (sugarcane, shale gas, oil, coal, water, food, etc.) build sustainable innovation policy regimes independent of these natural resources?

10:15 Coffee Break

10:45 Over-the-Horizon Innovation Challenges and the Opportunities for Public-Private Partnerships

There are many innovation challenges and opportunities too large for any one nation to tackle on their own.

Two broad sectors facing such global challenges and opportunities are the information and communications technologies industry (ICT) and the intersecting nexus between the energy, food and water resource industries.

For example, the ICT industry faces a host of cross-cutting challenges requiring a global response—whether dealing with cyber-security issues or preparing for increased energy needs to power ICT products. And within the energy-food-water nexus, responding to the challenges created by a growing global population on the ability to find clean water, grow nourishing food, and have access to energy. There are tremendous opportunities to collaborate, discover solutions and create global value for both nations.

Moderator

Mr. Chad Evans
Executive Vice President
Council on Competitiveness

Kick-off Discussants

Dr. Tilak Agerwala
Vice President, Systems
IBM

Dr. James Buntaine
Chief Technology Officer
CSEM Brasil

Dr. Mark M. Little
Senior Vice President and Chief Technology Officer
General Electric Corporation and
Director
GE Global Research

Mr. Luis Cassineli
Innovation Director
BRASKEM

Mr. Laercio Aniceto da Silva
Vice President for Business Development
CERTI Foundation

Dr. Klaus G. Hoehn
Vice President, Advanced Technology and Engineering
Deere & Company

Framing Questions

- What are 3 of the top innovation challenges facing your organization over the coming 5-10 years?
- What is one idea for an international collaboration —perhaps between the United States and Brazil (though not limited to these nations)—that might address and solve one of your top innovation challenges?

AFTERNOON

12:00 Innovation Infrastructure

A variety of means exist for building a regulatory environment that supports national innovation infrastructure, including advancing measurement science, standards, and intellectual property (IP) protection.

However, even in the face of a supportive regulatory environment, nations around the world often face a common challenge in building and effectively leveraging “national innovation commons”—geographically rooted collective R&D, engineering, and manufacturing capabilities.¹ These national innovation commons drive production at scale and throughout the supply chain.

Moderator

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

Kick-Off Discussants

Mr. Roger Kilmer
Chief Manufacturing Officer
National Institute for Standards and Technology

Dr. Jorge Ávila
President
Brazilian Patent and Trademark Office

Framing Questions

- Given the emergence of globally competitive markets—often employing different approaches to intellectual property protection—what strategies are Brazil and the United States deploying to support domestic entrepreneurship and innovation?
- How do we develop standards in individual countries for activities already occurring in a way that can lead to future agreement on global standards?
- What innovation assets are important for an attractive and resilient manufacturing base?

1:00 Building Talent to Drive Growth Locally and Compete Globally

Developing a talent pipeline that meets industry's skills needs requires new strategies responsive to today's business environment, operations and evolving workforce demographics.

Various efforts are taking place in many countries around the world—including the National Engineering Forum in the United States and the Scientific Mobility Program in Brazil—to develop a competitive, agile workforce responsive to the needs of industry, today and into the future. Sharing current efforts and best practices to align training with the capabilities and skills necessary will facilitate growing a country's talent pipeline for the needed skills and better prepare nations to compete in the 21st century.

Moderator

Dr. Roberto Alvarez
International Affairs Manager
Brazilian Agency for Industrial Development

¹ Pisano, G.P. and W.C. Shih. Restoring American Competitiveness. *Harvard Business Review*, July-August 2009.

Kick-off Discussants

Dr. Ray O. Johnson
Senior Vice President and Chief Technology Officer
Lockheed Martin Corporation

Mr. Luís Gustavo Delmont
Business Development Analyst
Brazilian National Confederation of Industry

Mr. Carlos Berto
Senior Manager
Embraer

Dr. Lawrence Schook
Vice President for Research
University of Illinois

Framing Questions

- What is the best way to ensure talent mobility to disseminate knowledge globally and yet retain expertise and innovation within a company/region/country?
- There have been recent articles and commentary in the popular press that nations like the United States and Brazil do not have sufficient numbers of qualified workers with STEM skills to meet industry needs.^{2, 3} Other recent commentary argues nations like the United States have too many workers with STEM skills than jobs to fill.⁴ If there is a skills gap, how does academia engage with industry to better prepare the workforce to fill the need?

2 Rotherham, Andrew J. The next great resource shortage: U.S. Scientists. *Time U.S.* May 26, 2011. Available at: <http://www.time.com/time/nation/article/0,8599,2074024,00.html>

3 Koebler, Jason. Report: Military engineer shortage could threaten security. *U.S. News*. March 6, 2012. Available at: <http://www.usnews.com/news/articles/2012/03/06/report-military-engineer-shortage-could-threaten-security>.

4 Vastag, Brian. U.S. pushes for more scientists, but the jobs aren't there. *Washington Post*. July 7, 2012. Available at: http://articles.washingtonpost.com/2012-07-07/national/35486154_1_research-jobs-life-sciences-scientists.

1:45 Roundtable Discussion for the 3rd U.S.–Brazil CEO Innovation Summit

Continuing our groundbreaking partnership, the Council on Competitiveness will co-host with ABDI, the Brazilian Competitiveness Movement (MBC), the Brazilian Development Bank (BNDES), and Brazil's National Confederation of Industry (CNI) the 3rd U.S.-Brazil Innovation Summit on September 11-12, 2013 in Rio de Janeiro, Brazil.

The Summit will build on over twelve Innovation Learning Laboratories, as well as both the 2007 and 2010 U.S.-Brazil Innovation Summits. The 3rd U.S.-Brazil Innovation Summit will leverage a bi-national network of hundreds of private and public sector leaders from the Western Hemisphere's two largest economies.

Summit participants will help design and catalyze concrete, mutually beneficial projects and collaborations addressing key innovation challenges and opportunities.

Moderator

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

Kick-Off Discussants

Dr. Mauro Borges Lemos
President
Brazilian Agency for Industrial Development

Ms. Gianna Sagazio
Advisor to the President
Brazilian Development Bank

Mr. Luís Gustavo Delmont
Industrial Development Analyst
National Confederation of Industry Brazil

2:15 Coffee Break

2:30 TLSI Next Steps

Mr. Chad Evans
Executive Vice President
Council on Competitiveness

2:45 Here and Now: “Big Data”

A 2011 IDC report estimates the total amount of data doubles every two years globally.⁵

In this environment of extreme churn and growth, how can enterprises—and the technology and innovation leaders in those enterprises—harness these large data streams to create new value and strategic opportunity, drive efficiency and optimize the workflow throughout their value chain?

And how can leaders navigate a global “big data” ecosystem riddled with incompatible standards, systems and formats, and other organizational and cultural variables that can inhibit data integration and analysis?

Exploring the broader role that companies, universities, national laboratories, and the public sector can play in predicting and mitigating challenges to the use of “big data” today and into the future, nations can work together to craft solutions through implementing best practices and creating partnerships.

Moderator

Mr. Chad Evans
Executive Vice President
Council on Competitiveness

Kick-Off Discussants

Dr. J. Michael McQuade
Senior Vice President, Science and Technology
United Technologies Corporation

Mr. Gilberto Teixeira
President and CEO
Elo Electronic Systems

Ms. Dona Crawford
Associate Director for Computation
Lawrence Livermore National Laboratory

Framing Questions

- How is your organization generating and collecting data today? How does the availability of data change your business from the previous five years? What will “big data”—and the proper curation of big data—allow you to accomplish in the near future?
- How, in an increasingly globalized world, can we develop new approaches for collecting and best utilizing data to drive efficiencies and improvements in both the public and private sectors across diverse regions?
- Reflecting back on lessons from Y2K and the nearly daily reports of cyber-security challenges, what is the next big problem/opportunity on the horizon that the global community should be prepared to face?

3:15 Closing Remarks

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

Dr. Klaus G. Hoehn
Vice President
Advanced Technology and Engineering
Deere & Company

Dr. Mark M. Little
Senior Vice President and Chief Technology Officer
General Electric Company and
Director
GE Global Research

Dr. Ray O. Johnson
Senior Vice President and Chief Technology Officer
Lockheed Martin Corporation

⁵ Ganz, John and Reinsel, David. *The 2011 Digital Universe Study: Extracting value from Chaos*. IDC: Sponsored by EMC Corporation, 2011.

TLSI DIALOGUE 9

Opening Remarks

After welcoming participants to the dialogue, the Honorable Deborah L. Wince-Smith, President & Chief Executive Officer (CEO) of the Council, spoke about the Council's recent projects and efforts and introduced the co-chairs of the Technology Leadership and Strategy Initiative (TLSI): Dr. Klaus Hoehn, Vice President for Advanced Technology and Engineering at Deere & Company, Dr. Ray O. Johnson, Senior Vice President and Chief Technology Officer of the Lockheed Martin Corporation, and Dr. Mark Little, Senior Vice President and Chief Technology Officer of the General Electric Company and Director of GE Global Research.

Ms. Wince-Smith also welcomed partners and leaders from Brazilian industry, government, and education to this TLSI dialogue and conveyed to the participants the importance of collaboration in advancing global innovation—especially between these two largest economies in the Western Hemisphere. She noted that both the United States and Brazil are performing below the Organization for Economic Co-operation and Development (OECD) average in terms of international, innovation-related linkages, publishing fewer scientific articles with international co-authorship and filing fewer patent applications with international co-inventions than others, and offered this as an area for the two countries to better collaborate. She also noted that the office of the Chief Technology Officer (CTO)—placed at the intersection of technology, business, and strategic planning—holds a unique role personifying both the need for and the challenges of linking the sources of innovation. These bi-national



The Honorable Deborah L. Wince-Smith, President & CEO, Council on Competitiveness; Dr. Mark M. Little, Senior Vice President and Chief Technology Officer, General Electric Company and Director of GE Global Research; and Dr. Klaus G. Hoehn, Vice President for Advanced Technology and Engineering, Deere & Company

conversations will continue to grow and bear fruit as the Council partners with these Brazilian leaders to hold its third U.S.-Brazil CEO Innovation Summit on September 11-12, 2013 in Rio de Janeiro, Brazil.

Following Ms. Wince-Smith's opening remarks, Dr. Hoehn suggested that both the United States and Brazil made progress towards collaborating within their respective countries, and both nations are continuing to create and work in partnership with other nations. Nonetheless, Dr. Hoehn noted that many opportunities exist to facilitate stronger collaboration internationally to address critical global challenges. He explained that Deere, with more than 135 years of experience and exposure to different countries, is guided by its mission to "feed the world" and seeks to partner with those who enable Deere to help fulfill its mission. Deere considers its

partnership with Brazil crucial, given the country's strong agricultural sector; Brazil leads the world in both sugar and soybean production. "In talking to our colleagues from Embraer and others in Brazil, it is obvious that we must collaborate on crucial issues," Dr. Hoehn remarked, "probably none of us, no one country, no one company alone can solve the tremendous challenges in providing the food and the fuel for the world in the near future...The Council provides for us an enormously helpful platform to push the agenda in terms of collaboration around the world."

Following Dr. Hoehn's remarks, Dr. Little added that GE recently established a partnership in Brazil through the creation of its newest industrial research laboratory. Following a century of success driven, in great part, by its first industrial research laboratory in the United States, GE began a globalization thrust at the begin of the 21st century; today GE is building a 400-employee facility in Rio de Janeiro that will foster GE's technology businesses across the healthcare, oil and gas, aviation, energy, and every other business and sector the company supports. "We are present in Brazil because we see it as a gateway to Latin America," noted Dr. Little. "We see it as a robust economy with very strong potential partners in industry and in universities. This center was built from the beginning around collaboration... We start with connections to our big customers—for example, Petrobras in oil and gas, Embraer in aviation, Vale in mining, MRS in transportation—and we welcome the opportunity to get to know our Brazilian colleagues better and find ways to collaborate."

Dr. Johnson brought the opening remarks to a close by noting that innovation and the role of technology has always been important to economies around the world, and supported Ms. Wince-Smith's earlier comment about the pivotal role of the CTO. Dr. Johnson pointed to the crucial role CTOs play in understanding technology and translating it into business practice, and creating value within the company by helping interpret roadmaps for technology development and products. Commenting on the compelling evidence for human contributions to global climate change and the challenges it presents, Dr. Johnson added that the need for sustainability spurs innovation, and the CTO can play a major role in sustainability for the planet and its resources when designing and manufacturing products. "We're in the middle of a materials, manufacturing, and energy nexus," he concluded, "and numerous opportunities are opening up for us to change the way that we manufacture, use, and dispose of products."

TLSI DIALOGUE 9

Shaping National & Regional Innovation Agendas

Dr. Mauro Borges Lemos

President
ABDI

I offer three major points regarding best practices in innovation policy and strategy for collaborations between the United States and Brazil. This is a discussion we will continue at the upcoming 3rd U.S.-Brazil Innovation Summit, co-hosted by the Council and ABDI in Rio de Janeiro in September 2013. The first point is supporting a collaborative innovation agenda between Brazil and the United States in the context of a bilateral dialogue. The second point is raising awareness regarding innovation opportunities in Brazil: new frontiers have emerged—while we highlight these frontiers at this TLSI dialogue, we also look forward to linking these discussions to our innovation summit in September. The third point is capitalizing on the available opportunities through market-driven innovation policies in Brazil.

The Innovation Agenda for Collaborations between Brazil and the United States

The State Visit of President Dilma Rousseff in October 2013⁶ proceeds from a history of friendly relations between the two countries, including the recent visit of Vice President Joseph Biden



Dr. Mauro Borges Lemos, President, Brazilian Agency for Industrial Development (ABDI)

to Brazil,⁷ and the previous exchanges between President Barack Obama and President Rousseff in 2011 and in 2012,⁸ respectively.

There is a convergence on an approach towards agreed-upon principles in procedures and in tactical behavior in international foreign affairs. The bilateral agenda is extremely forward-looking—toward the pivotal issues of science and technology. President Rousseff's State Visit to Washington, DC will reinforce this new path and relationship.

7 On May 31, 2013, U.S. Vice President Biden met with Brazil's President Rousseff. More information available at: <http://www.reuters.com/article/2013/05/31/us-brazil-usa-biden-idUSBRE94U14220130531>.

8 President Obama paid a State Visit to Brazil on March 19-21, 2011. The joint statement by President Rousseff and President Obama is available at: <http://www.whitehouse.gov/the-press-office/2011/03/19/joint-statement-president-rousseff-and-president-obama>. President Rousseff made an official visit to the United States on April 9, 2012. The joint statement by president Obama and President Rousseff is available at: <http://www.whitehouse.gov/the-press-office/2012/04/09/joint-statement-president-obama-and-president-rousseff>.

6 On September 17, 2013 this state visit was postponed until a later date.



Participants at TLSI Dialogue 9

The underpinnings of the bilateral innovation agenda are also very promising. Trade flow between the two countries increased after the 2008 economic crisis, despite a trade balance that favors the United States. A feasible target in the coming years is for the United States to regain its position as the primary trading partner of Brazil, especially when slowing economic growth in China—Brazil's current primary trading partner—is taken into account.

The second aspect is the recent structural change in the bilateral direct investment flow. From an imbalance in investment flow of more than ten to one, the ratio is now around four to one—and the opportunities for complementary investment are greater than before. This is partially because the people and business infrastructure are now in place, which is quite different from what existed 20 years ago.

Last but not least, we have common ground to build complementary trade and investment relationships to face common competitors, especially towards China. Investment in innovation is critical for both the United States and Brazil to work together across a wide array of organizations, such as universities, joint ventures between Brazilian and American corporations, national laboratories, and relationships across national laboratories and universities. An example of this cross-border collaboration is the Brazil Scientific Mobility Program (previously Brazil Science Without Borders) that provides scholarships for Brazilian university students in Science, Technology, Engineering and Mathematics (STEM) fields to study at colleges and universities in the United States for one year.

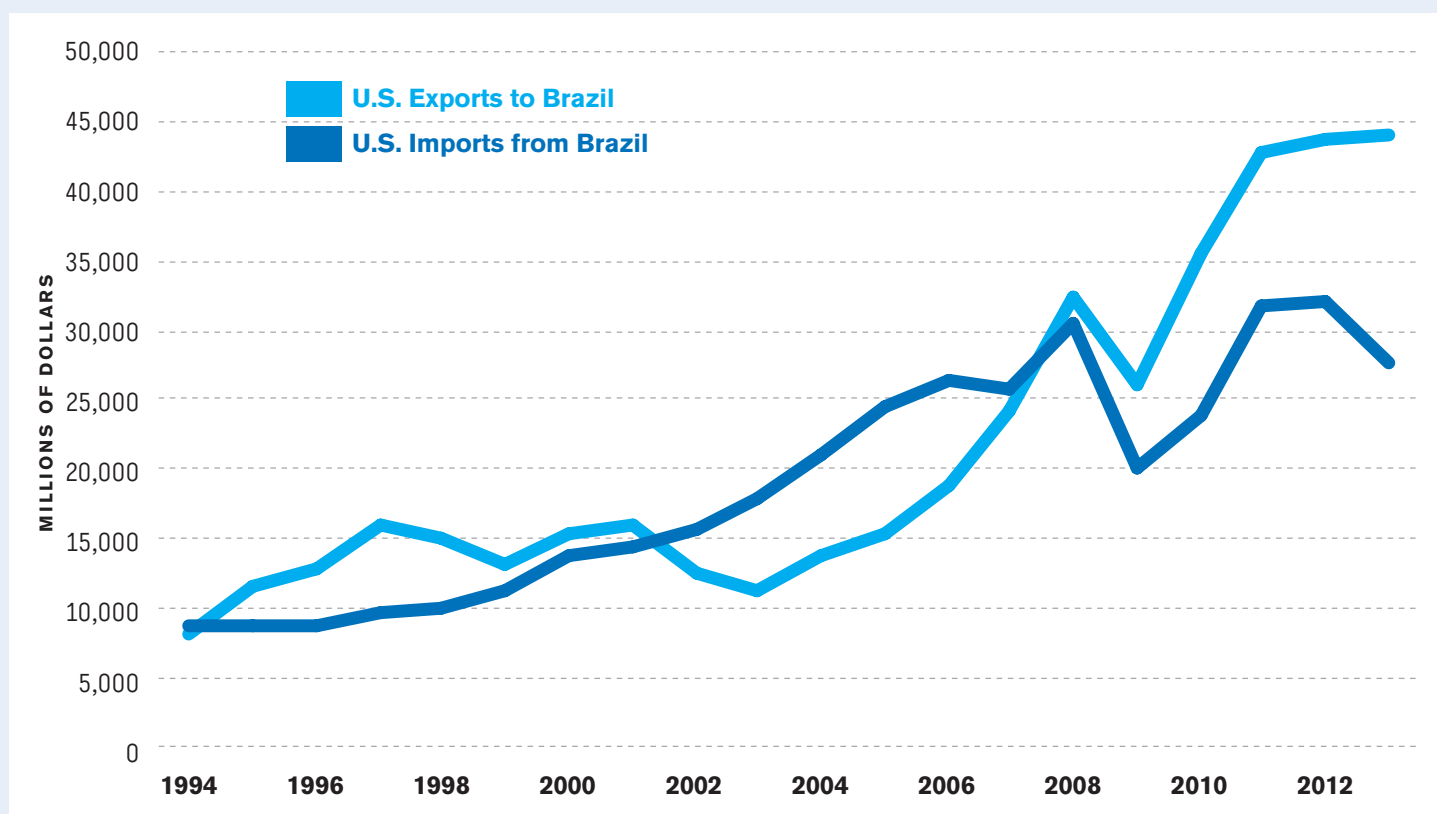
Blossoming Innovation Opportunities in Brazil

New frontiers have opened with Brazil's economic growth. I would like to share my perspective on innovation opportunities for which America maintains an advantage relative to other international partners.

Many opportunities exist in innovations related to Brazil's traditional economic base of natural resources and agriculture. We are building up new capabilities in agri-bio-technology and new systems for the production of agricultural machinery. There are also many opportunities in water management and renewable forests, optimizing these resources using Information and Communications Technology (ICT)—both software and hardware.

Figure 1: U.S. Exports to and Imports from Brazil in millions of U.S. dollars from 1994-2013.

Source: United States Census Bureau, U.S. Department of Commerce



Mining is another very promising sector for collaboration—not with mining technology, but with logistics. Software and hardware tools may offer significant opportunities to solve our logistical challenges.

And the third sector that offers offering tremendous opportunities is energy. In oil and gas, the deep water and subsea challenges are very well known—developing the solutions is a basis for investment. Renewable energy technologies are also of high interest—especially as we approach a second generation of bioenergy.

Opportunities in Brazil Opened by Market-Driven Innovation Policies

There are many opportunities for innovative technology generated by leveraging public procurement in Brazil. As an example, the health complex in Brazil—particularly the Brazilian national health system—is among the top five purchasing powers in the world's economy for pharmaceuticals and health equipment. In Brazil, we use a market-driven approach to face the challenges of an aging population.

The defense industry is another example where public procurement produces market-driven approaches to technology. Brazil's military is an important player in innovation, spinning off companies such as Embraer—and the United States, with its state-of-the-art defense industrial complex—is a natural partner. As an example, Embraer is working to produce a diversified defense system. In response to this goal, Boeing partnered with Embraer to produce the KC-390.⁹

The domestic market also creates a demand for innovation—two examples being ICT and new materials. Nowadays, we think scaling-up the purchases of semiconductors can be based on domestic demand. Ten or thirty years ago, this basis of domestic demand to fuel production increases was impossible. We did not have the domestic demand necessary to support or operate a large-scale ICT business. Today, we think we have enough of a domestic market to start a new operation through foreign trade.

These demands shape our needs for technological innovation and present opportunities for bilateral collaborations.

Working Together to Seize Opportunities and Bilaterally Increase Competitiveness

We can capitalize on these opportunities through two important blocks of policies: project development and networking between American and Brazilian systems of innovation. In terms of project development, President Rousseff launched

Figure 2: Embraer KC-390 Aircraft

Photo Source: Acromil



a program in April that we call *Inova Empresa* and *Plano Brasil Maior*, a daring innovation plan to coordinate innovation efforts with tangible results led by our development bank, Brazilian Development Bank (BNDES) and by our financial innovation agency, Financiadora de Estudos e Projetos (FINEP).

This program is based on integrated financial products that are tailor-made to specific projects. In this program, we make available non-reimbursable money to establish linkages between universities and industry and money to develop the supply chain of an anchoring enterprise like an original equipment manufacturer (OEM). We also provide access to financing and equity for risky R&D projects. All of these tools are integrated into *Inova Empresa*, where the mix of tools used per project is decided by the need and capability of the OEM.

⁹ Boeing and Embraer announced an agreement to collaborate on the KC-390 Program on June 26, 2012, sharing some specific technical knowledge and evaluating markets where they may join their sales efforts for medium-lift military transport opportunities. More information available at: <http://boeing.mediaroom.com/index.php?s=20295&item=2308>.

The *Inova Empresa* program presents an opportunity to the United States, because any American firm that operates in Brazil is constitutionally recognized as a “Brazilian firm” and can apply for the program. Through policies such as these, Brazil welcomes and encourages foreign enterprises within its borders—recognizing that without this integration, Brazil cannot leapfrog into competitive standing in the global marketplace of technology.

Two other programs support the Brazilian national system of innovation. The Brazil Scientific Mobility Program has a goal to bring about 30,000 Brazilian students into the United States in 2014, whereas the Brazilian Diaspora connects Brazilian nationals who are residents of the United States. We support the establishment of these Brazilians in the United States, because of the opportunities for development here, and look forward to accessing their scientific and technological knowledge through the Brazilian Diaspora program.

We count on your support and all of the board of the Council to develop and support these bilateral innovation agendas.



The Honorable Deborah L. Wince-Smith, President & CEO, Council on Competitiveness; Dr. Spiros Dimolitsas, Senior Vice President and Chief Technical Officer, Georgetown University; Mr. Marcus Dudkiewicz, International Advisor to the President, Brazilian Patent and Trademark Office (INPI); and Mr. Ernesto Henrique Fraga Araújo, Chargé d’Affaires, Ministry of Foreign Affairs

Inova Empresa

Source: BNDES.gov.br

Starting in 2011, *Inova Empresa* publishes public requests for proposals for financial support of innovative projects from participating organizations including BNDES and FINEP. Plans already published include:

- Inova Aerodefesa
- Agro Inova
- Inova Energy
- Inova Petro
- Inova Health
- Inova Sustainability Plan
- Innovation Support Plan for the Sugar-Ethanol and Sugar-Chemical Sectors (PAISS)

Framing Remarks

Ms. Wince-Smith thanked Dr. Borges Lemos for his overview of Brazil's national innovation strategy and highlighted a few key points to guide the proceeding discussion. First, she reiterated Dr. Borges Lemos' comments on the importance of both government leadership and vision in public-private partnerships concerning innovation and the demand-driving role that the private sector plays in collaborations. She also touched upon the challenges the United States faces in moving from start-up companies into scaled-up organizations: "How you turn start-ups into viable enterprises and the financing models that you've created in Brazil to do so—as well as your definition of a 'Brazilian enterprise'—are really things that we need to look at in the United States." Ms. Wince-Smith noted that the United States does not have a bank like BNDES that regulates internal investment and suggested that the Council could set up a binational investment treaty to accelerate the development of such an institution here. Finally, Ms. Wince-Smith pointed to developing standards in key innovation areas as a significant area of opportunity for collaboration.

Dr. Spiros Dimolitsas

Senior Vice President and Chief Technology Officer
Georgetown University

Dr. Dimolitsas began the opened up the conversation by noting that a nation's innovation sector is comprised of universities, national laboratories, industry, and government. Speaking from his professional experience at Georgetown University, he offered a vision of academia's function in the

process of innovation and noted that the traditional role of universities in the United States has been to create talent and to focus on individual-based innovation and discovery rather than problem-driven innovation. He suggested that U.S. universities are no longer the predominant institutions creating talent, particularly in STEM fields, with superior intellectual capacity and ingenuity being generated across the globe. "That has some implication for universities that feel the need to be globally connected," said Dr. Dimolitsas, "as to the source of students from [around the world] and how their presence may [impact] other places."

Next, Dr. Dimolitsas conveyed various ways that the innovation process is changing. First, research is becoming increasingly multidisciplinary. In part because of the advent of Big Data, research today incorporates greater input from the humanities and social sciences and allowing for those fields to become more quantitative and focused on solving problems like energy security. Finding more interdisciplinary opportunities and gauging how to fund them or classify them as either social science or STEM contributions also remains a challenge. Second, globalization requires that research and intellectual collaboration become more integrated. Present research has demanded the skill of several different institutions, rather than one individual. Because of this, the role of the intellectual property (IP) agreements has become critical. These transformational changes to the character of innovation pose challenges and require skills that universities don't currently have.



Mr. Nelson Fujimoto, Secretary of Innovation, Brazilian Ministry of Development, Industry and Foreign Trade, and Dr. José Muñoz, Chief Technology Officer, National Science Foundation

Mr. Nelson Fujimoto

Secretary of Innovation
Brazilian Ministry of Development,
Industry and Foreign Trade

Following Dr. Dimolitsas and in response to Dr. Borges Lemos' remarks on Brazilian initiatives and ideas, Mr. Fujimoto shared examples of the development of human resources in Brazil—and particularly the Brazil Scientific Mobility Program. This program is a potentially significant factor in building an innovation relationship between the United States and Brazil—with the United States receiving the largest portion of students; Brazil has sent twenty-three percent of its engineering and technology students to the United States.

Next, Mr. Fujimoto spoke about innovation policies and programs that Brazil has put in place. *Plano Brasil Maior* has established innovation as a priority to attract and elevate private sector investment

in R&D, while the *Inova Empresa* focuses on seven different areas: agribusiness, energy, oil and gas, health, aerospace and defense, ICT, and environmental sustainability. "The goal is to implement a new model to support innovation in Brazil, integrate and coordinate installments of different institutions," he said. "After some time, centralizing financial instruments to small and middle enterprises should allow Brazil to support projects with bigger technologies." Concluding his comments, Mr. Fujimoto noted that this achievement would not be possible without governments promoting innovation.

Dr. Jose Muñoz

Chief Technology Officer
National Science Foundation

Following Mr. Fujimoto, Dr. Muñoz opened his comments by offering some background information on the NSF. The NSF funds open science research, and its Computer Science Directorate has initiated eighty percent of all basic computer science research. Like many other federal agencies, the NSF is suffering from budget constraints; for this reason, noted Dr. Muñoz, the NSF is trying to leverage opportunities across the sciences. In particular, the NSF and others are focusing on Big Data. To this end, the Big Data Senior Steering Group (BD SSG), launched the White House Big Data R&D Initiative and chaired by the NSF and National Institutes of Health, was formed to identify current Big Data R&D activities across the federal government.

The advent of Big Data brings many challenges. Since 2007, more research data has been collected than can be stored. "Many datasets are too large to download," he said. "Gigabytes of data are no longer



Mr. Nelson Fujimoto, Secretary of Innovation, Ministry of Development, Industry and Foreign Trade; Dr. José Muñoz, Chief Technology Officer, National Science Foundation; and Dr. Jorge Ávila, President, Brazilian Patent and Trademark Office

unusual—terabytes (1×10^{12} bytes) are becoming very common.” Additionally, much of the data collected across disciplines is both poorly organized and heterogeneous—impeding the communication, transfer and use of data across datasets. Further complicating the situation are privacy concerns.

Laboratories and researchers need improved standards to enhance interoperability and translate this stored data into new information.

Dr. Muñoz also cited a national charge from the Office of Science and Technology Policy (OSTP) in the White House in 2013 regarding open access that requires all federal agencies that fund more than \$100 million in research annually to provide open access to research and data to the public community to stimulate innovation. Though having publications and data readily available would allow innovation to grow, Dr. Muñoz cited a number

of challenges created as a result: “For instance, because data has a certain intellectual property value, what does this mean for the principle investigators who make their data available? Who is responsible for errors in the data? Who will pay for storing it? How will we control it? Who will curate it? How do we guarantee the authenticity of the data? What if someone attempts to change it?” Open access to data requires that many of these contingent challenges be addressed early.

Lastly, Dr. Muñoz discussed Big Data through the lens of education for a 21st century workforce and noted that “by 2018, the United States alone will have a shortage of between 140,000 and 190,000 workers with analytical expertise in Big Data.” Dr. Muñoz anticipates a shortage in the millions of managers who are actively fluent in the language of Big Data and its contingent challenges and issues. The United States must educate the next generation of data scientists in order for the economy and nation as a whole to utilize the technologies that are being developed today.

He concluded that teaching has changed very little over the past 100 years, even though “today’s student doesn’t need to sit in a classroom for seven hours listening to somebody lecture. He can get on his mobile device. Through the internet, he can access a telescope; he can play modeling games. He can access and learn from top teachers in the world through media like this. We need to use today’s technologies to teach tomorrow’s students. That’s something that the National Science Foundation is also exploring.”

Dr. Mark Peters

Deputy Laboratory Director for Programs
Argonne National Laboratory

Dr. Peters opened his comments with support for building larger, more inclusive U.S. public-private partnerships (PPPs) as a major part of the solution to major challenges. Dr. Peters also noted that having a national innovation agenda is an important element.

Dr. Peters shared an example of an existing and inspiring PPP, one of the energy innovation hubs—a concept introduced by former U.S. Secretary of Energy Stephen Chu in 2010. In November 2012, Argonne National Laboratory was selected to lead one of five energy innovation hubs—the Joint Center for Energy Storage Research (JCESR)—to develop next generation batteries. “We built a large team of five laboratories, five universities, and four industry partners,” said Dr. Peters. JCESR was led by various guiding principles. For instance, the federal government provided the overarching vision, but industry was involved from the beginning to help set goals and strategies. An IP framework was established from the very beginning. Under Argonne’s leadership, JCESR set very broad, almost unattainable goals to influence the grid and transportation sectors and to drive innovation behavior and out-of-the-box thinking. Management constructs and advisory councils were also established and energy trusts were engaged in the process. Dr. Peters added, “they are able to connect us to the Michigan and Silicon Valley ecosystems” and provide us with further industry based feedback.



Dr. Mark Peters, Deputy Laboratory Director for Programs, Argonne National Laboratory

Tying up his remarks and building upon Dr. Muñoz’s comments regarding talent, Dr. Peters noted that working through JCESR, Argonne National Laboratory grows beyond primary investigator-driven research to build relationships with universities. Bringing post-doctoral researchers to and from the laboratory also aids in developing key talent. The laboratory also developed translational development teams of scientists and engineers working together to broaden perspectives and increase the expertise available on projects.

Open Discussion

Opening up the discussion for questions, Dr. Tomás Díaz de la Rubia, Director, Deloitte Consulting LLP asked the Brazilian delegation how Brazil views the role of national laboratories in the context of innovation, and how the country views its national laboratory system in comparison to systems in the

United States, Germany, or elsewhere. Dr. Jorge Ávila, President of the Brazilian Patent and Trademark Office (INPI), noted that Embrapii, a joint initiative of the Brazilian government and the National Confederation of Industry (CNI) is the Brazilian Corporation for Research and Industrial Innovation. “We are trying to build a network of institutions with this clearly defined role to build a bridge between academia and industry,” he added.

Mr. Luís Gustavo Delmont, from CNI, elaborated that CNI is currently in talks to develop new Brazilian national laboratories. “Right now, we are building 23 new innovation laboratories to help the innovation systems in Brazil,” he said. “This effort has the support of various partners outside of Brazil, including Harvard University and the Massachusetts Institute of Technology. We are also building and improving some of the other laboratories that we have in CNI. There are around 63 new laboratories; and we are also building and improving technology services to industries. This is a way that we can help our ecosystem of innovation in Brazil.”

Dr. Borges Lemos elaborated that the initiatives cited by Dr. Ávila and Mr. Delmont are aimed at repairing Brazil’s currently underperforming national laboratory system. Brazil’s national laboratories, created in the 1970s and 1980s, were constructed with what he called a significant deficiency: “innovation was not in the agenda of the Brazilian companies at that time, it was not in the national agenda” said Dr. Borges Lemos. Dr. Roberto dos Reis Alvarez, International Affairs Manager at ABDI, added that Brazil is currently putting in place new models, such as “CSEM Brazil, with an American CTO to work in Brazil” and the CERTI



Dr. M. Katherine Banks, Vice Chancellor and Dean, Dwight Look College of Engineering, Texas A&M University and Dr. Tomás Díaz de la Rubia, Director, Deloitte Consulting LLP

Foundation. “Both of these are new private research organizations in the country,” continued Dr. Alvarez, “that can give the TLSI dialogue participants a flavor of the ideas we are experimenting with and now implementing in Brazil.”

Dr. Jorge Luis Nicolas Audy, Vice President for Research and Graduate Studies, Pontifical Catholic University of Rio Grande do Sul brought the conversation to a close, adding that today, most of the collaboration between the United States and Brazil take place in the science and technological parks in Brazil, such as IBM and General Electric at the Federal University of Rio de Janeiro Science Park, Dell and HP at TechnoPool in the south of Brazil, and Google at the future Belo Horizonte Technological Park. He added that Brazil must focus on developing policies to further stimulate such collaborations.

TLSI DIALOGUE 9

Over-the-Horizon Innovation Challenges and the Opportunities for Public-Private Partnerships

The world faces cross-cutting innovation challenges too large for any one nation to address individually. Working in collaboration with other countries is imperative to developing solutions to problems such as feeding a growing global population, enabling wider access to clean water, and providing sustainable energy for developing cities. The path forward holds many challenges as well as opportunities for connection and collaboration among global stakeholders.

Dr. Tilak Agerwala

Vice President, Systems
IBM

Dr. Agerwala began by noting that growing challenges will demand increased levels of analytical insight, which will in turn demand “cognitive computing to enhance our ability, the world’s ability, to manage the ever-growing complexity facing [global problems].” The next generation will need computers that can process increasing amounts of unstructured data—which is increasingly important to understand economic trends and complex environmental phenomena.

Dr. James Buntaine

Chief Technology Officer
CSEM Brasil

Dr. Buntaine expanded upon Dr. Agerwala’s remarks, identifying additional challenges that need to be addressed, including global warming, scarcity of natural resources, and growing demands for energy. Dr. Buntaine noted the imperative not only to solve these problems, but also to do so in a way that harnesses renewable resources and utilizes globally



Mr. Carlos Berto, Senior Manager, Embraer; Dr. James Buntaine, Chief Technology Officer, CSEM Brasil; and Dr. Mark Little, Senior Vice President and Chief Technology Officer, General Electric Company and Director, GE Global Research

abundant resources rather than create technology which depends on finite resources such as rare earth elements, which can only be produced in small quantities.

Dr. Buntaine then turned towards innovations in computer technology. In response to Dr. Agerwala’s comments, he noted that in addition to computing expertise, a surrounding ecosystem must also be created that is resilient and responsive to continuously improving technologies. Brazil today is forging the connections between computing innovations and real world impact, explained Dr. Buntaine, where collaborations are formed with local talent to address important local problems. In order to take full advantage of the innovations in the computing arena, Dr. Buntaine stressed that the “United States and Brazil need to establish a free and rapid flow of people, equipment, and consumables in the innovation cycle.”

Dr. Mark Little

Senior Vice President and Chief Technology Officer
General Electric Corporation and
Director
GE Global Research

Dr. Little continued the discussion, noting that increased collaboration is needed both internationally and among various institutions within a country. He identified energy, software and the surrounding computing systems, and biofuels as areas ripe for collaboration between the United States and Brazil, and for which GE has already gone to Brazil to build partnerships. While GE previously found collaborations challenging, today the company works effectively with the U.S. government and continues to expand its collaborations across national borders, finding ways to work with foreign companies and governments, and increasingly, even with smaller companies. “We have moved towards working with the Brazilian government, trying to understand their priorities, to help shape their agenda and to build partnerships around this understanding.”

Mr. Luis Cassinelli

Innovation Director
Braskem

Mr. Cassinelli said that the way to best build such connections is by identifying places where the United States and Brazil maintain common interests and working from these common interests to create “projects where both countries have expertise, like second generation ethanol technologies or chemicals from renewable sources.” By beginning with projects where both countries have already formed connections and where both stand to profit from partnering, collaborations will grow more organically and achieve greater resilience.



Mr. Francisco Weffort, New Business Director, Braskem; Mr. Luis Cassinelli, Innovation Director, Braskem; Mr. Roberto Alvarez, International Affairs Manager, Brazilian Agency for Industrial Development; and Dr. James Roberto, Associate Laboratory Director for Science and Technology Partnerships, Oak Ridge National Laboratory

Mr. Laercio Aniceto da Silva

Vice President for Business Development
CERTI Foundation

Mr. Laercio Aniceto da Silva, Vice President for Business Development with the CERTI Foundation, elaborated on Mr. Cassinelli's comments, explaining that CERTI works towards fostering connections and collaborations “between the knowledge that is generated at the university and within the market” and noted CERTI's partnerships with technology companies and universities worldwide. While partnerships are currently limited in number, numerous opportunities exist. A challenge to overcome in increasing these partnerships is the need for greater access to funding and for a more synchronized, less bureaucratic process for co-funding partnerships.



Ms. Candida Oliveira, Chief of Staff, Brazilian Agency for Industrial Development; and Mr. James Phillips, Chairman and CEO, NanoMech Inc.

Dr. Klaus Hoehn

Vice President for Advanced Technology
& Engineering
Deere & Company

Dr. Hoehn then shared an example of how companies and countries can innovate and collaborate. With the exception of Africa, Dr. Hoehn noted that only Brazil has the soil, climate, and solar conditions to constantly produce crops. The recent decision by the Brazilian government to prohibit the incineration of the many millions of tons of residual sugarcane husks post-harvest inhibits the optimal growth of the next season's harvest. Currently, no such solution exists for this "so-called simple problem of removing tons of biomass per hectare. This is an example of a project where Deere collaborates with Brazilian partners to resolve an issue with a potentially negative impact on the global food supply." No one has resolved this

issue, he continued, "but we must. We have to feed two billion more people in a short period of time. We need more food—corn, wheat, soybeans—than ever before." Even more exciting, is the opportunity produced by this legislative decision—the challenge in removing the sugarcane husks can become an opportunity by turning husks into a renewable source of energy.

Open Discussion

The panel then opened the discussion to all TLSI Dialogue 9 participants. Mr. Jim Phillips, Chairman and CEO of NanoMech Inc., asked discussants whether the fear "from the masses is that we are really eliminating jobs, not increasing jobs" through implementation and deployment of innovative technology is valid. Dr. Agerwala replied, "when we introduce Watson in healthcare we do not eliminate jobs. We do not eliminate physicians or any of those important and related jobs. We make people in those jobs more effective and help them make better decisions." He added that there will always be a place for human beings in the economic system, and that with machines, we can make our economic system even better.

Complex problems require collaboration from all sectors and with international partners. Ms. Wince-Smith added, "from the inception of the Council 28 years ago, the mission always centered about collaboration—bringing four sectors together, industry, university, labor and laboratories—to understand challenges and take action. Collaboration is really our core DNA."

TLSI DIALOGUE 9

Innovation Infrastructure

Mr. Roger Kilmer

Chief Manufacturing Officer
National Institute for Standards and Technology (NIST)

Prior to my position as the Chief Manufacturing Officer at NIST, I was the Director of the Manufacturing Extension Partnership (MEP), a nationwide network of centers around the country that work primarily with small- and medium-sized manufacturers to help increase their productivity, innovate, introduce new products into the marketplace and improve their processes. Through the MEP, we align our strategies at NIST with those of the state, and those of large companies by creating partnerships. We see the importance of partnerships emphasized by the federal government as well; many programs are jointly funded, jointly managed, and jointly executed by multiple federal agencies including the National Network for Manufacturing Innovation (NNMI).

In my role as Chief Manufacturing Officer, I help forge connections between the expertise in the NIST laboratories and needs in industry. NIST does not provide standards for industry, but provides the measurement, science, and support needed for both the development and validation of those standards. This expertise is indispensable to any trade and transactional events, including those that occur with Brazil. I am the person who will connect the technology pieces of the NIST laboratories with industry to understand what industry really needs and also to help forecast, predict and lead that effort.

The effort and work accomplished at the NIST laboratories is considered to be foundational research—measurement science—rather than technology collaborations discussed today. My



Mr. Roger Kilmer, Chief Manufacturing Officer, National Institute of Standards and Technology; Mr. Laercio Aniceto da Silva, Vice President for Business Development, CERTI Foundation; and Dr. J. Michael McQuade, Senior Vice President for Science and Technology, United Technologies Corporation

focus on manufacturing at NIST allows me to evaluate a foundational science project with its business case in mind. If there is no business case for a project within some reasonable time frame, at some reasonable cost and at some reasonable scale, then we question the project and think through how to accomplish the stated goals better.

Some challenges arise from partnerships. Partnerships across government, academia, and industry must help the stakeholders understand the value to their organization and help them implement it. From a manufacturing perspective, a challenge is the total diversity—companies of all sizes, from all industry sectors and many different supply chains. Because manufacturing can mean many different things, the solutions to increased manufacturing competitiveness can vary widely.

Source: 2012 Annual Report, Hollings Manufacturing Extension Partnership





Dr. Jose Muñoz, Chief Technology Officer, National Science Foundation and
Dr. Jorge Ávila, President, Brazilian Patent and Trademark Office

Dr. Jorge Ávila

President

Brazilian Patent and Trademark Office (INPI)

I would like to highlight the role the IP system is supposed to play in innovation. IP helps appropriate the results of R&D to innovation investments. The IP system accomplishes that by protecting these investments from a dilution of their value. The backlogs in all Brazilian patent offices are an indicator of the increased interest of companies in protecting their IP, as is the increase in resources which have been allotted to innovative research activities. Under the new operating innovation paradigm in Brazil, the role of IP has not only been emphasized, but expanded; the system of intellectual property rights may facilitate collaboration as a solid basis for R&D collaboration to be negotiated and contracted.

In Brazil, we have advanced our understanding of the role of a country's IP system and its connection with fostering innovation, particularly under the *Plano Brasil Maior*, the central driver of private investments in innovation. At INPI, we believe the IP system should work cooperatively with other countries and collaborate with our sister offices. Many years ago, Brazil and the United States may have disagreed on the correct approach to IP rights, but through collaboration, this situation has changed dramatically. Today, INPI and the U.S. Patent and Trade Office (USPTO) are very close partners. USPTO has helped INPI on many technical issues and we are discussing interesting ideas around building a new international IP system based on the needs of a "knowledge economy." We believe it is necessary to have a common infrastructure when structuring an IP system and we do not think one unique solution already exists in the world. In the context of the World Intellectual Property Organization, Brazil and the United States have been playing a very important role in discussing the future of the patent system and discussing the future treaties regarding different aspects of intellectual property. Particularly relevant to this topic, we are finalizing the discussions on the new industrial design treaty, which has been led by Brazil and the United States for the first time—facilitating R&D collaboration and technology transfer across companies and universities of both countries at all scales.

A significant challenge for Brazil is to develop an innovation and IP culture throughout the entrepreneurial communities. As Dr. Mauro Borges Lemos said this morning, in Brazil, people have been trained

in an institutional environment that neither favors the development of an innovative culture nor encourages companies to use IP for protection or competitive advantage. To combat this, we are disseminating information on best practices regarding IP management among industries and universities in Brazil.

Dr. Agerwala earlier asked me, “When are universities in Brazil going to deal with IP in a better way than they do today?” I don’t know when, but they are trying. Ten years ago, we did not regulate protection of IP at universities and research centers. In 2004, the “innovation law” effectively established the minimum basis for IP protection. At that time, only three universities had formal entities to deal with IP protection. Now under the new law, 244 new entities have been built to serve more than 300 universities and research centers. This relates to what Dr. Dimolitsas mentioned earlier—there is a lack of expertise in promoting technology innovations and negotiating IP rights. This is an opportunity for collaboration between Brazil and the United States, to approach both American universities and similar entities in Brazil to learn more about best practices in technology transfer. Towards this effort, we—in partnership with the USPTO—approached the Association of University Technology Managers (AUTM) to begin this conversation.

This is a learning process and I’m very optimistic. Things are improving fast.

TLSI DIALOGUE 9

Building Talent to Drive Growth Locally and Compete Globally

The seeds of innovation begin with an innovative workforce. Cultivating such a workforce requires understanding needed skills, how students can acquire those skills, and in turn, how those students can be retained. Ms. Wince-Smith noted the continuum of talent required to support an innovative and flourishing economy and the challenge faced in the United States today to develop middle skills talent. She stated that the democratization of talent and skills presents both a huge challenge and opportunity, and addressing this democratization will require examining differential rates in learning along the continuum of talent. For the United States, Ms. Wince-Smith believes that our workforce must move beyond commodity skills to higher value skills.

Dr. Alvarez supported Ms. Wince-Smith's comments and added that talent remains a hot issue globally. Brazil has been working to develop talent in both the public and private sectors, recognizing that education is integral to innovation. The debate continues on the issue of growing talent and new models to facilitate this growth. One measure of success is the more than 100 percent increase of enrollment in higher education in Brazil over ten years, the result of a PPP where the government provided scholarships for students to enroll in private universities. Dr. Alvarez then highlighted concerns both in the United States and Brazil regarding whether jobs exist for those pursuing science and engineering.



Dr. Lawrence Schook, Vice President for Research, University of Illinois and Dr. Roberto Alvarez, International Affairs Manager, Brazilian Agency for Industrial Development

Dr. Ray O. Johnson

Senior Vice President and Chief Technology Officer
Lockheed Martin

In response to Dr. Alvarez, Dr. Johnson asserted “that fifty percent of the new jobs will have STEM components.” Moving beyond simply the need for STEM education, Dr. Johnson touched upon frequent misconceptions of the education system as a whole, sharing that “we have correlated success, wealth, and happiness with a college education.” This correlation “very well may be true, but unfortunately in the United States, I see kids graduating from high school expecting to go to college, not necessarily with the right background to go into STEM fields.” Because of this and a negative perception of manufacturing-related jobs, two-year colleges “prepare kids to go to four-year schools, when in fact these colleges should be preparing them to go to work.”



Dr. Ray O. Johnson, Senior Vice President and Chief Technology Officer, Lockheed Martin Corporation and the Honorable Deborah L. Wince-Smith, President and CEO, Council on Competitiveness

Although math and science are important, Dr. Johnson believes engineering is where theory becomes reality and, in turn, creates value. Because of the importance of engineering, and wanting to create both more and better engineers in the workforce, Dr. Johnson and the Council launched the National Engineering Forum (NEF). The NEF, which seeks to raise engineering to the celebrity career status of doctor, lawyer or CEO, is focused on three C's: capacity, capability and competitiveness. He noted that a national NEF Summit will be held in the near future, along with the national science and engineering festival to expose a broad range of people in the Washington, DC area to the fun and practical sides of engineering. Dr. Alvarez thanked Dr. Johnson for his remarks and proudly noted that in Brazil, "for the first time ever, the numbers of enrollments in engineering are higher than enrollments in law. And this is good for the country."

Mr. Luís Gustavo Delmont

Business Development Analyst
Brazilian National Confederation of Industry

Mr. Delmont began by noting that Brazil's educational system is made up of four institutions: CNI—which is the largest, largely focuses on industry issues; SESI, the social service for workers from industry focused on quality of life issues such as basic education, health and civil services, and sports, culture and leisure activities; SENAC, the National Service for Commercial Apprenticeship that is focused on vocational education as well as facilitating innovation and transfer of industrial technologies; and a fourth institution focused on executive education and corporate education and training programs.

Mr. Delmont then touched upon Brazil's business innovations and the movement currently taking place in Brazil. He noted that since 2008, Brazil has worked with six industrial CEOs to discuss how to drive industrial innovation in Brazil. The latest collaborative dialogue featured sixty CEOs alongside President Rousseff. Currently, about ten different policy agendas are under discussion, each led by one CEO working with industry and government. Mr. Delmont then reiterated the shortage in technical talent, such as engineers, that Brazil currently faces.



Mr. Luis Gustavo Delmont, Business Development Analyst, Brazilian National Confederation of Industry

Mr. Carlos Berto

Senior Manager
Embraer

Mr. Berto suggested that in the future, computers may perform much of the work that engineers perform today. In this situation, people will be needed to think and to create. "Sometimes technical skills are too vertical and do not represent a broad spectrum of thinking," said Mr. Berto. "We need different kinds of thinking to result in really different and innovative things. Sometimes we focus too much on the contents of technical skills, when we actually need people with a broader spectrum of thinking and knowledge."

Mr. Berto also noted the challenges involved in attracting and retaining talent in the aircraft industry, exacerbated by long development times that result in cycles of both shortages and excesses in talent.

To cope with this variability, Brazil has implemented various training programs. In the early 2000s the company developed a training program in partnership with the Instituto Tecnológico de Aeronáutica (ITA) for recent engineering graduates to train for an additional year and a half and further develop practical skills before working in product development for the company.

While this partnership with ITA helps develop practical skills in recent graduates, personal skills such as the ability to communicate and collaborate with others around the world in different languages on increasingly complex work remain an ongoing challenge. Developing interpersonal and communication skills will be critical to preparing future workers for successful careers, not only within the aeronautical sector, but within any innovative company.

Dr. Lawrence Schook

Vice President for Research
University of Illinois

According to Dr. Schook, what we are seeing now in the workforce is that "a lot of education does not necessarily mean you have talent. We have students with a lot of education—a lot of information—but talent is ability to use that information to solve problems." Solving problems is one of the cardinal elements of any research university. Beyond building talent in the classroom, Dr. Schook noted that the University of Illinois is fortunate to have an associated university research park, enabling students to obtain classroom experience during the day and to work on teams to solve real world industrial problems during the evenings and weekends.



Dr. Lawrence Schook, Vice President for Research, University of Illinois

Dr. Schook then alluded to Dr. Borges Lemos' earlier comment regarding the challenges of spurring innovation through Brazil's national laboratories, noting that the problem is not unique to Brazil. "We all focus on the idea that it's easy to build buildings. It's easy to put in programs. But it's very hard to really create innovation... I think the challenge is to create these innovation ecosystems where we can bring the right individuals together who have been well trained and begin to utilize their talents and education to solve complex problems."

Dr. Schook concluded his remarks by turning from technical talent creation to talent retention. "We retain talent by giving people ownership of their ideas," he noted. "The earlier students have ownership of their idea, ownership of the solution, they connect to the university. They won't leave their idea, so they stay."

Dr. Alvarez then brought the panel to a close, highlighting five key topics that were discussed regarding the development of talent pools and asking dialogue participants to consider potential areas for U.S.-Brazil collaboration in the education space during the upcoming Innovation Summit:

1. The STEM mindset needs to be developed beyond engineering and the hard sciences to reach across all levels of the education spectrum;
2. Numerous issues must be addressed regarding emerging models of education and talent development;
3. The case must be made for education and training in the STEM fields, both in the United States and in Brazil;
4. Of particular importance to Brazil, leaders must determine if public-private partnerships have the ability to improve human capital development to better respond to private sector demand; and
5. Methods for companies, countries and regions to retain talent must be further examined.

TLSI DIALOGUE 9

Roundtable discussion for the 3rd U.S.-Brazil CEO Innovation Summit

Ms. Wince-Smith opened up a roundtable discussion on the upcoming 3rd U.S.-Brazil CEO Innovation Summit on September 11 and 12 in Rio de Janeiro, Brazil, noting some of the possible themes that have emerged: next generation energy; the manufacturing revolution; the nexus of food, energy, and water; the information technology ecosystem, including both the enablers and the challenges; and the entire continuum of the health and life sciences.

Mr. Ernesto Henrique Fraga Araújo

Chargé d'Affaires
Embassy of Brazil

Mr. Fraga Araújo thanked Ms. Wince-Smith and noted that President Rousseff will come to the United States on October 23 for the first state visit by a Brazilian president since 1995. Brazil hopes that the innovation agenda will be at the center of her talks and her activities in Washington, DC and that the economic relationship and partnership between Brazil and the United States can be further strengthened. "We believe that innovation can be one of the keys to unlock an enhanced relationship," he added, "because we think it might fit perfectly with the domestic agenda in both countries, the shared goal of becoming or being a middle class, knowledge-based society with a strong manufacturing base. Our questions of jobs, of technology, of creativity, of education around the concept of innovation can be a real driving force for the relationship."

Mr. Fraga Araújo cited the 3rd U.S.-Brazil CEO Innovation Summit as "the most advanced and one of the most creative endeavors that we have between the two countries," noting that the U.S.-



"Innovation can be one of the keys to unlock an enhanced relationship between Brazil and the United States."

Mr. Ernesto Henrique Fraga Araújo

Chargé d'Affaires
Embassy of Brazil

Brazil CEO Innovation Summit in September is strategically positioned to contribute to President Rousseff's agenda. "We hope that it can, as it has in the past and maybe more so now, generate the ideas and the initiatives brought to the attention of and be consolidated by the two heads of state one month later."



Ms. Gianna Sagazio, Advisor to the President, Brazilian Development Bank (BNDES)

Ms. Gianna Sagazio

Advisor to the President
Brazilian Development Bank

Ms. Sagazio began by speaking on the importance of innovation for BNDES. BNDES serves as the main financing agent for development in Brazil promoting innovation is a priority for that development. Through the *Plano Brasil Maior*, BNDES aims to “stimulate business innovation and investment to increase Brazilian competitiveness, sustain economic growth and improve the quality of life of the Brazilian population.”

She also highlighted the recent launch of *Inova Empresa*, the entrepreneurial innovation plan through with the Brazilian government aims to expand the level of business investment in innovation in Brazil and supports projects with

technical risk. Within this plan BNDES hopes to strengthen relationships between companies, research institutes, and universities. This plan in its entirety aims to form a “national innovation system” to support the competitiveness of the entrepreneurial sector, and the September Innovation Summit will help advance the system’s formation.

Mr. Luís Gustavo Delmont

Industrial Development Analyst
National Confederation of Industry Brazil

Both events present an opportunity for all participating Brazilian entities to build relations with one another as well as with their U.S. counterparts. In particular, the upcoming Summit will provide the opportunity to create more partnerships and strengthen the relationship between the United States and Brazil.

TLSI DIALOGUE 9

Here and Now: “Big Data”

Mr. Evans introduced two members of the TLSI, Dr. J. Michael McQuade, Senior Vice President of United Technologies Corporation (UTC) and Ms. Dona Crawford, Associate Director of Computation for Lawrence Livermore National Laboratory (LLNL), as well as Mr. Gilberto Teixeira, President and CEO of Elo Electronic Systems and invited them to discuss the challenges and opportunities of Big Data in an era increasingly characterized by churn, transformation, and transition.

Dr. J. Michael McQuade

Senior Vice President, Science and Technology
United Technologies Corporation

Dr. McQuade opened the conversation by providing UTC's perspective on Big Data. At UTC, Big Data means thinking about “what is in our products, how our products work, what we need to make our products work and what we need to deliver our products to our customers.” From there it moves upstream to ubiquitous sensing: “how do we measure anything, anywhere, anytime, every chance we can get?”

Dr. McQuade noted a few areas that UTC associates with Big Data, like ubiquitous sensing. Ubiquitous sensing consists of two components: internal operations and “fleet management.” Analyzing internal operations—the movement of goods, supplies, people, parts, and the subsequent data analytics—raises questions on managing the entire supply chain more effectively, and what signals, analysis and measurement tools and techniques are needed to do so. In fleet management, UTC considers how to optimize fleet performance, which requires sensing as well as both local and distributed computation, where fleet



Mr. Roger Kilmer, Chief Manufacturing Officer, National Institute of Standards and Technology; Mr. Laercio Aniceto da Silva, Vice President for Business Development, CERTI Foundation; Dr. J. Michael McQuade, Senior Vice President for Science and Technology, United Technologies Corporation; Ms. Dona Crawford, Associate Director for Computation, Lawrence Livermore National Laboratory; and Dr. Tilak Agerwala, Vice President, Systems, IBM

refers to all manner of resources, from vehicles to elevators and HVAC equipment. Dr. McQuade noted that UTC also thinks about the offline analysis of what those fleets are doing and how to use data to manage both short-term and long-term performance to benefit the company and the customers. An example of this offline analysis is collecting data during helicopter flights and using the information to determine service intervals to optimize product lifespan.

Resulting from efforts to achieve ubiquitous sensing, UTC engages in two key research thrusts: sensor optimization and cybersecurity. In optimizing sensors, the Big Data questions that must be addressed are: “When is enough data enough? When is too much too much? What happens when you do not have robust systems and decisions must be made with



Ms. Dona Crawford, Associate Director for Computation, Lawrence Livermore National Laboratory; and Mr. Gilberto Teixeira, President and CEO, Elo Electronic Systems

uncertainty built into the system?” Because of this third question, UTC conducts research in uncertainty quantification. Because of the generation of large amounts of data, the second research thrust is cybersecurity: protecting data, algorithms, and custodianship of the data. Protecting this information becomes a non-trivial task, continued Dr. McQuade, “in a real time world where we use the internet to access large datasets to manage performance.”

Dr. McQuade concluded his remarks by noting that various challenges are linked with these research areas including the definition of data ownership and data authenticity. Using common data sources raises a variety of issues with regard to data authenticity and data security, as well as “significant issues around the responsibility for performance when using these data sources.” Crowdsourcing to define large databases and data techniques, creates further obstacles that will need to be addressed.

Mr. Gilberto Teixeira

President and CEO
Elo Electronic Systems

Mr. Teixeira noted that the “magnitude of files in the acquisition of data and the uses of data have always fascinated me.” Even with his work through Elo Electronic Systems, which deals with data generation instruments and largely with smart electricity meters, Mr. Teixeira still finds the data generation capacity of new devices to be astounding.

In this discussion around Big Data, Mr. Teixeira noted his main worry with regards to data ownership “is the capability of technology to acquire data without the knowledge of people or things generating it.” Mr. Teixeira elaborated that the enormous potential social and economic value in stored information should be considered “a social, ethical, and legal worry.” Big companies, government, universities, and other organizations should work together to understand the operational opportunities for and the complexities around Big Data. Mr. Teixeira continued with questions for dialogue participants to ponder.

- Is private data your own property, or is it public? “Information costs money to be acquired, to be stored, to be structured, to be made available,” he said. “The value that it can aggregate to some company should be considered.”
- What is socially acceptable today, and who should discuss and evaluate this approach? Mr. Teixeira noted that while many American companies—for instance, Google and Amazon—lead today in terms of collecting personal data, global players should have the opportunity to contribute their thoughts when defining policies and implementations that everyone will need to live with, for the good and for the bad, in the future.



Dr. J. Michael McQuade, Senior Vice President for Science and Technology, United Technology Corporation; Ms. Dona Crawford, Associate Director for Computation, Lawrence Livermore National Laboratory; and Dr. Tilak Agerwala, Vice President, Systems, IBM

Ms. Dona Crawford

Associate Director for Computation
Lawrence Livermore National Laboratory

Ms. Crawford began by describing LLNL as a national security laboratory, defined broadly as “domestic security, international security, economic security, environmental security,” she said. “We approach the protection of national security through science, technology and engineering.” For national and global security purposes—such as counterterrorism, nonproliferation, critical infrastructures, and our financial and global trade systems—“we need to be able to collect and analyze data to make good decisions.”

The ability to collect data does not necessarily mean it can be easily translated and analyzed. As mentioned earlier, data is collected in numerous incompatible standards, systems, and formats; to

achieve the potential that Big Data promises, data must be collected intelligently. Further, patterns must be discovered within the data to create knowledge, so that decision-makers can better predict what may happen and make decisions.

Ms. Crawford noted that LLNL uses modeling and simulation to try to understand physical phenomena and use that understanding to make better predictions, which introduces the need for high performance computing (HPC). Big Data and HPC overlap in technology, among other things. As an example, during modeling and simulation, high performance computers generate a tremendous amount of data; to validate models, large amounts of data from sensors on an experimental apparatus are required. High performance computers are then needed to analyze the experimental data.

Ms. Crawford noted that IBM uses the term “data-centric deep computing,” which highlights this overlap. “These two fields increasingly approach each other. We cannot work with Big Data without big machines,” she said. Under today’s understanding of the two topics, “the underlying technology is about eighty percent the same. The difference lies in the mindset and culture of these two groups. This difference produces one group that considers issues of data privacy, providence, ownership and another that wants to calculate and investigate because it’s now possible.” As these groups converge, the concerns around data privacy, providence, and ownership will likely become a larger and louder discussion for everyone—not just those in technology fields.

TLSI DIALOGUE 9

Conclusion

Ms. Wince-Smith thanked Dr. Dimolitsas and Georgetown University for hosting the discussion, the three TLSI co-chairs for their ongoing leadership, and the Brazilian delegation for joining in the first-ever global TLSI dialogue. She also invited guests to join the various National Engineering Forum dialogues taking place around the United States throughout the coming months. She then turned to the co-chairs for final remarks.

Dr. Johnson thanked everyone for joining, and shared that his endeavor with the National Engineering Forum, is aimed at achieving the Global Engineering Forum. He suggested starting a partnership with Brazil around broadening the scale and scope of the National Engineering Forum around engineering and education. Dr. Little also thanked the group, and in particular the Brazilian delegation, and welcomed the opportunity for future and ongoing collaborations with Brazil. Dr. Hoehn added that the day's dialogue provided further positive proof to TLSI contributions in solving global challenges by spurring public-private partnerships. He proposed that future TLSI dialogues should continue to build on this theme of global collaboration and interaction. "All the issues we are trying to address are not going to be solved overnight," he added. "But if we do have the patience and the endurance to go through that process, we will be contributing to the good of societies around the world and the good of our companies or organizations as well."



Dr. Klaus Hoehn, Vice President, Advanced Technology and Engineering, Deere & Company and Dr. Spiros Dimolitsas, Senior Vice President and Chief Technology Officer, Georgetown University



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