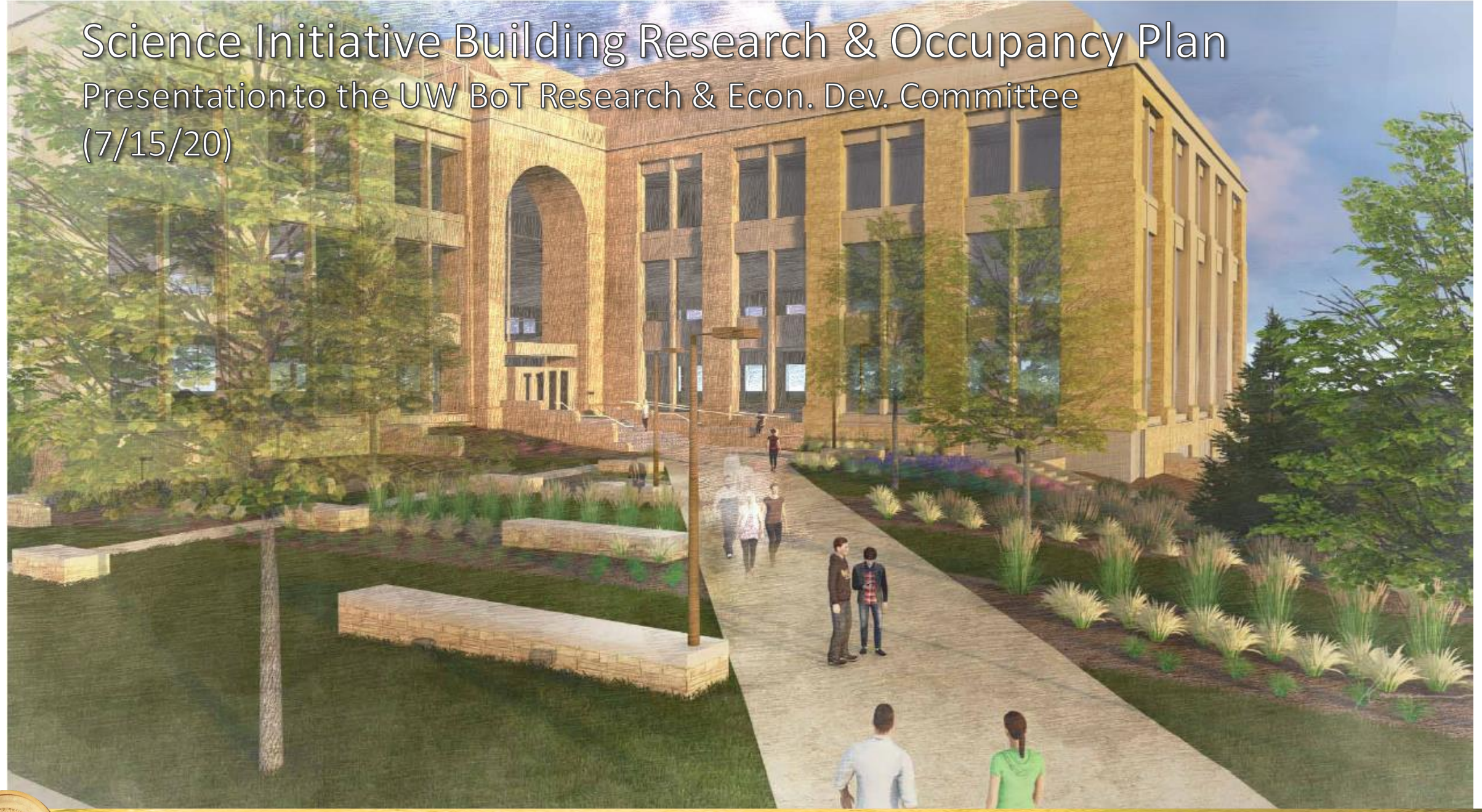
**Committee on Research and Economic Development**
**Tentative Agenda Topics and Documents**

1. Science Initiative Update – (Jay Gatlin)
   *Dr. Gatlin's previous presentation attached for reference
2. Council of Competitiveness update (David Sprott) –
   *see attachment and/or *https://www.compete.org* for information/reference
3. ATTAIN update - Electronic Research Administration project
4. UW Regulation 9-1 (Patents and Copyrights) – See attachments
5. ORED Optimization plan

# Science Initiative Building Research & Occupancy Plan

## Presentation to the UW BoT Research & Econ. Dev. Committee (7/15/20)



# Presentation Outline:

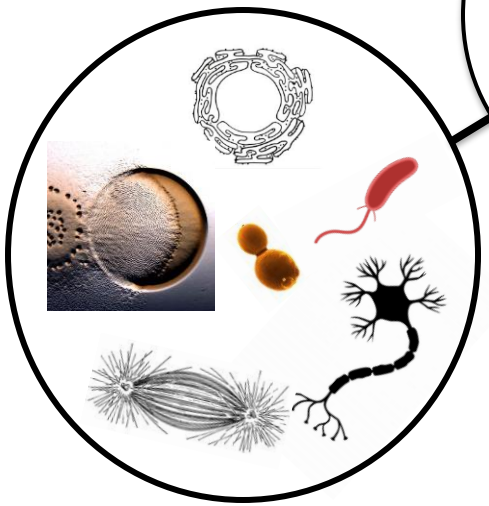
- **Vision for research in the Science Initiative Building (SIB)**
- **Virtual tour of research space**
- **Occupancy Criteria**
- **Selected SIB researchers**
- **Critical Planned (but unfunded) Resources**
- **Question & answer session**

# Vision

Organismal Biology

SIB Research

Cell Biology



Earth Systems Biology

# Vision

**The Science Initiative Building is expected to…**

- **Promote synergistic activities between its researchers resulting in new scientific frontiers, increased funding & productivity, and more opportunities for undergraduate and graduate student research/training.**
- **Generate cost-saving efficiencies in space and instrumentation to reduce operational expenses and start-up costs.**
- **Enable UW to be even more competitive in attracting world-class faculty in the life sciences.**
- **Establish a culture of exceptional research and high expectations that transcends individual departments.**

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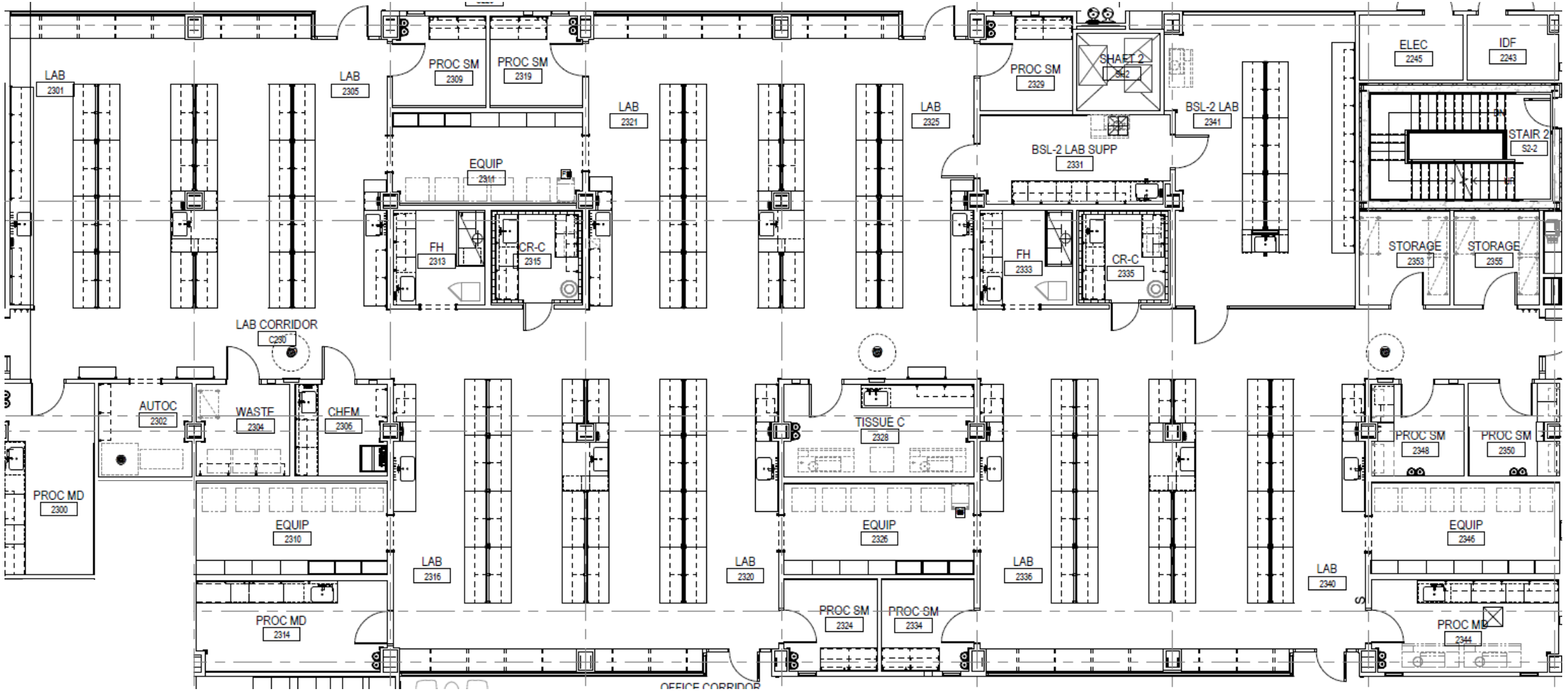
# Research Space Overview

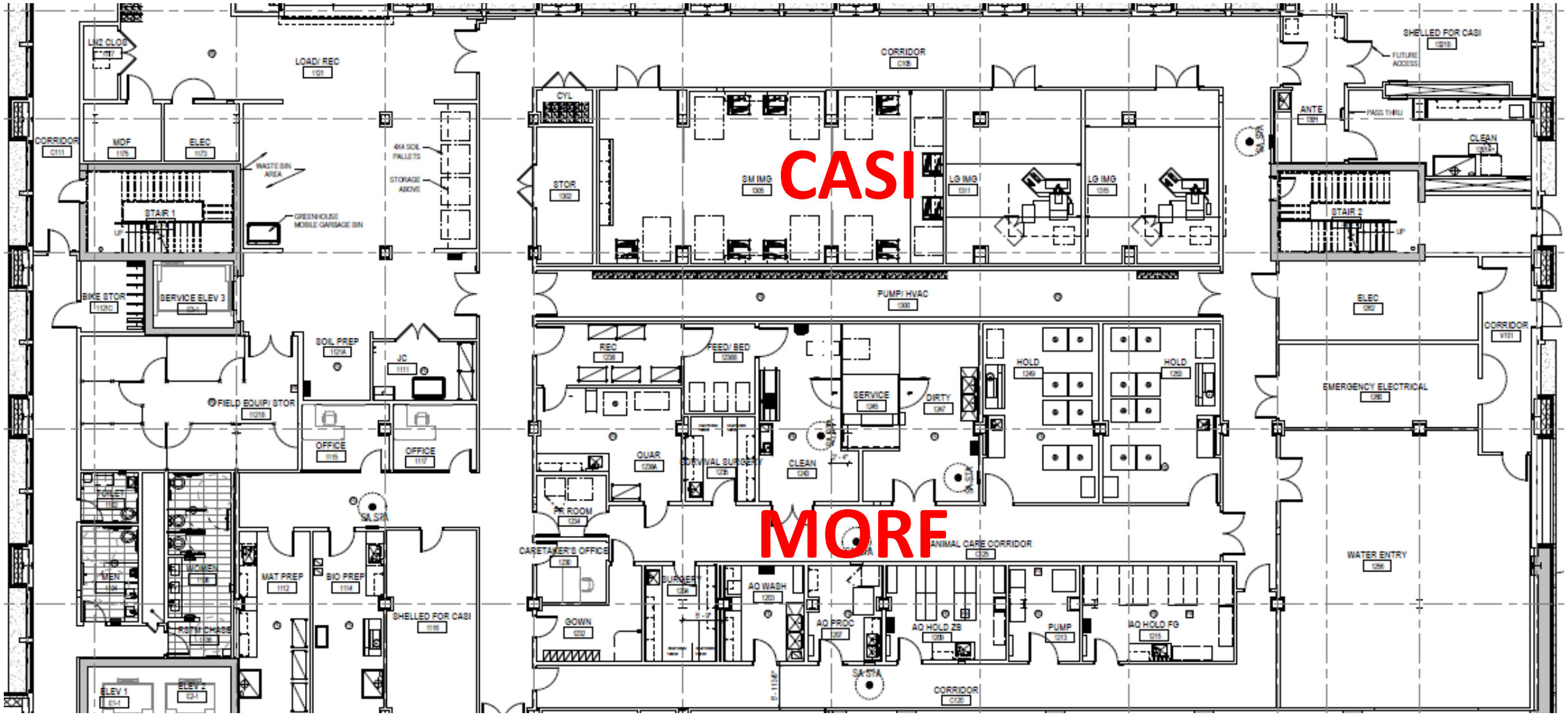
# Research Space
# Zoom-in Level 2



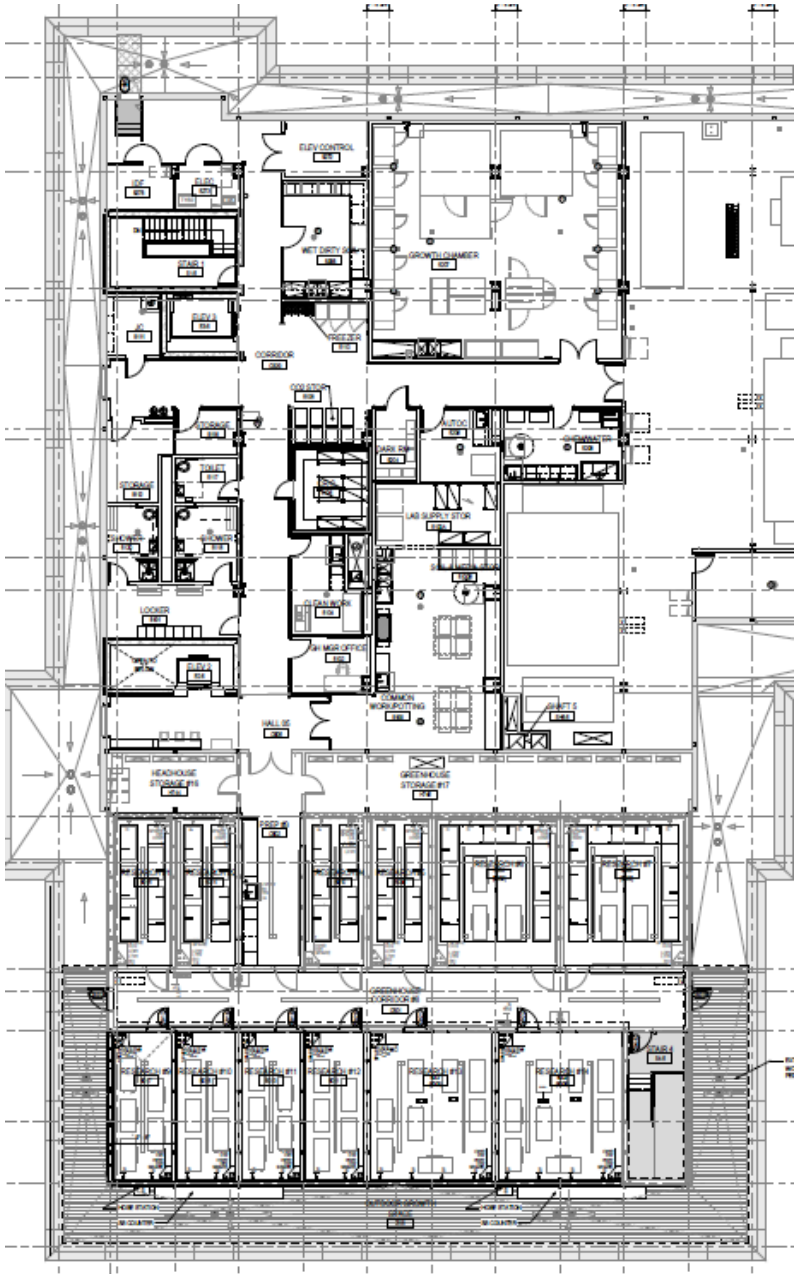
# Research Space

## Virtual Tour of Level 3 (provided by the EIC's Shell 3D Visualization Center)

# Shared Research Facilities
## Zoom-in Level 1



# Shared Research Facilities
## Zoom-in Level 5



**Growth chambers & Greenhouses**

# Presentation Outline:

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# Occupancy Criteria:

- ***Alignment of Research Interests:***

  **Candidate research interests should be aligned with one of the three major SI themes.**

- ***Potential for Research Synergy:***

  **Competitive candidates will possess evident potential to (i) synergize with ongoing SI Building research and (ii) use resources housed within the new SI building, including instrumentation in the Center of Advanced Scientific Instrumentation (CASI) and the Model Organism Research Facility (MORF; i.e. vivarium & greenhouses).**

- ***Justification/Benefit of Move (for on-campus investigators):***

  **Candidates currently conducting research elsewhere on the UW campus should be able to provide compelling justification of a move to the SI Building and how this move will benefit their research, their department, and the University as a whole.**

# Occupancy Criteria (cont):

- ***Record of collaborative/interdisciplinary research:***

  **Competitive applicants will have strong records of collaborative and interdisciplinary research with an emphasis on the past 5 years (established investigators) or well-described plans for such research activities (new investigators).**

- ***Record of commitment to undergraduate research:***

  **Competitive applicants will have a strong track record (established investigators) or a well-articulated plan (new investigators) for integrating undergraduate students into their research activities.**

- ***Maintaining "balance" within the SI Building research enterprise:***

  **The SI Oversight Committee will take into account the relative proportion of researchers and space allocated to each of the three main SI Building research themes with the explicit goal of maintaining balance. The committee will also strive to promote opportunities for new investigators within the SIB.**

# SIB Researchers (current invitees)

## Organismal Biology



Sho[illegible]uren
B[illegible]ex
Van Diepen, Linda
Weiss-Le[illegible]ann,
Chr[illegible]her
Weinig, Cynthia

## SIB Research

## Cell Biology

Boothby, Thomas
Bowman, Grant
Cherrington, Brian
Fay, David
Gatlin, Jay
Jarvis, Don
Levy, Dan
Navratil, Amy
Park, Eunsook
Schoborg, Todd

## Earth Systems Biology

Collins, Sara
Currano, Ellan
Ewers, Brent
Laughlin, Daniel
Murphy, Melanie
Shuman, Bryan
Ward, Naomi

# Presentation Outline:

- **Vision of research in the Science Initiative Building (SIB)**
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# Model Organism Research Facility

## Small Animal & Aquatics Husbandry

**Small-mammal cage systems & support**

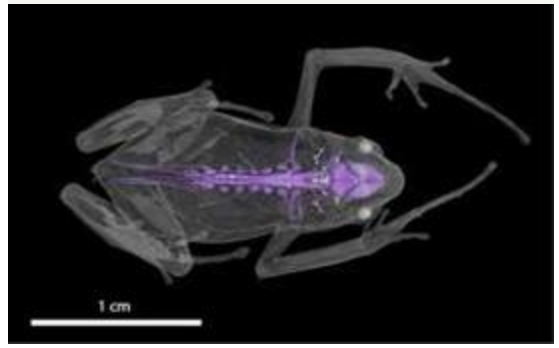
**Amphibian/fish aquaria systems & support**

(est. completion cost: $3.7 + 2.2 million)

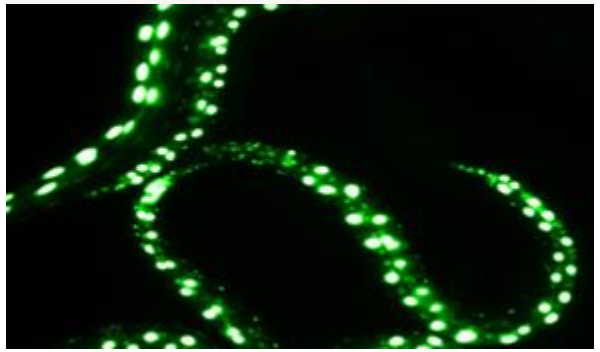
# Center for Advanced Scientific Instrumentation

## Initial Instrumentation Suite

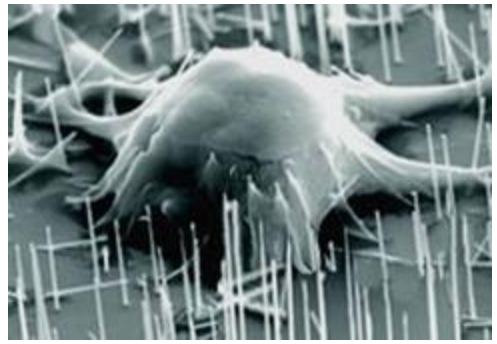
**Organism-scale imaging facilities**



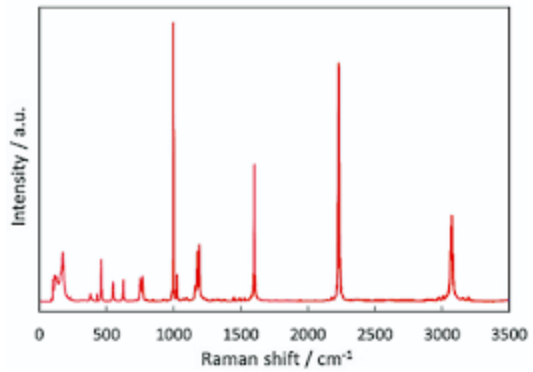

**Light microscopy core**




**Atomic-scale microscope facility**




**Misc instrumentation**




(est. cost: $9.8 million + staff salaries & annual maintenance contracts)

# Acknowledgements:


## CASI Steering Committee Members

Prof. Chip Kobulnicky, Physics & Astronomy (Chair)
Prof. Jay Gatlin, Molecular Biology
Prof. David Andersen, Chemistry (replaced by Prof. Debashis Dutta 2020)
Dr. Zhaojie Zhang, Zoology & Physiology
Prof. Bill Rice, Physics & Astronomy (replaced by Jifa Tian 2020)
Prof. Carl Frick, College of Engineering
Prof. Ken Driese, Botany (replaced by Prof. Katie Wagner, 2020)
Dr. Susan Swapp, Geology & Geophysics
Prof. Larry He, Pharmacy, College of Health Sciences
Tabatha Spencer, Science Initiative

## SI Building Occupancy Committee Members

Ed Synakowski, VP ORED
Diane Hulme, AVP ORED
Prof. Mark Lyford, SI Director
Prof Greg Brown, Botany
Prof. Bryan Shuman, Geology
Prof. Ginger Paige, ESM
Prof. Brent Ewers, Botany
Prof. Jonathan Prather, Zoology & Physiology
Prof. Scott Seville, Zoology & Physiology
Prof. Jay Gatlin, Molecular Biology

## SI Building Design Contributors

Molecular Biology Department faculty
Botany Department faculty
Geology Department Faculty
Numerous other faculty (many already on this list)

# Questions


# National Commission on Innovation & Competitiveness Frontiers

## A Council Plan to Redefine 21st Century Productivity, Prosperity and Security

# Table of Contents

# Vision for the Council's Next 5 Years

In today's global economy, low costs, high quality, rapid product and service design and deployment, and organizational dexterity all come together and form a baseline to compete—but, increasingly, these traits characterize many markets and nations.

Long-term prosperity requires strengthening this baseline—but it requires more.

It requires placing ever more attention on innovation to confer competitive advantage. Why? Innovation is a proven driver of productivity and economic growth, job creation, and rising living standards.

While the United States has stood apart from the rest of the world during the past half century in its record of sustained innovation, across industries old and new, and through the ups and downs of economic cycles, the nation today faces new realities and new imperatives transforming the context for continued innovation leadership. For example:

- **The United States faces new—perhaps even existential—challenges to its global leadership in innovation**. On the one hand, other nations are rapidly replicating the structural advantages that historically have made the United States the center of global innovation by investing in education and job skills, building modern information technology and network infrastructures, implementing laws to protect intellectual property and opening their markets to global trade.

  But on the other hand—and perhaps more challenging—is the fact that other nations and regions are developing their own, distinctive innovation ecosystems, which may not be compatible with or friendly to the U.S. system.

  Widespread fears that high-paying jobs are migrating overseas—or that automation is obviating these jobs—are just an aspect of this transformation. In the global marketplace, innovation is no longer a "nice to have." It is essential to be prepared to compete both with those playing by the same rules, as well as those looking to rewrite the global innovation and competitiveness playbook.

- **The nature of innovation has changed.** A dramatically more interconnected, turbulent and transforming world—driven by the convergence of the digital, the atomic and the genetic—places the American innovation enterprise at a distinctive inflection point in history.
- **The nation faces a fundamental change in how it thinks about and pursues innovation**. It is now possible for someone to imagine, develop and scale a disruptive technology independent of traditional institutions of innovation. And new business models are emerging, challenging the traditional; cutting the linkage between production and capital; increasing the pace of innovation by collapsing boundaries between fields, sectors and disciplines—thereby setting the stage for disruptive innovation.

What will America do in the face of these challenges at home and coming from abroad? Will we plan for the long term? Will we put in place the talent, innovation capital and infrastructure necessary for continuing success? Will we recognize the multifaceted nature of this problem and come together across all sectors to form a new "innovation compact" for economic and productivity growth?

The tremendous opportunity for the Council on Competitiveness (Council)—and this National Commission on Innovation and Competitiveness Frontiers—is to work with its members and other critical stakeholders around the United States to double down on all efforts to optimize the nation for this new, unfolding, innovation reality.

# Commission Goals

To confront and overcome critical challenges facing the U.S. innovation engine…

To create momentum in the United States to outpace the rest of the world in innovation capacity, capability and competitiveness…

To build on the Council's history of work in defining, articulating and activating America's innovation movement…

And to develop new-to-the-world partnerships and efforts to launch and scale innovation-based research, businesses and ventures in the United States…

The Council Board and Executive Committee has called for the formation of a new, **National Commission on Innovation & Competitiveness Frontiers**, (Commission) a multi-year effort to focus on America's innovation and competitiveness challenges and opportunities.

The opportunity for the Council is to leverage its distinctive membership, network and history to optimize the nation for a new, unfolding, innovation reality that will shape America's prosperity for the next half century.

Over the coming years, the Commission will assemble top minds from industry, academia, labor and the national laboratories to:

- Sharpen national, regional and local leaders' understanding of a dramatically changing innovation ecosystem, and provide them a **prioritized policy recommendation Roadmap for the coming decade**;
- Harness changes in the global innovation ecosystem and implement the Commission's recommendations to **accelerate and sustain annual productivity growth**, and **push U.S. living standards (GDP per capita) to the top of global rankings** by the end of the decade;
- **Address, propose and potentially launch private, public and public-private solutions to specific national and global grand challenges**—as defined by the Commission's work.

The Commission will explore and define today's long-term innovation drivers—from technologies to business models—and develop a national **Innovation Call to Action**, recommending the best private and public sector strategies to enhance and expand the nation's innovation capacities at the heart of competitiveness.

# Why the Council on Competitiveness?

The Council is strategically poised to launch and carry out this proposed Commission and work plan. The Council stands recognized as the world's most credible, non-partisan voice for innovation policy.

- The Council has an over 30-year proven track record in bringing together diverse stakeholders and interest groups—across the private and public sectors—to articulate, elevate and resolve cross-cutting challenges facing the nation through deep research and leveraging that research into concerted action:
  - From our work in the 1980s to define America's first critical technologies list;
  - To the **Going Global: The New Shape of American R&D** initiative that documented in the early 1990s, for the first time, the globalization of the industrial R&D enterprise;
  - To our **Energy, Security, Innovation and Sustainability** project that linked innovation to America's ability to fuel its manufacturing renaissance in a sustainable way;
  - To our path-breaking **National** and **Regional Innovation** initiatives of the late 1990s an early 2000s that mapped out the country's first private sector driven innovation agenda and underpinned the long-standing America COMPETES legislation;
  - To our more recent **Exploring Innovation Frontiers Initiative** with the National Science Foundation to lay the groundwork for a new national innovation agenda in an era of democratized innovation capabilities, and intense technological transformation and convergence.
- The Council is able to capitalize on expertise and networks from all of its current, major program areas to support the broad national innovation agenda of this proposed Commission—in particular:
  - Linking the findings and outcomes from the decade-strong Technology Leadership & Strategy Initiative that brings together 40+ chief technology officers from industry, academia and the national laboratories;
  - Incorporating the critical recommendations from the Energy & Manufacturing Competitiveness Partnership;
  - Leveraging existing Congressional and administration outreach, as well as its strategic, global engagements.
- The Council has successfully cultivated multi-decadal, bi-partisan support for its major initiatives in Washington, D.C. and around the country.
- The Council has created a peerless, cross-disciplinary innovation network at the local, state, regional, national and international level—along with concrete partnerships to carry out its innovation agenda.

# The Path Forward for the Commission

As Americans enter the third decade of the 21st century, a new urgency, a new innovation reality, and new imperatives face the nation. The Commission will acknowledge and respond to the urgency, understand and describe this new reality, and position the nation to prosper and thrive with a clear set of recommendations.

The Executive Board of the Council will invite distinguished CEOs, university presidents, national laboratory directors and labor leaders to join the Commission and launch this multi-year work plan along three critical competitiveness pillars:

1. Developing and Deploying at Scale Disruptive Technologies.
2. Exploring the Future of Sustainable Production and Consumption, and Work.
3. Optimizing the Environment for the National Innovation System.

- **The Commissioners**—representing pre-eminent thought leaders and "doers" whose concerted commitment to innovation and competitiveness has the potential to move the needle in this country toward a more pro-innovation stance—will work to guide and prioritize the most important talent, technology, innovation and infrastructure investments the nation must make to drive long-term productivity growth, economic strength and sustainability, and inclusive prosperity.

  The Commissioners will also serve as the public face and advocates of the effort—not only strategically shaping and approving the Commission's final reports, statements, etc., but also participating in their release.

  Commissioners will convene twice a year over the lifespan of the Commission: participating in one physical meeting each year, and having the option also to engage in the Council's annual National Competitiveness Forum.

- The Commissioners will appoint and have access to the counsel and support of an **Advisory Committee** of innovation leaders from all sectors of society. These high-level advisors will be the day-to-day points of contact and advice for the Council team driving the Commission's research and supported by a dynamic set of **Working Groups** (see next bullet).

  The Advisory Committee will serve as a strategic screen for the Commissioners—helping to coordinate and review the efforts of the Working Groups, as well as setting goals and tracking progress for the Working Groups. And in conjunction with the Council staff, the Advisory Committee will develop the final set of recommendations and reports for review, debate and approval by the Commissioners and the Board of the Council.

- The Commission will also have purview in appointing and suggesting topic-specific experts, leaders and colleagues from their or other organizations to populate a set of **Working Groups**. Each Working Group will study discrete issues and produce interim and final reports for initial review by the Advisory Committee (and, ultimately, the Commissioners). These reports will be integrated into a set of ongoing reports and recommendations the Commission will be releasing each year at the Council's National Competitiveness Forum.

## Council on Competitiveness Executive Board

**Dr. Mehmood Khan**
Chief Executive Officer
Life Biosciences, Inc.

**Mr. Brian T. Moynihan**
Chairman and Chief Executive Officer
Bank of America

**Dr. Michael M. Crow**
President
Arizona State University

**Mr. Lonnie Stephenson**
International President
IBEW

**Ms. Deborah L. Wince-Smith**
President & Chief Executive Officer
Council on Competitiveness

## Commission

30-50 distinguished senior leaders from industry, academia, national laboratories and labor

## Outreach & Engagement Committee

PR/Media
Political Liaison
Events Management
Tech Support

## Advisory Committee

30-50 innovation leaders from industry, academia, national laboratories and labor

## Working Groups

1. Developing and Deploying at Scale Disruptive Technologies
2. Exploring the Future of Sustainable Production and Consumption, and Work
3. Optimizing the Environment for the National Innovation System

The Working Groups will comprise representatives of the Commission, members of the Advisory Committee, and Council members and national affiliates. The Working Groups will also be open to issue area experts suggested by Commissioners. The Working Groups will meet in D.C. and across the country in a series of moderated dialogues; research issues in their field; and produce reports with a set of manageable, achievable and impactful recommendations to the Commission.

- An **Outreach & Engagement Committee** will develop and manage for the Commission a creative and actionable media, outreach and government relations strategy, as well as logistics and technical support for the initiative. This Outreach & Engagement Committee will comprise experts appointed by the Commissioners, as well as engaging media/outreach professionals specifically charged with amplifying the efforts and findings of the Commission.

In joining and leading this effort, Commissioners will be:

- Distinguishing themselves and their organizations as one of the nation's pre-eminent innovators—and articulating for a national and global audience what matters most for innovation success.
- Playing a role in defining and highlighting the cutting-edge of technological innovation–as well as receiving first-hand knowledge of technological advances critical to their own organizations and industry.
- Sharpening and driving pro-innovation policy at a time in which the innovation ecosystem is dramatically changing at the local, state, regional and national levels.
- Addressing, proposing and launching private, public and public-private solutions to specific national and global grand challenges, as defined by the Commission itself.
- Engaging with a unique set of peers from across industry, academia and the national laboratory system—a peer set that extends beyond traditional organizational and disciplinary boundaries.
- Harnessing the concrete findings of their work—new policies, new partnerships, new businesses—to affect a massive and transformational turn-around in the nation's systemic decline in productivity growth.

# Commissioners

Dr. Mehmood Khan, Co-chair
Chief Executive Officer
Life Biosciences, Inc., and
Chairman
Council on Competitiveness

Dr. Michael Crow, Co-chair
President
Arizona State University, and
University Vice-chair
Council on Competitiveness

Mr. Brian Moynihan, Co-chair
Chairman and Chief Executive Officer
Bank of America, and
Industry Vice-chair
Council on Competitiveness

Mr. Lonnie Stephenson, Co-chair
International President
IBEW, and
Labor Vice-chair
Council on Competitiveness

Dr. Steven Ashby
Director
Pacific Northwest National Laboratory

Dr. Dennis Assanis
President
University of Delaware

Dr. Mark Becker
President
Georgia State University

Mr. John Chachas
Managing Partner
Methuselah Advisors

Mr. Jim Clifton
Chairman and CEO
Gallup

Dr. Victor Dzau
President
National Academy of Medicine

Dr. Taylor Eighmy
President
The University of Texas at San Antonio

The Honorable Patricia Falcone
Deputy Director for Science and
Technology
Lawrence Livermore National Laboratory

Mr. George Fischer
Senior Vice President and President,
Global Enterprise
Verizon Business Group

Ms. Janet Foutty
Chair of the Board
Deloitte

Dr. Wayne A. I. Frederick
President
Howard University

Dr. W. Kent Fuchs
President
University of Florida

Ms. Joan T.A. Gabel
President
University of Minnesota

Dr. Sheryl Handler
President and CEO
Ab Initio

Mr. Charles O. Holliday, Jr.
Chairman
Royal Dutch Shell plc

Mr. G. Michael Hoover
President & CEO
Sundt Construction

The Honorable Steven J. Isakowitz
President and Chief Executive Officer
The Aerospace Corporation

Dr. Keoki Jackson
Vice President and Chief Technology
Officer
Lockheed Martin

Dr. Robert Johnson
Chancellor
University of Massachusetts Dartmouth

Dr. Paul Kearns
Director
Argonne National Laboratory

Dr. Pradeep Khosla
Chancellor
University of California, San Diego

Dr. Timothy Killeen
President
University of Illinois System

Dr. René Lammers
Chief Science Officer
PepsiCo, Inc.

Dr. Laurie Leshin
President
Worcester Polytechnic Institute

Dr. Thomas Mason
Director
Los Alamos National Laboratory

Dr. Gary May
Chancellor
University of California, Davis

Dr. Jonathan McIntyre
Chief Executive Officer
Motif Ingredients

Gen. Richard Myers
President
Kansas State University

Dr. Mark Peters
Director
Idaho National Laboratory

Dr. Edward Ray
President
Oregon State University

Dr. M. David Rudd
President
University of Memphis

Dr. Cathy Sandeen
Chancellor
University of Alaska Anchorage

Dr. Kirk Schulz
President
Washington State University

Dr. Elisa Stephens
President
Academy of Art University

Dr. Claire Sterk
President
Emory University

Mr. Steven Stevanovich
Chairman and CEO
SGS Global Holdings

Mr. Sridhar Sudarsan
Chief Technology Officer
SparkCognition, Inc.

Mr. Andrew M. Thompson
President & Chief Executive Officer
Proteus Digital Health

Dr. Satish Tripathi
President
The University at Buffalo

Dr. Satish Udpa
Interim President
Michigan State University

Dr. Marty Vanderploeg
Chief Executive Officer and President
Workiva

Dr. Kim Wilcox
Chancellor
University of California, Riverside

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

Dr. Wendy Wintersteen
President
Iowa State University

Dr. Michael Witherell
Director
Lawrence Berkeley National Laboratory

Dr. W. Randolph Woodson
Chancellor
North Carolina State University

Dr. Thomas Zacharia
Director
Oak Ridge National Laboratory

**WITH ADDITIONAL SUPPORT FROM:**

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Palantir Technologies, Inc.

# Setting the Stage for the Commission Working Groups

Despite significant strengths in its innovation capabilities and capacities—documented in the Council on Competitiveness *2018 Clarion Call for Competitiveness*—U.S. competitiveness is dynamic and ever transforming. And our nation's comparative position in the global competitiveness arena can change rapidly.

Now and into the future, U.S. companies, industries and our national and regional economies that expect to compete will have to rise to the challenge of this dynamic, and reorganize for an age of growing technological, economic and political disruption. Our government, communities and our education system must be prepared to support rapid change, and help those who are displaced or negatively affected by technological and competitive changes.

When the United States controlled the global direction of technology, we were positioned to control our economic destiny. That position is no longer guaranteed.

The United States must take stock. We must assess if our innovation ecosystem and its investments are enough to maintain our global economic and technological leadership. And, as technology seeps into nearly every aspect of American life, our national leaders and our governments at every level must bolster their knowledge and response capabilities to match the strengthening global competition, technological change and coming disruptions.

**What will the United States do in the face of challenges at home and coming from abroad?**

Will we plan for the long term, transforming challenge to opportunity? Will we put in place the talent, innovation capital and infrastructure necessary for continuing success in the decades to come? Will we recognize the multifaceted nature of today's global innovation race, and come together across all sectors to form a new "innovation compact" for economic growth, productivity and inclusive prosperity?

To confront and overcome critical challenges facing the U.S. innovation engine…

To create momentum in the United States to outpace the rest of the world in innovation capacity, capability and competitiveness…

To build on the Council's history of work in defining, articulating and activating America's innovation movement…

And to develop new partnerships and efforts to launch and scale innovation-based research, businesses and ventures in the United States.

The Board and Executive Committee of the Council has formed the National Commission on Innovation & Competitiveness Frontiers (Commission) to prepare the Nation for a new, unfolding and evolving innovation reality that will shape the nation's prosperity for the next half century.

In the first year of the Commission's work, the Council will build a powerful set of recommendations with **Working Groups focused on three core pillars:**

1. **Developing and Deploying at Scale Disruptive Technologies.**
2. **Exploring the Future of Sustainable Production and Consumption, and Work.**
3. **Optimizing the Environment for the National Innovation System.**

Following in this document are charters for each of the three Working Groups—defining challenges and opportunities, and posing potential questions for review by the Working Groups.

# Summary of Issues Highlighted in Working Group Charters

| Developing and Deploying at Scale Disruptive Technologies | Exploring the Future of Sustainable Production and Consumption, and Work | Optimizing the Environment for the National Innovation System |
|---|---|---|
| • Disruptive technologies (uses/impacts; biotechnology, sensorization, Internet of Things, big data, autonomous systems, artificial intelligence), etc.<br>• U.S. position in a multipolar technology world<br>• Ecosystem that can accelerate U.S. technological innovation (speed, scaling-up technology, and optimizing the system; barriers to speed)<br>• U.S. R&D investment compared to other countries<br>• U.S. public R&D investment; government programs<br>• Foreign competitor programs<br>• National program integration with state and regional programs<br>• Role of universities in supporting breakthrough innovations; university-industry partnerships<br>• Science and technology infrastructure<br>• China as rising technological superpower<br>• National leadership and strategy | • New, radical forms of sustainable production<br>• Business sustainability practices<br>• Sustainable consumption in cities and metros<br>• Public attitudes (i.e., does the public practice sustainability)<br>• Collaborative work with machines<br>• New, digitally-enabled forms of work organization; potential benefits to employers and workers; new skills, laws, regulations, and support systems needed<br>• Gender equity<br>• Strength of U.S. entrepreneurial and start-up punch; valleys of death; ecosystem for nurturing start-ups and tech entrepreneurs<br>• Development and reallocation of human capital in technology-driven reorganization of the economy; rising skill needs/skill gaps among dislocated industrial workers; role of U.S. education system, particularly higher education; transformation of higher education to serve diverse needs<br>• Aging U.S. science and engineering workforce | • Capital/tools to invest in innovation (venture capital, Federal funding, foreign investment, new FIRRMA provision on non-controlling foreign investments in technology firms)<br>• Intellectual property (diverse business needs/uses vs. one-size fits all system; challenges to business in accessing university IP; IP protection and theft)<br>• Standards (with examples in AI, autonomous systems, driverless vehicles, nanotechnology, gene-editing and personalized medicine; standards development for rapidly advancing technology)<br>• Global environment for high-tech trade (non-tariff barriers; examples in U.S. pharmaceuticals and digital trade; pressure to transfer technology for market access; Administration's more muscular approach)<br>• New mercantilism (Belt and Road) |

# Working Group 1: Developing and Deploying at Scale Disruptive Technologies

## Mission

The **Developing & Deploying at Scale Disruptive Technologies Working Group** aims to identify long-term, productivity and prosperity-enhancing technology pathways for the United States, and to recommend steps needed to ensure the development and deployment activities around these pathways create sustained value in the United States (jobs, new companies and industries, wealth, better living standards, etc.).

To accomplish this aim, the Working Group will map promising, strategic technology pathways to enhance productivity and economic growth. Building on those roadmaps, the Working Group will create and prioritize concrete, sector-appropriate (government, industry, academia, national laboratories, workforce) recommendations to bolster the talent, investments and infrastructure supporting the technology pathways.

## Timeframe

The Working Group will:

- Form in late summer and fall 2019, following the launch meeting of the Commission.
- Convene physically in early 2020 for cross-Working Group level set conference.
- Continue virtual engagement in spring 2020, with potential physical meetings hosted by a Commissioner.
- Target delivery of final recommendations at a summer 2020 Commission meeting.

## Background

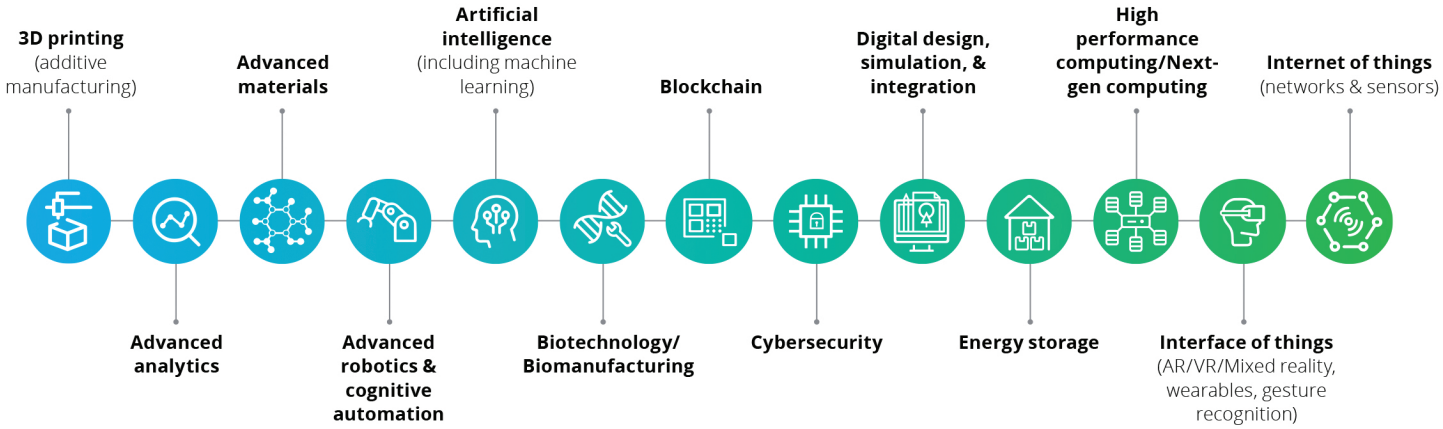
Great revolutions in science and technology are rapidly advancing—a new phase of the digital revolution characterized by vast deployment of sensors, the Internet of Things, artificial intelligence and big data; biotechnology and gene-editing; nanotechnology; autonomous systems; etc.

Each of these technologies—and others still emerging—has numerous applications that cut across industry sectors, society and human activities. Each is revolutionary; each is game-changing in its own right. But they are now colliding and converging on the global economy and society simultaneously. They are the drivers of 21st century global competitiveness, economic growth and productivity, with profound implications for U.S. national security and society. U.S. economic growth, jobs and standards of living will hinge on our ability to leverage and scale these technologies for economic impact.

For example:

**Biotechnology**
The cost of gene sequencing has dropped more steeply than Moore's Law, igniting the scaling of biotech in research; in industries such as agriculture, food, healthcare and pharmaceuticals; energy; and retail genomics screening for health risks and ancestry. New gene-editing technology such as CRISPR-Cas9 is taking biotech to the next level with, theoretically, the ability to cut and paste bits of DNA into the genome of any living thing with unprecedented precision and efficiency. Recently, a Chinese researcher announced he gene-edited human embryos with the aim of conferring HIV resistance, which resulted in the birth of twins, whose memory and cognition may have also been enhanced by

**Figure 1. A Snapshot of Exponential and Disruptive Technologies Driving Innovation**
Source: *Exponential Technologies in Manufacturing, 2018*, Council on Competitiveness, Deloitte and Singularity University.




the gene edit.[1] It has been reported that Chinese scientists used gene-editing to create transgenic monkeys with extra copies of a human gene that may play a role in human intelligence. As reported, the gene-edited monkeys demonstrated improved short-term memory.[2] Researchers are also working in the field of synthetic biology—stitching together long stretches of DNA and inserting them into an organism's genome, or synthesizing an organism's entire genome—to modify or create novel biological organisms not found in nature.

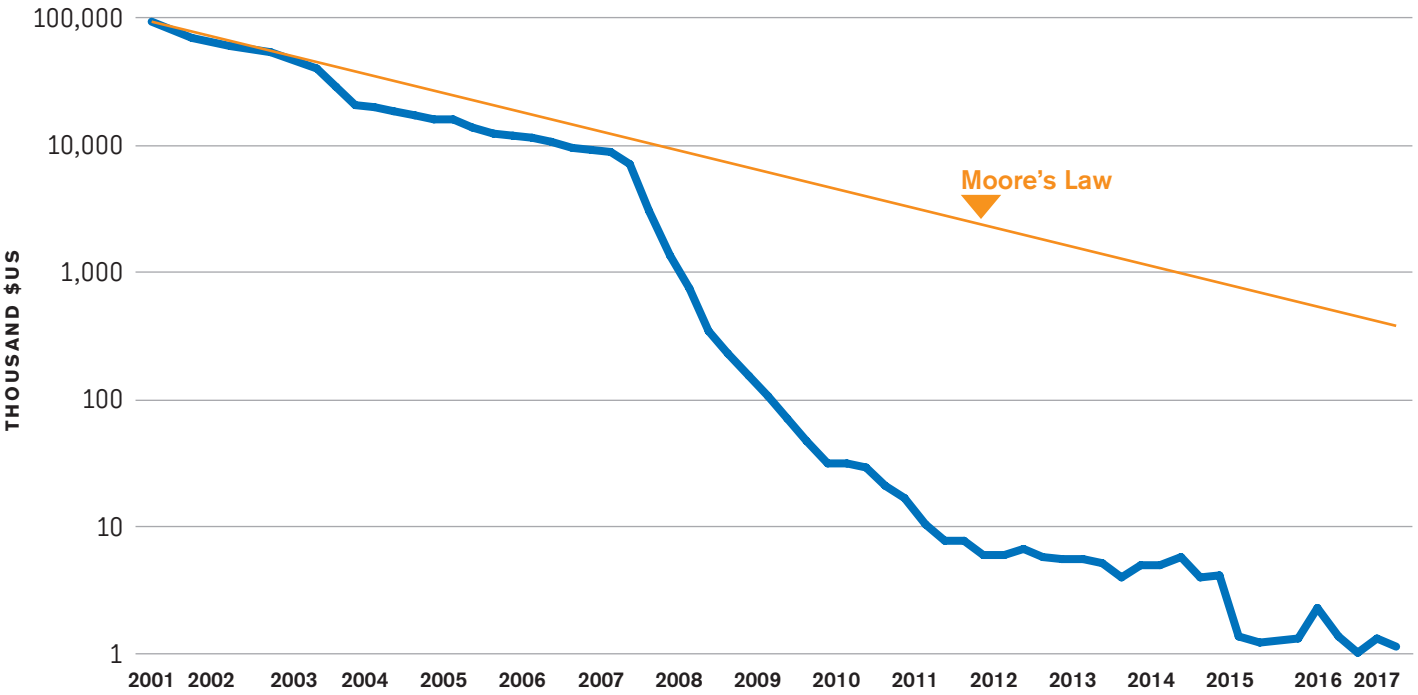
## Sensorization and the Internet of Things

Development of the largest system in human history is underway, in essence, a "nervous system" that detects, sends signals and responds, generating data at unprecedented scale for analysis. A wide variety of sensors are being deployed rapidly across natural, built, production and personal environments, many of them connected to networks. These sensors and networks are connecting people, machines and objects in a wide range of human activity, including industrial production, supply chains, the military, transportation systems, agriculture, utilities, public works, health monitoring, environmental monitoring and more. In these venues, the data generated and higher levels of control offer new ways to improve productivity, optimize production, improve products,

1 China's CRISPR Twins Might Have Had Their Brains Inadvertently Enhanced, Technology Review, February 21, 2019.

2 Chinese Scientists Have Put Human Brain Genes in Monkeys—and Yes, They May be Smarter, MIT Technology Review, April 10, 2019.

**Figure 2. Cost Per Genome**
Source: National Human Genome Research Institute, genome.gov/sequencingcosts.




enhance services and safety, and reduce costs. For example, it has been estimated that productivity gains based on the Industrial Internet of Things could add $15 trillion to global GDP by 2030.[3]

## Big Data

In addition to sensors deployed across natural and built environments, people are also generating mind-boggling amounts of data collected through cell phones, social media, transactions, internet searches, wearable devices and other activities. Estimates indicate this data tsunami is nearly doubling in size every two years, and pouring into every area of society and the economy.[4] Stunning analytic power is unleashed. Big data and data analytics are providing powerful new tools for gaining insight in a wide range of fields, such as business, manufacturing, marketing and advertising, financial transactions, health care, sports and entertainment, crime fighting, agriculture, transportation management, disaster management, animal migration, astronomy and historic research.

3 Industrial Internet, Pushing the Boundaries of Minds and Machines, Peter Evans and Marco Annunziata, GE, November 26, 2012.

4 The Digital Universe of Opportunities: Rich Data and the Increasing Value of the Internet of Things, IDC, April 2014.

For example, harvesting data from its user base of 2 billion people, Facebook can enable a previously unimaginable level of targeting, offering advertisers hundreds of thousands of personal attributes from which to choose in targeting ads.[5]

### Autonomous Systems

Deployment of autonomous systems is accelerating. Self-driving automated vehicles could be available within the next decade, with disruptive effects on employment and infrastructure, and numerous manufacturing and service industries such as auto manufacturing and repair, parking garages, the taxi industry, goods delivery, mass transportation systems, road and highway construction, traffic management and urban planning. Drones are deploying in a wide variety of applications, and about 2 million industrial robots are in operation worldwide, expected to grow to 3 million by 2020.[6] The use of service robots is increasing in areas ranging from logistics and medical applications to lawn mowing and window cleaning. Robots and autonomous systems are likely to become commonplace, working in homes and offices, assisting in hospitals and classrooms, helping run farms and mines, and caring for the elderly. These systems will interface and team with humans to enhance our daily lives and change the patterns of society.

> …the one who becomes the leader in this sphere (AI) will be the ruler of the world.
>
> **Vladimir Putin**
> President of Russia

### Artificial Intelligence

AI could be one of the most disruptive technologies of the 21st century. Broad application of AI could lead to an intelligent society, disrupting business, societal patterns, the workforce, the global balance of power and how we live our lives. It has been estimated that AI could contribute $15.7 trillion to global GDP by 2030, bigger than the GDP of any country other than the United States.[7] The nation that leads in AI—in its development, application and deployment—will lead and benefit from a massive global transformation.

## Issues

**The United States must compete in a multipolar technology world.** In 1960, the United States dominated global R&D, accounting for a 69 percent share of global R&D investment.[8] The U.S. share has dropped to 29 percent in 2017,[9] diminishing U.S. dominance and leverage over the direction of technology advancement. U.S. competitors around

5 The Secretary, United States Department of Housing and Urban Development, on behalf of Complainant Assistant Secretary for Fair Housing and Equal Opportunity vs. Facebook, Inc., Charge of Discrimination, March 28, 2019.

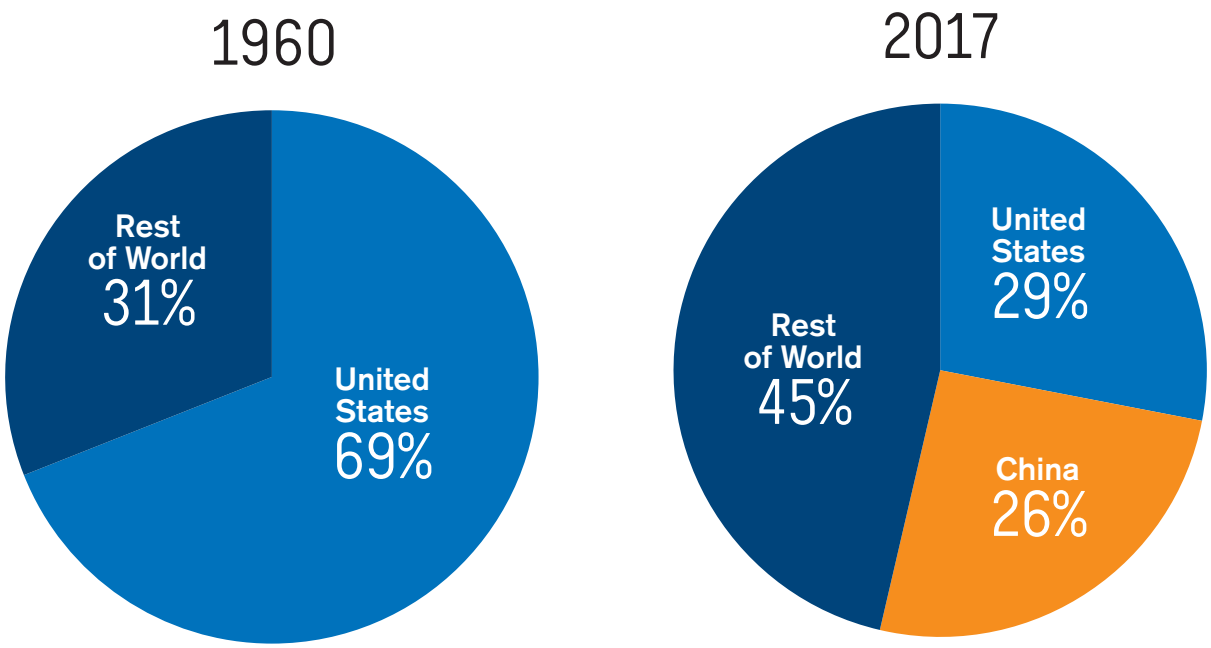
6 Robots Double Worldwide by 2020, International Federation of Robotics, May 30, 2018.

7 Sizing the Prize: What's the Real Value of AI for Your Business and How Can You Capitalise? PriceWaterhouseCoopers, 2017.

8 U.S. Department of Commerce, Office of Technology Policy, *The Global Context for U.S. Technology Policy*, Summer 1997.

9 Main Science and Technology Indicators, OECD.

**Figure 3. U.S. Share of Global R&D Expenditures**
Source: OECD.




the world seek to leverage emerging technologies to advancing productivity, job creation, standards of living and, in some cases, their geopolitical goals. As a result, many deploy policies and programs to scale new technologies and innovation, and to create a business environment to achieve this impact. These countries are instituting their own distinctive innovation ecosystems, which may not be compatible or friendly with U.S. systems of innovation.

Some nations' science, technology and innovation efforts are strongly guided by national strategic plans, and many have high-level ministries devoted to stimulating technology and innovation. Many countries have national research programs or projects that target emerging technologies and fields. Other countries may deploy protectionist policies and illicit means to advance their technology positioning.

**Potential questions for the Working Group to consider:**

- What is the outlook for U.S. global competitiveness in the application and deployment of disruptive technologies?
- In which of these technologies is the United States comfortably ahead globally, behind or at risk of falling behind?
- What factors account most for the U.S. global competitive position in disruptive technologies?

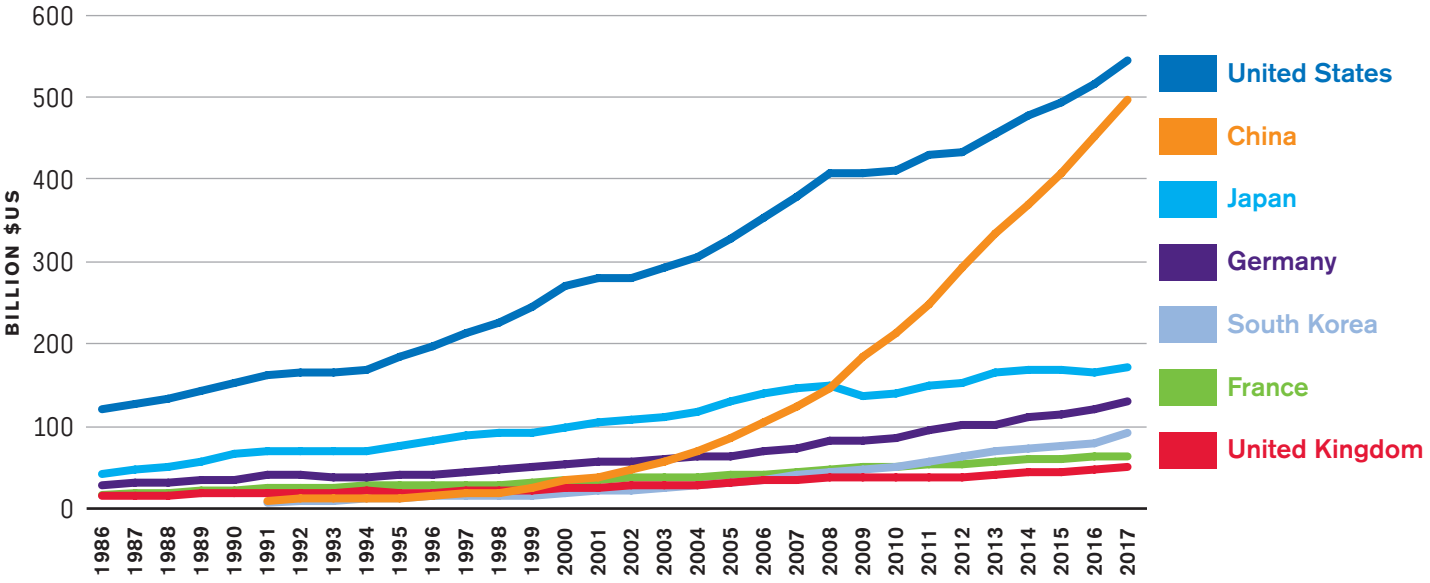
- Should the United States move its global technology leadership to the top of the national agenda?
- What kind of leadership structure in government—in both the Executive Branch and Congress—is needed to address the multiple factors affecting technology development, commercialization, deployment, and innovation in a strategic and integrated way?
- Should the U.S. government systematically monitor what other nations are doing to advance and scale new technologies and innovations?

**Gearing up an ecosystem that can accelerate U.S. technological innovation.** As the pace of technological change accelerates, achieving higher levels of U.S. GDP growth and maintaining U.S. global competitiveness will depend on the rate of U.S. innovation and flow of U.S. innovation processes.

**Potential questions for the Working Group to consider:**

- To what degree does the United States need to accelerate technology development, commercialization and deployment? How much faster do we need to go to keep pace with the technological and economic disruption that is happening? Can the current system be optimized to operate at that pace?
- Can the "tech transfer" model of innovation scale to the size of the emerging opportunities and operate at the speed at which technology is accelerating and disruption occurring?
- What in the fundamental structure of the U.S. innovation system is dragging down the speed at which the United States develops and scales new technologies?
- What factors play the most pivotal role in the speed with which the United States develops, scales and deploys technologies? What factors in government, universities and the private sector? What are the highest priorities for change?
- Overall, is the United States investing enough in research and technology development ($543 billion annually; 2.79 percent of GDP)? What areas of investment require more funding to maintain U.S. global technology leadership. Basic research? Applied research? Development? Research centers, hubs, accelerators, etc.?
- Do we need new types of R&D programs, such as national technology initiatives, technology focused centers and hubs, critical technology targeting, etc.? Should these efforts target the dynamism and innovation capabilities concentrated in U.S. metropolitan areas?
- In this era of disruptive technology and rising strategic competition, what is the proper balance between the speed and dynamics of marketplace, and greater national investment and strategic planning? Can these co-exist in a productive way?
- How can the efforts of national government be better integrated with those at the state and local level?
- How do we link geographic clusters of innovation to rural areas that need economic revitalization? Can we afford the costs (rural schools, health care, infrastructure)?

**Figure 4. Gross Domestic Expenditure on R&D**
Source: OECD Main Science and Technology Indicators




- Does the United States need to rethink how its spends its public R&D investment? Are we spending it at the right pivot points? And how can we spend it in ways that ensure the opportunities created by this investment are captured by the United States?
- As they become more globalized and remain open in their research, do U.S. research universities have a responsibility to help ensure U.S. taxpayers capture the benefits from the university R&D they fund? What more could universities do? Should they protect the technology?
- Should we embed more public R&D in private organizations as a measure of protection and ability to drive development toward commercialization?
- Should the United States launch a global dragnet for top researchers and innovators, and encourage them to come and work in the United States?
- Companies increasingly look outside the firm for breakthrough innovations, while technology breakthroughs increasingly come from universities and small start-up companies. Yet, industry spends just one percent of its R&D investment at universities.[10] What do research universities need to do to make partnering more attractive and productive for industry? Should universities seek routine industry input to shape and guide the research they perform? Do we need to reexamine IP/licensing models?

10 Table 6, U.S. R&D Expenditures, by Source of Funds and Performing Sector: 1953-2017, National Patterns of R&D Resources: 2016-17 Update, National Science Foundation, February 27, 2019.

- Are greater funding and more programmatic efforts needed to scale promising technologies being developed by U.S. start-ups? What would these efforts be, and who would deploy them?
- How can we increase flows of innovation across industries, enabling companies to tap innovations outside of their own industries?

**Key U.S. science and technology infrastructure is eroding.** Infrastructure that supports knowledge creation and technology development is vital for the 21st century knowledge economy and U.S. success in innovation-based global competition. This includes laboratories, research and technology demonstration centers, supercomputers, test-beds, wind tunnels, propulsion and combustion facilities, simulators and other user facilities. America's national laboratory system is considered a globally unique competitive asset. But, across the system, core scientific and technological capabilities are potentially at risk due to deficient and degrading infrastructure.

**Potential questions for the Working Group to consider:**

- How do we convince national leaders and the American public that this infrastructure is just as important to the economy as roads, bridges, waterways, etc., and worthy of substantial investment?
- Looking forward—facing accelerating technological advancement and other disruptive developments, such as the industrialization of space—what should be the plan for new science and technology infrastructure?

**Confronting rising competitive superpowers.** U.S. competitors around the world seek to build and strengthen knowledge and tech-based economies as the basis for advancing productivity, job creation, raising standards of living and, in some cases, advancing geopolitical goals. As a result, many deploy policies and programs to harness science, technology and innovation, and to create a business environment to achieve this impact. These countries are instituting their own distinctive innovation ecosystems, which may not be compatible or friendly with the U.S. innovation system.

Of particular concern—for social, economic and national security reasons—China is rising as a strategic competitive challenger, aiming to wrest global technology leadership from the United States. China:

- Is rapidly strengthening in science and technology. Its investment in R&D has more than doubled since 2010, reaching $496 billion in 2017, second only to the U.S. investment, and now accounts for 26 percent of R&D spending globally.
- Has overtaken the United States in science and engineering publications, and posted double-digit growth rates in international patent filings in every year since 2003, and now lags only the United States in patents filed.[11]
- Is growing its global venture investments at a rapid pace and is focusing on technologies foundational to future innovation: artificial intelligence, autonomous vehicles, augmented/virtual reality, robotics, gene-editing and the entire semiconductor industry ecosystem.

11 Patent Cooperation Treaty Yearly Review 2018, World Intellectual Property Organization, 2018.

## Will the 21st century economic center of the world be in the United States, or in Beijing, Berlin or Bangalore?

China is pursuing aggressive plans to dominate the next generation of technology. National policies—such as the 13th Five-Year Plan on National Scientific and Technological Innovation and the Made in China 2025 Plan ($3 billion committed)—are concerted efforts to cultivate indigenous technological innovation, backed by commitments for hundreds of billions of dollars in investment. China's national plan for artificial intelligence is breathtaking in its scope and ambition—estimated at more than $150 billion—a blueprint for constructing an AI innovation ecosystem that they believe will make China the world's AI leader by 2030. They have laid out a vision for the deployment of AI in the construct of society, with plans to invest billions, believing that the nation the leads in AI will shape a global transformation of the economy, society, human activity and national security. This will be backed up by plans also to invest more than $20 billion in the next-generation integrated circuit industry.

China is deploying a multi-pronged strategy to acquire technologies and intellectual property from other countries, including the United States, by both licit and illicit means. This includes building research centers in U.S. innovation hubs, forming partnerships with U.S. research universities, forced joint ventures for market access, sending students to the United States for academic studies, cyber theft and industrial espionage. Moreover, China's model of military-civilian fusion and its policies seek to reduce institutional barriers between civilian and defense science and technology, and to connect the People's Liberation Army, its defense R&D and manufacturing enterprises, government agencies, universities and private companies to create an ecosystem that delivers advanced technologies for China's military.[12]

**Potential questions for the Working Group to consider:**

- For both economic and national security, does the United States need to ensure that China (or other nations and regions) does not achieve an overmatch position against the United States in technology?
- In which critical technologies is the U.S. competitive position at risk of ceding to China? The European Union? Are there areas of technology for which we need to shore up U.S. efforts?
- Do we need a better understanding of the extent of China's technology collecting in the United States? Does the United States need to crack down on these efforts and how?

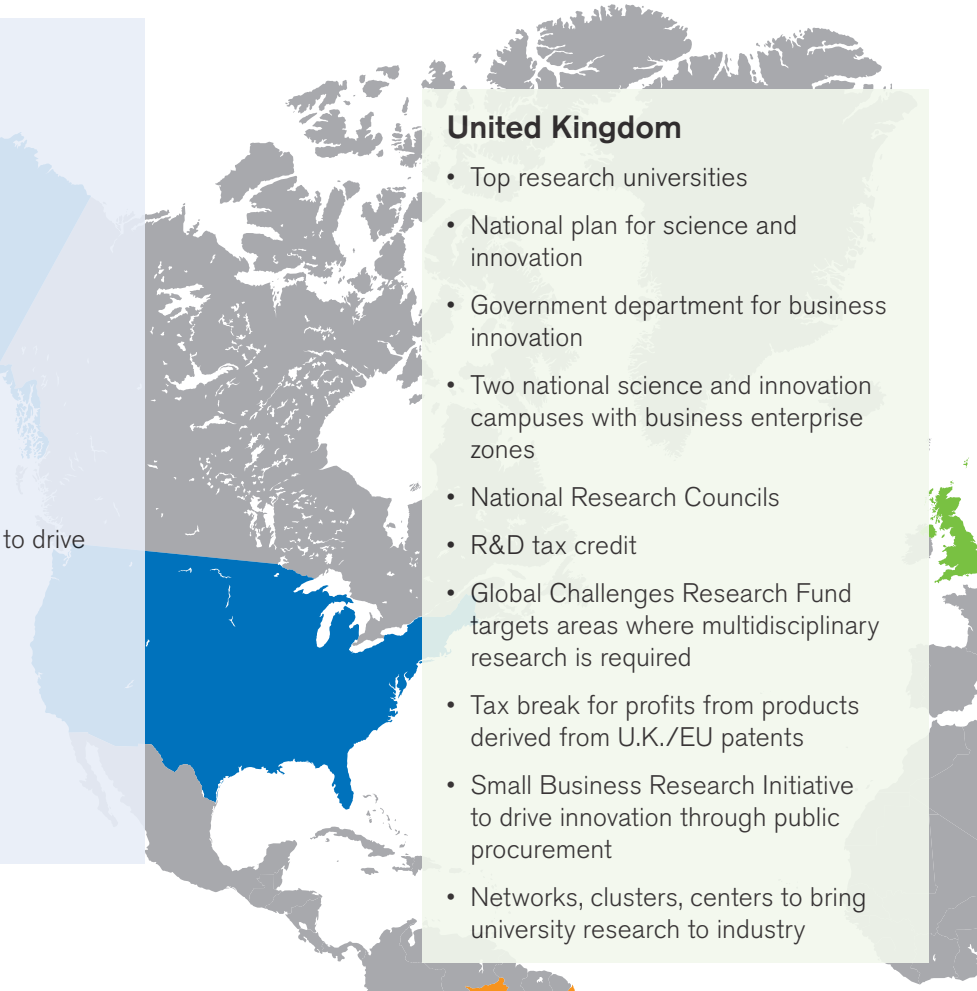
12 Blurred Lines: Military-Civil Fusion and the "Going Out" of China's Defense Industry, Pointe Bello, December 2016.

## Figure 5. Illustrative Innovation Ecosystem Characteristics/Practices

Sources: OECD Science, Technology and Innovation Outlook 2016; Science and Engineering Indicators 2018, National Science Foundation; 2018 Global R&D Funding Forecast, R&D Magazine, Winter 2018; national S&T plans.

### United States

- No. 1 global R&D spender
- No. 1 global spender on basic research
- No. 1 global spender on applied research
- Large expenditure on military R&D
- Business dominates R&D spending
- National research programs
- Unique national laboratory system
- Top research universities
- R&D tax credit
- Small Business Innovation Research program to drive innovation for government missions
- Manufacturing Innovation Institutes
- Science and research parks
- Start-up culture
- Strong venture capital system
- State/regional innovation programs



### United Kingdom

- Top research universities
- National plan for science and innovation
- Government department for business innovation
- Two national science and innovation campuses with business enterprise zones
- National Research Councils
- R&D tax credit
- Global Challenges Research Fund targets areas where multidisciplinary research is required
- Tax break for profits from products derived from U.K./EU patents
- Small Business Research Initiative to drive innovation through public procurement
- Networks, clusters, centers to bring university research to industry

### Brazil

- National science and technology programs
- Targeting key sectors
- Government-funded competitive grants for R&D in key sectors
- Government-funded technology parks
- Government grants for start-ups
- Tax incentives for purchase of research equipment
- Government credit, grants, equity financing for company innovation

## Germany

- R&D investment civilian focused
- National research ministry
- National high-tech strategy
- Industry 4.0 initiative to promote smart, digitally-infused manufacturing
- Public research institutes
- Large network of applied research institutes
- Funded efforts to strengthen university-business S&T partnerships
- Competitive grants to business
- Tax incentives/grants for investing in start-ups
- Public-private investment fund to ready start-ups for venture capital
- Government funds for cutting-edge research at SMEs
- Government support for promoting university spin-outs
- Tax incentives/grants for investing in start-ups
- Public-private investment fund to ready start-ups for venture capital

## China

- No. 2 global R&D spender
- No. 1 global spender on experimental development
- National S&T strategic plans
- National ministry
- National research centers
- Science and research parks
- National seed and start-up capital fund
- Funding for targeted emerging technologies
- Targeting industry clusters
- National strategy to foster entrepreneurship
- National demonstration projects
- Program to attract foreign S&T talent
- Business tax incentives for university research
- State subsidies to domestic firms
- Forced technology transfer for market access
- Espionage/IP theft

## Japan

- Science, technology and innovation dominated by large corporate groups
- Vast majority of R&D funded by business
- National S&T strategic plan and strategies
- Industry cluster plan
- Efforts to strengthen national research system
- R&D tax credit
- New expedited immigration policies to attract S&Es

## India

- R&D centers of global firms
- National ministry
- Government departments focused on industrial research & biotechnology
- National innovation strategy
- National S&T strategic plan
- National Manufacturing Policy
- National Biotechnology Strategy
- Plans for biotech clusters and incubators
- Start-up India initiative to promote entrepreneurial ecosystem
- Technology roadmap targets 12 technologies
- Innovation centers
- National innovation projects
- Plan to promote transfer of public R&D to industrial R&D
- Make in India promotes FDI in manufacturing in India
- Inclusive Innovation Fund/National Innovation Foundation supports innovators from poor and excluded groups

# Summary of Key Questions Working Group 1 Could Explore

| Topic | Questions |
|---|---|
| **U.S. Competitive Position** | • What is the outlook for U.S. global competitiveness in the application and deployment of disruptive technologies? In which of these technologies is the United States comfortably ahead globally, behind, or risk falling behind?<br>• What factors account most for the U.S. global competitive position in disruptive technologies?<br>• For both economic and national security, does the United States need to ensure that China does not achieve an overmatch position against the United States in technology?<br>• In which critical technologies is the U.S. competitive position at risk of ceding to China? Are there areas of technology for which we need to shore up U.S. efforts? |
| **Intelligence Gathering** | • Should the U.S. government systematically monitor what other nations are doing to advance and scale new technologies and innovations?<br>• Do we need a better understanding of the extent of China's technology collecting in the United States? Does the United States need to crack down on these efforts and how? |
| **Leadership** | • Should the United States move its global technology leadership to the top of the national agenda?<br>• What kind of leadership structure in government—in both the Executive Branch and Congress—is needed to address the multiple factors affecting technology development, commercialization, deployment, and innovation in a strategic and integrated way? |

| Topic | Questions |
|---|---|
| **Strategy** | • To what degree does the United States need to accelerate technology development, commercialization, and deployment? How much faster do we need to go to keep pace with the technological and economic disruption that is happening? Can the current system be optimized to operate at that pace?<br>• Can the "tech transfer" model of innovation scale to the size of the emerging opportunities, and operate at the speed at which technology is accelerating and disruption occurring?<br>• In this era of disruptive technology and rising strategic competition, what is the proper balance between the speed and dynamics of the marketplace, and greater national investment and strategic planning? Can these co-exist in a productive way?<br>• How can we protect U.S. technology? |
| **Fundamental Structure of Innovation Ecosystem** | • What within the fundamental structure of the U.S. innovation system is dragging down the speed at which the United States develops and scales new technologies?<br>• What factors play the most pivotal role in the speed with which the United States develops, scales, and deploys technology? What factors in government, universities, and the private sector? What are the highest priorities for change?<br>• How can the efforts of national government be better integrated with those at the state and local level?<br>• How do we link geographic clusters of innovation to rural areas that need economic revitalization? Can we afford the costs (rural schools, health care, infrastructure)?<br>• How do we convince national leaders and the American public that this infrastructure is just as important to the economy as roads, bridges, waterways, etc., and worthy of substantial investment?<br>• Looking forward—facing accelerating technological advancement, and other disruptive developments such as the industrialization of space—what should be the plan for new science and technology infrastructure? |

| Topic | Questions |
|---|---|
| **Investment** | • Overall, is the United States investing enough in research and technology development ($543 billion annually; 2.79 percent of GDP)? What areas of investment require more funding to maintain U.S. global technology leadership?<br>• Does the United States need to rethink how its spends its public R&D investment? Are we spending it at the right pivot points? And how can we spend it in ways that ensure the opportunities created by this investment are captured by the United States?<br>• As they become more globalized and remain open in their research, do U.S. research universities have a responsibility to help ensure U.S. taxpayers capture the benefits from the university R&D they fund? What more could universities do? Should they protect the technology?<br>• Should we embed more public R&D in private organizations as a measure of protection and ability to drive development toward commercialization?<br>• Are greater funding and more programmatic efforts needed to scale promising technologies being developed by U.S. start-ups? What would these efforts be, and who would deploy them? |
| **Programs** | • Do we need new types of R&D programs, such as national technology initiatives, technology focused centers and hubs, critical technology targeting, etc.? Should these efforts target the dynamism and innovation capabilities concentrated in U.S. metropolitan areas?<br>• Should the United States launch a global dragnet for top researchers and innovators, and encourage them to come and work in the United States? |
| **Partnerships** | • What do research universities need to do to make partnering more attractive and productive for industry? Should universities seek routine industry input to shape and guide the research they perform? Do we need to reexamine IP/licensing models?<br>• How can we increase flows of innovation across industries, enabling companies to tap innovations outside of their own industries. |

# Working Group 2: Exploring the Future of Sustainable Production and Consumption, and Work

## Mission

The **Exploring the Future of Sustainable Production and Consumption, and Work Working Group** aims to confront two critical issue sets—and to identify long-term, productivity and prosperity-enhancing recommendations that harness the nation's abundance of natural resources, energy, talent and ingenuity to power and unleash the most productive economy in the world.

First, this Working Group will examine the ever-evolving disruption underway in the production and consumption of goods. For example, the physical and digital worlds are converging across numerous dimension through sensors, networks, additive manufacturing and a data tsunami. At the same time, innovators are finding new ways to sustainably produce—moving beyond subtractive and additive manufacturing to the bioengineering production of goods.

Second, the Working Group will explore—coupled to this production revolution—the rapid evolutions unfolding in the American workforce. Up and down the career ladder, and across the workforce landscape, mega trends are affecting U.S. labor markets, the occupational mix in the country, what people do on the job and the skills they need to compete and succeed in a fiercely competitive global marketplace.

To accomplish these aims, the Working Group will create and prioritize concrete, sector-appropriate (government, industry, academia, national laboratories, workforce) recommendations to bolster sustainable production and consumption of goods in the United States (and how to capture global value from this innovative production), as well as support the creation of an inclusive, diverse, innovative and entrepreneurial workforce to create and capture value from this new manufacturing enterprise.

## Timeframe

The Working Group will:

- Form in late summer and fall 2019, following the launch meeting of the Commission.
- Convene physically in early 2020 for cross-Working Group level set conference.
- Continue virtual engagement in spring 2020, with potential physical meetings hosted by a Commissioner.
- Target delivery of final recommendations at a summer 2020 Commission meeting.

## Background

Following the 2004 release of its *Innovate America* report, the Council began a concerted effort to explore two emerging megatrends at the heart of long-term competitiveness: How to turbocharge a manufacturing and production renaissance in an unexpected era of energy abundance; and how to work and thrive in an increasingly turbulent, technological and transforming global economy.

These efforts—and key findings captured in Council reports *Work* (2016) and *Accelerate* (2018), among others over the past 15 years—document the speed and ease with which a country can reorganize its economy around new disruptive technologies, and how this plays a critical role in the competitive and economic benefits a nation can capture. The reorganization of the economy is a dynamic process undertaken by businesses, government and people, it is inherently disruptive, creating new opportunities for some and pain for others. But it is essential for

leveraging new technology to generate the greatest benefits in terms of jobs, economic growth, productivity and wealth.

## Issues

**Future of sustainable production and consumption.** Around the world, the pressure to make production and consumption more sustainable is growing. Radically different forms of production that answer that challenge are emerging. For example, with sensors, data and intelligent controls in smart manufacturing, producers can optimize production and minimize energy consumption and waste. 3D printing builds objects layer by layer from 3D model data, eliminating scrap. Vertical indoor farms are promising for making some food production more sustainable. They increase harvest productivity, cut water use by 70-95 percent and do not use pesticides. Fresh produce grown in vertical farms travels only a few miles to reach grocery store shelves compared to conventional produce, which can travel thousands of miles by truck or plane.

The world produces 300 million tons of plastic waste ever year. About 80 percent of it ends up in landfills, dumps or the natural environment and can persist in the environment for centuries.[1] One company uses a proprietary process to repurpose agricultural waste and biomass to produce cost-effective compostable food packaging that performs and feels like plastic. The packaging breaks down into organic material and can be used again to regenerate soil or other organic matter, creating a fully closed-loop cycle where the food grown creates the input materials for the packaging that carries food to the consumer and then, once used, is used to help grow more food.[2]

Production and consumption are concentrated in cities and expanding metro regions. Cities and metros have taken steps to enhance sustainability, ranging from banning plastic food containers to adopting renewable energy and building energy efficiency standards. Cities and metros could take advantage of new technologies, investments and trends that could make a significant difference in sustainability: new investment in infrastructure; new building energy efficient designs and technologies; intelligent highways and vehicles that optimize traffic flows and reduce congestion and idling; high levels of internet and computing penetration to support telecommuting; the introduction of autonomous vehicles for transit and deliveries, “lights-out” robotic and autonomous systems, etc. Cities and metros could leverage such opportunities in more integrated, systems approaches to sustainability.

While most Americans are concerned about the environment (75 percent), fewer (20 percent) say they make consistent efforts to help the environment as they go about their daily lives. Americans 65 and older are more likely to make an effort all the time vs. millennials and those under 23 years old.[3]

1 https://www.unenvironment.org/interactive/beat-plastic-pollution/.

2 Zume.

3 For Earth Day, Here’s How Americans View Environmental Issues, Fact Tank, Pew Research Center, April 20, 2017.

**Potential questions for the Working Group to consider:**

- How can we encourage companies to think about sustainability in systematic ways across the product life cycle—materials sourcing, production, packaging, distribution and warehousing, delivery to customer, customer use and final disposition?
- Has the business case for greater sustainability been made?
- How can companies influence the decisions suppliers and other actors across the product value chain make with respect to the sustainability of their practices and purchases?
- How can major corporations encourage and help their suppliers become more sustainable? What is the degree to which these efforts are global, deploying in countries that are growing contributors to environmental degradation?
- What is a good balance between market-generated solutions vs. regulation?
- Does the total quality movement or circular economy concept offer a model for change?
- How can we convert public concern into more sustainable daily decision making (that would also have the benefit of driving market change)? Do we need a movement?
- What are the challenges in harnessing American innovation to meet the need for low carbon energy across the board, at every scale, and around the world? Where is more investment needed? Will market-based approaches meet the challenge?
- How can we encourage cities and metro regions to leverage a larger tool box in more strategic approaches to sustainability?

**Future of work.** New technologies make entirely new forms of work possible—work without humans, work in which humans and technologies form teams, work performed in remote locations and, potentially, entirely new forms of work organized using today's powerful computing, internet and communications technologies. Rapid advances in cognitive science will provide new insight on creativity and how to better analyze, solve problems, adapt to new situations and make decisions. This new knowledge will be applied to improve how we work together, manage teams, design organizations, and interact with customers and machines.

**Work with machines.** Robots are likely to become commonplace, working in homes and offices, assisting in hospitals and classrooms, helping run farms and caring for the elderly. Autonomous systems will operate across factories, smart cities and infrastructure. Artificial intelligence is likely to affect portions of almost all jobs, changing the tasks performed, the way work is organized, the decisions made and the problems solved. Artificial intelligence could also change the size and mix of human capital and skills needed in an organization.

In the coming world of collaboration between humans, robots and intelligent systems—and as enterprises integrate extended (virtual, augmented and mixed) reality into operations—we could fundamentally reimagine how work gets done. For example, with augmented and virtual reality, workers

**Scaling Robotics in the Workplace**

Today, Amazon has 200,000 robots working in distribution facilities, making it possible to store 40 percent more inventory, and easier to fulfill orders. The company states it has added more than 300,000 jobs since the introduction of robots in 2012, including positions in IT and in servicing and maintaining robots. Robots work in 1,500 Walmart stores cleaning floors and checking inventory. Given Walmart's national footprint, millions of people will get their first close look and engagement with robots at work.

at different levels of skill can be trained to perform complex tasks remotely and center expertise around complicated problems and tasks. These tools could also be used to fulfill tasks without advanced training.

**Potential questions for the Working Group to consider:**

- Will the skill/wage gap grow—and if so, by how much—as AI, autonomous systems and robots increasingly perform routine tasks? Will rungs on lower/middle levels of career ladders disappear, closing-off traditional pathways to upward mobility? Does this present new kinds of challenges in reducing economic inequality?
- Do we need a new multidisciplinary field of work in engineering—the convergence of automation, cognitive and behavioral science, data analytics, organizational development, job design, systems integration, etc.?
- As machines increasingly perform routine work, does the public have a grasp on the potentially sharp upward trajectory of the economy's knowledge and skill requirements? What role must policymakers play in educating and supporting this shift?
- How will new machine-enabled work change daily lives and the patterns of work and society?

**New forms of work organization.** The prominent model for accomplishing work has been employer-based and carried out in a full-time job that is task-, time- (9-5 day), and place-based. Today's technologies enable other models for accomplishing work—such as telecomuting, working from remote locations and freelancing, as well as enabling more flexible work schedules and staffing—which can help achieve societal, environmental and economic benefits for both employers and workers. These models can help people integrate work more seamlessly into their personal lives—if juggling responsibilities for children, health issues or other activities—as well as access jobs outside of their geographic regions, a particularly important feature for those living in declining rural and industrial areas of the country, or those who cannot afford to live in job-rich, high cost-of-living locations. Time spent commuting can be significantly reduced, saving perhaps hours per week that can be devoted to other productive and personal activities.

More flexible patterns of work allow employers to tap a wider range of workers with knowledge and skills that can contribute value to the organization or business, but may reside in distant locations, or who cannot or prefer not to work in a 9-5, full-time job on

The high smartphone penetration and new infrastructures like cloud computing and big data make it possible to match up a person with a very special skill in Alaska with another special skill in Indonesia to serve a customer with a very special need in Angola.

**David Nordfors**
CEO, i4j Innovation for Jobs

employer premises. Remote work can also enhance labor mobility by providing an opportunity for work for a partner or spouse of an employee or new hire that is relocating. This broader landscape for recruiting can be especially valuable when unemployment is low and labor markets are tight, or recruiting for occupations in high demand. With a more flexible workforce and flexible staffing, employers can scale workforce size and mix as needed.

Uber and the Gig economy have established new models of worker independence. Digital technologies have made it easier to connect customers that need work performed with those able to perform it on a freelance basis.[4] While workers may face greater financial risk in the Gig economy, they may also engage in work of greater interest to them or make better use of their knowledge and skills in a place that may be more convenient, performed on a schedule of their choosing or more aligned with the demands of their lives.

New technologies could enable entirely new forms of people-centered, rather than employer-centered, and self-organized forms of work that optimize human capital and human capacity.[5] For example, today's digital technologies could be applied to identify markets of one or many around the globe, and search algorithms can match workers, goods and services with buyers, or workers around the world with each other, to form independent work teams that meet customer needs. Working on a global scale with five billion potential customers, a relatively small number of buyers can make a market. Service providers and innovators could facilitate marketing and matching for independent workers and forming of teams, helping them maximize their earnings.

**Potential questions for the Working Group to consider:**

- Will the redesign of work just organically emerge?
- Are employers comfortable with workers working remotely and out of sight?
- How can we encourage employers to expand the geographic scope of recruiting, for example, to rural areas, distant areas and globally?
- What kind of ecosystem and infrastructure would be needed to support a people-based (vs. employer based) economy?

4 Independent Work: Choice, Necessity, and the Gig Economy, McKinsey Global Institute, October 2016.

5 The Future of Work is 5 Billion Customers Looking for a Good Job, TechCrunch.

- What kinds of new knowledge, skills and support systems are needed for those working outside of traditional employer organizations?
- What kinds of new regulations or policies are needed to address the challenges of worker protection, benefits and income security in a workforce of freelancers?
- What is needed in the area of taxation and labor laws to reduce barriers to cross-state remote work in the United States? What is needed in the area of pay, labor regulation and standards, and taxation for cross-border remote work?
- What kinds of new laws might be needed to protect those buying work or services from independent workers or temporary freelancing work teams, especially those that cross international borders? Who is liable for the work performed, and what happens when a team disbands?
- What is needed to scale new forms of work organization that are not employer centered?

**Gender Equity.** While U.S. women exceed men in attaining bachelors degrees, they have not achieved parity in workforce participation, pay or career progression. The ratio of women's to men's median weekly earnings for full-time wage and salary workers in all occupations was 81.1 percent in 2017.[6]

The gap has narrowed, in part, because women are increasing their presence in higher paying occupations. Nevertheless, the earnings ratio is lower in some occupations, such as personal financial advisors, physicians and surgeons, real estate brokers, sales agents and chief executives. Majorities of Americans see men and women as equally capable in terms of qualities for leadership. Yet, only 4.8 percent of CEOs in the Fortune 500 are women, and only 22 percent of Fortune 500 board members. Women leaders are more prominent—though still a significant minority—in academia, with 30 percent of universities having women presidents in 2016.[7] In addition, women's rate of workforce participation has leveled off at 57 percent, compared to men at 69 percent, in 2017.[8]

Some of the reasons for the gaps include: inflexible career paths (while women have greater involvement in providing childcare), occupational selection, hours worked and industry of employment. For example, some higher paying jobs favor long hours and reward willingness to put work over other life activities. Also, working women are nearly twice as likely as men to say they have faced gender discrimination on the job, one in four working women say they have earned less than a man who was doing the same job, and more than one in five say they have been treated as if they were not competent because of their gender.[9]

6 U.S. Department of Labor Women's Bureau.

7 The Data on Women Leaders, Pew Research Center, September 13, 2018.

8 Bureau of Labor Statistics, U.S. Department of Labor.

9 For Women's History Month, A Look at Gender Gains—and Gaps—in the U.S., Pew Research Center, March 15, 2018.

**Potential questions for the Working Group to consider:**

- Employers have taken steps to support women in their workforces, including onsite daycare, family friendly leave policies, more flexible work schedules, etc. What more can employers do within the structure of company benefits? What can policymakers do?
- Can telecommuting and remote work be expanded to increase women's participation in the workforce and the organization? Does working off-site reduce women's ability to build company-specific skills and social capital within the organization that helps underpin their advancement?
- Is national legislation needed, for example, to mandate paid family leave or equal representation on boards of directors? Other?
- Should even greater effort be made to attract women to prepare to enter higher paid careers such as those in engineering, computer or financial occupations?

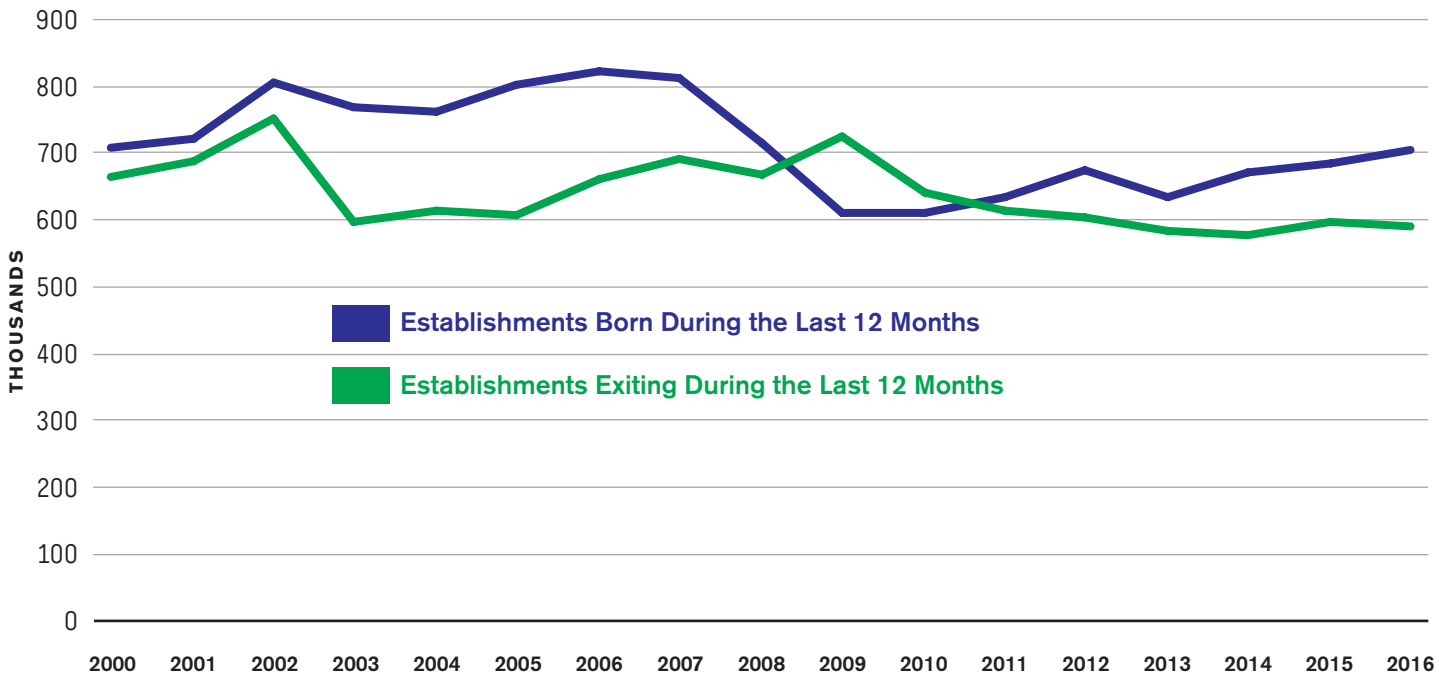
**Strength of U.S. entrepreneurial and start-up punch.** Entrepreneurs and start-ups play a vital role in leveraging new knowledge and technology to create and grow new businesses and, those that grow into large and successful firms can transform entire industries. The process of finding creative ways to combine new technologies and processes, and make novel products and services, leads to the start-up of businesses and the decline of less productive businesses or those whose business lines are made obsolete. This churning of firms—one way the economy reorganizes around disruptive technologies—helps revitalize the economy, reallocating resources from less profitable businesses to more profitable and competitive ones.

U.S. start-up and entrepreneurial punch weakened in the years surrounding the Great Recession, but is recovering, as illustrated by growth in the number of firms that are less than one year old. Also, based on the filing of business applications, business start-ups recovered gradually after 2009 and accelerated especially after 2013. By 2017, business applications came in far above the pre-recession levels. However, while business applications have recovered from their lows during the Great Recession, high-quality applications (high propensity applications)—those that have a relatively high likelihood of turning into job creators—have not fully recovered, and their volume is still far below its pre-recession levels.[10]

U.S. universities and federal laboratories are increasingly key sources of breakthrough technologies that entrepreneurs and start-ups spin out to develop and scale. However, entrepreneurs and small firms often lack funding to develop prototypes, and to validate and scale their innovations. Lacking adequate resources at this critical juncture in the innovative life-cycle, these technologies may fall into the "valley of death," stalling or terminating their development and commercialization and increasing their vulnerability to foreign acquisition. Other challenges include: the risk and challenge of establishing a venture;

10 Census Blog, Business Formation Statistics: A New Census Bureau Product that Takes the Pulse of Early-Stage U.S. Business Activity, February 8, 2018.

**Figure 1. Business Establishments Birth and Death in the United States, 2000-2016**
Source: Business Dynamics Statistics, U.S. Bureau of the Census.



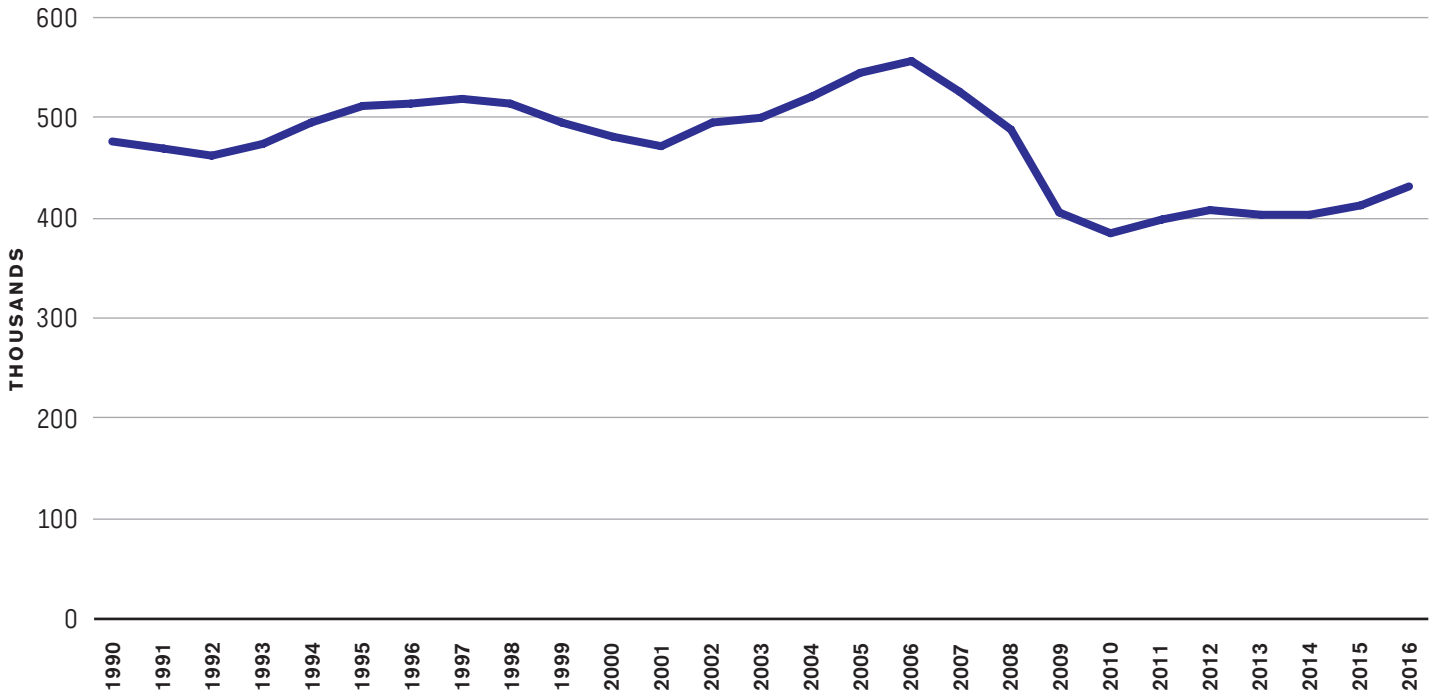

validation of the business in the marketplace; and finding the right talent and skill sets needed as the business is founded, responds to market developments and matures.

Ecosystems in support of small innovators are growing around research universities and in U.S. metro areas—work spaces, networks, training and events. Because these dynamic young firms play a key role in driving regional economic development, many state and regional governments have programs in place to nurture entrepreneurs and start-ups, including seed and venturing funds, incubators and accelerators. Some companies are nurturing new start-ups, and reaching out to access their technologies.

The United States has latent entrepreneurial potential. Among the U.S. adult population, 70 percent see good opportunities to start a firm in the area where they live (compared to a 46 percent global average), and 56 percent believe they have the required knowledge and skill to start a business.[11]

11 GEM Global Entrepreneurship Monitor 2018.

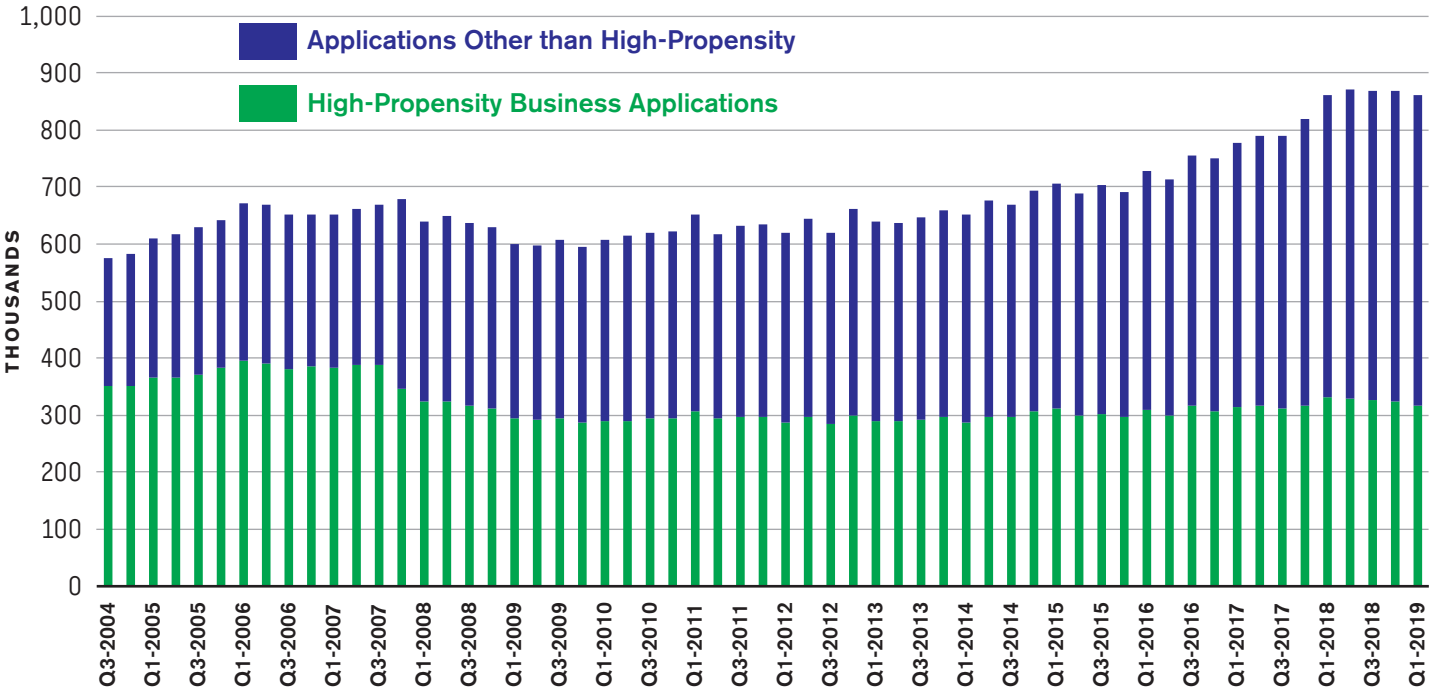
**Figure 2. Firms Less Than One Year Old**
Source: Business Dynamics Statistics, U.S. Bureau of the Census.




**Potential questions for the Working Group to consider:**

- What are the most important policies in the United States for starting and growing a business, and especially a technology-based start-up? Which ones play the most positive role, and which are serving as barriers to success?
- There are numerous efforts across the country to nurture entrepreneurs and start-ups—connected to state and regional economic development, at universities, and operated by private companies. Is this ecosystem adequate? Can it be better integrated to provide more seamless support through the innovation life cycle?
- What are the critical elements of university programs that successfully spur entrepreneurs and spin-out startups?
- What more needed to be done to address the "valley of death"?
- How can we tap more of America's entrepreneurial potential, encouraging more Americans to take the leap of starting a business?

**Figure 3. Quarterly Business Applications (Seasonally Adjusted)**
Source:




**Development and reallocation of human capital.** New knowledge and skills will be needed as work evolves around the emergence of new technological fields, and as new robotic and intelligent systems enter the workspace. In addition, the impacts of disruptive technologies on the economy and their rising frequency may increase the need for greater labor market flexibility, job-switching and moving around the county, raising the importance of the U.S. ability to retool, relocate and reallocate its human capital.

However, evidence suggests that labor mobility—job reallocation, worker churn, and geographic labor mobility—has been on the decline for the past 20 years or more.[12]

Higher-skilled workers are better able to use new technologies when they are introduced, and better prepared to move to new industries, new jobs, new occupations or new skills when displaced by technological, labor market or market disruptions. Workers with less knowledge and fewer skills, many in rural and rust belt areas of the country, are at greater risk

12 Declining Dynamism in the U.S. Labor Market, CRS Insight, Congressional Research Service, June 15, 2016.

of being left behind in an era of frequent technological disruption, shrinking numbers of jobs with routine tasks performed by humans and fewer jobs outside of metro areas. Some of these workers think they are too old to go back to school and may not have the basic computer or math skills to enter training programs for jobs that require more advanced skills.[13] Also, many of these workers have built social capital in a community that makes them reluctant to leave.

Increasing labor market dynamism also raises the importance of labor market signaling—employers conveying to education and training institutions, and workers the knowledge and skills they will need. It also increases the importance of employers and job matching mechanisms making it easy to identify organizations that are recruiting job candidates and jobs for which they are hiring.

As greater knowledge and higher-level education become necessary for employment for many, the costs of higher education in the United States is soaring, often leaving students with a heavy debt burden. Almost every other knowledge and service industry in the United States has been transformed by new technology. Yet, the basic model of education provision has changed very little, remaining largely a face-to-face delivery of service with limitations on scaling and limited modes for consumption.

**Potential questions for the Working Group to consider:**

- Is industry adequately engaged in giving direction to education and training institutions in terms of the knowledge and skills employers need? What are the best mechanisms for achieving that exchange of information? Are universities listening?
- Metropolitan areas are the most dynamic and innovative in the American economy. Can we afford to continue subsidizing the infrastructure, public services, etc., to support the continued existence of declining industrial areas in the country, or should investment instead be focused on more dynamic and growing areas, and getting people to move to them? What is an honest outlook for the revitalization of dying industrial communities?
- Is the U.S. education system preparing U.S. students and workers for the advanced economy ahead, (when AI and other automation perform routine tasks), and with the ability to respond to frequent disruptions in the labor market?
- Do we need to reevaluate the baseline of what people need to know and be able to do? And how do we balance the new baseline—the rise of multidisciplinarity in business and innovation—with the need for specialization? Is higher education structured to address these new needs?

13 From $22 an Hour to $11: GM Job Cuts in Ohio Show a Hot Economy is Still Leaving Parts of America Behind, Washington Post, March 5, 2019.

- What levers do we have to reduce the cost and improve the productivity of higher education? How do we change the cost structure? What is standing in the way of transformation in education?
- How do we incentivize universities to link their teaching with the needs of the economy and labor market to provide career- and life-relevant curricular experiences and credentials?
- Universities often stake their reputations on exclusivity, behaving as customers evaluating what prospective students are "selling." How do we democratize higher education, creating an education and training system that is inclusive regardless of current education and skills, age, income, work status, time for learning, etc.? How do we get universities to treat students as customers looking to buy knowledge and skills, and to compete to provide those?
- Generally, higher education institutions deploy the same education system model and bestow a credential recognized by employers and society. The power to bestow the credential serves as a barrier to non-traditional forms of education and training, reducing competition in the sector and pressure to reduce costs and improve productivity. Could alternative forms of credentialing create new entrants to and competitors in the education sector?
- The U.S. science and engineering workforce is aging, which could have important implications for the supply of science, engineering and technological expertise in the economy.[14] The number of science and engineering degree holders in the United States far exceeds those working in science and engineering jobs. What could draw these professionals back into innovation and to replace those aging out of the workforce?

14 The aging of the science and engineering labor force is reflected in the median age, which has risen from 40 years in 1993 to 43 years in 2015; the median age nationally for the U.S. population was 34 years in 1993 and 38 years in 2015. Another indicator, the percentage of individuals in the science and engineering labor force between 51 and 75 years of age, has risen from about 20% in 1993 to 33% in 2015; Science and Engineering Indicators 2018, National Science Foundation.

# Working Group 3: Optimizing the Environment for the National Innovation System

## Mission

Innovators start with an idea of what is needed by a society, market or individual. Like inventors, they create—but they also apply their creations. And those applications, in turn, generate further innovations, giving rise to new industries, and national and global markets; spurring productivity and economic growth; fueling wealth creation and profit; generating high-value, higher-paying jobs; and raising the standard of living for everyone touched by the innovation.

The **Optimizing the Environment for the National Innovation System Working Group** will examine the physical and policy structures that support innovators, including intellectual property protection; business regulation; structures for collaboration; capital availability (venture capital, federal funds, foreign investment); standards; new, emerging trading systems; etc.

To accomplish these aims, the Working Group will discuss ways in which to support and optimize the entire system in which the nation's innovators and enterprises operate. And though the private sector takes the lead—applying strategies, technologies, business models and capital that address genuine market needs—there are critical roles local, state and federal governments must play.

## Timeframe

The Working Group will:

- Form in late summer and fall 2019, following the launch meeting of the Commission.
- Convene physically in early 2020 for cross-Working Group level set conference.
- Continue virtual engagement in spring 2020, with potential physical meetings hosted by a Commissioner.
- Target delivery of final recommendations at a summer 2020 Commission meeting.

## Background

There are many factors that affect a country's ability to innovate and compete. This includes levels of investment in R&D, the availability of capital to fuel start-ups and innovation at critical stages, the availability of talent, the environment for entrepreneurship, and the general business environment including taxes, the level of business regulation, government support of business and the environment for global trade. These elements often vary in different countries around the world, playing a significant role in a country's competitiveness and capacity for innovation.

U.S. competitors around the world seek to build and strengthen knowledge and technology-based economies as the basis for advancing productivity, job creation, raising standards of living and, in some cases, advancing their geopolitical goals. As a result, many deploy policies and programs to stimulate innovation, and create a business environment to achieve this impact. These countries are instituting their own distinctive innovation ecosystems, which may not be compatible or friendly with U.S. systems of innovation.

**Potential question for the Working Group to consider:**

- Should the federal government perform a "whole of government" review of the federal role in creating a business environment for innovation?

## Issues

**Capital and tools to invest in innovation from start-up to scale-up.** The U.S. financial system—including financing for small and medium-sized enterprises and the availability of venture capital, both crucial for U.S. innovation—is considered among the very most, if not *the* most, competitive in the world.

Nevertheless, obtaining capital at critical points in the innovation development life cycle can be challenging for innovating entrepreneurs, and small and medium-sized enterprises. There are two key investment gaps. In the first, entrepreneurs and small firms—including those developing technologies transferred from universities and federal labs—often lack funding to develop prototypes, and to test and validate their innovations. Lacking adequate resources at this critical juncture in the innovative life cycle, these technologies may fall into the "valley of death," stalling or terminating their development toward commercialization, and increasing their vulnerability to foreign acquisition. A second area of challenge is securing adequate financing to scale-up to full production in the United States, when risk has been significantly lowered, but investment needs are significantly higher.

To capture the full fruits of the U.S. innovation ecosystem, the United States must bridge both gaps.

**Venture capital.** Venture capital plays an indispensable role in funding U.S. innovation, supporting the development of some of the most innovative and successful U.S. companies. Recognizing the powerful role U.S. start-ups and venture capital have played in U.S. innovation and competitiveness, other nations have adopted this model, and the U.S. lead in venture capital is shrinking. While the absolute level of venture capital coming to the United States has increased, the U.S. share of the growing global pool of venture capital—which has increased by more than 200 percent since 2010—has eroded sharply from more than 90 percent in the 1990s, to about half in 2018.[1] Moreover, venture capital investment is highly concentrated in certain geographic regions of the United States—particularly California, New York and Massachusetts—which, together, accounted for 79 percent of venture dollars invested in the United States in 2018.[2] Also concentrated, more than half of venture capital in the United States goes to software (36 percent) and life science (18 percent) companies.[3]

U.S. venture capital appears to be shifting, with capital increasingly concentrated in bigger funds and bigger investments, with fewer companies receiving investments. For example, the number of companies receiving venture capital has been on a downward trend since 2015, reaching a six-year low in 2018.[4] Large investments are taking a significant share, with investments of $100 million or more in venture-backed companies accounting for 47 percent of venture capital invested in the United States in 2018;

1 National Venture Capital Association 2019 Yearbook.

2 ibid.

3 ibid.

4 ibid.

unicorns—venture-backed companies valued at $1 billion or more—accounted for 35 percent of the total venture dollars invested, but only two percent of the deals.[5]

**Federal government funding for innovation.** Efforts to advance innovations by start-ups and small firms are supported by some government funding, but that funding can decrease abruptly after a technology is created, right when a company or entrepreneur needs funds to test and begin commercializing the technology. Some federal R&D grant programs have extended some funding further into the development life cycle. For example, the Small Business Innovation Research Program (SBIR) has a three-phase, merit-based R&D grant program. In Phase I, small businesses can receive up to $150,000 to establish the technical merit and commercial feasibility of their innovations. In Phase II, those who have participated in Phase 1 may compete for up to $1 million to further their R&D or to develop a prototype. In Phase III, SBIR awardees pursue commercialization, but there is no SBIR funding. Federal departments and agencies have authority to offer financial support beyond the first Phase II award, however, matching funds may be required. Through the SBIR program in 2018, federal departments and agencies awarded or obligated $3 billion in more than 5,600 awards to about 3,000 small firms.[6]

In another example, the Department of Energy awards merit-based grants for research and development to advance clean energy and energy efficiency technologies. Grants can range from several hundred thousand dollars to 10 million dollars or more. However, cost-sharing is often required and grant applications are complex, a challenge to cash- and time-strapped small businesses and start-ups.

**Foreign investment in U.S. innovation.** Foreign investment in start-ups and innovating companies is increasing. China and Russia—both considered strategic competitors to the United States—have interests in acquiring U.S. technologies by both licit and illicit means. For example, China is targeting development of the entire semiconductor ecosystem, including spending more than $150 billion over 10 years for investments and acquisitions.[7] Also, China is increasingly playing the role of venture capitalist, while U.S. investors' share has declined. In 1992, U.S. investors led 97 percent of the $2 billion in venture finance and accounted for about three-quarters just a decade ago. However, in 2017, U.S. investors led 44 percent of a record $154 billion in venture finance, with Asian investors (with China leading) accounting for 40 percent.[8]

The Foreign Investment Risk Review Modernization Act of 2018 reforms the national security reviews made by the Committee on Foreign Investment in the United States (CFIUS), broadening its scope to include certain noncontrolling transactions (as opposed to those that could result in foreign control of a U.S. business), and requiring mandatory declarations for both controlling and noncontrolling transactions that involve a foreign investor that fall into a critical technologies pilot program that includes

5 ibid.

6 SBIR Dashboard, https://www.sbir.gov/analytics-dashboard.

7 Made in China 2025: Global Ambitions Built on Local Protections, U.S. Chamber of Commerce, 2017.

8 Silicon Valley Powered American Tech Dominance—Now it has a Challenger, Wall Street Journal, April 12, 2018.

industries advancing a range of important emerging technologies, including aircraft and aerospace manufacturing, computer-related industries, R&D in nanotechnology and biotechnologies, and semiconductors, among others. CFIUS reviews potentially can discriminate among investors from certain countries that are determined to be a country of "special concern" that has a "demonstrated or declared strategic goal of acquiring a type of critical technology or critical infrastructure that would affect U.S. leadership in areas related to national security."

**Potential questions for the Working Group to consider:**

- Does the geographic concentration of venture capital prevent the United States from harnessing its full capacity for innovation? Do we need a more geographically inclusive venture financing system?
- Does the industry concentration of venture capital prevent the United States from fully exploiting a broader range of emerging technologies that could result in additional jobs and industrial expansion? Do we need a more industry inclusive venture financing system?
- Does the shift in venture capital to larger investments in fewer firms have the potential to undercut U.S. innovation by reducing the venture capital available to a broader, more technologically diverse set of start-ups? Or, does the U.S. benefit from larger infusions of capital into new firms that are perceived as more attractive to drive their scaling more quickly? What might be the shorter-term and longer-term impacts on technology-driven U.S. economic growth?
- Should the federal government play a larger role in providing capital at critical stages of the innovation life cycle, for example, to help bridge "the valley of death?" Are current federal programs—such as SBIR, Department of Energy R&D grants and the Manufacturing USA Institutes—the right kinds of tools to accelerate U.S. innovation by providing critically-timed financial support?
- What other kinds of investment tools—both public and private—are needed?
- Do crowdsourcing models have greater potential? Should we find ways to expand the scope of U.S. investors in innovation, or does that present too much risk?
- How can more private companies take a greater role in investing in innovations developed outside of the company that could potentially be of future interest and utility?
- Many state and local economic development agencies seek foreign investment to create new jobs. How should those needs be considered?
- Given both the U.S. interests in national security and global competitiveness, how do we balance the risk of losing critical technologies to foreign competitors with the need for funds for U.S. fast-growing industries, and start-ups and other companies advancing new technologies?

**Tax incentives and tax treatment that foster innovation.** While other nations have steadily lowered their corporate tax rates since 2001, the United States had a tax rate highest among all OECD countries. The Council has long advocated for lowering the U.S. corporate tax rate to 23 percent, in line with the upper quartile of OECD economies. The Tax Cuts and Jobs Act of 2017 reduced the

corporate income tax rate from 35 percent to 21 percent—making doing business in the United States significantly more attractive and freeing more private sector funds for investment.

The U.S. Research and Experimentation Tax Credit is a significant incentive for investment in R&D. The tax credit was permanently extended in 2015, and its provisions were expanded to further reach U.S. innovators. For example, prior to the changes, the R&E tax credit did not benefit start-up firms with no federal corporate income tax liability. Now start-up businesses with no federal income tax liability and gross receipts of less than $5 million can take the R&E tax credit against the employer portion of payroll taxes, creating a refundable credit capped at $250,000 for up to five years.

In addition, some states and localities have additional tax benefits and inducements for investing in R&D and to attract R&D facilities and high-tech companies.

**Potential questions for the Working Group to consider:**

- Is this basic tax structure adequate and/or optimal for getting the most innovation out of the U.S. system as possible?
- Do we need to do more to inform U.S. small businesses about the benefits available to them through the R&E tax credit, given the wide range of research, development, testing, manufacturing process advancements and other activities that qualify for the credit?
- Are there other opportunities for using tax or other financial incentives to encourage innovation?

**Intellectual property in a hyper-diverse innovation economy.** Is the U.S. intellectual property regime out of date—configured as a "one size fits all" model in a world riddled with diversity? The U.S. patent system was established and evolved for a simpler economy that was very different from today's hyper-competitive, hyper-paced, knowledge-driven, global economy. This is reflected in the 1790 U.S. Patent Act's very definition of the subject matter of a U.S. patent: "any useful art, manufacture, engine, machine, or device, or any improvement thereon not before known or used." Rather than built on mechanical devices, today's economy; its growth industries—such as microelectronics, software and biotechnology—company value, and competitive advantage are based on the generation, control and use of knowledge. These knowledge-based technologies and industries also enable a wide range of other industries in the economy, contributing to their growth and competitiveness. For example, retail industries gain advantage from big data and software that manages logistics, while the oil and gas industry depends on computing and seismic imaging.[9] Moreover, emerging technologies—such as synthetic biology—have the potential to create new types of intellectual property, for example, a new gene sequence.

Moreover, the U.S. patent system is "one-size-fits-all," while the needs of intellectual property (IP) holders and the ways in which they use IP protections are increasingly diverse. For example:

- The microelectronics industry, where product life cycles have collapsed, requires speed and shorter-term protection before products are commoditized

9 Needed: A New System of Intellectual Property Rights, by Lester Thurow, Harvard Business Review, September-October 1997.

and it turns to the next generation technology, while the pharmaceutical industry needs long-term protection to recover the billions spent on R&D, clinical trials, long-term studies, regulatory approvals and project failures.

- Securing patent protection is a complex and costly process that large firms are financially equipped to handle, while many small firms and start-ups without such resources tend to seek protection for trade secrets because it is cheaper and simpler.
- Some entrepreneurs, small firms and start-ups secure IP protections to attract financing or for a stronger position when seeking out a joint venture. Others do not intend to scale and commercialize their innovations, but seek IP protection for a stronger negotiating position in attracting potential suitors for an acquisition or licensing agreement.
- Large firms may use patents to keep competitors at bay.
- Different forms of IP protection may be important at different stages of the innovation life cycle, for example, trade secrets during R&D, before it is known if a new technology is worth patenting.

Also, challenging globally, different countries have different ideas about IP rights, for example, what can be protected, as well as the balance between what should be free to society and what can be sold by the private sector.

**Potential questions for the Working Group to consider:**

- Is it time to remake the U.S. system of IP protection more aligned with today's knowledge economy and diverse needs? What would be some of a new system's key features?
- Should greater consideration in IP protection be given to the benefits of faster, more widespread distribution of new knowledge and technology? Where is the balance between faster, more widespread distribution and incentives for the private sector to advance technology? Would faster dissemination drive greater ancillary and associated innovations, new firm entry, and speed up the transformation of the economy around new technologies?

**Challenges business face in engaging universities in technology transfer and IP.** U.S. technology transfer laws—which include provisions for patenting and licensing IP created with federal government financial support—are considered a U.S. competitive advantage. However, the challenges of negotiating IP agreements with universities is a continuing trouble spot for U.S. industry. In the Council's Technology Leadership and Strategy Initiative, many participants confirmed that industry-university collaboration falters most often over IP differences. Due to IP or other issues, U.S. business partners with universities on only a small percentage of its research, about 1.2 percent of business research funding.[10]

While a few U.S. universities are state-of-the-art in negotiating with start-up companies and established firms, there are often mismatches between the goals

10 National Science Foundation.

of a firm and a university, and over how each party values the IP in question. The entrepreneur or firm often has to acquire, license or create several patents in order for the whole IP package to generate value, and it is often difficult to determine the royalty stream appropriate for each IP component. This is pointed to as a significant barrier to industry-university collaboration.

Many universities employ master agreements that are "one-size-fits-all," despite vast differences in the market realities of different industries. Company-university collaboration may also suffer from current laws that incentivize universities to pursue more rigid profit-making IP strategies than would be best for commercialization. Most research universities overseas have a greater bias for commercialization, far fewer IP barriers to collaboration, and many offer greater IP flexibility.

**Potential questions for the Working Group to consider:**

- How can we reduce costs and delays in negotiating and transferring IP from universities and federal laboratories to businesses?
- How can we encourage universities to offer more flexible and attractive IP terms in corporate-university partnerships? Should the federal government use its leverage in funding university R&D to encourage more R&D engagement with industry and more favorable IP terms?
- Can we create model master agreements that offer greater flexibility for different industries and different types of projects?

A recent Department of Justice indictment reveals China's efforts to steal technology from Micron Technology, Inc., a global leader in semiconductors and the only U.S.-based company that manufactures DRAMs. According to the indictment, a Chinese individual illegally obtained Micron's trade secrets, valued at up to $8.75 billion.

**USTR 301 Report**

- Should we show preference to potential licensees in the best position to commercialize federal research and technology, even if that means a waiver to the small business preference?

**Protecting U.S. intellectual property.** The theft of U.S. IP is a continuing concern. IP is foundational to economies built on knowledge and technology, and its theft can be a serious blow to an individual company. The Commission on the Theft of American Intellectual Property estimated that the annual cost of IP theft to the U.S. economy exceeds $225 billion, and could be as high as $600 billion.[11]

11 Update to the IP Commission Report, The Theft of American Intellectual Property: Reassessments of the Challenge and United States Policy, Commission on the Theft of American Intellectual Property, 2017.

China remains the world's principal IP infringer. As it is committed to industrial policies that include maximizing the acquisition of foreign technologies, particularly in high-tech sectors, these policies could drive even greater IP theft. Collectors are especially interested in U.S. technologies vital to competitiveness and national security (Table 1).[12]

The Trump Administration has raised the protection of U.S. IP to a top-tier priority and made it a top goal of U.S.-China economic negotiations. The Foreign Investment Risk Review Modernization Act of 2018, which added new bite to the CFIUS processes, and the Export Control Reform Act of 2018 are measures that are expected to increase protection of U.S. IP. Also, several new government reports are bringing the China IP threat into sharper focus.[13]

The administration is using tariffs and the threat of more tariffs to compel China to respect IP rights, curtail IP theft by its companies and cease other unfair trade practices. However, some U.S. manufacturers are concerned that these tariffs will reduce their competitiveness, present a tough challenge for small businesses affected, lead to higher costs for Americans and lost jobs. After the G20 Summit in Buenos Aires in December 2018, where President Xi and President Trump said they would begin negotiations on IP protection, China announced a crackdown, releasing a list of 36 punishments for companies that engage in IP theft.

China is not the only county where IP protection and enforcement is inadequate. For example, long standing IP challenges facing U.S. businesses in India include those which make it difficult for innovators to receive and maintain patents in India, particularly for pharmaceuticals. Numerous other countries present a variety of IP protection and enforcement problems such as patentability criteria, inadequate protection for trade secrets and lack of IP enforcement.

**Potential questions for the Working Group to consider:**

- Is the level of theft of U.S. IP and emerging technologies an existential threat to U.S. global technology leadership and national security? Is the federal government giving the issue appropriate priority?
- Given the landscape of global commerce and scope of U.S. business transactions with foreign entities known to pose IP risks, how can we help U.S. businesses better understand the level of risk they face when doing business with a foreign entity?
- How can we use market mechanisms to encourage foreign companies to comply with laws and values that protect IP?
- Are there other sources of leverage the United States has to seek to compel foreign entities to provide adequate and effective protection and enforcement of U.S. IP rights?

12 Foreign Economic Espionage in Cyberspace, National Counterintelligence and Security Center, 2018.

13 How China's Economic Aggression Threatened the Technologies and Intellectual Property of the United States and the World, White House Office of Trade and Manufacturing Policy; Findings of the Investigations into China's Acts, Policies, and Practices Related to Technology Transfer, Intellectual Property, and Innovation under Section 301 of the Trade Act of 1974, U.S. Trade Representative; 2018 Report to Congress on China's WTO Compliance, U.S. Trade Representative; China's Technology Transfer Strategy: How Chinese Investments in Emerging Technology Enable a Strategic Competitor to Access the Crown Jewels of U.S. Innovation, Defense Innovation Unit Experimental, U.S. Department of Defense.

**Table 1. U.S. Technologies Vital to Competitiveness and National Security**

| Industry | Priority Sectors / Technologies | |
|---|---|---|
| **Energy / Alternative Energy** | • Advanced pressurized water reactor and high-temperature, gas-cooled nuclear power stations<br>• Biofuels<br>• Energy-efficient industries | • Oil, gas and coalbed methane development, including fracking<br>• Smart grids<br>• Solar energy technology<br>• Wind turbines |
| **Biotechnology** | • Advanced medical devices<br>• Biomanufacturing and chemical manufacturing<br>• Biomaterials | • Biopharmaceuticals<br>• Genetic modification and reprogramming<br>• Infectious disease treatment<br>• New vaccines and drugs |
| **Defense Technology** | • Aerospace and aeronautic systems<br>• Armaments | • Marine systems<br>• Radar<br>• Optics |
| **Environmental Protection** | • Batteries<br>• Energy-efficient appliances<br>• Green building materials | • Hybrid and electric cars<br>• Waste management<br>• Water / air pollution control |
| **High-End Manufacturing** | • 3D printing<br>• Advanced robotics<br>• Aircraft engines<br>• Aviation maintenance and service sectors<br>• Civilian aircraft<br>• Electric motors<br>• Foundational manufacturing equipment | • High-end computer numerically controlled machines<br>• High-performance composite materials<br>• High-performance sealing materials<br>• Integrated circuit manufacturing equipment and assembly technology<br>• Space infrastructure and exploration technology<br>• Synthetic rubber |
| **Information and Communications Technology** | • Artificial intelligence<br>• Big data analysis<br>• Core electronics industries<br>• E-commerce services<br>• Foundational software products<br>• High-end computer chips | • Internet of Things<br>• Network equipment<br>• Next-generation broadband wireless communications networks<br>• Quantum computing and communications<br>• Rare-earth materials |

- Should the government take greater punitive measures against foreign entities that are directly benefitting from U.S. IP theft, such as denying access to the U.S. market or banking system, or public reporting of the use of stolen IP when foreign entities seek to be listed on U.S. exchanges? What other kinds of sanctions could be levied against foreign entities that steal U.S. IP?
- Are other countries concerned about IP theft adequately engaged in showing a unified front in confronting IP thieves and enforcing IP laws? Should there be harmonized national and international legal and regulatory approaches?
- How can we improve coordination, intelligence gathering, and information sharing on IP threats and incidents among nations, and the public and private sectors?

**Shaping the standards and regulations around critical technologies that will be the future of innovation.** The disruptive technologies that will shape the economy for decades to come will require the development of a wide range of standards and some regulations. For example, artificial intelligence, machine learning, and autonomous and semi-autonomous systems will require technical standards for safety, interoperability, detecting bias, trustworthiness, human factors, privacy, transparency, and to protect these systems from malicious attacks and cyber intrusions that could have profound consequences for security. Since these systems will be used in transportation, health care and the military, failures could be catastrophic. Novel approaches may be needed, for example, for testing and verification to ensure that AI-based systems meet their specifications. Robots have been used for years in controlled industrial settings. As robots become more commonplace in a wide variety of venues, such as homes, hospitals and retail establishments, their exposure to humans will increase substantially in more intimate interactions, with implications for standards in areas such as safety, trust and human interfaces.

> The pace of innovation in automated vehicle technologies is incompatible with lengthy rule-making proceedings and highly prescriptive and feature-specific or design-specific safety standards. Future motor vehicle safety standards will need to be more flexible and responsive, technology-neutral, and performance-oriented to accommodate rapid technological innovation.
>
> **Preparing for the Future of Transportation, Automated Vehicles 3.0**
> U.S. Department of Transportation

Auto and high-tech companies are racing to get driverless vehicles on the road for passengers and goods transport and delivery. Standards must support the safe and effective operation of automated

vehicles that may not have steering wheels, pedals, mirrors or human controls; may have drastically different passenger seating; may rely on networks for their operations; must adhere to rules; and must react to unpredictable roadway conditions, interaction with other vehicles and pedestrians who may not always adhere to traffic laws or behave in unexpected ways. These may require new approaches to motor vehicle safety standards and regulations, and for when humans are and are not present in the vehicle. Also, as intelligent highways deploy and smart cities develop, standards will be needed to integrate into these platforms.

Standards and regulatory development is a critical aspect to commercializing nanotechnologies. As nanotechnology advances and is used more widely, there may be implications for protocols, standards and regulations throughout the product life cycle—in raw material production, consumer product manufacturing, worker exposure, industrial emissions, consumer use and exposure, ecological exposure and at product end-of-life in landfills and incinerators. For example, workers within nanotechnology-related industries have the potential to be exposed to uniquely engineered materials with novel sizes, shapes, and physical and chemical properties.

Concerns have increased about ethical guidelines and safety standards for gene-editing, and the scientific and international communities are getting discussions underway. Areas include the use of gene-editing in health care and disease mitigation, food production and environmental applications. Focus is particularly strong on germ-line editing and genetic enhancement. International guidelines and standards could be used for countries to set their own national regulations. However, ethical principles that could underpin domestic guidelines and standards vary across countries and regions, and the roles of public institutions and private companies in different countries.

Personalized medicine creates a different set of challenges. Standards of care have been developed based on the effects of treatments and medicines as observed in clinical trials involving large cohorts of individuals. But, in personalized medicine, addressing a patient's health is based on a range of an individual's specific characteristics and will increasingly include a person's unique genetics. This is expected to lead to an era of individualized diagnostics, therapy and medication, with dramatic implications for the development of standards of care.

Standards are often embodied in national regulations. While conforming to standards is voluntary, compliance with regulations is mandatory. Nations can craft standards and embody them in regulations to disadvantage competitors, impeding market access or sometimes requiring excessive testing or redesign of products. U.S. innovation and its global competitive position will benefit from an international environment of standards that reduces barriers and underpins open markets for the use and commercialization of these technologies. This involves both regulatory and non-regulatory approaches. Since the U.S. system of standards development is distributed and private sector-led, the development of U.S. standards and U.S. participation in international standards development will involve numerous actors, including government, industry, academia and society. Standards-related bodies are beginning to address these new needs. R&D for new metrology and instrumentation and new test-beds are needed.

**Potential questions for the Working Group to consider:**

- Are standards and regulations for new, disruptive technologies being developed in a timely fashion to match the rapid pace of technological advancement, and to fully capture the economic opportunities and societal benefits these technologies present? Where are we lagging, where are we leading?
- Is greater government leadership and coordination needed to drive, accelerate, and optimize standards development and deployment in the United States—to match the pace of new technology development and the challenges from strong competitors?
- How do we manage and/or prioritize both cross-cutting standards development for new technologies and for sector specific applications?
- How do we balance risk in promoting safety and rapid innovation?
- What is the degree to which we can draw from current standards to accelerate standards development for these new disruptive technologies?
- Will new R&D be required? If so, in what areas?
- What is the role of U.S. values and societal issues in developing standards, for example, in biotechnology and gene-editing? Will the willingness to push the envelop beyond internationally accepted guidelines and standards be a determinant in a country's global competitiveness?

**Challenges in the global environment for trade and new mercantilism.** The United States has long championed fair and equitable market access, and the reduction of non-tariff trade barriers, unfair government preferences for domestic producers, or demands for localized manufacturing. Non-tariff barriers can pose significant competitive and business challenges to U.S. firms and globally-leading U.S. industries. For example, the United States is a world leader in pharmaceuticals and medical device innovation. The pharmaceutical industry invests about $100 billion in R&D—no industry invests more. In addition, the federal government invests about $40 billion annually in life science R&D, which has supported the U.S. competitive edge.[14] U.S. pharmaceutical firms have raised concerns about policies and practices in several trading partners, for example, pressure for compulsory licenses, which can undermine incentives to invest in R&D, be used to advantage domestic companies, or to gain leverage in pricing negotiations. Other challenges faced include unreasonable regulatory approval delays, non-transparent reimbursement policies, and outright bans on some imported pharmaceutical products and medical devices in favor of local products.[15]

In another example, digital trade, U.S. firms have faced restrictions on cross-border data flows, data localization requirements, bans on foreign companies directly providing cloud computing services in domestic markets, web filtering and blocking of web sites, the prospect of tariffs on digital products transmitted electronically, and a EU proposal to single out

14 National Science Foundation.

15 2018 Special 301 Report, Office of the United States Trade Representative.

China currently blocks 10 of the top 30 global websites, and more than 10,000 domains in total, affecting billions of dollars in potential U.S. business.

digital services for taxes on revenues which would apply almost exclusively to U.S. firms. These have the potential to hurt U.S. start-ups and small innovators particularly. Data analytics, cloud computing and online platforms allow small businesses to keep costs low, scale up quickly without costly infrastructure investments and compete against larger, more established firms.[16]

When small countries deploy non-tariff trade barriers, the impact is relative to the size of their market. It is a different story entirely when a large, strategic competitor to the United States deploys these practices. In this regard, China presents a range of trade challenges to U.S. firms with respect to market access, foreign investment, government interference in private sector technology transfer decisions, and investment and other regulatory requirements that promote the acquisition of foreign technology by Chinese firms.

U.S. firms face requirements or pressures to transfer their technology in exchange for market access, or obtaining investment and regulatory approvals. For example, the 2018 China Business Report of the American Chamber of Commerce in Shanghai reported that 21 percent of member companies had felt pressure to transfer technology in exchange for market access. This pressure was particularly notable in high-tech industries, with 44 percent of aerospace and 41 percent of chemical companies reporting pressure to transfer technology. While these measures are sometimes meant to incentivize domestic "indigenous innovation," in practice they disadvantage U.S. companies, requiring them to give up their IP as the price of market entry.

Other long standing concerns include non-discriminatory access to China's standards setting processes; foreign ownership restrictions and foreign equity limitations; regulations that force U.S. companies seeking to license technologies to Chinese entities to do so on non-market-based terms that favor Chinese recipients; Chinese government facilitation of systematic investment in, and acquisition of, U.S. companies and assets by Chinese companies to obtain cutting-edge technologies; and using cyber security as a pretext to force U.S. industries to disclose IP to the government, to transfer it to a Chinese entity, or to require associated R&D be conducted in China.[17]

On an even broader front, China seeks to shape large swaths of the 21st century global economic and trading system. China's Belt and Road Initiative is staggering in scope; a new Silk Road of railways, energy pipelines, highways, shipping lanes and special economic zones, fueled by $1 trillion in Chinese investment. The initiative would touch more than

16 Fact Sheet on 2019 National Trade Estimate: Key Barriers to Digital Trade, Office of the United States Trade Representative, March 29, 2019.

17 2018 Special 301 Report, Office of the United States Trade Representative.

4 billion people in 65 countries, and $23 trillion in GDP. While the initiative has the potential to develop the infrastructure needed to drive global trade, investment and economic development, it also serves China's economic and geopolitical goals. It could serve as a route for its military expansion, a platform for Beijing-controlled institutions, align a large part of the world economy toward China, and position China to shape the rules and norms of economic activity in the region.

**Potential questions for the Working Group to consider:**

- Are we confronting new trading (mercantilist) systems in our global competitors? Can we compete with those systems? If not, what do we need to do as a nation to ensure U.S. made goods and services can compete in the global market place?
- The administration has taken a more muscular approach to trade, non-tariff trade barriers, the pressure to transfer (and the theft) of U.S. intellectual property, and other barriers to foreign market access. Is this the right approach; is the level of pressure appropriate? What are alternatives?
- How concerned should the United States be about China's Belt and Road Initiative? Does the United States need more aggressive investments and policies in that part of the world to counter-balance China's actions?

# Scope of Work

The scope of this Commission will focus on identifying significant means to increase U.S. innovation capacity and capability, thereby contributing to greater overall national productivity and prosperity, and identifying/defining one or more high-impact partnership models (private, public-private, etc.) to accomplish this goal.

To ensure the Council fully leverages the breadth and depth of its knowledge and national network in achieving these goals and objectives, the Council proposes to kick off and implement an aggressive project plan beginning at the end of 2018 and extending through 2021—a plan that will include recruiting, securing and funding a high-level, distinctive Commission; recruiting and securing an Advisory Committee for the Commission; forming a standing set of Working Groups; launching and managing a multi-year, progressive Working Group dialogue series with associated primer and post-dialogue reports; organizing and executing a major, annual gathering of the Commissioners and Commission stakeholders; and developing an overarching media and outreach campaign to elevate to national attention the importance of innovation for long-term productivity and prosperity.

**Phase 1: 2018–2019**

- Task 1 entails recruiting and securing Commissioners and the Advisory Committee.
- Task 2 entails planning for a formal launch meeting of the Commission at the Council's 2018 National Competitiveness Forum, and a first meeting in summer 2019.
- Task 3 entails shaping the Working Group topics—and identifying and recruiting members in the fall of 2019.
- Task 4 entails interviewing and hiring needed research and communications team to kick start the work plan.

**Phase 2: 2019 through 2021**

For each year in Phase 2:

- Task 1 entails the Commission meeting physically in the spring/summer.
- Task 2 entails the Commissioners, should they choose, convening at the Council's winter National Competitiveness Forum.
- Task 3 entails the Advisory Committee meeting physically at least once per year (and attending the Council's winter National Competitiveness Forum).
- Task 4 entails each Working Group—with an initial set of three—meeting physically/virtually twice a year in progressive dialogues to generate and write-up annual insights pertaining to the overall goals of the Commission.
- Task 5 entails Council staff and Advisory Committee vetting and editing—and preparing for review, approval and release by the Commissioners—the Working Groups' annual findings from their dialogues. This will form the basis of an annual report reviewed, edited and approved by the Commissioners, and publicly released by the Commissioners at the Council's winter National Competitiveness Forum.

Each task in Phases 1 and 2 of the Commission will incorporate a media and outreach strategy attuned to the scale and scope of the Commission's plans and proposals. An Outreach & Engagement Committee reporting to the Commissioners will work with Council staff to identify specific tasks and manage efforts.

# Tasks to Be Performed

## Phase 1: 2018–2019

**Task 1:** Recruiting and securing Commissioners and the Advisory Committee.

The Council is taking steps to capitalize and build on its acknowledged leadership role and momentum in driving America's innovation debate with research, action, advocacy and education to optimize the United States for the 21st century innovation economy by creating the National Commission on Innovation & Competitiveness Frontiers.

- Structure of the Commission
  - Recruit and secure CEOs, university presidents, labor leaders and national laboratory directors.
  - Invitation letters developed, co-signed and sent out by Mehmood Khan/Life Bioscinces, Inc.; Michael Crow/ASU; Deborah L. Wince-Smith/ Council.
- Structure of the Advisory Committee
  - Recruit and secure high-level innovation experts.
  - Participation on the Advisory Committee is voluntary and has no financial commitment.
  - Commissioners have right to nominate 1-2 members of the Advisory Committee.
  - Invitation letters developed, co-signed and sent out by Mehmood Khan/Life Bioscinces, Inc.; Michael Crow/ASU; Deborah Wince-Smith/ Council.

**Task 2:** Planning for a formal announcement of the Commission at the Council's 2018 National Competitiveness Forum, and a formal launch meeting in spring/summer 2019.

The Council will organize the formal launch of the Commission—and this includes developing an agenda and template for this inaugural meeting to define meeting focus.

The Council will capture key conclusions from the inaugural meeting in a succinct, highlights report.

***Deliverables:*** *Launch meeting agenda and post-report.*

**Task 3:** Shaping the Working Group topics and identifying and recruiting members for 2019 and 2020 dialogues.

***Deliverables:*** *A set of Working Group charters–describing the background and scope of the Working Group–and potential membership list.*

**Task 4:** Building out the needed research and communications team to kick start the Commission. In addition to its existing staff, the Council anticipates the need to bring on 2-3 new staff/consultants on the research side, as well as contracting with an external communications firm.

## Phase 2: 2019 through 2021

For each year in Phase 2, the following tasks will need to be fulfilled:

**Task 1:** Developing and executing the Commission's annual spring/summer physical meeting.

The Council will organize each year's spring/summer meeting—and this includes developing an agenda and template for these meetings to define meeting focus.

The Council will capture key conclusions from meetings in a succinct, highlights report–that will guide the Advisory Committee and Working Groups for each year's work program.

***Deliverables:*** *Meeting agenda and post-meeting report.*

**Task 2:** Developing and executing the Commission's annual winter gathering at the Council's National Competitiveness Forum.

The Council will organize each year's winter meeting—and this includes developing an agenda and template for these meetings to define meeting focus.

The Council will capture key conclusions from meetings in a succinct, final year, highlights report.

***Deliverables:*** *Meeting agenda and post-meeting report.*

**Task 3:** Developing and executing the Advisory Committee meeting physically at least once per year (and attending at the Council's winter National Competitiveness Forum).

The Council will organize each year's meeting—and this includes developing an agenda and template for these meetings to define meeting focus.

The Council will capture key conclusions from meetings in a succinct, highlights report.

***Deliverables:*** *Meeting agenda and post-meeting report.*

**Task 4:** Working Group dialogues

A progressive series of twice-per-year dialogues per Working Group (for 3 initial Working Groups)—held across the country and hosted by, for example, university presidents, national laboratory leaders, foundation heads, et al.—designed to produce fresh insights focused building actionable recommendations for the consideration of the Commissioners. Dialogue outcomes include increased national motivation and momentum to achieve a more robust innovation trajectory to support a competitive industrial base, generate new jobs, and drive U.S. competitiveness.

Each Working Group's twice-a-year dialogue over three years will be progressive in that the outcomes and findings from one dialogue will build and feed into the next one. In recognition of the ever-changing innovation landscape, the dialogues are intended to evaluate and capture up-to-the moment knowledge and insights of contributing participants. The 1-2 day sessions—invitation only—will be structured to facilitate cooperative conversations and build action-oriented recommendations. Relevant data, information and other materials that will support and facilitate effective conversation among participants will be developed for each session in a dialogue primer.

The Council will leverage its convening power; draw from its Commissioners; draw from its extensive network of business, academic, government and thought leaders to create a dynamic, multi-disciplinary and highly-informed deliberation and outcome in key areas.

The progressive dialogues become innovation and idea laboratories, incubators and accelerators—bringing together leaders and investors to generate the strategic development framework, engagement pathway, and business plan for the development of policies to connect data, trends and national findings to game-changing investments, collaborations and partnerships "on the ground" across the United States to turbocharge America's innovation capabilities.

The progressive dialogues will serve as the platform off of which innovation grand challenges and opportunities will be identified—and on which parties interested to solve the challenges and seize the opportunities (manufacturers, investors, service providers, universities, national labs, labor, foundations/non-governmental organizations) could come together to map out a partnership or concrete pilot project (from ideation, to project development/management, to funding requirements and in-kind contributions/commitments).

Based on the findings and outcomes of the progressive dialogues over the Commission's three years, the Council will develop for the Commissioners' review and approval a final report synthesizing the dialogues and outlining key recommendations to the nation, the administration, Congress, America's governors, et al. These recommendations should have the ability to scale to a national scope (if appropriate).

**Subtask 4.1 Develop templates for the progressive dialogues over 3 years**
For each of the 18 dialogues, the Council will define meeting focus topics and create agendas for the meetings.

***Deliverables:*** *Template for the progressive dialogues.*

**Subtask 4.2 Identify and recruit panelists, speakers, moderators and participants for the progressive dialogues**
With guidance from the Commissioners and Advisory Committee, the Council will research and select high-level experts to act as speakers and panelists. Participants will include relevant, high-level leaders from industry (small, medium and large companies across multiple industry sectors), academia, labor, state/local government, non-governmental organizations/think tanks, national laboratories, federal agencies, and/or congressional offices.

**Subtask 4.3 Develop dialogue primers**
Council shall develop for each of the dialogues a short pre-dialogue report outlining relevant data, information and other materials that will support and facilitate effective conversation among dialogue participants.

***Deliverables:*** *Primer report for each dialogue.*

**Subtask 4.4 Identify venues for progressive dialogues**
For each of the dialogues, the Council will select venue and implement meeting planning.

**Subtask 4.5 Conduct progressive dialogues**
Under the guidance of the Commissioners, the Council will conduct the progressive dialogues (meetings of relevant, high-level leaders from industry [small, medium and large companies across multiple industry sectors], academia, labor, state/local government, non-governmental organizations/think tanks, national laboratories, federal agencies, and/or congressional offices). The outcomes for each of the dialogues will include, but not necessarily be limited to, actionable recommendations supporting the goals of the Commission.

***Deliverables:*** *Agendas for each of the dialogues.*

**Subtask 4.6 Compile findings and recommendations of progressive dialogue post-reports**
The Council will capture key conclusions from each of the progressive dialogues in succinct meeting highlights reports.

***Deliverables:*** *Post-report for each dialogue.*

**Subtask 4.7 Final synthesis report**
The Council will draft for the Commissioners an annual summary report including key findings from each of the year's Working Group dialogues.

***Deliverables:*** *Final synthesis report.*

**Subtask 4.8 Develop strategic media plan for the progressive dialogue series**
The Council will create a relevant, strategic media plan for the progressive dialogue series.

***Deliverables:*** *Media plan. Elements of the plan could encompass both traditional media and other forms of public outreach. Elements of this plan might include—but not necessarily be limited by—the following to disseminate pre- and post-dialogue findings: press advisory and release, press briefing, social media outreach, mutual website postings at the Council and Commissioner websites, etc.*

**Task 5:** Entails Council staff and Advisory Committee vetting and editing—and preparing for review and approval by Commissioners—the Working Groups' annual findings from their dialogues. This will form the basis of an annual report reviewed, edited and approved by the Commissioners, and publicly released each year by the Commissioners at the Council's winter National Competitiveness Forum.

**Subtask 5.1 Develop a template for annual release of Working Group findings at National Competitiveness Forum**
With guidance from the Commissioners, the Council will define meeting focus topics and create an agenda for the Commissioners' annual gathering at the Council's National Competitiveness Forum.

***Deliverables:*** *Template for Commissioner annual meeting.*

**Subtask 5.2 Develop strategic media and outreach plans for the Commission's annual meetings at the National Competitiveness Forum**
The Council will create a relevant, strategic media plan for the Commission's annual physical meeting at the National Competitiveness Forum—this would include, for example, identification of potential meeting media partner(s); outreach activities preceding, during and post-meeting; etc.

***Deliverables:*** *Media plan. Elements of the media plan could encompass both traditional media and other forms of public outreach. Elements of this plan might include—but not necessarily be limited by—the following to disseminate pre- and post-summit findings: press advisory and release, press briefing, social media outreach, mutual website postings, etc.*

In addition to this media plan, overall outreach deliverables could include promoting a federal innovation strategy with the White House, government agencies and Capitol Hill. For example:

**Administration outreach.** The Council will continue to work with the highest levels of the administration and agency leaders to implement Commission recommendations—and to elevate the innovation agenda to a first-tier national economic priority. Members of the Commission would meet with senior administration officials. The Council will also call upon its own members who serve on distinguished bodies like the President's Council of Advisors on Science and Technology, the National Science Board, etc.

**Federal Affairs Committee.** The Council would reinvigorate its Federal Affairs Committee (comprised of government affairs executives from Council members' Washington, D.C. offices and our National Affiliates) to coordinate and track congressional activity on the Commission's rolling set of recommendations, with individual members taking lead responsibility on specific legislative areas.

**Legislative white papers.** To aid federal policymakers and others, the Council could develop a series of legislative white papers—taking its recommendations to the next level of detail necessary for Congressional staff to begin drafting legislation: explaining what problem a recommendation addresses; the potential impact of a recommendation and why it fixes a problem; the stakeholders involved; and the cost involved.

**Congressional hearings, briefings, and the Council's Competitiveness Caucus.** The Council would work to position Commissioners for relevant Hill testimony to amplify recommendations and build allies. The Council would also host various Hill events designed to rally support for the Commission's recommendations.

# About the Council on Competitiveness

For more than three decades, the Council on Competitiveness (Council) has championed a competitiveness agenda for the United States to attract investment and talent, and spur the commercialization of new ideas.

While the players may have changed since its founding in 1986, the mission remains as vital as ever—to enhance U.S. productivity and raise the standard of living for all Americans.

The members of the Council—CEOs, university presidents, labor leaders and national lab directors—represent a powerful, nonpartisan voice that sets aside politics and seeks results. By providing real-world perspective to Washington policymakers, the Council's private sector network makes an impact on decision-making across a broad spectrum of issues from the cutting-edge of science and technology, to the democratization of innovation, to the shift from energy weakness to strength that supports the growing renaissance in U.S. manufacturing.

The Council's leadership group firmly believes that with the right policies, the strengths and potential of the U.S. economy far outweigh the current challenges the nation faces on the path to higher growth and greater opportunity for all Americans.

**Council on Competitiveness**
900 17th Street, NW
Suite 700
Washington, D.C. 20006
+1 (202) 682-4292
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**UW Regulation 9-1 (Patents and Copyrights)**
**Report to Acting President Theobald**

*June 1, 2020*

## I. The Charge

Acting President Theobald charged Vice President and General Counsel, Tara Evans to review recent efforts to revise UW Regulation 9-1 (Patents and Copyrights), to develop recommendations with respect to University intellectual property, and to present a report by June 1, 2020.

## II. Working Group Formation and Meetings

President Theobald and Vice President Evans formed a Working Group consisting of faculty members, department heads, deans and administrators to provide input. The Working Group members were:

*Faculty Members*: Rudi Michalak, Faculty Senate Chair-Elect, David Bagley, Faculty Fellow, Academic Affairs; Cynthia Weinig, Professor, Botany

*Department Heads*: Scott Turpen, Department Head, Music; Denny Coon, Department Head, Petroleum Engineering

*Deans*: Kem Krueger: Dean, School of Pharmacy

*Administrators*: Tara Evans: Vice President/General Counsel (Chair); Jim Ahern: Associate Vice Provost For Graduate Education; Jerry Fife, Interim Senior Director, Sponsored Programs; Victoria Bryant, Director, Wyoming Technology Transfer and Research Products Center

The Working Group met May 8, 2020, May 15, 2020, May 22, 2020 and May 29, 2020 with electronic communications during the intervening times. At the initial meeting an historical account of the regulation review and revision process to date was presented and the group identified key challenges to consider. The remainder of this report examines areas of agreement identified by the group as well as provides recommendations from the group upon which complete agreement may not have been achieved. When agreement was not reached, majority and minority recommendations are both presented.

## III. Areas of Agreement with Respect to University Intellectual Property

The group agreed that:

1. The University of Wyoming must update UW Regulation 9-1 to account for the changing landscape of intellectual property and to provide clarity to all University employees regarding ownership over patentable and copyrightable creations.

2. The extent of University resource use by the creator is an appropriate criterion for assigning ownership and protecting the institution's interests in inventions (identified as "patentable Intellectual Property" in the draft update to UW Regulation 9-1).

3. In most instances, the rights of ownership in academic course materials should rest with their creators, the faculty.

4. The University should maintain a perpetual license to use academic course materials for any of the university's teaching and educational purposes as well as for administrative purposes such as accreditation.

5. The rights of ownership in scholarship (identified as "works of authorship" in the draft update to UW Regulation 9-1) should remain with their creators.

6. The distribution of income from patents as it exists in the current regulation is appropriate and should not be modified.

## IV. Charge 1: Protection of Inventions (Patentable Intellectual Property)

*Background*. The current regulation assigns the University ownership of all patentable inventions developed by faculty and other employees, except those developed on an individual's personal time and without any use of institutional facilities or employees. While the regulation is appropriate, existing terms can lead to confusion and do not address situations where the creator may be utilizing institutional resources while on their personal time. The majority opinion of the working group, therefore, is that UW Regulation 9-1 should be clarified to better delineate where University ownership over patentable intellectual property will result.

*Majority Recommendation*. ***Clarify existing policy that establishes University ownership of patentable intellectual property that is created with the "use of University Resources" by defining University Resources. Add further specification that inventions created "within the scope of the employee's duties" are also University owned.***

The majority of the group agreed that:

1. Existing regulations that establish institutional ownership over patentable intellectual property created with the use of "University Resources" are appropriate, but lack clarity.

2. To provide clarity to employees and address many circumstances not currently contemplated by the existing regulation, the working group recommends defining the key term "University Resources." The working group further recommends the following terminology as an appropriate definition for the term:

   *Facilities, equipment, funds, or funds under the control of or administered by the University but not to include: office space, library facilities, ordinary access to computers and networks, or salary.*

3. Establishing ownership over patentable intellectual property created "within the scope of the employee's duties," removes the ambiguity associated with the term "Personal Time" and facilitates the protection of inventions created with University support.

*Minority Opinion*. ***Do not establish University ownership over patentable intellectual property that is created "within the scope of the employee's duties."***

The minority opinion does not support establishing University ownership over patentable intellectual property created "within the scope of the employee's duties." Rather, the minority posits that the inclusion of the phrase "use of University Resources" adequately addresses situations where employees have created patentable intellectual property in which the University has made a contribution that

warrants ownership. Specifically, the University has not taken a role in the employee's training or development of expertise and therefore has not contributed to the intellectual underpinnings of the work, as is potentially implied by the phrase of "within the scope of the employee's duties." The minority also indicated that institutional ownership based on "within the scope of the employee's duties" is unnecessary, because employees are readily aware of work that is performed within or outside of their scope of duties.

## V. Charge 2: Ownership of Academic Course Materials

*Background*. The current regulation states that videotaped courses of instruction or other audio-visual productions are the sole property of the University but otherwise does not adequately address the ownership of academic course materials developed by faculty while employed by the institution. As a result, many academic course materials are currently included in works-for-hire policies, and are owned by the institution. The working group unanimously agreed that UW Regulation 9-1 should be modified to establish faculty as the owners of academic course materials they have created and to provide the University with a perpetual license to utilize them for limited educational purposes of the institution.

*Unanimous Recommendation*. ***Modify policy to provide ownership of academic course materials to their creators, and reserve a perpetual license for the institution to utilize such materials for teaching, education and accreditation.***

The working group agreed that:

1. Creator faculty members should be the owners of their academic course materials, including those developed while employed by the institution. Providing this ownership will incentivize academic innovation and further the academic mission of the institution.

2. By updating the policy to provide the institution with a perpetual license to utilize these academic course materials, the institution shall be able to meet its educational, teaching, and accreditation needs without unduly burdening the faculty's rights in their materials.

3. To provide clarity to employees and address many circumstances not contemplated by the current regulations, the working group recommends the inclusion of the following policy statement:
   *The University makes no claim to copyright ownership for noncommissioned academic course materials initiated and completed by academic personnel. However, for those created within the scope of employment, the University will claim a perpetual, nonexclusive, worldwide, royalty-free license to use the Academic Course Materials for any of the University's teaching and educational purposes as well as for administrative purposes for accreditation.*

*Additional Thoughts*.

1. The working group discussed the implications of placing a time limitation on the license provided to the institution, however, ultimately decided doing so would be impractical.

2. The working group also noted that much of the academic course material becomes outdated within a relatively short period of time. As a result, perpetual licensure effectively lasts until the institution has determined the material has become outdated.

3. The working group noted that the institution's use of licensed academic course materials will require additional steps to ensure that faculty are utilizing electronic delivery/recording methods related to these materials.

4. Internal policies should be developed to work with departing faculty to review academic course materials, especially those pertaining to foundational courses where content does not change substantially with time. In particular, the working group recommends that unit heads have the responsibility for ensuring that academic course materials are retained for future use.

## VI. Charge 3: Ownership of Scholarship (Works of Authorship)

*Background*. The current regulation assigns ownership of copyrightable materials to their creators, however, does not adequately define or provide examples of works that are covered by the policy. Additionally, the regulation does not make a policy distinction between works created by academic personnel (i.e. faculty) versus non-academic personnel (staff). As a result, there is general confusion as to the applicability of the policy. The working group agreed that UW Regulation 9-1 should be updated to provide clarity related to these concerns.

*Unanimous Recommendation*. ***Clarify existing policy that academic personnel shall be the owners of Works of Authorship they have created. Additionally, the regulation should clarify that the University shall own Works of Authorship created by non-academic personnel and within the scope of their employment. Finally, a non-exhaustive list of examples of "Works of Authorship" should be included in the regulation to provide clarity to all employees.***

The working group agreed that:

1. Scholarship, or "Works of Authorship" should remain the property of the academic personnel who created them. Similar to Academic Course Materials, providing this ownership will incentivize academic innovation and further the academic mission of the institution.

2. Works of Authorship created by non-academic personnel within the scope of their employment should be owned by the institution. This concept reinforces policies on works-for-hire and protects the institution's investment in resources devoted to the works created by non-academic employees.

3. By defining Works of Authorship and providing examples, the regulation will provide clarity to employees and better delineate policy nuances related to copyrightable works.

## VII. Charge 4: Distribution of Income from Patents

*Background*. The current University regulation provides that distribution of net income or royalties received by the University related to patents shall be distributed sixty percent (60%) to the inventor/author and forty percent (40%) to the University. The existing regulation further prescribes that half of the University's share shall be provided to the originating department or college while the other half shall be paid into a research and development fund.

*Unanimous Recommendation*. ***Maintain the current distribution of income from patents; 60% to the inventor/author and 40% to the University.***

The working group agreed that:

1. The current regulation on the distribution of income from patents reflects a modern approach when compared nationally, and is clear and concise.

2. While other institutions have implemented a tiered approach based on the amount of net proceeds earned by the patent, the committee believes such a policy would over complicate the process and may not truly incentivize efforts from the creator.

3. While the distribution to the inventor (60%) may be slightly high when compared nationally, the rate serves as an important tool for the recruitment of high level academic talent to the institution.

## VIII. Additional Recommendation

Through the working group's review of several other institution's regulations, the group identified the effectiveness of including a strong institutional policy statement through the inclusion of a preamble to the intellectual property regulations. In particular, the group identified the University of Illinois' General Rules Concerning University Organization and Procedure Article III Section 1 as a well written example and recommends institutional leadership consider the inclusion of similar verbiage into the updated University of Wyoming Regulation 9-1.