NIST Update and Agenda Preview

VCAT Meeting: October 18, 2016
Boulder, CO

Willie E. May

Under Secretary of Commerce for Standards and Technology and NIST Director

In Memoriam

- **Katharine Blodgett Gebbie** passed away Wednesday, August 17 at the age of 84
- 48-year NIST career included serving as the Founding Director of PML and its predecessor, the Physics Laboratory
- Under her leadership, four NIST scientists earned Nobel Prizes in Physics from 1997 to 2012
  - William Phillips, 1997
  - Eric Cornell, 2001
  - John Hall, 2005
  - David Wineland, 2012

- Among Gebbie's many honors are:
  - 2006 Presidential Rank Award
  - 2006 Government Women's Visionary Leadership Award
  - 2002 Service to America Award, Department of Commerce Gold Medal and election to the American Academy of Arts and Sciences
  - 2015 NIST's Building 81 in Boulder renamed "the Katharine Blodgett Gebbie Laboratory" in her honor

Visionary Leader and Mentor to four Nobel Prize Winners

In Memoriam

- **Deborah S. Jin** passed away Thursday, September 15 at the age of 47
- Jin pioneered work to understand exotic states of matter such as superconducting materials and superfluids
- Jin's 20 year career at NIST began as a NRC postdoctoral fellow with Eric Cornell in 1996.
- Among her many honors are:
  - 2002 American Physical Society Maria Goeppert Mayer Award
  - 2003 the first NIST person to receive a MacArthur "Genius" Fellowship
  - 2005, second-youngest woman ever elected to the National Academy of Sciences
  - 2007 Fellow of the American Academy of Arts and Sciences
  - 2008 Benjamin Franklin medal in Physics
  - 2013 L'Oreal/UNESCO "For Women in Science" award
  - 2014 Comstock Prize of the National Academy of Sciences
  - 2014 IOP Isaac Newton Medal

A critical part of the glue that held JILA together

"Jin's work with fermion condensates and extremely cold polar molecules demonstrated for the first time some of the universal laws that underpin fundamental quantum behavior" ---

IOP pays tribute to Professor Deborah Jin, Sept. 20, 2016

Topics: NIST Update and Agenda Preview

- **Safety and Site Security**
- **Budget Status**
- **Research and Program Highlights**
- **Agenda Preview**

Actions to enhance safety at NIST since plutonium contamination event (June 2008)

- **New Chief Safety Officer position (June 2009)**
  - New Safety Office
- **Clear safety roles and responsibilities**
  - Line management
  - Safety Office
- **Strong NIST leadership support**
  - Safety policy from NIST Director
    - Management commitment to safety as core value
    - Focus on personal responsibility for own safety, safety of coworkers, and safety at NIST as a whole
  - NIST Executive Safety Committee
- **Employee Safety Rights and Responsibilities**
  - Speaking up without fear of retaliation
- **Robust safety programs**
  - Hazard Review Program (process for line-management authorization of work and workers)
  - Incident Reporting and Investigation Program
  - Safety Education and Training Program
  - Biosafety, nanomaterials, compressed gases, radiation safety, etc.

Numerous improvements based on DOE Special Review, Blue Ribbon Commissions I and II, VCAT and VCAT Subcommittee on Safety, safety climate assessments, etc.

Two Major Security Incidents Indicated a Need for Improved Security at NIST

July 18, 2015: Explosion in a laboratory room in Bldg. 236, Gaithersburg campus

- A member of the NIST security force assigned to the Gaithersburg campus suffered non-life threatening injuries,
- The NIST Police and Fire Departments responded and due to the presence of what appeared to be meth manufacturing evidence requested the assistance of the Montgomery County Police and Fire Departments.
- The officer resigned from Federal Service, effective July 19 and pleaded guilty on Aug. 21, 2015 to attempting to manufacture amphetamine in a NIST laboratory
  - **On January 8, 2016 was sentenced to 41 months of federal prison time**

April 16, 2016: Unauthorized access incident on Boulder campus

- On Saturday April 16, 2016 an intruder was found wandering in Bldg. 81 in Boulder (the Katharine Blodgett Gebbie Laboratory) by a DOC Police officer responding to a fire alarm.
  - The individual had no identification and was not an authorized user of the laboratory.
  - As he was being questioned, the individual stated that he was feeling ill and started to become incoherent. An ambulance was requested and the individual was transported to the hospital.
- An initial review of the toxic gas monitoring system and video system recordings in the Bldg. 81 cleanroom did not indicate any release of or exposure to chemicals.
- DOC Police (and Federal Protective Service) investigated, charged the intruder with trespassing on federal property.
  - **Trespasser likely gained entrance from an open 5th story window and had access to Bldgs 1 and 81 for 5-6 hrs**
  - **Found guilty and assessed a $35 fine**

Responses to Security Incidents and Inquiries

- Audits of our Police, Security Guard and Foreign National Visitor programs were conducted by the Federal Protective Service and the DoC Office of the Inspector General.

- Three independent security experts were solicited to review the NIST Security requirements and practices and to each then independently provide their findings and recommendations.

High Level Security Improvement Themes from External Security Experts

Authorities

- **There was no firm evidence found that clearly articulated NIST senior management's authority and responsibility** to assure the security of NIST facilities, people, property and assets

Culture

- **The NIST corporate culture is not amenable to strengthening security measures** at either location (Gaithersburg or Boulder) in any way that would further reduce the collegial atmosphere conducive to science. Security policies are seen as a hindrance to NIST's need to be open to industry and academia.

Risk

- **There is no designated official who is responsible for accepting risk on behalf of NIST in the security area.** The decision to accept risk is one that should not be taken lightly and subsequently is generally reserved for those officials with overall responsibility for an organization. NIST does not have a robust program for identifying and mitigating security risks

Organization

- **NIST's current organizational structure limits the effectiveness of the security program.** The security organization is bifurcated and located too low in the organizational structure for security leaders to carry out their mission effectively. The daily operational environment at NIST does not appear to warrant both a security and a law enforcement cadre.

Resources

- **Security resources at NIST (staffing, services, equipment and systems) are undersized for the breadth of responsibility of the program.** In many instances functional areas of security are only one deep, creating single points of failure.

Strategic Planning

- **There is no long term security management strategy/sustainment plan in place for NIST.** A comprehensive plan should identify key threats/risks and those capital investments necessary to sustain and improve the NIST security infrastructure.

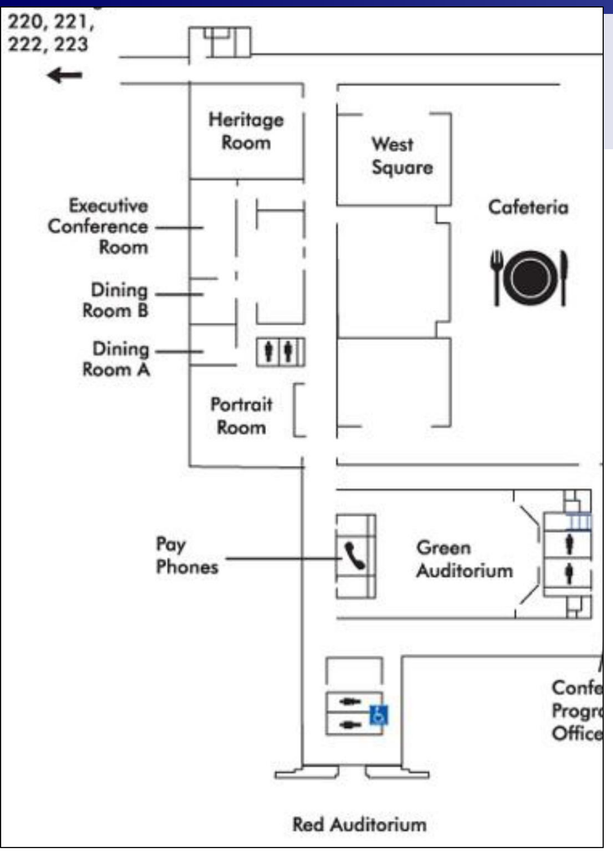
Consensus Recommendations from Security Experts

- Strengthen a number of security measures on both the Gaithersburg and Boulder campuses
- Move leadership for our security functions higher in the organization to ensure that critical issues quickly receive the attention of senior management
- And improve the NIST security culture period!!!

NIST was already planning critical steps to enhance security at its facilities

- **Physical Security Improvements include**:
  - providing expanded coverage of the sites via CCTV cameras
  - installation of cyber locks for individual labs within Lab Buildings
  - improvements to both visitor registration and associate systems;
  - improving visitor control points at key access points located in the Building 101 complex
- **IT Improvements include:**
  - critical IT network security equipment upgrades;
  - expanding staff and equipment resources for privileged access management at the system-to-system level;
  - inclusion of federal, contract, associate, and international associate indicators within the display name of all NIST email accounts (ex. john.doe (intlassoc)@nist.gov)
- **Foreign Guest Workers:**
  - NIST and the DoC Office of Security (OSY) are working with the DoC Office of the Inspector General to review NIST Foreign Guest Researcher program.

Controlling Access to Lab Buildings from Building 101



It has become part of the NIST culture to convene and host meetings and conferences that are open to the public

A Security Turnstile was put in place to control access to lab buildings from the public space in Bldg 101

Security Turnstiles for access control to lab buildings adjacent to Bldg. 101 in Gaithersburg

Over the past 7 months, a number of safety incidents reported associated with turnstile

- Primarily minor scratches and a few bruises caused by doors closing while people were passing through
- For the most part, proper protocol not being followed

Near term actions:

- Activated the lane sensors in the turnstile.
- Posted a guard at the turnstile during business hours M-F for security/safety purposes
- Formed a small group to identify a longer-term solution.

Resulting Concrete Actions

- **realigned security functions**
  - from the Office of Facilities and Property Management
  - to report jointly to the Associate Director for Management Resources and the Department of Commerce Director of Security.

- **developed a new NIST Security Policy**, which is currently under review by the Directives Review Board.

- **establishing an internal Security Advisory Board**
- **committed $1.62 million of additional investments in security staffing, equipment, emergency response, and system upgrades during this FY alone!**
- **implemented better planning for our long-term needs**, including strategies to manage risks and budgeting for capital investments to sustain and improve our security approaches and systems.

In Boulder, we have also:

- **disabled PIN only access to buildings** and are requiring two factor authentication with something you have (badges) and something that you uniquely know (your PIN).
- increased number of security guards and patrols.
- initiated after-hours locking of Service Galley Doors
- repaired a number of interior and exterior doors
- held all-hands Town Meeting with NIST, NOAA, and NTIS staff to discuss imperative for upgrading security
- met with City Staff and Congressional Delegations to discuss the imperative for upgrading our security posture

Goal of these improvements and actions

- Ensure that everyone that works at or visits NIST leaves here each day as safe, healthy, and secure as when they arrived.
  - Do so in ways that maintain an open research environment.
  - We know that a free flow of ideas and visitors are critical to maintain our world class research environment.

By taking preemptive efforts to enhance the security of our campuses, we help ensure that the existential “free flow of people and ideas” can continue.

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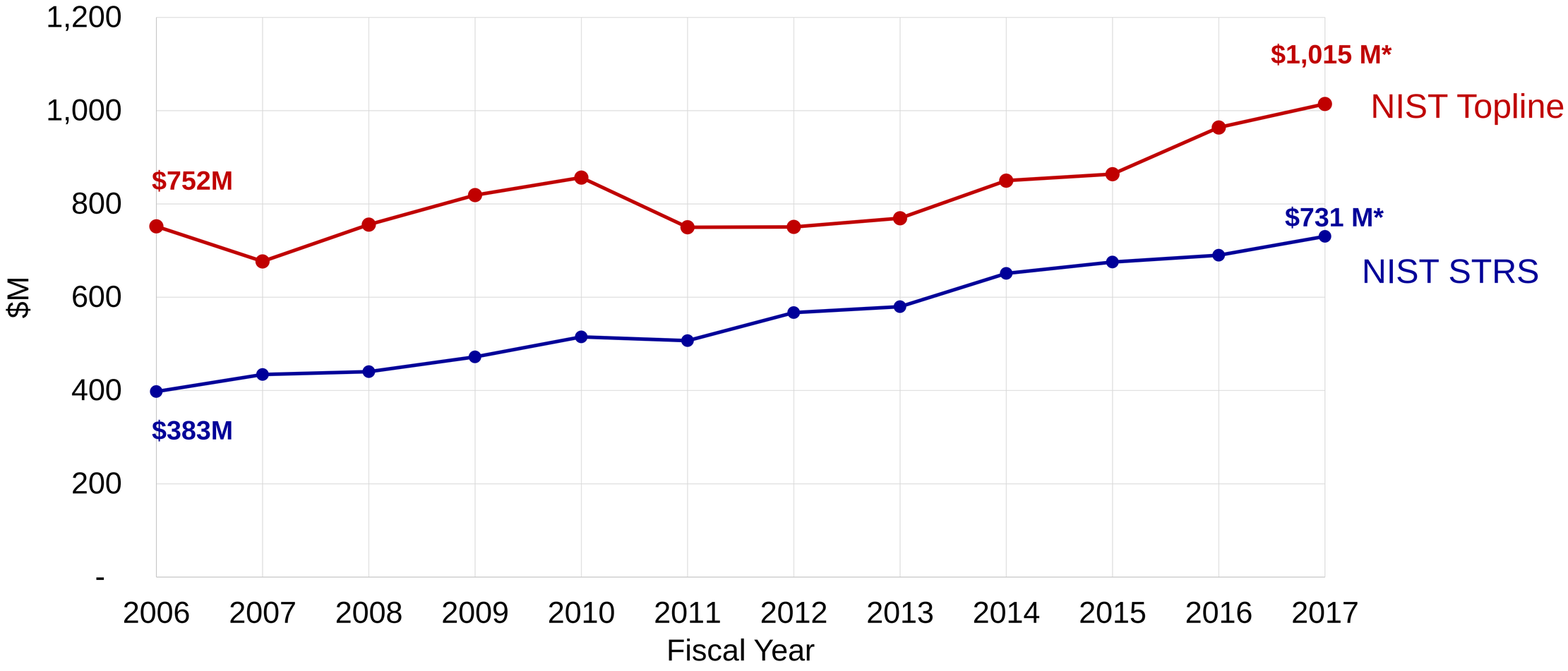
NIST Budget ($M): FY2006 – FY2016



* FY 2017 President's Request

Budget

FY 2016 Enacted	FY2017 President's Request	FY2017 Senate Mark	FY2017 House Mark
$964.0 M	$1014.5 M	$974.0 M	$865.0 M

President's 2017 Request (+$50.5M)

- Grow key laboratory programs:
  - Future Computing (+13.6 M)
  - Ensuring Neutron Facility (+4.8 M)
  - Biomanufacturing (+2.0 M)
  - Advanced Sensing for Manufacturing (+2.0 M)
  - Advanced Communications (+2.0 M)
  - Lab to Market (+2.0M)
- Continue renovations of Building 245 and Boulder Labs (-$24.0 M)
- Grow NNMI (+22.0M) and MEP (+12.0 M)

Current Status is:

- A Ten-week Continuing Resolution passed on September 28, 2016.
  - NIST is funded at FY16 enacted levels until December 9, 2016.

10 weeks / 52 weeks x "FY16 Enacted" = approx. 19% x $964 M = **approx. $185.6 M**

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NNMI Authorized by:
Revitalize American Manufacturing & Innovation Act

(118 bipartisan sponsors)

Our first priority is making America a magnet for new jobs and manufacturing.

Last year, we created our first manufacturing innovation institute in Youngstown, Ohio. *A once-shuttered warehouse is now a state-of-the art lab where new workers are mastering the 3D printing that has the potential to revolutionize the way we make almost everything. There's no reason this can't happen in other towns.*

So tonight, I'm announcing the launch of three more of these manufacturing hubs, *where businesses will partner with the Departments of Defense and Energy to turn regions left behind by globalization into global centers of high-tech jobs.*

And I ask this Congress to help create a network of 15 of these hubs *and guarantee that the next revolution in manufacturing is made right here in America.*

President Obama State of the Union Address, February 13, 2013

RAMI calls upon the U.S. Secretary of Commerce through the NIST to:

1. **Establish the "Network for Manufacturing Innovation Program"** to convene and support existing and future manufacturing innovation Institutes.
2. **Establish new "Institutes for Manufacturing Innovation"** that address private sector needs using an open topic, open competition process
3. **But, at the time of passage, no new funds allocated to implement the Act… and we were forbidden to use any existing funds**

The Advanced Manufacturing National Program Office hosted by NIST given responsibility to oversee the program coordination, network support, and reporting.

NNMI given new public name

National Network for Manufacturing Innovation (NNMI) rebranded as Manufacturing USA

- On September 12, 2016 Secretary Pritzker announced new brand at the International Manufacturing Technology Show (IMTS) in Chicago
- The network consists of public-private institutes dedicated to securing the nation's future through manufacturing innovation, education, and collaboration.
- The new Manufacturing USA name will be used to increase awareness throughout the manufacturing community.

"This name embodies our vision for a unified American manufacturing sector – where the brightest minds and the most innovative companies come together to develop the most cutting-edge technology in the world."

- **Secretary Penny Pritzker**

Manufacturing℠ USA

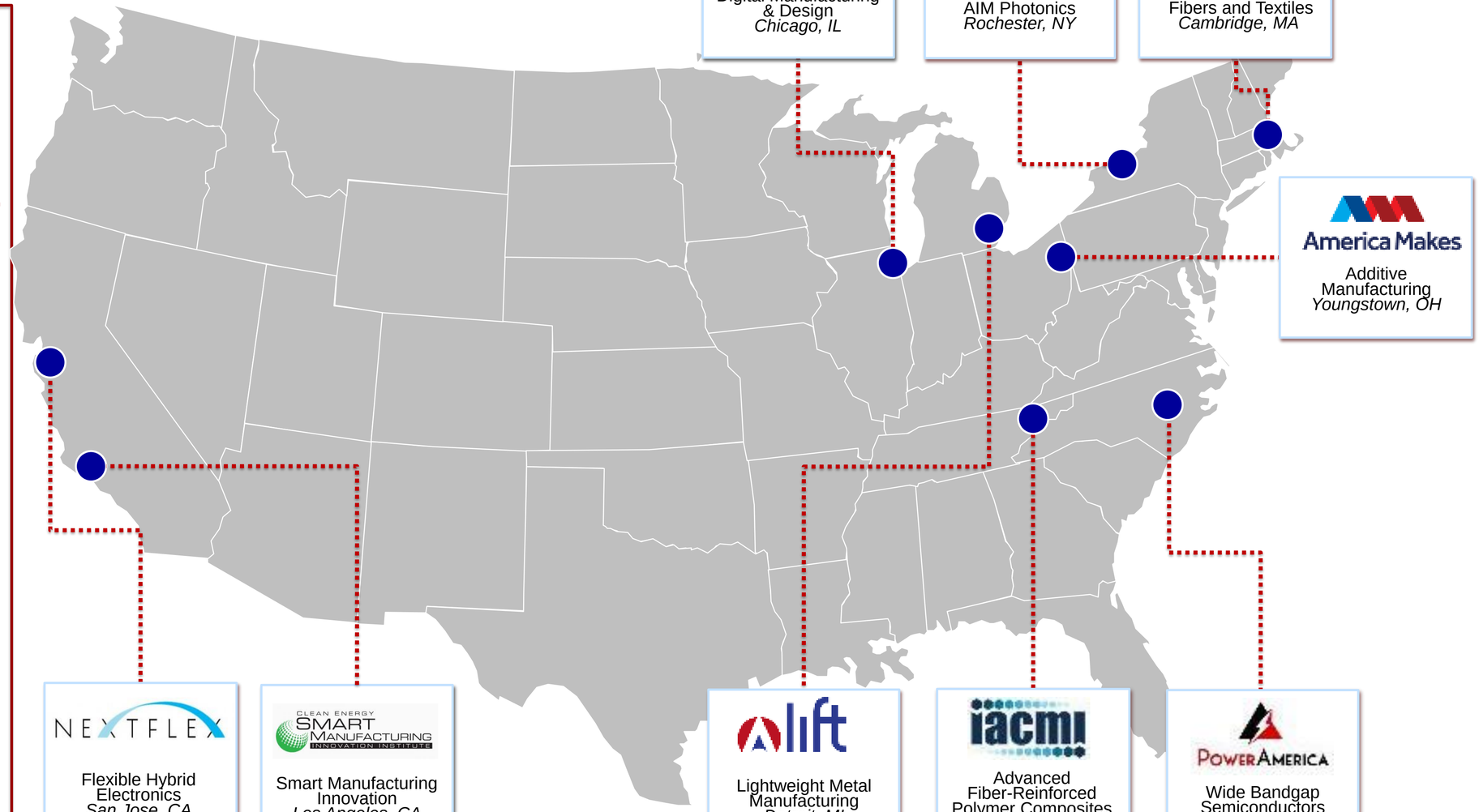
Next Institutes

Department of Commerce/NIST
1-2 Open-Topic Institutes

Department of Energy
Modular Chemical Process Intensification

Department of Defense
Robots in Manufacturing Environments
Advanced Tissue Biofabrication

Goal: 15 by end of Administration



MEP State Competitions Update

In 2014, NIST initiated a carefully planned, systematic, multi-year recompetition of the national system of Centers.

- **Objective:** Optimize the impact of the Federal investment on U.S. manufacturing and to allocate additional funds to areas with higher concentrations of manufacturers.
- **Goal**: Complete competition of the entire 50 State (plus Puerto Rico) national network over three years (by early 2017)

Rounds 1 and 2: July 1, 2015 – Nov 13, 2015

- **Recompetitions Completed for** CO, CT, IN, MI, NH, NC, OR, TN, TX, VA, AK, ID, IL, MN, NJ, NY,OK, WA, WV, WI
- OH/UT did not result in a successful award (being competed in Round 3)

Round 3 Competition in 12 States and Puerto Rico (COMPLETED):

- Awards announced August 31, 2016 and September 19, 2016 for AL, AR, CA, GA, LA, MA, MO, MT, OH, PA, PR, UT and VT
- Award Kick-Off Meeting – Will be conducted October 25-27, 2016

Round 4 Competition for 11 States (In Progress):

- FFO –Closed September 27, 2016 for DE, HI, IA, KS, ME, MS, NV, NM, ND, SC, and WY
- Anticipated announcement of awards – January 2017; Start Date of Awards – April 1, 2017

Baldrige Performance Excellence Program

Purpose

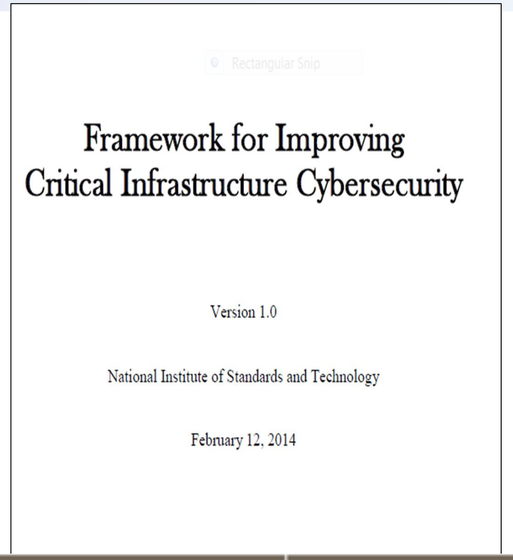
A 28 year old public-private partnership to improve the performance and competitiveness of organizations in the US

Legacy Functions

- Establish the standard of excellence: Baldrige Criteria
- Identify role model organizations: Baldrige Award
- Foster use of the standard and share best practices
  - Provide educational materials and events; Support state programs

New Initiatives

- Executive development: Baldrige Fellows Program
- **Non-Award based assessments and tools**
- Social media, training programs, and workshops
- Broaden scope: Cybersecurity and Communities



Framework for Improving
Critical Infrastructure Cybersecurity

Version 1.0

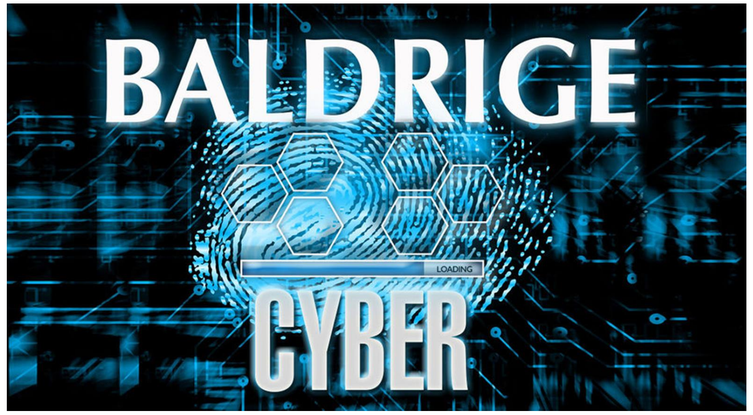
National Institute of Standards and Technology

February 12, 2014

Functions	Categories	Subcategories	Informative References
IDENTIFY			
PROTECT			
DETECT			
RESPOND			
RECOVER			

Baldrige Cybersecurity Excellence Builder: New Tool

- New initiative to promote excellence in cybersecurity
- Integrates the Baldrige Framework with the NIST Cybersecurity Framework
- Voluntary program driven and supported by private-sector



Purpose of this tool:

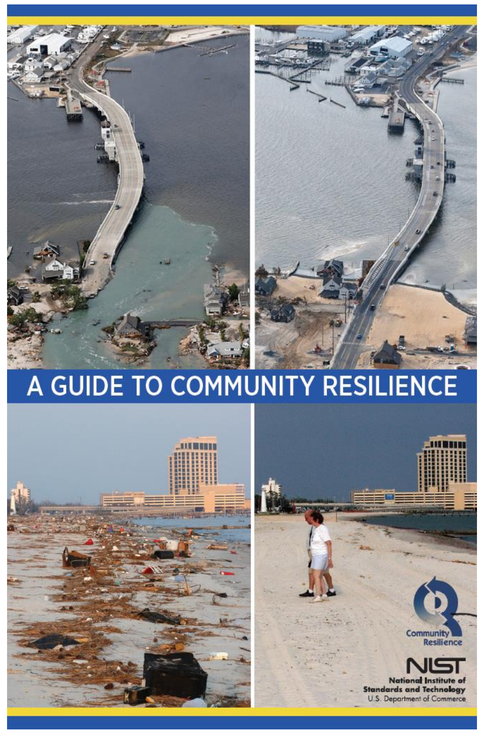
- To help organizations assess the robustness and effectiveness of their cybersecurity practices and risk management efforts.
- To internally gauge how cybersecurity efforts align to organizational strategy.
- To emphasize the tracking and use of performance metrics to drive decision making.

Community Resilience

Developing science-based tools to assess resilience, support resilience investment decisions, and provide guidance for planning and implementation of resilience measures

Planning Guide

- Community Resilience Planning Guide for Buildings and Infrastructure Systems (Vol 1 & 2) released in October 2015
- More implementation tools are being designed and released.
- **Adopted by two communities in Colorado and is encouraged as a useful tool by US Department of Housing and Urban Development**



Community Resilience Panel

- **Community Resilience Panel for Buildings and Infrastructure Systems launched November 9, 2015, meetings in April and September 2016.**
  - Approximately 300 stakeholders representing government agencies, community and emergency planners, utility managers, insurance industry, etc.
  - The Panel's efforts will inform updates to the Planning Guide

Changes in Needs/Expectations in Forensic Science Sector

- **Forensic science is in a period of changing expectations and requirements.**
  - There is growing concern about the scientific foundation, measurement rigor, and statistical validity of many forensic analyses that is leading to renewed attention to how scientific data are presented in evidentiary settings as well as to expectations of forensic science laboratories.

In the News

The Washington Post

National accreditation board suspends all DNA testing at D.C. crime lab

A wake-up call on the junk science infesting our courtrooms

Washington Post, September 20, 2016

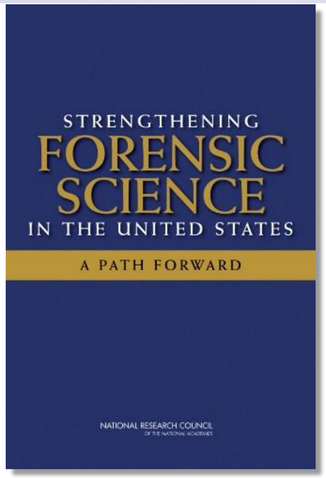
the Atlantic

CSI is a Lie

The New York Times

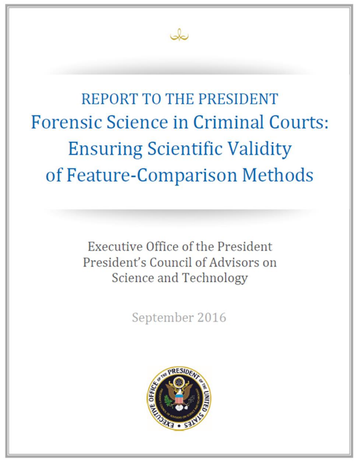
Fix the Flaws in Forensic Science

Status of Forensic Science in U.S.



2009 U.S. National Academy of Science Report

- *"With the exception of nuclear DNA analysis, no forensic method has been rigorously shown to have the capacity to consistently, and with a high degree of certainty, demonstrate a connection between evidence and a specific individual or source." (p.7)*
- [It] also criticized the 21 Scientific Working Groups advising the forensics jurisprudence community as being "too highly fragmented with very different structures and outputs . . .the resulting standards were not enforceable or developed in an open and transparent manner.
  - NIST responded in Feb 2013 with creation of a new entity – the **Organization of Scientific Area Committees (OSAC)**



2016 President's Council of Advisors on Science & Technology (PCAST) Report

- President Obama's asked PCAST, in 2015, as to whether there are additional steps on the scientific side, that could help ensure the validity of forensic evidence used in the Nation's legal system
- In Report to the President issued Sep 2016, ***Forensic Science in Criminal Courts: Ensuring Scientific Validity of Feature-Comparison Methods, PCAST identified two important gaps:***
  - *the need for clarity about the scientific standards for the validity and reliability of forensic methods*
  - *the need to evaluate specific forensic measurement methods to determine whether they have been scientifically established to be valid and reliable. The study aimed to help close these gaps for a number of forensic "feature-comparison" methods*

Technical Merit of Forensic Science Methods

PCAST report of Sept 2016 addresses:

- ❑ DNA
- ❑ Bite Marks
- ❑ Footwear
- ❑ Firearms
- ❑ Latent fingerprints

> "NIST should take a leadership role in transforming three important feature-comparison methods that are currently subjective—latent fingerprint analysis, firearms analysis, and, under some circumstances, DNA analysis of complex mixtures—into objective methods""

Initial NIST efforts would look at three examples selected from different areas, as we learn if the approach can be effective:

- DNA Mixtures
- Ballistics and Tool Marks
- Bite Marks

Biologic Drugs

- **The Cost of Protein therapeutics is one of the fastest growing components to the overall cost of health care in the U.S.**
  - The global biologics market is estimated to grow to **~$380 B by 2019 from $200 B in 2013** (BCC Research),
    - These "biologic drugs" are not synthesized chemically, but rather are made in bioreactors using living cells
- These drugs have proven to be **very therapeutic and substantially improve patients' health and quality of life.** However, they are **very expensive and generics are not widely available in the U.S.**
  - Globally, biologics with estimated sales of $100 billion will come off patent protection by 2020

NIST was asked by both FDA and the industry to apply its unique combination of expertise in the physical, chemical, and the biological measurement sciences **to underpin the development and regulatory approval of follow-on biologic/biosimilar drugs**

Atorvastatin (Lipitor)

Small chemical molecule

800-1000 Da

Produced via chemical synthesis

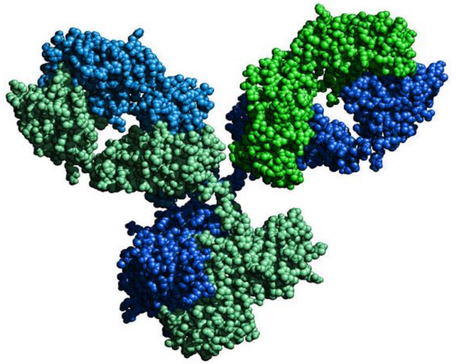
Note: relative scale is illustrative

Calcitonin

Simple Biologic

3455 Da, ~32 Amino acids

Produced in yeast, bacteria



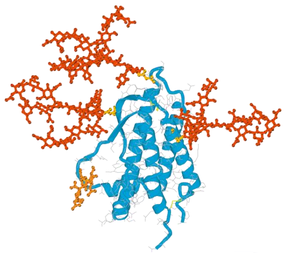
Monoclonal Antibody (IgG)

Complex Biologic

150,000 Da, ~1300 Amino acids (with host cell modifications)

Produced in mammalian cells

NIST Program Plan



Measurement science, tools & standards to support manufacturing & regulatory approval of biologic drugs

Program Areas:

1. **Protein structure: higher order structure, post-translational modifications**
   - **“Structural Sameness”** of the manufactured biopharmaceutical

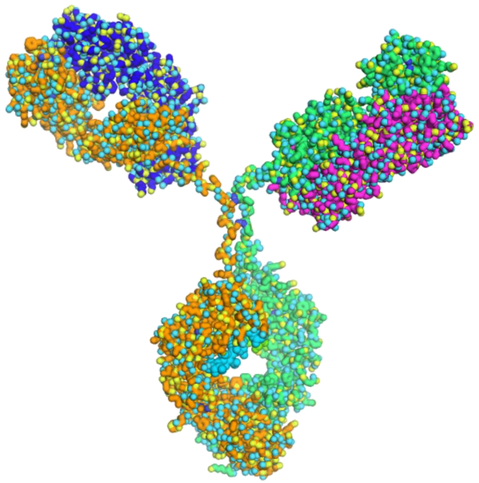
2. **Measurements & standards for protein stability, aggregation, & particles**
   - **Propensity** of the biopharmaceutical **to induce an Immune Response in Patients**

3. **Measurement tools & science to understand production cell variability**
   - **Complex Inner Workings of Cells** used in the production of Biologic Drugs

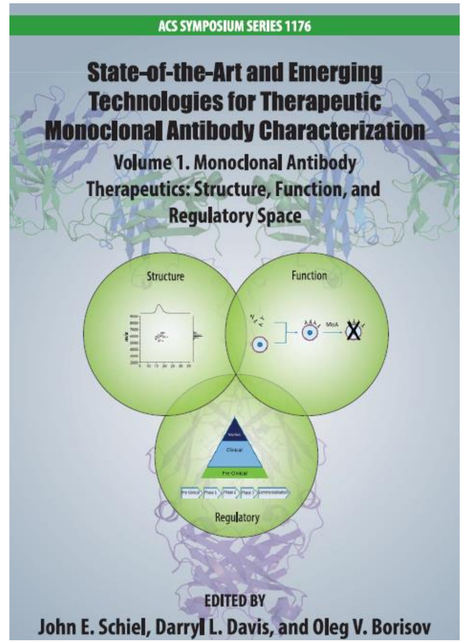
Congressional Subcommittee Hearing - Need for Measurement Standards to Facilitate R&D of Biologic Drugs, Sept. 2009
(From L to R): ***Dr. Anthony Mire-Sluis (Amgen)***
Dr. Patrick VJJ Vink (Mylan)
Dr. Steven Kozlowski (FDA)
Dr. Willie E. May (NIST)

New Monoclonal Antibody Reference Material: NISTmAb

Approach for developing the NISTmAb reference material



- The material was donated by MedImmune
- A global “crowdsourcing” characterization study involving over 100 scientists from the biopharmaceutical industry, regulatory agencies, analytical instrument vendors, and academia
- Results from study formed basis of 3 volume ACS book series



Intended uses:

- Help manufacturers determine that their analytical methods are working properly
- Assess the performance of new analytical technologies
- Speed the development of innovative mAb therapeutics

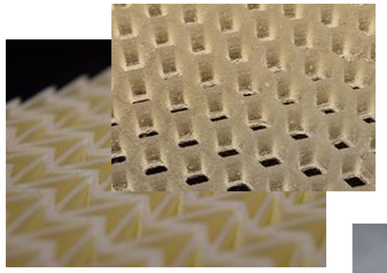
NIST Partnership in Head Health Challenge III

Stimulate development of innovative energy absorbing and dissipating materials

HEAD HEALTH CHALLENGE III

- $250,000 to 5 finalists to advance performance of their innovative materials over 2016.
- Winner will receive $500,000 Grand Prize in February 2017.

Materials Innovations of Finalists

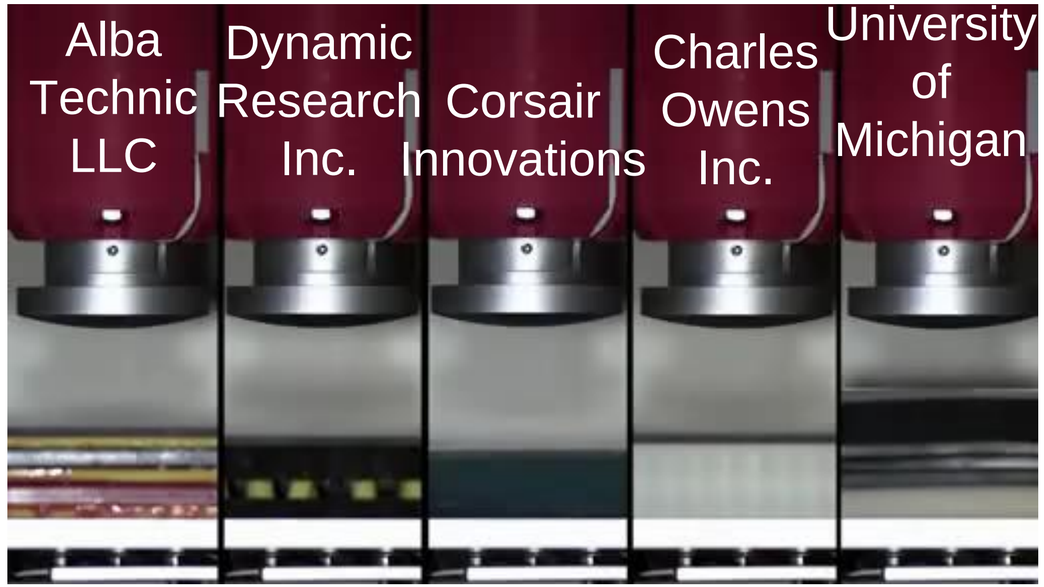


3D printed energy absorbers

Impact absorbing textiles

Designed Multi-layers

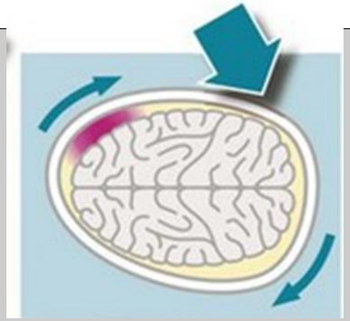
"Architected" Impact Absorbers



NIST testing of finalist materials will help determine the HHCIII Grand Prize Winner

Measurement Challenges Addressed through parallel NIST Research:

- ***Metrology:*** **Materials energy absorption in shear - address brain injuries from rotation**
- ***Modelling:*** **Of the innovative "architected" materials HHCIII finalists produced (w/CHiMAD)**
- ***Standards:*** **Test methods for energy absorbing materials under multiaxial deformation**



First-Round Awardees: Head Health Challenge III - Advanced Materials for Impact Mitigation

- **Alba Technic, LLC** (Winthrop, Maine)
  - patented, shock-absorbent honeycomb material with an outer layer that diverts the energy from a fall or hit.
  - upon impact, the outer layer changes into a hard shell to spread the energy and protect the user from injury.

- **Charles Owen Inc.** (Lincolnton, Ga.)
  - material with a stacked, origami-like design can fold efficiently to optimize energy absorption.
  - material based on originally developed for applications such as solar array packing for space industry.

- **Corsair Innovations** (Plymouth, Mass.)
  - a textile that uses tiny, spring-like fibers to repel rotational and linear impacts,
  - is washable, breathable, wicks sweat and can be easily engineered to meet impact performance requirements.

- **Dynamic Research Inc.** (Torrance, Calif.) and **6D Helmets LLC**
  - 6D's single-impact suspension technology is being evolved for use in repeated impact conditions.
  - 6D's multi-layer, suspended internal liner system allows the outer layer to move independently of the inner layer in order to reduce the effect of both angular and linear impact forces.

- **University of Michigan** (Ann Arbor, Mich)
  - a lightweight, multi-layered composite that includes a viscoelastic material.
  - material can be uniquely utilized to help limit the force of multiple and repeated impact events.

Voting Systems

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Steve Woods

The Help America Vote Act (HAVA) gave NIST a key role in helping to realize nationwide improvements in voting systems.

To assist the Election Assistance Commission (EAC) with the development of voluntary voting system guidelines, this Act established the Technical Guidelines Development Committee (TGDC) and directed NIST to chair the TGDC

NIST research activities include:

- security of computers, computer networks, and computer data storage used in voting systems
- methods to detect and prevent fraud
- protection of voter privacy
- the role of human factors in the design and application of voting systems, including assistive technologies for individuals with disabilities (including blindness) and varying levels of literacy
- the recommendation for accreditation of testing labs to the EAC. The EAC, not NIST, certifies voting systems for use in elections

All of these activities focus on ensuring that all Voters can cast ballots as intended, votes are recorded as cast, and counted as recorded

Topics: NIST Update and Agenda Preview

- Safety and Site Security
- Update on Director’s Priorities
- Budget Status
- Research and Program Highlights
- Agenda Preview

VCAT Meeting Focus:

- **Supporting the NIST Core**
  - Evolution of NIST Research Agenda
  - Research Facilities
  - Open Research Environment

- **Updates on Major Programs**
  - Manufacturing Extension Partnership
  - Cybersecurity Convening Activities
  - SI Redefinition
  - Communications Technology Lab

Thank You for Your Attention

Questions / Discussion ?

Gaithersburg, MD
62 buildings; 578 acres

Boulder, CO
26 buildings; 208 acres