NextFlex

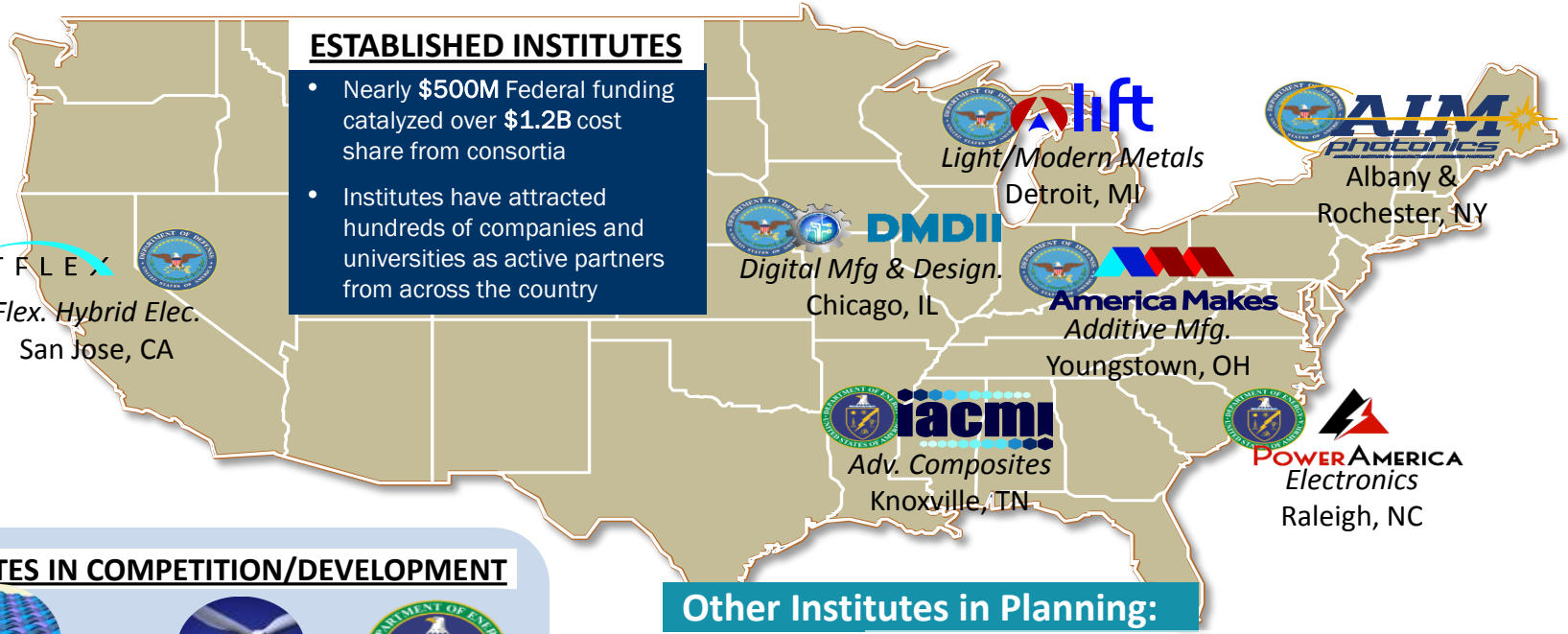
THE FLEXIBLE FUTURE OF ELECTRONICS

iMAPS New England 43rd Symposium & Expo
May 03, 2016

NEXTFLEX
America's Flexible Hybrid Electronics Manufacturing Institute

Building a National Network of Institutes

Network Status



ESTABLISHED INSTITUTES

- Nearly **$500M** Federal funding catalyzed over **$1.2B** cost share from consortia
- Institutes have attracted hundreds of companies and universities as active partners from across the country

NEXTFLEX
Flex. Hybrid Elec.
San Jose, CA

DMDII
Digital Mfg & Design.
Chicago, IL

lift
Light/Modern Metals
Detroit, MI

America Makes
Additive Mfg.
Youngstown, OH

AIM photonics
Albany & Rochester, NY

iacmi
Adv. Composites
Knoxville, TN

PowerAmerica
Electronics
Raleigh, NC

INSTITUTES IN COMPETITION/DEVELOPMENT

Revolutionary Fibers & Textiles
Proj. Award: FQ2/2016

Smart Mfg. for Energy Efficiency
Proj. Award TBD

Topic TBA

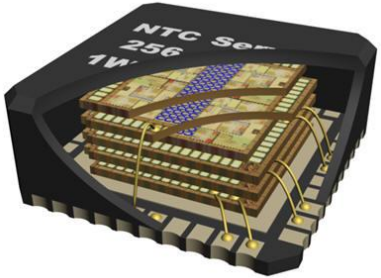
Other Institutes in Planning:

Open topic competition – *addressing "white space" between mission agency topics*

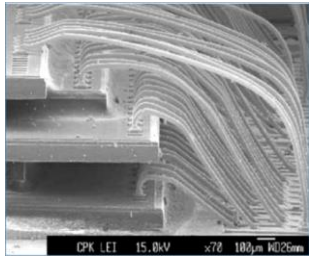
Selected topic competitions supporting Agency mission – *using agency authorities and budgets*

Broad Spectrum of Electronic Packaging

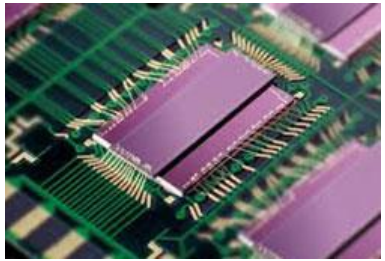
2.5D and 3D Die stacking Component/Devices



Prof. David Wentzloff Univ Michigan EECS

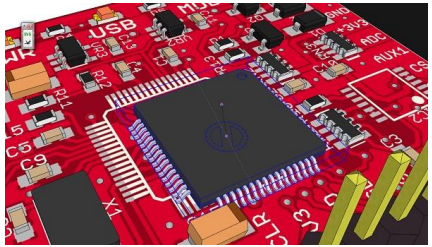


http://www.palomartechnologies.com
Stack Die (3D IC) Assembly
Traditional Wire-bonding

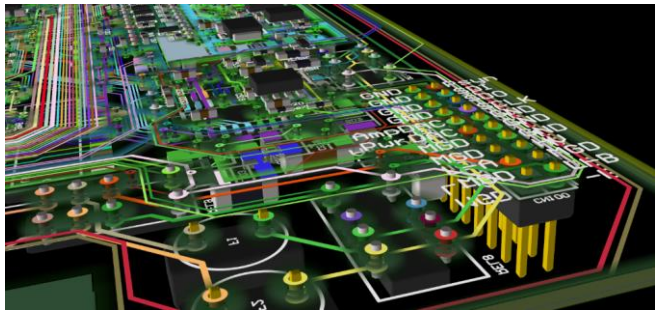


OPTOMEC
3D Additive Die interconnects

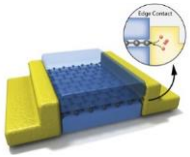
Electronic Manufacturing Technologies that deliver DoD Systems



Printed Circuit Board Layouts
Multi-layer thru-vias



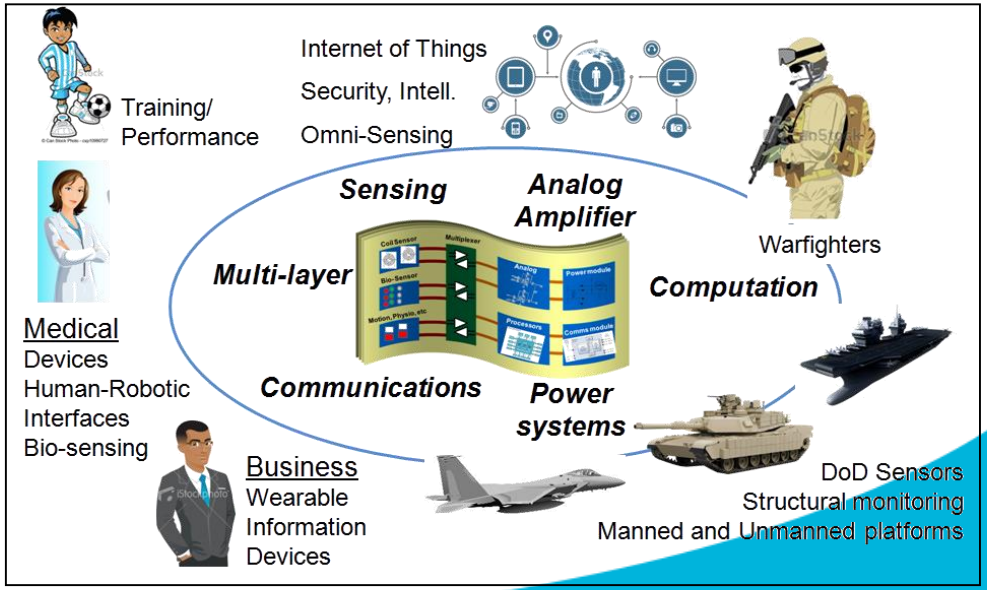
Longer-term RD (Low TRL)



- 2D materials that support future components (processors, memory, etc)
- Printed electronics: Longer term for Active Components

What is Flexible Hybrid Electronics?

- Integration of electronic components onto non-traditional flexible, stretchable substrates
- Intersection of high performance printing industry with thinned CMOS using EMS supply chain
- Medium density / medium area electronics which can bend / conform / or even stretch.
- Increased functionality through integrated electronics which measure or act at the point of interest
- Use novel materials, components, interconnects and designs while adopting existing electronics manufacturing processes and tools as much as possible.



Flexible Hybrid Electronics

IMPACT

- **Novel Form Factors**
- **Light-weight, rugged**
- **Low-cost approaches through new manufacturing**
- **Enabling novel-sensing capabilities**

NextFlex is supporting a wide Range of DoD missions



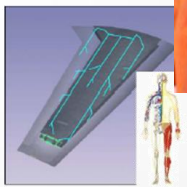






DOD EXAMPLES

Flexible ubiquitous Sensors

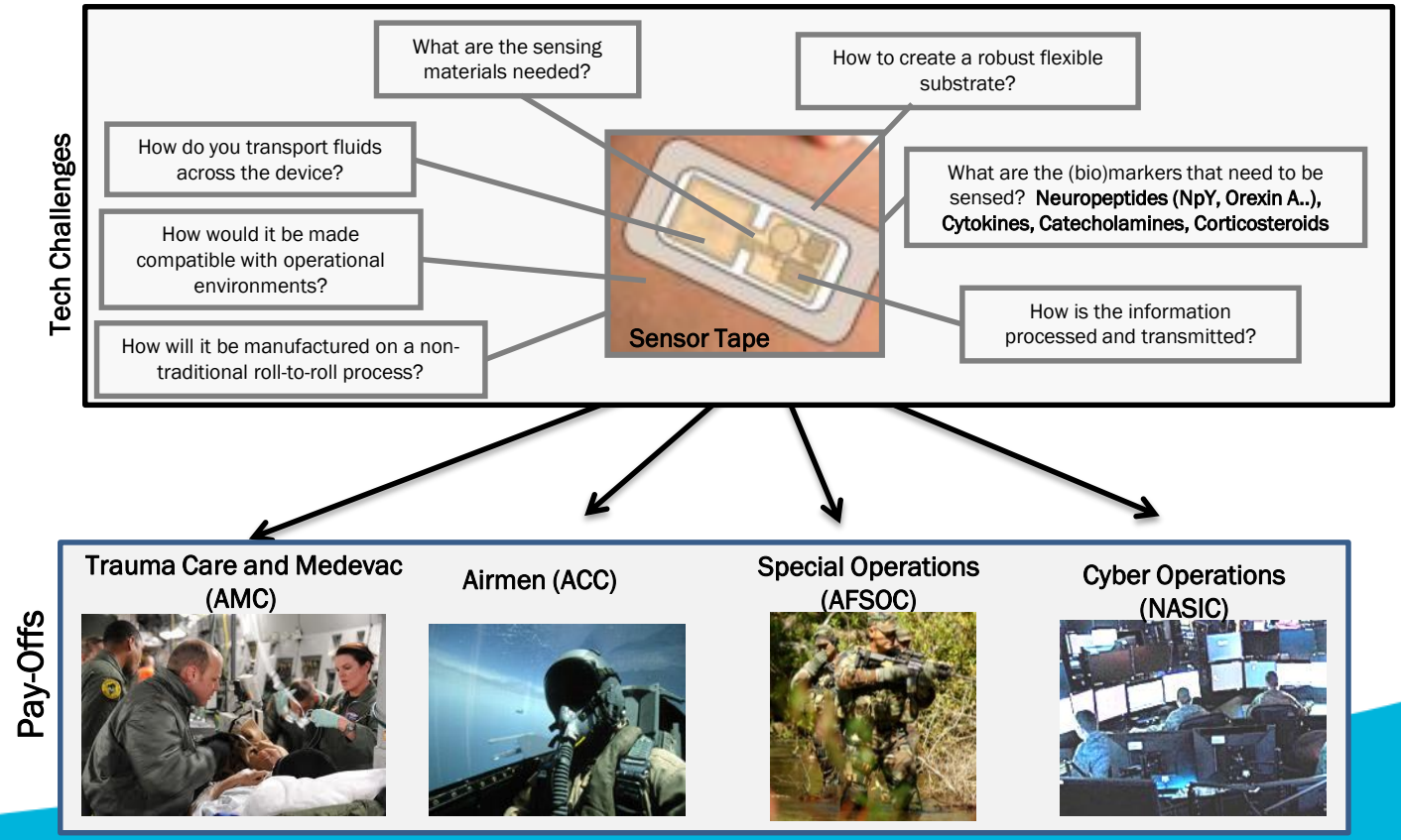




Conformable, compact, lightweight, flexible, low-power electronics and sensors

Bio-marker sensors (AFRL)

Future Vision Example - Human System Platforms
Detecting Biomarkers in Sweat

Goal: <$2, 24-72 hr, non-invasive, tailorable, common mfg platform, integrated with local network



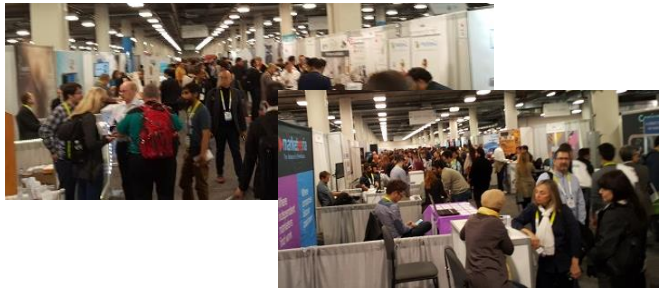
Flexible Hybrid Electronics

Commercial Manufacturing Ecosystem

Enabling a Manufacturing Eco-system…

Sensors Floor Images

Start-up Floor



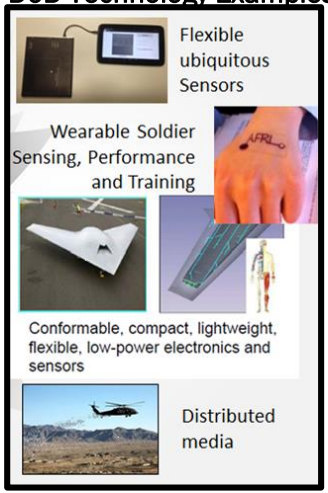
2016 International CES®

…to support technology

Examples

Nobo (N0360)
Hydration

DoD Technology Examples



Manufacturing core investment → *Agency or IRD investment*

NextFlex | America's Flexible Hybrid Electronics Manufacturing Institute

Established: 28 August 2015
Lead: FlexTech Alliance
Hub location and fab: San Jose, California
Proposed Members: 145+ in 27 states
Federal Funding: $75M
Gov't agency engaged: 17 DOD and OGAs

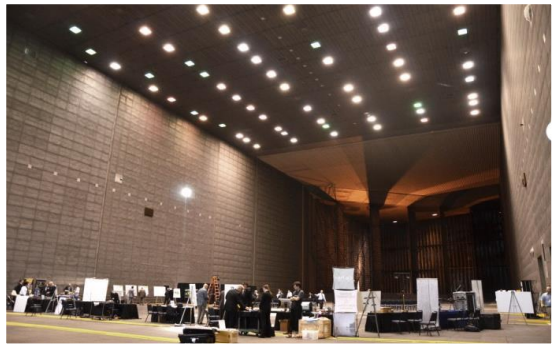
<u>Focus:</u> Combining the entrepreneurial & innovative culture of Silicon Valley with a national network of regional & technology nodes to commercialize FHE technology through manufacturing advancements in integrated printing & packaging, system design tools, materials scale-up, thinned device processing, and reliability testing & modeling.

Manufacturing development for technology Applications

Catalyzing a robust and innovative manufacturing ecosystem at the intersection of the electronics and high performance printing industries.

Announcement Day

AUGUST 28, 2015



NEXTFLEX

Building a Robust Public-Private Partnership

Current Membership

Corporate

Tier 1

BOEING

Tier 2

brewer science

EASTMAN

Tier 3

ACELLENT technologies, inc

CUSTOM ELECTRONICS, INC.

Eink

molex

JABIL

Raytheon

ON Semiconductor

SI2

sti electronics

SRI International

uniqarta

HARRIS

United Technologies Research Center

Observer

American Semiconductor
www.americansemi.com

Academic/Non-Profit

Tier 1

AUBURN UNIVERSITY
SAMUEL GINN COLLEGE OF ENGINEERING

BINGHAMTON UNIVERSITY
STATE UNIVERSITY OF NEW YORK

Georgia Tech

UMASS LOWELL

TEXAS
The University of Texas at Austin

Tier 2

THE UNIVERSITY OF ARIZONA

UCONN
SCHOOL OF ENGINEERING

PURDUE UNIVERSITY

WESTERN MICHIGAN UNIVERSITY

UNIVERSITY of WASHINGTON

WASHINGTON STATE UNIVERSITY

Tier 3

UNIVERSITY OF ARKANSAS

Associations

FlexTech Alliance

semi

IPC

Economic Development

TeamNEO

IOM

Federal Government

Dept Army

Dept AF

Dept Navy

DTRA

DoD Lab

LPS
The Laboratory for Physical Sciences

DMEA
Defense MicroElectronics Activity

DARPA

Dept Energy

NASA

NIST

FDA

NIH
National Institute of Biomedical Imaging and Bioengineering

USFS

NSF

Dept Education

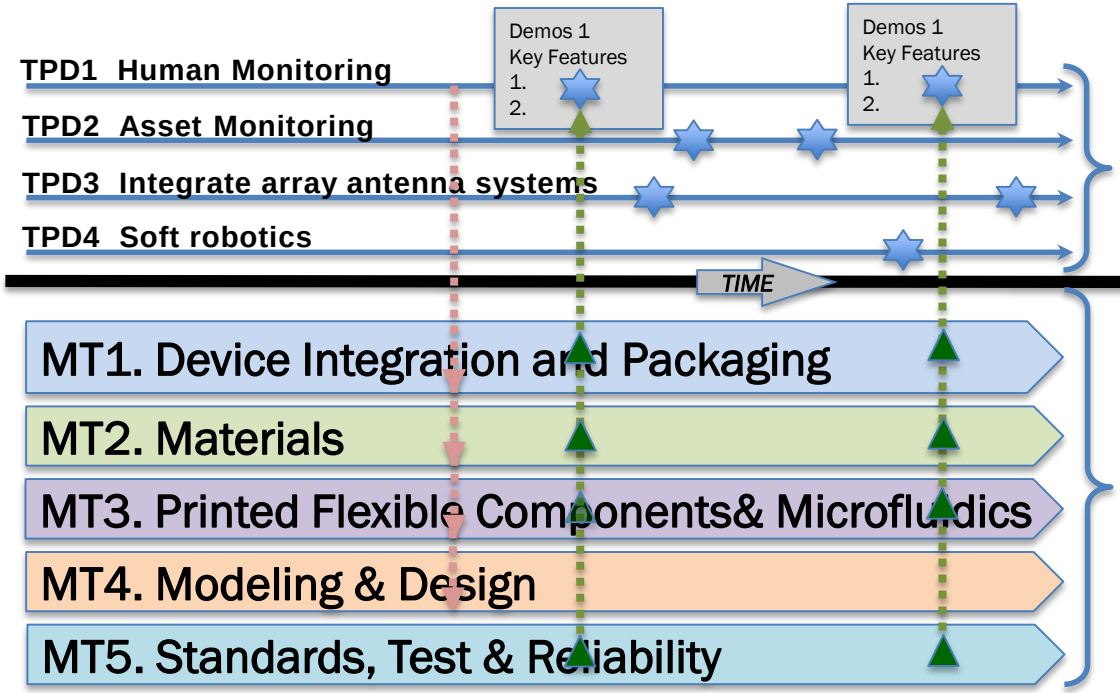
State/Local Government

CITY OF SAN JOSE
CAPITAL OF SILICON VALLEY

NEXTFLEX


NEXTFLEX
America's Flexible Hybrid Electronics Manufacturing Institute
UNIVERSITY of WASHINGTON
WASHINGTON STATE UNIVERSITY
American Semiconductor
SRI International
ACELLENT
ON Semiconductor
THE UNIVERSITY OF ARIZONA.
TEXAS
brewer science
molex
IPC
PURDUE UNIVERSITY
TeamNEO
EASTMAN
sti
Georgia Tech
AUBURN UNIVERSITY
SAMUEL GINN COLLEGE OF ENGINEERING
JABIL
CUSTOM ELECTRONICS, INC.
BINGHAMTON UNIVERSITY
UCONN
UMASS LOWELL
Eink
uniqarta
Raytheon

Strategic Roadmapping Framework



"What" we do

- Led by Tech council
- Strong end-user participation
- Demos describe "What" the institute is doing in manufacturing
- Revised annually

"How" we do it

- Industry Led at WG level
- Clear boundaries, detailed roadmaps and deliverables feeding into TPDs
- Develop "How" – gap analysis
- Drive Project Calls
- Revised semi-annually

Last week we had 660 attendees at FLEX2016 from Industry, academia, government (FTA run)
Technical Working Groups: 140 participants focused on the Roadmapping

NEXTFLEX

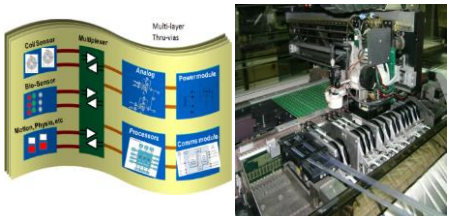
Technical Development Approach

Manufacturing Thrusts

- **Five** Manufacturing Thrusts
- The manufacturing thrust are **demonstrated** through four “Technology Platform Demonstrations”

MT1- Device Integration & Packaging

Development of new tools for testing, slicing, and thinning of silicon wafers as well as for electronic device and sensor integration on flexible, stretchable, and/or foldable substrates. Leveraging advanced precision printing and high-speed automated pick & place for integration of device components, interconnects, and data lines.



MT2-Printed Flexible Components & Microfluidics

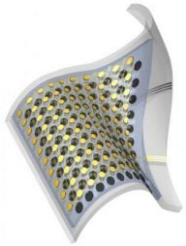
Developing and maturing contact and non-contact printing processes that support hybrid device concepts, including sensors and discrete device components. Printing & integration of microfluidic channels and fluidic control elements.

Technical Development Approach

Manufacturing Thrusts (cont.)

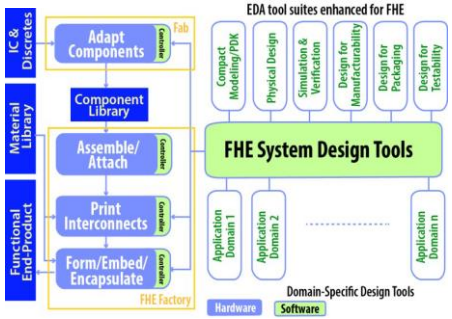
MT3- Materials

Manufacturing scale-up of conductive and dielectric inks and pastes, adhesives, encapsulant materials, and flexible substrates.



MT4- Modeling & Design

Leveraging existing software & hardware design capabilities, simulation techniques, and manufacturing process control tools while also integrating novel manufacturing design rules for FHE.



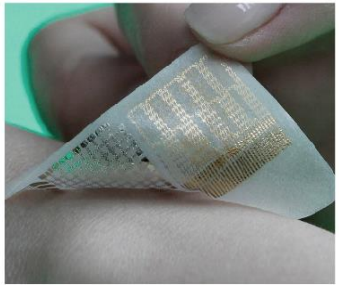
MT5- Standards, Testing, and Reliability

Developing tools and test protocols to evaluate device-level and system-level FHE performance as well as reliability in both commercial and military environments. Partnering with standards organizations and professional societies to develop specifications & standards.

Technology Platforms Demonstrations

1

Human Monitoring Systems



2

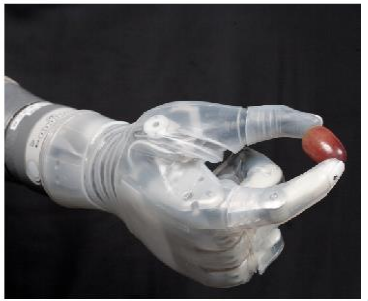
Asset Monitoring Systems

3

Integrated Array Antenna Systems

4

Soft Robotics



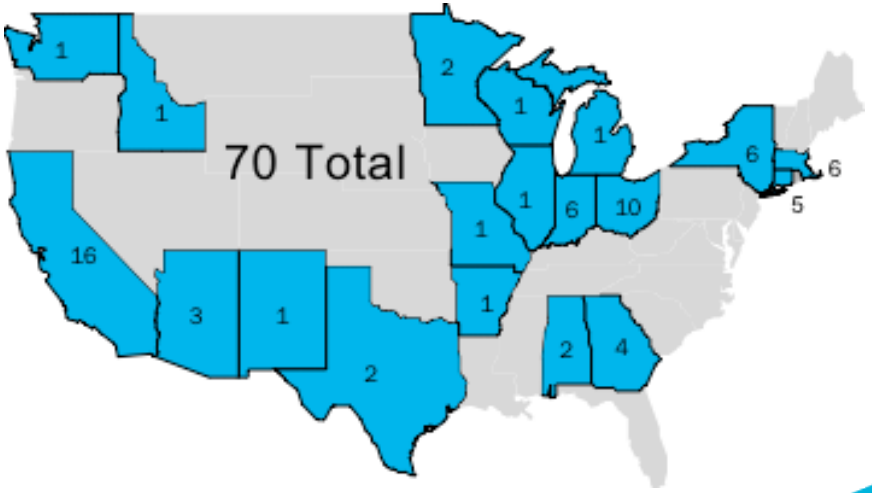
Technical Development Approach

Institute has Five Major Programmatic Thrusts

1. **Institute Acquisition Process** Develop FHE manufacturing ecosystem through Industrial-led Projects
2. **Pilot-scale manufacturing facility** in San Jose, CA for FHE integration
3. **Trained STEM work force** from K-12 outreach through workforce development and re-training
4. **Collaborative discussions** between industry, government and academics to focus the FHE ecosystem
5. **Rapid acquisition vehicle** for agency FHE funding
    1. Open competition for government funding
    2. Leverage NextFlex review government-private expert structure
    3. Agencies control their own funding, final funding authority& management
    4. Rapid project award through existing Open Project Call process

Project Call 1.0 Distribution

- “Fast Start” - delivers fastest path to first Project Call
  - 67 days from award to PC1.0 release
- Enthusiastic response
  - 70 Pre-proposals
  - Broad geographic diversity in lead institutions
  - 21 Industrial leads
  - 70 Industrial partners
- 18 Full proposals Received
- 11 Reviewers/Category
  - (3 Industry, 3 Academic)

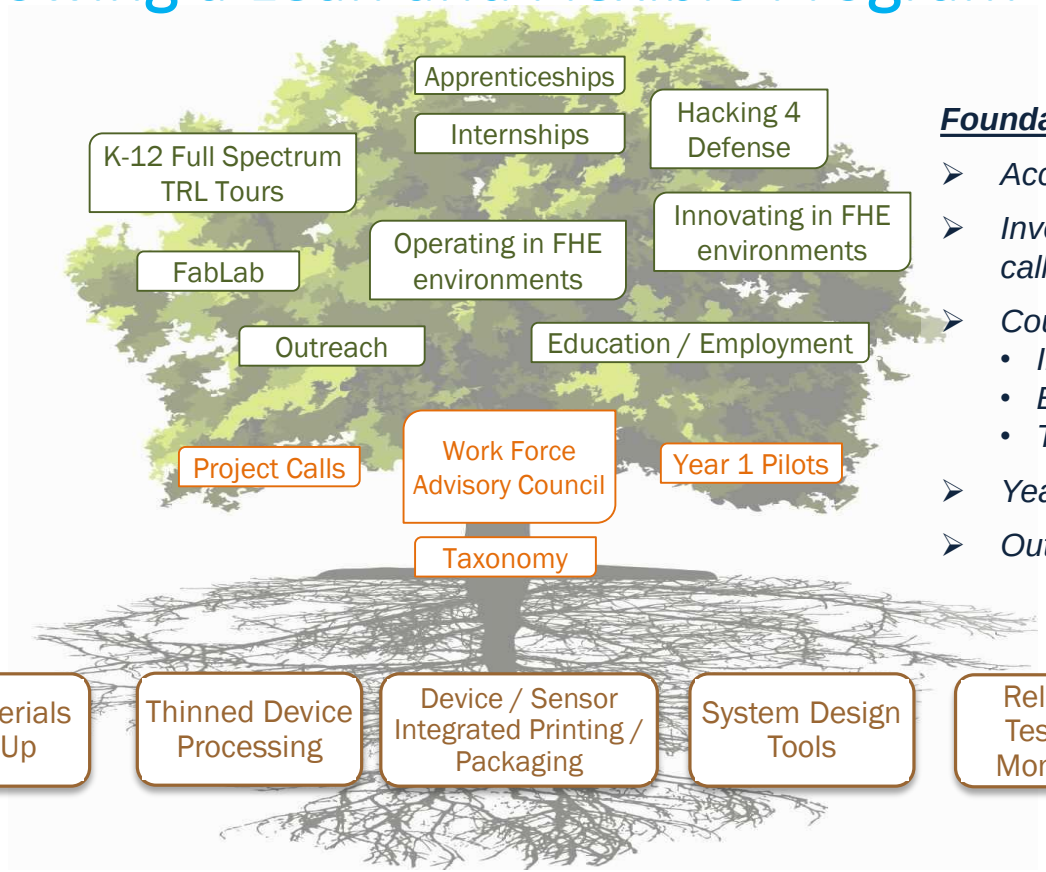


Workforce Development

Growing a Lean and Flexible Program

Mission

Facilitate and enable the outreach, education, and employment of the FHE talent pipeline with partnered companies and schools and with the support of government and non-profit organizations.



Foundational Tenets

- *Accurate workforce taxonomy*
- *Investment through project call process*
- *Council to help synchronize:*
  - *Industry demand*
  - *Educational alignment*
  - *Talent pool outreach*
- *Year 1 pilot programs*
- *Out year iterative sustainment*

5 Focus Areas → FHE Materials Scale Up | Thinned Device Processing | Device / Sensor Integrated Printing / Packaging | System Design Tools | Reliability Testing & Monitoring

Key WFD Activities to Date

Initiated Taxonomy Study

- Employment and Employer demand
- Wages
- Trends
- Education and Skills needs
- Program completions
- National and Regional viewpoints

Hacking 4 Defense pilot programs

- Helping to solve national security problems at SV speed with young technologists
- Collaboration with DIUx,
- Graduate level course using Lean LaunchPad and the Mission Model Canvas
- 14 x agency problems tackled by over 50 x students applicants in first iteration

Kicked off coordination for Internship and Apprenticeship Pilots in OH and CA

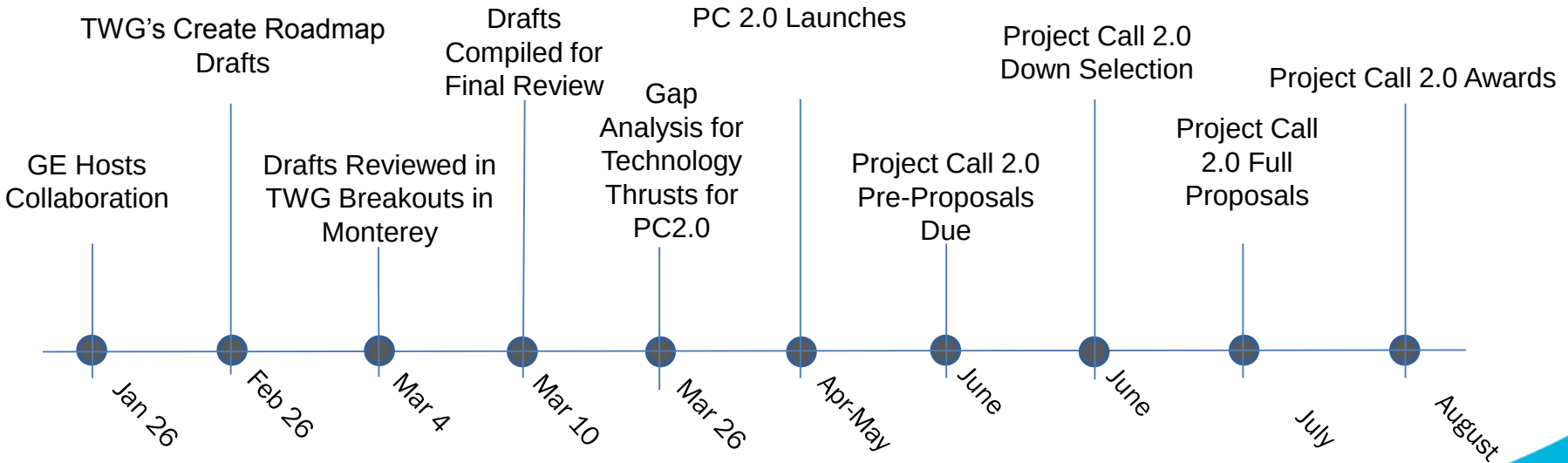
- Internships
  - NE Ohio / Loraine County Community College Advanced Manufacturing Technician (Mechatronics) consortium
- Apprenticeships
  - San Jose area ICW San Jose City, Manex, ATCs, SRI, and local companies

Commenced Outreach Tours within the Hub Region

- Informing, inspiring, attracting HS students and veterans into FHE pathways
- Full spectrum facility tours
  - Research and Development
  - Production and Manufacturing

Roadmap & Project Call 2.0 Process

Calendar



More Information

www.NextFlex.us

Contact: James Zunino – US Army
NextFlex Working Group
Phone: (973) 724- 6773
Email: james.l.zunino.civ@mail.mil

Contact: Paul Semenza
Director of Commercialization
Phone: (408) 577-1311
Email: psemenza@nextflex.us

Contact: Eric Forsythe – US Army
NextFlex Project Manager
Phone: (301) 394-0606
Email: eric.w.forsythe.civ@mail.mil

Contact: Ben Leever – US Air Force
NextFlex Government CTO
Phone: (937) 255-9141
Email: benjamin.leever@us.af.mil

NEXTFLEX

Technical Strategy Development Approach

Technology Platform Demonstrations

TPD1- Human Monitoring Systems

Wearable, unobtrusive, and non-invasive devices for sensing and reporting physiological state of warfighters, athletes, geriatric populations, and medical patients in varied environments.

TPD2- Asset Monitoring Systems

Conformal or integrated devices for sensing and reporting the state of infrastructure, vehicles, logistics, or the environment. Networks of sensors or devices for Internet of Things concepts.

TPD3- Integrated Array Antennas

Patterning of efficient printed wideband array elements on flexible or conformal surfaces and integration of thinned electronics with printed wideband array elements.

TPD4- Soft Robotics

Soft, compressible sensors and devices for robotic functionality, enabling active clothing, wearable robots or robotic tools, advanced prosthetics. Improved robot-human interactions for surgery, manufacturing, and consumer electronics.