Pipeline Safety Research & Development Program Update

Gas/Liquid Pipeline Advisory Committees
November 14, 2019

Sentho White

Director, Engineering and Research Division
Office of Pipeline Safety
Pipeline and Hazardous Materials Safety Administration

Pipeline Safety Research Program

R&D Mission

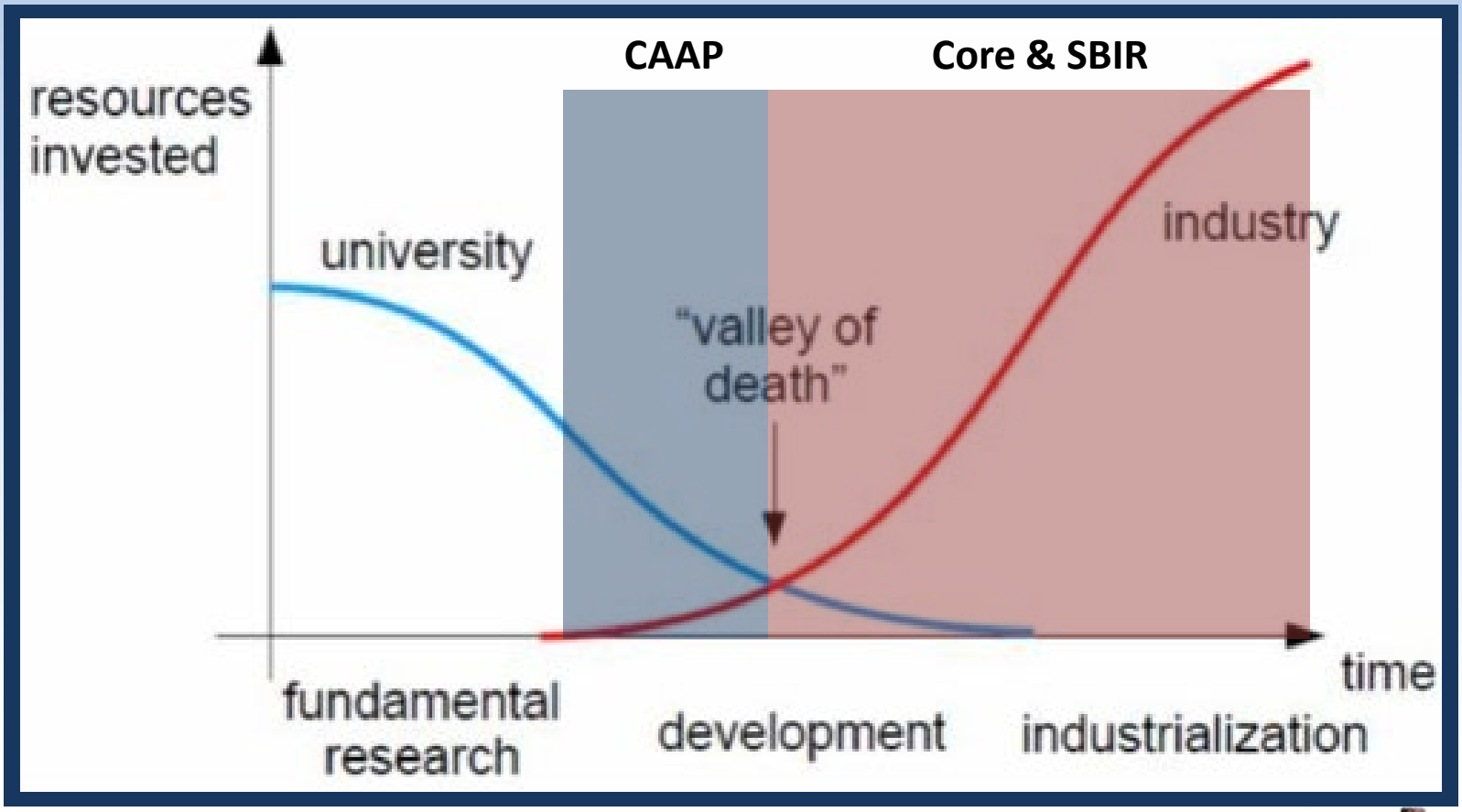
To sponsor research and development projects focused on providing near-term solutions for the Nation's pipeline transportation system that will improve safety, reduce environmental impact, and enhance reliability.

Pipeline Safety Research Programs

- **Competitive Academic Agreement Program (CAAP)**
  - PHMSA partners with universities on pipeline safety research to validate proof of concept of a thesis or theory.
  - Introduces students to transportation of energy by pipelines.
- **Small Business Innovative Research (SBIR)**
  - PHMSA partners with small businesses to commercialize technologies that can advance safety.
- **Core**
  - PHMSA partners with research entities to develop safety technology solutions.

Program Design

Technology Readiness Level



Investment History

Total Investment Since 2002

Name	Amount	Number of Projects
CAAP*	$11.2M	50 Projects
Core	$118.7M	248 Projects
SBIR	$11.0M	37 Projects
Total	**$140M**	**335 Projects**

**CAAP launched in 2013*

Performance History Since 2002

Technology

Category	Technology Projects	Technology Demonstrations	Patent Applications (U.S. + Other)	Patents Granted (U.S. + Other)	Tech-Transfer/ Commercialized Technologies	PHMSA ($M)	Cost Share ($M)
Threat Prevention	23	11	3	3	5	$10.06M	$11.50M
Leak Detection	15	9	2	0	6	$ 8.46M	$ 6.03M
Anomaly Detection	42	27	22	7	14	$27.66M	$31.21M
Anomaly Characterization	9	3	0	0	1	$ 4.32M	$ 2.80M
Materials	7	2	2	2	1	$ 8.15M	$ 7.98M
Welding	7	5	0	0	2	$ 4.92M	$ 6.12M
Joining	3	2	1	0	0	$ 1.35M	$ 1.36M
Alternative Fuels	3	2	1	1	2	$ 1.09M	$ 0.56M
Totals:	**109**	**61**	**31**	**13**	**31**	**$66M**	**$68M**

Performance History Since 2002

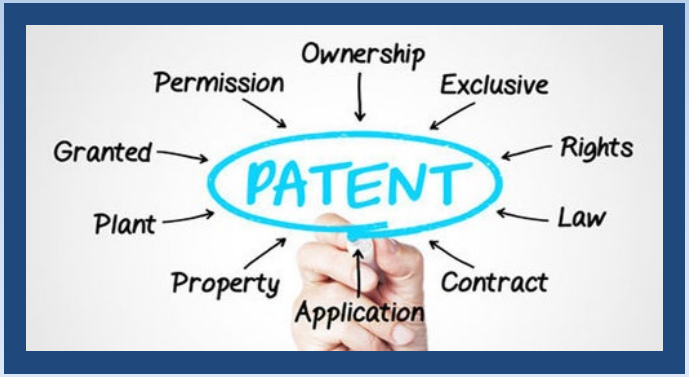
Knowledge Development/Dissemination

Event Type	Events Held	Stakeholders Reached
Blue Ribbon Panel	2	39
Government/Industry R&D Forums	8	1,755
Interagency Coordination Meetings	15	122
R&D Workshops/Conferences	14	2,135
Safety Advisory Committees	1	30
Totals	**40**	**4,081**

Performance History Since 2002

Knowledge Development/Dissemination

Website Metric	Measure
Total Hits	22,248,507
Average Hits/Month	112,366
Downloads Since 2008	1,704,176



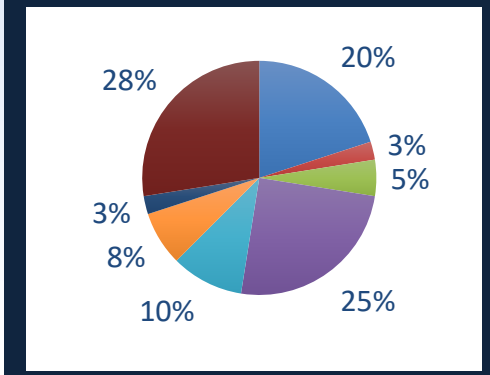
Frequent Program Downloads

Knowledge Promotion Metric	Count
Final Reports	240
Conference or Journal Papers	191
Public Events	40
Annual Peer Reviews Held	13

Research Technology Transfer

Preventing Excavation Damage

- GPS-based Excavation Encroachment Notification
  - UtilAlert by Hydromax
    https://www.hydromaxusa.com/
    https://utilalert.com/
  - Supports excavation only in marked areas
  - Minimizes damages and enhances public safety



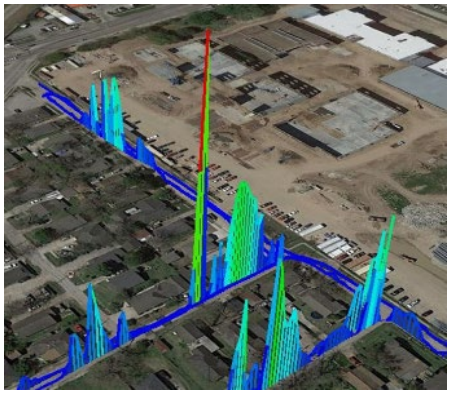
Pictures Courtesy of the Gas Technology Institute

Research Technology Transfer

Methane Emissions Leak Detection

- Natural Gas Pipeline Leak Rate Measurement System
  - Heath Consultants, Inc.

    https://heathus.com/
  - Supports the MobileGuard™ gas leak-detection system
  - Improved methane/ethane analyzer
  - Two-dimensional gas leak rate imager—the first of its kind!



Pictures Courtesy of Heath Consultants, Inc.

Research Technology Transfer

Methane Emissions Leak Detection

- Rapid Aerial Small Methane Leak Survey
  - Ball Aerospace and Technologies Corp.
    https://www.ball.com/aerospace
  - Fixed-wing differential absorption LiDAR (DIAL) technology
  - Plume imagery identifies methane/ethane and naturally-occurring sources (i.e, biogas)
  - A wider-swath sensor enables cost-effective area mapping

Pictures Courtesy of Ball Aerospace and Technologies Corp.

FY 2019 Investments

Name	Amount	Number of Projects
Core*	$10.3M	19 Projects
CAAP	$1.9M	8 Projects
SBIR	$3.9M	4 Projects
Total	**$15.7M**	**31 Projects**

* Includes Interagency Project with National Institute of Standards and Technology

FY 2019 New Core Awards

1. Threat & Damage Prevention

Subsurface Multi-utility Asset Location Detection	Gas Technology Institute
	$1,028,122
Improving Subsurface Non-metallic Utility Locating Using Self-aligning Robotic Ground-penetrating Radar	ULC Robotics
	$393,690
Procedures for Selecting Locating and Excavation Technologies	Operations Technology Development
	$495,000

Picture courtesy of Pasco County Utility Locating Services

FY 2019 New Core Awards

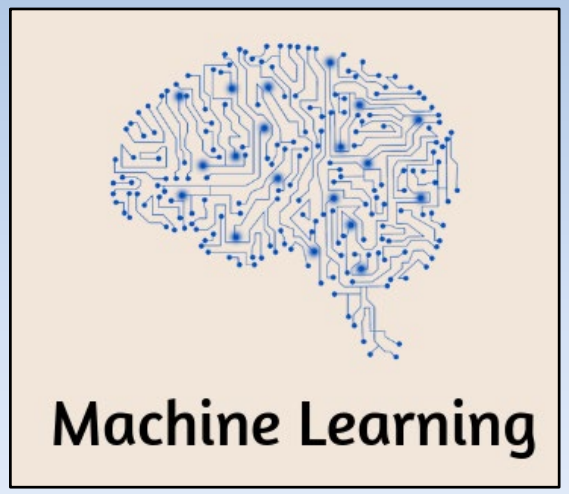
2. Remote Sensing/Leak Detection

Picture courtesy of Drone Deploy

Develop a Remote-sensing and Leak-detection Platform That Can Deploy Multiple Sensor Types	Pipeline Research Council International
	$307,881
Develop and Demonstrate a Remote Multi-sensor Platform for ROW Defense	Operations Technology Development
	$439,000
Mapping Indication Severity Using Bayesian Machine Learning from Indirect Inspection Data into Corrosion Severity for Decision-making in Pipeline Maintenance	Texas A&M University
	$310,000

FY 2019 New Core Awards

2. Remote Sensing/Leak Detection (cont.)



Picture courtesy of Quora

Data Collection, Normalization, and Integration Methods to Enhance Risk-assessment Tools for Decision-making	Gas Technology Institute
	$1,161,597
Improving the Reliability, Detection, and Accuracy Capabilities of Existing Leak-detection Systems Using Machine Learning	Pipeline Research Council International
	$177,717
Validation of Remote-sensing and Leak-detection Technologies Under Realistic and Differing Conditions	Operations Technology Development
	$500,000

FY 2019 New Core Awards

3. Anomaly Detection/Characterization

Program to Advance Computed Tomography for the Development of Reference Standards for Pipeline Anomaly Detection and Characterization	Pipeline Research Council International
	$500,000
Improve Dent/Cracking Assessment Methods	Pipeline Research Council International
	$353,084
Improve In-line Inspection (ILI) Sizing Accuracy	Pipeline Research Council International
	$725,000

Picture courtesy of Mistras

FY 2019 New Core Awards

3. Anomaly Detection/Characterization (cont.)

Systematize 20 Years of Mechanical Damage Research	Pipeline Research Council International
	$393,783
Validate In-Line Inspection (ILI) Capabilities to Detect/Characterize Mechanical Damage	Pipeline Research Council International
	$1,397,722

Picture courtesy of Mistras

FY 2019 New Core Awards

4. Liquefied Natural Gas

Picture courtesy of Cameron LNG

Develop a Risk-based Approach to and Criteria for Hazard Detection Layout	Blue Engineering and Consulting Company $269,952
Evaluation of the Efficacy and Treatment of Hazard Mitigation Measures for LNG Facilities	Gas Technology Institute $319,707
Develop an Evaluation Protocol for Non-LNG Release Hazards – Modeling	Blue Engineering and Consulting Company $391,564

FY 2019 New Core Awards

5. Materials

Review the Intent and Safety Impact of Hoop Stress and Percentage of Specified Minimum Yield Stress Boundaries on Natural Gas Transmission and Distribution Pipelines	Gas Technology Institute
	$431,902

Picture courtesy of Rajendra Piping

FY 2019 New Core Awards

NIST IAA Project 1

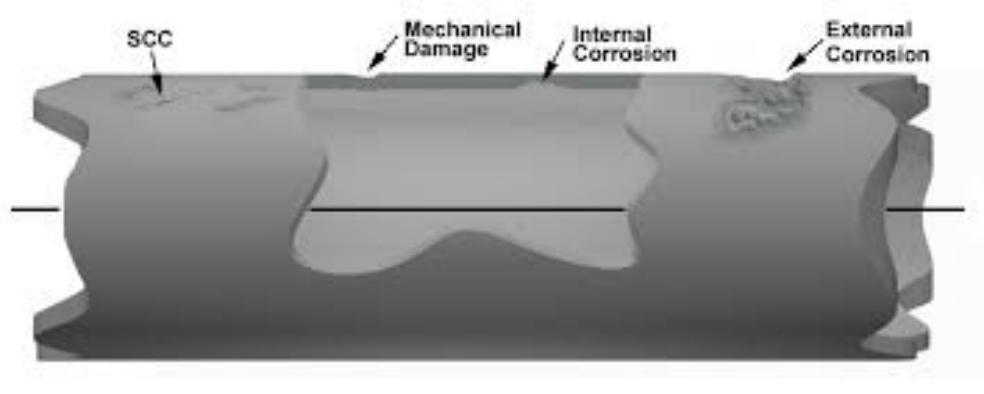
Picture courtesy of DOC/NIST

Mechanical Metallurgy on Vintage X100 Experimental Pipe	National Institute of Standards and Technology
	$705,000

FY 2019 New CAAP Awards

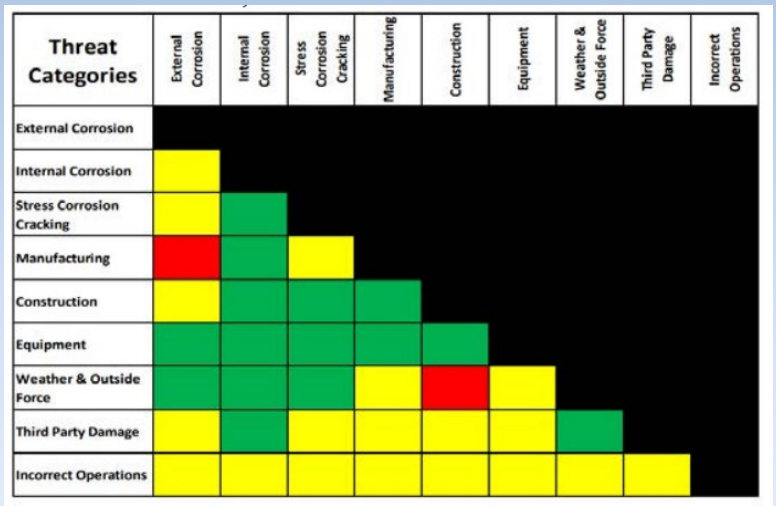
AI-enabled Interactive Threats Detection using a Multi-Camera Stereo Vision System	Arizona State University
	$250,000
Fundamental Understanding of Pipeline Material Degradation under Interactive Threats of Dents and Corrosion	Iowa State University
	$250,000

Pipeline Anomaly Detection and Characterization: Interactive Threats



PHMSA R&D Forum, 2016

FY 2019 New CAAP Awards



Threat Matrix, courtesy of Arizona State University

Pipeline Anomaly Detection and Characterization: Interactive Threats

Improved NDT Detection and Probabilistic Failure Prediction for Interacting Pipeline Anomalies	Brown University
	$250,000
Multi-modal NDE Assisted Probabilistic Pipeline Performance Evaluation under Interactive Anomalies	University of Akron
	$249,926
Distributed Fiber Optic Sensor Network for Real-time Monitoring of Pipeline Interactive Anomalies	Stevens Institute of Technology
	$250,000

FY 2019 New CAAP Awards

Photo courtesy of West Virginia News

Unmanned Aerial Systems (UAS) to Enhance Pipeline Safety

Unmanned Aerial Systems for Pipeline Inspection, Monitoring, and Landscape Analysis	West Virginia University
	$206,920
An Unmanned Aerial System of Visible Light, Infrared and Hyperspectral Cameras with Novel Signal Processing and Data Analytics	Missouri University of Science and Technology
	$250,000
An autonomous UAS inspection platform for high-efficiency 3D pipeline/route modeling/change-detection and gas leak detection-localization	University of Nebraska-Lincoln
	$249,964

FY 2019 New SBIR Awards

Photo courtesy of the iMech Institute

Innovative Technologies for Nondestructive Determination of Fracture Toughness for Pipeline Steels in Transportation Infrastructure

Non-Destructive Coercimetry Fracture Toughness Assessment for Steel Pipelines	Innerspec Technologies, Inc.
	$999,235
NonDestructive Testing of Fracture Toughness for Pipeline Steels	FBS, Inc. (d.b.a. Guidedwave)
	$999,470

FY 2019 New SBIR Awards

Courtesy TD Williamson

Dual Purpose Internal Integrity Assessment and Cleaning Tool for Hazardous Liquid Pipelines

Combined Cleaning and Guided Wave Inspection System for Hazardous Liquid Pipelines	ULC Robotics
	$993,938
Multimodal Acoustic Tool for Inline Pipe Inspection	CREARE LLC
	$994,865

Where Are We This Fiscal Year?

FY 2020 Anticipated Investment

Name	Amount	Award Month
Core*	$17.6M	Feb & July
CAAP	$2M	May
SBIR	$0.4M	July
Total = $20M		

*2 Core Research Announcements planned

Pipeline Safety Research Updates

Pipeline R&D Forums

- Biennial: every 2 years
- February 19-20, 2020
- Arlington, VA
- Government/Industry Steering Committee for agenda development
- Primary action for developing research agendas

Path Forward

- Continual Program Improvement
- Solicit stakeholder input
  - New ideas
  - Ideas from the PACs
  - 2020 R&D Forum
- Fall 2019: next Core and CAAP program research solicitation
  - Address damage prevention challenges, research gaps provided from the Special Notice, and NTSB recommendations

Thank You!

Sentho White
Director – Engineering & Research
Department of Transportation
Pipeline & Hazardous Materials
Safety Administration
Office of Pipeline Safety
(202) 366-2415
sentho.white@dot.gov

Joshua Arnold
General Engineer
Department of Transportation
Pipeline & Hazardous Materials
Safety Administration
Office of Pipeline Safety
(202) 366-6085
joshua.arnold@dot.gov

Robert Smith
Program Manager
Department of Transportation
Pipeline & Hazardous Materials
Safety Administration
Office of Pipeline Safety
(919) 238-4759
robert.w.smith@dot.gov

Zhongquan Zhou
General Engineer
Department of Transportation
Pipeline & Hazardous Materials
Safety Administration
Office of Pipeline Safety
(202)-366-0318
zhongquan.zhou@dot.gov