# Accelerated Workforce Readiness in Fiber-Optic Sensing for Shipboard Applications

**Kevin P. Chen, PhD | Founder & CTO**

AiMiLi (AiMiLight Sensors and Intelligent systems) Inc. and RLS Fibers Inc
University Partner: Penn State University – Electro-Optic Center
Shipbuild partners: NASSCO, *Fincantieri*



# Why DFOS for shipbuilding?

Continuous, distributed sensing for safety and structural health monitoring, enable condition-based maintenance, and support shipboard operation



**USS Bonhomme Richard fire, July 2020**

Earlier warning and faster fault localization

## Immune to electromagnetic interference

Optical sensing near power cables and motors.

## Robust, passive sensing

Protective packaging for harsh shipboard conditions.

## Distributed coverage

Thousands of sensing locations along cable routes.

## Multimodal measurements

Temperature, acoustic/vibration, vibration, load, water flooding, fire

## Retrofit deployment

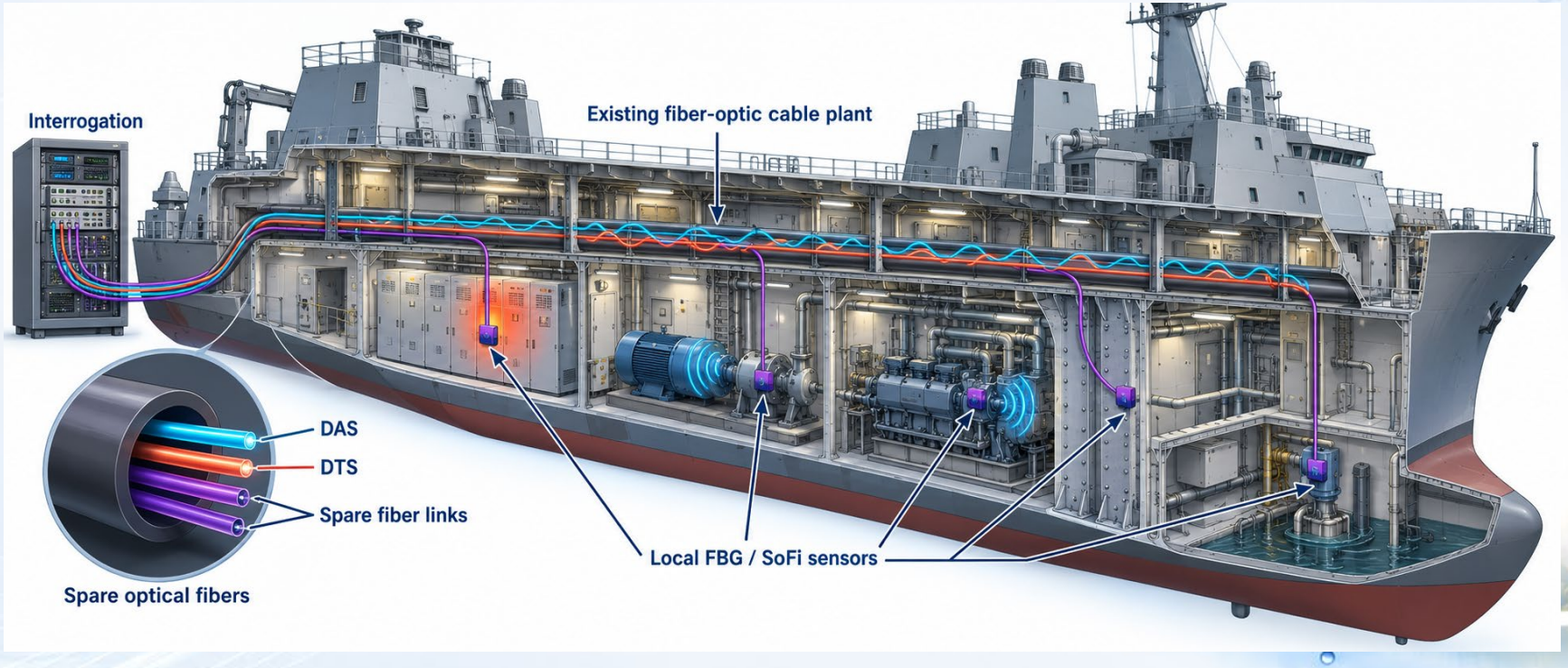
Reuse compatible spare fiber or attach sensing fiber to existing cables and pathways.

**Training enables reliable installation, commissioning, and interpretation.**

Photo: U.S. Navy / MC3 Mar'Queon A. D. Tramble, DVIDS 6273814. *With appropriate fiber, packaging, and interrogation. Illustrative incident; DFOS prevention of this event has not been established.

# A shipwide sensing nervous system

**Ture qualified spare optical fibers into hundreds of thousand of sensors for broad coverage and focused equipment monitoring.**




## Fiber as the distributed sensor

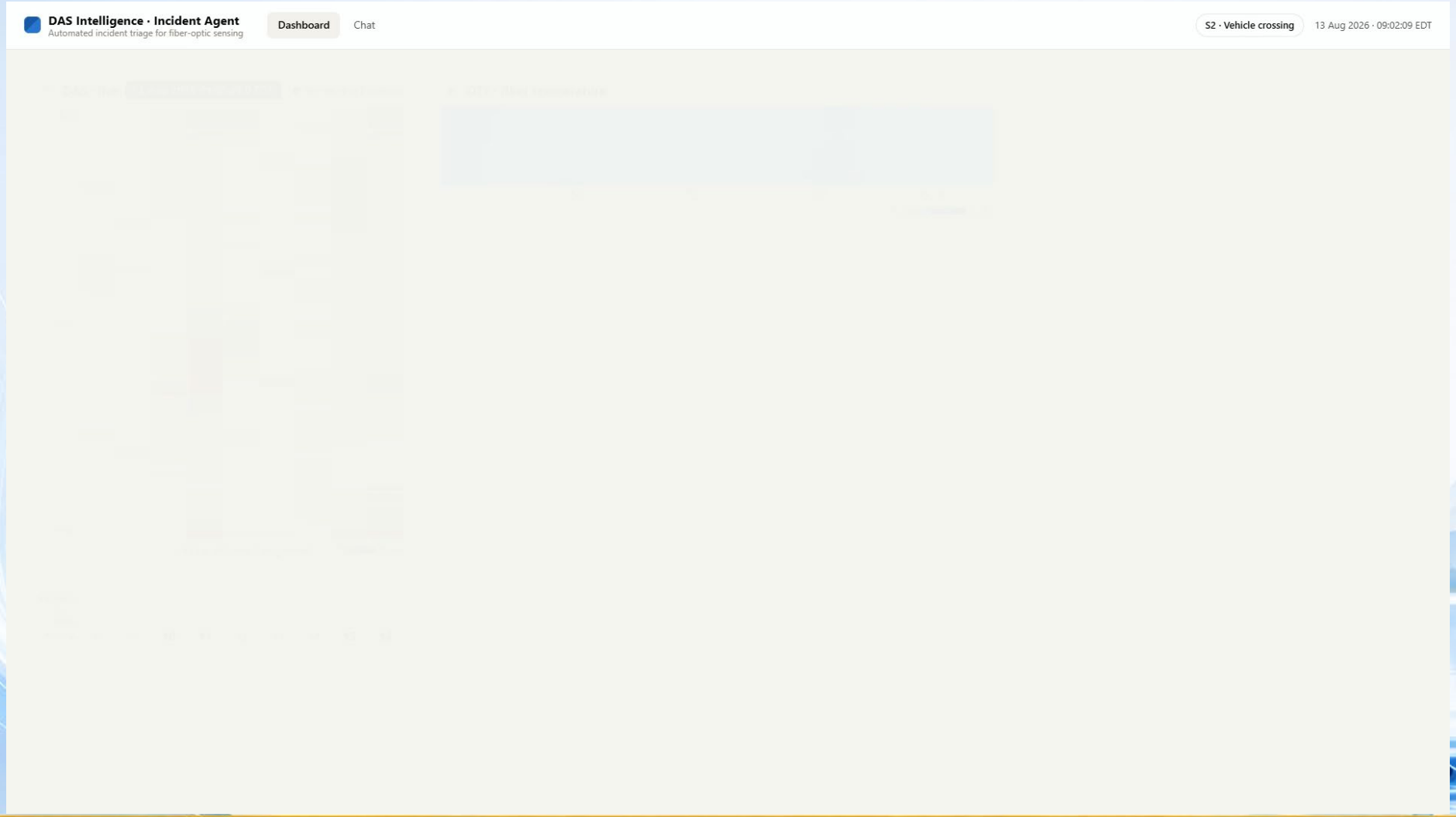
DTS temperature and DAS acoustic/vibration coverage

## Fiber as the connection to local sensors

Focused FBG / SoFi measurements at selected equipment

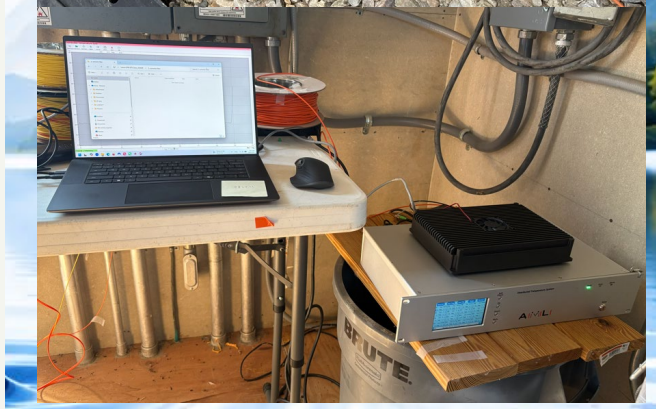
# DFOS using cable with AI agent analytics

## Field deployment of smart-tape sensor for temp. & ground vibration sensing







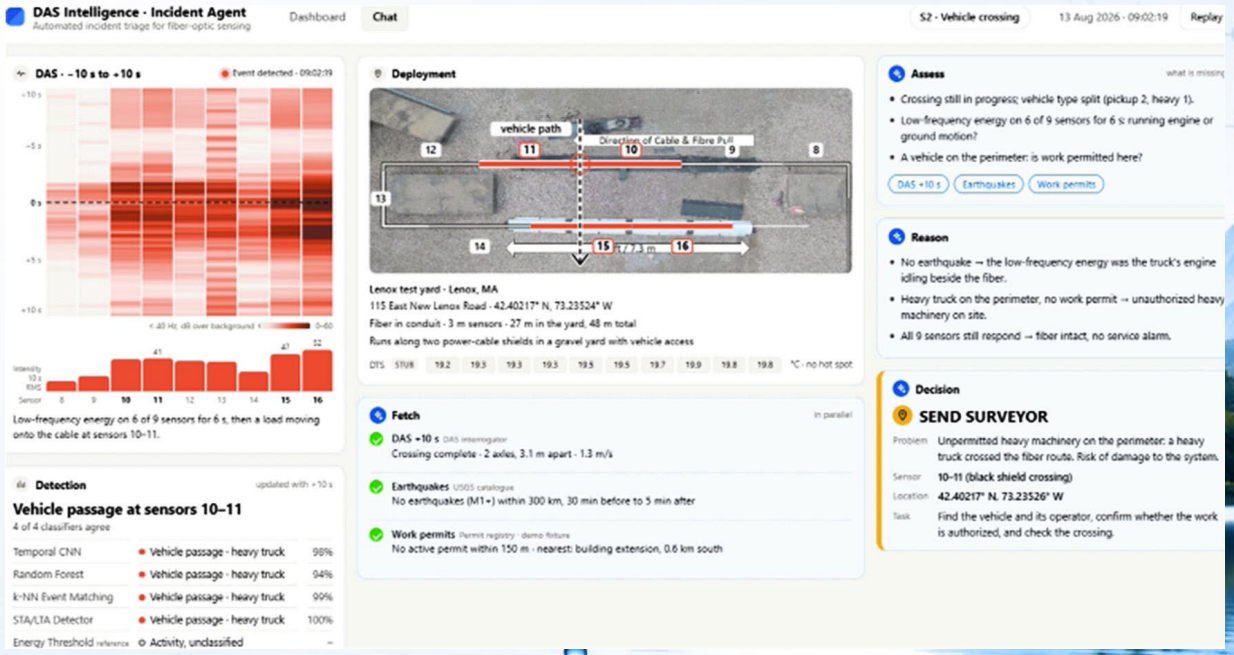



# AI makes DFOS easy – no need for vendor DFOS specialist

## We need to understand the technology – that is the point of this project

- Natural-language setup of monitoring tasks and visualizations.
- Event localization and temperature–vibration comparison.
- Targeted reanalysis using validated processing tools.
- Evidence-linked findings with plots and technical references.
- Reusable tools and AI-assisted software development to reduce customization effort.

**“Investigate vibration near Pump 2 and compare it with the temperature trend.”**




**Existing vehicle-event agent demonstration**

Shipboard workflow adaptation is proposed.

Training focus: supported AI workflows, evidence checking, and operator review.
Reliable measurements still require correct installation and calibration.

# DFOS workforce development and transfer

Proposed 12-month project: $200,000 to develop, validate, and transfer a reusable training program.

| Schedule | Development and validation | Tangible outputs |
|---|---|---|
| **Months 1–3** | Define shipyard job tasks, priority applications, and competency baselines. | Requirements matrix and practical assessment criteria. |
| **Months 3–6** | Develop FBG, DAS, and DTS lessons and controlled fault exercises. | Curriculum, 2 reusable training kits, reference datasets, and instructor guides. |
| **Months 7–9** | Deliver 2 pilot cohorts. Assess installation, interpretation, and troubleshooting. | Measured learning gains and revised exercises. |
| **Months 10–12** | Prepare shipyard instructors and transfer the training package. | Train-the-trainer materials and repeat-delivery guidance. |

## Six training modules with practical competency assessments

- Fiber handling and commissioning
- DAS vibration monitoring
- FBG temperature and strain
- AI-assisted diagnostics
- DTS thermal mapping
- Installation and troubleshooting

Evaluation: installation errors, calibration and localization accuracy, troubleshooting time, and independent competency. Instructor materials support continued delivery across shipyards.

# Accelerating Workforce Readiness in Fiber-Optic Sensing for Shipboard Applications

**Project Lead Organization:** AiMiLi Inc., Corning Inc, and RSL Fiber Systems Inc.
**Project Team Members:** Pittsburgh Laser Engine – University of Pittsburgh, Penn State Electro-Optic Center

## Concept/Idea

**Issue:** Distributed Fiber-optic sensors (DFOSs) are increasingly used aboard Navy ships as a neural network for fire detection, machinery and electrical-system monitoring, and condition-based maintenance. However, shipyards lack standardized training in installing, testing, troubleshooting, and interpreting DFOS information, limiting adoption & increasing reliance on outside specialists.

**Proposed Solution(s):** Develop and demonstrate a standardized, hands-on DFOS training program for shipyard technicians and engineers. Modular instruction will cover Distributed acoustic sensor (DAS), Distributed temperature sensors (DTS), FBG sensors, and Sensor-over-Fiber (SoF) technologies; shipboard installation; interrogator operation; data interpretation; system testing; and troubleshooting. Pilot courses, competency assessments, and train-the-trainer materials will support industry-wide adoption.

## Benefits/Justification

### Benefits of the Project:

- Accelerates adoption of DAS, DTS, FBG, and SoFi technologies.
- Establishes consistent DFOS skills across shipyards.
- Reduces training time for DFOS technology and reliance on external specialists.
- Creates reusable training materials and a train-the-trainer framework for industry-wide implementation.
- Improves installation quality, testing accuracy, and troubleshooting efficiency.
- Supports fire safety, machinery diagnostics, condition-based maintenance, and ship readiness.

## Project Approach

### High Level Statement of Work:

- Define DFOS training requirements and targeted shipyard roles.
- Develop modular instruction for DAS, DTS, FBG, and SoFi systems.
- Create hands-on exercises for installation, testing, operation, and troubleshooting.
- Conduct pilot training and competency assessments.
- Refine and deliver train-the-trainer materials.

### Metric(s) of Success:

- Standardized DFOS curriculum completed.
- Hands-on training modules and materials delivered.
- At least two shipboard applications demonstrated.
- Trainee competency improvement validated.
- Industry implementation and training-transfer plan completed.

## Cost/Images/Relevant Information

### Project Estimated Cost:

- $ 200,000
- 1 year duration

