

Lawrence Livermore National Laboratory (LLNL) has a mission of strengthening U.S. security by developing and applying world-class science, technology, and engineering that

- Enhances the nation's defense;
- Reduces the global threat from terrorism and weapons of mass destruction; and
- Responds with vision, quality, integrity, and technical excellence to scientific issues of national importance.

Many of these key LLNL programs rely on data science techniques like artificial intelligence (AI). By investing in multiple domains—and by encouraging collaboration through the Data Science Institute (DSI)—LLNL simultaneously addresses mission-focused challenges and advances the field of data science itself.

JOINT WARFIGHTING OPERATIONS

Collaborative autonomy is a broad term describing a network of humans and autonomous machine partners interacting and sharing information and tasks efficiently and in a way that doesn't distract the human operator.

LLNL researchers are creating a **coordinated and distributed smart network** of “nodes” or machines with AI capability, which could be applied to any type of autonomous vehicle, drone, or robot that might need to network and perform detection missions.



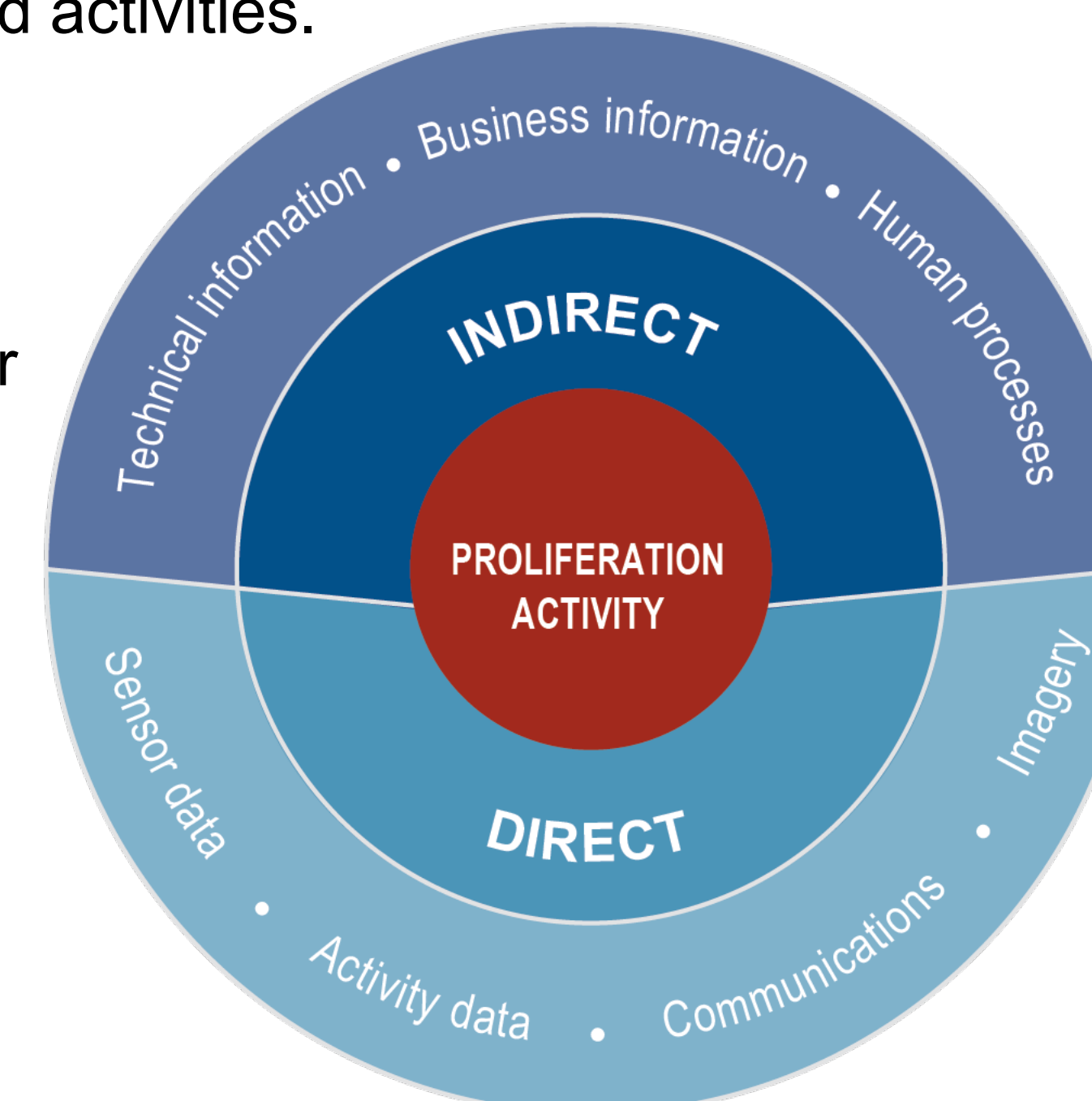
The goal of such efforts is to **develop the algorithms and computing capabilities** that enable an adaptive network of mobile and autonomous platforms that collaborate in real time to construct an actionable “picture” of the operating environment.

THREAT REDUCTION AND PROTECTION

LLNL's national security mission includes developing scientific and technological solutions to address the **evolving landscape of nuclear proliferation threats**. This means monitoring and detecting weapons of mass destruction as well as preventing the spread and availability of related materials and infrastructure.

The **Advanced Data Analytics for Proliferation Detection (ADAPD) project** aims to make a tangible difference in this crucial mission space through early detection of low-profile proliferation activity that may be small, inaccessible, or buried in background activities.

ADAPD is developing **next-generation AI methods** to push nuclear proliferation detection farther “left of boom.” In one approach, ADAPD uses AI to uncover trails of ongoing research within the nuclear fuel cycle. This increases the possibility of **early identification of illicit activities** before nuclear material production begins.



ADAPD is funded by the Department of Energy and the National Nuclear Security Administration's Office of Defense Nuclear Nonproliferation.

RESOURCE LOGISTICS

To improve the low availability of the U.S. Marine F/A-18 fleet, LLNL scientists undertook **extensive data analysis** of 6 million maintenance records and 320 cost accounts to find relationships between budgets and productivity. The team used **statistical and machine learning techniques** to mine a 20-year period of data collection.



The project identified parts that pose high maintenance burdens, optimal allocation of funding to minimize delays, and workload balance among work centers and squadrons—helping **justify future budget requests**.

WARFIGHTER HEALTH

Since the wars in Afghanistan and Iraq began in 2001, more than 350,000 cases of **traumatic brain injury (TBI) in servicemen and women** have been reported to the Department of Defense. Despite several decades of failed clinical trials, there remains no acute treatment for TBI and few tools to aid clinicians in providing a prognosis for TBI patients—military or civilian.

Through a new multi-year project involving LLNL and other collaborators, scientists and engineers in the **Transforming Research and Clinical Knowledge in Traumatic Brain Injury (TRACK-TBI) consortium** plan to simultaneously challenge the Department of Energy's supercomputing resources, advance AI capabilities, and enable a precision medicine approach for TBI.



Researchers are using the complex problem of TBI to open new frontiers in AI and data science on high-performance computing systems and to develop new diagnostic methods.

LLNL's TRACK-TBI team addresses **three focus areas**: data infrastructure, the connectome (a model of the structural connectivity of the human brain), and machine learning.

LEARN MORE

- LLNL website: www.llnl.gov
- LLNL careers website: careers.llnl.gov
- DSI website: data-science.llnl.gov
- Data Science Summer Institute (internship program): dssi.llnl.gov

We leverage data science to address scientific issues of national importance.