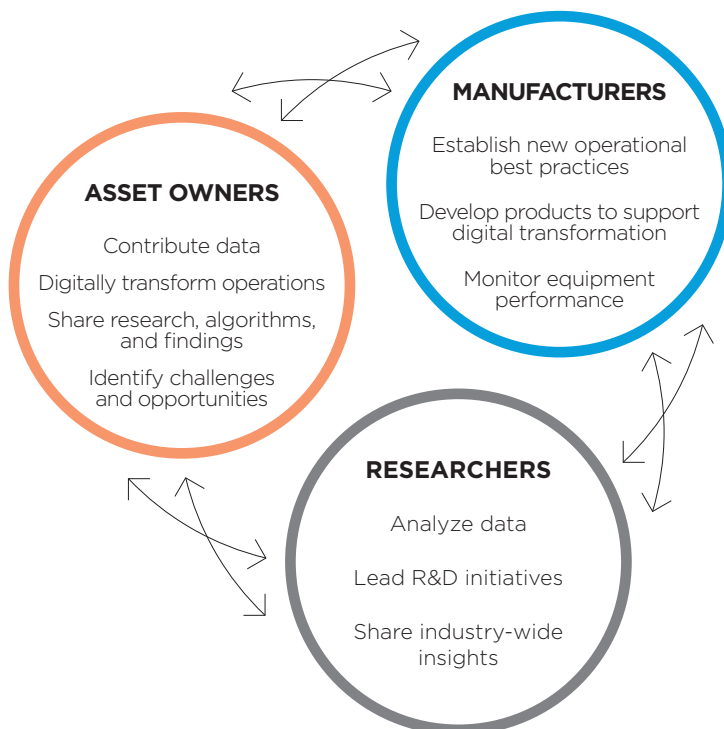




YOU HAVE ALL THIS DATA — WHAT ARE YOU DOING WITH IT?

INDUSTRY CHANGES & DIGITAL TRANSFORMATION

The energy market and landscape is evolving rapidly. With the rise of low and carbon neutral energy sources, there is more pressure on the hydropower industry to change how it utilizes its assets. In order to remain competitive, hydropower asset owners are finding ways to reduce operational costs while improving reliability, availability, and quality. As compared to wind and solar, hydropower offers the benefit of service as renewable storage. This capability will require hydropower to become an on-demand resources drastically changing today's more predictable operations.



As with other industries, digital transformation is the best means to addressing hydropower's changes and challenges. By leveraging the data the industry has already collected, operators can predict and avoid outages using deep and machine learning. Manufacturers can create the next generation of equipment and sensors. Researchers can predict how changes to operational strategies will impact equipment, the environment, and the industry as a whole.

WHAT IS THE HRI?

The Hydropower Research Institute (HRI) is a data-driven collaborative formed by and designed for industry leaders to drive the digital transformation of hydropower. The HRI's goal is to benefit all participants—asset owners, manufacturers, and researchers—by:



STREAMLINING how data is classified within a hydropower plant, amongst manufacturers and different types of units. HRI staff work with every contributor to ensure data is classified consistently using our standardize classification system. HRI data can be easily compared across plants, regions, and continents.



ENHANCING the data set by ingesting data on a regular and ongoing basis. The current dataset dates back to 2002, and is dynamic and expanding with every new contributor and upload. The dataset is assessed for quality upon ingestion and regularly thereafter.



CONNECTING the asset owners, equipment and sensor manufacturers, and researchers to share, discuss, and discover. The HRI facilitates communicating challenges, collaborating on solutions, and driving change in the industry.

By aggregating data across the industry, the HRI enables asset owners to grow their available datasets to develop and refine algorithms for machine learning and predictive maintenance. Asset owners can compare their operations to other plants anonymously and harness the data they have generated for years. Meanwhile, hydro asset owners are able to connect with manufacturers to identify and develop new market products, and researchers to prepare them for the next generation of energy production.

The HRI will aggregate hydropower operational data, assist hydropower owners in their digital transformation, and facilitate research and development of new technology for hydropower facilities and equipment, ultimately resulting in:

- ▶ **REDUCED OPERATING COSTS**
- ▶ **FEWER FORCES OUTAGES**
- ▶ **MINIMIZED MAINTENANCE TIME**
- ▶ **INCREASED REVENUE**

YOUR DATA, INDUSTRY DATA, AND YOUR PARTNERSHIP WITH THE HRI

Data is the fuel that powers digital transformation, and the reason behind the formation of the HRI—by asset owners and for asset owners. Digital transformation is the best, most proven means for the hydropower industry to handle stiff competition from other renewables, lower costs, and improve operations. With data from across the industry and around the globe, HRI participants will have access to a large

searchable dataset, allowing them to build models, analyze data, and compare their equipment to others'. This data is used to feed and improve predictive models powered by deep and machine learning, which highlight anomalous behavior aiding in the prevention of unscheduled outages and failures. HRI participants will then share discoveries that increase predictability, availability, and efficiency, including key sensor recommendations to monitor the data to safeguard investments in major pieces of equipment and the maintenance of them.

The HRI facilitates the data collection, transformation, and collaboration so analysts can focus on solving the most pressing issues, understanding relationships, and leveraging industry discoveries.

According to NewVantage Venture Partners, **Big Data** is delivering the most value to enterprises by **decreasing expenses** (49.2%) and creating new avenues for **innovation and disruption** (44.3%)

SOURCE: NEWVANTAGE VENTURE PARTNERS,
BIG DATA EXECUTIVE SURVEY 2017

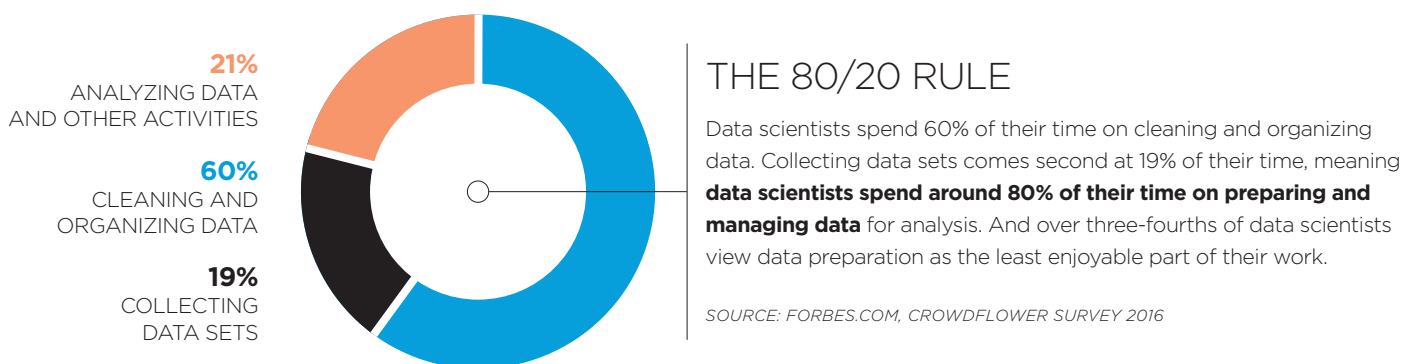
SECURE, HIGH QUALITY DATA

INGESTION & SECURITY

The HRI staff works closely with HRI contributors to identify all available data. Contributors are responsible for extracting their data from their systems and providing the raw data to the HRI, as well working with HRI staff to understand tag names, the location on the equipment, and various equipment details. The HRI is responsible for transforming data as necessary to ingest into the HRI, and performing all mapping and data classification. Data is always transferred and stored securely using Amazon Web Services.

DATA QUALITY

Before a dataset can be analyzed, it must be standardized so that it is comparable across different variables and sources. The Hydropower Research Institute does this work for you. With input from each contributor, the HRI identifies the origin of tags within the hydropower plant, translates tags one-by-one, and ensures that all tags are appropriately mapped to the standardized, hydropower-specific classification system. This system includes the specific component, detailed location information, and the specifics of the measurements, such as units and material. This allows HRI users to analyze precisely what interests them.



The HRI recognizes that data quality is the difference between a valuable data set and useless information. We are committed to reviewing all aggregated for quality to ensure data integrity and comparability. All data ingested passes through our quality assurance process. This process starts during data discovery, during which the HRI communicates directly with the contributing asset owner. At any point, if data is deemed “bad” or not understood by the HRI, it will not be visible to HRI participants or included on reports. Data in the platform is regularly tested for numeric quality, and any questionable data is flagged for review. The QA and mapping processes allow HRI participants to create reports that are delivered quickly and securely in a consistent format without worrying about the quality of the data.

HOW DO I SIGN UP OR LEARN MORE?

If you are interested in becoming a participant in the HRI call us at **509-866-4475** or email **Join@HRIData.org** to have someone contact you.