

Analysis

- Remote Monitoring
- Third Party O&M
- Software

MHPS Monitoring Gas Turbines from Orlando

All data points received from each unit are streamed into the RMC every one to three seconds, and stored for no less than two years for historical reference, making this system a very dynamic troubleshooting tool. Approximately 1,000 to 1,200 data points are monitored for each gas turbine configuration, including all of the auxiliary system information. Examples of parameters monitored for a standard gas turbine unit include:

- • Ambient Conditions
- • Hot Gas Path Conditions
- • Combustor Dynamics (CPFM)
- • Control System Features
- • Vibration Indications
- • Valve Demand, Position and Feedback Signals
- • Auxiliary System Parameters
- • Alarm Indications and Set Points

MHPS Combining OSIsoft Monitoring Software with Cloud Based Analytics in Strategic Alliance

- MHPS laid the foundation for the Digital Power Plant in the 1980s and made a major step in 2004 when it began using the OSIsoft PI System at its Remote Monitoring and Diagnostics Center in Orlando, FL. This service has successfully demonstrated and delivered improved plant reliability and performance.
- The OSIsoft PI System captures sensor-based data from industrial equipment and process systems. Deployed across 19,000 industrial sites in more than 125 counties the PI System enables digital transformations and improves process efficiency, energy use, asset reliability, quality and safety.
- The PI System will serve as the core for new interactive, cloud-based analytics services MHPS will use at power plants world-wide. In addition, the PI System will continue to form the data infrastructure platform for existing total plant remote monitoring and diagnostics services, both for MHPS and other manufacturers' equipment.
- “Our customers face new regulatory pressures and competitive realities. MHPS is offering a distinct Revolutionary Energy concept which includes a range of digital solutions that maximize plant performance,” said Rick Inskip, MHPS Senior Vice President, Service. “Power plant owners have always needed to maximize reliability, an area in which MHPS excels. And they increasingly need to adapt during the lifecycle of a power plant to shifting grid and generation mix requirements, while optimizing operations, flexibility, maintenance cycles and environmental performance tradeoffs. The MHPS digital solutions meet these needs.”
- A digital power plant requires a robust information infrastructure to leverage the massive amount of data that is generated during plant operations. OSIsoft is a proven pioneer and market leader in managing big data to support operational intelligence. As part of this strategic alliance MHPS and OSIsoft will collaborate to define and promote new integrated digital solutions that add intelligence to power plants around the world, using best-in-class software and leveraging their respective knowledge and expertise.



Remote Water Chemistry Control

- Water chemistry control is a major concern for all electric utilities. If water chemistry is not controlled, it can cause corrosion-related failures and reduce energy conversion efficiency. A leading factor of unplanned outages is inadequate control of water treatment. With older power plants, proper water chemistry control may be the only way the plant can operate economically. Advanced simulation tools and diagnostic systems are now being used to remotely monitor and diagnose water chemistry problems.
- In the early 2000s iSagacity, Inc., Half Moon Bay, California, developed a web-based monitoring and diagnostic system for water chemistry and performance monitoring at electric power plants. According to Peter Millett, founder and CEO, iSagacity, the technology can be managed remotely at a central monitoring center or it can be installed on a utility's intranet. The technology is able to interface with a variety of plant data sources including data historians, SCADA and distributed control systems.
- A typical system could have 100 or more sample points (with a sample rate of once/minute), several months of on-line data storage, and long-term storage of minimum, maximum and average data. "Remote Manager," an internet-based management tool utilizing a secure web site hosted in iSagacity's California Data Center, is used to access the plant's data. The Remote Manager performs basic statistical tests to help in identifying key trends on all incoming data. A data view page on the website allows any authorized user to create trend plots of historical data. Multiple parameters can be viewed on a single screen and, if needed, saved for future analysis.
- According to Millett, a key feature of their technology is the pattern recognition technique used to diagnose the data. This approach can use a mathematical model, a simulator of the process or a library of patterns of data of operational events or scenarios. In addition, the model can be used to generate "fingerprints" of equipment operations under abnormal condition. By creating a set of fingerprints, or scenarios of the plant, it is possible for the system to simulate and track a fault condition.

In a joint venture with Nalco Company, iSagacity installed a remote monitoring and diagnostic system (remote manager) at Portland General Electric's Coyote Springs Unit 1, a 250 MW gas fired combined-cycle plant



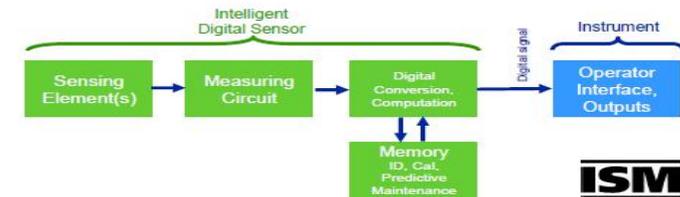
Nalco Data Management for Cooling Towers

- 3D TRASAR Technology is a flexible and effective data management and system control platform locally, as well as enterprise-wide across multiple locations. It offers a single technology platform for expanding and standardizing system control, data management and effective decision making across every plant location, anywhere in the world. 3D TRASAR Technology is an enabling automation system and method for benchmarking and establishing best practices.
- 25,000 systems are currently in use. 10,000 water systems are monitored 24/7/365 by Nalco experts, supported by 5,000 on-site experts. But innovation is a continuous process. The next generation of 3D TRASAR Cooling Water Technology
- At a High Plains power plant during a drought, TRASAR™ Optimizer, determined that the plant could safely increase the cooling tower cycles of concentration and reduce the amount of water needed to run the plant without risking equipment failures. The solution has been permanent: the plant can meet the region's needs during times of peak energy demand, and the power district has dramatically reduced its annual withdrawal of water from the river.
- *Note that the Mcilvaine Decision Systems also provide information on the cooling tower filtration which in this case will be tasked with removing greater quantities of solids. So it is not just the cooling tower itself which would be impacted.*

Sensor Improvement Enhances Remote Monitoring Mettler Toledo

Intelligent Sensor Summary

- Digital Intelligent Sensors
 - Measuring circuit
 - Digital signal conversion
 - Extensive memory
 - Predictive diagnostics
- Conductivity
 - Improved accuracy
 - Much wider rangeability
- pH
 - Improved signal reliability
 - Predictive diagnostics
- Dissolved oxygen
 - Improved signal reliability
 - Predictive diagnostics
- Enables full benefit of multiparameter instrumentation



Intelligent digital sensors: the future of process analytics.
More information is available at www.mt.com/pro_power

GE Incorporates Remote Monitoring into Third Party Services

- GE Energy is one of the world's largest third party providers of plant Operation and Maintenance services, currently with more than 16,000 MW at 60 sites in 17 countries under O&M contract. Global resources combined with over 20 years of O&M experience, enable GE to provide complete plant services across the turbine island and balance of plant—for both GE and non-GE equipment.
- GE Energy's O&M sites also benefit from use of extensive remote monitoring and diagnostic equipment, as well as online tools such as PowerSmarts™, and EMAP+ to provide detailed analysis, reporting and predictive data on plant performance.

GE Services, continued

O&M services are guided by the specific needs of the customer. GE Energy works closely with plant developers and owners to identify their goals and create a power plant O&M plan designed to achieve the desired results. GE Energy's broad range of services include:

- Daily operation and maintenance of the plant
- Complete plant staffing
- Planned and unplanned maintenance services, including parts
- Local and remote monitoring and diagnostics
- Comprehensive training
- Environmental health and safety programs
- Site documentation and procedure development
- Site-specific computerized maintenance management programs
- Switchgear maintenance and management
- Power delivery
- Fuel management



IHI has Flexible Suite of O&M Services

- IHI Power Services Corp. (IPSC) supports power plant owners with a flexible suite of operations & maintenance services.
- IPSC acts as a third-party operator to help plant owners achieve the full economic potential of their plant resources. IPSC is built to provide U.S. power generators with experienced professionals who can utilize their years of hands-on power industry experience to ensure optimal operation of power plant fleets. An example of the company's power plant operations & maintenance services is their training guidance. The company's experts work with plant teams to ensure they are committed to and capable of meeting the industry's best practices. Through customized training programs aligned with the client's plant objectives, the IPSC team guides plant workers on their roles within the organization. It's a service that assures companies of consistently productive working environments and focused personnel.
- IPSC also has experience in the area of maintenance planning. Their team can help plant operators understand the costs of shutdowns and mitigate these costs utilizing set maintenance program. The IPSC staff crafts customized maintenance programs for plant operators designed to take into consideration the current market environment and the potential long-term operational issues the company may face regarding their equipment. This expert planning guidance empowers proactive decision-making and helps prevent shortfalls in productivity due to unexpected plant downtime.
- Another key area in which IPSC specializes is staffing. Because of the company's experience at the helm of a large number of power plants, they have developed an understanding on plant staffing requirements.

Wood Group will be O&M Provider for CAES Plant

- Wood Group GTS and Apex Bethel Energy Centre signed a three-year operations and maintenance (O&M) agreement for the Bethel Energy Centre in East Texas, USA.
- Under the US\$12 million (£9 million) contract, Wood Group GTS will be responsible for care, custody and control of the facility when it begins commercial operation in 2017. The plant, which will utilize compressed air energy storage (CAES) technology.
- CAES is a way to store energy generated at one time for use at another time. At utility scale, energy generated during periods of low energy demand (off-peak) can be released to meet higher demand (peak load) periods.
- “We needed an O&M partner willing to work with us during the development stage of the project. In Wood Group, we found a highly experienced O&M service provider with an excellent reputation in the industry and is well respected by investors,” said Jack Farley, CEO of Apex. “Their customer-focused technical and commercial engagement made the negotiation of the service agreement very productive. Also, their ability to work within a tight schedule along with the OEM, which has minority interest in the facility, was critical to meeting our schedule.”

Ethos Energy Supplies a Range of O&M Services

EthosEnergy provides comprehensive third party operations and maintenance (O&M) services for power plant owners. The programs, practices and procedures have been honed from a solid foundation of operating experience, with a focus on enhanced plant performance and reliability, commercial optimization and regulatory compliance.

O&M Services for gas and steam turbine operations include:

- Daily plant operations
- Operator training and qualification
- Routine maintenance
- Supply chain, major maintenance management
- CMMS system integration
- Performance monitoring & diagnostics
- Personnel staffing and Human Resource functions
- Procurement services
- Regulatory Compliance for environmental, health & safety and NERC
- NERC managed services



EDF Maintains and Operates many Renewable Energy Facilities and Sub Stations

Substation operations and maintenance services

- Remote control 24/7
- Access management
- Relations with the grid manager and telecom operator
- Security
- Preventive and corrective maintenance
- Management of regulatory inspections
- Management of warranties, subcontractors

SoftDEL

SoftDEL offers software design and development for a system that helps to gather, analyze and distribute information to users in real-time.

- **Features**

- Selection of RTOS and GUI toolkit
- Event- and time-based data logging
- Real-time, fault-tolerant architecture
- Implemented state machine for start/stop/failover sequence
- Integration and testing of Input/Output
- Decision support system

- **Benefits**

- Better productivity and efficiency with timely capture of quality data for analysis
- Improved data accuracy and data integrity
- Elimination of redundant data
- Improved information sharing as everyone has access to the same data at the same time
- Elimination of unplanned downtime due to early predictability of maintenance issues
- In-house customized solution for process monitoring with no need of third party applications for process monitoring

OSISoft

PI System has the ability to collect, analyze, visualize and share large amounts of high-fidelity, time-series data from multiple sources to people and systems across all operations. Here are two examples in Power

CAISO, the operator for the bulk of California's power grid, deploys PI System technology to:

- run reliably, securely and efficiently
- facilitate effective open markets that engage and empower consumers, diversify resources and reduce costs
- meet California's policy target to integrate renewables, reduce greenhouse gas emissions and secure energy

Juwi Wind Turbines : To simplify ongoing management and maintenance as well as standardize its calculations, Juwi extensively leveraged PI Asset Framework™ (PI AF) templates.

- The PI System has made it easier for Juwi to integrate new assets and shifted the way Juwi works with its data and monitors its assets. “Before we were happy at the end of the day if we could get the data from all sites in our box and all the turbines were running – it didn't really matter how well they were running. Now the data is coming automatically and we're starting to drill down into why are things not running well, going into a predictive view of things, and it makes things easier,
- Better data and better monitoring tools has changed Juwi's relationship with the its equipment manufacturers. “Most of our assets have double supervision, we supervise and the manufacturer does also. Usually they always knew things before we did and this has changed. Now we call them.”

Valvkeep and OSHA 29CFR1910.119 para. (d) aka Process Safety Management

- Documentation is what drives compliance with this part of the standard; being able to verify (prove) that PSV's are sized/selected correctly for the application and then are properly maintained is the cornerstone. Maintenance intervals must be determined (historical data) and then reviewed periodically to insure they are appropriate. OSHA requires documentation of how the interval was determined and documentation that maintenance was actually performed to that interval. ValvKeep makes compliance with these provisions much easier; PSV sizing records can be stored, historical data easily accessed, reports generated to validated repair intervals, and each event documented in detail.
- ValvKeep® handles the OSHA requirement to establish maintenance intervals “based on prior operating experience” by providing a variety of analysis functions that allow customers to best determine the appropriate maintenance cycle. Once determined, ValvKeep® automatically tracks each piece of equipment and proactively notifies the customer when the next required maintenance date is approaching. Charlie Weiland of Chalmers & Kubeck-South OSHA concludes “Mechanical Integrity” compliance is NO PROBLEM with ValvKeep®.

ValvKeep Lays the Foundation for Remote O&M

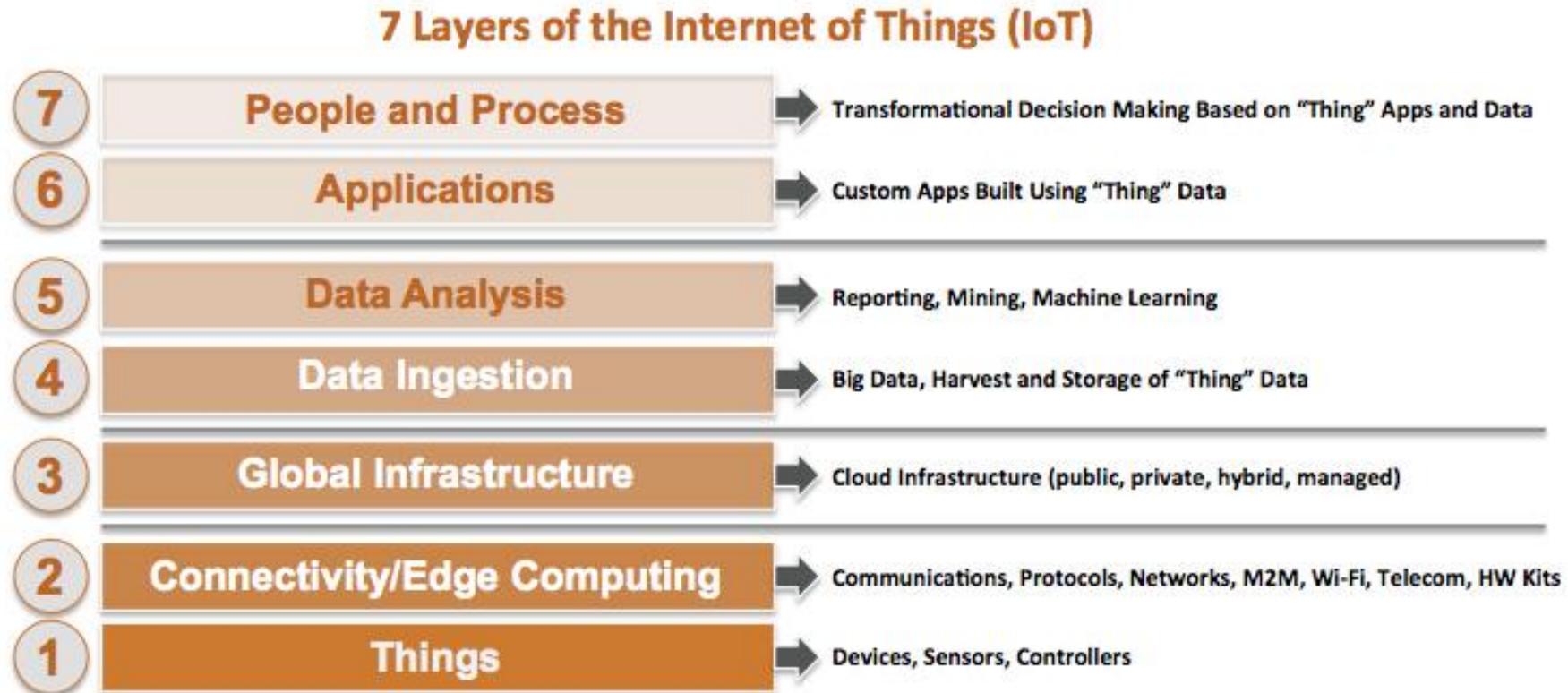
ValvKeep® addresses Control Valves, Pressure Relief Valves, Motor Operated Valves, and Manual Line Valves (gate, globe, check, ball, plug, diaphragm, etc.); in other words it truly is "Valve Keep". Owners have instant access to their valve and instrument service records (both current and historical) via secure internet portals from anywhere in the world 24/7. Critical valve dimensions, individual part evaluation, photo documentation, test results, supporting documentation (P&ID's, maintenance manuals, wiring diagrams, spring charts), maintenance intervals, etc. are all stored in ValvKeep® for immediate retrieval. This program is a GE program which is used by distributors such as Chalmers and Kubeck. Owners have instant access to their valve and instrument service records (both current and historical) via secure internet portals from anywhere in the world 24/7. Critical valve dimensions, individual part evaluation, photo documentation, test results, supporting documentation (P&ID's, maintenance manuals, wiring diagrams, spring charts), maintenance intervals, etc. are all stored in ValvKeep® for immediate retrieval.



Assetscan used by Donaldson to Monitor Filters on Off Road Vehicles

AssetScan is a fully customizable, sensor-agnostic solution designed to work seamlessly with virtually any industrial product. Electronic sensors are added to a static industrial product to measure desired variables. A battery-powered monitor with cellular connectivity is installed to transmit data to the cloud. Users with an Internet connection can view and analyze real-time product data from anywhere in the world via the cloud and the web-based ATEK Intelligence Platform.

Scott Grossbauer, Global Director of Clean Solutions at Donaldson Company, said, "AssetScan lets our end-users know when their filters are plugging and need to be changed. This allows them to achieve significant savings by avoiding unscheduled downtime of critical pieces of equipment. Here is the Assetscan view of the IoT layers



Analysis of IoT Pump Opportunities by John Hilberg of Accudyne

(full article linked in the intelligence system , originally appeared in 2016 in Pumps and Systems)

The IoT concept has led manufacturers to be unsatisfied with selling just a single component to the end user. Instead, they are beginning to take more ownership of the full system by providing multiple components that improve the operating efficiency of an entire process. IIoT can offer new opportunities beyond merely providing smarter pumps. It could enable better predictive analytics and preventive maintenance to help end users fix pump problems before failures occur. Also, the IIoT's data analytics and reporting provide pump manufacturers with more detailed information about the operation of their systems in the field, which could benefit product development. If the reporting suggests common modes of failure or design flaws, manufacturers can proactively make changes to eliminate these problems and deliver better-performing pumps—often before they even hear a complaint.



AMI

As a leader in Industrial Internet of Things (IIoT) and Internet of Agriculture (IoA), AMI provides systems, solutions and strategies for the world's industrial markets. AMI brings manufacturer's products to a mobile environment quickly, efficiently and with a dynamic impact on establishing our partners as leaders in this space.

AMI helps manufacturers and distributors navigate the complexities of bringing their products to a connected world. It is not a matter of "if" but truly a matter of "when".

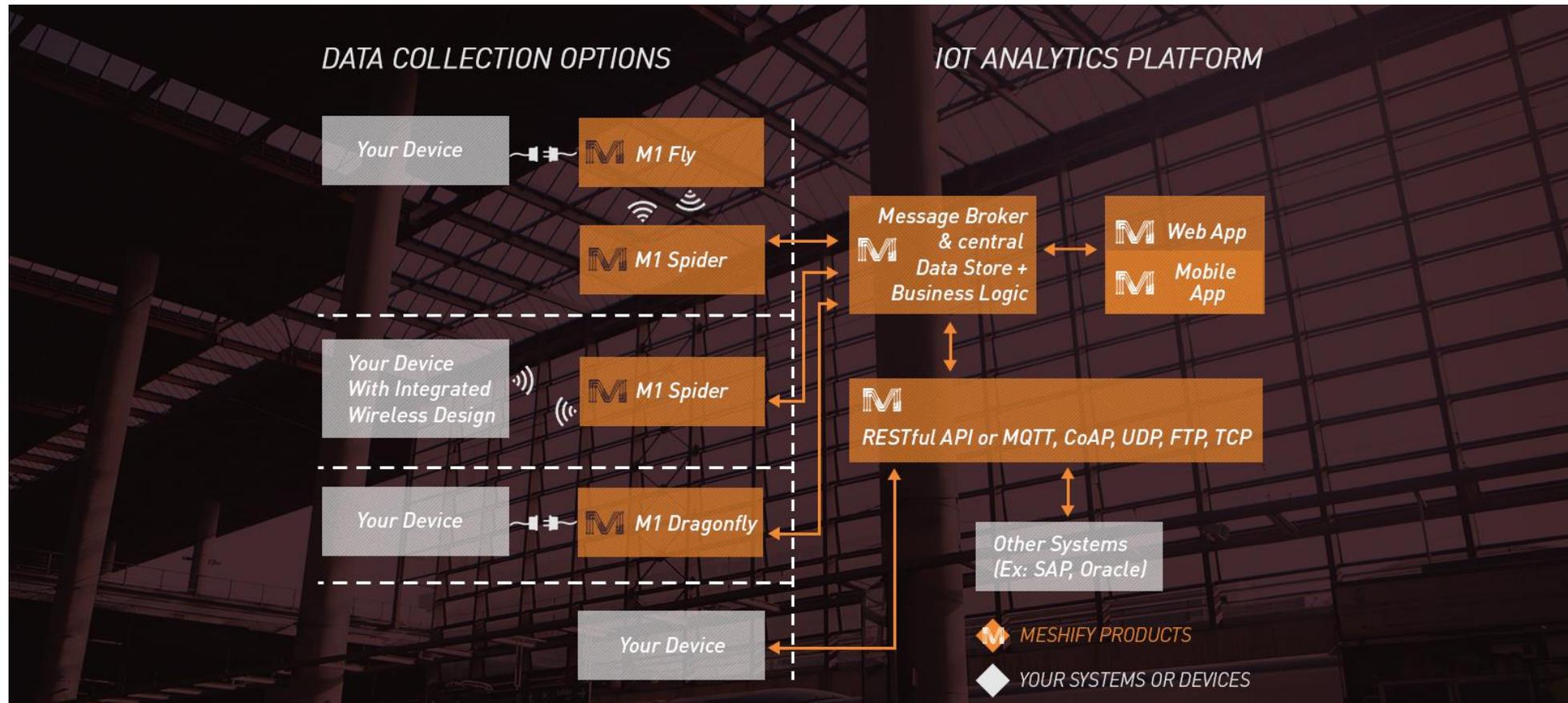
Partnership, value, service, agility and innovation. These five words best describe AMI. AMI is an Industrial Internet of Things solution provider providing infrastructure for hardware, communication, software, servers and database management. Cloud based programming, monitoring, management, reporting, data management and remote diagnostics across multiple industries, including sensors, water management, agriculture, turf irrigation, pumping, variable frequency drives (VFD), oil, gas, mining, dewatering and industrial automation. Custom engineered solutions.

Specialties: Solution driven business development and marketing. Industrial IoT based control and monitoring solutions across a multi-industry platform.



Meshify IoT Solutions for Pumps and Other Flow Control and Treatment Processes

The back-end software is configured right in the browser to create user roles and permissions, brand the solution, show data visualizations, and send commands to devices. The custom business intelligence layer enables your company to roll up statistics across all your devices. Receive real-time and time-series analytics from virtually any type of data point and device. By deploying Meshify's hardware and software, Henry Pump was able to monitor, control and analyze their onsite assets through the cloud. Their collection of connected assets include pump-off controllers (POC's), flow meters and tank level sensors.



Decisive Classification is the Key to Integration with Software

- Decision making is a series of decisive classifications
- Clarity in defining options is important
 - Mcilvaine conducted a webinar for catalyst manufacturers who ultimately agreed to three ways to clean catalyst (physical, chemical, and re impregnation). The three classifications were precisely defined and translated into Chinese.
 - 1000s of classifications for monitoring needs have been organized based on medium (oil, gas, air, water), type of measurement (pressure, flow, contaminants) and type of instrument.
 - All suppliers of flow and treat products including those in China are identified with a financial entity number thus eliminating spelling variation confusion
- Comprehensive Decision Systems for each industry each major technology and each large end user as per the following examples:
 - Coal Fired Power Plant Decisions: <http://home.mcilvainecompany.com/index.php/decisions/2-uncategorised/86-44i>
 - Berkshire Hathaway Supplier Connect : <http://home.mcilvainecompany.com/index.php/databases/28-energy/1185-4s01>
- Common metric to measure all harm and good e.g each pollutant but also wildlife loss, water comfort, beauty (unsightly turbine or transmission line) Mcilvaine has developed such a system based on life quality. So it is simple and accurate.