pixelvelocity™
Insight Accelerated

Real Time Risk Awareness

New Energy Sector Mitigation Solutions

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Recently introduced, the AECOM-Pixel Velocity energy sector risk detection platform is aimed at delivering a new class of risk reduction services to the Build-Operate portion of the Design-Build-Operate market that AECOM is actively pursuing. It fits squarely with emerging sector technologies that digitize operations in real time and automatically detect and report emergent response requirements.

Pixel Velocity builds and delivers advanced analytic image sensors and intelligent event management software that creates real time data and metrics around our customers' critical assets.

The risk detection algorithms at the heart of the automated system, originating from military aerial optical systems, are without peer for reliability. This is a truly game changing element, and key factor driving the joint AECOM-Pixel entry into energy-related risk detection services.

This unprecedented level of reliability in edge sensor risk detection analytics means the introduction of these platforms to the energy sector offers an opportunity to remove persistent real time knowledge gaps that drive continuity, safety and response risk in a broad range of energy operations, including complex production, process, transport and storage operations, especially hazard dense ones.

Automated hydrocarbon leak detection is the newest addition to the sensor arrays the AECOM-Pixel team is aiming at the energy market. While there are firms that offer lab bench solutions of varying reliability in the

- The path for the platform to maximize its value-adding effect includes newly available resources:
- AECOM has recently commissioned a platform-specific Center of Excellence (C/E) with Pixel Velocity for proofs of concept for custom configurations and commissioning new technology. The C/E is available to platform partners, clients and customers for the same.
- AECOM now offers addenda to its standing Master Services Agreements that transfer any or all platform-related capital expenditure items to a comprehensive services wrap.
- The AECOM services wrap can cover life cycle platform operations, and include design, deployment, commissioning, integration, maintenance, upgrades and related analytic services. AECOM's once government-only cybersecurity services are expected to be included, and should be considered essential for bi-directional IPC options.
- The cumulative effect of analytic services cycling back into platform operations are expected to be a major source of platform value accretion.

continuous leak detection, nearly all of the energy sector's critical leak detection work is being done on a calendar basis manually, with a range of hazards to highly skilled personnel and, often, an acceptance of risks to operational continuity as part of protocols for actions to be taken upon detection — reflecting basic safety best practices.

The first major difference between the team's platform and current detection options is a quantum improvement in leak detection performance, with the removal of major safety and continuity risk across the board. Leaks are identified and alerted in real time, and detection no longer exposes skilled detection personnel to safety risk. Continuous detection, mated with the edge sensor analytics based on the Pixel algorithm, offers the benefits of on demand verification and automated unattended alerts. The leak detection algorithm can distinguish an active vapor leak from ambient vapor chemicals for about 20 hydrocarbons molecules (using the same field-proven cold core detection processor FLIR now markets in the current industry standard manual solution).

The second major difference is that data streaming from the edge sensor analytics on these Pixel arrays will scale across locations and, ultimately, the entire enterprise. This means thousands of operating sites can be monitored continuously with high reliability in real time. This scaling will apply to ICS/SCADA integrated data streams as well, as inputs from operational control systems become more frequent and more useful as part of an integrated sensor platform. And, because the analytics will occur at the sensor edge, the aggregate scale effect is feasible under almost all telecommunication network conditions. Satellite bandwidths are feasible for scaling from remote global locations and broadband is not a requirement.

In most applications, platforms are likely to be integrated with thermal and optical sensor arrays, which Pixel already has been deploying as risk detection solutions for years. These platforms are known primarily as long life cycle hardware systems with field upgradable software, operating at the state of the art for automated risk detection and identification. They are used primarily as situation awareness systems delivering automated threat detection, identification and tracking, specializing in high-congestion / high-vulnerability solutions where speed, accuracy and the breadth achievable from scaled automation delivers a critical difference in risk mitigation and event management solutions. Airports, stadiums, industrial facilities and high value locations, both civilian and military, are the most prevalent deployments to date.

A basic integrated package, optical sensors, hydrocarbon leak detection and ICS/SCADA analytic data streams, will give remote operators a nearly complete real time view of what is happening on sites where hydrocarbons play a role. This is a quantum improvement in performance and safety from manual detection, and as such offers the prospect of protocols that do not require skilled detection personnel on site to initiate leak detection assays or immediate process shutdown upon leak detection. Also, with continuous leak detection and

identification from the array, much earlier and even preventive operator response options become feasible.

With leak detection, one configuration with integration is on-demand thermal or optical or other sensor feeds that automatically alert after commissioning and are available on demand as soon as the system is operational. With Pixel's edge sensor analytics architecture, a cached record of relevant area activity from the moment of detection is available for review and transmission from even the most constrained telecommunication network locations.

Automated activity identification on site will be helpful for safety and security teams, and operators and construction managers during outage and expansion periods — when site activity is usually seen as posing heavier than normal safety and security challenges and when delays of any sort are especially costly.

Rationale

The initial source of enterprise value will derive from the delivery of analyzed information at unprecedented speeds, while retaining precision and reliability that facilitate early response and what can reasonably expected to be continuously increasing options for risk prevention.

There will likely be broad flexibility in the ways platform information streams can be put to use across the enterprise. It is highly likely that the platform's value will scale across enterprise-wide operations, largely because the platform's very high reliability analytics can close knowledge gaps in real time, supporting operations, safety, security and environmental risk information requirements concurrently. Servicing this broad range of requirements from a single solution set in itself offers significant potential value to the entire enterprise.

However, it seems clear that the platform's value can extend beyond industrial operations and into business operations more generally, such as data streams that add in-house real time production or loading information for energy marketing and customer services. On the savings side, burdensome and time-consuming financial reporting requirements might also be facilitated by automated real time revenue-linked operations information feeding directly into financial reporting systems.

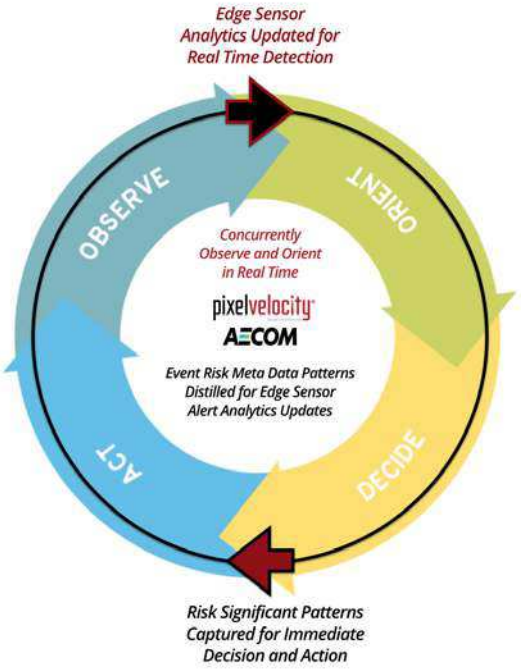
With AECOM's services option, no client will need to own and operate any or all of the platform's elements to get maximum value from the platform.

Considerations

The platform's value at all levels of use is likely to grow from the outset. With data streams that include operational control data, the platform can scale from automated risk alerts that can

respond to securely polled SCADA at significantly higher frequencies to ultimately reporting on both production and disruption, all in real time, across all asset fleets and operating locations.

With world leading AECOM engineering services as part of the package, the platform's value will also come from deepening insight into preventable risk and capturing it for analytics in real time, improving options for risk prevention within increasing economies of scale.



Some of the knowledge base for risk prevention comes at the outset with the initial platform deployment but deepening knowledge will result from an ongoing process of capturing experience and expertise in identifying additional preventable risk and detecting it. Under AECOM's services model, the cost of this virtuous performance improvement cycle can largely be fixed while the value to the energy firm needing improvements in production and deliver, moving beyond continuity, remains accretive (*see graphic*).

Pixel's Event Velocity and edge sensor platforms are designed to capture and scale expert insight from AECOM Design, Build and Operations services:

- Each platform deployment is aimed in at core priorities as part of each site deployment design and commissioning process — this process includes both site managers and corporate oversight;
- Each site deployment captures in real time the emergence of risk precursors and indicators in a broad array of high priority areas such as operations, maintenance, health, security, safety, environment, and social responsibility (or O&M and HSSE-SR) and stream real time alerts to the right response teams
- As a legacy aspect of its national security origins, each deployment is designed to form a part of a seamless total real time enterprise wide awareness platform
- Each deployment contributes automatically to a total information stream that scales up the management chain and across revenue streams
- The platform can reflect and even provide a bridge for integration of supplier and customer operating elements in joint operating areas.

- Each platform is inherently capable by design of precision automated real time risk identification in high operational tempo periods, such as product loading, site construction, and major maintenance. The automated high accuracy-low noise algorithm can become an essential tool in such periods when demands on personnel are often high and sustained at surge levels.
- Platform architecture is designed to perform under a broad range of infrastructure conditions, from high concentration areas (urban, suburban and port environments), and remote facilities (offshore, inland) that are usually not well supported by local infrastructure and utilities.

Performance improvement cycle drivers tend to reflect the legacy of decisions about system architecture that can be expected to drive continuous overall performance improvement over the entire deployment life cycle:

- Each platform is field upgradeable;
- As a result of regular upgrades built into even the most basic services package, analytics alert on the latest set of patterns and sequences known to be risk significant;
- Expert insights at one location or in one event can be captured as risk significant for delivery in edge sensor analytics to all locations; and
- Operating deployments get the latest insights in upgraded edge sensor analytics.

Under a services wrap, benefits are likely to accelerate with a strong focus on the capture of insight and expertise in edge sensor risk analytics.

Key Decision Points

At initial deployment, the platform already represents a significant advance across the HSSE-SR spectrum. With its services wrap, AECOM is effectively ensuring that the platform features a complete new class of risk reduction tools for the Build-Operate space, especially its O&M range.

It is clear, however, that there is significant potential to extend the new tools benefit to the major transaction-driven areas of the energy business. This potential begins with information streams for marketing and transport business operations. The potential goes from there via AECOM and Pixel jointly open receptivity to continuously updating real time platform analytics.

Also, it almost goes without saying that adding peace of mind from an on-demand dashboard deliverable real time awareness of production and P&L-linked operations can only assist senior managers in meeting objectives across the enterprise.

Third party responders, including law enforcement and fire suppression, seem likely to pose no additional burden to the event management dashboard, with their connectivity being an intuitive feature available in any initial deployment.

The platform will support current and foreseeable compliance with security, safety and environmental regulations, and deliver controllable regulator-friendly real time awareness, based initially on the reporting of everything from unauthorized activity to hydrocarbon leaks, from the moment of occurrence.

There is already strong interest in these sorts of awareness-first solutions from regulators who are already overburdened with reporting obligations that only tangentially achieve improved performance. By contrast, the platform seems likely to help industry leaders set new benchmarks far ahead of compliance assurance, raising social responsibility and community confidence to new levels in an especially sensitive community and regulatory moment.