

*How to  
clear the air*



## Shannon Katary, Maestro Digital Mine, considers the best methods of air ventilation in underground mines.

**A**s mines continue to go deeper, temperatures rise and require more energy to adequately ventilate which leads to an increase in cost and an ongoing demand for critical data to ensure worker safety and increased production. Underground mines have challenging environmental conditions, including toxic gases from blasting, operating vehicles and/or gases emitted by the surrounding strata rock. The air is denser and continues to pick up heat from the exposed rock, causing worker heat stress concerns. The use of innovative digital technologies is vital to advancing mine production and safety. Maestro Digital Mine understands that mining companies face significant challenges to obtain real-time data at the face both in terms of simplicity, cost and the ability to advance the network using any tradesperson or development miner.

Identifying the demand for real-time data to monitor and control air quality, the company works with mining companies around the world to address the challenges associated with working in the harsh underground mining environment by protecting miners from acute or chronic gas related health conditions. The air quality stations needed to be cost effective and used with the existing mine infrastructure. As a result, Maestro developed the Vigilante AQS™ air quality station to measure environmental conditions in real-time for worker health and safety and to reduce the total installed infrastructure costs.

The station is a multi-variable air quality station designed to monitor and control air quality in underground mines that accurately measures airflow rate, direction, wet and dry bulb temperature, gas concentration and dust particulates, enabling miners to return to the face sooner and safer. This Industrial Internet of Things (IIoT) device connects directly to any network without the requirement of adding an expensive and complex programmable logic controller (PLC). This solution is compact, easy to install and train people to use. Best of all, the system is 50 – 70% less expensive than conventional options.

To ensure worker safety, fixed environmental sensors transmit real-time data from the underground workings to the surface command centre. The real-time data from the sensors allows miners to return safely to their working areas more quickly, allowing significant productivity increases along with monitoring critical areas for potential fires. All critical sensors require frequent maintenance and calibration to maintain accurate and

reliable measurements. The previously used technology required underground calibrations at each individual location using test gases and calibration equipment. However, several physical and environmental challenges prevented accurate and repeatable calibrations. Calibrating gas sensors underground is very difficult, time consuming and fraught with calibration errors thereby limiting the confidence of the legacy monitors.

Working in partnership with the mines to meet their requirements, the company aids in installing the Vigilante AQS Air Quality Stations that feature digital gas sensors that can be calibrated on surface in a stable controlled environment. The digital sensors then can be 'hot swapped' by a ventilation technician without the requirement of any sort of underground calibration. Built upon the IIoT, the digital sensors compensate for barometric pressure and temperature and have a complete suite of real-time diagnostics to help determine the health of the complete system and provide maximum system uptime.

Eight fully customer-configurable plug and play digital sensors and module inputs can be freely mixed and matched according to the underground requirements. Whether two airflow measurements and three different gas sensors are required, or control of a mine booster fan, the station can easily be reconfigured in minutes to adapt to the changing mine requirements.

All sensors and modules that connect to the station utilise industry standard digital protocols. This enables integral or remote mounted sensors creating an expandable and adaptable web, increasing coverage area and data accuracy, while reducing CAPEX costs.

The Vigilante AQS fully supports the two most popular network communication protocols Modbus TCP/IP and Allen-Bradley EtherNet/IP. Simply plug the station into a network switch, configure the settings via the built-in web pages and start measuring. The Vigilante AQS offers an optional digital to analogue I/O module that can tie into any legacy system.

Based on direct customer feedback, the company's digital products save mining companies on average 50 – 70% of CAPEX compared to conventional monitoring solutions. The company supports its equipment with free firmware updates for life of mine. The full savings to mining clients is in the range of 70 – 80% over the full life cycle with no hidden hooks or costs to bear in the OPEX maintenance cycle.

## Enabling connectivity to improve worker safety and reduce energy consumption

Since achieving full production, the Canadian underground mine has made advances in the ability to monitor and control the ventilation equipment over Ethernet. This mine is equipped with top of the line technologies for monitoring and control of the ventilation

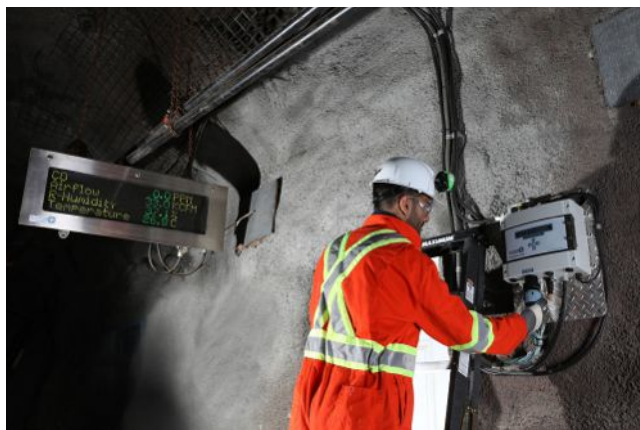


Figure 1. Maestro Digital Mine's products are designed with the direct input of its global mining customers, improving productivity, health and safety, and reducing energy for significant CAPEX and OPEX savings.



Figure 2. Using the Vigilante AQS airflow rate worker heat stress, humidity, barometric pressure, wet and dry bulb temperature are tracked for health and safety requirements.



Figure 3. The Vigilante AQS is a multi-variable IIoT device monitoring air quality and quantity. Blast gas levels are monitored, allowing for a quicker and safer return to the face.

systems resulting in benefits to health and safety, production and energy savings. From the surface control room, the Vigilante AQS permits mine wide monitoring of gases, humidity, airflow and temperature conditions during the complete shift.

As part of the mine's efforts to minimise and reduce capital and operational costs at the mine site, they reviewed and tested several competing solutions underground to monitor and control air quality and ventilation. The mine required a system that had a proven track record in the underground environment; one that kept workers safe and helped achieve significant savings. The company's Vigilante AQS air quality station met the requirements and was successfully tested, becoming the standardised system at the mine.

The mine completed their first trial by connecting a Vigilante AQS to a CISCO wireless access point (AP) through the Power-over-Ethernet (PoE) port. The AP provided a single point connection for both data and power thereby eliminating an additional 120 VAC power source. Again, reducing the total cost of installation, complexity and unnecessary labour. Any unit can be mounted, commissioned and calibrated in less than a shift using a single PoE connection to a CISCO APs.

In addition to significant measured energy savings, miner safety is provided by monitoring gas levels, worker heat stress and monitoring for fires. The real-time data from the gas sensors also assure safe blast clearance allowing the miners a quicker and safer return to the working face providing an additional 10% productivity improvement.

The next technology the mine crew tackled were the regulators. Regulators control the amount of fresh air on each level based upon strict regulations. Originally, the MaestroFlex™ regulators were supplied with traditional analogue and discrete inputs and outputs to control and monitor the louver position. This required expensive panels to be fabricated using remote I/O. The next and current generation of MaestroFlex regulators utilise Ethernet actuators.

The company's distributed control system (DCS) controller, located in the surface control room, communicates directly to the actuator thereby eliminating the cost of the engineering, remote I/O panels, multiple cable runs and terminations. They simply connect a single Ethernet communication cable and 600 V power cable to control and verify all the functions of the regulator.

The mine's communication infrastructure allows full connectivity of the network switches, wireless access points, air quality stations and regulators.

## Conclusion

Using IIoT devices can allow for a dramatic reduction of electronic hardware, software, engineering, fabrication, testing and construction for underground automation resulting significant reductions of cost and complexity. **GMR**