



Case Study: Aquila Group

*Manufacturing information,
instructions, and performance
metrics in real time*

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CASE STUDY: AQUILA GROUP

Manufacturing information, instructions, and performance metrics in real time

THE CHALLENGE: REAL-TIME MANUFACTURING AND ASSET MANAGEMENT

Implementing manufacturing execution systems (MES) or enterprise resource planning (ERP) systems that also integrate overall equipment effectiveness (OEE) monitoring can be a daunting task.

Monitoring and analyzing data points—uptime, machine utilization, material utilization, and downtime—often requires painstaking manual data collection and entry on paper forms, which can lead to erroneous outcomes in production.

Manufacturers also face challenges in interfacing operations technology (OT) with information technology (IT).

IT software systems traditionally used for MES and ERP, such as SAP and Oracle, do not interface with the communication protocols and technology used by OT equipment. OT equipment—the PLCs and I/O systems used in production and manufacturing. And IT systems are typically separate silos within a manufacturing or production plant.

ERP and traditional MES software systems are designed for macro-level visibility of manufacturing and production. They do not provide operators on the shop floor with visibility into real-time production statistics or the OEE data to help operators keep the shop floor running as efficiently as possible.

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THE SOLUTION: ENABLING DIGITAL MANUFACTURING

International consulting firm The Aquila Group, Inc. is tackling this problem directly.

Using the technology powering the Industrial Internet of Things (IIoT), they have begun knocking down those barriers, providing a bridge between IT and OT resources. Their customers, from smaller manufacturers to large ones like Eaton Electrical, Kohler, Fiat, and Siemens, now have visible data for process improvement, without disrupting current manufacturing.

The Aquila Group specializes in true *demand-pull* practices and philosophies. Demand-pull is part of the Lean manufacturing philosophy.

In demand-pull practices, primary emphasis is placed on the consumption or shipment of goods rather than forecasting, with the realization that schedules and shipments change daily. The difference is like setting a fixed schedule to refuel your car every Monday (push) instead of monitoring the gas gauge and filling the tank when the level approaches empty (pull).

Together with solutions from Opto 22, The Aquila Group has developed a software solution that automatically collects machine-level data points for real-time OEE

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calculations and then integrates that data directly with demand-pull based MES/ERP software.

The result? A new level of real-time information from shop floor to C-suite, enabling customers to see and control the entire order-to-shipment process and feed this expert level information back to the main corporate systems such as SAP.

Using the Green Light

The Aquila Group's Green Light Monitoring System software interfaces directly with Opto 22 SNAP PAC controllers and I/O to passively monitor electrical points on a machine.

"To poll data from the Opto 22 SNAP PAC controllers, we use several methods," says David Wilmer, Vice President of Manufacturing Systems at The Aquila Group.

"As a manufacturing engineer and developer, I had no issue using Opto 22 SDKs [software development kits] to enable our software to interface directly with the Opto 22 I/O system. I found it consistent with other SDKs we have

used and fully functional for any task we have encountered.

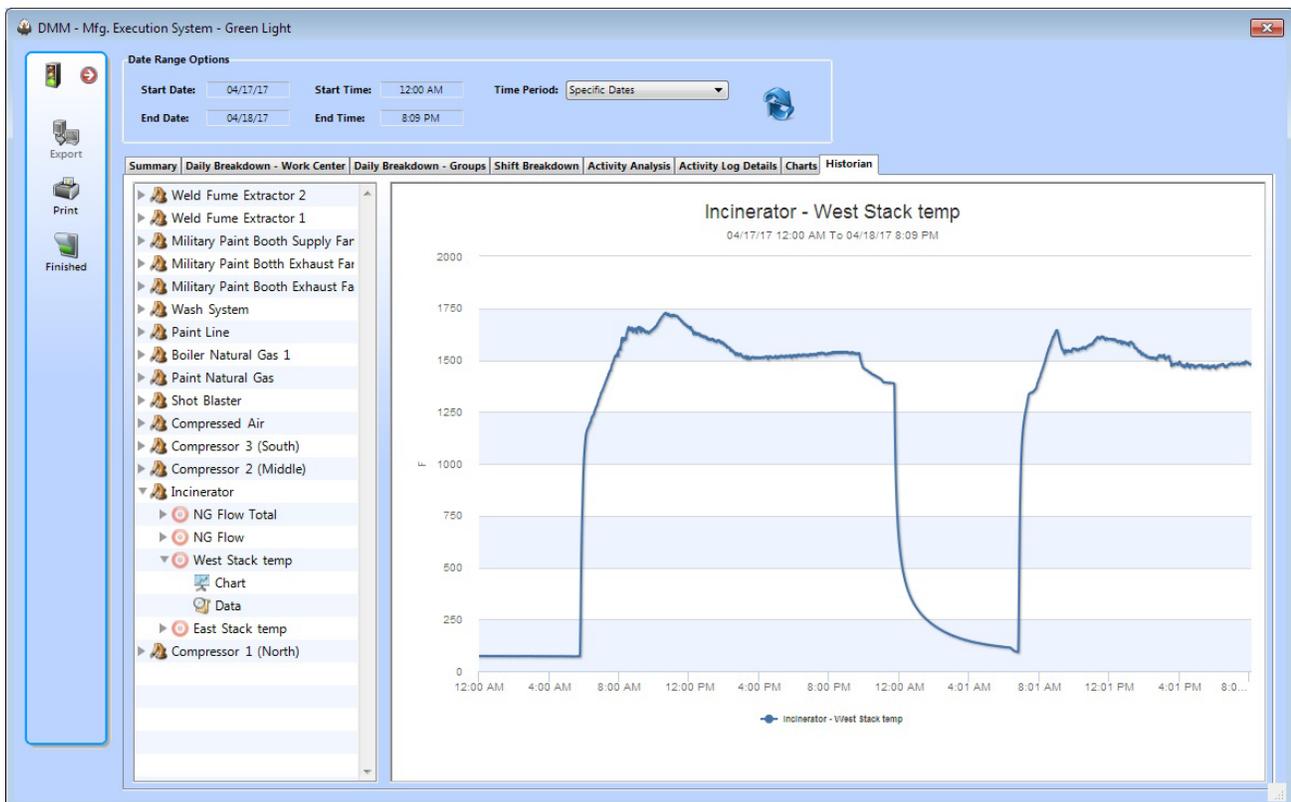
"With the SDKs, we use Opto 22's memory map protocol (OptoMMP) to access the memory maps for I/O brains. Given we have over 20 years of experience working with the current Opto 22 devices and their predecessors, it is safe to say we have used them all.

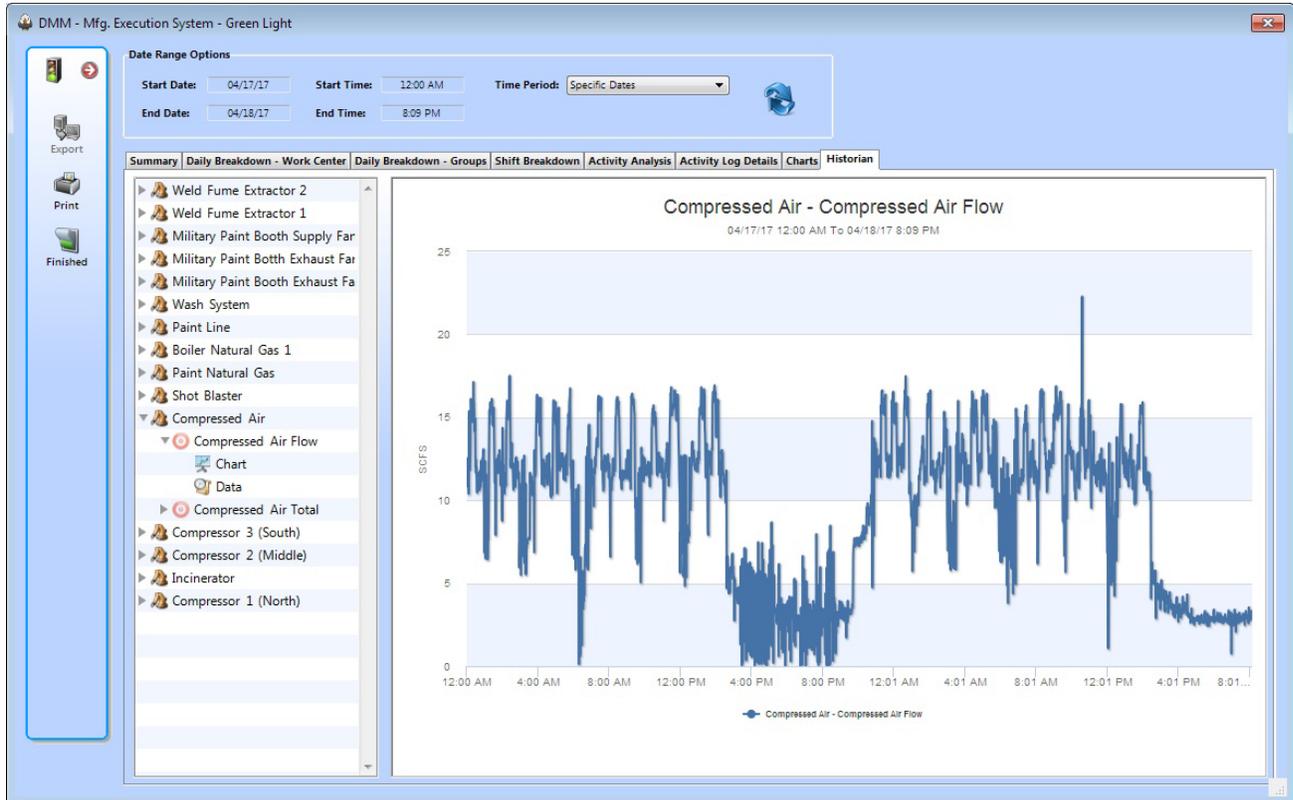
"My preferred method is to simply read all contents of memory in a single read and parse once on the PC side. This minimizes network traffic and provides a complete picture of input/output states in real time."

The Green Light Monitoring System polls the SNAP PAC System for electrical signal values (either analog or digital) and control system variables. It then translates these values into actionable information it records about the machine:

- Whether or not the machine is running
- How fast it is running
- Its current uptime and downtime
- And other data for real-time OEE calculations

Aquila Group's Green Light Monitoring System translates machine values into actionable data.





In addition, the system also collects signals and alarms for automatically and manually reporting downtime events, utilizing the system's machine activity Log feature.

The Log feature can collect downtime reason codes at the work center over a defined time frame, for example five minutes. The operator picks from a company-defined list of codes to indicate the root cause of this non-production event.



This data can then be accumulated over a week or a month, sorted by severity to the process, and then used to determine downtime impact and create more traditional Kaizen events with the goal of reducing downtime events in the future.

Both the Green Light Monitoring software and the SNAP PAC System provide the flexibility to tailor a solution for each individual process or machine being monitored—all without interfering with existing operations.

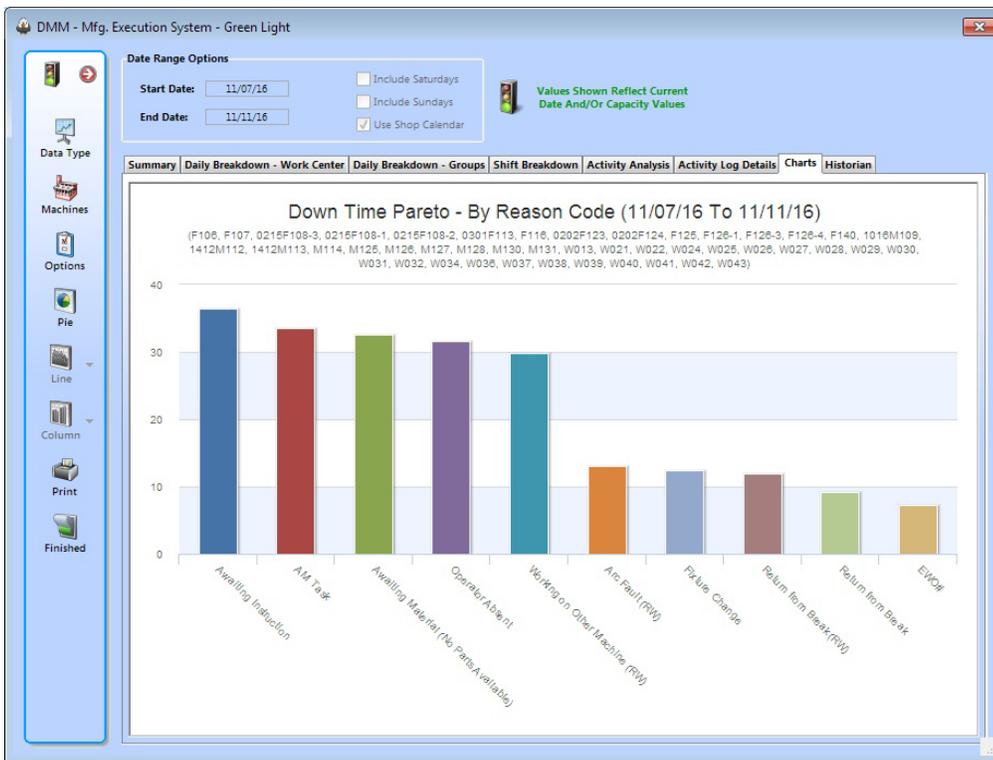
“The ability to tap into manufacturing equipment and gain real-time insights on the overall production system, without having to replace any existing hardware or software, is a huge benefit for our customers,” says Wilmer.

“The Opto 22 hardware provided a lot of capabilities in a small form factor. We can install a single Opto 22 controller and have it monitor 25 to 30 different machines.”

Visualizing data where it's needed

Once the Opto 22 SNAP PAC System is connected to the customer's existing machinery and equipment, engineers at The Aquila Group use Opto 22's *groov* to build and

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With the Green Light Monitoring System's Log feature, operators can log the reasons for machine downtime by picking from a pre-defined list of codes.

deploy operator interface screens. An IIoT application development and visualization appliance, *groov* provides a simple way to make key data visible.

During installation of the PAC system, Aquila engineers create custom tags that make the task of visualizing the data in *groov* perfectly match the existing cultural norms of each facility.

Authorized operators can monitor any of the control system tags from their smartphones or tablets. They can check real-time production information, see KPIs (key performance indicators), and view machine-level data, right on the shop floor, on anything from a smartphone to a PC to a smart TV.

The Green Light software also provides alerts and notifications for operators and engineering staff, with escalation capabilities. After a specified amount of time, production outages are escalated from the shop floor, to the engineering manager, and finally to the facility manager, until production is returned to normal operations.

Integrating with MES/ERP

In addition, OEE data can be integrated into The Aquila Group's MES/ERP software, Dynamic Machine Management (DMM).

By integrating Green Light Monitoring with DMM, companies can capture valuable information about the reasons for machine downtime and then use this information to focus on process improvement where it matters most.

DMM is a straightforward, user-friendly, demand-pull-based MES designed on a simple, commonsense approach of providing the right information to the right people at the right time. DMM makes it possible to create, collect, distribute, and manage manufacturing information, instructions, and performance metrics in real time.

Through real-time shop floor control, the DMM System creates a new production schedule with every machine cycle. Shop floor requirements for each work order can be entered into DMM manually or configured to work seamlessly with a manufacturer's existing ERP/MRP system, such as SAP or Oracle.

DMM interfaces to almost any ERP/MRP system through APIs (application programming interfaces) that allow the software to digitally read in production orders and then electronically distribute work orders directly to shop floor work centers.

The result is completely paperless production and work orders, while creating a complete order tracking system. Manufacturers have total visibility and real-time production information over their entire operation, eliminating hours of nonproductive time searching for parts and available shop resources.

With specialized screens available to control Punch, Laser, Press Brake, Weld Area, Machining, Kitting Area, Paint and Assembly, and overall General Production, the DMM System can run almost any work center in any facility.

Built-in dynamic nesting screens interface directly with nest engine software packages such as JETCAM, Metamation, Optimization, Hypertherm CAM, SigmaNest, and NCEXpress. Operators can generate machine code and setup instructions for a nested sheet metal program in a

matter of seconds, based upon the very latest demand requirements.

Handling multiple facilities

The Aquila Group's software solution can also be deployed across multiple facilities. Using VPN (virtual private network) connectivity between remote sites, The Aquila Group links plants so that all plants see each other's current and forecast production orders, inventory, and production line status.

This connection helps product management with equipment load sharing. Schedulers can literally move demand and production around by dragging and dropping demand in DMM from one plant or facility to another.

If excess capacity is available at a particular location, other metrics like freight costs are automatically analyzed to figure out where to push the demand. For example, if a manufacturing line goes down and it's only a two-hour truck ride to move parts and demand to another facility, it's a clear choice for production schedulers.

Flexible systems

Currently The Aquila Group supports 20 of the largest sheet metal manufacturers in the world, including Fiat, Cutler Hammer, Siemens, and Kohler.

Typical manufacturing systems supported by The Aquila Group range from just a few I/O points monitored on a single machine up to much larger installations with over 3,000 I/O points and more than 70 machines.

With production on such a large scale, The Aquila Group also built tools for monitoring energy consumption of machines, pH of water being used in the manufacturing process, and a variety of other sensors to provide a complete view of operations and manufacturing costs for their customers.

"With an Opto 22 I/O module for almost any electrical signal, it's easy for us to integrate almost any sensor into the MES system to gain visibility into production costs as manufacturing scales," says Wilmer.

"We're able to digitize and analyze virtually every point of a customer's manufacturing and production process. This data identifies new opportunities to increase machine uptime and improve overall equipment effectiveness—all



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**- David Wilmer, VP Manufacturing Systems,
The Aquila Group**

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“In our opinion, there is no such thing as a machine that can’t be monitored.”

- David Wilmer, The Aquila Group

while improving the quality of the products our customers are producing.”

In order to tap into existing electrical signals, Aquila Group engineers work with the plant and the manufacturer of the equipment, as well as relying on their own internal expertise, to determine which signals should be monitored for each device or machine.

“In our opinion, there is no such thing as a machine that can’t be monitored,” says Wilmer. “We work with just about any type of electrical signal including 4-20 mA, 0-10 VDC, pretty much any analog or digital signal. We’ve interfaced to hundreds of different sensors: energy, pressure, temperature, viscosity, etc.”

LOOKING AHEAD

Over the next several versions of DMM, The Aquila Group plans to transition their software systems to expand use of the RESTful API included in Opto 22’s SNAP PAC controllers. Using the API, their software will communicate directly from DMM to a SNAP PAC controller, reading I/O and control variables using HTTP GET and POST messages.

The Aquila Group has also begun to use the Node-RED development environment on the *groov* Box appliance, with the goal of enabling edge computing and predictive analytics of machine failure, before a production line goes down.

This vision is in production already at a beta site, and Aquila expects it to be a standard feature in its software suite in the very near future.

ABOUT THE AQUILA GROUP

The Aquila Group, Inc. is a national consulting firm specializing in the implementation of true demand-pull practices and philosophies. The firm strives to do this through the appropriate use of technology, in conjunction with the effective management of people, processes, and

disciplines. For more information, visit www.the-aquila-group.com

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ABOUT OPTO 22

Opto 22 was started in 1974 by a co-inventor of the solid-state relay (SSR), who discovered a way to make SSRs more reliable.

Opto 22 has consistently built products on open standards rather than on proprietary technologies. The company developed the red-white-yellow-black color-coding system for input/output (I/O) modules and the open Optomux® protocol, and pioneered Ethernet-based I/O.

In early 2013 Opto 22 introduced *groov*, an easy-to-use IoT tool for developing and viewing mobile operator interfaces—mobile apps to securely monitor and control virtually any automation system or equipment.

In addition to SSRs and *groov*, Opto 22 is best known for its [high-quality I/O](#) and SNAP PAC [programmable automation controllers](#), which include a RESTful API.

All Opto 22 products are manufactured and supported in the U.S.A.



Because the company builds and tests its own products, most solid-state SSRs and I/O modules are guaranteed for life.

The company is especially trusted for its continuing policy of providing free product support, free training, and free pre-sales engineering assistance.

For **more** information, visit opto22.com and groov.com or contact **Opto 22 Pre-Sales Engineering**:

Phone: **800-321-6786** (toll-free in the U.S. and Canada) or **951-695-3000**

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