

# AI predictive maintenance with Clea by SECO Mind

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Figure 1: Machinery requires maintenance in the form of time and material to fix inevitable breakdowns.

Since the beginning of mass manufacturing and automation, machinery has required maintenance in the form of time and material to fix the inevitable breakdowns. In its most basic form, maintenance is reactive and performed on machinery that is already broken. This means unplanned downtime, unpredictable lost production and, ultimately, lost profits.

In the second maintenance iteration, modern factories, vehicle fleets and even vending machine operations have implemented preventive maintenance programs. In this scenario, potentially downtime-causing wear items are replaced or serviced at regular intervals. While an improvement in terms of scheduling, this also means that machinery being “PM’d” (preventive maintenance-ed) must be out of service more than absolutely necessary.

The third maintenance paradigm, predictive maintenance, takes efficiency one step further. Here the engineer or operator — or even better, the system itself — is able to sense when something is amiss, well before problems arise. This allows maintenance operations to be set up and executed when convenient before a full breakdown of equipment.

This third iteration avoids both excess planned downtime and emergency situations where machinery simply “schedules its own maintenance,” or breaks down. However, true predictive maintenance programs normally take significant work and intelligent planning to set up and execute. So, while the benefits may be evident, it is still not always implemented. But why?

When considering the transition to predictive maintenance, three questions will naturally arise:

While an AI maintenance and reliability solution with Clea does involve some upfront costs, once set up, it can be a huge net positive to profitability.

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1. How does one know when machinery needs maintenance without an actual breakdown?
2. Is predictive monitoring difficult to set up?
3. Does predictive maintenance mean continuous monitoring by an engineer when learning the system, and further monitoring once implemented?

As discussed below, the answer to all three questions is Clea, a predictive artificial intelligence (AI) solution from SECO Mind, which can be deployed at the edge or in the cloud expediently for a given operation.

### Set up Clea AI to predict maintenance needs before critical failure

Clea is an AI predictive maintenance system that learns and monitors the steady state of machinery via onboard or external sensors. When it senses that something is “off,” it can then notify maintenance personnel that intervention is needed and estimate when failure will occur. It is thus designed to automate the prediction element of true predictive maintenance.

Machinery here can mean factory automation equipment, a fleet of vehicles, vending machine operations and more. Clea is hardware agnostic, allowing it to run on a wide [variety of computing setups](#) — such as Arm and x86 single-board computers (SBCs), computer-on-modules (COMs), integrated HMI solutions and the ESP32-based [Easy Edge IoT retrofit package](#) — according to the needs of a particular implementation or class of machinery.

Beyond being hardware agnostic, Clea is able to run system analysis locally, or can instead be set up to rely heavily on cloud computing. This is a distinct advantage because, in certain scenarios, database access is available — in an office building, for instance — and in others the necessary data transfer is relatively difficult or expensive — a fleet of vehicles crisscrossing a large region, for instance. One can set up Clea however works best according to the situation, rather than having to adapt or expand machine capabilities to fit the needs of the predictive maintenance system.



### Is predictive monitoring with Clea labor intensive?

While the first two questions are addressed above, to address the third: no, an engineer does not have to be dedicated to continuously monitoring machinery for predictive analysis. Once initially set up, Clea monitors system variables to intuit a proper steady state, then keeps tracking these inputs to see when failure is on the horizon. It can then proactively monitor a machines status to predict failures before they adversely affect a device’s functionality.

Clea can be implemented for fleet management, vending machines, OEM products and much more, and it is flexible enough to work in a variety of customer-vendor relationships and billing scenarios. So rather than the end-user calling for service when something is broken, Clea makes it possible for the service provider to instead contact the machinery owner before a problem even presents itself.

### Success story: Industrial refrigeration predictive maintenance

One predictive maintenance solution using Clea involves monitoring the energy efficiency of refrigeration units. Here SECO Mind was able to implement a model based on a recurring LSTM (long short term memory) network, capable of memorizing a time sequence and highlighting distinctive patterns in the machine’s behavior.

Considering data patterns over time, SECO Mind found a correlation between malfunctions and the environment where the machine is located. This data is used as a part of an “anomaly index,” which takes into account the electrical current usage of the machinery, room temperature, internal equipment temperature and the variation of machine vibrations. Currently, a ranking system is being developed that enables identification of which internal component is subject to a given anomaly, allowing for more focused interventions.

As implemented now, this early warning system allows personnel to estimate the time of an impending failure. Maintenance can then be scheduled and performed when convenient before an actual breakdown occurs.

### All-in-one or integrate with hardware

Clea is not only platform and cloud-agnostic, but can also be set up to use existing sensors, or use new sensor hardware specifically implemented for Clea predictive analysis (or some combination of both). Clea can also work with existing SCADA systems in the

form of Clea apps. This versatility allows engineers the flexibility to choose the proper sensor package that will result in optimum data collection.

Clea can refine collected data to make predictions, and even combine it with outside data — such as the outside temperature range for the date — to further enhance accuracy. SECO Mind can help build an appropriate AI software package integrating the relevant sensor data as needed. They also offer UX design expertise, helping integrators meet the needs of end-users who will ultimately benefit from a more streamlined interface.

### Vending machine data analysis



Figure 2: Predictive maintenance can be used to predict inventory on-hand. inevitable breakdowns.

Note that “predictive maintenance” here extends beyond oiling pneumatic cylinders, replacing light bulbs, servicing bearings and the like. It can, in fact, be used to predict inventory on-hand, such as in the case of vending machines. For example, one might assume that the sale of cold drinks correlates positively with higher temperatures in the area, as well as vehicular traffic. Clea’s AI can put this data together with other inputs, such as actual inventory on-hand to test such a theory. Once fully implemented, it can then let operators know when it is time to restock. Such a system keeps a vending operation from losing sales due to lack of inventory while saving trips to a location. This ultimately saves costs while maintaining profitability.

### Services offered

SECO can offer a customized hardware stack to best suit different scenarios, and can also offer support during certification as needed. With hardware and sensors in place, SECO Mind can then analyze machine data to build a custom set of AI algorithms to be deployed on the Edge or the cloud. Clea allows integration with several AI and machine learning algorithms, including ARMA (auto regressive moving average) and ANN (artificial neural networks) in order to recognize trends and the remaining useful life of a component.

SECO Mind, the AI company backed by SECO, offers:

- IIoT one-stop solution: the Clea software suite integrates AI, the Internet of Things (IoT), cloud/Edge computing and big data analysis with customer service.

SECO’s portfolio of services, on the other hand, includes:

- Quick proof of concept: rapid prototyping service allows SECO to verify a project’s feasibility and access potential risks in an extremely short period of time.
- Design and industrialization: standard and custom solutions with boards and modules using x86, Arm and FPGA architectures.
- System integration: services including pre-installation of customer software, assembly and even design and customized production of the end product.
- Manufacturing: lean manufacturing production process enables continuous improvement to the end product, reducing waste and accelerating time-to-market.
- Software: complete integration of electronic components with software applications via BIOS customization, firmware and driver development, and BSP Linux and Android development. Solutions include long-term customer support for the product life cycle.

### Success story: Pulmonary ventilator

SECO Mind is in the process of developing an experimental model for air quality control for a pulmonary ventilator. In this case, attention to detail was of the utmost importance, as any equipment failure could adversely impact the medical condition of the user. Such specialized attention is needed for any type of critical medical equipment, and SECO Mind stands ready to implement Clea AI software to assist with product reliability and maintenance.

### Industries served

While every application is different, it is hard to find an industry or sector that cannot be enhanced with the help of Clea and SECO Mind. To list just a few:

- **Medical devices:** Ensuring medical devices function properly with no interruption is of utmost importance. SECO Mind can assist with reliability as discussed in the pulmonary ventilator scenario discussed above.
- **Utilities:** Comprised of a variety of legacy, non-interoperable technologies, the oil and gas industry can be enhanced with Clea's versatile installation and administration capabilities.
- **Domotics —Home and building automation:** Smart homes and buildings are capable of generating vast amounts of data, which can be integrated into a Clea-based system.
- **Industrial automation:** Clea capabilities can be integrated into industrial applications for enhanced predictive maintenance via hardware such as HMI devices and visualization solutions.
- **Vending:** As outlined earlier, Clea AI can be used to enhance vending machine operations, and hardware/software can be customized to a specific operation's needs.
- **Digital signage:** With SECO Mind's combined hardware and software solutions, products can be equipped with rich functionality to enable predictive maintenance and rapid part replacement.

### The bottom line

While an AI maintenance and reliability solution with Clea does involve some upfront costs, once set up, it can be a huge net positive to profitability. The end user is able to rely on increased uptime and process insights, while the manufacturer potentially benefits from increased service revenue and customer satisfaction.

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#### ABOUT SECO

SECO is a center of excellence in the field of innovation and technological integration. SECO has been operating in the high-tech market for over 40 years, designing, developing, and manufacturing cutting edge proprietary technological solutions. SECO Mind is a European and Silicon Valley AI company backed by SECO, founded for the explicit purpose of further developing AI and IoT capabilities. Whatever the application, whether vending, transportation, medical, manufacturing or a wide variety of other systems, SECO, along with SECO Mind, stands ready to help. Find out more information [about Clea here](#), and more information on SECO Mind [via this page](#).