Savigent SOFTWARE

CASE STUDY

Target Maintenance Tracker

Industry

Semiconductor Manufacturing

Application

Savigent Platform™

Background

This manufacturing operation uses over 200 disparate tools that all require scheduled maintenance based on usage data such as the number of kilowatt hours or number of units produced since the last scheduled maintenance. Failure to do this preventative maintenance produces a costly increase in scrap. Usage data is periodically collected manually off of each machine and logged into spreadsheets. Engineers then compare this usage data to a maintenance schedule for a particular machine to determine whether maintenance is needed.

Challenge

The manual processes used to collect usage data for over 200 machines and monitor the maintenance schedules are time intensive and error prone, leading to lost productivity for engineers and a higher-than-necessary scrap rate on machines that are overdue for maintenance.

Results

Reduced scrap production and lower long term repair costs for manufacturing equipment.

Solution

Savigent Platform's solution is to automate collection and calculation of usage data from the various machines and compare that data to a centrally managed copy of the maintenance schedules. A web interface allows users to view the current maintenance status for any machine and an automatic alarming system notifies the appropriate personnel should a machine exceed its defined maintenance interval. The system is comprised of three major parts as described below and illustrated in figure 1.

Web Clients – Simple web-based user interfaces to manage new and existing schedule data as well as monitor current machine status.

Maintenance Tracker Server – A database responsible for storing schedule data, configuration data and machine usage data. In addition to the database a logical component monitors the usage data and compares it to maintenance schedule data to determine when a particular machine is due for maintenance as well as alerting the appropriate personnel when it is time for maintenance.

Machine Integration – Consists of lightweight logical components that provide connectivity to, and usage calculations for, each distinct machine. That usage data is then reported back to the central server for comparison with maintenance schedules.

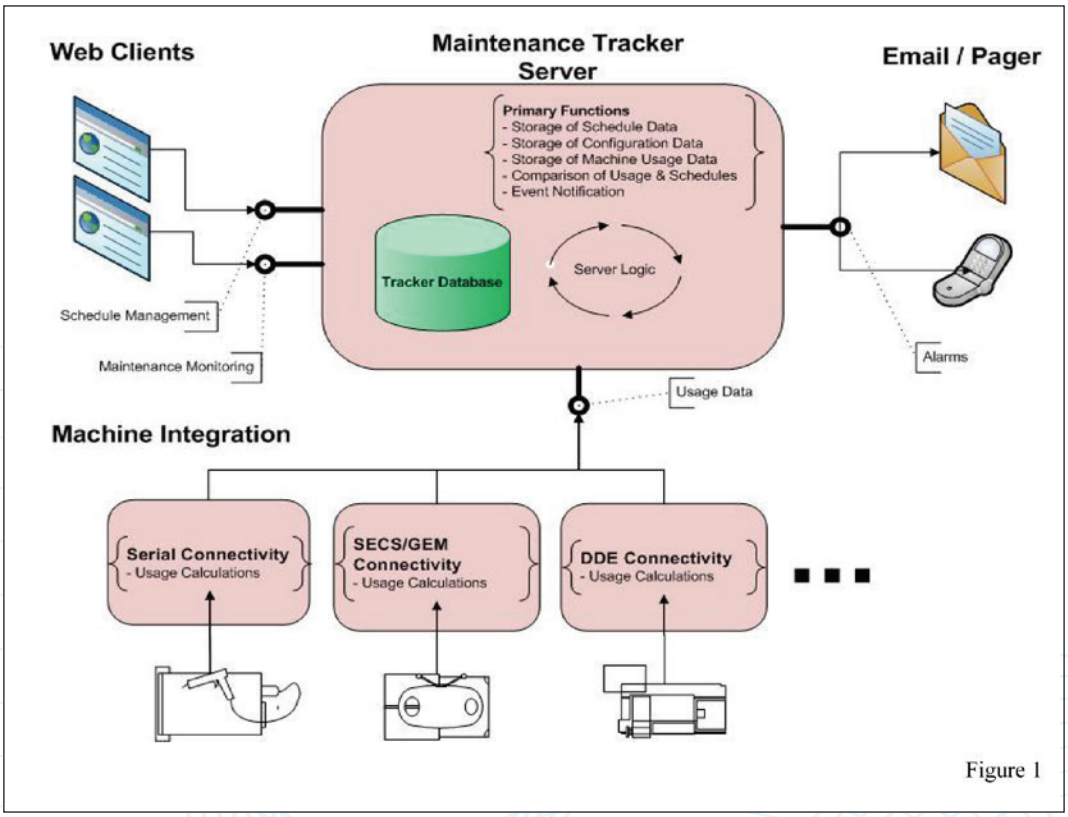

Figure 1

Centralize Maintenance Schedule Information

The first step in automating the manual administration of the preventative maintenance was to consolidate and centralize the maintenance schedules for the over 200 dissimilar machines used in the manufacturing operation. To do this, a database was created to hold all of the maintenance schedules. Additionally, a browser-based user interface was deployed to report on the existing maintenance schedule data as well as edit existing schedules and add new schedules. This centralization of the maintenance schedules simplified the management of the data and made it more accessible for reference by engineers and maintenance personnel.

Additionally, configuration options were added to enhance the scheduled maintenance processes over the manual processes. For each schedule the following configuration options were added:

- Warning Threshold – Creates a "warning event" when a machine was within X number of kilowatt hours of required maintenance, giving maintenance personnel time to respond before maintenance was actually required
- Maintenance Required Threshold – Creates an "action required event" when a machine had exceeded its maintenance schedule
- Machine Lockout Event – Configuration option that allows a critical machine to be locked out until maintenance is performed to prevent scrap or machine damage
- Alarms – Any of the above events can be configured to generate an alarm via email and/or pager to alert the appropriate personnel that action is required

Automate Calculation/Collection of Usage Data

Usage data for the machines is measured using various metrics each requiring some calculation or interpretation of the data to drive the maintenance schedules. One such usage measurement is kilowatt hours. Some machines output kilowatt hours directly, while others might output some or all of the following: watts, volts, amps, ohms, and elapsed run time. Because of the dissimilar nature of the machines and the variety of outputs, logic was distributed to each machine to monitor the available outputs and execute the appropriate calculations to report kilowatt hours according to one or more of the following calculations:

$$kilowatt\ hours = watts \times elapsed\ run\ time\ hours \div 1{,}000$$

$$watts = volts \times amps$$

$$watts = amps^2 \times ohms$$

$$watts = volts^2 \div ohms$$

Another measurement that can be used to drive the maintenance schedules is number of units produced. Many of the machines output this value each time a unit moves through a production step. This value is then used directly to drive maintenance for some of the equipment.

In addition to the challenges associated with different machines providing different combinations of outputs the machines also use a variety of different communications protocols including the following:

- Dynamic Data Exchange (DDE) – An older Windows data exchange technology
- Flat File – File communications requiring custom parsing and file management
- Serial Communications – RS-232 communications
- SECS/GEM – Semiconductor industry's standard for equipment-to-host communications

It was clear that the solution had to be flexible enough to accommodate all the uniqueness introduced by the variety of outputs needed to compute usage data, compounded by the variety of communication protocols used by individual machines. In addition, the solution was required to be able to accommodate these differences in a distributed fashion since these machines are widely distributed across the manufacturing environment.

The usage data that is calculated according the processes described above is recorded every hour in the central database on behalf of each machine.

Compare Usage Data to Maintenance Schedule

On the database server a process continuously scans the usage data and compares it against the maintenance schedule data. Any warning, maintenance required or machine lockout events are identified and updated on the user interface and any associated alarms are generated to notify personnel of required action. This provides a means to balance the benefits of both a proactive and reactive system. Maintenance personnel are able to proactively check the web-based user interface to any machines that are approaching their maintenance interval and take the appropriate action before it is required. In addition, the system allows for alarming and machine lockouts for any equipment deemed critical to guard against increased scrap production or machine damage as a result of a missed maintenance event.

Challenges

Disparate Machines

The variety of the manufacturing machines used in this particular case study provided the biggest challenge. With various data outputs coming from various communications protocols the ability to pragmatically develop an interface to each distinct machine was critical. Savigent Platform's open connectivity provided base agents to communicate via all of the protocols involved in this case study. Additionally, the logic environment provided a way to easily incorporate the necessary usage calculation for a particular machine, thereby normalizing all of the usage data before publishing it to the server for comparison with the maintenance schedule.

Automatically Alert/Lock Out When Machines Need Maintenance

Another requirement for the project was to error proof the process so that in the event a required maintenance was missed the appropriate personnel would be alerted and/or the machine could be locked out to prevent the creation of unnecessary scrap or damage to the machine. With the previous manual process this requirement was simply impossible to meet. Savigent Platform's ability to communicate to external systems like an email server or pager made this requirement not only possible, but easy to implement.

Result

The results of the Target Maintenance Tracker project enabled by Savigent Platform included several benefits over the manual maintenance management processes used in the past, including the following:

Reduced Scrap – Since preventive maintenance events are not missed, machines stay within acceptable process limits and produce significantly less scrap.

Lower Long-Term Repair Costs – Since machines are held to a strict maintenance schedule, long-term repair costs are lower.

Improved Productivity – By automating the collection of data to drive the maintenance schedules, engineers and maintenance personnel have more time for mission-critical activities.