

Maintenance Forecasting for High Volume Manufacturing

Author: Christopher Conley

To increase overall manufacturing productivity unplanned downtime needs to be reduced as much as possible. In Photolithography, there are opportunities to forecast and schedule downtimes in the area of optical degradation compensation (consumable parts). Nikon has created an automated solution to perform this forecasting. In order to accomplish this, one must first characterize the degradation signatures, understanding both the root cause of the signature and the compensation and or repair method. However, most degradation signatures can be very noisy over time, due to normal adjustments and part replacements. Nikon has overcome this with the development of a proprietary algorithm that locates and filters for flyers, events and areas of non-linearity. Using this filtering, a degradation rate can be calculated and limits can be set to determine the projected date of impact to product.

Nikon created a web based software solution to automate the calculation and delivery of reports showing the forecasted time to reach these limits and the parts needed to return the tool to an optimum condition. This allows for "just in time" parts ordering, ensuring availability of parts when the maintenance activity is due, and reducing the need for long-term parts storage. To reduce the impact to manufacturing, maintenance is scheduled in advance. The amount of time needed to perform the maintenance is reduced since troubleshooting is no longer required. An additional benefit to the automation software is the ability to use the data to create analysis reports for trend troubleshooting, not only on a tool-by-tool basis, but also on comparisons across populations of tools. This level of analysis is useful to identify not only problematic machines, but can be fed-back to design groups for development of potential improvement modifications and/or design changes on future models.

Challenges exist affecting the accuracy and reliability of the reporting. These challenges mostly exist in the area of data collection. Due to limited access to equipment networks from outside of the fab, automation cannot be fully employed. As a result data collection efforts are typically performed manually. The manual data collection causes delays in entering data into the database, as well as increasing person-hours needed to manage the program. With direct server to tool "pipeline" availability, not only is the cost in person hours reduced, but also if the data is real or near real time alerts, warnings and reports can be generated and delivered to users automatically.