Edwards Vacuum: Transforming the Sub-Fab Through Semiconductor Intelligent Service

For decades, Edwards Vacuum has been a trusted backbone of semiconductor manufacturing, providing critical vacuum and abatement systems to fabs worldwide. Now, as chipmakers race to meet the demands of AI, high-performance computing and hyperconnected devices, the company is also becoming a strategic partner in fab performance.

At the heart of this transformation is Edwards' Semiconductor Intelligent Service (SIS) unit, led by Amalia Frank, Marketing Vice President, responsible for business transformation for the Edwards Vacuum semiconductor service division.

"We're really trying to use data to drive our decision-making," Frank explains. "With AI and machine learning models, we're starting to 'plan the unplanned' in the sub-fab and make operations more efficient and streamlined. It's about helping customers unlock value and achieve the outcomes they're looking for."

Frank sees this shift clearly: "We're not as 'sexy' as what's happening in the fab, but the stuff we do is so core to everything. We're getting incredible insights into what's actually happening, and now we're making it easier for customers to predict and reduce risk."

Predictive maintenance: the new core

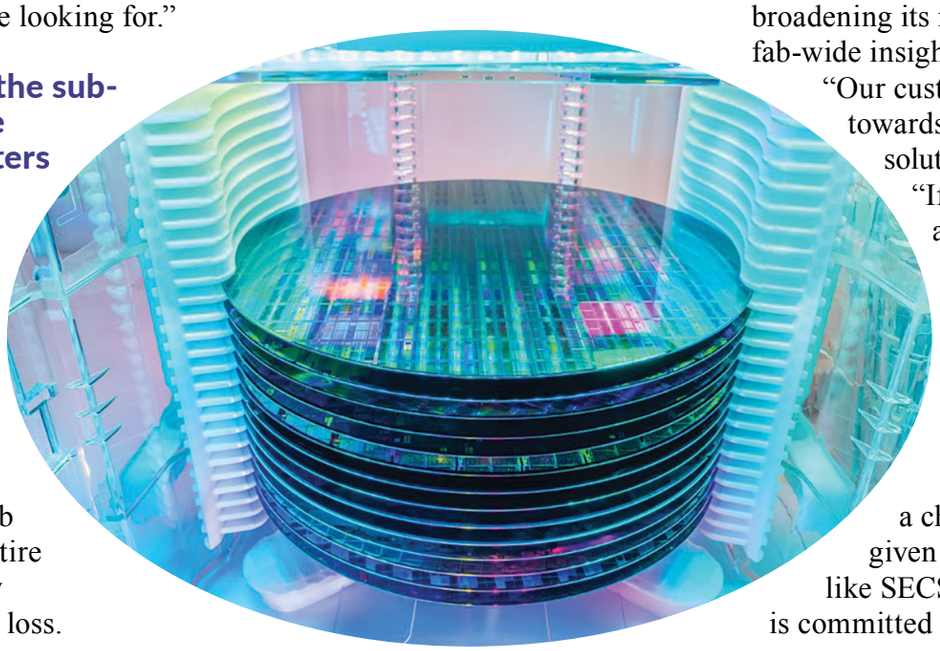
at the heart of sis is predictive maintenance (pdm)—turning decades of edwards' expertise into data-driven, ai-powered services.

"predictive maintenance is at the forefront of what we're doing," frank says. "we're taking our traditional way of maintaining equipment and turning it into ai-driven early warning systems. that gives us insight and foresight into what's going to happen—fewer surprises for our customers."

in recent trials, edwards' models achieved up to 95% prediction accuracy across both pump and abatement systems. this not only improves uptime but also streamlines maintenance schedules, reduces costs, and enables fabs to "do more with less."

From the fab to the sub-fab: Why service intelligence matters

While fabs often capture the spotlight, the sub-fab—where vacuum pumps, abatement, and support equipment live—is equally critical. A single failure in the sub-fab can ripple across entire fabs, creating costly downtime and yield loss.



Beyond pumps: Data, integration, and ecosystem thinking

SIS is not limited to Edwards' own tools. The team can already connect to a range of other subfab equipment, and is looking at how to expand data collection across the subfab, broadening its role as a platform for fab-wide insights.

"Our customers are moving towards a single data solution," Frank notes. "If we can collect data across the subfab, we can use our technology to provide insights into machine health and availability across the ecosystem."

Integration remains a challenge, particularly given legacy standards like SECS/GEM, but Edwards is committed to

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aligning with customer requirements. “If everyone wants SECS/GEM, we’re here for it. If expectations change, we’ll shift accordingly.”

Customer-first transformation

What distinguishes SIS is not just technology, but its value-based approach to customers. Rather than selling generic service packages, Frank’s team works backwards from the customer’s goals.

“Instead of a customer saying, ‘I just want this,’ we try to uncover the actual problem,” she explains. “It might be yield, uptime, or sustainability. Predictive maintenance might not always be the answer, but with fleet monitoring, upgrades, or analytics, we build the right solution to meet their outcomes.” This outcome-driven engagement reflects Edwards’ transformation into a more agile, customer-aligned partner.

While SIS is built on AI and machine learning, Frank emphasizes that people remain central:

“The technology is outstanding, but honestly, the expertise of the people in the field is the cornerstone. The domain knowledge and decades of experience from our teams make it possible to deliver this to customers. We couldn’t do it without them.”

As Edwards continues to invest in new U.S. facilities in Arizona and New York, backed by CHIPS Act initiatives, SIS will play a central role in ensuring fabs operate with greater resilience, sustainability, and efficiency.

Frank is optimistic: “It feels like a futuristic view of what’s coming. With AI, machine learning, and the expertise of our people, we’re excited to take this to the next level with our customers.”

Conclusion

Edwards’ Semiconductor Intelligent Service unit represents more than a service portfolio—it’s a transformation of how the company defines value for its customers. By combining predictive analytics, AI, and deep domain expertise, Edwards is reshaping the sub-fab into a proactive, intelligent environment.

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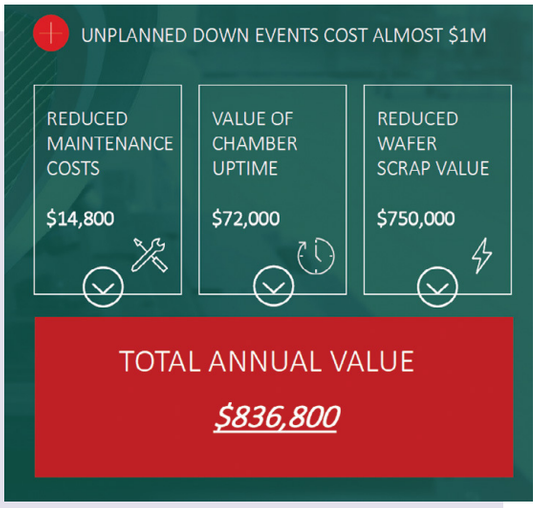
Customer Use Case

A semiconductor foundry needs to eliminate the risk of wafer loss from unplanned downtime in the sub-fab



The foundry's next growth phase set the fab team in search of new channels for innovation. All areas of the manufacturing chain needed to increase their contribution to fab yield. Their vacuum and abatement systems had evolved over the years, concealing hidden variables affecting the potential performance of the wider fab. Unplanned vacuum system failures during wafer processing were a pressing concern. Advancing semiconductor manufacturing processes were also placing increasing demands on vacuum and abatement equipment.

Fab downtime

A pump "crash" during a batch process that causes the scrap of an entire production batch –up to 125 wafers –could be a huge loss in product and process downtime. Even in the single wafer processes, unplanned vacuum pump faults could cause significant losses as process tools require many hours or even days to requalify.

The foundry sub-fab monitoring system was unable to provide insight on the occurrence of vacuum equipment faults. A time-based maintenance regime was in place on vacuum pumps supporting critical process tools. This interrupted valuable production schedules, where expensive process tools were often taken down too early or just as a precaution. Even on reduced maintenance intervals, pump faults still occurred, contributing to tool downtime and wafer loss.

In need of a solution, the foundry approached Edwards to look first at a batch furnace application causing high value risk from a small number of unplanned events.

Solution: Making vital changes in the sub-fab to reduce risk

Both the fab and the sub-fab teams were open to discuss important changes, required for the sub-fab to better contribute towards fab value and success. New conversations started to take shape between teams. They started to move their thinking from the traditional "break-fix" approach to how to optimize and align their service schedule to better support the process tools. This formed an approach of Operational Excellence, where the operation of people, machines, processes and data all worked together to achieve the best results. Predictive Maintenance (PdM) and Remaining Useful Life (RUL) technologies were installed in parallel with the existing sub-fab monitoring system. Leveraging Edwards' domain expertise to understand vacuum pump condition, the company's operational excellence specialists created a condition-based maintenance plan which centered around the objectives of the wider fab.

The plan identifies any developing pump faults in advance and in good time. It includes adjustments to the pump to improve management of process by-products and further decrease the likelihood of unexpected pump fault. The accuracy of PdM and RUL insights were confirmed by post-mortem analysis and comparison to our global knowledge base. This proof gave the fab the confidence to move from time-based maintenance scheduling to a proactive strategy, focused on operational excellence. A collaborative engagement allowed us to share actionable insight with process tool owners.

The extended fault prediction horizon allowed the sub-fab team to notify the process tool owners 6 weeks in advance of sub-fab maintenance requirements. With this increased transparency, the tool owners saw a benefit of communicating their process tool schedules. Co-managing risk in this way meant the sub-fab and clean room maintenance activities became better aligned.

Outcome: Maintenance intervals extended by 6 weeks

With the advanced insight gathered on how changing manufacturing processes affect the deterioration of pumps, the sub-fab team made recommendations to optimize pump configuration. With the confidence provided by the PdM technology and verified RUL calculations, the fab team agreed to extend maintenance intervals by at least 6 weeks (25%), without any risk of unplanned downtime. The overall effect was to reduce the risk of wafer losses, and performance improvements continue to be visible across the entire fab, as tool availability and fab yield improve.