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NOVO NORDISK DEBOTTLENECKS WITH EMERSON'S RTMs SOFTWARE

By Jim Montague

Because quicker data and answers allow faster decisions and optimization, close to real-time results enable the fastest solutions.

That's what Novo Nordisk discovered when it deployed Emerson's Real-Time Modeling System (RTMS) in the expression, engineering and formulation processes for its therapeutic proteins and peptides products. Implementing RTMS software allowed the pharmaceutical company to:

- Resolve bottlenecks and determine capacity analyses by using plant data to run what-if scenarios. This identifies other, previously unseen bottlenecks, which can also be resolved to improve throughput even more.

- Implement unified, site-wide real-time scheduling (RTS) using a Level 2/Level 3 automation-based finite scheduling module, which produces schedules that are continually updated and always feasible using the RTMS model. This includes integrating RTS with corporate manufacturing execution system (MES), enterprise resource planning (ERP), quality management system (QMS), distributed control systems (DCS) and maintenance systems to generate further updates.

- Employ Crosswalk software for statistical analyses, data fitting and process evolution tracking. This lets users create datasets from batch historians that RTMS can use. It also allows analysis independent of RTMS for use in overall equipment effectiveness (OEE), process evolution or golden batch projects.

"RTMS lets users add new data to their simulations, recalculate, update schedule times, and adjust future times," said Keith Hope, RTMS engineering manager at Emerson. "Each activity is also mapped to markets in the automation system, which shows the impact on scheduled activity, and indicates if maintenance is needed and how to get back on track."

Hope and Mikael Johansen, project director at Novo Nordisk, presented "Hidden treasures: How to unlock additional value in your plant by adding RTMS software" this week at the Emerson Exchange Immerse event in Anaheim, Calif.

So far, Novo Nordisk has implemented RTMS at two of its existing proteins and peptides facilities, and is

RTMS lets us know when a high-utilization day is likely coming, so we can prepare our equipment and systems to handle them." Novo Nordisk's Mikael Johansen discussed how real-time management system software helped to dramatically improve unit productivity and process operations.

preparing to install it at a third facility that's presently under construction.

Streamlined by scheduling

In 2020, Novo Nordisk deployed RTMS for day-to-day scheduling on three screens in the control room used by one plant's operating teams, which previously tried different planning systems. This plant lacked a unified production schedule, and had low confidence that it could ramp up production

"We wanted to capture all the knowledge we could for better planning, and perhaps add a couple of batches, which we couldn't do before due to a lack of training," said Johansen. "RTMS let us go from running four or five batches per week to five or six batches per week, which was about a 20% increase in output."

RTMS also pointed out some gaps in operator competencies among the plant's teams, which required some tasks to be done at certain times of day. Making the production schedule more visible during higher run rates showed where added training was needed. RTMS also codified and modeled the tacit knowledge that plant staff needed when scheduling manually, and that model was used to train new schedulers, process controllers and engineers.

Simulations untangle snags

In 2022, Novo Nordisk adopted RTMS for debottlenecking analysis at a second plant to reach designed production rates more quickly and easily, and reports it went on to achieve the fastest ramp-up to full production in the company's history. This new facility performs upstream and downstream production with buffer-stock solutions in a complex tank network and strives to process one batch every 24 hours.

"We built simulation models for all of the plant's process steps, which let us add more data to our simulations," explained Johansen. "This plant also simulated about 20 years of production, and identified long-term bottlenecks, such as buffering system delays. We often found that removing one bottleneck led us to find more behind the first one, which gave us an opportunity to resolve those, too."

Johansen reported that Novo Nordisk also used RTMS to monitor the utilization loads on its clean-in-place (CIP) stations. Most averaged 29-37% utilization, but some days they ran at 60-70%, which could cause delays and risk the loss of a batch due to their often short, critical holding times. "RTMS lets us know when a high-utilization day is likely coming, so we can prepare our equipment and systems to handle them."

New protein-peptide plant—with robots

While it's still being built, Novo Nordisk's third RTMS deployment is going into its $2.3 billion plant. It will have four independent mammalian-cell production trains with a shared weigh-and-dispense (W&D) area, and an RTMS application for each train. At this facility, RTMS will:

- Forecast demands for the shared W&D area and perform real-time tracking of resource constraints for managing shutdowns and maintenance.
- Help the plant's automated guided vehicle (AGV) robots make deliveries by using the RTMS schedule to predict demand for materials, and work with the AGVs' fleet manager software to monitor and coordinate their locations.
- Similar to the second plant, RTMS will also be used during ramp-up at the third facility to identify process bottlenecks preventing full-capacity operations.

Real-time lessons learned

Johansen reported that using RTMS taught Novo Nordisk several valuable lessons, such as supporting sites and staffers to adopt new ways of working.

"In the past, each team did things in different ways. RTMS shows where we can optimize and improve operations," said Johansen. "If a schedule says a process must be done at 2 p.m., it can't be done at 3 p.m. because other tasks or processes may need that equipment."

The system also helped prepare for go-live operations and transition off old systems, and measure success for future gains. "We think old planning systems should die quickly, instead of running legacy and new systems in parallel for so long before shutting down the old one," he said. "Even veterans, who know the most about these systems, still don't know everything. This is where putting all our process knowledge into RTMS models can be a big help."

RTMS models also capture key process and scheduling know-how, which mitigates the impact of turnover on the scheduling team, helps onboard new employees and assists in communication with management. Centralizing expertise in RTMS drives consistency, improves responsiveness to process needs, and maintains expertise with a consistent work stream.

Johansen revealed that RTMS even enhanced Novo Nordisk's culture. "We had heavy involvement from operations in building our RTMS models. However, when we first did them, they looked like our operations interfaces used to. This meant they might not get used if there wasn't enough of a difference," he said. "So, we let the new RTMS models look like the old displays for a while, and adjusted them later, which helped us get more buy-in."