

Aurora

Maintenance Repair and Overhaul (MRO)

Competition. Quick turnaround. Cost pressures. Uncertainty.

Managing maintenance, repair, and overhaul (MRO) operations has never been more challenging.

Aurora™ is the world's leading planning and scheduling software solution that combines expert knowledge with artificial intelligence. Aurora helps many of the world's most demanding organizations manage their mission-critical operations more flexibly and efficiently. For example, Boeing selected Aurora to help them manage their MRO, Boeing 787 Dreamliner™ airliner assembly operations, and 60 other commercial and defense applications.



Lean and Mean

Intense competition drives MRO prices and cost allocations down, so highly efficient operations are essential. This means activities must be scheduled to maximize resource utilization and minimize expenses.

The Need for Speed

In order to satisfy customers and maximize the availability of their fleets, a quick MRO turnaround is essential. But reducing turnaround time (TAT) is costly, requiring more resources to handle uneven demand.

Each Aircraft is Unique

Unlike manufacturing, which produces products from standard parts and materials, the operating history and condition of each vehicle is unique, so MRO activities must be tailored to the constantly changing mix of vehicle requirements.

Unpleasant Surprises

Discovering emergent work and identifying additional MRO tasks is a fact of life. Adjusting to these unpleasant surprises requires rapid, intelligent reprioritization and re-scheduling, so human schedulers can quickly test scenarios when needed.

Stottler Henke

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Introducing Aurora

Aurora was developed to help tackle difficult, mission-critical scheduling problems—by using artificial intelligence technologies to encode and apply extensive domain knowledge and decision rules to generate more efficient schedules.

Today, Aurora manages the most demanding operations for organizations like The Boeing Company, Mitsubishi Heavy Industries, Bombardier Learjet, Spirit AeroSystems, General Dynamics Electric Boat, Korea Aerospace Industries, and the US Air Force, US Space Force, and US Navy.

At NASA's Kennedy Space Center, Aurora scheduled MRO activities for the Space Shuttle as well as for spacecraft components prepared for flight or refurbished for return to the International Space Station (ISS).

Aurora Outperforms Traditional Schedulers

In a study conducted by The Boeing Company, Aurora managed resources more efficiently than any other software Boeing could identify, including software that Boeing had developed and maintained specifically for managing its own operations over almost two decades.

Compared to Primavera, Aurora reduces turnaround time by 20%. Compared to Microsoft Project, Aurora's schedules are 30% shorter.



In addition to supporting MRO operations, the Boeing Company uses Aurora to prioritize production of the Boeing 787 Dreamliner commercial airliner, in addition to other commercial and defense aircraft in Boeing's product line. Aurora's dynamic assembly schedule adapts to real-time production variations, so Boeing can produce aircraft as efficiently as possible.

How Aurora Works

Most other scheduling systems use simple rules to select and schedule tasks and assign resources to carry them out. These rules usually consider only limited information about the required tasks, resources, and constraints, so the generated schedules are far from optimal.

Other systems rely on mathematical optimization to search systematically for the best scheduling solution. However, as the number of scheduled tasks and constraints grows, the computer time needed to solve the problem grows exponentially, making this approach impractical for managing large, complex operations.

Aurora solves complex scheduling problems effectively by encoding and applying sophisticated scheduling knowledge and decision-making rules, along with complex constraints and resource requirements.

Aurora encodes attributes of data objects representing individual tasks, groups of tasks, resources, resource sets, and constraints.

Aurora's built-in and user-supplied decision rules produce better schedules by considering the values of these attributes at key scheduling decision points such as:

- Determining which task to schedule next,
- Assigning the best time and resources to each task to optimize the overall schedule, and
- Handling situations in which some resources are unavailable when the task is scheduled.

Aurora's knowledge-rich approach enables it to combine human expertise with intelligent algorithms to generate superior schedules.

Aurora technology addresses MRO challenges by:

- Generating near-optimal schedules for highly efficient MRO operations.
- Generating and revising schedules rapidly, so organizations can quickly adapt to changing conditions.
- Providing complex constraint support beyond what is found in other scheduling tools.
- Explaining why Aurora selected the scheduled time and resources for each task.
- Exploiting domain-specific scheduling knowledge and requirements, entered quickly and easily via graphical user interface.
- Detecting and highlighting scheduling problems such as unresolved conflicts.



Mitsubishi Heavy Industries selected Aurora to accelerate its production of composite wings for the Boeing 787 Dreamliner.

Complex Constraint Modeling

Conventional scheduling systems often support only basic constraints such as finish-to-start, start-to-start, finish-to-finish, and start-to-finish. Without a complete and accurate model of the constraints that schedules must satisfy, simpler systems cannot even determine whether a candidate schedule is valid.

By contrast, Aurora enables specification and enforcement of complex constraints, so it can schedule projects that other tools cannot even model. Examples of these constraints include:

- Resource requirements for each task (e.g., labor, equipment, space, materials),
- Exclusivities (incompatible tasks that cannot run concurrently),
- Preferred resources,
- Ergonomic constraints,
- Shift-based constraints, and
- Same-resource constraints for related tasks.

Advanced Algorithms

Aurora uses advanced techniques such as bottleneck avoidance, which pre-analyzes the resources required by all the tasks, prior to scheduling them, to ensure that the most constrained resources are assigned to the tasks that have the greatest need for them, resulting in better schedules.



The US Navy selected Aurora software to schedule submarine maintenance operations at the Naval Submarine Support Facility (NSSF).



In service for 18 years at NASA's Kennedy Space Center (KSC), Aurora/AMP generated short- and long-term (10 year) schedules of ground-based activities that prepared and refurbished Space Shuttles before and after each flight. Rapid scheduling enabled NASA to analyze numerous what-if scenarios efficiently.

Recognition and Awards

- Aurora has been featured in *MDA Tech Update*, *Defense Tech Briefs*, *NASA Tech Briefs*, *Air Force Launch Stories*, and *Spinoff*, NASA's premier publication featuring successful spinoff technologies.
- NASA designated Aurora a Small Business Innovation Research Success Story and showcased Aurora technology in a *Hallmarks of Success* video.

About Stottler Henke

Stottler Henke (www.stottlerhenke.com) creates and applies artificial intelligence and other technologies to deliver solutions for planning and scheduling, autonomy, knowledge management and retrieval, education and training, and machine learning and data analytics.

By combining cognitive modeling and knowledge engineering with symbolic reasoning and machine learning technologies, Stottler Henke solves problems that defy traditional approaches.

Learn More

We invite you to discover how Aurora can help you manage your operations more efficiently, possibly in ways you did not think were possible.

To find out how Aurora can help you obtain an unfair competitive advantage, call Rob Richards, Director of Aurora Strategic Solutions at (650) 931-2700, or send email to aurora@stottlerhenke.com.

Or, you can visit the Aurora website at www.stottlerhenke.com/aurora.



Spirit AeroSystems, Inc., the world's largest first-tier aerostructures manufacturer, leverages Aurora to schedule equipment, labor, and timing for large airplane component sub-assembly for a number of airplanes. The company builds several important pieces of Boeing aircraft, including the fuselage of the 737, portions of the 787 fuselage, and the cockpit section of the fuselage of nearly all of its airliners.

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