

The Role of Scheduling in Lab Orchestration: Driving Efficiency and Innovation

Efficiently managing workflows in modern labs is essential in life sciences, where the complexity of experiments continues to grow. As labs utilize more advanced instrumentation and generate increasingly vast amounts of data, effective scheduling and orchestration become crucial tools for ensuring success. While both processes are essential, understanding their distinctions and how orchestration elevates operations can redefine lab efficiency.

Artificial, an enterprise orchestration platform, is paving the way with a cuttingedge solution that integrates human roles, robotics, hardware, and software to create a seamlessly coordinated workflow. This article explores the distinctions between scheduling and orchestration, highlights the benefits of orchestration, and explains how Artificial addresses existing challenges with its innovative platform.

What Is Scheduling in Life Sciences?

Scheduling refers to the process of defining and managing the timing of specific activities within a lab. Historically, scheduling in the life sciences can be broken down into two primary levels:

- 1. **Device-Level Scheduling:** This is often the starting point, managing individual instruments such as liquid handlers. These schedulers dictate specific protocols for instruments—what tasks are performed, in what sequence, and when. While highly efficient for individual tasks, these systems are limited to managing one device or task at a time.
- 2. Work Cell-Level Scheduling: Labs with multiple devices integrated into purpose-built work cells rely on more advanced schedulers. These coordinate activities across instruments in the cell, ensuring seamless task handoffs between devices, such as moving plates between instruments with robotic arms. However, work cell-level scheduling is still bound by its localized scope and generally does not account for the broader lab environment or human roles.

While traditional schedulers focus on devices and work cells, they operate within static parameters and are disconnected from the dynamic and interconnected reality of modern labs. This is where orchestration plays a more significant role.

The Evolution to Orchestration

Unlike traditional scheduling, orchestration offers an integrated, real-time, and end-to-end approach to managing lab workflows. At its core, orchestration is a continuous optimization process that adapts to dynamic changes, integrates human actions, and provides a centralized view of laboratory operations.

Key Differences Between Scheduling and Orchestration

- **Broader Scope:** While scheduling concentrates on specific devices or work cells, orchestration considers the entire lab or even multiple labs. It oversees all interactions among people, robotics, instruments, and work cells, ensuring full workflow optimization.
- **Dynamic Replanning:** Orchestration is not static. When unexpected events occur, such as equipment malfunctions or priority changes, it dynamically replans and reschedules in real-time.
- Human Integration: Traditional scheduling systems often overlook the roles of humans in the process. Orchestration recognizes the critical role of lab technicians, integrating their tasks into the workflow to ensure seamless collaboration.
- Enterprise-Level Visibility: Orchestration provides a centralized, global view of all operations, connecting workflows across multiple labs regardless of geographical location. This enables researchers and managers to monitor the progress of complex experiments and make data-driven decisions.

Orchestration in Practice

Artificial's enterprise orchestration platform sets a new standard for labs at any level of automation. By sitting above individual instruments, work cells, and localized schedulers, Artificial provides complete visibility and optimization for all laboratory operations. Here's how it works:

 Continuous Workflow Optimization: Artificial's cloud-native platform intelligently coordinates workflows across instruments, work cells, and human roles. Its dynamic replanning capabilities ensure that disruptions like equipment downtime are addressed seamlessly without compromising efficiency.

- 2. **Human-in-the-Loop Integration:** Unlike traditional systems that exclude human roles from the equation, Artificial incorporates human tasks alongside automated ones. Technicians and researchers receive real-time guidance through digital workflows, which not only simplifies their responsibilities but also reduces error rates.
- 3. **Scalability Across Labs:** Artificial's platform connects multiple labs across geographically diverse locations. For instance, an experiment initiated in San Francisco can seamlessly continue in Boston, with full visibility into every step.
- 4. **Comprehensive Data Integration:** Artificial provides end-to-end connectivity across all systems. By integrating with any hardware, software, or Al algorithm, whether vendor-provided or custom-made, the platform ensures holistic visibility in workflows, data, and results.

Addressing Historical Challenges

Overcoming Fragmentation in Existing Labs

Many labs operate in environments where legacy systems, unconnected schedulers, and manual processes dominate. Artificial excels in these settings by digitizing and unifying workflows. For example, it integrates with existing laboratory information management systems (LIMS), electronic lab notebooks (ELNs), and instrument schedulers to create a complete end-to-end workflow.

Moving Beyond Static Scheduling

Traditional scheduling systems were typically static, unable to adapt to changes in real time. Artificial takes this a step further with advanced orchestration capabilities that dynamically respond to changing conditions, avoiding bottlenecks and optimizing workflows.

Why Orchestration Matters Today

Orchestration is critical for labs aiming to streamline processes, accelerate experiments, and stay competitive in the fast-paced life sciences industry. Benefits include:

- **Improved Efficiency:** By coordinating all lab activities, orchestration eliminates redundant steps and minimizes downtime, ensuring higher throughput.
- **Real-Time Decision Making:** The ability to dynamically adjust workflows in response to real-time data leads to more informed and agile decision-making.
- Enhanced Collaboration: Orchestration bridges the gap between instruments, software, and people, promoting seamless teamwork across all aspects of lab operations.
- Global Connectivity: Multilab orchestration gives researchers and managers a centralized view of operations, enabling them to monitor and optimize experiments globally.

Artificial's Value to Enterprise Labs

Designed for Flexibility and Integration

Artificial's commitment to interoperability sets it apart. It integrates seamlessly with any hardware, software, or AI algorithm, regardless of vendor or customization. This adaptability ensures that labs can modernize their operations without overhauling existing systems.

A Pioneer in Cloud-Native Orchestration

Artificial's cloud-native design supports real-time control and coordination across multiple labs. Its foundational technologies, including Python scripting and REST APIs, make it accessible and scalable for labs of all sizes.

Intuitive and User-Friendly

Artificial combines cutting-edge technology with a user-friendly interface. Its dynamic Gantt charts and Digital Twin visualization provide a clear and interactive representation of all lab activities, allowing users to monitor progress and make adjustments.

Unlock the Potential of Your Lab

From enhancing efficiency to seamlessly connecting labs across the globe, Artificial's orchestration platform transforms how work is done in modern labs. It delivers unparalleled end-to-end visibility and optimization by bridging the gap between devices, work cells, software, and human roles.

Take the next step in lab automation today.

Schedule a demo with Artificial and see how orchestration can transform your lab.

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