Flexible lab automation with mobile robotics

AMRs solve life science challenges while paving the way for continuous innovation

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WHITE paper

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Introduction

Life sciences play a critical role in improving humanity's future. Advancements in this field have led to breakthroughs in medicine, agriculture and environmental sustainability. To accelerate the pace of scientific discovery and find cures faster, laboratories are embracing automation. However, as research rapidly evolves and workflows change quickly, flexibility and user experience design become critical factors for automation success.

One promising solution that addresses these challenges is the use of autonomous mobile robots (AMRs). AMRs provide a flexible solution that adds value in changing work environments, fostering innovation.

This white paper explores the specific challenges facing life science labs, the inherent value of AMRs, and presents a real-world success story of how mobile robots have been integrated into lab orchestrations.

It will provide insights into the benefits and shed light on their potential to transform laboratory automation and accelerate scientific discoveries.

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The benefits of automation in the life sciences

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As the life sciences industry brings disruptive discoveries to the market, the pressure to find the next groundbreaking revolution grows.

Labs are often faced with a multitude of pressing questions, including:

- How to accelerate research?
- How to optimize research and maximize cost efficiency?
- How to screen out failures more quickly?
- How to miniaturize work to use resources more efficiently?
- How to mitigate safety and ergonomic risks?
- How to maximize the operational hours of equipment, ensuring continuous progress in research?

These types of questions can be largely addressed by incorporating automated solutions that help scientists keep research running smoothly and allow lab employees to be more productive with fewer repetitive tasks. This can be clearly seen in a study published in the Journal of Healthcare, which found that when comparing two similar labs, one adopting a total automation system and the other a discrete analysis system, the number of tests performed per single worker increased to an average of 1.4 and 3.7 times with total automation in clinical chemistry and serology sections, respectively.

Error reduction is another key benefit of automation. In addition to making repetitive yet error-prone research tasks the domain of machines, automation also makes it easier to work with tiny sample quantities for maximum efficiency. A paper published in the Association for Clinical Chemistry noted that following the installation of automation, error reduction rates exceed 70%, while staff time per specimen collection is reduced by over 10%. Patient safety is also increased by an average 50% reduction in specimen turnaround time directly attributable to automation.

Other research published in the Journal of Clinical Chemistry and Laboratory Medicine suggests that lab automation can yield an array of other benefits, such as lower long-term costs, decreased congestion in the laboratory, improved sample management and traceability, and improved quality of testing.

The unique challenges of automation within laboratory environments

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As research and workflows evolve rapidly, it's important to balance significant investments in automation with a focus on flexibility and user experience design. Otherwise, there is a risk that the automation investments may not be fully utilized.

Additionally, there are few standards in the lab automation space, and this often leads to challenges when connecting hardware and software solutions from multiple vendors to create automated systems that enable true walkaway time for the scientist. Frequently, automated tools are designed to manage one small step of the scientific process, accomplishing one task within the discovery process. But humans still must move samples between these individual tools to keep the research flowing. Accelerating research means finding ways to overcome these obstacles to still capture the advantages of using automation.

Autonomous mobile robots have emerged as a powerful solution for alleviating some of the significant challenges with lab automation by supporting flexible, 24/7 operations. With their ability to self-navigate safely through dynamic and peopled environments, AMRs can solve a wide variety of materials transport issues without requiring any factory modifications. Moreover, these mobile bases can be fitted with robotic arms to create a complete pick-and-place solution.

When it comes to materials transport, laboratory automation systems have long made use of robotic arms to pass precious samples between tools. However, the idea of placing a robotic arm on a mobile robotic base for flexible operations is a dramatic shift in lab automation space. AMRs free up scientists from doing time-consuming pick-ups and drop-offs throughout the lab, and humans and mobile robots can interact harmoniously in the same space at the same time whenever necessary.

Mobile robots allow scientists to lay out the lab workspace however they want, with

Enter the autonomous mobile robot: a flexible and modular solution

minimal spatial constraints. Oftentimes, AMRs can be integrated into an existing lab layout with minimal adjustments. This flexibility means that labs can more frequently and easily adjust their layouts as needed and have the robots adjust with them, eliminating the need to completely refactor the automation. For instance, a lab can swap an island or workstation with less downtime when utilizing a mobile robot. AMRs can even move beyond the lab, transferring materials into other buildings and even up elevators and onto other floors.

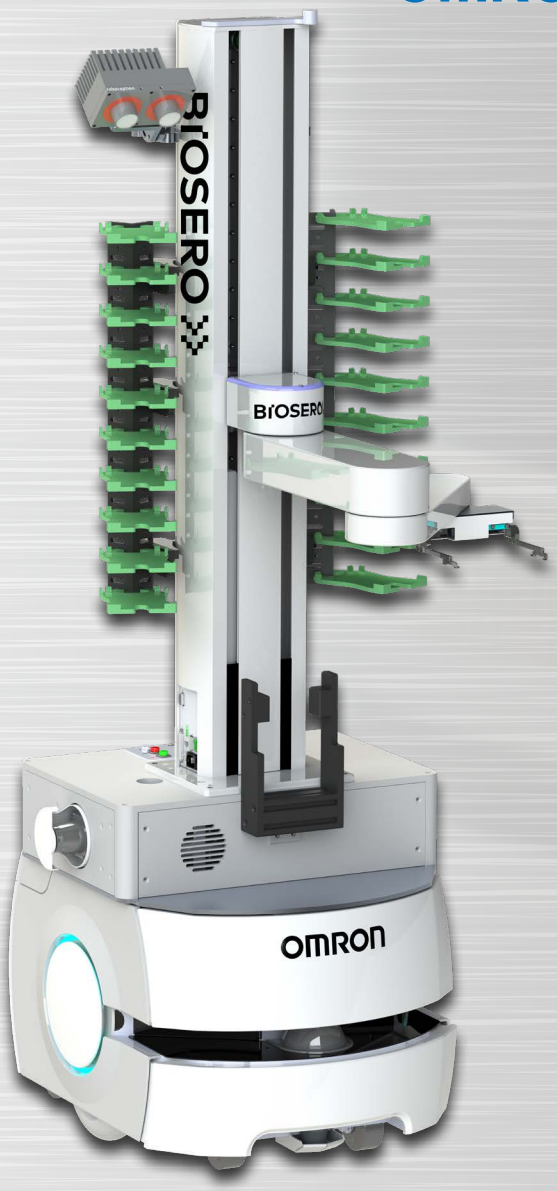
Additionally, scientists can leverage the equipment during the day while AMRs continue to work in the off-hours on "third shifts." Samples frequently need to be managed on a tight timeline, and basic disruptions in those timelines — like a scientist arriving late for a step — can jeopardize the research. By automating tasks and supporting them with flexible robotics, impacts to the schedule are minimized. Ultimately, AMRs help scientists reimagine what's possible in an automated laboratory or research campus.

Key features and benefits of AMRs

Autonomous mobile robots can operate safely in dynamic and peopled environments, bringing flexibility and round-the-clock functionality to the laboratory. Benefits include:

- **ISO 5 cleanroom protection.** AMRs can operate in environments sensitive to contamination.
- **Long runtime.** AMRs can operate for more than 12 hours on a single charge.
- **Automatic charging support.** AMRs can charge themselves automatically when not assigned to a task.
- **Natural feature navigation.** AMRs can navigate without facility changes and can easily adapt to obstacles in the environment.
- **Dynamic obstacle avoidance.** AMRs can predict the trajectory of moving objects to reduce the occurrence of standoff scenarios.
- **Fleet operation.** Users can control multiple robots together via a single interface while the fleet manager automatically picks the best-suited robot for a given task.
- **Lights-out operation.** AMRs can operate without lighting.
- **Quiet operation.** AMRs do not create distracting noise in quiet environments.

A mobile robot success story: Biosero's new solution with Green Button Go



Thanks to the flexibility they offer, new automation opportunities are being adopted by labs at the forefront of discovery. Biosero® is a global leader in the development of science-centric software and laboratory automation tools, and has been working closely with scientists interested in bringing mobile robotics into the lab environment. Biosero seamlessly integrated Omron AMRs with its Green Button Go laboratory scheduling software, leveraging the full potential of automation in their laboratory workflows. This robot-software pairing coordinates optimal path planning with clear directions regarding when the robots should pick up and drop off laboratory resources of any type. The AMRs that Biosero assembles and pairs with Green Button Go include a base to move the robot around the lab, a robotic arm to help with transportation of objects (like plates and consumables), and a series of sensors that help the robot prevent collisions with people and inanimate objects. Storage options are often attached to the mobile robot to facilitate the transfer of multiple sample plates at once.

The AMR solution allowed Biosero to support a global pharmaceutical company to:

- Efficiently change laboratory workflows
- Increase instrument utilization
- Eliminate redundant setups across lab facilities
- Identify new targets and more effective drug candidates
- Boost productivity
- Use time more efficiently
- Reduce costs
- Flexibility to shift priorities when needed
- Work on many different assays
- Evolve workflows efficiently

Ultimately, Biosero's investment in Omron AMRs and their successful integration with Green Button Go further solidifies their commitment to driving innovation and advancement in laboratory automation. The combination of Omron AMRs and Green Button Go has provided Biosero with a powerful automation solution that optimizes laboratory processes, streamlines workflow management and enhances overall efficiency.

The transformative power of Biosero's solution with Omron mobile robots

Biosero's solution pairing AMRs with their Green Button Go software allowed them to routinely and efficiently:

- Change laboratory workflows
- Increase instrument utilization
- Eliminate redundant setups across lab facilities
- Spend less on new equipment while getting more out of their current equipment

Ultimately, automation and the smart use of an AMR fleet helped a global leader in pharmaceutical development identify new targets and more effective drug candidates by:

- Boosting productivity
- Saving time
- Reducing costs

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Summary of mobile robot capabilities and benefits

For life sciences customers looking to implement a similarly flexible automation solution, the following is an overview of the value that Omron and Biosero's AMR system can provide in a laboratory setting.

- **Rapid deployment.** Mobile robots are simple to implement since they don't have to be bolted in place or set up next to lab equipment like conveyor belts. As long as the lab has a good internet connection, mobile robots can be installed and put to work quickly.
- **Scalability.** Mobile robots add next-level flexibility to a lab. They are an easy way to connect standalone devices in the same lab or across labs. Labs can also seamlessly increase or decrease the number of mobile robots working at any given time. Robots can be assigned to work exclusively on specific jobs or within specific labs.
- **Safety.** Mobile robots use internal sensors and cameras to navigate and work in the lab environment. With some careful planning, lab staff can work safely without worrying about robots bumping into them or their equipment.
- **Easy repurposing.** Priorities are constantly shifting, and scientific workflows frequently need to be adapted, but moving fixed lab equipment can be tedious and expensive. Furthermore, the process can risk damage to the instruments or components. With mobile robots, reconfiguring a workflow and repurposing instruments is easier than ever.
- **Simple integration with scheduling software.** If the lab already uses Green Button Go, there's no need to purchase separate software for new robots. The existing Green Button Go software can seamlessly integrate with the newly introduced robots, allowing for a smooth inclusion into the lab's established workflows.

Empowering people through automation

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Note: Specifications are subject to change.

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