8 Lab Automation Complaints PI's Get Wrong

From automation only being for high-throughput labs to manual pipetting being more accurate than liquid handlers, there are several misconceptions about lab automation held as truth among PIs. Here are the facts.

Written by
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INTRODUCTION

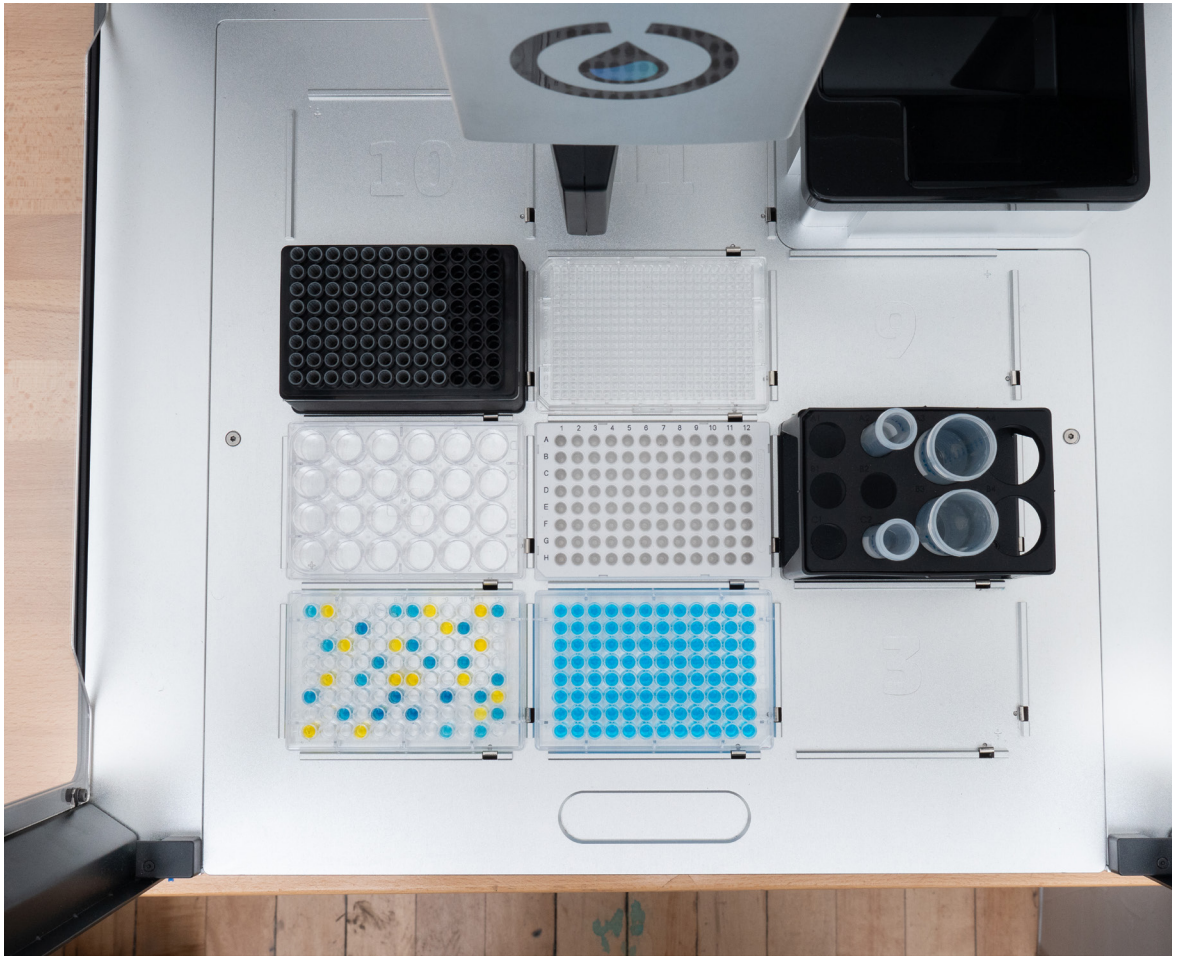
8 Lab Automation Complaints P.I.s Get Wrong—& How To Get Them Right

As a researcher considering lab automation, you're bound to be skeptical of the tools on the market. It's a big decision, and you won't really know if it works for you and your team until it's installed in your lab.

Plus, the manufacturers make so many claims: they say their tools are easy to use; they promise you won't need to learn complicated programming languages or spend hours on setup; they defend the tens (or even hundreds) of thousands of dollars you'll spend by insisting the time and effort you save will be worth it. It's a lot of information to process.

This book is aimed at researchers like you who want to save time and money while increasing the productivity of your staff and the quality of your lab. We know your goal is to focus on experiment design, data analysis, writing, and publication.

We've spoken to dozens of researchers who have asked the same questions and expressed the same concerns you probably have about lab automation—and we've worked to demystify the most common misconceptions so you can make an informed decision.



OBJECTION 1

"We don't do enough pipetting to invest in an automation tool."

SCENARIO

A researcher in the department of pediatrics at an academic research center builds next-generation sequencing libraries. She is the only person in her lab pipetting, and she doesn't think she moves enough liquid to invest in a liquid handler.

REALITY

Not all labs need automation—and automation isn't just for high throughput labs.

In 2020, liquid automation tool prices range from $5,000 to more than $120,000. That means that labs running fewer than five hours a week of wet lab work likely won't be able to justify the cost of an automated liquid handler.

The best way to determine if an automated liquid handler can benefit your operation is to calculate how much time pipetting takes in your lab. Include all pipetting steps, the logistics of moving samples to and from equipment, time to adjust plates and labware, and even interruptions and distractions in workflow. Many labs underestimate how much bench time they spend on these tasks, undercounting how frequently tedious tasks such as prepping a PCR plate, doing a DNA extraction, and plating cell media are done on a daily, weekly, monthly, and even yearly basis.

If all this time totals five hours a week or more, then automation can save you time, increase the productivity of your lab staff, and make time for more intellectual lab work like data analysis and experiment design.

Some liquid automation tools are engineered for low- and medium-throughput workflows. Systems such as these offer opportunities to labs that wouldn't otherwise have them, and give labs the opportunity to experiment with the efficiency of lab automation without budgetary constraints.

OBJECTION 2

"Liquid handlers don't get used often—and that's money wasted."

SCENARIO

A principal investigator plans to expand the number of researchers in her academic lab, but is hesitant to purchase a liquid handler because it might not be used.

REALITY

Most laboratory equipment sits idle most of the time. But it's not the fault of any individual liquid handler; it's often just the nature of the industry.

Why might lab automation tools go unused? As many as 25 percent of labs using these tools are engaged in highly complex projects that take time to activate, and labs may not have the time to set up these tools. Also, some automation solutions are only set up to do one protocol, making it difficult or even impossible to switch applications when needed by the lab. Other tools are so complicated that only one or two members of the lab have the expertise to use them, causing all lab members to rely on those few to keep the tools running. And, frankly, some workflows just can't be automated, which is a tough reality to accept after a robot is gathering dust in the lab.

But in general, most labs that purchase a robot can successfully run their desired protocol. Some vendors even offer such a comprehensive setup process that labs are up and running within 30 days of receiving and setting up the tool and its accessories. In contrast to past products and protocols, which were too difficult or expensive to modify, many platforms today are remarkably flexible and open, allowing easy customization and the automation of multiple protocols.

Innovative manufacturers are offering versatile apps, support, and dedicated account managers so bench scientists don't have to become equipment tech experts—they're free to do what they do best. And researchers who first establish that their workflows can truly be automated are well-positioned to take full advantage of such a helpful, time-saving tool.

Indeed, labs that are the most successful with liquid handling automation have learned that incorporating a robot into their protocols increases efficiency, consistency, and reproducibility. They learn how to set up, calibrate, and program the tool, and they find optimal ways to use it in multiple workflows to derive even greater value. Because, with the right tool for their lab, the members of the research team quickly realize that upfront time invested learning the tool will pay dividends for the entire lab.

OBJECTION 3

"Manual pipetting is more accurate than a liquid handler."

SCENARIO

The chief scientific officer at a therapeutic biotechnology company is diluting her samples before purifying the isolated DNA samples. She has been pipetting for more than a decade with relatively reproducible results, and does not want to lose that accuracy by using a liquid handler.

REALITY

Manual pipetting *is* more accurate than a liquid handler… but only if the operator uses the exact same technique every single time without making a single mistake. Because even the most skilled bench scientists make mistakes, the comparison between manual and robotic pipetting accuracy isn't realistic.

That said, while a few liquid automation tools can accurately and consistently pipette at sub-microliter volumes, generally for volumes lower than one microliter (1µL), manual pipetting is recommended.

Even when used for larger volumes and properly calibrated, liquid handler pipettes can fail to yield consistent results—but that is typically due to manual errors in calibration or protocol input. Poor technique, usage outside the pipette's range, inaccurate volume selection, and fast or careless aspiration and dispensing can all cause unfavorable results.

For some researchers, the mere possibility of inaccuracy in a workflow prevents them from pursuing automation. Researchers who have invested significant time designing workflows that require manual pipetting often feel comfortable with those workflows. They know their manual pipetting gets the job done, and they would prefer to avoid the discomfort and uncertainty that comes with learning how to automate.

But a quality automated liquid handler can achieve most of the nuances of manual pipetting, including speed, volumes, aspiration settings, tip positions, incubation times, pause steps, tip touch, and blowouts—every single time. Once the tool is properly set up and calibrated, human error decreases, and the speed, accuracy, and reproducibility of conducting experiments increases.

Additionally, an automated liquid handling robot causes fewer repetitive strain injuries for your staff, and decreases their exposure to hazardous materials used in certain experimental protocols, further improving both productivity and morale in your lab.

OBJECTION 4

"Liquid handlers are too complicated to incorporate into my lab."

SCENARIO

A senior researcher at a cancer research center studies tumor immunology. His team is considering a liquid automation tool to automate qPCR preps, but he is concerned because most liquid handlers on the market will be very complicated to incorporate.

REALITY

Any lab automation will require upfront investment, but you can find automation partners who are committed to not only working with your lab, but helping you incorporate the technology to succeed.

It's true that many liquid handlers are based on complicated, decades-old designs that require installation and training from the manufacturer, and highly technical skills to set up.

In contrast, newer liquid handling robots tend to be designed around the user experience. You can install them. You can set them up. You can control them. You can learn how to use and integrate them into your workflows. You might even be able to get your protocol up and running within 24 hours. All by yourself.

While that may sound daunting, you're not alone: some new vendors have a 60-day, no-risk, no-questions-asked return policy to give you the opportunity to experience how the automation solution actually works in your lab. They may also offer other tools or packages to help you get your feet off the ground, including prebuilt protocols and applications for standard wet lab operations, bundled workstations with verified protocols and reagents, drag-and-drop protocol designing software, and even a customized protocol development service for more complex workflows.

It's never fun being promised something easy and discovering it's quite the opposite. Automation does require some front-end labor, but the right robot will quickly repay your initial investment and become a valued, seamless, stress-free member of your team.

OBJECTION 5

"Liquid handlers require too much time to set up and learn to use."

SCENARIO

A senior researcher at a genomics company has designed a multi-step protocol that uses PCR to amplify DNA from patients. It is precise and tailored to the lab, and the researcher needs to ensure that any automation equipment supports that protocol. Sticking with the manual process just seems easier.

REALITY

Saving time can be the most valuable benefit of liquid handling automation—but those time savings only happen after the tool is set up and calibrated.

While some researchers are eager to automate their workflows because they believe a liquid handling robot will do all their pipetting for them, automation is not a magic wand. It takes time to determine how to add automation to workflows, learn the tools, and fine-tune your protocols. At first, it may very well feel difficult and complicated.

But once it's correctly integrated into your workflow, an automated liquid handler allows for greater accuracy at each liquid handling step because it minimizes human errors. It increases throughput and enables efficient workflow scale-up. It also gives you an accurate record of exactly what happened to your samples during your experiment, facilitating much more sophisticated analyses.

> **"I thought the whole [setup] process was easy... fantastic... Really, really impressed."**
>
> **– Tom Huckvale, YouSeq**

Once you and your team are no longer tediously pipetting for days on end, you'll be running more accurate, repeatable experiments. That should free up time for you to focus on designing new experiments, reviewing data, writing papers, or even attending those conferences you've been eyeing.

OBJECTION 6

"I must learn programming to use a liquid handler."

SCENARIO

A microbiologist in an industrial pharmaceutical lab runs ELISA assays as part of his drug discovery workflow. It takes 12 hours and is tedious and painful on his hands and back, so he'd like to automate, but he doesn't have coding experience or time to learn.

REALITY

Today, liquid handling automation solutions range from proprietary systems that require an on-site technician, to open-source, easy-to-learn tools, to more sophisticated options for those who just love to code.

Let's take a look at each type of system.

Proprietary systems can offer software that is easy to use, but most do limit you and your lab to the manufacturer's preferred programming solutions—meaning, you may indeed need to learn a programming language that only works with that tool, or call in the vendor's tech support team. That's not ideal.

Instead, the liquid handler you choose should have straightforward technology that meets users at their skill level. If a researcher wants the vendor to create a custom protocol for them and upload it to their liquid handling robot, that should be an option. If the researcher wants to modify an existing protocol created by another researcher, that should be easy to do. Since most liquid handling robots come with drag-and-drop protocol creation tools designed to work like iPhone apps, both of these options should be easy to find. However, if a researcher is familiar with automation and wants to make custom modifications to the robot or its software, then they need a system built on an open-source platform.

Open-source liquid handling systems offer user-friendly protocol design software that also doesn't require learning a complicated programming language. Some manufacturers give you access to a community library of shared, standardized protocols that are easy to understand and replicate. Open-source systems are best for scientists who have bandwidth to learn new tools, are comfortable tinkering with machines and software, and understand that an investment in learning will save time, decrease errors, and increase reproducibility.

Of course, advanced protocol development options should also be available for folks who are more comfortable using coding languages such as Python.

So while you certainly will need to learn to set up, calibrate, and program your liquid-handling robot, you won't need to spend time becoming an IT expert to enjoy saving time and achieving reproducible, consistent results that make your lab a more competitive player in your industry.

> **"The robot frees my hand. I don't need to be occupied by the ELISA, I can set it up and go. I can do other stuff, more efficient work, and just do the ELISA on the side. Before, I had to leave one day for one ELISA run. Now, I just do it on the side and do other work as well. It saves my time."**
>
> **– Annabelle Shang, MilliporeSigma**

OBJECTION 7

“One lab automation tool can’t run multiple protocols.”

SCENARIO

A scientist at a genomics company has created a serial dilution protocol using an automation tool. Others in her lab have developed a multi-step PCR prep protocol. The lab wants to automate both protocols on the liquid handler.

REALITY

Protocol turnover happens. Many research labs change and add experiments from month to month, and liquid handlers can be shared by multiple researchers who need it to run their own customized workflow.

Often, a lab will invest in a liquid handler with a particular application in mind. After the first protocol is completed, or even while it is still running, lab members realize they are benefitting from less human error, more consistency, and a decreased chance of contamination or sterility issues. They decide they want to execute other protocols on the same robot using different sample counts or kits, or changing other parameters.

This requires uploading a new protocol, labware definitions, and deck layout to the liquid handling robot, and that can feel daunting. Every protocol involves setup, optimization, and the uncertainty involved with trying something new. But just because the setup doesn’t work immediately doesn’t mean it isn’t possible; in fact, running multiple protocols is exactly what the right liquid handling robot can and will do for you.

Some liquid handler vendors do require that you call—and wait for—a technician to help you change your protocol. If you’re a large lab running many protocols and you can afford the wait time to get back up and running, that might be acceptable. But it can still be frustrating to rely on someone else to set up or reconfigure your own experiments.

However, most liquid handlers today are designed around the reality that you will change the direction of your research. That’s how science advances. So manufacturers are now building robots that are simple to program and sterilize, with multiple types of disposables available. They make it easy to switch protocols and run new workflows in-house without tech support, while also offering protocol development services to help keep things moving.

As opposed to handling liquids manually, automation gives you much more flexibility to tweak your protocols every day. Just like any other tool, when you learn how to use it, you won’t be limited by it—you’ll grow with it. Once you’ve set up a new protocol, all you have to do is sterilize, load the new settings, put the labware and samples in the same slots, and you’re ready to go. Even if it takes time to switch your protocols, robotic automation reduces user error and contamination, improves repeatability, and gives you the unique ability to collect more data with new, high-throughput work.

OBJECTION 8

"Liquid handler vendors don't respond to customers."

SCENARIO

A scientist at a synthetic biology company using E. coli for industrial purposes was considering a liquid automation tool to accelerate the screening of colonies, but hit a roadblock when tech support fell short of expectations.

REALITY

Every liquid automation tool company offers different levels of support, and not every type of support will work for every lab. You need to partner with the vendor who will be there for your team when you need them.

Just as with any other purchase, service levels after the deal is closed can vary greatly. Some vendors will send a technician to help you set up. They may provide regular in-person and online service visits, as well as technician visits when you need help. When you modify or start a new protocol, their techs might be available 24/7 via phone, email, in-app chats, and videoconferencing. Some vendors even offer a 100 percent, no-risk refund for any reason within 60 days of purchase.

Before you decide to make your lab automation tool purchase, do your research and explore the support options offered by reputable vendors.

Request a referral to speak to a customer whose lab is comparable to yours, and ask about both the tool's functionality and the vendor's service reality. And here's a tip—send an inquiry or call the vendor's support team during off-hours. The responsiveness may surprise you... and give you a good idea of what to expect moving forward.

> **"Extremely easy to program and operate, and the suppliers are very helpful in helping to solve challenges. Very quick responses and seem eager to help."**
>
> **– Anne Kroll Kristensen, Novo Nordisk**

APPENDIX

About Opentrons & Special Thanks

Opentrons makes robots for life scientists. Our mission is to provide members of the scientific community with a common platform to easily share protocols, reproduce each other's results, and affordably increase their productivity. Our robots automate manual experiments, allowing our community to spend more time pursuing answers to the 21st century's most important questions.

We designed the Opentrons OT-2 liquid-handling robot with and for researchers to deliver a full range of uniquely valuable benefits:

- **Easy to Afford:** The starting price for an Opentrons OT-2 pipetting robot is $5,000—an investment that can be quickly recovered with time saved in the lab.
- **Easy to Set Up:** The Opentrons OT-2 arrives ready to work; just grab an Allen wrench and screwdriver for assembly. Nearly 70 percent of Opentrons customers are new to automation, and most report they've assembled and calibrated their OT-2 within an hour. 80% are up and running in 30 days or less.
- **Easy to Program:** The OT-2's intuitive, drag-and-drop, open-source Protocol Designer requires no programming knowledge and allows users to build end-to-end protocols. Users can also download an existing protocol from our Protocol Library featuring hundreds of protocols created by our customers. Users who prefer to program from scratch can use our Python API built around an easy-to-learn but powerful programming language. Users can also request a custom protocol from an Opentrons Applications Engineer.
- **Easy to Change Protocols:** It's a snap to program, sterilize, and use a wide variety of consumables, reagents, and verified labware with an OT-2.
- **Easy to Get the Best Support in the Industry:** At every step, the Opentrons Support Team provides online, phone, and video support. Customers who need help with more complex questions can open a ticket and get support within 24 to 48 hours.

If you're thinking about how to automate your lab, or if you have questions we didn't address, we invite you to email us at info@opentrons.com.

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