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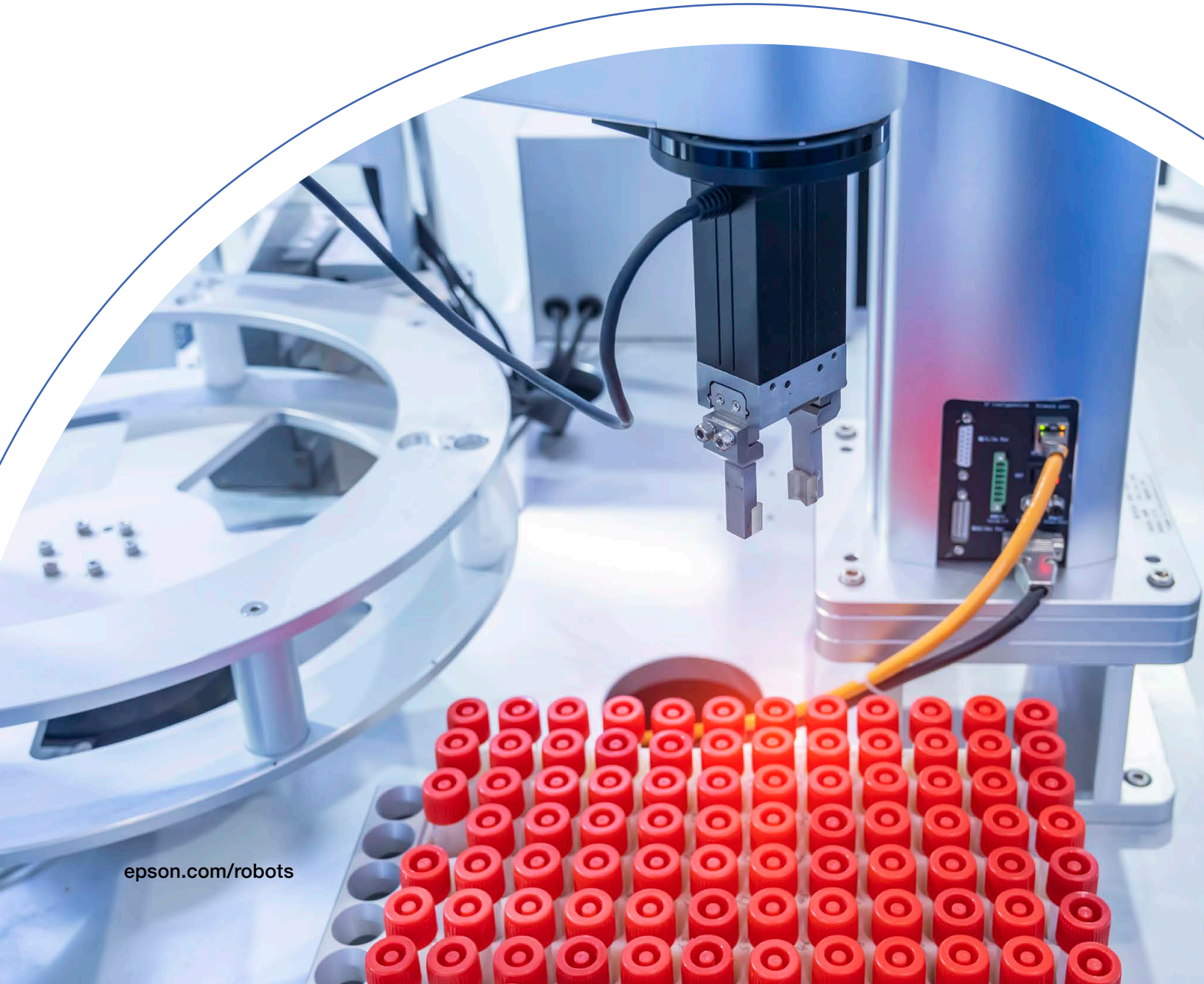
The Top 5 Laboratory Automation Pitfalls— and How to Avoid Them



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Automating routine life sciences lab tasks helps researchers and lab managers save time and reduces the risk of human error. But workflow, process, and team member mistakes can cause problems that may be costly — both in money or effort — to resolve.

Knowing these pitfalls before you begin your lab automation project makes a world of difference (and can save your project from expensive delays). That's why the experts at Epson are sharing the most common life sciences lab automation mistakes, learned from our 40+ year heritage of robotics development.

On the pages that follow are the top five life sciences lab automation pitfalls — complete with quick tips to combat them — and an actionable automation checklist to help you avoid those mistakes in future projects.

The top 5 life sciences lab automation pitfalls

1 Lack of **flexibility**

You can adapt your processes to changing requirements, conditions, and parameters with lab automation flexibility. Flexibility (such as modular designs or multi-purpose instruments) gives you the opportunity to change processes, multi-task, scale, future-proof, and stay competitive in a rapidly changing scientific landscape.

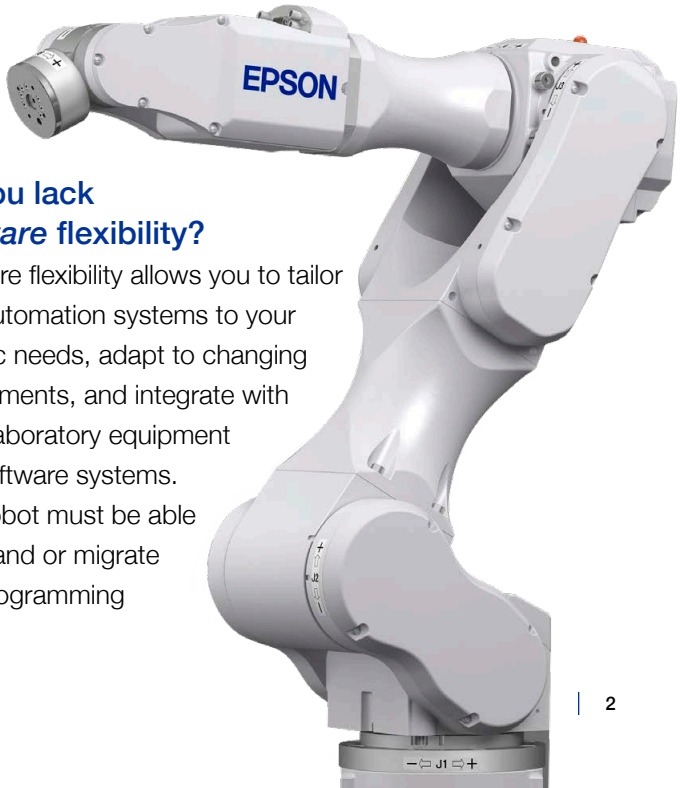
Suppose you don't build flexibility into workflows, processes, and software. In that case, you run the risk of not being able to adjust based on new information or process changes — which means you run the risk of not obtaining accurate and meaningful results. That might result in obsolete automation that needs to be replaced.

> Two of the most common flexibility pitfalls are **scale flexibility** and **software flexibility.**

Do you lack *scale* flexibility?

Scaling is key in lab sciences automation — if you can't translate your product from bench to bedside, you won't have a product. On the other hand, if you have scale flexibility, your systems can be used across multiple applications and sample sizes, helping to increase their overall value. It also can reduce the need for additional costly equipment and the investment in team time setting it up.

Epson Quick Tip: From the very beginning of the automation process, consider how your equipment will be able to adapt through each stage so you can get the most out of it.



Do you lack *software* flexibility?

Software flexibility allows you to tailor your automation systems to your specific needs, adapt to changing requirements, and integrate with other laboratory equipment and software systems. Your robot must be able to expand or migrate to a programming

language and a development environment. You might have a great software solution but, if you lack software flexibility, you may not be able to put that code into a robot, potentially rendering it worthless (and costing time and money).

Epson Quick Tip: Make sure your robot can communicate with external devices and different systems to optimize workflows and processes such as scheduling and dispensing.

2

Poor **traceability**

Traceability allows you to accurately and reliably document your entire lab automation process, from sample preparation to data analysis. It also ensures you can track and verify all data, providing a clear chain of custody. In projects that lack proper traceability, you run the risk of errors, inconsistencies, or even inadvertent non-compliant activities in your lab automation.

> One of the most common traceability pitfalls is **untraceable process steps.**

Are any steps in your processes untraceable?

Regulatory agencies such as the Food and Drug Administration (FDA) require traceability to ensure safety and quality standards compliance. Your lab must demonstrate that your procedures meet these standards, and traceability provides the necessary documentation.

Traceability also provides a way to track changes you make to experiments, allowing for transparency and accountability in the scientific process. This means keeping an audit log so you know who, when, or what made code or parameter changes for regulatory compliance. If any step in your process is untraceable, you may have to re-certify your automation system, which may result in significant financial and time loss.

Epson Quick Tip: Hire an automation expert to audit the FDA paperwork to help ensure regulatory compliance.

3

Not thinking about **reliability**

Lab automation systems must be reliable to justify their financial and time investment. If a system requires frequent maintenance or replacement, it can disrupt ongoing research projects and lead to additional costs.

> Two of the most common reliability pitfalls are **system/equipment reliability**, and **vendor partnerships.**

How long does this system need to run? Do you understand your equipment's reliability?

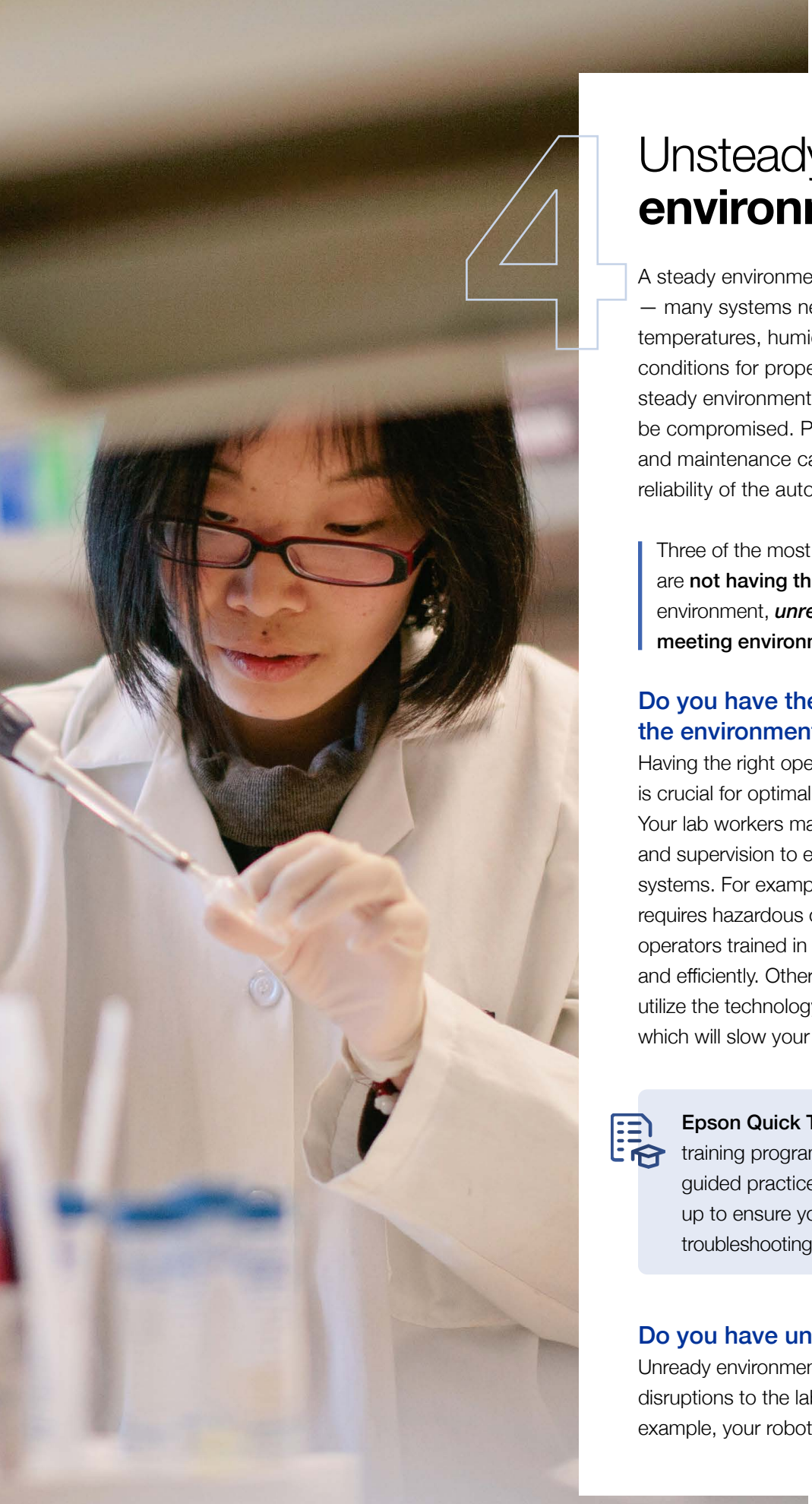
The reliability of your lab system and equipment determines your return on investment. Once you're through certifications, you'll need to produce your product or results consistently. A more reliable system reduces the frequency of maintenance and replacement, which can disrupt experiments and cost you a great deal of time.

Have you considered your vendor partnerships?

The right vendor will provide technical support, equipment maintenance, and upgrades and updates, all of which help contribute to the reliability of the lab automation system. It's important to know whether or not your vendor partner has worked in your vertical before and their level of expertise so you can scale your processes and be traceable. For your robot to run reliably, your vendor partner needs to support you for the lifetime of your workcell — for your robot to last 10 years, your vendor partner also needs to last 10 years. Otherwise, you run the risk of having to start the process over with a new vendor at a significant time and financial cost.

Epson Quick Tip: Choose a vendor that is at the forefront of advancement so you get the most innovative system or equipment updates and upgrades.

Epson Quick Tip: Part of planning for reliability is ensuring your robot has the tools it needs to run effectively throughout its entire life cycle. Epson robots monitor conditions to give you insight into system performance. These insights help make sure that the system stays consistent and reliable during every operating cycle.



4 Unsteady **environments**

A steady environment is critical to lab automation — many systems need to maintain certain temperatures, humidity levels, and/or lighting conditions for proper functioning. Without those steady environmental conditions, your results may be compromised. Proper equipment calibration and maintenance can also affect the accuracy and reliability of the automation process.

> Three of the most common environmental pitfalls are **not having the right operators** for the environment, ***unready* environments,** and **not meeting environmental requirements.**

Do you have the right operators for the environment?

Having the right operators for a specific environment is crucial for optimal and safe automation systems. Your lab workers may need certain expertise, training, and supervision to effectively operate robotics systems. For example, in a lab environment that requires hazardous or sensitive materials, you need operators trained in handling those materials safely and efficiently. Otherwise, you may not be able to fully utilize the technology or optimize your lab processes, which will slow your automation.

Epson Quick Tip: Don't skimp on your training program. Create one that includes guided practice, informal testing, and follow-up to ensure your team's expertise using (and troubleshooting, if need be) the robotics system.

Do you have unready environments?

Unready environments can cause delays and disruptions to the lab automation process. For example, your robot may require a washdown

environment (typically used in unwrapped food transportation lines) or a clean environment (often used for pharmaceutical production); if the environment isn't properly prepared or set up before beginning the automation process, you'll waste time and resources adjusting as you go.

Epson Quick Tip: Start by considering your robot's physical workspace. What is the size and layout of the area? Are there any potential obstacles? Does it have the infrastructure you need (remember to consider power outlets!)?

Have you considered environmental requirements?

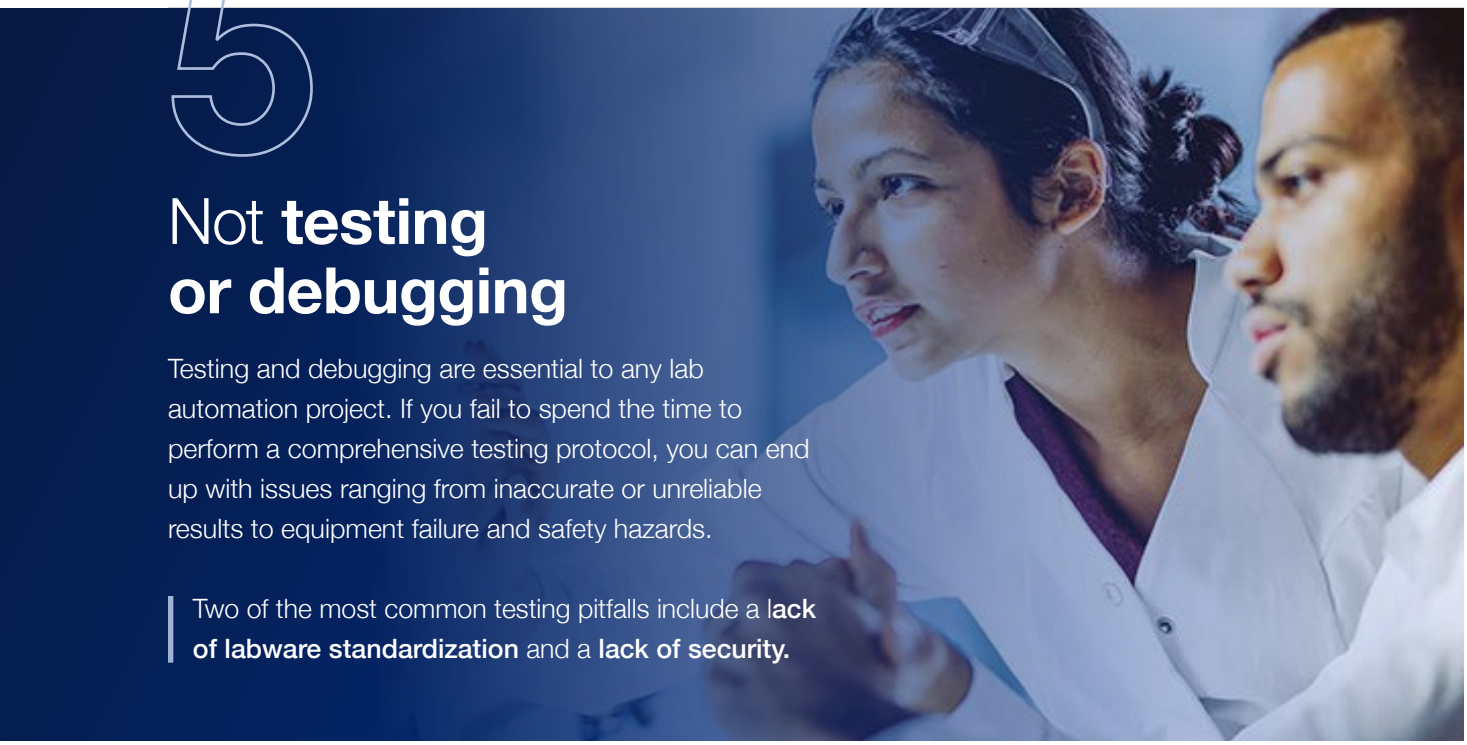
When implementing your lab automation, you must consider the relevant regulations and guidelines. These may include certain environmental requirements from the FDA, the International Organization for Standardization (ISO), and the Association for the Advancement of Medical Instrumentation (AAMI).

For example, vaporized hydrogen peroxide (VHP) is a commonly used sterilization method in the healthcare and pharmaceutical industries; the FDA has issued guidelines for using VHP in medical device sterilization. Any lab automation system that uses VHP must comply with these guidelines to ensure the safety and efficacy of the sterilization process. If regulations aren't met, you may see delays in the approval process, additional costs, and the need for further testing, which will slow down your automation process.

Epson Quick Tip: If you're in healthcare or pharmaceutical lab management, put an expert in charge of environmental regulations at the outset so you're compliant with safety and quality standards.

5

Not **testing or debugging**



Testing and debugging are essential to any lab automation project. If you fail to spend the time to perform a comprehensive testing protocol, you can end up with issues ranging from inaccurate or unreliable results to equipment failure and safety hazards.

> Two of the most common testing pitfalls include a **lack of labware standardization** and a **lack of security.**

Do you lack standardization of labware?

Different vendors' labware can range in size and shape. Automation equipment must accommodate these variations. For example, a robot's gripper should be capable of programmatically adjusting to different sizes of trays or vials. If your equipment can't handle labware variations, you may encounter process inefficiencies, broken equipment, or costly modifications further in the process.

Epson Quick Tip: Rather than using hard-tooled equipment that's suitable for one type of labware only, plan for variability among components to prevent delays.

Do you lack security?

It's critical to implement security measures on your robot to protect sensitive data, prevent tampering, ensure safety, and comply with regulations. Any tampering with the robot or its programming could compromise the accuracy and reliability of the project's results, leading to delays or additional accrued costs.

Epson Quick Tip: Implement access control, encryption, and other forms of security to protect sensitive data from unauthorized access, modifications to the robot's programming, or theft.

Your 4-step checklist for avoiding robotics automation pitfalls

As we've seen, five robotics lab automation pitfalls can lead to significant loss — both financial and time — for life sciences labs. Fortunately, you can avoid many of these mistakes by creating an automation strategy in advance. Follow this four-step checklist to craft your own strategy:

1

Create a plan

- **Define clear goals, objectives, and requirements** for your lab automation. With a clear plan in place, you can more accurately select the right robot for your needs.
- **Identify and select the appropriate equipment and technologies.** Make sure everything used — such as labware — is compatible with your robot to minimize mistakes.
- **Develop standard operating procedures** for carrying out automated processes. Consistency and repeatability improve the accuracy and precision of your results.
- **Offer adequate staff training and support.** You'll reduce human error and improve the efficiency and effectiveness of your lab.

2

Start automating

- **Identify and address potential issues** *before* they become problems. Test the functionality of your equipment, software, and processes, and note areas that require further optimization.
- **Make sure all equipment, software, and processes are compatible.** This can help avoid future problems, such as a robot that can't read barcodes.
- **Monitor your lab automation's performance** to identify possible improvements. Optimizing the system over time keeps it effective and efficient.

3

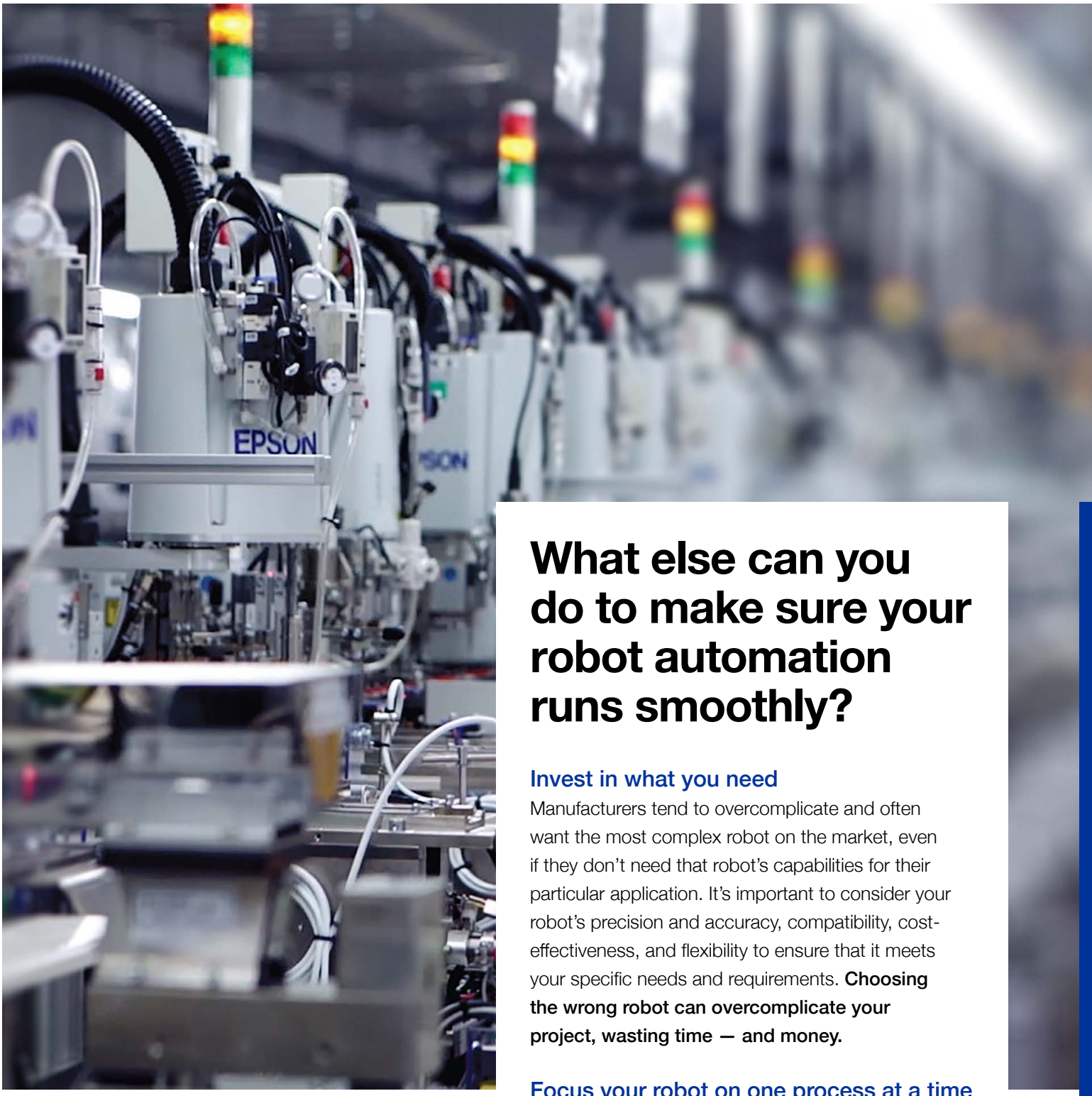
Analyze and measure your results

- **Test and calibrate your equipment** frequently to identify potential problems. Keep an audit log and note any document or process changes.
- **Look for data patterns and trends.** You may be able to identify anomalies that could be the result of faulty equipment or processes.
- **Try to identify the root cause** in the event of a problem. Analyzing data and measuring equipment performance can help you find the issue and take corrective action to avoid similar pitfalls in the future.

4

Adapt as needed

- **Create a more flexible process.** By designing systems you can easily modify — to accommodate new instruments, workflows, or use cases — you can adapt to necessary changes without disruption.
- **Reduce workflow complexity** to help minimize errors. For example, integrate lab instruments with data management systems to help ensure the accuracy and reliability of your data.
- **Identify bottlenecks and inefficiencies.** As you find areas that need improvement, make changes to optimize your processes.



What else can you do to make sure your robot automation runs smoothly?

Invest in what you need

Manufacturers tend to overcomplicate and often want the most complex robot on the market, even if they don't need that robot's capabilities for their particular application. It's important to consider your robot's precision and accuracy, compatibility, cost-effectiveness, and flexibility to ensure that it meets your specific needs and requirements. **Choosing the wrong robot can overcomplicate your project, wasting time — and money.**

Focus your robot on one process at a time

Robots are flexible machinery, so lab managers often gravitate toward having one robot perform several processes — for example, pipetting and microplate handling. But this tends to be the wrong way to automate. **Dedicating a robot to a singular process is usually more efficient and more accurate.**

10 applications for our robots

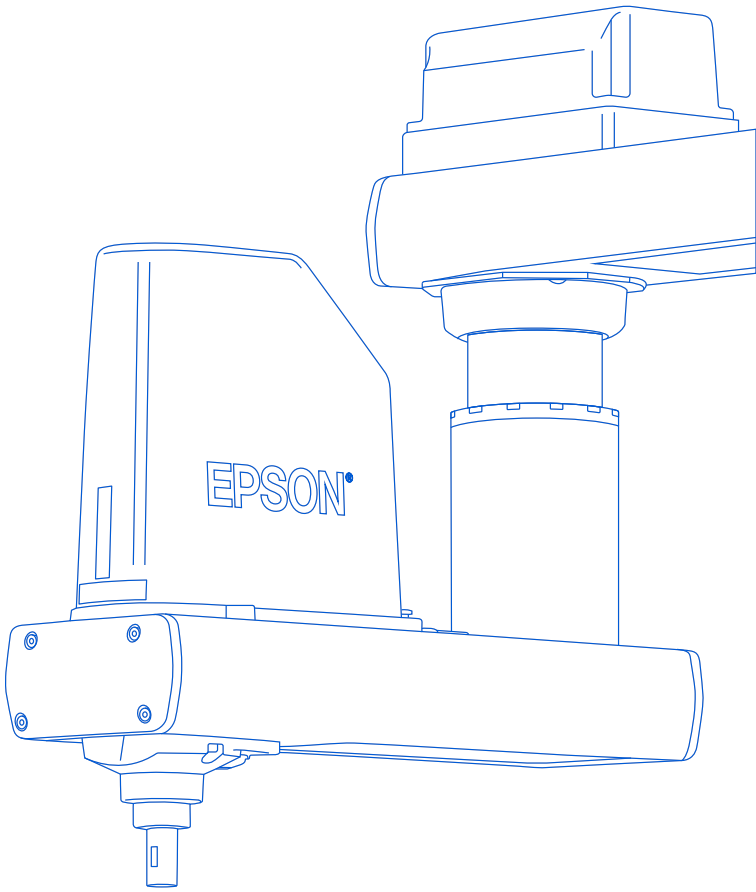
One more lab automation pitfall to keep in mind is forgetting about the myriad of applications for robots that can help you save time — and money — in ways you may not have considered. The world's top manufacturers rely on our robots for everything from assembly and dispensing to lab analysis and packaging. **These are just a few of the application possibilities for our robots:**

- Drug discovery
- Genomics
- Lab sample management
- Cell-based assays
- Clinical testing
- Cell culture automation
- Protein purification
- Blood testing
- Precision vial dispensing
- Test tube handling and packaging

10 questions to ask that might improve your lab automation

Before starting any automation project, you should know the **answers to these 10 questions:**

1. Why and what do I want to automate?
2. How is my automation going to scale?
3. What are the requirements of my lab and regulators?
4. What are my environmental considerations?
5. Has the product I'm using gone through FDA approvals in the past?
6. Have my vendors worked in this vertical before?
7. What type of robot is best suited for my application?
8. What would this robot be capable of doing?
9. Do I need my robot to communicate with peripheral devices?
10. Will I be able to know the life cycle of a product or part through the entire automation process?



Considering automation?

The Epson Robots Applications team can provide insight and help you answer your automation questions.

Let us help you find the right solution for your project or application. Give us a call at **1(562)-290-5900**. Or visit **epson.com/lifesciences** today.

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