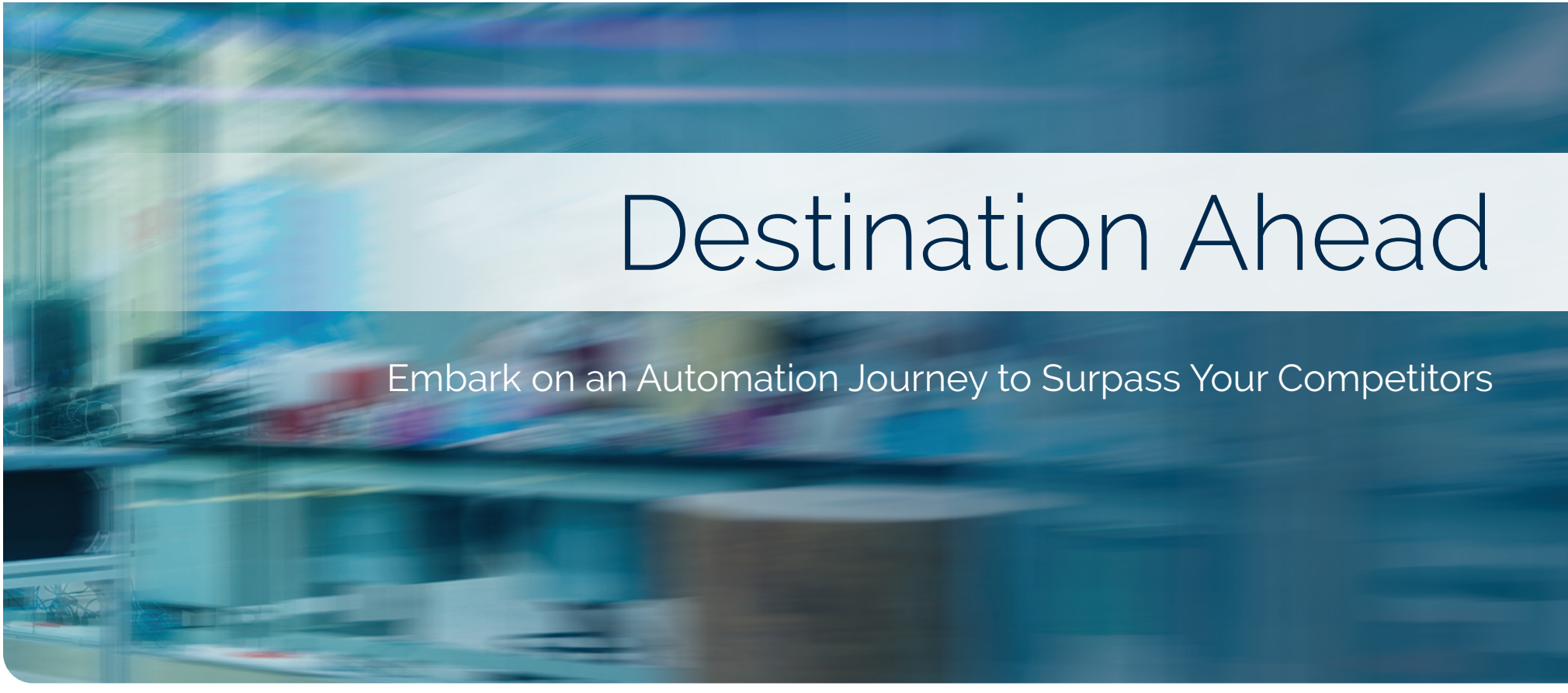


Destination Ahead

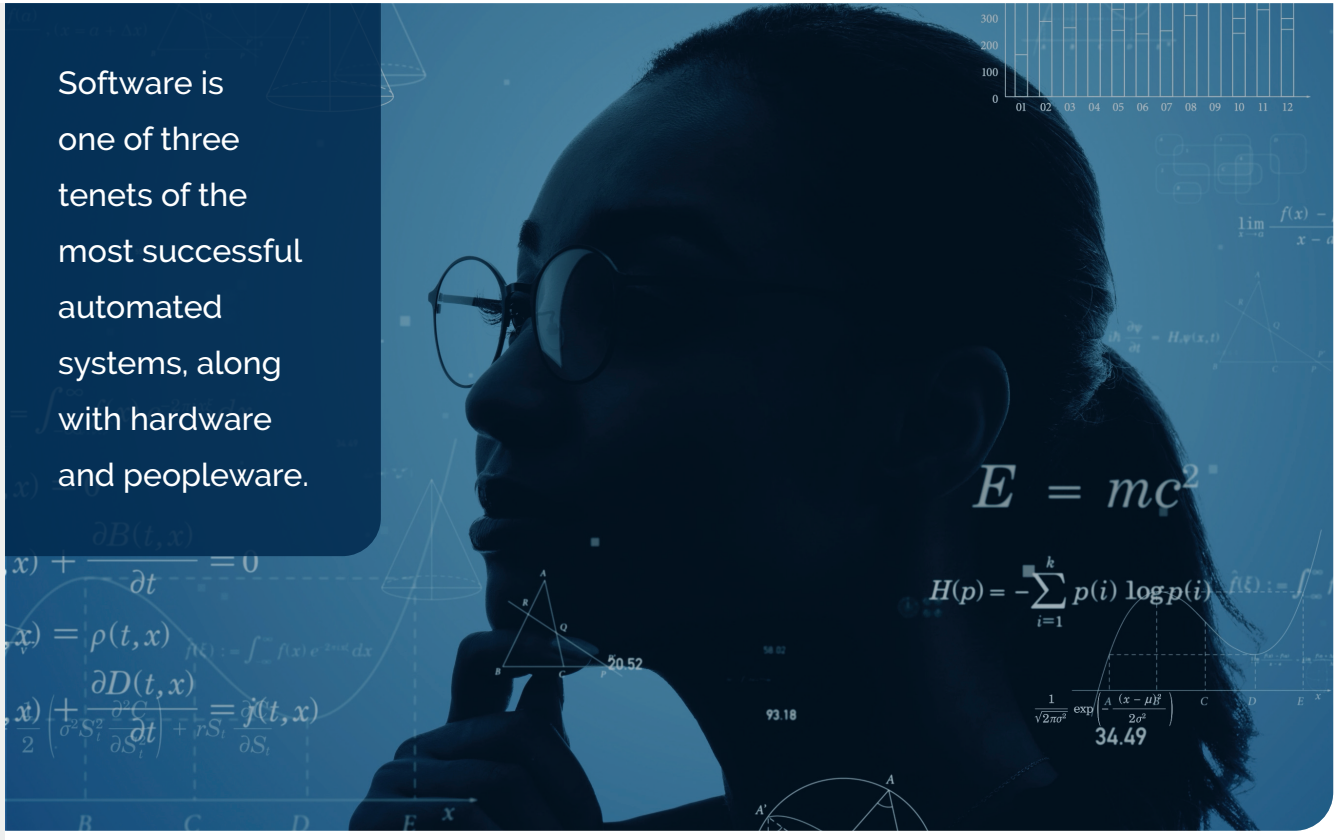
Embark on an Automation Journey to Surpass Your Competitors

HighRes® biosolutions


The Need For More

In our previous Destination Ahead e-books, we covered your need to outpace your competition to achieve your vision, and how to start planning for your journey. With the plan and team in place, we explored the world of hardware devices, including automated liquid handlers (ALH).

The next destination on your journey is the rapidly evolving world of software. Software is one of three tenets of the most successful automated systems, along with hardware and peopleware.



So how can you maximize your organization's efforts and surpass those of your competitors?

What To Expect

In this seven-part Destination Ahead e-book series, we'll guide you through major phases that you can expect of your automation journey.

For those well-experienced with automated solutions, you might read a few sections to refresh your memory.

On the other hand, for those new to or lightly familiar with automation, and especially whole lab workflow automation, we encourage you to take in as much information as possible in every section.

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The **Destination Ahead** e-book series will cover:

PHASE 1

The Beginning & End

Journey from status quo lab workflows to the land of whole lab automation for opportunity and a competitive edge. Whole lab workflow automation experts like HighRes Biosolutions serve as your North Star and personal escort along the way.

PHASE 2

Understand Your Situation, Your Goals, and Your Team

Introspection and a first-class crew make short work of pre-journey planning. Gather and organize your thoughts, and the thoughts of others, as you assemble your goal guideposts.

PHASE 3

Dive Deep into the World of Hardware

Hardware Harbor encompasses a large area. Learn helpful tips to traverse through seemingly endless devices and capabilities. Narrow capabilities and features to those best-suited for your budget as well as your current and future needs.

YOU ARE HERE

PHASE 4

Immerse Yourself in the World of Software

The Port of Software is an amazing destination along your journey. Gain an overview of data flow and software types and how to orchestrate all through a single, high-functioning information virtuoso. Then determine which platforms stack up to meet your needs.

PHASE 5

Finalize your Proposed Automated Solution Design

Did you chart the right course, or is a major correction in order? Before committing to a final whole lab workflow automation design, review the project overview and details from multiple perspectives.

PHASE 6

Set the Project Build in Motion

It's time to navigate from vision into reality. Get your teams and your site ready with close communication, detailed planning, and rigorous testing.

PHASE 7

Deploy!

Your automation journey isn't finished once the automated solution is in place. Prepare users and you new whole lab workflow automation system with knowledge transfer and system optimization. Put it to the ultimate battery of tests in your environment and with your samples and a host of quality and regulatory guidelines.


Explore the World
of Software

As previously stated, software is equally as important as hardware and peopleware when it comes to the success of your automated process. Throughout the life sciences, software has quickly evolved beyond merely driving a workflow process.

Today, software can be the overarching communication network that translates and eases the flow of information between people, devices, other software, and data processors.

What is a Data Stack or Software Stack?

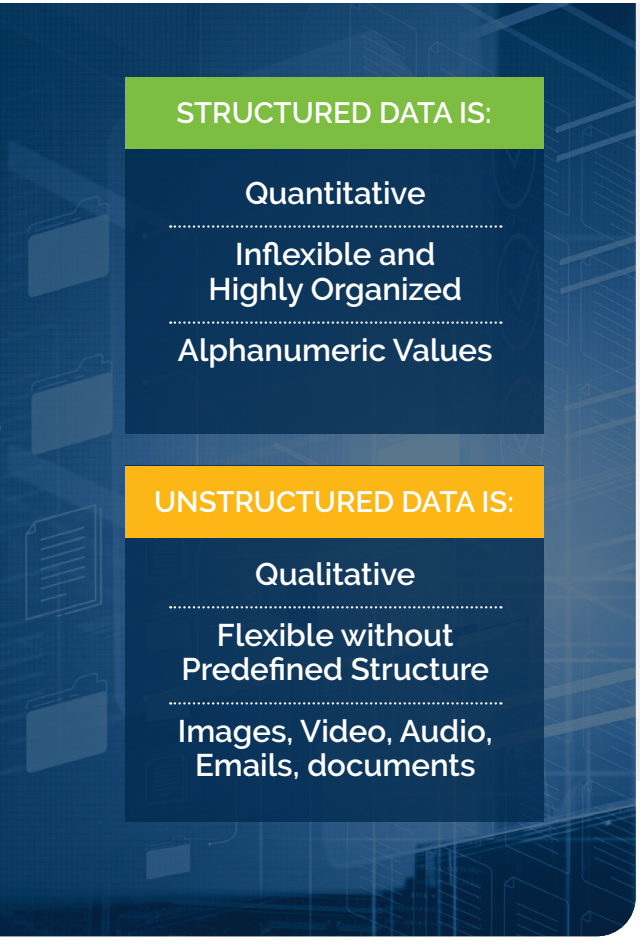
In today's modern lab automation, software is best utilized when it can be stacked. Stacking means that specific tools coordinate to gather, organize, store, manage, process, and analyze data coming from your lab or lab network.

So, rather than using and managing discrete data sources and parallel software platforms that don't talk to each other, they all become connected as an organized and easy to use or manage digital software stack.

Software solutions can span multiple layers, and some offer local hosting, while the popular option now is to host securely in the cloud combined with services as part of a Software-As-A-Service (SaaS) subscription.

There is no pre-set or off-the shelf software stack. Instead, you determine the components or stacks based on the need you outlined in your user requirement specification (URS). (see "*Understand Your Situation, Your Goals, and Your Team*")

A typical lab automation software stack may be expanded at any time as your lab or lab network grows, and includes any of the following layers:



LIMS/ELN Solutions – A laboratory information management system (LIMS) collects and stores structured data and also moves data to a data lake (central repository) for storage and archiving. A LIMS can manage and track lab inventory, connect devices, and share/standardize protocols throughout the lab or larger enterprise. Many LIMS can also manage and track samples.

Similarly, electronic lab notebooks (ELNs) collect, store, and move structured and unstructured data to a data lake.

Experimental Design – Design of Experiments (DOE) software aids researchers in conceiving, building, connecting, and adapting workflow designs virtually without consuming precious samples and expensive reagents before implementing them in a real-lab environment.

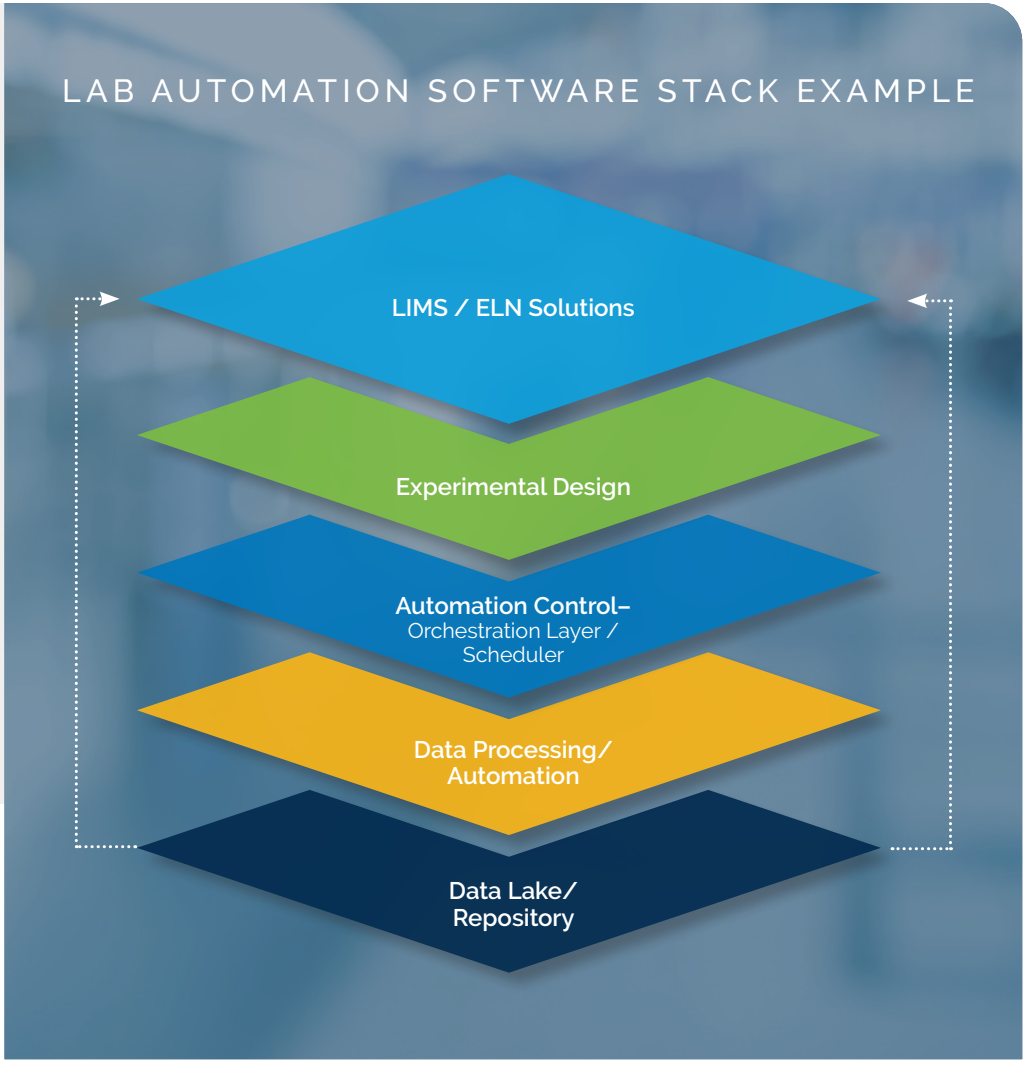
Automation Control – Whole lab workflow automation software orchestrates or pulls everything together in a single, cohesive cloud-native network. Two-way communication streams are opened between automated work cells, connected hardware devices and various software platforms.

Universal serial bus (USB), Ethernet, or wireless connection protocols are all supported to streamline communications. Data streams, including meta, event-based, and raw analytical data, are integrated in a single digital workflow.

On top of communications and data capture, this software can schedule work requests for immediate or future fulfillment. Static scheduling follows a predetermined schedule whereas dynamic scheduling adjusts in real-time based on changing conditions, workloads, or priorities.

Automation control software also orchestrates the appropriate and available devices or work cells and implements the automated workflow protocol. Advanced whole lab workflow automation platforms can even pull in manually derived data to reduce the risk of errors and lost data.

Finally, whole lab workflow automation software pulls information related to device performance and links it to preventative maintenance schedules and alerts to reduce the risk of unexpected downtime.



Data Processing – Data processing software takes digital workflow data collected by the whole lab workflow automation software, associates analytical data with the appropriate meta and event-based data, and normalizes it in a standard format.

Standardizing data makes it easier for the data to be used and analyzed by different devices and software. It also facilitates sharing and communication with other colleagues and stakeholders.

This software can also use the data to gain operational insights to further optimize work cell or device use or support preventative maintenance scheduling.

Data Lake – A company-built or third-party data lake is a flexible, scalable, and centralized data repository. Data can flow into and out of the lake as needed and requested to support insights, further optimize experimental design, or even inform other projects.

Configuring Your Software Stack

If you are not currently gathering and using data to the fullest potential, then do you feel that your organization is equipped to receive and manage the vast data increase that comes from an automated system?

How will you make sense of and structure your data?

Will the additional data provide an advantage in performance, speed, quality, and compliance compared to your current data?

This is where overarching whole lab workflow automation software is particularly useful as it organizes and streamlines information going to and coming from the automated system.

Again, there is no single software or software combination to solve every need. Instead, your solution will depend on what makes most sense for your process and goals.

Start from an internal perspective regarding your data. Are you currently capturing meta and event-based data along with analytical data? How are you leveraging these data, and have you identified gaps that are hampering the progress of your project?

With automated systems processing higher sample throughputs and generating an influx of different data types, your laboratory or multi-site lab network will transform into a high-performing data factory.

Like you did with hardware processes, physically map out the data flow processes including details about how your data will move along the data highway.

Where are the pain points or data gaps? Who is interacting with the software, and where? Compile feedback from users to look for issues that you may have missed. What would you like to change?

Here again, flexibility and expandability for your future needs in twelve to thirty-six months and beyond, whether in a single lab or across an enterprise, is important to maximize the automated solution's utility and lifespan.

Clarifying your needs and data flow help to develop and define your lab's data management strategy. Clarity also aids in narrowing the vast array of software to those that are truly relevant to your vision.

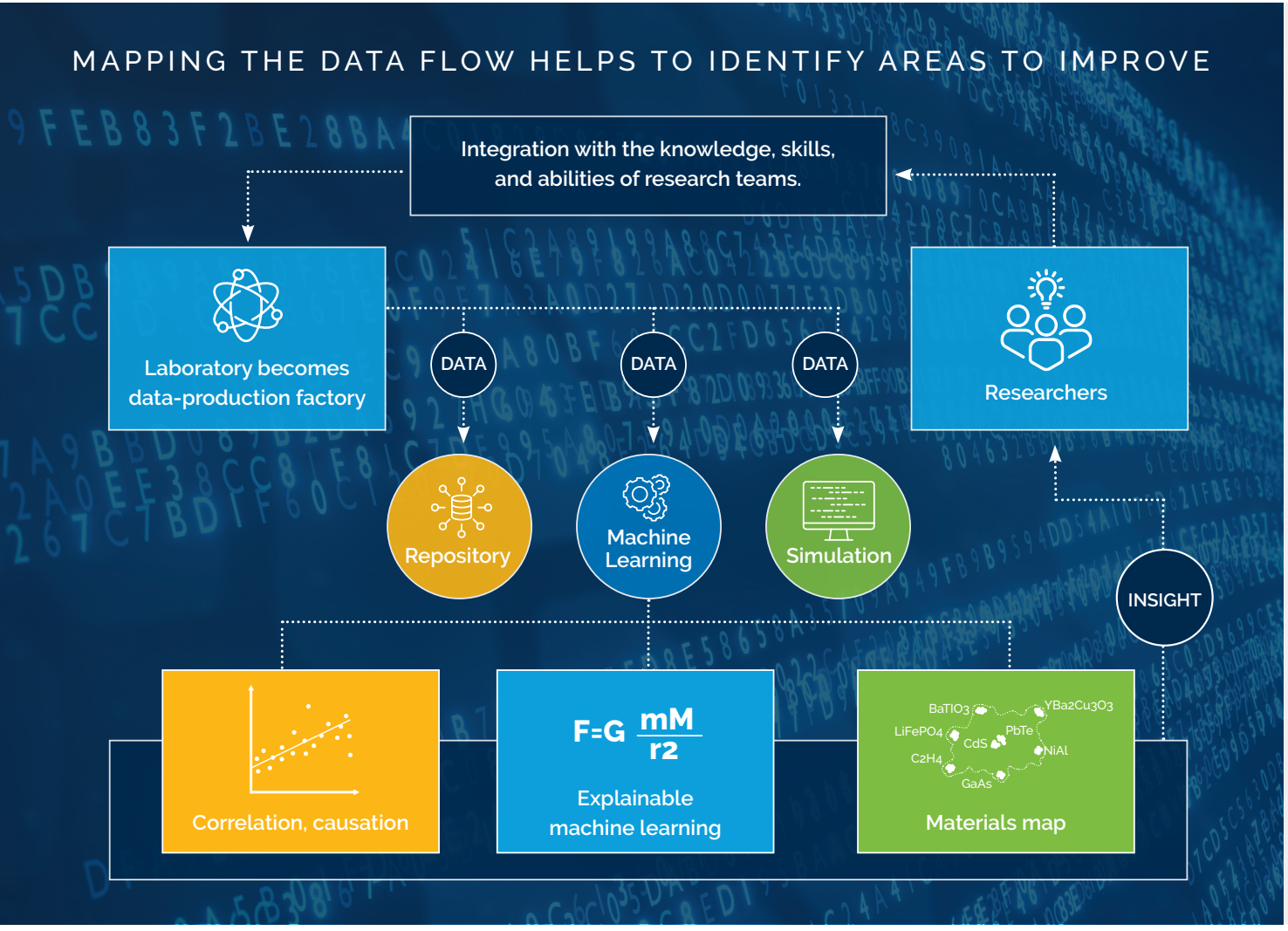

Interconnecting
Data And Devices

As you venture into the diverse world of software, imagine how disparate software platforms in your data infrastructure might work together and also connect with hardware devices in a single orchestrated automated system.

As previously mentioned, leading automation providers supply whole laboratory workflow automation software to unify and orchestrate software and hardware operations, simplify human oversight, and drive scientific discovery between human and robot.

This overarching whole lab software encapsulates the IoT in today's smart and data centric lab.

Integrating data informatics and device communication can be a significant game changer in a highly competitive market. Improving scientific data management and stewardship through FAIR principles (see page 21) can also help you to surge ahead of your competition.



With a centralized and open application programming interface (API), all third-party devices across the lab or enterprise are supported regardless of manufacturer or format.

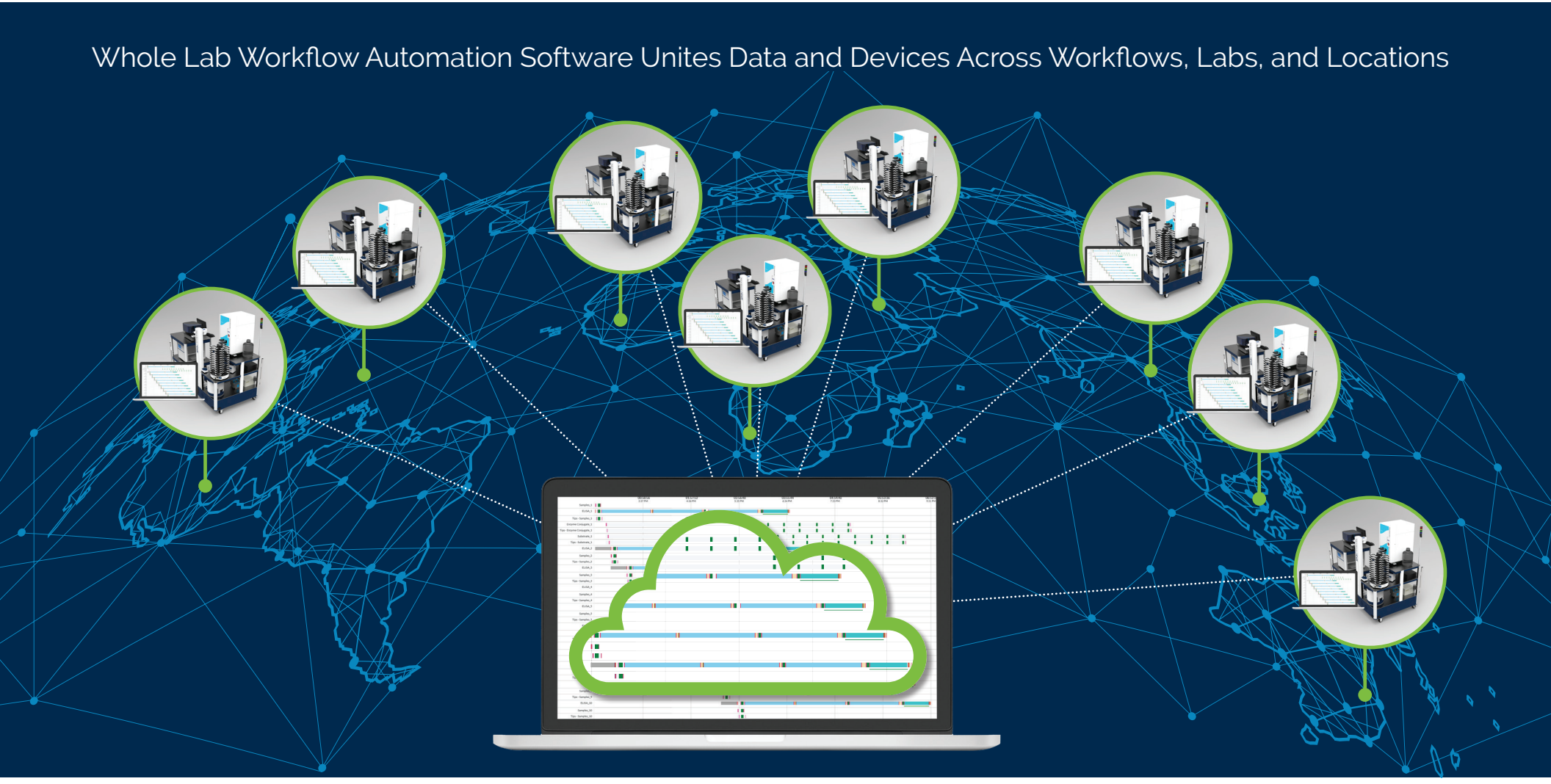
APIs are small bits of code that facilitate communication between devices and software. An open and extensible API allows integration and data sharing with other applications and systems while a closed or private API is highly restricted and proprietary.

Whole lab workflow automation software supports a variety of means - ranging from manual, operator moved samples to mobile or rail-based sample conveyance tools - to help to eliminate physically separated islands of automation and energize sample workflows.

Each connected device communicates with the whole lab workflow automation software through a device-specific driver which is a small intermediary software program that tells the device how to function.

Whole lab workflow automation software streamlines data flow and capture, directs and monitors device performance, and even harmonizes manual and automated processes in a way that no other software can. As a result, productivity is accelerated to empower your lab(s) to make better and faster decisions, mitigate procedural bottlenecks, and automatically comply with regulatory requirements.

Whole Lab Workflow Automation Software Unites Data and Devices Across Workflows, Labs, and Locations




Is Your Data FAIR?

In your data-centric and hands-free workflow and overall product approach, automated data systems are necessary to manage the increase in data volume, complexity, and creation speed. However, software still lacks the processing complexity of the human mind when it comes to sifting through data in a multitude of different formats.

ACCORDING TO THESE FOUR PRINCIPLES, DATA SHOULD BE:

Final Software Search Tips

Five additional factors can apply to any software that you research.

1. **As recommended in the e-book "Deep Dive into the World of Hardware", look at the people behind the product.** One training session may not be enough for users to fully grasp the software's capabilities, or maybe your project would benefit from assigning superusers with a deep product understanding.

   Does the provider offer basic and advanced training to meet these needs? Also, survey support services like application support, software updates, and scripting development support. What services can you anticipate needing and do they fit your budget?

2. **Ask for software demonstrations in your lab.** This gives users a chance to evaluate how easy or difficult is it to learn and navigate, and if it is well-suited for your use case.

   With on-site convenience, other team members have an opportunity to evaluate the software from their unique perspective. For example, IT can assess the software's connectivity and communication and determine if additional resources are required on their end. You may also want to note the ability of to scale to support more complex applications and recover from errors.

3. **Simulate your real-world processes with the software.** By doing so, you can assess plate-to-plate uniformity and even timings, even for complex interleaved work. You can also see how devices may be used over time and optimize the workflow to eliminate pain points.

4. **Evaluate the software's architecture and output.** Is the data structured (alphanumeric) or unstructured (images, video)? Will it easily harmonize with your proposed automated solution and LIMS? Will it integrate with the proposed hardware devices?

5. **Take account of the software relative to your environment.** A robust audit trail provides a persistent record of all actions and conditions relative to the process that can be uploaded to other data systems and parsed for useful meta data. User controls and permissions help to manage system utilization. Some software versions are available to comply with good practice (GxP), 21 CFR Part 11, or other federal or global regulations.

REMINDERS

- Communicate Often
- Evaluate Timelines
- Review Budget

Connect with Us Before you Take the Next Step

Embarking on an automation journey? Depend on HighRes Biosolutions to be a friendly and experienced team member! Our multi-faceted experts are on hand to provide personalized guidance, helpful insights, and actionable tips through each phase of your unique journey.

Before you take that next step into automation, including whole lab workflow automation, reach out to us at sales@highresbio.com.

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Learn More

We invite you to read the fifth e-book in this Destination Ahead series, *"Finalize Your Proposed Automated Solution Design".* Here, apply your learnings to your plan and address any remaining details before you finalize the system design and sign on the dotted line.

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