

EBOOK

5 Ways to Reduce Risk in Lab Operations

Harnessing the Digital Twin Revolution



hopara

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Introduction

Precision, data integrity, and quality are paramount in the dynamic world of life sciences labs. Lab operations managers, directors, and QA/QC professionals shoulder the immense responsibility of ensuring experiments are accurate, compliant, and efficient. The consequences of lapses in lab operations can range from costly delays to regulatory compliance issues or even threats to patient safety. It's a high-stakes environment where risks are omnipresent, and the pursuit of excellence is non-negotiable.

Imagine a scenario: A life sciences lab is meticulously following established procedures, and the pressure to produce reliable results is immense. However, environmental conditions can fluctuate unpredictably and spreadsheets, legacy systems, or manual approaches for tracking preventative maintenance on aging equipment leaves equipment prone to unexpected failures or human error. The lab's reputation, budget, and the integrity of its research hang in the balance.

The Digital Twin Advantage

This is where digital twins enter the scene as a revolutionary force in lab operations. A digital twin is a virtual replica of a physical entity, be it equipment, a process, or an entire lab. It's a living, breathing model that mirrors real-world conditions in real time. The digital twin concept is not new, but its application in life sciences labs is groundbreaking.

Why Digital Twins?

In a world where the margin for error is slim and the pursuit of excellence is constant, digital twins offer a transformative advantage:



RISK MITIGATION

Digital twins continuously monitor lab operations, equipment, and environmental conditions. They are vigilant guardians, capable of predicting issues before they escalate. With this foresight, labs can mitigate risks and prevent disruptions that could cost in the range of \$10,000 to \$50,000 an hour or more.



REAL-TIME INSIGHTS

Imagine having the ability to see inside your lab equipment, processes, and workflows, 24/7. Digital twins provide this level of visibility. They empower lab managers and QA/QC professionals with real-time insights into the heart of their operations.



EFFICIENCY AND COMPLIANCE

In a regulatory landscape where data integrity and quality are non-negotiable, digital twins offer robust compliance support. They record and validate every step of lab operations, ensuring processes adhere to regulatory standards.



COST SAVINGS

Lab equipment downtime, emergency troubleshooting and maintenance, and inefficient processes are costly. Digital twins can help labs optimize their operations, reduce downtime, and eliminate inefficiencies.

In this ebook, we help you explore the potential of digital twins in life sciences labs to play a key role in lab digitization and digital transformation initiatives. You will learn about their role in mitigating risks, optimizing operations, and driving innovation. Through real-world case studies and expert insights, you will learn how digital twins are revolutionizing the lab operations landscape.

But first, let's understand the challenges that life sciences labs face in their pursuit of excellence.

Understanding Lab Operations Risks

Life sciences labs are vibrant hubs of discovery and progress. They are also complex ecosystems where the convergence of equipment, personnel, processes, and regulations creates a fertile ground for risks. Let's examine some of the common challenges that lab operations professionals encounter:



Lack of real-time visibility into equipment inventory and status. Lab managers need to know what devices they have, where they are, and what data they are producing to manage their lab. And they need to see these in the context of their lab's floor plan for rapid response.



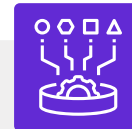
Time-consuming and error-prone manual processes for tracking and analyzing equipment data. General-purpose tools like spreadsheets, legacy apps with asset management capabilities (eg. SAP, JDE) or basic maintenance software make it difficult or impossible to move beyond manual tracking and monitoring of equipment usage and maintenance schedules.



Regulatory Compliance: In the life sciences sector, regulatory compliance is non-negotiable. Labs must meticulously document their processes, maintain data integrity, and adhere to rigorous standards. The consequences of non-compliance are severe.



Equipment Downtime: Equipment failures and unscheduled maintenance can lead to costly downtime. Yet many labs lack the ability to proactively optimize maintenance schedules to prevent equipment failure. Preventative maintenance should ideally be planned and scheduled in advance to avoid entire facilities being down at the same time. The need for rapid response and resolution is a constant pressure.



Environmental Variables: Labs often operate in sensitive environments, where changes in temperature, humidity, or other factors can affect experiments. Ensuring stability in these conditions is vital.

Five Ways Digital Twins Can Play a Role in Lab Risk Mitigation

With companies amassing vast amounts of data, particularly through IoT sensors, and traditional tools struggling to handle the volume and complexity of data, how can organizations effectively visualize their data, akin to a Google Map, leveraging custom canvases such as floor plans, connecting to multiple real-time databases, and enhancing user experience to boost data utilization in daily tasks?

As the challenges in lab operations such as those above continue to evolve, digital twins have emerged as a powerful tool to mitigate these risks. They offer an innovative solution that addresses the complexities of lab environments and equips professionals with the tools they need to excel.

Digital twins are like virtual sentinels, watching over lab operations in real time. They offer a multi-faceted approach to risk mitigation:

- 1 PREDICTIVE MAINTENANCE:** Digital twins monitor equipment health and usage patterns. By analyzing this data, they can predict when equipment is likely to fail. This proactive approach minimizes unscheduled downtime and reduces the risk of experimental disruptions..
- 2 REAL-TIME MONITORING:** Lab managers and QA/QC professionals can access real-time data from digital twins, providing immediate insights into equipment and process performance. This level of visibility allows for rapid response to any deviations or anomalies.
- 3 COMPLIANCE ASSURANCE:** With their ability to record and validate every step of lab operations, digital twins provide a robust foundation for regulatory compliance. They ensure that processes adhere to standards, helping labs avoid compliance-related risks
- 4 COST REDUCTION:** Through predictive maintenance, process optimization, and risk mitigation, digital twins contribute to cost reduction. They help labs do more with less, maximizing the efficiency of budget allocations.
- 5 ENVIRONMENTAL CONTROL:** By monitoring environmental conditions, such as temperature and humidity, digital twins help labs maintain stable experimental environments, reducing the risk of experiments being affected by external variables.

In the following sections of this e-book, you will learn how a new approach to digital twins is revolutionizing lab operations in the life sciences sector. You will also get practical guidance on implementing digital twins effectively, ensuring that the benefits of risk reduction and efficiency gains are realized.

Key Capabilities of Digital Twins for Labs

Digital Twins are a modern way to solve these problems, but traditional digital twins typically take more than a year to build and deploy - usually as custom-coded projects - and they are purpose-built for just one use case. They also could cost well into the range of hundreds of thousands of dollars up to millions of dollars to build and deploy for just one use case. This problem led Professor Mike Stonebraker, 2014 Turing Prize winner and Professor at MIT's AI Lab (CSAIL), to pioneer the concept of Agile Digital Twins.

Agile Digital Twins are digital representations of physical objects or analog processes that can seamlessly connect to real-time operating data, such as IoT sensors, within an engaging and user-friendly environment. By combining the principles of Agile Development with significantly reduced data requirements, Agile Digital Twins deliver highly effective SaaS applications in a fraction of the time and cost typically associated with full-scale digital twins.

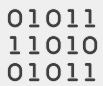
The key advantages that set Agile Digital Twins apart are as follows:



MINIMIZED REQUIREMENTS TO BUILD

Agile Digital Twins eliminate the need for ETL processes or data movement by connecting in real-time to where the data resides. 3D models are not required with an Agile Digital Twin, so you can start with a 2D blueprint and then add 3D when it's needed. Unlike traditional digital twins, Hopara Agile Digital Twins require no geospatial data. The Agile Digital Twins solution provides the ability to visually position floor plans and sensors, and it also helps users get started quickly by including a built-in library of 3,000 icons to represent assets and objects in a 2D format. In addition, App templates help users get started very quickly visualizing their data in the exact way they prefer.

With this approach, businesses benefit in many ways. Prototypes can be built in as fast as hours, and solutions are built and deployed in as fast as a few weeks, rather than months or years. The time, costs, and data corruption risks associated with data movement are eliminated, and the insights are always highly accurate because the data is always up-to-date.



LOW-CODE APPROACH

Agile Digital Twins empower data analysts or data engineers building the digital twin to accomplish most or all of the work without coding. This low-code approach simplifies the implementation process and allows users to easily create different visualizations targeted at specific business use cases. Unlike typical digital twins that require a high level of technical skills and coding expertise, Agile Digital Twins enable users to achieve their objectives without extensive coding requirements.

This low-code approach with an Agile Digital Twin enables advanced data visualization solutions to be built and implemented ten times faster compared to coding a traditional digital twin. In addition, no additional costs are incurred to expand an existing agile digital twin build with 2D models to 3D.



MINIMIZED REQUIREMENTS TO BUILD INFINITE ADAPTABILITY

Hopara Agile Digital Twins offer limitless adaptability to solve a wide variety of use cases. They can be updated and adapted quickly as business cycles change, ensuring flexibility and agility. With the ability to customize every aspect of the Agile Digital Twin from the start, users can easily incorporate new data feeds, such as IoT sensors, or expand the scope to include additional locations without the need for recoding of the entire project.

With this infinite adaptability unique to Hopara's solution, users have the ability to target a variety of different use cases and optimize various processes using the same Agile Digital Twin tool. This offers considerable savings in cost and time to adapt or create new Agile Digital Twins, as compared to alternative solutions.



ADVANCED DRILL-DOWN

Agile Digital Twins provide an advanced drill-down capability, allowing users to navigate swiftly from the highest level of abstraction to the most granular details. With just a few clicks and in a fraction of a second, users can pan and zoom through data to access the precise information they need in the same way they would browse the Internet. The platform ensures that users see only the relevant data for their specific level of view, eliminating distractions and focusing on decision-making. Data is presented in a beautiful, visually appealing manner within a "single pane of glass," enabling users to view and analyze the entire operation spanning multiple sites and a large number of assets, while still being able to drill down into the details of individual assets.

Hopara's advanced drill-down enables instant business insights that drive real-time decision-making which increases equipment uptime and availability and reduces costs. With superior insights come greater business value compared to traditional approaches.

Lab Operations Use Cases for Agile Digital Twins

USE CASE 1: ENHANCE ASSET UTILIZATION

Problem: In a bustling life sciences lab, where experiments are time-sensitive and precision is non-negotiable, lab managers faced a challenge – optimal asset utilization. Aging equipment, resource allocation inefficiencies, and the fear of unexpected breakdowns were all impacting lab productivity and incurring unnecessary costs. Asset underutilization was a persistent concern, hindering both experiments and budget management.

Solution: Enter Agile Digital Twins. These innovative virtual replicas of lab equipment provide real-time monitoring and analytics, offering lab managers unprecedented visibility into equipment utilization. Their advanced drill-down capabilities enable lab professionals to swiftly navigate data, optimizing scheduling and asset allocation decisions. The visually appealing data presentation focuses on relevant information, making it easier to spot areas for improvement. Agile Digital Twins help labs enhance asset utilization and improve productivity, ultimately leading to significant cost savings.

USE CASE 2: EMPOWER AGILE MAINTENANCE

Problem: In a fast-paced life sciences lab, where precision is paramount and experiments must run smoothly, maintenance-related disruptions were a constant headache. Lab equipment breakdowns and incidents were causing costly downtime, delaying experiments, and frustrating lab professionals. Troubleshooting and responding to incidents swiftly were crucial, but the lack of real-time insights and proactive maintenance strategies hindered these efforts.

Solution: Agile Digital Twins empowered agile maintenance in the lab. With their real-time monitoring and analytics, they continuously collect performance data from lab equipment, providing actionable insights to lab managers and maintenance teams. These solutions use data analytics to predict maintenance needs, enabling proactive issue identification and resolution. Lab professionals can now more rapidly troubleshoot and respond to incidents, minimizing disruptions and ensuring the smooth flow of experiments. Agile Digital Twins are the vigilant guardians that help lab operations achieve a proactive maintenance approach, reducing costly downtime and enhancing operational reliability.

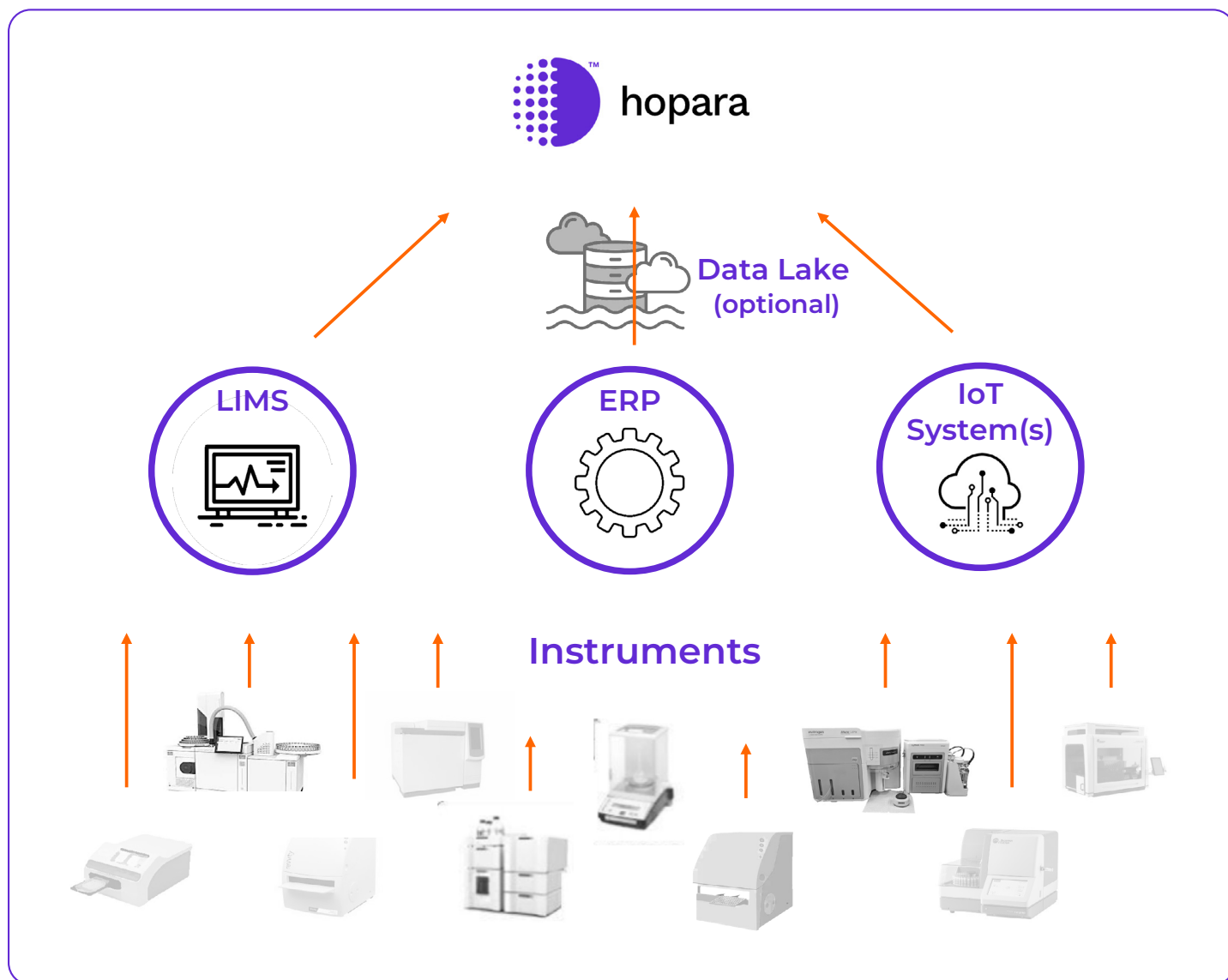
USE CASE 3: PREDICT & PREVENT DOWNTIME

Problem: In a dynamic life sciences lab where experiments are time-sensitive and precision is critical, downtime was a looming threat. Unplanned outages and equipment failures disrupted experiments, leading to data loss, budget overruns, and delays in critical research. The lab needed a solution to schedule preventive actions, minimize disruptions, and elevate operational reliability.

Solution: Agile Digital Twins offered a transformative solution for predicting and preventing downtime. These virtual replicas of lab equipment allowed lab professionals to schedule preventive actions based on real-time equipment performance data. With advanced predictive maintenance capabilities, Agile Digital Twins alerted lab managers to potential issues before they escalated, allowing for timely maintenance and upgrades. This proactive approach minimized disruptions, safeguarded experiments, and maintained the continuous flow of critical lab activities. Agile Digital Twins became the vigilant guardians of lab operations, helping efforts to avert unplanned outages, reduce risks, and elevate operational reliability in the lab.

Integrating Digital Twins in Lab Operations

Hopara integrates seamlessly with existing systems through APIs or direct database connections. The diagram below depicts how Hopara integrates within existing environments. All data is fetched live, which means no data is stored in Hopara and all updates reflect immediately. End users can interact with Hopara to get insights in a manner similar to how they browse the Internet.



Conclusion

The life sciences sector is on the frontlines of human progress, but labs face immense pressure to deliver reliable results while adhering to rigorous standards. In this high-stakes environment, risks exist around asset maintenance and utilization, and the costs of a failure can be substantial. As this ebook has explored, challenges like aging equipment, lack of real-time insights, and unplanned downtime can disrupt lab operations and undermine productivity.

However, the digital twin revolution brings hope. These virtual replicas provide labs with an innovative advantage. By mirroring real-world conditions in real time, digital twins offer predictive insights that help mitigate risks. Their ability to monitor equipment health enables reliability-centered maintenance. Their continuous tracking facilitates regulatory compliance assurance. By mitigating risks, optimizing operations, and enhancing efficiency, they set to usher in a new era of lab excellence and transform lab operations.

