



The Simplicity Imperative

Why Human-Centred Workflow Design Is Becoming the Defining Competitive Advantage in Modern Laboratory Operations

A Strategic Whitepaper by Axon, Craig Funnell

For laboratory managers, molecular diagnostics professionals, NGS workflow specialists, and scientific distributors navigating the operational realities of modern laboratory environments.

*"Perfection is achieved not when there is nothing more to add,
but when there is nothing left to take away."
— Antoine de Saint-Exupéry*

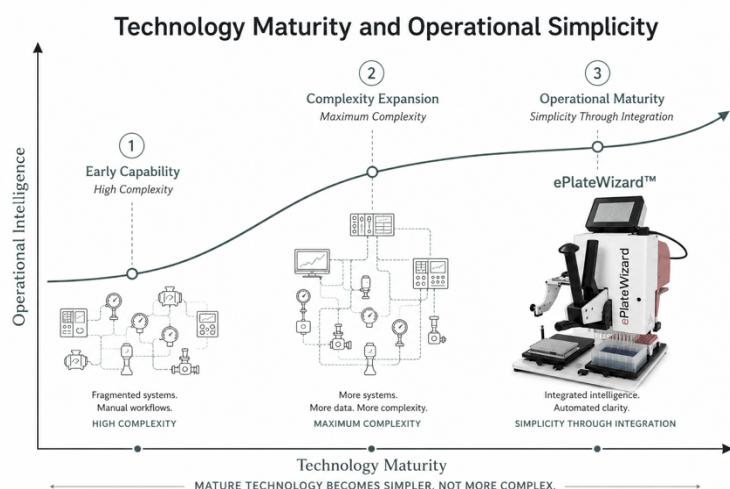
Executive Summary

For decades, the laboratory technology industry operated on an implicit assumption: that sophistication meant complexity. The more features, the more hardware modules, the more configuration options — the more advanced the system. Complexity was the signal. Simplicity, by implication, was for entry-level users who hadn't yet graduated to the real tools.

That assumption is being quietly dismantled.

As laboratory throughput demands intensify across genomics, molecular diagnostics, drug discovery, and clinical research, a different kind of operational intelligence is emerging. Laboratory managers and workflow specialists are discovering that excessive complexity carries hidden costs — in training time, implementation friction, error rates, and operator fatigue — that accumulate silently and erode the very efficiency that automation was supposed to deliver.

This whitepaper argues that simplicity is no longer a compromise. It is a strategic feature. And in the most operationally sophisticated laboratories of 2025 and beyond, it is becoming a competitive advantage.



1. Introduction: The Paradox of Progress

Modern laboratories face a genuine operational paradox.

On one hand, throughput expectations have never been higher. Next-generation sequencing workflows demand the preparation of hundreds of samples in compressed timeframes. Molecular diagnostics laboratories operate under regulatory and turnaround pressures that leave little tolerance for inefficiency. Discovery research teams are scaling assay volumes that were unimaginable a decade ago.

On the other hand, the workforce available to manage these workflows has not scaled proportionally. Skilled laboratory technicians are in high demand and short supply. Training cycles are expensive. Staff turnover introduces recurring knowledge gaps. And the operational complexity of many automation platforms — the lengthy installation procedures, the expert-level software interfaces, the intricate maintenance regimes — often consumes the very time savings they were designed to create.

The global laboratory automation market, valued at approximately USD 5.97 billion in 2024 and projected to reach USD 9.01 billion by 2030, reflects an industry responding urgently to the throughput challenge. But market growth does not automatically translate into workflow efficiency. What the market builds, and what laboratories actually need, are not always aligned.

The laboratories that are pulling ahead operationally are not necessarily those with the most automation. They are the ones that have found the most intelligent balance — between throughput and flexibility, between capability and deploy-ability, between power and simplicity.

2. The Growing Complexity of Modern Laboratory Workflows

To understand why simplicity has become strategically valuable, it is worth examining how laboratory complexity has compounded over the past decade.

Modern laboratory workflows are no longer single-instrument processes. A typical NGS sample preparation workflow, for example, requires coordinated execution across nucleic acid extraction, library preparation, quantification, normalisation, and pooling — each step with its own protocol, its own reagent set, and its own potential for error. Molecular diagnostics laboratories managing high-volume PCR or immunoassay workflows face similar coordination demands, layered over strict quality control requirements and regulatory compliance obligations.

The instrumentation landscape has become correspondingly dense. Liquid handlers, plate readers, thermal cyclers, centrifuges, and robotic arms from multiple vendors often share the same laboratory bench — each with its own software interface, its own calibration schedule, and its own failure modes. Integration between systems is rarely seamless. Data flows frequently require manual intervention. And when a single instrument in the chain requires maintenance or recalibration, the entire workflow can stall.

This complexity is not an accident. It is the natural consequence of scientific ambition meeting technological expansion. But it creates a real operational challenge: as laboratory systems grow more capable, they also grow more difficult to deploy, operate, and maintain. And for many laboratories — particularly mid-sized clinical operations, growing biotech companies, and core facilities with variable throughput demands — the complexity load of full robotic automation has become disproportionate to the problem they are actually trying to solve.

3. The Hidden Cost of Operational Friction

Operational friction is one of the most underappreciated cost categories in laboratory management. Unlike capital expenditure, it does not appear in procurement budgets. Unlike reagent costs, it does not show up in consumables tracking. But it accumulates continuously, and its aggregate impact on laboratory productivity can be substantial.



The Training Burden

Complex laboratory automation platforms require significant operator training before they can be used productively. Implementation timelines for high-end robotic liquid handling systems routinely extend across weeks or months, encompassing hardware installation, software configuration, protocol validation, and staff certification. Each additional operator who joins the laboratory — whether through normal turnover or team expansion — must repeat a significant portion of this cycle. In high-turnover environments, the training burden is not a one-time cost; it is a persistent operational overhead.

Research across manufacturing and industrial contexts consistently demonstrates that systems with higher interface complexity generate higher cognitive load for operators, particularly during onboarding and non-routine tasks. Laboratory environments are not immune to this dynamic. When operators must maintain detailed procedural knowledge to navigate software, configure run parameters, and interpret system feedback, cognitive resources that could be directed toward scientific judgment are instead consumed by tool management.

Implementation Inertia

Many laboratories that could benefit from increased throughput delay or forgo automation investments because the perceived implementation burden is too high. The fear is rational: a failed or underutilised automation implementation is worse than no automation at all. Capital is consumed, workflows are disrupted during the transition, and — if adoption is poor — the system sits idle while manual processes continue alongside it.

This implementation inertia is not a failure of scientific ambition. It is a rational response to systems whose complexity creates genuine deployment risk. Laboratories with lean operational teams, limited IT support, or variable throughput patterns have learned, often through experience, that the total cost of deploying a complex system is rarely captured in the vendor's installation quote.

Workflow Rigidity and the Adaptability Gap

High-complexity automation platforms are typically optimised for the specific workflows they were configured to run. This specialisation is a genuine strength at scale — but it introduces rigidity for laboratories whose throughput demands fluctuate, whose assay portfolios evolve, or whose teams operate across multiple application areas.

When a fully automated system is configured for a specific 96-well library preparation protocol, repurposing it for a different assay format requires new protocol development, re-validation, and often additional vendor support. The flexibility that mid-sized laboratories require — the ability to run 48 samples today, 192 tomorrow, 384 next month, and adapt the workflow next quarter as the project scope changes — is structurally difficult for highly specialised robotic platforms to provide.

The cost of this rigidity is not always visible in the short term. But over a multi-year operational horizon, the laboratories that can adapt their workflows quickly and confidently consistently outperform those locked into fixed automation architectures.

4. Why Complexity Is No Longer a Premium Signal

There is a broader technology maturity principle at work here that extends well beyond laboratory science.

In the early stages of any technology category, complexity is a proxy for capability. When a product can do more, it is necessarily more complex. Users accept this because the alternative — less capability — is worse. Complexity, in this phase, genuinely signals sophistication.

But as technology categories mature, a reversion occurs. The most capable products are no longer the most complex ones. They are the products that have internalised complexity — absorbed it into elegant design — so that the operator experience becomes simpler even as the underlying capability grows. This is the maturity signal that defines the transition from industrial technology to truly operational technology.

This pattern is visible across technology sectors. Enterprise software that once required weeks of implementation consulting now deploys in hours, with user interfaces designed for non-technical operators. Diagnostic imaging systems that once demanded dedicated technologist training increasingly guide operators through workflows with minimal prior expertise. Industrial cobots (yes, cobots) that once required safety engineers and programming specialists now operate alongside production workers with minimal setup.

The laboratory automation industry is arriving at this inflection point. The next generation of laboratory workflow tools will not be distinguished by feature count or configuration depth. They will be distinguished by the intelligence embedded in their design — the work done on the engineering side so that the operator side is frictionless.

Simplicity, in this framing, is not a reduction of capability. It is evidence of a system that has been designed with genuine operational intelligence — with deep understanding of how laboratories actually work, where the friction points actually live, and what operators actually need to do their best work.

5. The Rise of Human-Centred Workflow Design

The concept of human-centred design has deep roots in industrial ergonomics and software engineering. Its application to laboratory workflow design, however, is more recent — and more strategically consequential than many in the industry have yet recognised.

Human-centred workflow design begins with a different question than traditional laboratory automation development. Traditional automation asks: what can this system do? Human-centred design asks: what does the operator need to achieve, and how do we make that as frictionless as possible?

The distinction sounds philosophical, but its operational implications are concrete. A system designed from the operator's perspective prioritises intuitive interfaces over feature-rich complexity. It minimises the procedural knowledge required before a new user can be productive. It provides feedback in forms that match the operator's mental model of the process. It handles error states gracefully, guiding users toward resolution rather than confronting them with technical failure codes. And it integrates into existing laboratory rhythms rather than demanding that laboratories reorganise their workflows around the system.

Human-centred laboratory design also addresses a dimension that purely technical automation strategies frequently overlook: the cognitive and physical wellbeing of laboratory personnel. Repetitive manual pipetting carries well-documented risks of repetitive strain injury. High-cognitive-load procedures increase the probability of protocol deviations. Operators managing complex, multi-step workflows under time pressure are at elevated risk of procedural error — not because of incompetence, but because of the fundamental constraints of human attention and working memory.

Systems designed with genuine human-centricity reduce these risks by design. They allocate repetitive mechanical tasks to the instrument. They present information in formats that support rather than overwhelm operator decision-making. They build quality control checkpoints into the workflow rather than relying on operator vigilance alone. The result is not merely a more comfortable working environment — it is a more reliable, higher-quality workflow outcome.

6. The Emerging Middle Layer Between Manual Pipetting and Full Automation

One of the most significant and underserved gaps in the current laboratory technology landscape is the space between traditional manual pipetting and fully robotic laboratory automation.

At one extreme, manual pipetting remains the default approach for the majority of lower-throughput laboratory applications. It requires no capital investment beyond a basic pipette, imposes no implementation burden, and is fully flexible. But it is also slow, physically demanding, and — at higher sample volumes — a significant source of inter-operator variability and repetitive strain risk.

At the other extreme, fully automated liquid handling systems — robotic platforms capable of processing thousands of samples per day with minimal human intervention — represent the pinnacle of throughput capability. They are transformative for high-volume operations. But they carry correspondingly high price points, lengthy implementation timelines, significant maintenance requirements, and structural rigidity that makes them ill-suited for laboratories whose workflows are dynamic or whose throughput demands do not justify the investment.

Between these two poles lies a large and underserved category of laboratory operations: those that have outgrown manual pipetting but do not require — or cannot justify — the full complexity and cost of robotic automation.

These are the laboratories running 96- or 384-well plate workflows for NGS library preparation at moderate throughput. The molecular diagnostics labs processing 50 to 200 samples per shift. The biotech discovery teams validating assays across multiple plate formats. The contract research organisations managing variable workloads for multiple clients simultaneously. For these operations — which represent a substantial proportion of the global laboratory ecosystem — what is needed is not full automation. What is needed is accelerated workflow capability with the flexibility and simplicity of a human-operated system.

This middle layer is not a compromise. It is a distinct and legitimate operational category — one that is increasingly recognised by laboratory workflow strategists as the most appropriate solution architecture for a large and growing segment of laboratory operations. The defining characteristics of this category are:

- **Assisted liquid handling:** instrumentation that extends human precision and speed without replacing human judgment
- **Rapid deployment:** systems that are operational within hours, not weeks
- **Format flexibility:** native support for 96- and 384-well plate formats with minimal reconfiguration
- **Throughput scalability:** the ability to process varying sample volumes without workflow redesign
- **Low training overhead:** interfaces designed for productive operation after minimal familiarisation
- **Benchtop footprint:** integration into existing laboratory environments without infrastructure modification

This is not a category defined by what it lacks. It is defined by what it enables: the throughput advantages of automation, delivered with the adaptability and operational simplicity of a human-operated workflow.

7. Simplicity as a Competitive Advantage

The operational case for simplicity in laboratory workflow design is clear. But there is also a strategic competitive dimension that laboratory decision-makers are increasingly recognising.

Laboratories that can deploy new workflows quickly have a structural advantage over those that require extended implementation cycles. When a new assay format becomes commercially relevant, or when a clinical protocol update requires workflow modification, the ability to adapt in days rather than months translates directly into competitive positioning — whether that means faster time-to-market for a biotech application, improved service responsiveness for a CRO, or faster diagnostic turnaround for a clinical laboratory.

The ability to onboard new operators quickly is similarly strategic. In a talent environment where experienced laboratory technicians are consistently in demand, reducing the training cycle from weeks to days means that new team members become productive contributors faster, that workflow continuity is preserved during personnel transitions, and that temporary or contract staffing can be deployed without compromising protocol integrity.

Simplicity also reduces operational risk. Complex systems with many interdependent components and configuration variables present more opportunities for user error, protocol deviation, and system failure. The operational cost of a workflow interruption — in sample loss, repeat runs, delayed results, and staff time — is consistently underestimated in procurement decision-making but consistently significant in operational experience. Systems designed for simplicity reduce the probability and severity of these interruptions.

Finally, simplicity has a direct impact on laboratory capacity utilisation. When operators spend less time configuring systems, troubleshooting errors, and navigating complex interfaces, they spend more time running samples. This throughput efficiency — the ratio of productive instrument time to total operating time — is where the practical return on simplicity investment is most clearly realised.

8. The Future of Flexible High-Throughput Workflows

The trajectory of laboratory workflow design over the next five to ten years is becoming clearer, and it points toward a fundamental rebalancing of the automation paradigm.

The dominant model of the past decade — in which full robotic automation was positioned as the aspirational endpoint for all laboratory operations — is giving way to a more nuanced and operationally sophisticated view. Laboratories are increasingly recognising that the right automation strategy is not the most comprehensive one, but the most appropriate one for their specific operational context.

This shift is being accelerated by several converging forces. The growing cost and operational complexity of maintaining highly sophisticated robotic systems is prompting reassessment of total cost of ownership across longer operational horizons. The increasing diversity of assay formats — driven by the rapid expansion of genomics, proteomics, and cell-based assay applications — is creating demand for workflow flexibility that rigid, specialised automation platforms cannot easily provide. And the broader technology industry trend toward human-centred design — evident in enterprise software, medical devices, and industrial automation — is beginning to reshape expectations among laboratory decision-makers and buying-influencers.

The emerging model prioritises workflow intelligence over system sophistication. In this model, automation is not deployed to replace laboratory operators but to augment them — handling the repetitive, high-precision mechanical tasks that drain operator capacity and introduce variability, while leaving the judgment-intensive, protocol-adaptive decisions in human hands. This human-in-the-loop architecture is not a transitional phase on the way to full automation. It is a mature operational philosophy in its own right.

The laboratories that position themselves for this future are those that are building modular, adaptable workflow infrastructures — ones that can scale throughput without scaling complexity, that can integrate new assay formats without requiring workflow redesign, and that can maintain high operational efficiency without demanding high operational expertise. The competitive advantage in laboratory operations over the next decade will not belong to those with the most automation. It will belong to those with the most intelligent, adaptable, and friction-free workflows.

9. The PlateWizard™ Approach

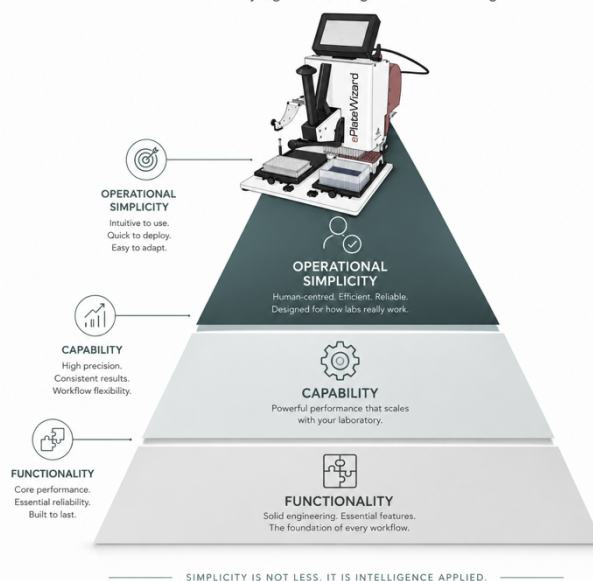
Against this strategic backdrop, Axon has developed the PlateWizard™ product family as a direct response to the operational challenge facing modern mid-throughput laboratories.

PlateWizard™ systems are not robotic automation platforms. They are not designed to replace automation, laboratory operators, or eliminate the need for scientific judgment. They are designed to occupy the intelligent middle layer described in this whitepaper — providing the throughput acceleration and precision consistency of an assisted liquid handling system, with the flexibility, simplicity, and rapid deploy-ability that the modern laboratory operational environment demands.

The design philosophy behind PlateWizard™ is grounded in a clear operational understanding: the laboratories most underserved by the current automation landscape are not those that lack scientific ambition, but those whose operational context — team size, throughput variability, assay diversity, implementation capacity — makes fully robotic automation either inaccessible or inappropriate. For these laboratories, a system that delivers genuine throughput acceleration, without demanding robotic-level implementation investment, represents a fundamentally different value proposition than anything currently available from the major automation vendors.

THE SIMPLICITY IMPERATIVE

The maturity signal of intelligent workflow design



Accelerated Workflow, Human Control

PlateWizard™ systems are engineered to accelerate the pipetting workflows that consume the greatest proportion of laboratory operator time — multi-well plate preparation, sample normalisation, reagent dispensing, and format transfers across 96- and 384-well architectures. By enabling parallel processing across full plate formats, PlateWizard™ dramatically reduces the time required for these operations compared to manual multi-channel pipetting, while maintaining the operator oversight and flexibility that manual pipetting provides.

The throughput benefit is not theoretical. Workflows that require 45 to 60 minutes of manual pipetting effort can be completed in a fraction of the time with a PlateWizard™ system — without the extended setup, calibration, and programming cycles associated with robotic liquid handlers. Operators are productive on day one.

Simplicity as a Design Principle

The PlateWizard™ interface and workflow architecture have been designed from the ground up to minimise the knowledge and effort required to achieve productive operation. Protocol setup is intuitive. Format switching is straightforward. The system integrates into standard laboratory benchtop environments without infrastructure modification. And because the

operational model keeps the operator engaged with the process rather than abstracting them away from it, the learning curve is steep in the right direction — competence is achieved quickly, and that competence is retained.

This is not the simplicity of reduced capability. PlateWizard™ systems are precision instruments designed for the accuracy demands of NGS library preparation, molecular diagnostics, and high-throughput screening applications. The simplicity is in the experience — the result of careful engineering decisions that have absorbed complexity into the instrument design rather than leaving it for the operator to manage.

Flexible Throughput Scaling

One of the central operational advantages of the PlateWizard™ approach is its inherent scalability across throughput demands. Laboratories running variable sample volumes — a common reality in clinical research, CRO operations, and academic core facilities — can deploy PlateWizard™ systems without configuring for a fixed throughput ceiling. The system scales naturally with the workflow, supporting efficient operation whether the day's run involves 48 samples, 96 or 384.

This flexibility has significant long-term value. As laboratory throughput demands evolve — driven by project growth, new client requirements, or assay portfolio expansion — PlateWizard™ systems remain operationally relevant without requiring replacement or major reconfiguration. The workflow adapts to the laboratory's needs, not the reverse.

Bridging the Automation Gap

For laboratory decision-makers evaluating their workflow automation strategy, PlateWizard™ offers a genuinely distinct value proposition: automation efficiency with human flexibility. The system bridges the operational gap between manual pipetting and fully robotic automation — not as a transitional step toward something more complex, but as the appropriate solution for a large and legitimate category of laboratory operations.

For distributors and laboratory consultants advising on workflow strategy, PlateWizard™ represents a category that has historically been underserved by the automation market: the intelligent middle tier, where most real-world laboratory operations actually live.

Further information on the PlateWizard™ product family, including application notes and workflow assessments, is available at platewizard.eu. Information on Axon's broader portfolio of laboratory workflow solutions can be found at axon-labortechnik.de.

10. Conclusion: The Maturity Signal

The emergence of simplicity as a premium feature in laboratory workflow design is not a trend driven by user convenience preferences. It is a maturity signal — evidence that a technology category is moving from early adoption to operational sophistication.

The most capable laboratory workflows of the next decade will be distinguished not by the complexity of their automation, but by the intelligence of their design. They will handle high throughput with low friction. They will deploy quickly and adapt easily. They will support the humans who operate them rather than demanding expertise as the price of access. And they will deliver reproducible, high-quality results not despite their simplicity, but because of it.

Laboratories that recognise this shift early — that invest in workflow architectures optimized for adaptability, usability, and operational efficiency — are positioning themselves for a structural advantage that will compound over time. The question is not whether simplicity will become a competitive differentiator in laboratory operations. It already is.

The question is which laboratories — and which technology partners — will be on the right side of that inflection.

About Axon

For over 37 years, Axon has developed laboratory instrumentation, consumables, and workflow solutions for life science laboratories worldwide, with particular expertise in molecular biology applications. Combining precision engineering with practical laboratory insight, Axon delivers reliable technologies and ongoing laboratory supply solutions designed to improve accuracy, efficiency, and workflow performance across research, diagnostics, and genomics.

This whitepaper is intended for laboratory managers, workflow specialists, scientific decision-makers, and distribution partners evaluating liquid handling workflow strategy. The views expressed represent the strategic perspective of Axon and are based on industry observation, published market research, and operational experience in laboratory workflow design.

For more information about Axon PlateWizard™ platform, to request a demonstration, please contact your regional Axon distributor, or visit our websites:

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