Beyond the Initial Cost: Achieving the Full Lifecycle Value of LC Investments

How lab managers and analytical scientists can maximize ROI, minimize hidden costs, and drive sustainable profitability with smarter LC decisions

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Executive Summary

Value for Lab Managers and Business Owners

This eBook is a comprehensive, data-rich guide that reframes LC investment from a transactional purchase into a strategic business decision. It delivers clear, actionable insights for decision-makers who are responsible for lab performance, cost control, and long-term profitability.

Strategic insights for decision-makers

Lab managers

Gain tools to optimize workflows, reduce downtime, and justify upgrades with hard data.

Business owners/CEOs

See how LC investment directly impacts profitability, scalability, and competitive advantage.

Procurement officers

Understand why lowest upfront cost does not equal best value, and learn how to ensure smarter deals.

Analysts

Benefit from reduced manual tasks, improved training, and more reliable results.

Key value takeaways

Key Value	Why It Matters	Business Impact
Total Cost of Ownership (TCO) transparency	Many labs focus on upfront costs, but this eBook shows how hidden costs (downtime, maintenance, training, infrastructure) can erode ROI	Helps managers avoid false economies and make smarter, lifecycle-based purchasing decisions
Quantified ROI comparisons: HPLC versus UHPLC	Tables and infographics show that UHPLC delivers up to 5.4× more throughput and 5× lower cost per sample than HPLC	Enables clear financial modeling and justification for upgrading systems
Smart automation = Time and cost savings	– **Agilent InfinityLab Assist:** Saves up to 125.5 hours/year per instrument by automating purging, diagnostics, and maintenance – **Agilent InfinityLab Level Sensing:** Prevents pump and column damage, saving US$1,500/year – **Agilent BlendAssist Software:** Reduces solvent waste and prep time, saving US$900– 1,200/year	These features reduce labor costs, prevent errors, and increase uptime - critical for efficient lab operations
Sample economics and profitability modeling	Detailed tables show how analysis time, sample throughput, and cost per sample vary across LC types	Lab managers can calculate profit per sample and ROI timelines—e.g., fast UHPLC achieves ROI 100× faster than standard HPLC
Risk mitigation and compliance	– **Agilent InfinityLab Sample ID Reader:** Saves up to 135 hours/year by reducing manual errors and improving traceability – **Agilent Intelligent System Emulation Technology (ISET):** Enables method transfer across instruments, saving up to US$16,000/year	Reduces regulatory risk, improves audit readiness, and supports digital transformation

What Really Drives the Cost of LC Ownership

A guide to more efficiency and fewer costs

In today's competitive lab environment, cost control is no longer optional, it's a strategic imperative. This eBook explores how understanding the full life cycle cost of LC instruments can unlock hidden savings, improve uptime, and drive smarter investment decisions. From hidden costs to high-impact automation, this guide reveals how UHPLC delivers 5× lower cost per sample, 100× faster return on investment (ROI), and up to US$20,000 in annual savings—making Agilent LC systems the smarter choice for long-term lab profitability.

UHPLC = Efficiency + ROI

UHPLC cuts cost per sample by up to 5×, boosts throughput by 5.4×, and delivers ROI up to 100 times faster than HPLC.

Smart features, real savings

Agilent's intelligent tools can save up to US$20,000 per year and unlock up to 260 extra hours per year of productive uptime per single LC instrumentissues.

Low upfront cost does not equal low total cost

Budget LC instruments often incur higher long-term expenses due to frequent maintenance, downtime, and reliability issues.

Understanding value pays off

Agilent LC systems offer longer lifespans, higher resale value, and maximum uptime.

Why the cost of ownership matters

Modern labs are under constant pressure to deliver faster, more cost-effective results—without compromising data quality. This is especially true in highly regulated sectors like environmental testing, food safety, and pharmaceuticals.

This eBook explores the key cost drivers in LC operations, offers practical comparisons, and provides actionable insights to support smarter investment decisions. Sample calculations are illustrative only and not exhaustive.

Many labs face profitability challenges driven by rising regulatory demands, market pricing pressures, and increasing client expectations. To stay competitive, it's essential for laboratories to focus on their core competencies and optimize noncore activities.

One such noncore activity is the lifecycle management of LC instruments—from purchase and installation to operation, maintenance, repair, and eventual replacement.

Understanding and managing these lifecycle costs is a strategic advantage. Best practices include case-based cost adjustments and leveraging predictable cost-saving opportunities—without compromising data quality or regulatory compliance.

Workflow disruptions, whether from routine maintenance or unexpected failures, can erode lab efficiency and inflate operating costs. Unplanned repairs and downtime significantly impact long-term economic performance and the total cost of ownership of an LC instrument.

Beyond the price tag: Understanding LC's true cost

The TCO is a comprehensive financial estimate that helps lab managers understand both the direct and hidden costs of purchasing and operating an LC instrument over its full lifecycle. These costs go far beyond the initial price tag and can vary significantly depending on the instrument, infrastructure, and lab setup (see Figure 1).

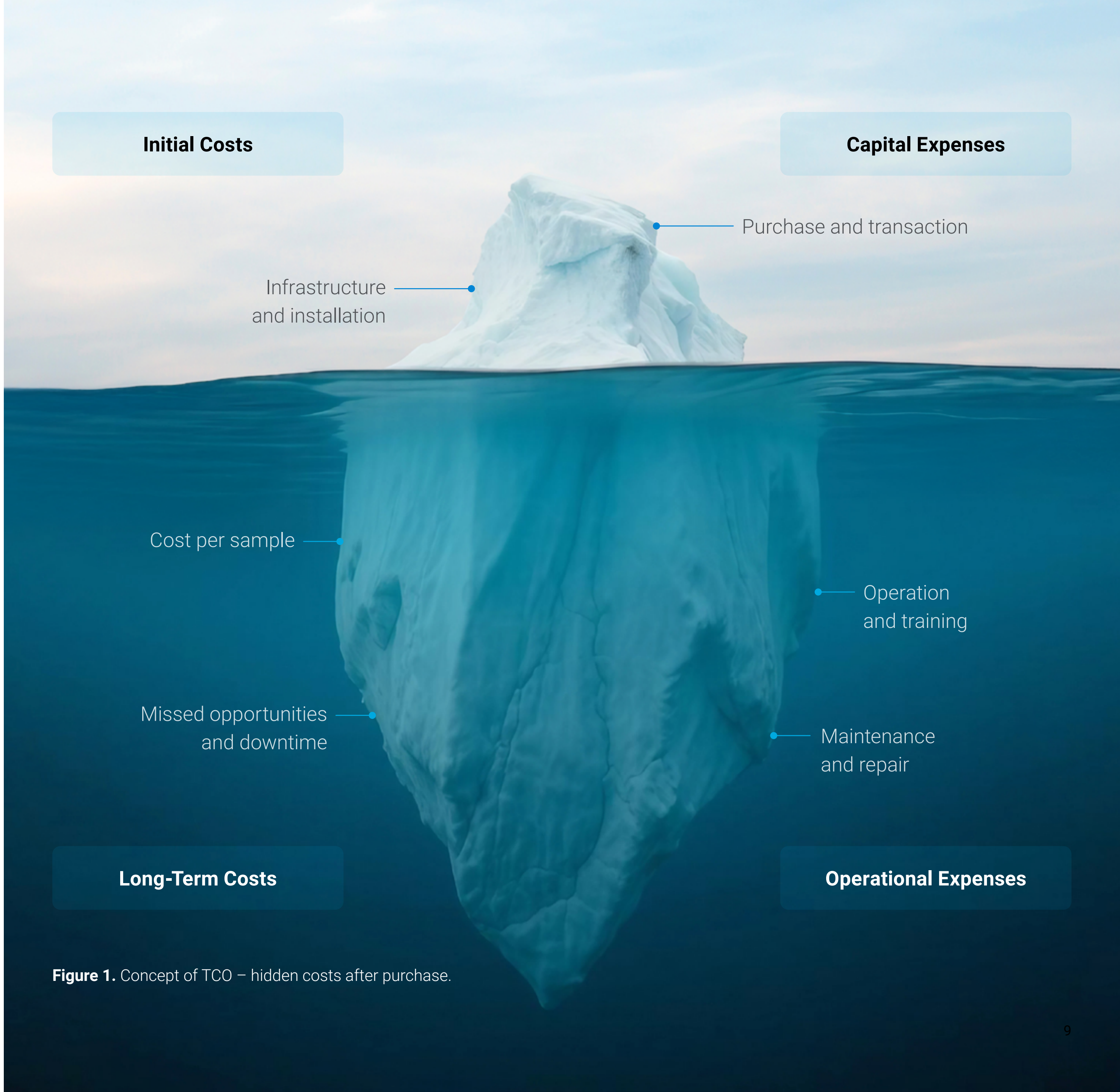


Figure 1. Concept of TCO – hidden costs after purchase.

Why TCO transparency matters

Labs that focus only on the lowest purchase price are often surprised to find that these instruments cost more in the long run—even after accounting for initial expenses. Here's why:

Purchase and transaction

Deep discounts may trigger quick decisions, but often mask compromises in performance, robustness, and usability. These "budget" instruments frequently lack essential accessories or services, which must be added later at a premium. Additional costs may include leasing fees, loan interest, transport, customs, insurance, and depreciation.

Infrastructure and installation

Installing an LC instrument can require more than just bench space. Depending on the detector and lab setup, additional infrastructure—like gas supply, air extraction, surge protection, or even lab expansion—may be needed. Integration with existing systems may also require rewiring, plumbing, or software upgrades.

Operation and training

Ongoing costs include energy consumption, solvents, columns, vials, and proper disposal of used consumables. Software updates and integration tools add further expense. Budget instruments often require more training due to complex or less intuitive operation, increasing time and cost.

How smart maintenance cuts hidden costs

High-quality LC systems typically require predictable, annual preventive maintenance, often with built-in alerts for part replacement. In contrast, lower-cost instruments may need servicing two to three times a year, with unpredictable failures and longer downtime. Maintenance complexity, varied service intervals, and incompatible parts can drive up costs significantly.

Missed opportunities and downtime

Opportunity costs arise when an LC instrument limits lab capabilities—whether through insufficient sensitivity, poor flow stability, or constant operation at maximum capacity. These limitations can lead to lost revenue, reduced throughput, and reputational damage if results are compromised.

Inferior materials may also affect data integrity. For example, leaching from wetted parts can skew results, undermining customer trust and risking contract losses. These hidden costs can quickly exceed several thousand dollars annually, far outweighing any initial savings.

Depreciation and disposal

Quality LC instruments last longer, retain resale value, and are easier to recycle or dispose of. Cheaper systems may require more frequent part replacement, generate more waste, and pose greater challenges for decontamination and disposal. High-quality wear parts also reduce cleaning frequency and prevent damage from abrasion or contamination.

Upfront investment: What you pay first

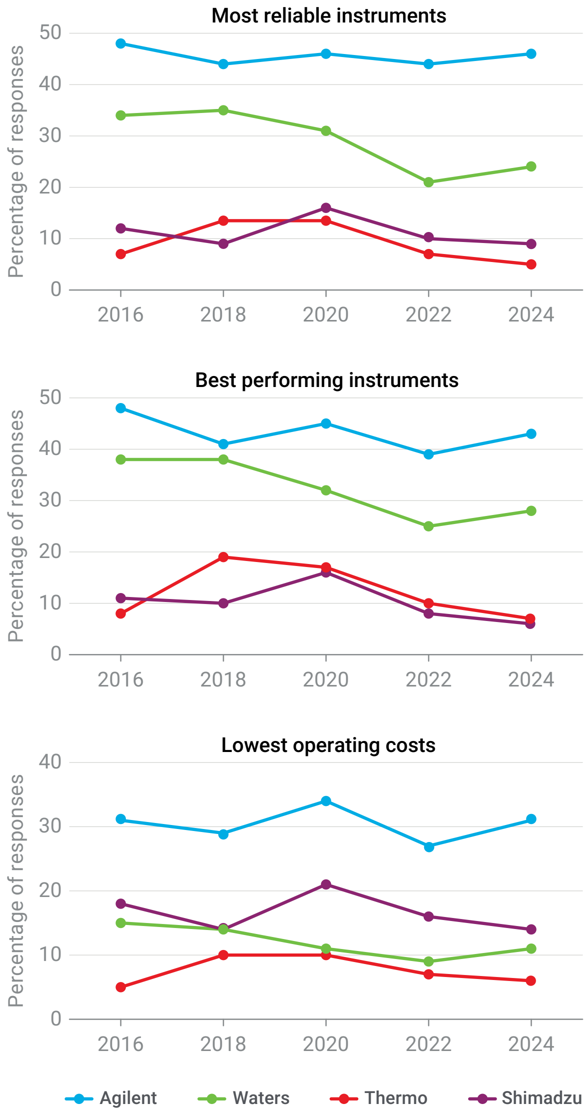
The initial costs of purchasing an LC instrument go beyond the price tag. They vary depending on local conditions, buyer-specific requirements, and country-specific regulations. These factors influence whether payment options like leasing, installment plans, or credit purchases are available.

Additional costs—such as transfer, installation, insurance, and training—may or may not be included, depending on the purchase agreement. Discounts can also vary based on order volume or purchase frequency. In some cases, service contracts may bundle training and maintenance into the initial deal.

A 2025 publication by LCGC magazine[1] revealed the top decision-making criteria for analytical LC instrument users:

– **95% prioritize highest reliability**
– **92% seek the best performance**
– **76% value price-performance ratio**
– **68% consider lowest TCO as essential**

These findings highlight that lab managers are increasingly focused on long-term value—not just upfront saving.



Figures 2 to 4. LCGC survey results.[1]

The long game: Hidden costs and ongoing spend

While upfront costs are important, it's the ongoing operational expenses that have the greatest impact on long-term lab profitability. Keeping these costs low is essential for running efficient, cost-effective LC analyses.

Recurring expenses include routine maintenance, unplanned repairs, and productivity losses caused by instrument downtime. These disruptions not only inflate operating costs but also reduce lab throughput and reliability.

Instrument reliability is critical—not just for consistent results, but also for minimizing downtime and ensuring smooth workflows. Equally important is the reliability of the manufacturer, especially when it comes to:

- **Backward compatibility**
- **Method transferability**
- **Future upgradeability**

These factors directly influence the true price-performance ratio of an LC system.

Figures 2 through 4 illustrate how leading manufacturers compare in terms of reliability, performance, and TCO, based on feedback from hundreds of LC users. When combined, these metrics reveal which vendors offer the strongest overall value.

Another major cost driver is solvent usage and disposal. Solvents are often hazardous and expensive to manage. Using high-quality solvents not only ensures consistent analytical performance but also reduces waste and rework—further lowering total operating costs.

How sample economics drive ROI in LC

If the average analysis time is known, it is easy to estimate how many samples per day can be processed for a typical LC application per LC instrument. Cost items can be calculated on a workday basis to determine the daily labor and consumption costs per LC instrument, resulting in an average cost estimate per sample.

The more cost items included in the calculation and the more accurate and comprehensive these are, the better the cost per sample and TCO of the LC instrument over a given timeframe can be estimated. This calculation helps determine the optimal LC instrument to achieve the fastest ROI.

A simplified cost breakdown for a typical HPLC analysis is shown in Table 1. In this example, the purchase price of an average HPLC instrument is assumed to be US$40,000. Labor and overhead costs per day are estimated at US$400 and include all expenses for the provision and operation of a single HPLC instrument, including the associated laboratory infrastructure, excluding the costs of the HPLC column and solvents used for an average HPLC application. The working time in this example laboratory is 10 hours per day, and work is carried out on 260 days.

Downtime for maintenance and troubleshooting is considered by calculating reduced LC instrument availability and thus fewer sample analyses, while the costs are covered by in-house personnel or a service contract. Downtime also applies to a repair, but a service technician must be paid in addition. In principle, more cost items could be added, but those listed in Table 1 are sufficient for an example calculation. In this example, the cost per sample is US$21.

The simple total cost per sample calculation as shown in Table 1 is common practice and similar templates or calculations can be found online. The grey values in Table 1 can be replaced to create a case-specific cost calculation. Some daily recurring tasks seem to be left out of this simple calculation, but there is a reason for this.

Depending on usage patterns or analysis volumes, preparing the LC instrument can be very time consuming. Essential tasks include purging and equilibrating during start-up or after changing a solvent bottle or LC column, performing system suitability tests, or injecting calibration standards for quantitative analysis of samples. This can easily sum up to about 10 days over the course of a year, which can be added to the average system maintenance days per year in Table 1.

After adding 10 extra maintenance days in Table 1, the number of annual system operating days consequently decreases from 253 to 243 per year and the number of annual samples during working time decreases to 5832 per year, resulting in lower annual laboratory revenue or profit. Interestingly, this has little impact on the cost per sample. In the example of Table 1, the cost per sample increases from US$21 to US$21.06 or by 0.3%.

Table 1. Simplified cost estimate for an average HPLC analysis.

Flow rate	1	mL/min
Typical analysis time	25	min
System purchase price	40000	US$
System lifetime	10	years
Average system maintenance	2	days/year
Average troubleshooting by employee	3	days/year
Average service by Agilent engineer	2	days/year
Service engineer costs including material	2500	US$/day
Working days	260	per year
System operating hours	10	per day
Labor and overhead costs	400	US$/day
Average column cost	600	US$
Average column lifetime	1000	# of samples
Average solvent cost	70	US$/1000 mL
Average solvent waste cost	20	US$/1000 mL

System operating days	253	per year
Annual system operating time	2530	hours
Daily samples during working time	24	# per day
Annual samples during working time	6072	# per year
Solvent used	600	mL per day
Total costs	**127505**	**US$ per operating year**
Service costs	20	US$ per operating day
System depreciation	16	US$ per operating day
Labor and overhead costs	400	US$ per operating day
Solvent costs	42	US$ per operating day
Solvent waste costs	12	US$ per operating day
Column costs	14	US$ per operating day
Total costs	**504**	**US$ per operating day**
Cost per sample	**21**	**US$**

From cost to throughput:
Why UHPLC outpaces HPLC

Traditional or routine HPLC may still use monographs that are many years old and employ HPLC columns with an inner diameter of 4.6 mm, a length of 250 mm, and a particle size of 5 µm. A trend that has continued for decades is the use of shorter columns with smaller inner diameters and smaller particles. Consequently, more modern column formats are increasingly being used in pharmacopoeias, displacing the 4.6 x 250 mm HPLC columns. This reflects the ongoing transition from standard HPLC to fast HPLC, standard UHPLC, and fast UHPLC.

Table 2. Comparison of typical analysis times for average HPLC and UHPLC applications with full or partial re-equilibration of the LC instrument.

	Standard HPLC	Fast HPLC	Standard UHPLC	Fast UHPLC
Example System Gradient Delay Volume (µL)	1100 (±100)	700 (±100)	350 (±50)	130 (±50)
Typical Column Length x ID (mm)	4.6 x 250	3.0 x 150	2.1 x 100	2.1 x 50
Typical Flow Rate (µL/min)	1000	500	250	250
Column Void Volume (µL)	2742	700	229	114
Typical Gradient Analysis Time (min)	**25**	**15**	**10**	**5**
Full Equilibration Volume (mL)	27.4	7	2.3	1.4
Time for Full Equilibration (min)	27.4	14.0	9.1	4.6
Typical Analysis Time with Full Equilibration (min)	**52.4**	**29.0**	**19.1**	**9.6**
Time Difference Versus Standard HPLC (%)	0	-45	-64	-82
Time difference Versus Fast HPLC (%)	+81	0	-34	-67
Time difference versus Standard UHPLC (%)	+174	+52	0	-50
Time Difference Versus Fast UHPLC (%)	+446	+202	+99	0
Partial Equilibration Volume (mL)	6.6	2.1	0.81	0.36
Time for Partial Equilibration (min)	6.6	4.2	3.2	1.4
Analysis Time with Partial Equilibration (min)	**31.6**	**19.2**	**13.2**	**6.4**
Time Difference Versus Standard HPLC (%)	0	-39	-58	-80
Time Difference Versus Fast HPLC (%)	+65	0	-31	-67
Time Difference Versus Standard UHPLC (%)	+139	+45	0	-52
Time Difference Versus Fast UHPLC (%)	+394	+200	+106	0
Time Savings with Partial Versus Full Equilibration (%)	**40**	**34**	**31**	**33**

The total LC analysis time, which includes both the gradient method and the re-equilibration phase, becomes important when comparing standard HPLC with fast HPLC, standard UHPLC, and fast UHPLC[2]. While this total analysis time could have been included in Table 1, to be comparable with similar online information, only the analytical run time was used as the typical analysis time, which (strictly speaking) corresponds to an isocratic application.

It is commonly recommended that 10 times the column void volume is required to fully re equilibrate an LC column. A more recent approach assumes that two times the column void volume is sufficient for LC column reconditioning, and thus LC results are assumed to be reproducible.[3] In Table 2, the system delay volume is added to two times the column void volume to obtain the more generous partial equilibration volume, making reproducible LC results more likely.

To allow for the best possible comparison, Table 2 lists the typical system gradient delay volume, the most used LC column format with the resulting column void volume (66% of the column volume), and the most used flow rate and gradient time for a typical application when using either standard HPLC, fast HPLC, standard UHPLC, or fast UHPLC.

This results in different values for the typical gradient analysis time, typical analysis time (including full equilibration) and analysis time with partial equilibration. Since the equilibration of the LC column is important to obtain reproducible and reliable results, only the two cases with column equilibration are compared. The time savings with partial equilibration compared to full equilibration are between 30 and 40% (see Table 2).

Regardless of whether partial or full equilibration is used, a fast HPLC analysis requires about 40%, a standard UHPLC analysis 60%, and a fast UHPLC analysis about 80% less time than a standard HPLC analysis. However, the greatest time savings of about 50% is achieved by switching from standard UHPLC to fast UHPLC. These and other relationships are shown in Table 2.

Although UHPLC instruments are more expensive to purchase and require high-quality columns and solvents, the performance improvements are significant.

Table 3. Comparison of typical sample throughput and cost per sample from standard HPLC to fast UHPL.

	Standard HPLC	Fast HPLC	Standard UHPLC	Fast UHPLC
Average Instrument Purchase Price (US$)	40000	55000	70000	90000
Average Column Purchase Price (US$)	600		750	
Average Solvent Cost (US$/1000 mL)	70		120	
Typical Analysis Time with Full Equilibration (min)	52.4	29.0	19.1	9.6
Annual Samples During Working Time (# per year)	2900	5200	7900	15700
Annual Samples/Annual Samples with Standard HPLC	1.0×	1.8×	2.7×	5.4×
Cost per Sample (US$)	**43.01**	**23.05**	**15.44**	**8.14**
Cost per Sample/Cost per Sample with Fast UHPLC	5.3×	2.8×	1.9×	1.0×
Analysis Time with Partial Equilibration (min)	31.6	19.2	13.2	6.4
Annual Sample Throughput (During Working Time)	4800	7800	11400	23500
Annual Samples/Annual Samples with Standard HPLC	1.0×	1.6×	2.4×	4.9×
Cost per Sample (US$)	**26.17**	**15.47**	**10.90**	**5.67**
Cost per Sample/Cost per Sample with Fast UHPLC	4.6×	2.7×	1.9×	1.0×
Cost Savings with Partial Versus Full Equilibration (%)	**39**	**33**	**29**	**30**

A comparison of real-world values clearly demonstrates the financial advantages of UHPLC instruments. Table 3 shows typical values for all these parameters commonly found in laboratories and with customer methods. Using Table 1, the expected cost per sample can be calculated for each instrument type listed in Table 3.

As well as time savings, the cost savings with partial equilibration compared to full equilibration are also between 30 and 40% (see Table 3). When switching from standard HPLC to fast HPLC, the cost per sample decreases on average by a factor of 1.7, to standard UHPLC by a factor of 2.5, and to fast UHPLC by a factor of 4.9. **The cost per sample is inversely proportional, being about five times higher with standard HPLC than with fast UHPLC**. Table 3 shows all values to enable further individual comparisons.

Similar factors also apply to the increase in annual sample throughput. There is always a doubly positive effect on the laboratory's profitability when switching from standard HPLC to fast HPLC, standard UHPLC, or fast UHPLC. In a direct comparison between standard HPLC and fast UHPLC, for example, around five times more samples can be analyzed in the same timeframe, with the cost per sample being around five times lower.

Turning investment into impact: Maximizing LC profitability

The average price for a simple contract sample or single LC analysis may be around US$80. In some cases, this rate may be significantly higher (but rarely less), while an analysis in an in-house laboratory may be billed internally at an average rate of US$45. In Table 4, theoretical annual profits are calculated using the classic LC analysis with full column re-equilibration, as well as the fast approach with partial re-equilibration based on the figures from Tables 1 to 3.

Table 4. Theoretical annual profit per sample analysis, assuming the values from Tables 1 to 3.

	Standard HPLC	Fast HPLC	Standard UHPLC	Fast UHPLC
Profit with US$43.01 Income (Full Equilibration, US$)	0	19.96	27.57	34.87
Profit with US$45 Income (Full Equilibration, US$)	1.99	21.95	29.56	36.86
Profit with US$80 Income (Full Equilibration, US$)	36.99	56.95	64.56	71.86
Profit with US$26.17 Income (Partial Equilibration, US$)	0	10.70	15.27	20.50
Profit with US$45 Income (Partial Equilibration, US$)	18.83	29.53	34.10	39.33
Profit with US$80 Income (Partial Equilibration, US$)	53.83	64.53	69.10	74.33

The example values assume full utilization of the LC instrument and account for the deductible operating costs listed in Table 1. To determine the actual profit per sample, use the real sample throughput and subtract all relevant one-time or recurring costs. These may include method development, revalidation of methods or instruments, complex sample preparation, and any unused consumables, such as solvents, that are discarded. All such costs should be deducted on a proportional basis.

While UHPLC systems have a higher upfront cost than HPLC, they offer better long-term value when sample throughput supports full instrument utilization. Profitability can also be improved by partially equilibrating the LC column before analysis, rather than fully equilibrating it. This approach applies to all LC instruments, but its effectiveness depends on the robustness and specific requirements of the LC method.

Transitioning from traditional HPLC monographs to faster LC methods may require a higher initial investment, procedural changes, staff training, and administrative effort—but it delivers long-term benefits. An LC system capable of both HPLC and UHPLC, while meeting all system suitability and method transfer requirements, offers a significant competitive edge.

Due to different LC instrument characteristics such as gradient delay volume, peak dispersion behavior, or technologies used, special features and functions are required to enable a fast UHPLC instrument with a 4.6 x 250 mm column to achieve the same results as on a standard HPLC. Advanced technology is also increasingly used to gain more insight into the LC instrument, stay connected to it, and automate daily LC routines. Automated HPLC operation with real-time information and system support makes an LC instrument work more effectively and efficiently. When comparing fast UHPLC to standard HPLC, the financial and operational advantages are clear across both in-house and contract LC analysis (Figure 5). These results underscore the significant economic and throughput benefits of fast UHPLC, especially when full column equilibration is used.

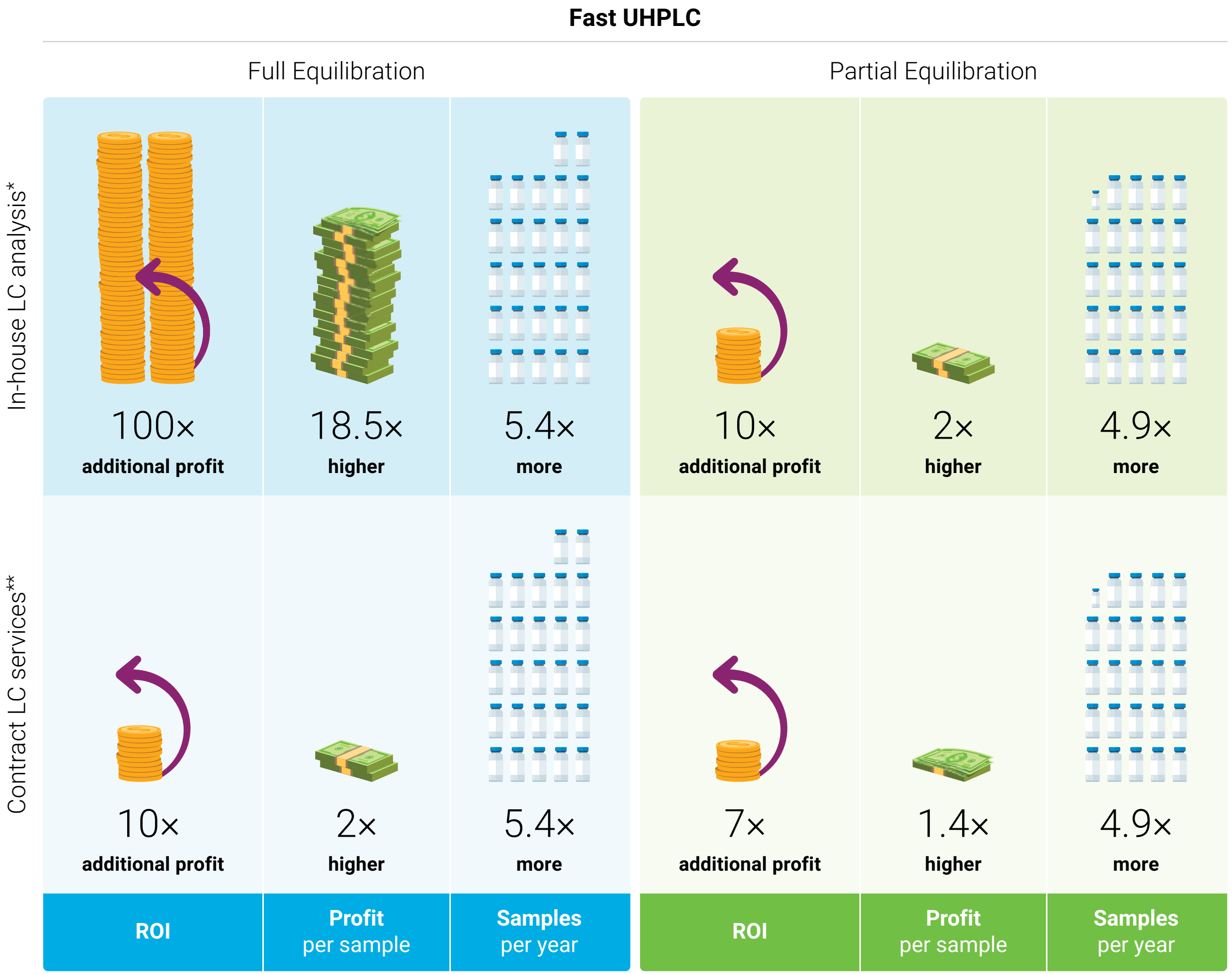


Figure 5. Financial impact of fast UHPLC versus standard HPLC: Annual profit per sample outcomes across lab business models.

* billed internally at US$45
** analysis costing US$80 per sample, see Tables 3 and 4

How Agilent InfinityLab LC Systems drive sustainable profit

What if your next LC investment could save over 125 hours of lab time per year, without adding complexity? Agilent InfinityLab Assist transforms routine LC operations into strategic time savings, freeing up resources, reducing errors, and protecting sample throughput. For lab managers, this means faster onboarding, fewer disruptions, and measurable returns on every instrument hour.

InfinityLab Assist

The Agilent Infinity III LC Series adds features that increase system intelligence, reduce demands on the user, and prevent interruptions before they occur. A real-time dashboard provides users with instant insights into instrument usage and wear, trends, and assisted guidance for maintenance and troubleshooting tasks. This results in a lower cost of ownership.

Designed to support both novice and experienced users alike, the InfinityLab Assist helps users perform tasks that can't be automated, saving time and reducing errors.

> ***"What impressed me most about the Infinity III is its convenience and efficiency. It liberates us from the heavy workload in the lab. With InfinityLab Assist, the instrument can be purged and equilibrated before I arrive at the lab. Thanks to InfinityLab Assist, junior lab technicians can quickly improve their skills – troubleshooting issues and performing instrument maintenance with ease."***
>
> – **Ling Zhou**, Healthy Star Bio-Tech R&D Ltd, China.

Its intuitive local interface enables hands-on training and skill development at the bench, while remote access via a web browser allows managers to monitor and guide operations in real time. This dual approach minimizes operational overhead and accelerates onboarding, contributing to a more efficient, error-resistant lab environment.

Benefits include built-in diagnostics, with guided maintenance and troubleshooting right in front of the instrument. Automation of daily HPLC routines such as instrument startup, shutdown, and purge can be scheduled or initiated at anytime from anywhere (see Table 5).

The health of the LC instrument can be viewed immediately as it is logged and can be accessed via the touchscreen display or a remote browser. Users can assess performance changes and quickly identify potential root causes. In the event of unexpected or too rapid wear of a part or consumable, users can be automatically notified, allowing them to proactively avoid unplanned instrument downtime or the need to re-analyze samples.

A source of error can be located and corrected much faster, significantly reducing instrument downtime. Improved data compliance can be achieved by minimizing the likelihood of out-of-specification results.

Up to 125.5 operating hours, representing about 12.5 days or 5% of LC instrument uptime, can be saved per year for sample analysis.

The samples saved per year in Table 6 are solely due to the time saved by InfinityLab Assist. For the sake of accuracy, it must be pointed out that the numbers given here represent sample losses that occur without using InfinityLab Assist. This is not an additional number of samples or profit increase, but an avoidance of sample and profit losses.

Fewer repairs and, as a result, lower service costs can also be expected with an intelligent LC instrument that predicts, assists, guides, and checks correctness of maintenance activities with self-diagnostics. It quickly becomes clear that the investment in InfinityLab Assist pays for itself very quickly.

Table 5. Data generated through laboratory tests to estimate time savings per LC instrument operating 10 hours/day and 253 days/year.

	Time Saving Potential	Hours Saved per Year	Supporting Information
Access Customizable Home Screen	~3 min, daily	12.5	Saves time by gaining instant insight into important role-related information without having to click through the display menu
View Instrument Status Screen	~5 min, daily	21	Saves time compared to checking instrument performance by logging into the PC and then opening the CDS
Schedule Tasks (see below)	~10 min, weekly	8.5	Saves time by creating repeatable tasks for scheduling and processing these automatable tasks
Automated Purging (Task)	~15 min, weekly	12.5	Saves time compared to manual LC system purging, without standing in front of the LC system, and can be an automated task
Make System Ready (Task)	~30 min, weekly	25.5	Saves time through automatic system start, including equilibration and further settings of the LC system as an automated task
System Standby (Task)	~20 min, weekly	17	Saves time through automatic system shutdown, including flushing and further settings of the LC system as an automated task
System Diagnostic (Task)	~5 min, weekly	4.5	Saves time through simple routine diagnosis that the user can carry out system-guided or as an automated task
Use PIN-Protected User Roles	~45 min, monthly	9	Saves time by avoiding unintentional operating errors or interruptions that cause incorrect results or system shutdown
Receive Health Status Notification	~0.5 day, annually	5	Saves time with push notifications for minor problems and disruptions to avoid major and unexpected outages
Run Guided Maintenance and Assisted Troubleshooting	~0.75 day, annually	7.5	Saves time through guided maintenance tasks and the elimination of small to medium issues
Access Independent System Log	~0.25 day, annually	2.5	Saves time with instant insight into the system log for audits or root cause analysis with unquestioned data compliance
Up to		**125.5**	**hours per year can be saved in total**

InfinityLab Level Sensing

The automatic solvent level detection of InfinityLab Level Sensing prevents bottles from running dry. Solvent consumption is predicted and compared with the solvent supply before starting a sequence. If there is not enough solvent in one of the bottles used, a warning is issued so that sample analyses can be completed successfully.

Through InfinityLab Level Sensing, damage to LC pump parts is prevented, and time-consuming pump overhauls and sample re-analysis are avoided. This saves on wear parts, maintenance, and downtime costs. Worn piston seals or check valves due to a pump running dry are no longer a problem. These maintenance activities can cause two hours of downtime, which can be converted into productive lab hours per year with InfinityLab Level Sensing.

When an LC column runs dry, it often becomes unusable and must be replaced, even if it is brand new. Uptime lost to maintenance results in lost sample throughput and profit, and an underused LC column increases overall costs. Some samples may also need to be re-analyzed if the solvent lines run dry during or before sample analysis. Overall, approximately US$1,500 in material and time costs can be saved annually with InfinityLab Level Sensing.

InfinityLab Sample ID Reader and Advanced Sample Linking

The use of sample barcodes simplifies any analytical LC workflow. Many potential user errors are eliminated because the assignment of the correct sample to the analysis is much easier to handle, check, and correct. This not only creates the greatest possible analysis reliability, confidence, and convenience, but also saves processing time and costs.

Agilent 1260 and 1290 Infinity III Multisamplers can be optionally equipped with the InfinityLab Sample ID Reader, which identifies sample vials by reading their barcode. It adds the barcode information of the scanned sample to the OpenLab sequence table or compares it with the stored sample information for verification.[6]

Manual labeling of sample vials is no longer necessary with data matrix code labeled vials from Agilent. Sample mix-up investigations are avoided because sample vials can be placed anywhere in the tray. The sample identified by the barcode is listed in the results table, with misplaced samples being highlighted in the OpenLab sequence.

The InfinityLab Sample ID Reader allows samples to be measured in a specific desired order. This means that samples can be loaded into an Infinity III Multisampler in any order.[7] The barcode information of the identified position is listed in the OpenLab sequence table after data analysis for final confirmation of the sample measurement. This saves time and increases user convenience by avoiding all kinds of errors.

Table 6. Samples saved per year due to the 125.5 hours saved per year from Table 5, considering Tables 2 to 4.

	Standard HPLC	Fast HPLC	Standard UHPLC	Fast UHPLC
Samples Saved, Full Column Equilibration (#/year)	144	260	394	784
Samples Saved, Partial Column Equilibration (#/year)	238	392	570	1177
Samples Saved, No Column Equilibration (#/year)	301	502	753	1506

Integrating an Agilent Infinity III LC instrument with the InfinityLab Sample ID Reader in a client-server environment allows the use of additional software such as Advanced Sample Linking[8] and Agilent Sample Scheduler for OpenLab. This enables a complete digital workflow solution that reduces the risks associated with manual sample transfer and labeling steps.

Samples from any laboratory information management system can be seamlessly linked to their sample vials. This workflow uses barcodes that allow each individual sample to be tracked from first sample preparation to final LC analysis result. The presence of a barcoded sample is detected without the need to manually enter its location. This saves time and improves usability, minimizing errors throughout the workflow.

When manually creating a sample sequence, the time required to enter a sample position and check the corresponding input is at least 15 seconds.

This results in the times given in Table 7 for an assumed sample throughput with partial equilibration of the LC column. If an error occurs in just 0.5% of all annual samples, e.g., due to incorrect labeling or sample mix-up, 1% of the annual LC instrument availability is lost because the required re-analysis time must be added. Interestingly, this adds up to 25 hours for all LC instrument variants, since full utilization is assumed for all of them.

Assuming a fast error detection time of five minutes on average, the time for error investigation adds up to several hours per year (see Table 7). In individual cases, the time required can be many times higher. This has the potential to save 135 operating hours per year, which can then be re-invested for other profitable projects.

It is not surprising that eliminating manual sample entry into the OpenLab sequence table and avoiding all kinds of manual errors results in enormous time savings, especially in UHPLC. This leads to a **13-fold increase in the number of samples saved per year**. The numbers are approximately 10% lower if the column is fully equilibrated before analysis.

BlendAssist Software

Agilent flexible pumps can produce various solvent mixtures with all kinds of additives in stock solutions. The intelligent BlendAssist Software feature enables automatic mixing of buffer or additive concentrations without manual interaction, simplifies an always reproducible LC solvent preparation, and accelerates method development.

Instead of having to manually prepare many different solvent bottles with different concentrations of buffers or additives, only pure solvent and concentrated stock solutions are prepared. After entering the stock concentration and the desired concentration into the BlendAssist software feature, flexible pumps provide the mobile phase composition required for each specific analysis. In this way, the costs of purchasing and disposing of solvents can be significantly reduced compared to manual premixing. Automation also eliminates errors in solvent preparation and ensures its reproducibility.

The economics of BlendAssist depend on the number of different solvent blends required per year. For example, typical method development tasks include evaluating six buffer or other additive concentrations. With a premixing procedure, laboratory personnel would have to manually prepare up to 12 solvent bottles, two for each concentration. However, with BlendAssist, only four solvent solutions need to be prepared.

After LC analyses are completed, especially after method development, a portion of the premixed solvents is often not reused. This portion can represent up to 15% of the annual solvent consumption.[4, 5] With BlendAssist, solvent use becomes precise and on-demand, eliminating the need to dispose of unused solvent. The savings shown in Table 8 reflect only the solvent used for analysis. They do not account for the additional cost of wasted or discarded solvent, which BlendAssist helps avoid entirely.

Table 7. Estimated savings per year for sample analyses running with partial column equilibration.

	Standard HPLC	Fast HPLC	Standard UHPLC	Fast UHPLC
Manual Sample Entries in LC Sequence (Hours per year)	20	33	45	100
Sample Repetition Due to Manual Error (Hours per year)	25			
Investigations Into Errors with Samples (Hours per Year)	2	3	5	10
Total System Operating Hours Saved per Year	47	61	75	135
Samples Saved; Partial Column Equilibration (#/year)	89	191	341	1266

Table 8. Costs saving potential when using BlendAssist and theoretical annual profit per fully utilized LC instrument, assuming the values from Tables 1 to 3.

	Agilent 1260 Infinity III Flexible Pump	Agilent 1290 Infinity III Flexible Pump
Approximate Solvent Cost per Year (Purchase and Disposal) (US$)	8000	6000
Solvent Cost Saving with BlendAssist per Year (US$)	**1200**	**900**

Intelligent System Emulation Technology (ISET)

Agilent 1290 Infinity II and III and 1260 Infinity II and III Prime LC instruments have the unique ability to emulate other LC instruments including non-Agilent systems using ISET.

ISET enables smooth and hassle-free HPLC method transfers. Before methods are sent to partner labs, they can be proactively adapted to the target instrument. When a method is received, ISET simply emulates the LC instrument on which the original method was developed. This risk-free, one-click transfer of methods from one LC instrument to another offers several ways to minimize instrument-related costs. The first is the method transfer functionality described, as it is used directly with ISET and without any instrument adjustments.

The second option is the opposite. All LC methods are developed on an Agilent 1290 Infinity II and III or 1260 Infinity II and III Prime LC instrument that can emulate target instruments using ISET. The developed LC method thus provides all desired LC results without adjustments to the target LC instrument. This enables the fastest possible method development at UHPLC speed, even if an HPLC method is the target.

A single Agilent LC instrument with ISET functionality can emulate up to seven LC instruments, as it can run all those LC methods without compromise. In addition, working with just one type of instrument saves space, simplifies the overall lab workflow, and reduces costs for additional instruments, training, spare parts, maintenance, and more. Legacy HPLC methods can also be converted and run at UHPLC speed with ISET to take full advantage of improvements in resolution and sensitivity.

Depending on its utilization level, a single Agilent LC instrument with ISET can easily take over the tasks of other LC instruments due to its emulation capabilities. On average, this can eliminate the need for up to one other LC instrument.[4] This not only saves the purchase price of the other LC instrument, but also the annual maintenance and repair costs over the average 10-year lifetime of an LC instrument, resulting in cost savings of up to US$16,000 per year (see Table 9).

Table 9. Cost-saving potential of ISET for different LC instrument types.

	Standard HPLC	Fast HPLC	Standard UHPLC	Fast UHPLC
Average Instrument Purchase Price (US$)	40,000	55,000	70,000	90,000
Average Maintenance and Service Costs (US$ per year)	7,000			
In Total After 10 Years (US$)	110,000	125,000	140,000	160,000
Savings per Year (US$)	**11,000**	**12,500**	**14,000**	**16,000**

InfinityLab Fitting

An incorrect LC column connection can lead to dead volume. In such a case, peak tailing, peak broadening, split peaks, or carryover are observed. This can distort the analysis results, which when in doubt must be repeated or requires a lot of documentation. Incorrect connections can damage the LC column, leading to productivity losses and unplanned costs (for example, repeated LC analyses). The Agilent InfinityLab Quick Connect Fitting and Agilent InfinityLab Quick Turn Fitting simplify installation and ensure that every user, regardless of experience, achieves a perfect column connection.[4]

Every one to two years, an LC column can become damaged due to or following incorrect installation and must be replaced, costing an average of US$600 to 750 per LC column. Often, two columns are used in an LC instrument, either by swapping or manual replacement, multiplying the number of broken columns by about a factor of two. In short, using the InfinityLab Quick Connect and Quick Turn Fittings can save up to US$1,500 per instrument per year.

Automatic Column Regeneration and Dual Needle Injection

Continuous LC analysis can reduce overall analysis time by 45% through eliminating the time required to wash and re-equilibrate the column. Automatic Column Regeneration (ACR) uses an LC instrument with two individual pumps. This allows two analytical columns to be switched to optimize LC instrument productivity. Starting the gradient separation of the next sample on a second column while the first column is equilibrated after analysis achieves continuous LC analysis.

Further time optimization can be achieved with the dual needle option on InfinityLab multisamplers. The smart overlap high-throughput mode allows injection with the first needle to start an analysis while the second needle prepares a sample for the next run.

Time savings of up to 60% (Figure 6) can be achieved by alternating column regeneration and dual needle injection.[9] The time for re-equilibration of the LC analytical column and the cycle time for sample collection can be converted into productive time when ACR is combined with dual needle injection.

Table 10. Time saving potential per analysis through automatic column equilibration (ACR).

	Standard HPLC	Fast HPLC	Standard UHPLC	Fast UHPLC
Typical Gradient Analysis Time (min)	25	15	10	5
Typical Analysis Time with Full Equilibration (min)	52.4	29.0	19.1	9.6
Time Savings with ACR (min)	**25**	**14**	**9.1**	**4.6**
Analysis Time with Partial Equilibration (min)	31.6	19.2	13.2	6.4
Time Savings with ACR (min)	**6.6**	**4.2**	**3.2**	**1.4**

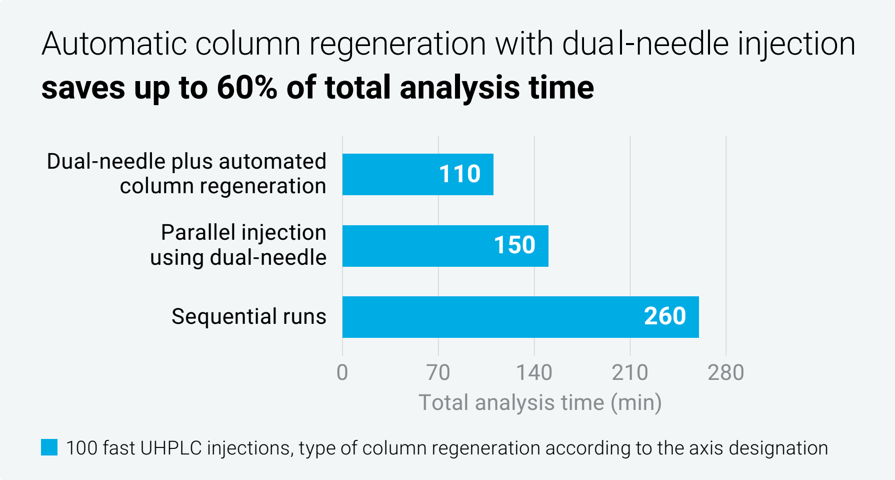
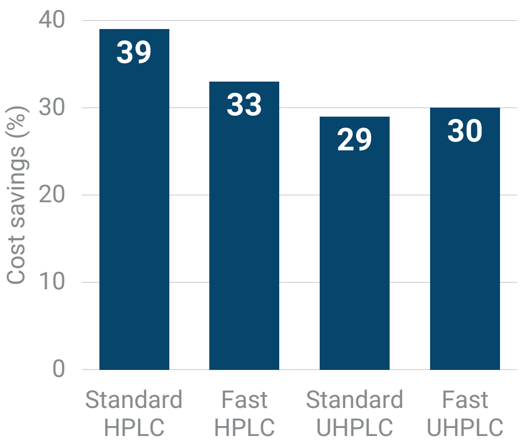


Figure 6. Time savings with ultrahigh throughput UHPLC over 100 injections using alternating column regeneration and dual needle option.[9]

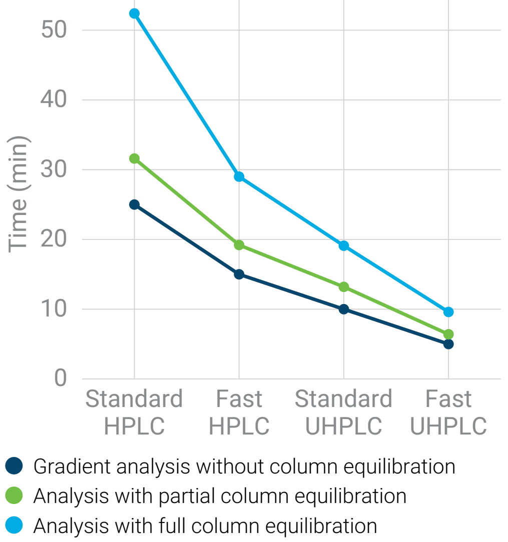
Real-world wins:
Savings with Infinity III LC instruments

LC users consistently rate Agilent LC instruments as market leaders in quality and efficiency.[1] Agilent LC instruments have always been valued for their exceptional accuracy and precision, reliably delivering best repeatability and performance in LC analysis without compromising on robustness or ease of use. The infographics below explore key cost-saving considerations covered in this eBook, from purchase to TCO of LC instruments.

Cost savings per sample for partial versus full LC column re-equilibration after analysis



Comparison of average analysis times

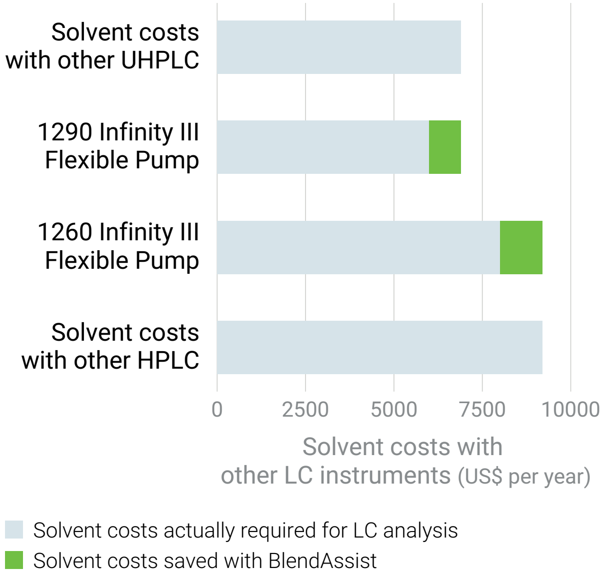


Figures 7 to 8. Cost-saving considerations from standard HPLC to fast UHPLC.

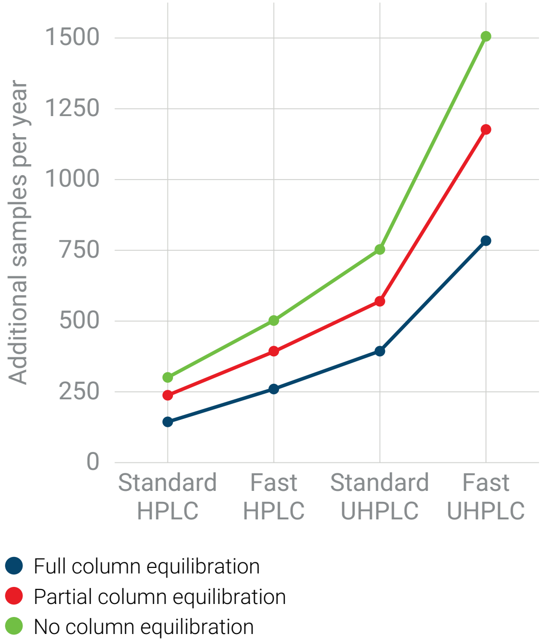
Sustainable features that intelligently automate daily tasks directly address the challenges faced by LC users. With Agilent Infinity III LC instruments, unique features have been implemented with the thoughtful robustness and reliability Agilent is known for. The exceptional ease of use and intelligent diagnostic technology directly translates to lower cost of ownership without compromising on data quality.

The comparison values in the infographics are based on examples from this eBook and represent maximum estimates. The actual results depend on parameters that are unique to each specific calculation case.

BlendAssist saves up to 15% of solvent costs



InfinityLab Assist saves up to 125 operating hours per year



Figures 9 to 10. Cost-saving considerations with Agilent InfinityLab LC solutions.

The bottom line:
Why smart LC investment pays off

At first glance, a low-cost LC instrument may seem like a smart choice. But over time, hidden costs begin to surface. Lower build quality often leads to frequent breakdowns, increased maintenance, and costly downtime. These systems tend to be less flexible and reliable, making planning difficult and long-term performance inconsistent. They also require more training and involve more complex operation.

By contrast, investing in a high-quality LC system—like those from Agilent—delivers lasting value. These instruments are built for durability, ease of use, and consistent performance, helping labs stay productive and efficient.

Switching from standard HPLC to UHPLC involves an initial investment, but when the system is fully utilized, the ROI is rapid. Over time, labs benefit from significantly lower cost per sample and improved profitability—especially when UHPLC analysis is priced at traditional HPLC rates.

Agilent Infinity III LC systems are engineered to maximize efficiency and reduce hidden costs.

Key features include:

- **InfinityLab Assist:** Prevents interruptions and saves up to 125.5 operating hours per year
- **InfinityLab Sample ID Reader with Advanced Sample Linking:** Adds 135 hours per year in time savings
- **Dual Needle Injection:** Automates column regeneration, reducing analysis time by up to 60%
- **BlendAssist Software, InfinityLab Level Sensing, and InfinityLab Fitting:** Each saves US$1,200 to 1,500 per year
- **Intelligent System Emulation Technology (ISET):** Saves up to US$16,000/year

When fully utilized, these features can deliver US$20,000 in annual savings and recover 260 additional hours of productive uptime. With a second pump and autosampler needle, labs can achieve up to a 120% increase in sample throughput by offloading equilibration and preparation time.

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DE-010712

Published in the USA, October 31, 2025
5994-8725EN

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