

Total Value of Ownership (TVO) Assessment: Lenovo Engineered Solution for Microsoft SQL Server

Sponsored by Lenovo

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Executive Summary

The speed and scope of online transactions and business decision-making is rapidly growing because of several emerging technology trends – Cloud, Social, Mobile, the Internet of Things (IoT), Analytics and Artificial Intelligence/Machine Learning (AI/ML). As the volume and variety of data continue to explode, many organizations are investing in Microsoft SQL Server to support faster and more secure online transactions and to extract deeper actionable insights.

However, rising operations costs, cumbersome manual processes and disparate data sources have become the Achilles heel in deploying and operating Microsoft SQL Server at many organizations. Downtime, security/compliance/governance and lack of skilled resources are also major issues. To meet these challenges, organizations must deploy a cost-effective, easy-to-use, high-performance, reliable and integrated IT solution to consistently deliver the best business outcomes.

The Lenovo Engineered Solution for Microsoft SQL Server is designed to address these challenges. It delivers the right mix of hardware infrastructure, software, and services to optimize a wide range of data warehouse and transactional database use cases. Pre-tested and tuned hardware configurations help reduce the total cost of ownership (TCO) and time to value through better price and performance, rapid deployment, and consolidated storage. With better regulatory compliance and governance, this solution also streamlines complex online transactions and accelerates data-driven decision making by empowering innovation and lowering security and downtime risks.

*Compared to competitive alternatives, the Lenovo Engineered Solution for Microsoft SQL Server enables quicker deployments, faster time to value, lower risks of failure and higher revenues/profits. It also enhances the productivity of database administrators, architects, data scientists, data engineers, application developers and analysts; allowing clients to optimize their **Total Value of Ownership (TVO)**, which is Total Benefits – Total Costs.*

The comprehensive TVO analysis presented in this paper compares the Lenovo Engineered Solution for Microsoft SQL Server with a corresponding competitive alternative for three configurations – small, medium and large. This cost-benefit analysis framework considers cost/benefit drivers in a 2 by 2 continuum: Direct vs. Derived and Technology vs. Business mapped into four quantified quadrants: Costs, Productivity, Revenues/Profits and Risks.

*Compared to a competitor, clients deploying the Lenovo Engineered Solution for Microsoft SQL Server **can improve the three-year ROI for all three configurations** even assuming slightly higher hardware acquisition costs. Likewise, the Payback Period (PP) for the Lenovo solution is shorter; providing clients faster time to value. In fact, these ROI/PP improvements grow with configuration size; offering clients better investment protection as they deploy higher value Analytics and as data volumes and complex transactions continue to grow.*

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Optimizing Business Value

To Harness the Growing Value of Data, Infrastructure Matters

The relentless rate and pace of technology-enabled business transformation and innovation are astounding. Several fast-growing intertwined technology trends (Figure 1) – Cloud, Big Data Analytics, Social, Mobile, Internet of Things (IoT) and Artificial Intelligence (AI)/Machine Learning (ML) – continue to be profoundly disruptive, reshaping the information technology (IT) industry. Central to these trends is Data which is growing exponentially.

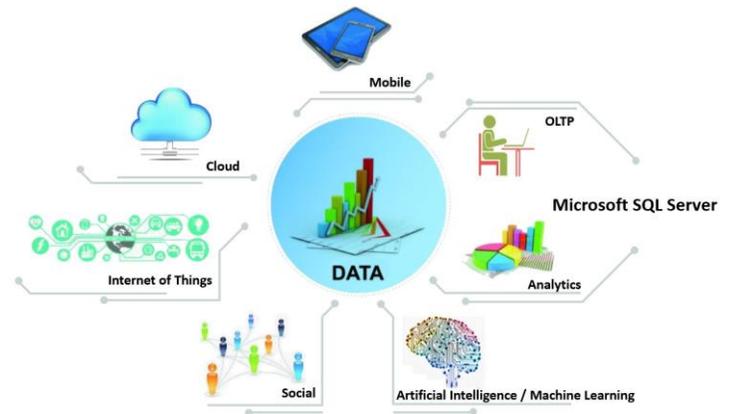


Figure 1: Intertwined Technologies of Cloud, Social, Mobile, IoT, Transactions, Analytics and AI/Machine Learning

By 2025, the world is expected to have a total of 180,000 exabytes or 180 trillion gigabytes (10^{18} bytes), up from less than 10,000 exabytes in 2015.¹ In 2018, about 4.3 exabytes of data is expected to be created daily. Twelve exabytes require about 100,000 square feet of data center space, or the size of a Walmart Superstore.²

To support complex online transaction processing (OLTP) and Business Analytics and get actionable and time-critical insights from this ever-increasing volume and variety of data and stay competitive, many organizations are investing in and modernizing the Microsoft SQL Server database. The reasons why the Microsoft SQL Server database will continue to be the preferred method to work with data include:

- Widespread use with millions of well-trained users.
- Stability with relational database management systems supporting SQL compatibility, transactional consistency, enforced schema and enhanced security required by enterprises.
- Optimized for performance and scale with consolidated data/storage and with significant reduction of system testing and tuning.

To deploy complex Analytics and OLTP, many organizations use cumbersome manual processes and/or multiple disparate systems/tools that don't easily integrate or interoperate. This impedes business value realization and lowers the Total Value of Ownership (TVO).

Lenovo Engineered Solutions for Microsoft SQL Server integrate a variety of Lenovo ThinkSystem servers, storage, and infrastructure products combined with the capabilities of Microsoft SQL Server 2016/2017 Enterprise and Standard Editions. These solutions provide many benefits to address the data deluge:

- Seamless growth – scaling capacity or performance is fast and painless; often triggered with a click or by a simple command.
- Schema flexibility – as applications mature, schema changes can be made without taking the system down.
- High availability – higher reliability with fault tolerance and multiple redundancies

¹ "IoT Mid-Year Update From IDC And Other Research Firms," Gil Press, *Forbes*, August 5, 2016.

² <https://www.forbes.com/sites/kashmirhill/2013/07/24/blueprints-of-nsa-data-center-in-utah-suggest-its-storage-capacity-is-less-impressive-than-thought/#573c96127457>

Data central to key emerging technology trends

Eighteen-fold increase in data volumes in 10 years

Lenovo Engineered Solutions for Microsoft SQL Server provide a validated and tuned platform for better data consolidation, governance, compliance and security

- Advanced security features – built in the hardware encryption, in-memory security technology, security on Windows, Linux, and Docker containers.
- Microsoft validated and certified solutions for business analytics.
- Intel Select validated solutions for transactional database requirements.

These high-value infrastructure solutions are being deployed by many organizations worldwide to support faster and more trusted online transactions and to extract deeper actionable insights amidst the growing volume and variety of data.

This paper uses a Total Value of Ownership (TVO) model that quantifies some of the key interrelated cost and benefit drivers and differentiators of the Lenovo Engineered Solution for Microsoft SQL Server over a competitive alternative. These cost and value drivers were identified using several in-depth interviews representing Lenovo customers and Analytics experts across multiple industries and company sizes, Lenovo input and other research. This holistic cost-benefit analysis examines various configuration sizes (small, medium and large) for both Analytics and OLTP that are best suited for any enterprise – small or large.

High Level TVO Framework + Key Cost/Value Drivers

The TVO framework (Figure 2) categorizes the interrelated cost/value drivers (circles) for Analytics and OLTP by each quadrant: Costs, Productivity, Revenue/Profits and Risks. Along the horizontal axis, the drivers are arranged based on whether they are primarily **Technical** or **Business** drivers. Along the vertical axis, drivers are arranged based on ease of measurability: **Direct** or **Derived**.

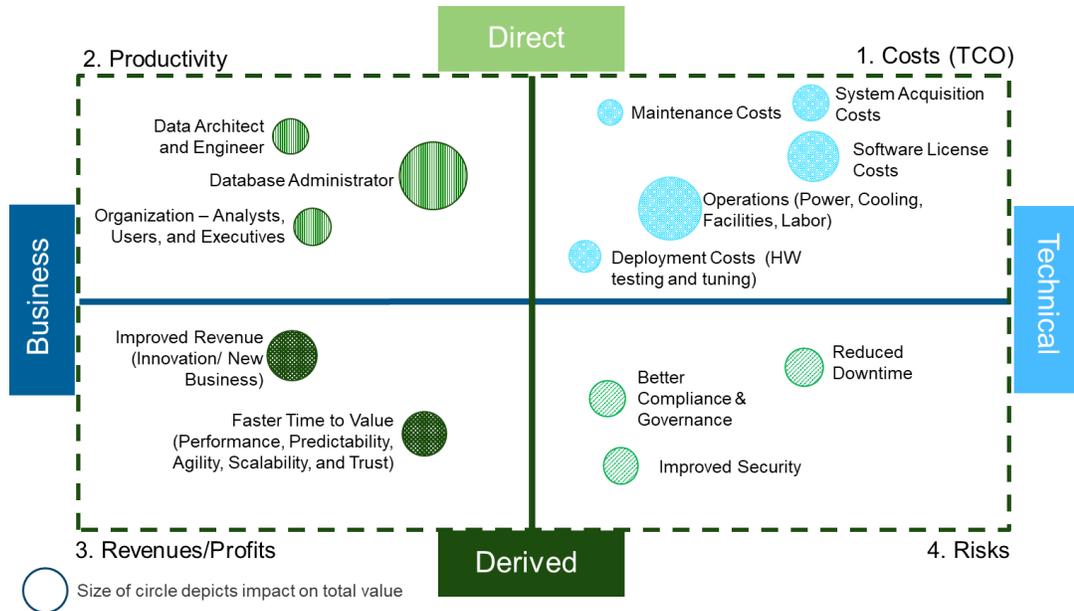


Figure 2: TVO Framework for Analytics and OLTP with Cost/Value Drivers

The cost/value drivers for Analytics are depicted as circles whose size is proportional to the potential impact on a client’s Total Value (Benefits – Cost) of Ownership or TVO as follows:

1. **Total Costs of Ownership (TCO):** Typical costs include: one-time acquisition costs for the hardware and deployment, and annual costs for software, maintenance and operations. Operations costs are typically the largest cost component for these solutions.

Through in-depth interviews and research, key cost/value drivers identified and quantified holistically

TVO Framework organized by Technical/Business and Direct/Derived cost and value drivers

Value includes lower costs, enhanced productivity, higher revenues/profits and lower risks

TVO typically grows with data/configuration size

3 Year TVO analysis for three configurations: small, medium and large

Operations costs are typically the largest costs for OLTP and Analytics projects

- 2. Productivity:** The TVO model quantifies the value of productivity gains of database administrators, data engineers/architects, and the organization (analysts, users and executives).
- 3. Revenue/Profits:** Faster time to value with better performance-optimized parallel and in-memory processing and a single open, flexible and agile platform. Greater innovation and better decision-making capabilities spur growth, revenues and improve profits.
- 4. Risk Mitigation:** Lower risk of project failure (even well-planned Analytics projects have up to 60% failure rate³) with lower downtime, improved governance/compliance and enhanced security/ privacy.

The TVO for both Analytics and OLTP typically grows with data/configuration size, with key differentiated features in the Lenovo Engineered Solution for Microsoft SQL Server (detailed in Results Discussions section) driving added value over competitive alternatives.

Total Value of Ownership (TVO) – Assumptions

The Cost-Benefit Analysis presented here quantifies the Total Value (Total Benefits – Total Costs) for Three Years of operations. The Lenovo Engineered Solution for Microsoft SQL Server is compared with a corresponding competitive alternative. Three configurations (Table 1) are analyzed: small, medium and large. All costs and benefits grow with data/configuration size.

Key Assumptions: Hardware acquisition costs were provided by Lenovo and licensing costs for Microsoft SQL Server were obtained from a Microsoft site.⁴ Other costs such as maintenance, operations and deployment were included in the TVO model from commonly used data center costs from public sources and interviews. Electricity costs are assumed to be \$.09/kWh. The Lenovo systems acquisition costs were assumed be 10% more than the corresponding competitive alternative.

Lenovo Configuration	Small	Medium	Large
Database (TB)	9TB	44TB	90TB
Rack Server	SR630 1U	SR650 2U	SR950 4U
Type of Processor	6142	8180	8180
Memory (GB)	128GB	768GB	1536GB
Storage (TB)	12TB	54TB	102TB
No. of IT Personnel	5	12	24
No. Business Users	10	20	20
No. of C-Level Executives	3	4	6

Table 1: System Configuration and Personnel Details for the Lenovo Solution

For both Lenovo and a competitive alternative, the same number of staff (IT and Business) were assumed to be associated with the development and deployment of Analytics and OLTP projects. These skills are often very scarce, and organizations compete for them and

³ Why big data projects fail and how to make 2017 different, Expansion of Gartner’s prediction that 60% of big data projects fail; By Sameet Agarwal, *Network World* Feb 16, 2017.

⁴ <https://www.microsoft.com/en-us/sql-server/sql-server-2017-pricing>

pay a premium. Operational people costs are typically the largest cost component of Analytics/OLTP projects. So, solutions that reduce staff costs and/or enhance personnel productivity help improve the TVO of these projects.

Total Value of Ownership (TVO) – Results

Results for a Small Configuration: Figure 3 depicts the costs and benefits mapped by each quadrant and value driver. Lenovo's larger assumed acquisition costs are more than offset by lower costs for deployment and higher client benefits in enhanced productivity, greater revenues/profits and lower risks.

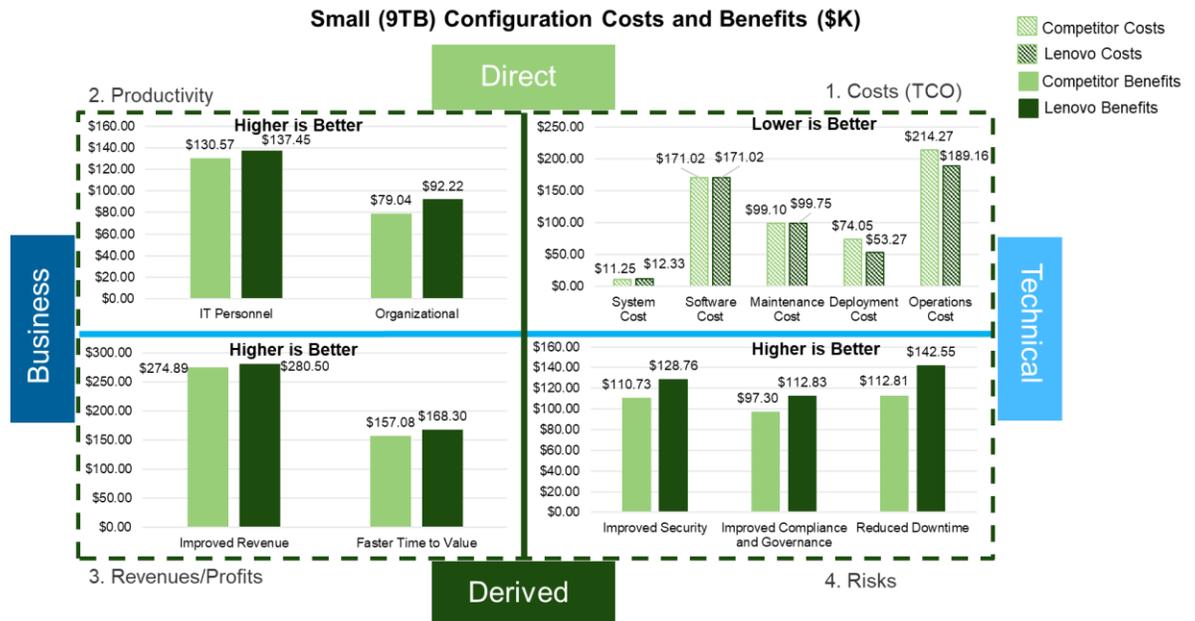
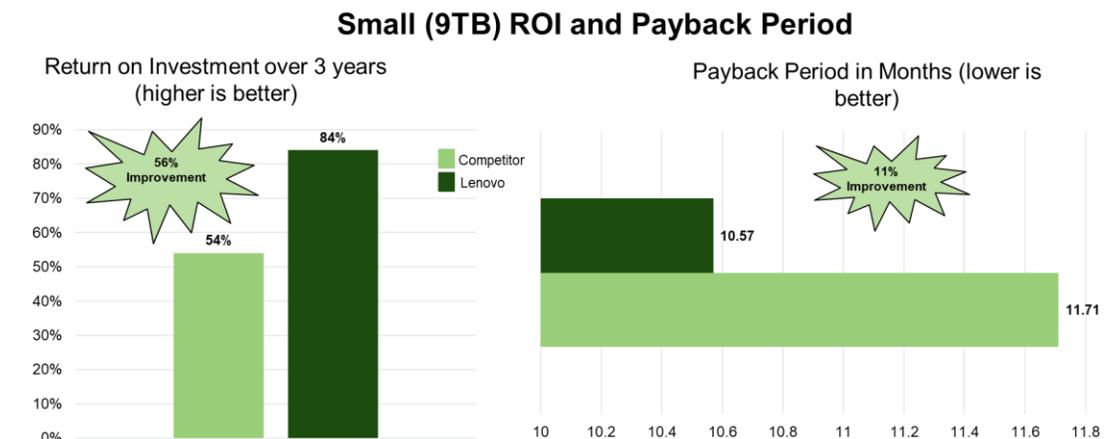


Figure 3: Costs and Benefits by Driver. Lenovo vs. Competitor for Microsoft SQL Server (Small)

The 3-year ROI and Payback Period for a small configuration for Lenovo are better than a competitive alternative (Figure 4).



Based on **SR630 1U** rack Servers; **6142 processors** and **128GB memory**; Samsung SATA Solid State Drives; Relative Performance: Row Store Throughput: 91; Column Store Throughput: **183**; Max. User Data Capacity: **12TB**; SQL Server 2017

Figure 4: Better ROI and Payback Period with Lenovo vs. Competitor for Small Configuration

For small configs, the Lenovo solution reduces TCO and provides more productivity, faster time to value, lower risks and higher revenue/profits

The ROI and Payback Period for a small configuration for Lenovo are better than a competitive alternative

For medium configs, the Lenovo solution also reduces TCO and provides even more productivity, faster time to value, lower risks and higher revenue/profits

Results for a Medium Configuration: Figure 5 depicts the costs and benefits mapped by each quadrant and value driver. Again, Lenovo's slightly larger assumed acquisition costs are more than offset by even greater client benefits in enhanced productivity, higher revenues/profits and lower risks.

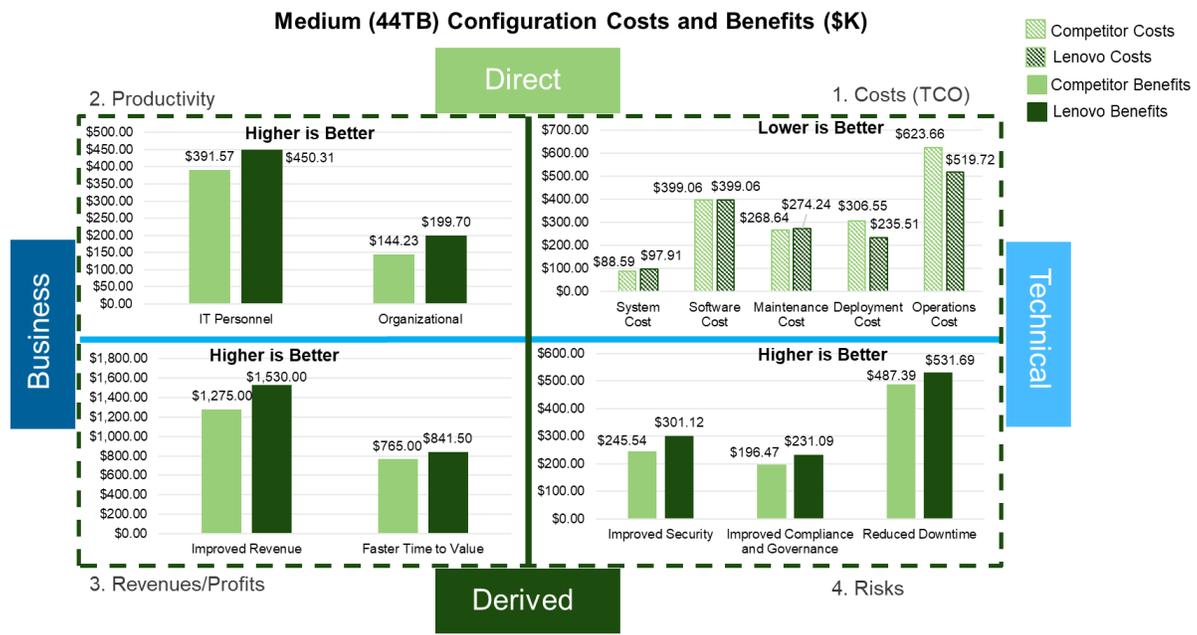


Figure 5: Costs and Benefits by Driver. Lenovo vs. Competitor for Microsoft SQL Server (Medium)

The 3-year ROI and Payback Period for a medium configuration for Lenovo are better than a competitive alternative and this difference is greater than the preceding small case (Figure 4).

The ROI and Payback Period for a medium configuration for Lenovo are better than a competitive alternative and this difference is greater than the small configuration

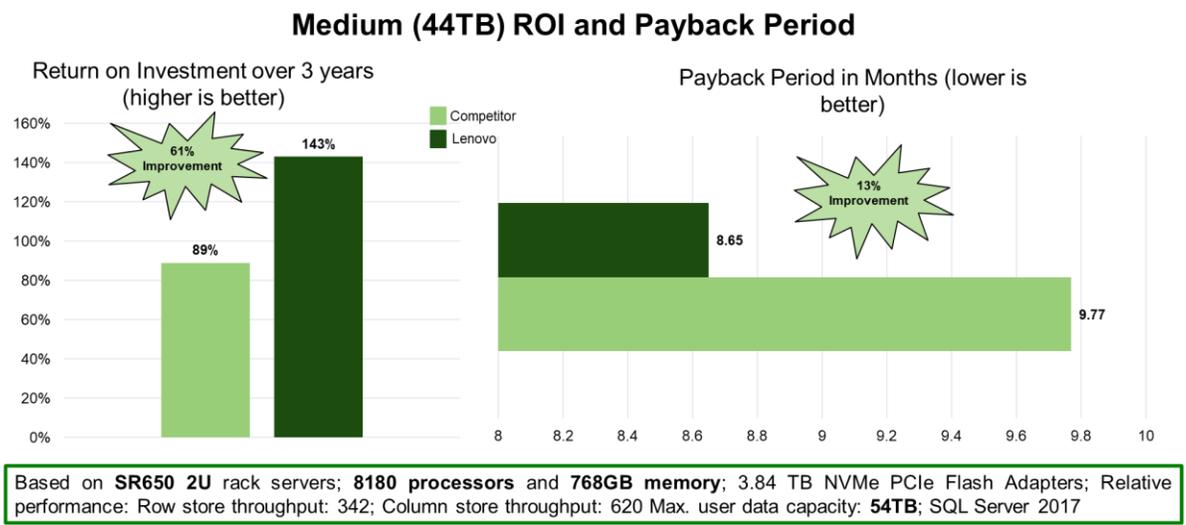


Figure 6: Better ROI and Payback Period with Lenovo vs. Competitor for Medium Configuration

Results for a Large Configuration: Figure 7 depicts the costs and benefits mapped by each quadrant and value driver. Again, Lenovo's slightly larger assumed acquisition costs are

considerably more than offset by even greater client benefits in enhanced productivity, higher revenues/profits and lower risks.

For large configs, the Lenovo solution can further drive radical innovation and create entirely new business opportunities

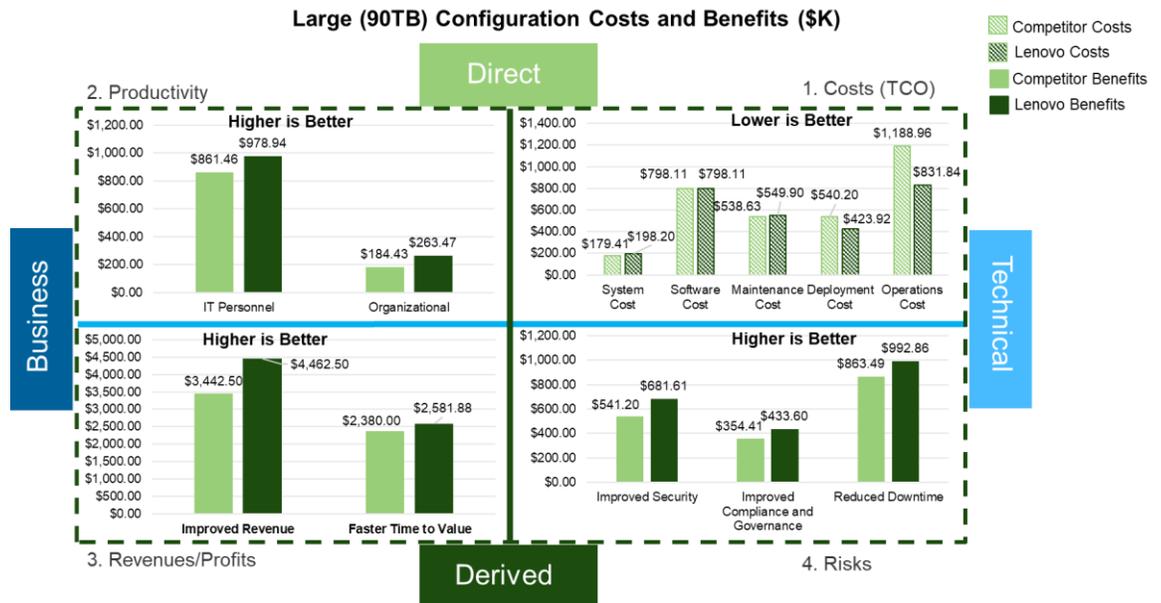


Figure 7: Costs and Benefits by Driver. Lenovo vs. Competitor for Microsoft SQL Server (Large)

Again, the 3-year ROI and Payback Period for a large configuration for Lenovo are better than a competitive alternative with a higher margin than the prior medium case (Figure 8).

The ROI and Payback Period for a large configuration for Lenovo are better than a competitive alternative with a higher margin than the medium case

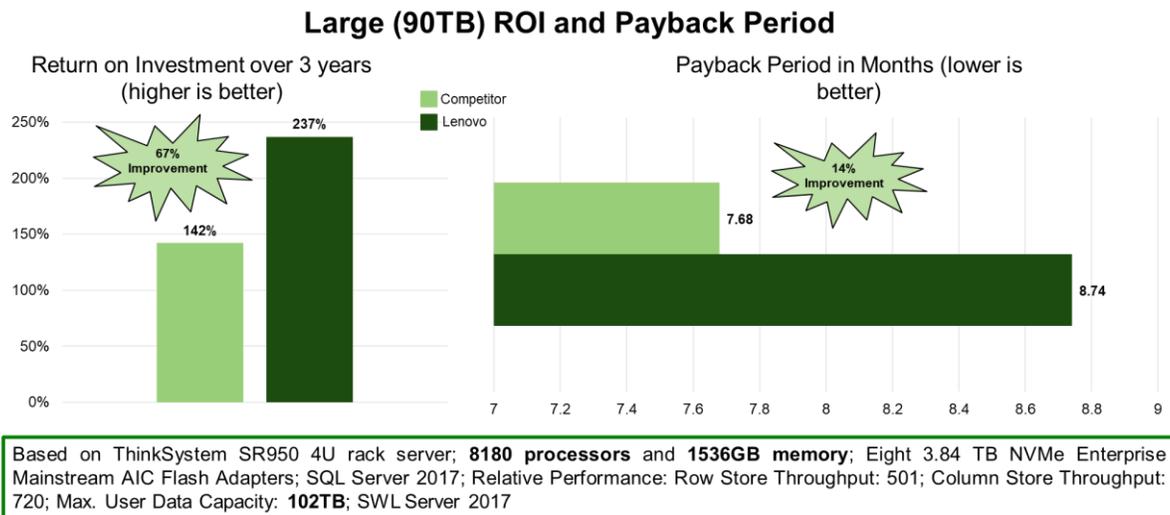


Figure 8: Better ROI and Payback Period with Lenovo vs. Competitor for Large Configuration

These large configurations can be very complex to manage and operate. However, with the Lenovo solution, clients can get significant value because of unique capabilities for higher-value Analytics and faster OLTP performance. These large solutions also help drive radical innovation and have the potential of creating entirely new business/product/customer categories for clients across many industries as they consolidate and scale up their database environments and progress on their Analytics journey from traditional Business Intelligence to Predictive to Prescriptive Analytics, and to Artificial Intelligence and Machine Learning.

Clients can consolidate and scale up their database environments and progress on their higher value journey

Discussions of Results from the Total Value of Ownership Model

Most Total Cost of Ownership (TCO) models only quantify costs in Quadrant 1. The TVO model outlined here considers these costs and the benefits from the remaining three quadrants. Compared with most competitive alternatives, the Lenovo Engineered Solution for Microsoft SQL Server reduces costs and improves benefits for all configurations by:

- 1. Lowering Annual Operational and One-Time Deployment Costs:** The Lenovo solution consistently delivers excellent performance and scalability.⁵ This reduces the data center footprint and hence lowers facilities and power and cooling costs. Lenovo clients can also reduce the need for expensive skilled experts with a single point of contact for buying and supporting all hardware (servers, storage and networks), automated support and ease of use administration features. A pre-tested, integrated, performance-tuned hardware and software solution with APIs to facilitate applications integration reduces personnel costs and lowers deployment time. All these differential savings with the Lenovo solution grow with configuration size.
- 2. Enhancing Productivity:** Some key Lenovo solution features that further improve productivity of key staff by roles and the organization include:

- a. *Database Administrators (DBAs)* who consolidate and provide ongoing maintenance of production and other databases; plan, design, and develop new database applications or make major changes to existing applications; and manage an organization's data and metadata.

Since the Lenovo solution is pre-integrated, tested and optimized for performance in the lab, the DBA does not have to do this. When database sizes or numbers grow, the DBA can continue to work without interruptions as the Lenovo solution is scalable; moving to a larger configuration is largely automated. Advanced security features in the Lenovo solution ensure that the DBA must manage fewer security breaches.

- b. *Data Engineers/Architects* who promote the use of standards and leverage existing knowledge among team members. They architect how data is organized and ensure operability, and work with application developers to change database schema to optimize code for performance and function.

Architects save time by using standard well-integrated components. Pre-tested data sources, integration testing of the hardware and software environment help manage schema changes efficiently. Lenovo's reliability, scalability and availability (RAS) capabilities help architects troubleshoot better and enhance overall performance.

- c. *Organization:* Business users and executives benefit from OLTP and Analytics applications to generate revenue from faster and better decisions. Faster and more accurate and trusted real time actionable insights/transactions with the most current data enhance organizational productivity. Higher system availability and reliability and a consistent look and feel of the application enable users to optimize computing resources, reduce errors and rework, and work with minimal interruptions.

⁵<http://www.tpc.org/default.asp>

The Lenovo solution drives additional benefits and lowers costs – especially operational and deployment costs

Enhances productivity of DBAs, architects and the entire organization

Increases revenues and profits with deeper and more current and accurate transactions and insights

Mitigates security, downtime and non-compliance risks

3. Increasing Revenues/Profits: In addition to enhancing productivity, the Lenovo Engineered Solution for Microsoft SQL Server delivers faster time to value with better performance and RAS, scale, ease of deployment, integration and streamlined operations. By uncovering the most current and accurate insights and with more frequent and deeper transactions, executives can make better financial decisions and build long-term strategic, trusted and personalized customer relationships to drive revenue and profits.

Greater innovation and better decision-making capabilities with trusted data also help improve customer service and support, identify new customers/markets/products/services, reduce time to market, build better pricing models and more.

4. Mitigating Risks: The Lenovo solution lowers risk of project failure and delays with lower downtime, advanced security features and better governance and compliance especially for highly regulated industries.

a. *Security* is critical to any organization and breaches are costly and can be very harmful; often leading to unexpected and unplanned loss of customers and a negative long-term impact on brand equity.⁶ Security costs depend on the size of the breach or the number of records lost or stolen and the time it takes to identify, contain and notify victims of a data breach.

Advanced security features in the Lenovo solution significantly reduce the time to identify and contain a breach, and the probability of recurrence. Disaster Recovery (DR) automation and orchestration also reduce the per day cost of a breach.

b. *Downtime* costs can be considerable⁷, and systems must maintain stringent performance and service levels. Otherwise organizations risk losing customers and revenues. Lenovo systems consistently have among the lowest downtimes⁸ compared to equivalent competitive systems.

Lenovo provides proactive support to stay ahead of downtime, resolving issues before they impact the business. With Lenovo, it is also possible to configure heartbeat networks and nodes, set partition sizes and memory allocations, and leverage clustering, RAID and application/storage failover to proactively improve uptime.

c. *Proper Governance and Compliance* assures an organization reliably achieves objectives, addresses uncertainty and acts with integrity. This reduces risks⁹ of significant damage to an organization's finances or reputation – fines and attritions.

The Lenovo solution provides a review of all backup and recovery settings and procedures and the ability to understand the functions of the respective databases. It also automates documentations and streamlines compliance audit to reduce penalties, ensures that products (including from suppliers) are designed, tested and comply with the laws and regulations in each major country for safety, electromagnetic compatibility, ergonomics and other requirements throughout their lifecycle.

⁶ Ponemon Institute, 2017 Cost of Data Breach Study Research Report. (optional addition: Benchmark research sponsored by IBM Independently conducted by Ponemon Institute LLC)

⁷ How to calculate the true cost of downtime, 2017 report by Data Foundry; True Cost of Downtime and the Business Case for Business Continuity, Continuity Co, LLC 2017; Cost of downtime by industry; IDC report 2016

⁸ itic-corp.com/blog/2018/01/ibm-lenovo-top-latest-itic-global-server-hardware-reliability-poll/

⁹ Understanding the costs and benefits of SOX compliance, 2016 research report from Protiviti; Compliance insights 2018 – Protiviti

Better ROI/Payback for Microsoft SQL Server with Lenovo

Key financial metrics for a 3-year time horizon for all three configurations for Lenovo and competitor (Figure 9) include: Return on Investment (ROI) and Payback Period (PP).

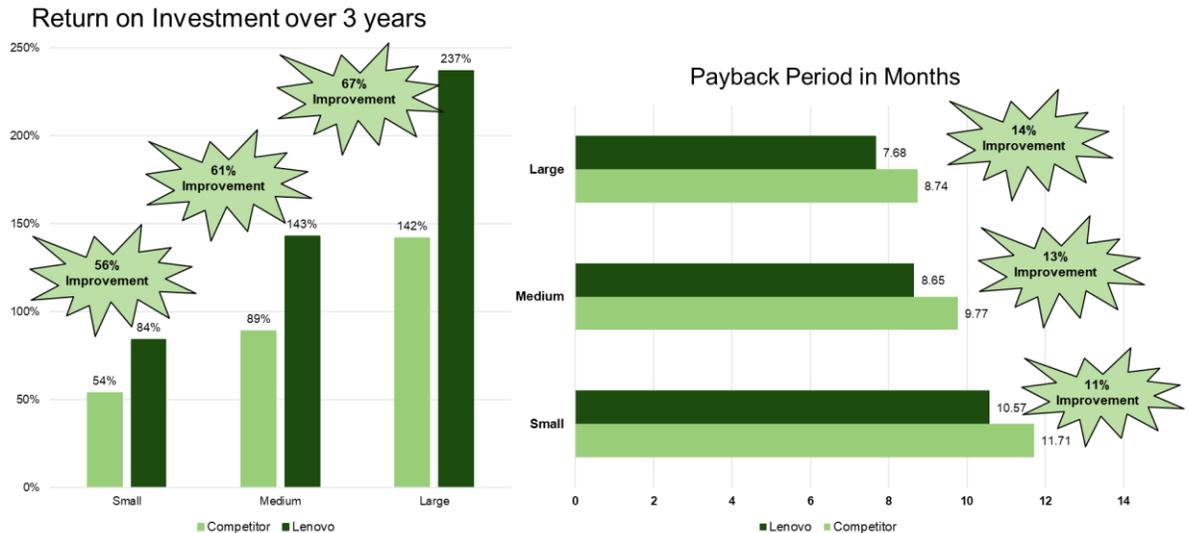


Figure 9: Better ROI and Payback Period with Lenovo Over Competitor for Microsoft SQL Server

For all cases, the ROI and Payback Period improve as configuration sizes grow from small to medium to large. This is expected. Clients typically increase the configuration size as they consolidate and scale up their database environments and progress on their Analytics journey from traditional Business Intelligence to Predictive to Prescriptive Analytics, and to Artificial Intelligence and Machine Learning.

The percent improvements in ROI and Payback Period for Lenovo over a competitor also grow (Figure 9) with configuration size. This means as clients grow their Microsoft SQL Server footprint to drive more innovation, the Lenovo solution delivers even more value.

Conclusions and Recommendations

The rapidly growing speed and scope of online transactions and business decision making are game-changing business opportunities for companies to deliver exceptional customer experience, enhance marketing effectiveness, increase operational efficiencies, reduce financial risks, improve product quality and reliability, and more.

However, as the volume and variety of data grow and as organizations consolidate and scale up their database environments, they need enterprise-grade solutions to produce more realistic, reliable, actionable, trusted and time-critical results.

The Lenovo Engineered Solution for Microsoft SQL Server delivers the right mix of pre-tested hardware infrastructure, software, and services to optimize a wide range of data warehouse and transactional database use cases to provide the following features and benefits:

ROI and Payback Period improve as configuration sizes grow

The Lenovo solution consistently delivers better ROI and Payback compared with a competitor

ROI and Payback differentials improve with configuration size

The Lenovo solution delivers the right mix of pre-tested hardware infrastructure, software, and services to optimize data warehouse and transactional database use cases

Delivers faster time to value, greater productivity, more innovation, better decisions and lower risks

Considerable ROI improvement of 56% (small) to 67% (large) over a competitor

Lenovo is a reliable partner offering some of the highest performing pre-tested systems for Microsoft SQL Server

- Faster time to value with better performance, scale, ease of deployment and integration.
- Greater productivity of staff including Database Administrators, Data Engineers, Data Scientists, Application Engineers, Business Analysts and C-level executives.
- More new product/business ideas, better decisions and innovation from deeper insights gleaned by higher-value Analytics and faster and more trusted online transactions.
- Lower downtime, better governance and compliance and more advanced security.

For clients, these features/benefits collectively reduce costs, enhance productivity, drive revenues/profits and mitigate risks.

The 3-year TVO analysis presented here quantifies all these cost/value drivers holistically for three configurations: small, medium and large. The ROI for the Lenovo Engineered Solution for Microsoft SQL Server ranges from 84% (small) to 237% (large) while a corresponding competitor solution delivers a ROI of 54% (small) to 142% (large). This implies that Lenovo delivers a considerable ROI improvement of 56% (small) to 67% (large) over a competitor. These benefits are accretive as the number of databases increases in the data center. So, if there are hundreds of databases as is typically the case, Lenovo benefits will add up.

Likewise, the Payback Period (PP) in months for the Lenovo solution ranges from 7.68 (large) to 10.57 (small) while the corresponding competitor solution delivers a PP in months of 11.71 (large) to 8.74 (small). This implies that the Lenovo solution also delivers better Payback improvements from 14% (large) to 11% (small) over a competitor solution.

Even with a slightly larger assumed acquisition cost over a competitor, clients deploying a Microsoft SQL Server solution for Analytics and online transactions should seriously consider Lenovo systems for the data center for the following reasons:

1. The cost-benefit analysis and business case are compelling for all configurations.
2. The business value and ROI/PP differential improve as configurations get larger.
3. The investment is protected and continues to deliver even greater marginal value for larger configuration sizes and for the entire data center.
4. This allows clients to further consolidate and scale up their database and online transaction environments and progress on their Analytics journey from traditional Business Intelligence to Predictive to Prescriptive Analytics, and to Artificial Intelligence and Machine Learning.
5. Globally, Lenovo is a reliable partner and offers some of the best performing pre-tested systems for Microsoft SQL Server database.

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