The Total Economic Impact™ Of Microsoft SQL Server 2016

Incremental Cost Savings And Improved Performance From Upgrading

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Project Director:
Jonathan Lipsitz

Project Contributor:
Jon Erickson

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Benefits And Costs

Increased transaction processing throughput:
4x to 6x

Increased application developer productivity:
10% to 20%

Reduced hardware and software infrastructure growth-related costs:
10%

Executive Summary

Microsoft SQL Server 2016 is the backbone of many mission-critical applications and systems. Microsoft commissioned Forrester Consulting to conduct a Total Economic Impact™ (TEI) study and examine the potential return on investment (ROI) enterprises may realize by upgrading to Microsoft SQL Server 2016 (SQL Server 2016) from a mix of previous versions, primarily 2012 and 2014. The purpose of this study is to provide readers with a framework to evaluate the potential financial impact of SQL Server 2016 on their organizations.

To better understand the benefits, costs, and risks associated with this investment, Forrester interviewed six customers using SQL Server 2016. The core systems and revenues of these companies were dependent on Microsoft SQL performance and availability.

Prior to using SQL Server 2016, the customers were using a mix of previous versions of Microsoft SQL Server, mainly 2012 and 2014. To support their growth, the customers needed improved performance and scalability without adding a lot of cost. For this reason, along with the desire for newer features in SQL Server 2016, they migrated to the newer version.

Key Findings

Quantified benefits. The following risk-adjusted quantified benefits are representative of those experienced by the companies interviewed and applied to the composite organization (European-headquartered logistics company with 250 cores using Microsoft SQL Server 2016 and having migrated from a mix of SQL Server 2012 and 2014), which is discussed in more detail later in the study:

› **Database performance improved dramatically, which improved throughput and reliability.** The most important reason companies gave for moving to SQL Server 2016 was that they could achieve much better performance without adding a lot of additional hardware. Interviewees reported that they could handle up to 6x the number of transactions without adding additional hardware and Microsoft SQL licenses. They also reported that improved performance meant much less downtime or time when diminished performance could hurt revenues, e.g. customers going to the competition. For the financial analysis, Forrester included the revenue protection associated with less downtime. Over three years, the total revenue protection was worth a present value (PV) of $4.4 million.

› **IT effort to manage the solution and support users was significantly less.** The interviewed companies said that application developers and database administrators (DBAs) were much more productive after moving to SQL Server 2016. Additionally, there were fewer help desk calls from users inquiring about performance problems. The total PV savings over three years was $1.1 million.

› **Hardware and software costs were lower because growth could be handled without increasing the IT estate.** Prior to moving to SQL Server 2016, interviewed companies were adding a lot more cores (10% per year), which increased hardware and Microsoft SQL license costs. Avoiding these additions eliminated incremental SQL license, hardware, and maintenance costs. The three-year total savings was $672,356.

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ROI
116%

Benefits PV
$6.2 million

NPV
$3.3 million

Payback
11.6 months

Unquantified benefits. The interviewed organizations experienced the following benefits, which are not quantified for this study:

› **Improved business outcomes.** Companies said that improved performance resulted in winning new customers and increasing revenues. It also allowed them to bring new products to market faster.

› **The new features in SQL Server 2016 provide improved analytics and business intelligence.** Companies stated that they have improved their analytics and business intelligence capabilities and that insights were available much faster. This empowered them to make better decisions.
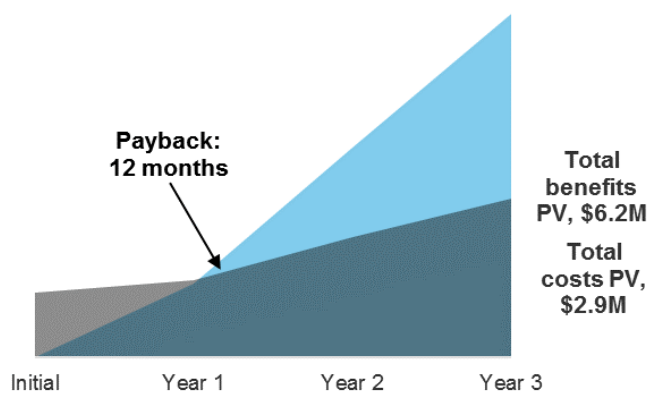
Benefits If Moving From An Older Version of Microsoft SQL Server. If an organization is moving from an older version of SQL Server than depicted in this study, typically SQL Server 2008, there are many additional benefits that should be realized. These include additional performance, security, and high availability benefits. These were not included in this study and can be found in the other Forrester study titled "The Total Economic Impact™ Of Microsoft SQL Server: Cost Savings And Business Benefits Enabled By Microsoft SQL Server 2014 And SQL Server 2012 For Mission-Critical Transaction-Processing Applications."

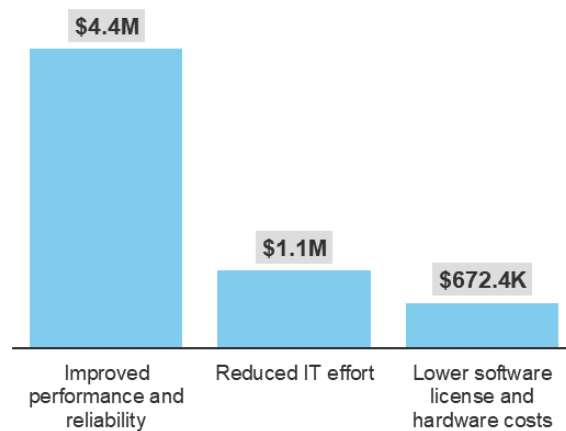**Costs.** The interviewed organizations experienced the following risk-adjusted costs:

› **SQL Server 2016 implementation effort was much less than previous migrations.** Interviewed companies said that the migration was straightforward and typically took a couple of months. In addition to internal effort, there were usually outside professional services, which were often delivered as part of a Microsoft Premier Support contract. The total implementation cost was $111,563.

› **SQL Server 2016 licenses and Software Assurance were required for 250 cores.** A mix of Enterprise and Standard licenses were required, and the annual cost included Software Assurance. The total PV cost over the life of the study was $1.9 million.

› **One-fourth of the servers were replaced out of the normal refresh cycle.** As part of the upgrade, older servers were replaced sooner than would otherwise have happened. This equated to servers comprising 63 cores, and the total PV cost with maintenance was $380,603.

› **One full-time equivalent (FTE) was responsible for maintaining/patching servers.** For the ongoing management of the solution, one FTE was responsible for patching servers. The total PV cost over three years was $506,074.

Forrester's interviews with six existing customers and subsequent financial analysis found that an organization based on these interviewed organizations experienced PV benefits of $6.2 over three years versus costs of $2.9 million, adding up to a net present value (NPV) of $3.3 and an ROI of 116%.

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Financial Summary

Payback:
12 months

Total benefits PV, $6.2M

Total costs PV, $2.9M

Initial   Year 1   Year 2   Year 3

Benefits (Three-Year)

$4.4M

$1.1M

$672.4K

Improved performance and reliability

Reduced IT effort

Lower software license and hardware costs

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> The TEI methodology helps companies demonstrate, justify, and realize the tangible value of IT initiatives to both senior management and other key business stakeholders.

TEI Framework And Methodology

From the information provided in the interviews, Forrester has constructed a Total Economic Impact™ (TEI) framework for those organizations considering implementing Microsoft SQL Server 2016.

The objective of the framework is to identify the cost, benefit, flexibility, and risk factors that affect the investment decision. Forrester took a multistep approach to evaluate the impact that Microsoft SQL Server 2016 can have on an organization:

DUE DILIGENCE
Interviewed Microsoft stakeholders and Forrester analysts to gather data relative to SQL Server 2016.

CUSTOMER INTERVIEWS
Interviewed six organizations using SQL Server 2016 to obtain data with respect to costs, benefits, and risks.

COMPOSITE ORGANIZATION
Designed a composite organization based on characteristics of the interviewed organizations.

FINANCIAL MODEL FRAMEWORK
Constructed a financial model representative of the interviews using the TEI methodology and risk-adjusted the financial model based on issues and concerns of the interviewed organizations.

CASE STUDY
Employed four fundamental elements of TEI in modeling Microsoft SQL Server 2016's impact: benefits, costs, flexibility, and risks. Given the increasing sophistication that enterprises have regarding ROI analyses related to IT investments, Forrester's TEI methodology serves to provide a complete picture of the total economic impact of purchase decisions. Please see Appendix A for additional information on the TEI methodology.

DISCLOSURES

Readers should be aware of the following:

This study is commissioned by Microsoft and delivered by Forrester Consulting. It is not meant to be used as a competitive analysis.

Forrester makes no assumptions as to the potential ROI that other organizations will receive. Forrester strongly advises that readers use their own estimates within the framework provided in the report to determine the appropriateness of an investment in Microsoft SQL Server 2016.

Microsoft reviewed and provided feedback to Forrester, but Forrester maintains editorial control over the study and its findings and does not accept changes to the study that contradict Forrester's findings or obscure the meaning of the study.

Microsoft provided the customer names for the interviews but did not participate in the interviews.

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The Microsoft SQL Server 2016 Customer Journey

BEFORE AND AFTER THE SQL SERVER 2016 INVESTMENT

Interviewed Organizations

For this study, Forrester conducted six interviews with Microsoft SQL Server 2016 customers. Interviewed customers include the following:

INDUSTRY	REGION	INTERVIEWEE	# OF EMPLOYEES
Online software	Headquartered in UK	Chief architect	1,500
Online gaming	Headquartered in UK	Engineering manager	2,500
eCommerce marketer	Headquartered in US	DBA team manager	700
Retail trading platform	Headquartered in UK	Development team lead	600
Transport and logistics	Headquartered in Denmark	Lead developer	3,000
Transport and logistics	Headquartered in Switzerland	Global DBA manager	10,000

Key Challenges

The interviewees expressed a range of challenges around supporting growth while managing costs. Some of the main challenges before upgrading to SQL Server 2016 were:

> **Supporting growth was too costly in terms of adding hardware and SQL Server licenses.** All the interviewed companies said that supporting anticipated growth with their previous versions of Microsoft SQL Server would have required the addition of a lot of hardware and SQL Server licenses. This was not something the companies were willing to do from a budget perspective.

> **Microsoft SQL Server performance was beginning to lag behind the business needs.** The interviewed companies like to be on the latest version of technologies, including Microsoft SQL Server, because these versions typically bring improved performance and new features. This was especially true in the case of Microsoft SQL Server 2016, which delivered significantly better performance, partly because of the new features.

> **The IT team was receiving complaints from external customers and internal business users.** Because they were reaching performance and scale limits, both external customers and internal business users were impacted. This resulted in lost revenues from existing customers and a delay in adding new customers and services.

"Based on our application growth, we needed better database performance, especially around latency. This was crucial for adding new customers."

Chief architect, online software

Solution Requirements

The interviewed organizations searched for a solution that could:

> Provide much better performance in terms of transaction processing speed, latency, and scale.

> Deliver improved performance without increasing solution costs.

> Provide improved security and analytics capabilities.

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› Be familiar to users to reduce retraining and change management effort.

For some of the interviewed companies, there was no question as to whether Microsoft SQL Server 2016 would be the solution of choice since they were a full-stack Microsoft shop. Other interviewed companies looked at solutions from other vendors but decided on Microsoft SQL Server 2016 because it best met their requirements. Regardless, many new features in SQL Server 2016 made the move very compelling. The ones most often cited included:

› Real-time operational analytics.

› Enhanced Always On.

› JSON support.

› Query Data Store.

› Temporal tables.

› In-memory OLTP.

› In-memory columnstore.

› Open Source R with in-memory and massive scale — multithreading and massive parallel processing.

› Row-level security.

› PolyBase — simple T-SQL queries across relational and Hadoop data online and offline access.

› Enhanced SQL Server Reporting Services (SSRS) and SQL Server Analysis Services (SSAS).

› Mobile Business Intelligence.

Key Results

The interviews revealed that key results from the Microsoft SQL Server 2016 investment include:

› **Moving to SQL Server 2016 enabled company growth in terms of adding customers and increasing revenues.** One of the key recurring themes across interviews was that the companies were growing faster than their previous database solutions could support. This meant that they could not bring on new customers, who in some cases were very high value, and they were missing out on increased revenue opportunities. One customer said: "We were supporting 7,000 concurrent users. When we moved to 2016, out of the box we could support 10,000 users. When we started using some of the new features, we could support 30,000." Additionally, some of the companies explained how the improved analytics and business intelligence features in SQL Server 2016 helped them make smarter decisions faster to better serve customers.

"The biggest reason we moved to 2016 was performance. There are a lot of enhancements, especially OLTP, that we could get without spending more. After we transitioned, the performance was better than we expected."

Transport and logistics, lead developer

"Our company is growing fast, and that pushes the platform more each year. SQL Server 2016 has given us the best performance optimization we have seen from SQL in a long time. We get better performance on the same hardware, which is always a win for us. The way our revenue model works is that we take a cut of what our customers sell online. We need the added performance to process their orders as fast as possible to maximize our revenues and our customers' revenues."

eCommerce marketer, DBA team manager

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› **The increased performance efficiencies within SQL Server 2016 arrested hardware and software cost increases.** Prior to SQL Server 2016, companies were adding hardware and SQL databases to handle business growth. This came with a lot of added cost, and IT departments were struggling to get additional budget. Because of the computational efficiencies within SQL Server 2016 versus 2012 or 2014, significantly more database transactions can be processed on the same or less hardware, which brings down costs. One interviewee provided the following example: "Performance has increased dramatically from SQL Server 2012 to 2016. We have 928 core licenses, and, without SQL Server 2016, we would be adding 200 cores per year."

› **IT teams can focus on higher value activities.** Improved database performance means that application developers and DBAs can bring new solutions to market faster and less time is spent on "keeping the lights on" and troubleshooting. One interviewee said: "Our developers are 10% to 20% more productive now because of better tools and performance. SQL Server 2016 gave them a better approach on how to roll out projects and quality assurance. This means they can deliver more to the business."

Composite Organization

Based on the interviews, Forrester constructed a TEI framework, a composite company, and an associated ROI analysis that illustrates the areas financially affected. The composite organization is representative of the six companies that Forrester interviewed and is used to present the aggregate financial analysis in the next section. The composite organization that Forrester synthesized from the customer interviews has the following characteristics:

Description of composite. The composite organization is a European-headquartered transportation and logistics company with operations around the world. It has 6,000 employees, almost all of which are knowledge workers. The Microsoft SQL Server 2016 solution is built around 250 cores, and more than two-thirds of the mission-critical applications are dependent on these databases performing well. Previously, the company was on a mix of SQL Server 2012 and SQL Server 2014, although some older versions also existed prior to the migration.

Companies moving from older versions of SQL Server should realize additional benefits, and these can be found in another Forrester study titled "The Total Economic Impact™ Of Microsoft SQL Server: Cost Savings And Business Benefits Enabled By Microsoft SQL Server 2014 And SQL Server 2012 For Mission-Critical Transaction-Processing Applications."

> "Because of the new features in SQL Server 2016, it made sense for us to make the move sooner than we otherwise may have. We needed them to make our applications simpler from a code perspective and to improve performance."
>
> *Online gaming, engineering manager*

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Financial Analysis

QUANTIFIED BENEFIT AND COST DATA AS APPLIED TO THE COMPOSITE

Total Benefits

REF.	BENEFIT	YEAR 1	YEAR 2	YEAR 3	TOTAL	PRESENT VALUE
Atr	Improved performance and reliability	$1,080,000	$2,160,000	$2,160,000	$5,400,000	$4,389,782
Btr	Reduced IT effort	$218,025	$538,650	$666,900	$1,423,575	$1,144,422
Ctr	Lower software license and hardware costs	$173,979	$273,836	$383,171	$830,987	$672,356
	Total benefits (risk-adjusted)	$1,472,004	$2,972,486	$3,210,071	$7,654,562	$6,206,560

+ Improved Performance And Reliability

Improved database performance and reliability were central to companies' decision to move to SQL Server 2016, and interviewees spent most of the time talking about these improvements. Performance improved in terms of transaction processing time, latency, and scalability. This translated into fewer service level agreements (SLAs) being missed and demonstrable business benefits, which are discussed later in the study. Uptime and overall application reliability were also greatly improved.

Some of what Forrester heard regarding improved performance and scalability included:

› "Our query latency has gone from 20 milliseconds to sub 10 milliseconds."

› "This gives us the opportunity to synchronize databases in the development environment, leading to a more agile environment in which servers can be spun up when we need them."

› "Because of improved caching, one application went from 200,000 events per second in SQL Server 2012 to 1.2 million in SQL Server 2016."

› "Ninety-nine percent of the improvements we've seen with SQL Server 2016 are attributable to in-memory OLTP. We've seen a 100% increase in throughput, and our future target is a 700% increase."

› "We were able to cut trade execution time in half. We also largely eliminated outliers. In the past, 80% of transactions took fewer than 5 milliseconds, and we have gotten that up to 98%."

› "In-memory OLTP gives us faster response time for individual queries and more efficient CPU usage."

The table above shows the total of all benefits across the areas listed below, as well as present values (PVs) discounted at 10%. Over three years, the composite organization expects risk-adjusted total benefits to be a PV of more than $6.2 million.

"Our peak period is Thanksgiving through Cyber Monday. For some of our customers, this is 80% of their revenues. This year we doubled our transactions per second, and OLTP was a big part of that. We are now able to process 4x the transactions per second we were doing in 2012, largely because of SQL Server 2016."

eCommerce marketer, DBA team manager

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Some of what Forrester heard regarding improved reliability and uptime included:

› "We now have fully automated recovery with SQL Server 2016, which reduces our risk. In the past, we would have to bring systems up manually, which meant longer downtime and reduced income. It could mean €1 million in lost revenue."

› "Things have become more stable, mainly because of in-memory OLTP."

› "We used to get complaints from employees and customers about downtime. Consolidating everything onto SQL Server 2016 largely eliminated that."

› "We have 30 fewer hours of unplanned downtime and 60 fewer hours of planned downtimes per year. Unplanned downtime can cost us [around $150,000 per hour]."

› "SQL Server 2016 has features that provide more feedback and make troubleshooting easier. This helps us find problems before they become too serious and lead to downtime."

› "Performance is completely different now because of how synchronization works. Everything is more fluid, and we have less downtime."

Improved performance has a lot of financial impacts on a company as the interviewee quotes above demonstrate. For the financial analysis, Forrester included one specific example — revenue protection from less downtime. Readers are encouraged to think about their organization and how it may financially benefit from improved systems performance and uptime. Specific model assumptions based on what interviewees reported include:

› Twenty fewer hours of unplanned downtime per year (10 in Year 1) with average revenue loss of $100,000 per hour.

› Forty fewer hours of planned downtime per year (20 in Year 1) with average revenue loss of $10,000 per hour.

The amount or revenue protection a company experiences will depend on their business model, the types of applications built on Microsoft SQL Server, and previous database/application performance. To account for these risks, Forrester adjusted this benefit downward by 10%, yielding a three-year risk-adjusted total PV of $4.4 million.

> "We are using Availability Groups for faster, more efficient backup and disaster recovery, which has tremendous business value for us, especially given the immediacy that users expect from a gaming environment."
>
> *Chief architect, gaming company*

> Impact risk is the risk that the business or technology needs of the organization may not be met by the investment, resulting in lower overall total benefits. The greater the uncertainty, the wider the potential range of outcomes for benefit estimates.

Improved Performance And Reliability: Calculation Table

REF.	METRIC	CALC.	YEAR 1	YEAR 2	YEAR 3
A1	Less unplanned downtime (hours)		10	20	20
A2	Lost revenue per hour — unplanned		$100,000	$100,000	$100,000
A3	Less planned downtime (hours)		20	40	40
A4	Lost revenue per hour — planned	A2*10%	$10,000	$10,000	$10,000
At	Improved performance and reliability	A1*A2+A3*A4	$1,200,000	$2,400,000	$2,400,000
	Risk adjustment	↓10%			
Atr	Improved performance and reliability (risk-adjusted)		$1,080,000	$2,160,000	$2,160,000

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+ Reduced IT Effort

Interviewees universally said that moving to SQL Server 2016 has improved DBA and application developer productivity. This comes from several factors, including better database performance so people can work faster, better tools and features, and less time required for "keeping the lights on" activities like patching and troubleshooting. Additionally, better database and application performance meant fewer user calls to the help desk. Some specific examples included:

› "Our DBAs spend less time troubleshooting, which has helped us avoid additional hires."

› "Without SQL Server 2016, we would have needed to add at least one or two more DBAs on top of our existing team of eight."

› "Moving from 2012 to 2016 has made things much easier because of the new features and scalability. We were able to move one-third of our DBAs to other activities."

› "Our DBA team has been constant since 2013. However, they are able to do a lot more. Our data storage has more than doubled, we are processing four to five times the number of transactions, and the number of SQL server instances has doubled. That tells you how much more productive our people are."

› "We are adding two DBAs to handle all of our growth. If we were still on 2012, we would have needed one more on top of that."

› "Moving to SQL Server 2016 helps application developers code faster since they don't have to worry about database performance. They also seem happier because of this."

› "We have seen a 10% to 15% decrease in help desk call related to application performance."

For the composite organization, Forrester included the benefits described above and assumes that:

› Thirty application developers are 20% more productive, half of which is achieved in Year 1.

› Help desk calls are reduced by 10%, half of which is achieved in Year 1.

› Fewer DBAs are added to support growth than would have been required if pervious SQL versions were still in use. This savings increases over time as growth increases.

› An average fully burdened cost of $135,000 was used across all IT roles.

› The productivity savings for application developers and help desk activities were adjusted down by 50% since not all productivity gains translate into additional work. If headcount is reduced, this benefit should be recognized at 100%.

The amount of time savings will vary depending on how productive teams were before and the effort required for troubleshooting and similar activities. To account for these risks, Forrester adjusted this benefit downward by 5%, yielding a three-year risk-adjusted total PV of $1.1 million.

"We save time troubleshooting when someone comes and says there is a performance problem. Query Data Store gives us the capability to go back and see what was happening during the slow down."

eCommerce marketer, DBA team manager

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Reduced IT Effort: Calculation Table

REF.	METRIC	CALC.	YEAR 1	YEAR 2	YEAR 3
B1	Application developer savings	30 FTEs*20% [50% Year 1]	3.0	6.0	6.0
B2	IT help desk savings	4 FTEs*10%	0.4	0.4	0.4
B3	Productivity adjustment		50%	50%	50%
B4	Fewer DBAs added		0.0	1.0	2.0
B5	Average fully burdened IT cost		$135,000	$135,000	$135,000
Bt	Reduced IT effort	((B1+B2)*B3+B4)*B5	$229,500	$567,000	$702,000
	Risk adjustment	↓5%			
Btr	Reduced IT effort (risk-adjusted)		$218,025	$538,650	$666,900

+ Lower Software License And Hardware Costs

As discussed earlier, moving to SQL Server 2016 meant that interviewed companies could handle many more transactions and scale without adding as much, if any, new servers. Since Microsoft SQL Server 2016 is priced on a per core basis, this also meant that less database software was required. Together, this resulted in a lower total cost of ownership (TCO) for a comparably performing solution. Some of what Forrester heard from interviewees included:

› "When you move from a 2014 Windows cluster with the requirement for high performance central storage to SQL Server 2016, you don't need a storage area network (SAN) anymore. Direct attach local storage was a big win for us from a performance and cost perspective."

› "Our database costs went down 10% last year, half of which is attributable to SQL Server 2016 and half to SQL Server 2014. We are saving €200 to €300 thousand per year."

› "We were able to eliminate third-party query tools. The initial product cost $100,000 per year, and yearly support was $30,000."

› "In the past we used to purchase eight additional four-socket servers each year and license them with Microsoft SQL Server. Now, we continue to replace old servers but haven't had to add anymore SQL licenses."

› "We do a partial refresh to lower our core counts but at higher clock speeds. We can increase overall computing power without adding licenses. We used to buy 256 cores worth of licenses each year."

› "We are using fewer input/outputs (IOs) and can utilize the CPUs more. We are getting more value from our SQL licenses."

› "SQL license costs are way down. We are very good at consolidating a lot of databases on one instance and better utilizing the infrastructure to bring costs down."

› "We can now do with one server what used to take six."

For the financial analysis, Forrester included the example of doing more with less from a hardware and SQL license perspective. Previously, the composite organization was growing its server estate 10% per year. With SQL Server 2016, it can handle growth without adding cores and the associated SQL Server licenses. Specific assumptions include:

> "When you do all flash and you do flash so fast that it runs at memory speed, all of a sudden you can start using CPUs at 60, 70, 80 percent utilization. That means a lot less equipment, a lot less cooling, a lot less licensing, and a lot less patching."
>
> *Transportation and logistics, DBA team manager*

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- The infrastructure at the time of the SQL Server 2016 deployment consisted of 250 cores. Without SQL Server 2016, that would have grown 10% per year.

- Sixty percent of the SQL Server 2016 licenses are Enterprise Edition, and 40% are Standard Edition, resulting in an average annual license cost of $2,725, which includes Microsoft software assurance.

- Physical servers were not replaced with an average cost of $4,000 per core and maintenance of 15%.

The hardware and SQL license cost savings may be smaller if a company is not growing or had a lot of spare capacity. To account for these risks, Forrester adjusted this benefit downward by 5%, yielding a three-year risk-adjusted total PV of $672,356.

	Lower Software License And Hardware Costs: Calculation Table				
REF.	METRIC	CALC.	YEAR 1	YEAR 2	YEAR 3
C1	Cumulative number of cores not added	Eliminated 10% YoY growth (250 base) [rounded up]	25	53	84
C2	Annual SQL license and SA cost	$3,870*60%+$1,009*40%	$2,725	$2,725	$2,725
C3	Annual SQL license and SA savings	C1*C2	$68,136	$144,449	$228,938
C4	HW purchase savings	C1[current year - previous year]*$4,000	$100,000	$112,000	$124,000
C5	Avoided HW maintenance	C4[through current year]*15%	$15,000	$31,800	$50,400
Ct	Lower software license and hardware costs	C3+C4+C5	$183,136	$288,249	$403,338
	Risk adjustment	↓5%			
Ctr	Lower software license and hardware costs (risk-adjusted)		$173,979	$273,836	$383,171

+ Unquantified Benefits

Interviewees described a couple of other benefits that either underpin the quantified benefits already discussed or could not be quantified for the study. They are described below.

Improved Business Outcomes

Previously, the study described how improved database performance and availability delivered revenue protection. Interviewees also said that SQL Server 2016 can increase revenues, decrease risks, and deliver other business benefits. Some examples are included below:

- "Our company is very interested in high value customers that can be worth millions a year to us. In the past, we couldn't take them on because of system limitations."

- "We offer prices and have to hedge against them. The faster we hedge, the less risk we have. That has improved a lot because we can execute faster."

- "We can roll out features that previously we could not because of increased performance from SQL Server 2016."

- "From a business operations perspective, we have a team that spends 90% of their time on customer queries. We will be able to reduce the growth in this team and make their lives easier."

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- "With the performance improvements we've achieved, we can release new products and attract different types of customers."

- "We have increased our top line because of SQL Server 2016. We can better cater for event-driven spikes. We need to be as CPU-efficient as possible, and SQL Server 2016 has given us that. It allows us to build out new solutions that would have been difficult on the previous infrastructure."

- "We can now onboard customers that we couldn't before and guarantee execution times."

- "We have improved from a regulatory and operational perspective. We have the history of all our trades in the SQL Server 2016 database."

- "In the past, we missed SLAs because of database performance issues. That was a real pain point and much less of an issue now."

Enhanced BI And Analytics Capabilities

SQL Server 2016 has a range of new business intelligence (BI) and analytics capabilities that helped some of the interviewed companies achieve valuable insights and improve company performance. Not all interviewees are using these features yet but are interested in them in the future. Some examples included:

- "We are currently working on a project that will use [in-database advanced analytics (R-built in)]. The main driver is better predictive analytics to get inventory levels right and differentiate us from our competitors."

- "We have a lot of dashboard analytics that our customers use. The product managers wanted these to load in under three seconds, and we were able to achieve that using columnstore. Some of these used to take a minute to load. Our customers are happier, and that helps with loyalty."

- "We can now do a lot of the analytics on the IT side instead of relying on the business analytics team. We are using PowerBI to directly query the columnstore."

- "Columnstore is the biggest benefit, a big leap forward. One BI query is 9,531x faster that with the previous version of SQL server."

- "Wow. We can now do so much more. We can look at our large amounts of data in a decent period of time. Some things used to take days to compute."

- "We are introducing machine learning. We have seven or eight years of data from a lot of applications. We can now do machine learning using Microsoft R stack and BI stack."

- "Business intelligence was the biggest improvement for the company. We are moving from static reports and replacing them with PowerBI dashboards. It has had a huge impact at the highest levels of management."

Flexibility

The value of flexibility is clearly unique to each customer, and the measure of its value varies from organization to organization. There are multiple scenarios in which a customer might choose to implement Microsoft SQL Server 2016 and later realize additional uses and business opportunities.

One area that the interviewed companies are looking at is making better

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use of the enhanced security capabilities built into SQL Server 2016. Always Encrypted is one feature that interviewees were eager to implement to better protect customer data. Rolling out improved security was a next step on many roadmaps.

Implementing or enhancing BI and analytics capabilities was another high priority. As described above, companies see the value of these capabilities, but they often include change management and organizational changes so were sometimes not implemented as part of the initial deployment.

Some other future opportunities interviewees discussed included:

› "SQL Server 2016 opens up a lot of new opportunities, but we are not sure when we will leverage them all. PolyBase is definitely something we are looking at in the near term."

› "We are the market leader, and, to maintain and grow that lead, we will need to take advantage of the new features. That will help us gain new customers and keep them satisfied."

› "Up to now, everything has been on-premises. We have a new project that includes virtual machines in Azure."

None of these flexibility opportunities were included in the financial analysis.

Flexibility, as defined by TEI, represents an investment in additional capacity or capability that could be turned into business benefit for a future additional investment. This provides an organization with the "right" or the ability to engage in future initiatives but not the obligation to do so.

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Total Costs

REF.	COST	INITIAL	YEAR 1	YEAR 2	YEAR 3	TOTAL	PRESENT VALUE
Dtr	Implementation effort	$111,563	$0	$0	$0	$111,563	$111,563
Etr	Microsoft SQL Server 2016 licenses	$794,967	$0	$681,400	$681,400	$2,157,767	$1,870,053
Ftr	Hardware replacement	$277,200	$41,580	$41,580	$41,580	$401,940	$380,603
Gtr	Ongoing management	$0	$203,500	$203,500	$203,500	$610,500	$506,074
	Total costs (risk-adjusted)	$1,183,729	$245,080	$926,480	$926,480	$3,281,769	$2,868,293

- Implementation Effort

Most interviewees said that the migration to SQL Server 2016 was relatively fast and straightforward, especially compared to previous Microsoft SQL Server upgrades. The normal range for companies moving from SQL Server 2012 or 2014 lasted from six weeks to five months. One early adopter spent approximately one year on the migration due to when the company implemented and overall complexity. Companies also used some professional services, usually in the form of Microsoft Premier Support. Some of what Forrester heard about the initial implementation included:

› "The entire process to upgrade all the servers took around one month elapsed time. The effective work was about three nights. The rest of the time was prep, testing, and configuration."

› "We used availability groups and updated 70 servers in a 2-hour maintenance window. Everything took six weeks in total to fit around monthly release schedules. Our DBAs worked 20% of their time on the upgrade over the six weeks, and we had one FTE system administrator dealing with storage configuration."

› "We had two DBAs managing the implementation. It was pretty easy, and they did some PowerShell scripting to move instances. In total, it took 500 to 600 hours spread out over a year because we were moving to Hyper V. Otherwise, we could have gotten it done in a little over two months."

› "To get the real performance benefits going, we had to use the in-memory feature, and that came with a high learning curve. It goes against some of the principles a developer would have used in the past."

› "We don't use much professional services for SQL Server. We switched to Microsoft Premier Support for that."

For the composite organization, Forrester used a middle scenario for a nonearly adopter. The implementation took two months and required 2.5 FTEs with an average fully burdened annual cost of $135,000. In addition, $50,000 in Microsoft Premier Support was used as part of the migration.

Implementation time may be higher if not coming from a previous version of Microsoft SQL Server or if the deployment is especially complex. To account for these risks, Forrester adjusted this cost upward by 5%, yielding a three-year risk-adjusted total PV of $111,563.

The table above shows the total of all costs across the areas listed below, as well as present values (PVs) discounted at 10%. Over three years, the composite organization expects risk-adjusted total costs to be a PV of more than $2.8 million.

"We upgrade every time there is a new version of Microsoft SQL Server. 2016 was the smoothest upgrade so far. We were able to create an automated, repeatable process for all environments."

eCommerce marketer, DBA team manager

Implementation risk is the risk that a proposed investment may deviate from the original or expected requirements, resulting in higher costs than anticipated. The greater the uncertainty, the wider the potential range of outcomes for cost estimates.

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Implementation Effort: Calculation Table

REF.	METRIC	CALC.	INITIAL	YEAR 1	YEAR 2	YEAR 3
D1	Number of months		2			
D2	Number of FTEs		2.5			
D3	Monthly fully burdened cost	$135,000/12 months	$11,250			
D4	Professional services		$50,000			
Dt	Implementation effort	D1*D2*D3+D4	$106,250			
	Risk adjustment	↑5%				
Dtr	Implementation effort (risk-adjusted)		$111,563			

- Microsoft SQL Server 2016 Licenses

As discussed earlier, SQL Server 2016 licenses are typically less than what would have been spent on a comparable computation infrastructure using previous versions. For the composite organization, Forrester assumed that there are 150 cores using Enterprise Edition licenses at $3,870 and 100 cores using Standard Edition licenses at $1,009. This annual license includes software assurance. The initial period was prorated to include 14 months of licenses — two months of implementation and the full first year.

Because list pricing was used, no risk adjustment was applied. If a reader's company has a much larger deployment, these costs will be higher but so will the benefits, likely resulting in a similar ROI and payback period. The three-year total PV was $1.9 million.

Microsoft SQL Server 2016 Licenses: Calculation Table

REF.	METRIC	CALC.	INITIAL	YEAR 1	YEAR 2	YEAR 3
E1	Number of cores — Enterprise license		150	150	150	150
E2	SQL Enterprise license and software assurance annual cost	[Initial cost includes initial period + Year 1]	$4,515		$3,870	$3,870
E3	Number of cores — Standard license		100	100	100	100
E4	SQL Standard license and software assurance annual cost	[Prorated in initial period]	$1,177.17		$1,009	$1,009
Et	Microsoft SQL Server 2016 licenses	E1*E2+E3*E4	$794,967	$0	$681,400	$681,400
	Risk adjustment	0%				
Etr	Microsoft SQL Server 2016 licenses (risk-adjusted)		$794,967	$0	$681,400	$681,400

- Hardware Replacement

Most of the interviewees replaced hardware as part of the upgrade prior to complete end of life. This was done to improve efficiency and reduce

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the number of cores. For the financial analysis, Forrester assumed that one-fourth of the servers were replaced, representing 63 out of 250 cores. The average cost per core was $4,000.

If more of the hardware is closer to end of life or not high performance, it is more likely to be replaced to reduce the total number of cores and associated SQL license costs. To account for these risks, Forrester adjusted this cost upward by 10%, yielding a three-year risk-adjusted total PV of $380,603.

Hardware Replacement: Calculation Table						
REF.	METRIC	CALC.	INITIAL	YEAR 1	YEAR 2	YEAR 3
F1	Number of cores replaced out of cycle	25% [rounded up]	63.0			
F2	Cost per core		$4,000			
F3	Total purchase costs	F1*F2	$252,000			
F4	Annual maintenance	F3*15%		$37,800	$37,800	$37,800
Ft	Hardware replacement		$252,000	$37,800	$37,800	$37,800
	Risk adjustment	↑10%				
Ftr	Hardware replacement (risk-adjusted)		$277,200	$41,580	$41,580	$41,580

- Ongoing Management

There is some effort for "keeping the lights on" activities such as patching. Interviewees said that this was less than in the past. A typical explanation was, "We have one FTE DBA rotating who is responsible for patching and other related activities." Additionally, companies typically have Microsoft Premier Support or some other type of professional services contract in place to help with new configurations and new features. These two components were used in the financial model.

Ongoing management efforts may be higher if the infrastructure is much larger or there are some other complexities. To account for these risks, Forrester adjusted this cost upward by 10%, yielding a three-year risk-adjusted total PV of $506,074.

Ongoing Management: Calculation Table						
REF.	METRIC	CALC.	INITIAL	YEAR 1	YEAR 2	YEAR 3
G1	Internal effort	1 FTE		$135,000	$135,000	$135,000
G2	Professional services			$50,000	$50,000	$50,000
Gt	Ongoing management	G1+G2		$185,000	$185,000	$185,000
	Risk adjustment	↑10%				
Gtr	**Ongoing management (risk-adjusted)**			**$203,500**	**$203,500**	**$203,500**

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Financial Summary

CONSOLIDATED THREE-YEAR RISK-ADJUSTED METRICS

Cash Flow Chart (Risk-Adjusted)
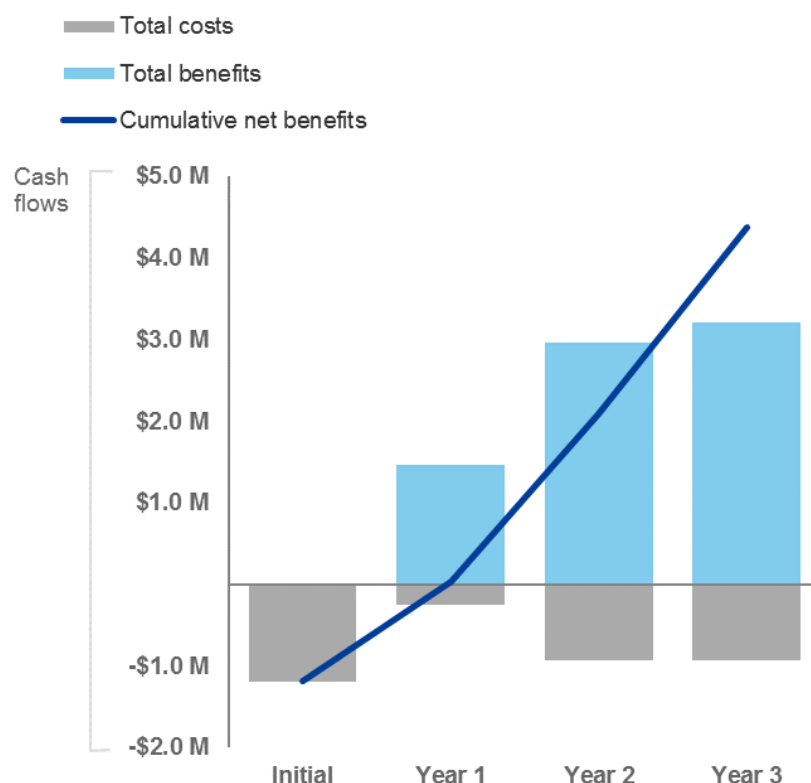
The financial results calculated in the Benefits and Costs sections can be used to determine the ROI, NPV, and payback period for the composite organization's investment. Forrester assumes a yearly discount rate of 10% for this analysis.

These risk-adjusted ROI, NPV, and payback period values are determined by applying risk-adjustment factors to the unadjusted results in each Benefit and Cost section.

Cash Flow Table (Risk-Adjusted)

	INITIAL	YEAR 1	YEAR 2	YEAR 3	TOTAL	PRESENT VALUE
Total costs	($1,183,729)	($245,080)	($926,480)	($926,480)	($3,281,769)	($2,868,293)
Total benefits	$0	$1,472,004	$2,972,486	$3,210,071	$7,654,562	$6,206,560
Net benefits	($1,183,729)	$1,226,924	$2,046,006	$2,283,591	$4,372,793	$3,338,267
ROI						116%
Payback period						11.6 months

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Microsoft SQL Server 2016: Overview

The following information is provided by Microsoft. Forrester has not validated any claims and does not endorse Microsoft or its offerings.

SQL Server 2016 is the foundation of Microsoft's data strategy, encompassing innovations that transform data into intelligent action. With this new release, Microsoft is delivering an end-to-end data management and business analytics solution with mission-critical intelligence for your most demanding applications as well as insights on data on any device.

SQL Server 2016 is ideal for:

› Mission-critical intelligent applications delivering real-time operational intelligence by combining built-in advanced analytics and in-memory technology without having to move the data or impact end user performance.

› Enterprise scale data warehousing with enhanced in-memory columnstore that increases query performance by over 100x versus disk-based solutions. With SQL Server 2016, you can also access optimized massively parallel processing (MPP) scale out software that can be combined with the Analytics Platform System (APS) or Azure SQL Data Warehouse.

› Applications requiring the highest levels of security with Always Encrypted technology that protects data at rest and in motion without impacting database performance.

› Comprehensive business intelligence solutions on mobile devices with an end-to-end mobile BI solution built-in that can deliver insights on any device. It is also easy to manage all key performance indicators (KPIs), mobile reports, and traditional reports from a modern web portal.

› New big data solutions that require combining relational data with nonrelational data with PolyBase technology built-in that allows querying structured and unstructured data with the simplicity of T-SQL.

› Hybrid cloud solutions that can reduce storage costs, improve high availability, and simplify IT operations with new Stretch Database technology. This keeps more historical data available by transparently and securely stretching warm and cold OLTP data to Microsoft Azure on-demand without application changes. In addition, faster replicas can be placed in Azure to provide cost-effective disaster recovery and backups.

With this new innovation, SQL Server 2016 is the first born-in-the-cloud database, where features such as Always Encrypted and Row Level Security were first validated in Azure SQL Database by hundreds of thousands of customers and billions of queries.

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Appendix A: Total Economic Impact

Total Economic Impact is a methodology developed by Forrester Research that enhances a company's technology decision-making processes and assists vendors in communicating the value proposition of their products and services to clients. The TEI methodology helps companies demonstrate, justify, and realize the tangible value of IT initiatives to both senior management and other key business stakeholders.

Total Economic Impact Approach

Benefits represent the value delivered to the business by the product. The TEI methodology places equal weight on the measure of benefits and the measure of costs, allowing for a full examination of the effect of the technology on the entire organization.

Costs consider all expenses necessary to deliver the proposed value, or benefits, of the product. The cost category within TEI captures incremental costs over the existing environment for ongoing costs associated with the solution.

Flexibility represents the strategic value that can be obtained for some future additional investment building on top of the initial investment already made. Having the ability to capture that benefit has a PV that can be estimated.

Risks measure the uncertainty of benefit and cost estimates given: 1) the likelihood that estimates will meet original projections and 2) the likelihood that estimates will be tracked over time. TEI risk factors are based on "triangular distribution."

The initial investment column contains costs incurred at "time 0" or at the beginning of Year 1 that are not discounted. All other cash flows are discounted using the discount rate at the end of the year. PV calculations are calculated for each total cost and benefit estimate. NPV calculations in the summary tables are the sum of the initial investment and the discounted cash flows in each year. Sums and present value calculations of the Total Benefits, Total Costs, and Cash Flow tables may not exactly add up, as some rounding may occur.

PRESENT VALUE (PV)

The present or current value of (discounted) cost and benefit estimates given at an interest rate (the discount rate). The PV of costs and benefits feed into the total NPV of cash flows.

NET PRESENT VALUE (NPV)

The present or current value of (discounted) future net cash flows given an interest rate (the discount rate). A positive project NPV normally indicates that the investment should be made, unless other projects have higher NPVs.

RETURN ON INVESTMENT (ROI)

A project's expected return in percentage terms. ROI is calculated by dividing net benefits (benefits less costs) by costs.

DISCOUNT RATE

The interest rate used in cash flow analysis to take into account the time value of money. Organizations typically use discount rates between 8% and 16%.

PAYBACK PERIOD

The breakeven point for an investment. This is the point in time at which net benefits (benefits minus costs) equal initial investment or cost.

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