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Dedication

This book is lovingly dedicated to Elizabeth Rankins, my wonderful and supportive wife of 27 years.
—Ray Rankins

Dedicated to my children, for the countless times they heard me say, “No, not now, I’m writing chapters!” Thanks Paul Jr., Marissa, Nina, Juliana, and Donny, I love you all very much!
—Paul Bertucci

This book is dedicated to my Aunt Toni. She has always been the one that “remembers” and the one that has helped nurture family bonds. Her love and her thoughtfulness have bridged the physical distance between our families for years, and often times this would go without thanks. This dedication is just one small Thank You for remembering me and my family. We are thinking of you.
—Chris Gallelli

My work on this book is dedicated to my father, Harry Silverstein, a fellow man of letters. For, while his stay with us on this planet was not nearly long enough, he left us with a feeling of kindness and a call to humanity and fellowship with all that has remained for a lifetime. Thank you, Harry, for having been you.
—Alex T. Silverstein
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Most of all, I want to thank my loving wife, Elizabeth, for her patience and understanding during the long days, late nights, and lost weekends spent working on yet another book.

—Ray Rankins

With any writing effort, there is always a huge sacrifice of time that must be made to properly research, demonstrate, and describe leading-edge subject matter. The brunt of the burden usually falls on those many people who are near and very dear to me. With this in mind, I desperately need to thank my family for allowing me to encroach on many months of what should have been my family’s “quality time.”

However, with sacrifice also comes reward in the form of technical excellence and high-quality business relationships. Many individuals were involved in this effort, both directly and indirectly, starting with the other authors (thanks RR, CG, & AS!), Yves Moison (Data by Design & Database Architechs FRANCE), Rene Fluhler (RightShare, Switzerland), Munir Noorali (Autodesk), Christopher Charles (Autodesk), Anthony Vanlandingham (CSAA), Mark Ginnebaugh (DesignMind), and Ryan McCarty (Data by Design). Their expertise in and knowledge of database engines, SQL, performance and tuning, data replication, database mirroring, database snapshots, business intelligence, data integration, SQL Clustering, Master Data Services, Data Quality Services, and high availability are unmatched.

—Paul Bertucci

Writing a book of this size and scope requires a tremendous amount of time and dedication. The time and dedication apply not only to the authors who are writing the book but also to their family members. My wife and daughters were very understanding while I was holed up working on this book, and that understanding helped make this book happen. My love and thanks to them.
I would also like to thank many of my clients who embraced SQL Server 2012 and gave me the opportunity to use it in the real world. In particular, I would like to thank Ray McQuade and his company, Spruce Computer Systems. Spruce has had tremendous success with SQL Server 2005 and SQL Server 2008, and now SQL Server 2012.

—Chris Gallelli

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—Alex T. Silverstein
We Want to Hear from You!

As the reader of this book, you are our most important critic and commentator. We value your opinion and want to know what we’re doing right, what we could do better, what areas you’d like to see us publish in, and any other words of wisdom you’re willing to pass our way.

We welcome your comments. You can email or write to let us know what you did or didn’t like about this book—as well as what we can do to make our books better.

Please note that we cannot help you with technical problems related to the topic of this book.

When you write, please be sure to include this book’s title and author as well as your name and email address. We will carefully review your comments and share them with the author and editors who worked on the book.

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Visit our website and register this book at informit.com/register for convenient access to any updates, downloads, or errata that might be available for this book.
Since the release of SQL Server 2000, SQL Server has established itself as a robust and reliable database platform whose performance, scalability, and reliability meet the implementation needs of businesses and corporations from small desktop applications on up to multi-terabyte enterprise-wide systems. The updates and enhancements in SQL Server 2012 further solidify its position in the marketplace as a robust enterprise system providing a database engine foundation that can be available 7 days a week, 365 days a year.

One of the biggest challenges we face writing the SQL Server Unleashed series of books is how to provide comprehensive, in-depth coverage of all SQL Server features within a single book. Over the past few releases, the number of SQL Server features and components has increased, and many of these (for example, SQL Server Integration Services, Reporting Services, SQL Server Analysis Services, and .NET Framework integration) provide material enough to warrant separate titles. To cover each topic sufficiently would require more information than could reasonably fit in print in a single volume. So, we had to make some hard decisions as to what to include in print.

We decided that the printed portion of the book would provide detailed coverage of the core database server features and the day-to-day administrative and management aspects and tools of SQL Server 2012. We want to ensure that we provide enough of the necessary information, tips, and guidelines to get you started making effective use of these features. At the same time, there is a wealth of useful information we want to provide on additional SQL Server 2012 features and major components of SQL Server, such as SQL Server Integration Services, Reporting Services, Analysis Services, T-SQL programming, and SQL Server integration with the .NET Framework. Rather than leave this valuable information out entirely, we decided to include the chapters with this material on the eBook for registered owners of the printed version of this book. Also on the Web, you will find all of the sample scripts, databases, and other code samples and material that support the book content.

Another primary goal in writing this book was for it to be more than just a syntax reference. SQL Server Books Online is a fine resource as a syntax reference. This book attempts to pick up where Books Online leaves off, by providing, in addition to syntax where necessary, valuable insight, tips, guidelines, and useful examples derived from our many years of experience working with SQL Server. Although we do provide the core, and sometimes advanced, syntax elements for the SQL commands discussed, SQL Server Books Online provides a much more extensive syntax reference than would make sense to try to...
duplicate here. As a matter of fact, at times, we may even direct you to Books Online for more detail on some of the more esoteric syntax options available for certain commands.

We hope that we have succeeded in meeting the goals we set out for this book and that it becomes an essential reference and source of expert information for you as you work with SQL Server 2012.

Who This Book Is For

This *Unleashed* book is intended for intermediate-level to advanced-level users: SQL Server administrators who want to effectively manage and administer their SQL Server environments and developers who want a more thorough understanding of SQL Server to help them write better Transact-SQL (T-SQL) code and develop more robust SQL Server applications. If you are responsible for analysis, design, implementation, support, administration, or troubleshooting of SQL Server 2012, this book provides an excellent source of experiential information for you. You can think of this as a book of applied technology. The emphasis is on the more complex aspects of the product, including using the new tools and features, administering SQL Server, analyzing and optimizing queries, implementing data warehouses, ensuring high availability, and tuning SQL Server performance.

This book is for both developers and SQL Server administrators who are new to SQL Server 2012 as well as those who are already familiar with prior versions of SQL Server. Each chapter provides a brief summary of the major changes or new features or capabilities of SQL Server related to that topic. If you are already familiar with SQL Server, you can refer to this summary to focus on the content that covers the new features and capabilities in more detail.

This book is intended to provide a behind-the-scenes look into SQL Server, showing you what goes on beneath the various wizards and GUI-based tools so that you can learn the underlying SQL commands. Although the GUI tools can make your average day-to-day operations much simpler, every database administrator should learn the underlying commands to fully unlock the power and capabilities of SQL Server.

What This Book Covers

The book is divided into the following parts:

- **Part I, “Welcome to Microsoft SQL Server”—** Chapters in this part introduce you to the Microsoft SQL Server 2012 environment, the various editions of SQL Server that are available, and the capabilities of each edition in the various Windows environments. In addition, it provides an overview of and introduction to the new features found in SQL Server 2012, which are covered in more detail throughout the rest of the book.

- **Part II, “SQL Server Tools and Utilities”—** Chapters in this part cover the tools and utility programs that SQL Server 2012 provides for you to administer and manage your SQL Server environments. You’ll find information on the various management tools you use on a daily basis, such as SQL Server Management Studio and the
SQLCMD command-line query tool, along with information on SQL Server Profiler. If you are not familiar with these tools, you should read this part of the book early on because these tools are often used and referenced throughout many of the other chapters in the book.

- **Part III, “SQL Server Administration”**—Chapters in this part discuss topics related to the administration of SQL Server at the database server level. It begins with an overview of what is involved in administering a SQL Server environment and then goes on to cover the tasks related to setting up and managing it, including installing and upgrading to SQL Server 2012 as well as installing SQL Server clients. These chapters also include coverage of database backup and restore, using the Database Mail facility, scheduling and notification using SQL Server Agent, and configuring and using Policy-Based Management.

- **Part IV, “SQL Server Security Administration”**—With the growth of software and database development in the world, there is an increased importance placed on security—enough so that these topics warrant a separate set of chapters to emphasize their importance. The chapters in this part cover security and compliance, the importance of security best practices, SQL Server security and user administration, and protecting data using encryption.

- **Part V, “SQL Server Database Administration”**—Chapters in this part delve into the administrative tasks associated with creating and managing a SQL Server 2012 database, including the creation and management of database objects such as tables, indexes, views, stored procedures, functions, and triggers. It also covers database snapshots and database maintenance tasks and responsibilities.

- **Part VI, “SQL Server Performance and Optimization”**—Chapters in this part provide information to help you get the best performance out of SQL Server. It begins with a discussion of data structures, indexes, and performance—key items to understand to help ensure good database performance. It then builds on that information with chapters on query optimization and analysis, locking, database design and performance, and ways to manage workloads using the new Resource Governor, concluding by providing a methodology for monitoring and optimizing SQL Server performance.

- **Part VII, “SQL Server High Availability”**—Chapters in this part cover topics related to achieving high availability for your SQL Server instances, including SQL Server high-availability fundamentals and best practices, as well as chapters on SQL Server replication, database mirroring, SQL Server failover clustering, and SQL Server 2012’s new AlwaysOn feature.

- **Part VIII, “SQL Server Application Development”**—Chapters in this part provide a comprehensive overview of what’s new in T-SQL in SQL Server 2012, T-SQL programming guidelines, tips, and tricks, and advanced stored procedure programming and optimization. In addition, chapters in this part provide an overview of .NET integration with SQL Server and creating .NET CLR objects information, working with XML in SQL Server, and working with additional SQL Server
components that are not part of the core Database Engine such as Service Broker and Full-Text Search.

- **Part IX, “SQL Server Business Intelligence Features”**—Chapters in this part provide a comprehensive overview of SQL Server 2012’s built-in business intelligence features: Analysis Services, Integration Services, and Reporting Services, enhancements to Master Data Services as well as an introduction to Data Quality Services and the Parallel Data Warehouse offering.

- **Part X, “Bonus Chapters”**—This part provides a few chapters for which there just wasn’t room enough to include elsewhere in the appropriate sections of the book. These chapters provide expert advice and information on managing linked servers, planning for SQL Server disaster recoveries, and understanding SQL Server configuration options.

- **Book Materials on the Web**—Many of the code samples, scripts, databases and other materials that supplement various chapters of this book are available for download on the Web at informit.com/title/9780672336928. Also available for registered owners of the print version of this book are 17 additional chapters that are not included in the print version of the book. Please visit the web page periodically for any updated or additional code samples and bonus material as it becomes available.

### Conventions Used in This Book

Names of commands and stored procedures are presented in a special monospaced computer typeface. We have tried to be consistent in our use of uppercase and lowercase for keywords and object names. However, because the default installation of SQL Server doesn’t make a distinction between upper- and lowercase for SQL keywords or object names and data, you might find some of the examples presented in either upper- or lowercase.

Code and output examples are presented separately from regular paragraphs and are also in a monospaced computer typeface. The following is an example:

```
select object_id, name, type_desc
from sys.objects
where type = 'SQ'
```

<table>
<thead>
<tr>
<th>object_id</th>
<th>name</th>
<th>type_desc</th>
</tr>
</thead>
<tbody>
<tr>
<td>1977058079</td>
<td>QueryNotificationErrorsQueue</td>
<td>SERVICE_QUEUE</td>
</tr>
<tr>
<td>2009058193</td>
<td>EventNotificationErrorsQueue</td>
<td>SERVICE_QUEUE</td>
</tr>
<tr>
<td>2041058307</td>
<td>ServiceBrokerQueue</td>
<td>SERVICE_QUEUE</td>
</tr>
</tbody>
</table>

When syntax is provided for a command, we have attempted to follow these conventions:
Consider the following syntax example:

```
grant {all | permission_list} on object [{column_list}] to {public | user_or_group_name [, [...]]}
```

In this case, `object` is required, but `column_list` is optional. Note also that items shown in plain computer type, such as `grant`, `public`, and `all`, should be entered literally, as shown. (One exception to this is any argument with the “_name” suffix, which is a placeholder for the specified object name that must be provided.) Placeholders are usually presented in monospaced italic, such as `permission_list` and `user_or_group_name`. A `placeholder` is a generic term for which you must supply a specific value or values. Also, any values enclosed in angle brackets `< >` indicate a specific value that needs to be provided. The `ellipsis` ([...]) in the square brackets following `user_or_group_name` indicates that multiple user or group names can be specified, separated by commas. You can specify either the keyword `public` or one or more user or group names, but not both.

Most of the examples presented in this book make use of the `AdventureWorks2012` database, which is not automatically installed with SQL Server 2012 nor included with the SQL Server installation media. To install the `AdventureWorks2012` sample database, you must first download the installer from the Microsoft SQL Server Samples and Community Projects website at http://sqlserversamples.codeplex.com.

Some of the chapters in the Part IX, “SQL Server Business Intelligence Features,” make use of a sample database called `CompSales`. The `CompSales` database provides a good star-schema model that represents a real-world production database. This database is provided on the website in the Code Listings and Sample Databases folder at www.informit.com/title/9780672336928. To install the `CompSales` database, follow these steps:

1. Copy the `CompSales.mdf` file into the SQL Server data folder where you want it to reside.
2. Ensure that the Read-Only property of the `CompSales.mdf` file is not enabled.
3. Attach the CompSales database by using a command similar to the following. (Edit the path to match the location of the CompSales.mdf file on your system.)

```
sp_attach_single_file_db 'CompSales',
   N'D:\MSSQL\DATA\MSSQL.1\MSSQL\Data\CompSales.mdf
```

**Good Luck!**

If you have purchased this book, you are on your way to getting the most from SQL Server 2012. You have already chosen a fine platform for building database applications, one that can provide outstanding performance and rock-solid reliability and availability at a reasonable cost. With this book, you now have the information you need to make the best of it.

Many of us who worked on this book have been using SQL Server since it was first released. Writing about each new version challenges us to reassess our understanding of SQL Server and the way it works. It’s an interesting and enjoyable process, and we learn a lot writing each of these books. We hope you get as much enjoyment and knowledge from reading this book as we have from writing it.
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With SQL Server currently on a 2-year release cycle, each release is more of an evolutionary change from the previous release than a revolutionary change. Therefore, Microsoft SQL Server 2012 is not a quantum leap forward from SQL Server 2008 R2, but it does provide a number of interesting new features and enhancements that further extend the performance, reliability, availability, programmability, and ease of use of SQL Server. This chapter introduces the major new features provided in SQL Server 2012 and covers a number of the enhancements to previously available features.

**New SQL Server 2012 Features**

So what does SQL Server 2012 have to offer over SQL Server 2008 R2? Following is an overview of the new features provided in SQL Server 2012:

- **New storage features**—Columnstore indexes, FileTable storage.

- **New Transact-SQL (T-SQL) constructs**—Sequence objects, `THROW` statement, new conversion, logical, string, and date and time functions, and ad hoc query paging.

- **New scalability and performance features**—Indirect checkpoints, `FORCESCAN` table hint, number of table partitions increased to 15,000.

- **New security features**—Database Audit, user-defined server roles, contained databases.
New availability features—A number of high-availability enhancements known as AlwaysOn, which include AlwaysOn Availability Groups and AlwaysOn Failover Cluster Instances.

Statistical Semantic Search—Statistical Semantic Search builds upon the existing full-text search feature in SQL Server by querying the contextual meaning of terms within a document repository.

Data Quality Services—This new feature allows you to build a knowledge base of data rules and use those to perform a variety of critical data quality tasks, including correction, enrichment, standardization, and de-duplication of your data.

The following sections take a closer look at each of these new features and, where appropriate, provide references to subsequent chapters where you can find more information and detail about the new features.

New and Improved Storage Features

SQL Server 2012 provides a few new features related to data storage, primarily intended to improve performance.

SQL Server 2012 provides an enhancement to FILESTREAM storage by allowing more than one filegroup to be used to store FILESTREAM data. This can improve I/O performance and scalability for FILESTREAM data by providing the ability to store the data on multiple drives. FILESTREAM storage, which was introduced in SQL Server 2008, integrates the SQL Server Database Engine with the NTFS file system, providing a means for storing unstructured data (such as documents, images, and videos) with the database storing a pointer to the data. Although the actual data resides outside the database in the NTFS file system, you can still use T-SQL statements to insert, update, query, and back up FILESTREAM data, while maintaining transactional consistency between the unstructured data and corresponding structured data with same level of security. For more information on using FILESTREAM storage, see Chapter 20, “Creating and Managing Tables.”

A new storage features introduced in SQL Server 2012 is FileTable storage. FileTable is the new type of table that was added in SQL Server 2012. The FileTable builds upon the FILESTREAM capability that was introduced in SQL Server 2008. Like FILESTREAM, FileTable storage provides SQL Server access to files that are stored in the Windows file system. FileTable differs from FILESTREAM in that FileTable allows for Windows applications to access the files that are part of the FileTable definition. This file access is nontransactional, and it comes without having to make changes to the Windows program that is accessing the files. For more information on FileTable storage, see Chapter 44, “What’s New for Transact-SQL in SQL Server 2012.”

SQL Server 2012 also introduces a new data warehouse query acceleration feature based on a new type of index called an xVelocity memory optimized columnstore. This new index, combined with enhanced query processing features, improves data warehouse query performance by hundreds to thousands of times in some cases and can routinely give a tenfold speedup for a broad range of decision support queries. Columnstore indexes
can limit or eliminate the need to rely on prebuilt aggregates, including user-defined summary tables and indexed (materialized) views. Unlike typical row storage, which stores multiple rows of data per page, a columnstore index stores the values for a single column in its own set of disk pages. The advantage of columnar storage is the ability to read the values of a specific column of a table without having to read the values of all the other columns. For more information on the structure of columnstore indexes, see Chapter 30, “Data Structures, Indexes, and Performance.” For more information on creating and using columnstore indexes, see Chapter 57, “Parallel Data Warehouse Appliance.”

**New Transact-SQL Constructs**

What would a new SQL Server release be without new T-SQL commands and constructs to further expand the power and capabilities of the T-SQL language? SQL Server 2012 is no exception. The new constructs provided in SQL Server 2012 include the following:

- **Sequence objects**—Sequence objects can be used to generate a sequence of numeric values according to the definition of the object. Sequence objects provide an alternative for generating autosequencing values, similar to an Identity column but independent of any specific table. Sequence objects provide more flexibility and allow applications to apply a sequence value across multiple tables.

- **THROW statement**—The THROW statement can be used to raise an error condition and transfer execution to a CATCH block of a TRY...CATCH construct or to re-raise the error condition that invoked the CATCH block.

- **New conversion functions**—PARSE, TRY_PARSE, and TRY_CONVERT.

- **New logical functions**—CHOOSE and IIF.

- **New string functions**—CONCAT and FORMAT.

- **New date and time functions**—DATEFROMPARTS, DATETIME2FROMPARTS, DATETIMEFROMPARTS, DATETIMEOFFSETFROMPARTS, SMALLDATETIMEFROMPARTS, TIMEFROMPARTS.

- **New rows and range clauses**—Provides support for windows framing, which can be used to restrict the results to a subset of rows by specifying the start and end points within the partition of the OVER clause.

- **New window offset functions**—LAG and LEAD functions used in conjunction with OVER clause let you return a value from a specific row that’s a certain offset from the current row.

- **New window rank distribution functions**—PERCENT_RANK, PERCENTILE_CONT, PERCENTILE_DISC, CUME_DIST.

- **Ad hoc query paging**—Provides a mechanism to implement paging using the relatively simple syntax provided by the ANSI standard ORDER BY ... OFFSET / FETCH clause.
For more information and examples of the new T-SQL features and enhancements, see Chapter 44.

**New Scalability and Performance Features**

SQL Server provides some new scalability and performance features including indirect checkpoints and the `FORCESCAN` table hint.

Indirect checkpoints provide a mechanism for configuring checkpoint intervals at the individual database level. Indirect checkpoints can provide potentially faster, more predictable recovery times for your critical databases than automatic checkpoints. For more information on indirect checkpoints, see Chapter 27, “Transaction Management and the Transaction Log.”

The new `FORCESCAN` table hint complements the `FORCESEEK` hint by allowing you to specify that the query optimizer use an index scan operation as the access path to the table or view referenced in the query. For more information on the `FORCESCAN` table hint, see Chapter 31, “Understanding Query Optimization.”

**New Security Features**

SQL Server 2012 introduces Database Audit. Similar to SQL Server Audit, Database Audit is based on the new Extended Events feature and enables you to audit database-level events or groups of events. For more information on Database Audit, see Chapter 16, “Security and Compliance.”

SQL Server 2012 also adds user-defined server roles. These new server roles provide the same type of flexibility that is available with user-defined database roles, but they are instead defined at the server level and improve manageability of the permissions at the server level, giving administrators an option that goes well beyond the rigid fixed server roles. For more information on creating user-defined server roles, see Chapter 17, “Security and User Administration.”

Contained database support was added in SQL Server 2012 along with the related changes to support authentication to this type of database. Users can now be added to a database without having a corresponding SQL Server login. Authentication instead takes place at the database level. Contained databases can be easily moved from one server to another without the authentication issues that make noncontained database migrations more difficult. For more information on configuring contained databases, see Chapter 19, “Creating and Managing Databases.”

**New Availability Features**

One of the key new features in SQL Server 2012 is the AlwaysOn availability features. The new AlwaysOn features provide SQL Server administrators more power and flexibility in their efforts toward providing both high availability and disaster recovery. The AlwaysOn features consist of AlwaysOn Availability Groups and AlwaysOn Failover Cluster Instances.

AlwaysOn Availability Groups support a failover environment for a discrete set of user databases that fail over together. A single SQL Server instance can host multiple
availability groups. In the event of a failure, each availability group can be configured to fail over to different SQL Server instances. For example, one availability group can fail over to instance 2, another availability group to instance 3, and so on. You no longer need to have a standby server that is capable of handling the full load of your primary server. An availability group consists of a set of one or more read-write primary databases and from one to four remote secondary copies. The remote secondary databases can be set up as read-only copies that you can run certain backup operations and reporting activity against, taking significant load off the primary server without the maintenance and overhead of creating snapshots of the secondary databases.

The other feature that is part of the AlwaysOn Availability offering is AlwaysOn Failover Cluster Instances. This feature is an enhancement to the existing SQL Server failover clustering, which is based on Windows Server Failover Cluster (WSFC). AlwaysOn Failover Clustering provides higher availability of SQL Server instance after failover. Some of the improvements of AlwaysOn Failover Clustering over the existing SQL Server failover clustering include the ability to set up multisite failover clustering for improved site protection, more-flexible failover policies, and improved diagnostics capabilities.

For more information on the AlwaysOn Availability features of SQL Server 2012, see Chapter 43, “SQL Server 2012 AlwaysOn Features.”

**Statistical Semantic Search**

Statistical Semantic Search builds upon the existing full-text search feature in SQL Server but enables new scenarios that extend beyond keyword searches. While full-text search lets you query the words in a document, Semantic Search lets you query the meaning of the document. Semantic Search attempts to improve document searches by understanding the contextual meaning of the terms and tries to provide the most accurate answer from a given document repository. If you use a web search engine like Google, you are already familiar with Semantic Search technology.

SQL Server Semantic Search builds its indexes using the indexes created by full-text search. With Semantic Search, you can go beyond just searching for specific words or strings in a document. Solutions are possible that include automatic tag extraction, related content discovery, and hierarchical navigation across similar content. For example, you can query the index of key phrases to build the taxonomy for an organization, or you can query the document similarity index to identify resumés that match a particular job description.

For more information on Statistical Semantic Search, see Chapter 51, “SQL Server Full-Text Search.”

**Data Quality Services**

Within Master Data Services (MDS), SQL Server 2012 adds Data Quality Services. Data Quality Services complements MDS and is usable by other key data manipulation components within the SQL Server environment. This feature enables you to build a knowledge base of data rules and use those to perform a variety of critical data quality tasks, including correction, enrichment, standardization, and de-duplication of your data. This also
includes the ability to do some basic data profiling to better understand the integrity and overall data quality state of your core data.

Data Quality Services (DQS) consists of a Data Quality Server and a Data Quality Client. The DQS Server consists of three SQL Server catalogs with data-quality functionality and storage. The Data Quality Client is a SQL Server shared feature that business users, information workers, and IT professionals can use to perform computer-assisted data quality analyses and manage their data quality interactively. These DQS Cleansing components can also be used in Integration Services and MDS.

For more information on working with Data Quality Services, see Chapter 56, “Master Data Services and Data Quality Services.”

**SQL Server 2012 Enhancements**

In addition to the brand new features in SQL Server 2012, there are a number of enhancements to existing features provided by SQL Server 2012. The following sections provide an overview of some of the major enhancements.

**SQL Server Management Studio Enhancements**

The standout features in the SQL Server 2012 SSMS that have been added or enhanced include the following:

- **Alternative keyboard shortcut schemes**—SSMS support two keyboard shortcut schemes. The default is based on the Microsoft Visual Studio 2010 keyboard shortcuts. The other scheme matches the keyboard shortcuts from SQL Server 2008 R2. The SQL Server 2000 shortcuts are no longer available in SQL Server 2012.

- **Query Editor T-SQL debugger**—The debugger was enhanced in a number of different ways, including improved breakpoint processing, expanded Watch window capabilities, and the ability to debug prior instances of SQL Server, including SQL Server 2005 (SP2) or later.

- **Query Editor snippets**—T-SQL code snippets are a new type of template that was added in SQL Server 2012. These templates are another great starting point when writing new T-SQL statements in the Database Engine Query Editor.

- **Query Editor IntelliSense**—IntelliSense has been optimized to produce better string matches. It has also been enhanced to support the newly added snippets.

- **Extended Events GUI**—SSMS now provides a graphical interface to create, manage, and monitor Extended Events sessions for monitoring SQL Server.

- **Database Recovery advisor**—The Database Recovery tool is launched from the Restore Database window and displays visual timeline that outlines the database backups that are available for restore, allowing a user to restore to a point in time by simply clicking the visual timeline; the necessary backups will be selected for recovery.
For more information on these enhancements to SSMS, see Chapter 4, “SQL Server Management Studio,” Chapter 35, “Monitoring SQL Server Performance,” and Chapter 11, “Database Backup and Restore.”

**Resource Governor Enhancements**

SQL Server 2012 provides enhancements to the Resource Governor that enable you to more effectively govern performance, especially for machines with a large number of CPU cores. The enhancements include the following:

- Support for up to 64 resource pools, an increase from the previous maximum of 20, to better enable partitioning larger machines between more workloads
- A new `CAP_CPU_PERCENT` option for resource pools to provide a means of setting a hard-cap limit on CPU resource usage, which can provide greater predictability
- A new `AFFINITY` option for resource pools providing a mechanism to affinitize resource pools to one or more schedulers and NUMA nodes, which can provide greater isolation of CPU resources

For more information on these new enhancements to Resource Governor, see Chapter 37, “Managing Workloads with the Resource Governor.”

**Spatial Data Enhancements**

SQL Server 2012 adds four new spatial type classes: `FULLGLOBE`, `CIRCULARSTRING`, `COMPOUND Curve`, and `CURVE POLYGON`. SQL Server 2012 also includes features and enhancements that improve performance for spatial data and operations, including new spatial indexes, a spatial index hint, compression, improved index build time, and a new query plan for spatial queries. In addition, SQL Server 2012 provides further performance enhancements at the spatial library level for `Distance()` and `ShortestLineTo()` methods along with performance improvements at the SQL level for methods which are based on them, including `ST Distance()` and `ShortestLineTo()`.

For more information on the enhancements to spatial data and working with spatial data in SQL Server 2012, see Chapter 44.

**Integration Services Enhancements**

In SQL Server 2012, Microsoft has further extended the capabilities of SSIS into a much more comprehensive and robust data integration platform—with the emphasis on the word *platform*. The following are some of the highlights of SSIS 2012:

- A new deployment model for deploying projects to the Integration Services server.
- The ability to use server environments to specify runtime values for packages contained in a project.
- New views, stored procedures, and stored functions to help in troubleshooting performance and data problems.
The Flat File connection manager now supports parsing of flat files with embedded qualifiers.

Improved remapping of columns by the SSIS Designer when a new data source is connected. (Columns are remapped based on their name and data type rather than by lineage ID.)

The Integration Services Merge and Merge Join transformations are more robust and reliable.

Integration Services now includes the DQS Cleansing transformation that enables you to more easily and accurately improve the quality of data.

The ability to use SQL Server 2012’s Change Data Capture technology from within Integration Services.

For more information on working with SQL Server Integration Services, see Chapter 54, “SQL Server Integration Services.”

Service Broker Enhancements

In SQL Server 2012, Service Broker includes the following new features:

- The ability to send messages to multiple services.
- The ability to reconfigure poison message handling and to view this setting for any service.
- Built-in tracking for how long a message has been in a queue. (A new column message_enqueue_time now exists on every queue.)
- Built-in support for AlwaysOn Availability.

For more information on Service Broker, see Chapter 50, “SQL Server Service Broker.”

Full-Text Search Enhancements

SQL Server 2012 full-text search enhancements include improvements in performance and scale and new functionality, including the previously discuss Semantic Search capability.

Full-text search in SQL Server 2012 now scales to more than 100 million documents. Significant improvement can also be realized in the traditional full-text query performance, which is reported to be approximately 7 to 10 times faster than in the previous versions of SQL Server. Additional performance improvements are a result of improved internal implementation, improved query plans, and preventing queries from blocking index updates.

The new functionality associated with full-text search includes the following:

- Property Search—In SQL Server 2012, users can now conduct searches on document properties.
Customizable Near—The Custom Proximity Operator, or Customizable Near, makes it possible for users to specify how close a search term must appear to others before it is considered a successful match.

New Wordbreaks

For more in-depth coverage of these new features and an introduction to SQL Server full-text search, see Chapter 51, “SQL Server Full-Text Search.”

Analysis Services Enhancements

SQL Server 2012 provides enhancements to almost every component of SSAS, along with the addition of major scale-out and in-memory capabilities. The following are some of the top new features and enhancements in SSAS:

- A new architecture for SQL Server 2012 SP1 PowerPivot that supports a PowerPivot server outside of a SharePoint 2013 farm that leverages Excel Services for querying, loading, refreshing, and saving data.
- PowerPivot (in Microsoft Excel 2013) supports deeper integration with data exploration workflows.
- Tabular models enhancements, including optimized storage for measures and key performance indicators (KPIs), extended data categorizations, extended characters, hierarchy annotation, and improved support when importing from Data Market (external data) data feeds.
- Tabular Model Designer Diagram View, which displays tables, with relationships between them, in a graphical format.
- xVelocity In-memory Analytics Engine for tabular models.
- New trace events in multidimensional databases to help troubleshoot lock-related query or processing problems.
- Unified business intelligence (BI) semantic modeling schema.
- Increased language support, which now includes MDX, DMX, DAX, XML/A, and ASSL.

For more information on the new features and enhancements to Analysis Services, see Chapter 53, “SQL Server 2012 Analysis Services.”

Reporting Services Enhancements

SQL Server 2012 includes only a small number of significant updates to the core SSRS platform, which is not surprising considering the SSRS overhaul that came with SQL Server 2008 R2. The enhancements provided in SQL Server 2012 include the following:

- An updated rendering extension for Microsoft Excel 2007-2010, supported both by Report Builder and the SSRS web rendering controls
An updated rendering extension for Microsoft Word 2007-2010

The ability to view web-based reports on touch-screen Apple iOS 6 devices and on Microsoft Surface-based tablet devices

For more information on Replication Services in SQL Server 2012, see Chapter 55, “SQL Server 2012 Reporting Services.”

**Master Data Services Enhancements**

Several new usability and flexibility improvements and enhancements have been added in the SQL Server 2012 version of Master Data Services (MDS). Following are some of the top new features and enhancements of MDS:

- The ability to use Excel to manage master data via the Master Data Services Add-in for Excel.
- The ability to match data before loading, to confirm that you are not adding duplicate records, using SQL Server Data Quality Services (DQS) matching to compare two sources of data.
- The ability to load all members and attribute values for an entity at one time.
- A new higher-performance `MDSModelDeploy` command-line tool is now available to create and deploy packages with data, in addition to a Model Deployment Wizard in the web application that is used to deploy model structures only.
- A new Model Package Editor that enables you to deploy selected parts of a model rather than the entire model.
- Creating a recursive hierarchy with three or more levels is now supported in MDS.
- SharePoint workflow integration.

For a more in-depth overview of the features and capabilities of MDS, see Chapter 56, “Master Data Services and Data Quality Services.”

**Deprecated Features**

In addition to the new and enhanced features in SQL Server 2012, it’s important to note the features for which support has been deprecated and discontinued. Table 2.1 lists the unsupported/deprecated features along with their replacements, if any.

<table>
<thead>
<tr>
<th>Deprecated Feature</th>
<th>Replacement</th>
</tr>
</thead>
<tbody>
<tr>
<td>SQL Server Profiler</td>
<td>Extended Events and the Extended Events GUI in SSMS</td>
</tr>
<tr>
<td>Sqlmaint.exe</td>
<td>None</td>
</tr>
</tbody>
</table>
### Deprecated Feature

<table>
<thead>
<tr>
<th>Makepipe.exe and readpipe.exe commands</th>
<th>None</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>BACKUP</strong> { DATABASE</td>
<td>LOG } <strong>WITH PASSWORD</strong> and <strong>BACKUP</strong> { DATABASE</td>
</tr>
<tr>
<td><strong>RESTORE</strong> { DATABASE</td>
<td>LOG } ... <strong>WITH DBO_ONLY</strong></td>
</tr>
<tr>
<td>SQL Mail</td>
<td>Database Mail</td>
</tr>
<tr>
<td>sp_dboption</td>
<td>ALTER DATABASE</td>
</tr>
<tr>
<td><strong>80 compatibility level</strong></td>
<td>Support provided only for compatibility levels 90 and higher</td>
</tr>
<tr>
<td>Database mirroring sp_dropgroup, sp_helpgroup</td>
<td>AlwaysOn Availability Groups</td>
</tr>
<tr>
<td><em>= and =</em> OUTER JOIN syntax</td>
<td>LEFT OUTER JOIN or RIGHT OUTER JOIN</td>
</tr>
</tbody>
</table>

To help keep track of deprecated features so that you can identify potential future upgrade and compatibility problems, SQL Server 2012 provides the SQL Server: Deprecated Features performance counter and the Deprecation Announcement and Deprecation Final Support event classes, which you can monitor via SQL Server Profiler or SQL Trace.

## Summary

SQL Server 2012 provides a number of new and long-awaited features and enhancements. This chapter provides an overview of the new features and enhancements that ship with SQL Server 2012. To learn more, refer to the other chapters referenced here.

However, before we get into covering the features and capabilities of SQL Server 2012, we’ll first take a look at some real-world production implementations of SQL Server to give you an idea of what is possible with SQL Server in both the online transaction processing (OLTP) world and in the decision support systems (DSS)/business intelligence (BI) realms.
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ALWAYSON FAILOVER CLUSTERING INSTANCES

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