Microsoft SQL Server 2008 R2 Business Intelligence

SQL Server White Paper

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Applies to: SQL Server 2008 R2

Summary: Microsoft® SQL Server® 2008 R2 expands on the value delivered in SQL Server 2008 to make actionable business intelligence accessible to all employees, leading to better, faster, more relevant decisions. More than ever, organizations can empower individuals to gain deeper insight into all aspects of their business and to share their findings effortlessly and securely. SQL Server 2008 R2 helps organizations improve IT and developer efficiency. Simply put, it redefines how organizations deliver and succeed with BI.

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Executive Summary

Delivering actionable business intelligence remains a top priority for IT organizations. CIOs continually tell Microsoft that they need more tools and new capabilities to deliver and succeed with BI. Their wish list includes the capabilities to give users the power to drill into any aspect of their business on their own, manage enterprise information, encapsulate data sources, gain control over user-generated solutions, and create intuitive, shareable reports and analytical applications. In short, organizations need new technologies and solutions to expand the reach of BI from traditional organizational domains into team workspaces and personal BI areas.

SQL Server 2008 R2 unveils groundbreaking new technologies and tools, specifically targeted at empowering users, assisting in seamless, secure sharing and collaboration, and increasing IT and BI developer efficiency. Innovations, such as Master Data Services, Report Builder 3.0, and PowerPivot for Excel® 2010 and SharePoint® 2010, don't just tackle typical enterprise BI challenges—they change the game.

End users will see the greatest impact from the uniform way they now have of working with BI solutions. Using familiar Microsoft Office applications, anyone can process vast amounts of data and obtain actionable insights without having to rely on developers or IT. Analyzing large datasets on desktops with familiar tools in a ***managed*** way will be routine. Obtaining insights quickly, drilling down into details, and discovering new information, questions, and answers will all be easier.

Lessening the burden on BI developers, end users can create team and personal solutions in a managed BI environment that facilitates seamless and secure sharing and collaboration on self-service BI solutions. In the process, they'll also learn details about organizational BI needs, which they can effectively communicate to developers. This should create faster delivery cycles, clearer requirement definitions, and more time for developers to produce high-quality organizational BI solutions.

The biggest impact of SQL Server 2008 R2 on IT comes from the new generation of management tools that drive direct stewardship, ensuring data quality, compliance with laws and regulations, and oversight over spreadmarts. IT professionals can track and control data entry and changes across all information systems, and determine who is using shared self-service BI applications when, how often, and with what application. By taking proactive steps to avoid conflicting and outdated spreadsheet data, IT can mitigate causes of misleading analysis, confusing results, and decision-making complications.

This white paper contains information for technical decision makers evaluating the business benefits of SQL Server 2008 R2 for their enterprises and planning to adopt a business intelligence strategy based on the Microsoft BI Solution Stack. The paper assumes familiarity with database management systems, data warehouses, SharePoint farms, and Microsoft Office applications. A high-level understanding of the data integration tools and technologies available on the Microsoft SQL Server 2008 R2 platform will also help. You'll find detailed information on the Microsoft Web site at http://www.microsoft.com/sqlserver/2008/en/us/r2.aspx.

Introduction

Here's an all-too-common enterprise scenario: Information Workers needing actionable insights into their business ask IT for an analytics solution. The ensuing development cycle burdens requesters and developers alike with requirements analysis, design suggestions, user approvals, data modeling, code development, integration and acceptance testing, further tweaking, and sometimes feature creep. When the solution finally arrives—weeks or months later—it merely delivers information, not the needed insights. Or the requirements have changed. Or the need is long gone. The organization still lacks the power to make informed decisions, misses opportunities, and fails to become more efficient.

Commonly, business professionals take matters into their own hands using readily available tools such as Microsoft Office Excel. The user interface is familiar, the analysis and data-mining features are comprehensive and intuitive, and spreadsheets are easy to use and share. Spreadsheets can incorporate business rules, aggregate data, and calculate results. Frequently, those spreadsheets evolve into mission-critical tools so quickly that IT remains entirely unaware—until a change in the underlying data sources breaks the spreadsheets (spreadmarts, as they're known) and users turn to IT for urgent troubleshooting.

Unmanaged spreadmarts come with many issues. Conflicting and outdated data are main causes of decision-making complications. Similar and equally serious issues arise when enterprise information systems, such as those used for CRM, ERP, and GL, aren't integrated. Lack of system integration and the absence of centralized data management can lead to non-compliance with laws and regulations; achieving efficiency is nearly impossible; and the organizations endure greater decision-making risks than necessary.

It doesn't have to be that way. You can implement a central solution to manage master data. You can create a BI environment that turns wayward spreadmarts into managed self-service solutions, and brings developers together with power and business users. You can have potent new reporting and analytics tools that integrate with familiar Office applications. SQL Server 2008 R2 packs the power to deliver it all. It changes the BI game from the ground up.

Business Benefits of the Microsoft BI Solution Stack

A comprehensive, end-to-end BI solution must include several distinct platforms: a data infrastructure and BI platform, a business collaboration platform, and a business user platform. SQL Server 2008 R2 establishes the data infrastructure and BI platform, integrates with Microsoft SharePoint Server 2010 to supply a reliable and secure collaboration platform, and extends Microsoft Office 2010 to provide an intuitive and familiar user platform with powerful analytics capabilities. Together, SQL Server 2008 R2, SharePoint Server 2010, and Office 2010 form the Microsoft BI Solution Stack, as illustrated in Figure 1. The Microsoft BI Solution Stack is a cornerstone in the Microsoft BI vision to provide business insight to all employees, leading to better, faster, more relevant decisions.

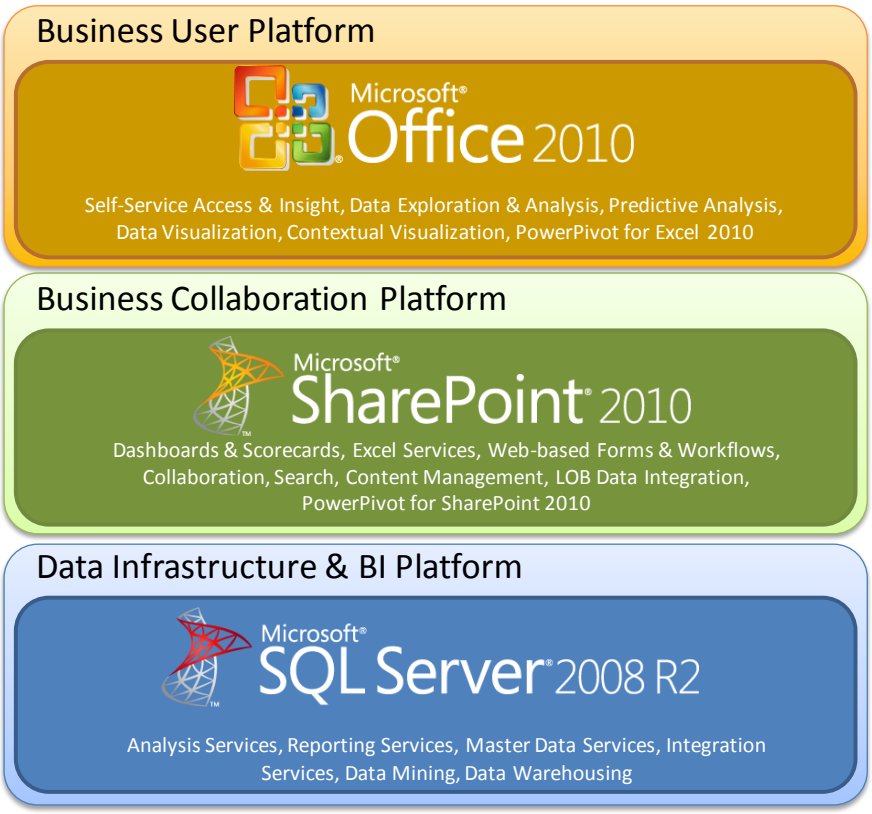

Figure 1: The Microsoft BI Solution Stack

Table 1 lists key business benefits that the Microsoft BI Solution Stack provides to the organization, business users, and the IT department.

Organization	Business Users	IT Department
Increased business agility through better, faster, more relevant decisions.	**Maximized utilization of familiar Excel features**, such as the Office Fluent™ user interface, PivotTables, PivotCharts, and the new Slicers feature.	**Increased IT efficiency** associated with monitoring and managing business data, data sources, and mission-critical self-service BI applications in the enterprise.
Auditable, repeatable management processes by maintaining a complete version history of all changes to business data for internal and external auditing purposes.	**Fast calculations and advanced analysis capabilities**, such as through automatically established data relationships and Data Analysis Expressions (DAX), which make actionable insight readily accessible to everyone.	**Increased consistency, integrity, security, compliance, reliability, and scalability** for business data and self-service BI applications based on standard SharePoint-based features.
Maximized ROI into SQL Server 2008 R2, SharePoint Server 2010, and Office 2010.	**Intuitive authoring and publishing of business reports** through Report Builder 3.0.	**High degree of data quality and accuracy** for decision-making through automatic data refreshing.

Reduced operations costs associated with maintaining and supporting self-service BI applications in the enterprise.	**Access to relevant information virtually anytime and from any location** through browser support and PowerPivot galleries in SharePoint.	**Reduced IT backlog** by delegating BI support responsibilities to power users in each department.
Compliance with laws and regulations by enabling a single, unified view of the truth as the basis for accurate and verifiable corporate reports.	**Fewer dependencies on IT** for quick and easy reporting and analysis and to compress decision cycles.	**Ability to translate latest hardware trends into business efficiency**, such as high-end server systems with 256 logical processors and 2 terabytes of memory.
Increased employee and team productivity through shared self-service BI applications.	**Rich visualizations based on reusable components** to deliver meaningful, effective reporting solutions quickly and efficiently.	**Centralization of authority** to manage business data across all enterprise information systems and solutions efficiently.
Higher potential to generate tangible and intangible assets by accumulating, integrating, managing, sharing, and utilizing substantially more business data than in the past.	**More and faster answers by combining massive amounts of data from a multitude of sources**, including relational databases, multidimensional sources, cloud services, data feeds, Excel files, and text files, in the corporate network and on the Internet.	**Ability to encapsulate enterprise information systems** that might otherwise not be accessible through a Master Data Management solution and through report-based data feeds.
Lower risks in business decision-making.	**Seamless and secure access to more reporting and analytical solutions** based on team and personal BI needs.	**Higher user satisfaction and regained confidence in the ability of the IT organization** to deliver and succeed with BI.
New and more efficient BI processes leveraging the knowledge and skills of power users in addition to organizational BI developers.	**Dynamic workgroup collaboration on user-generated BI solutions** with the ability to provide feedback and usage metrics on user-generated solutions.	**Greener data centers** through linear scalability on a single server with up to 256 logical processors, terabytes of memory, and support of emerging storage technologies.

Table 1: Business Benefits of the Microsoft BI Solution Stack

Taking Advantage of Latest Hardware Trends

There are three important hardware trends that an organization can translate directly into business benefits by using SQL Server 2008 R2 technology: More cores and logical processors per CPU instead of faster cores; increasingly affordable memory making large capacities feasible; and enterprise flash drives (EFD) entering the storage market. This was impressively demonstrated by Bill Laing, Corporate Vice President, Windows Server® and Solutions Division, at the Microsoft Windows® Hardware Engineering Conference (WinHEC) 2008. Bill showed a SQL Server build fully exploiting an HP Integrity Superdome with 64 Intel Itanium processors, 256 logical processors, and 2 terabytes of memory, achieving an almost linear scalability.

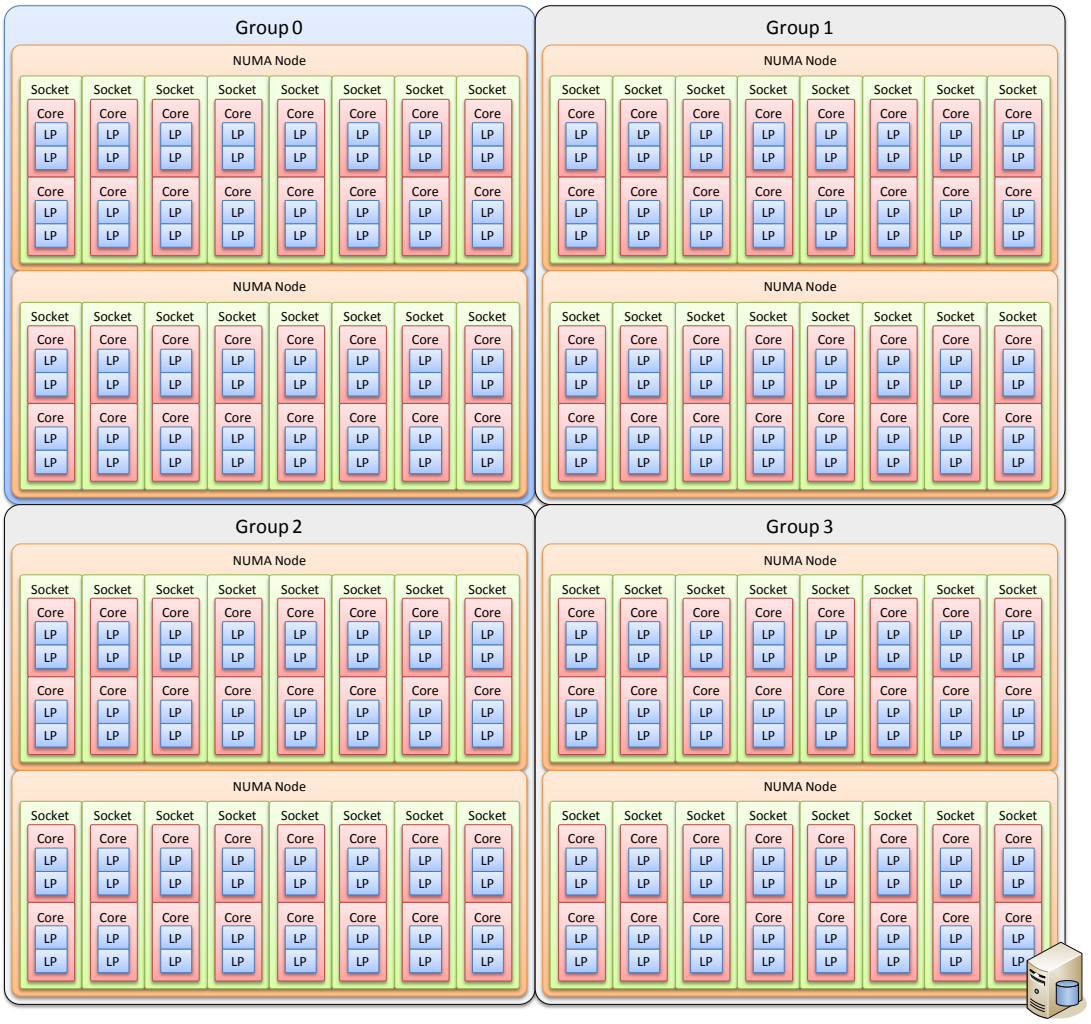

Figure 2: The Relational Engine of SQL Server 2008 R2 on a Server with 256 Logical Processors

Figure 2 illustrates how Windows Server 2008 R2 and the relational engine of SQL Server 2008 R2 support more than 64 logical processors based on processor groups and NUMA (Non-Uniform Memory Architecture) nodes. A group contains up to 64 logical processors that are physically close to one another. The premise is that a system achieves best performance when running related code on processors in the same group. The kernel determines which logical processor belongs to which group during the system boot routine.

Scale-Up Designs based on Top-End Server Models

It makes sense for organizations with large data warehouses to invest in scale-up designs based on top-end server models. Top-end systems, such as HP Integrity Superdome, Unisys ES7000, and IBM x3950 M2, not only deliver massive processor power and memory capacity for multi-terabyte data warehouses to handle their business-critical workloads with record-setting performance, but also provide high-end reliability, availability, and serviceability. For example, 50 percent of the processors and memory banks can fail in an HP Integrity Superdome and the faulty components can be replaced without incurring system downtime.

Scale-up systems also offer a lower footprint in the data center in comparison to scale-out systems based on commodity hardware. They offer lower power consumption and heat dissipation, which facilitates efforts to build a green data center.

Enterprise Flash Drives

Lower power consumption and heat dissipation as well as dramatically increased performance are also compelling reasons to invest in EFD-based storage systems, such as EMC Symmetrix DMX-4 storage arrays. According to EMC, enterprise flash drives can achieve Input/Output (I/O) rates 10 times higher than traditional magnetic disk drives while consuming up to 98 percent less energy per I/O, offering substantial total cost of ownership (TCO) advantages over traditional storage media. Testing conducted jointly by the Microsoft SQL Server Customer Advisory Team (SQLCAT) and EMC Symmetrix Partner Engineering proved that flash drives can vastly increase the performance of database applications. For details, refer to the white paper "EMC Symmetrix DMX-4 Enterprise Flash Drives with Microsoft SQL Server Databases" at http://www.emc.com/collateral/hardware/white-papers/h6018-symmetrix-dmx-enterprise-flash-with-sql-server-databases-wp.pdf.

Note: The relational SQL Server engine supports row-level and page-level compression for tables and indexes, which helps to saves storage cost while improving performance.

Next Generation Client Hardware

Top-end systems and innovative storage technologies are an obvious option for database management systems; perhaps less obvious are the options surrounding client hardware. Microsoft assumes that by 2012, 64-bit computing will be the standard even on client computers, as will 12-core processors. And memory capacities will continue to increase while the price per gigabyte continues to fall. Microsoft Windows 7 and SQL Server 2008 R2-related client technologies enable organizations to tap into this potential.

Like Windows Server 2008 R2, Windows 7 offers support for up to 256 logical processors, and SQL Server PowerPivot for Excel 2010 makes the most of multi-core processors and gigabytes of memory for massive data analysis on the desktop, including the fastest processing of billions of rows in about the same time as thousands. Note, however, that 64-bit multi-core processors are not a PowerPivot for Excel 2010 requirement. PowerPivot workbooks are limited to 2 gigabytes in size, which helps to avoid memory exhaustion on a 32-bit system. It is therefore not necessary to upgrade a client computer in order to run PowerPivot for Excel 2010.

However, test results vary depending on the compressibility of the data. For fastest processing performance, Microsoft recommends multi-core processors and more than 4 GB of RAM.

Note: The maximum file size of a PowerPivot workbook is 2 gigabytes, but there are no restrictions regarding the amount of data users can import into a workbook. It is just not possible to save workbooks exceeding the maximum file size. PowerPivot for Excel 2010 features a very efficient compression algorithm. A 2-gigabyte workbook size typically corresponds to a 4-gigabyte dataset.

SQL Server 2008 R2 BI Technologies

The SQL Server 2008 R2-based data infrastructure and BI platform comprise five key SQL Server technologies: Integration Services, Relational Engine, Master Data Services, Reporting Services, and Analysis Services (see Figure 3). The main purpose of Integration Services is to implement a scalable enterprise data integration platform with Extract, Transform, Load (ETL) processes to load data from a wide array of data sources into the organization's data warehouses. The Relational Engine implements the relational data store and database management system for data warehouses. Master Data Services, a new member of the SQL Server family, enables organizations to implement a Master Data Management (MDM) system for central management of master data models, entities, and hierarchies across all information systems in the enterprise. Reporting Services offers a full range of tools and services to create, deploy, and manage reports and report-based data feeds. Finally, Analysis Services provides the OLAP and data-mining platform to analyze large quantities of multidimensional data based on OLAP cubes and PowerPivot workbooks.

Particularly important for team and personal BI scenarios are the improvements available with Reporting Services and Analysis Services. By using Reporting Services, an organization can encapsulate enterprise information systems through report-based data feeds so that Excel users can more easily import the data into their self-service BI applications, s. Analysis Services, on the other hand, provides the basis for server-based analytical processing. In addition to standard Multidimensional OLAP (MOLAP), Relational OLAP (ROLAP), and Hybrid OLAP (HOLAP) storage modes, the SQL Server 2008 R2 version of Analysis Services supports (when installed as a service in SharePoint 2010) the new VertiPaq™ mode to allows you run PowerPivot workbooks In-Memory in a SharePoint 2010 farm.

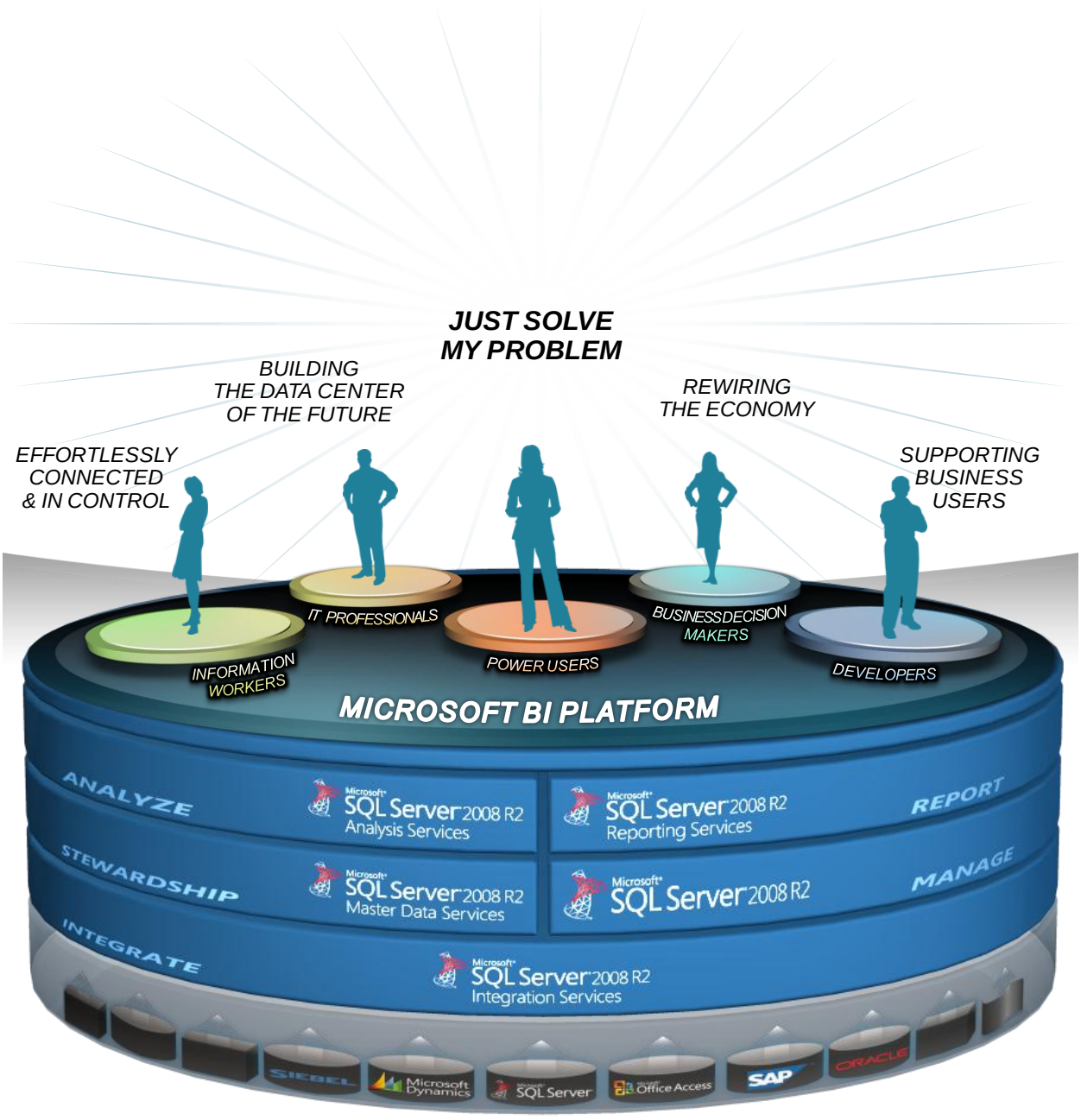

Figure 3: The SQL Server 2008 R2-based Data Infrastructure and BI Platform

Table 2 summarizes the most important improvements and innovations regarding key technologies included in SQL Server 2008 R2.

SQL Server Technology	Improvements/Innovations	Comments
Integration Services	No significant changes apart from patches and fixes, which will also be available in a Cumulative Update for SQL Server 2008.	The focus of SQL Server 2008 R2 is to expand the reach of BI based on existing infrastructure technology.

Relational Engine	Enhancements in: • Manageability • Availability • Programmability • Scalability and performance • Security	Enhancements relate to the ability to manage data-tier applications and multiple instances of SQL Server from a central SQL Server Utility Control Point (UCP); new database mirroring options to support hot-standby servers without data loss; new data storage features; new data types; a revamped full-text search architecture; and numerous Transact-SQL improvements. Scalability and performance improvements achieve higher query-processing performance, and new encryption functions increase security.
Master Data Services	• Centralized data management and delegation of administration • Stewardship portal • Data integration and synchronization services • Data cleansing service • Workflows and business rules • MDS Platform APIs • Reporting and auditing capabilities • Versioning for data entities and hierarchies	Supports data replication through Transact-SQL and Web services and a broad range of hierarchy and attribute management strategies; provides secure, role-based Web access to master data for browsing, editing, authoring, auditing, and approving; and enables anyone in the organization to access and update master data directly with minimal impact on IT. Role-based security features enable fine-grained, secure access to master data, and MDS can automatically notify data stewards of business-rule violations. The reporting, auditing, and versioning features help to protect master data and ensure compliance by maintaining change histories and logging user, date, and time for each master data update as well as pertinent audit details, such as type of change, member code, and prior versus new value.
Reporting Services	• SharePoint integration enhancements • Reusable report parts • Shared datasets • Cache refresh plans • Sparklines, data bars, and other design enhancements	Supports SharePoint Lists as a data source, multiple SharePoint Zones, and the SharePoint Universal Logging service. Offers the ability to store the individual parts of reports as shared components on a report server or on a SharePoint site for reuse in other

	• Rich geospatial visualizations • Rendering reports to data feeds • Business Intelligence Development Studio (BIDS) support • Report Builder 3.0	reports. Provides the ability to retrieve data from shared data sources that connect to external data sources. Improves data retrieval and report viewing response times by caching and refreshing reports and shared dataset query results. Includes new visualization and design features to convey as much information as possible in little space, and uses maps for rich visualizations by combining spatial and analytical data sources. Offers the capability to render report data to an Atom service document, which is included by default in all reports created with Report Builder 3.0.
Analysis Services	• SharePoint integration in VertiPaq™ mode • Aggregation design enhancements • Cube design enhancements • Dimension design enhancements • Backup and restore enhancements • Personalization extensions • Filtering and cross-validation of data mining models • Support for Office Data Mining Add-Ins	Provides the backend query-processing service for PowerPivot for SharePoint 2010, as well as a multidimensional database and data mining system in traditional OLAP environments. Design improvements make it easier to create, browse, and modify aggregations, dimensions, and attribute relationships. Also features a new storage structure for a more robust repository of archived databases with no practical limit to the size of the database files, nor is there a limit to the number of files a database can have. Personalization extensions enable developers to provide new objects and functionality dynamically in the context of the user session, and the data-mining enhancements support new methods of filtering model cases and assessing the accuracy of data mining models directly in Excel when using the Data Mining Add-Ins.

Table 2: Important Technological Improvements and Innovations in SQL Server 2008 R2

Note: For a detailed description of all features, improvements, and innovations available with SQL Server 2008 R2, refer to the SQL Server 2008 R2 product documentation on Microsoft TechNet at http://msdn.microsoft.com/en-us/library/bb418432(SQL.10).aspx.

Empowering Business Users

SQL Server 2008 R2 helps organizations empower their users by means of the following tools: Office applications and add-ins, PowerPivot for Excel 2010, and Report Builder 3.0. Standard Office applications, specifically Excel, have long been the preferred data analysis tools of business users. Excel includes a formidable formula engine, a familiar user interface, and extensive data manipulation, analytics, and data mining capabilities, including PivotTables, PivotCharts, and SQL Server Data Mining Add-ins. PowerPivot for Excel 2010 extends these capabilities by adding an in-memory BI engine and new compression algorithms to load even the biggest data sets into Excel. PowerPivot also introduces Data Analysis Expressions (DAX) for advanced analytics in familiar Excel formula syntax. Report Builder 3.0, on the other hand, is a separate ad-hoc authoring tool for intuitive reports based on Reporting Services. By using Report Builder 3.0, users can create attractive business reports in a matter of minutes, featuring conditional formatting and rich geographical visualizations. In combination, Office applications, PowerPivot for Excel 2010, and Report Builder 3.0 are the keys to bringing managed self-service BI to all employees, leading to better, faster, more relevant decisions.

Intuitive Authoring, Analysis, and Publishing

Microsoft recommends that power users and business users with advanced analytics requirements use Excel 2010 and PowerPivot for Excel 2010 for intuitive authoring and analysis on the desktop. PowerPivot for Excel 2010 is an application-level add-in, available as a Web download at www.powerpivot.com.

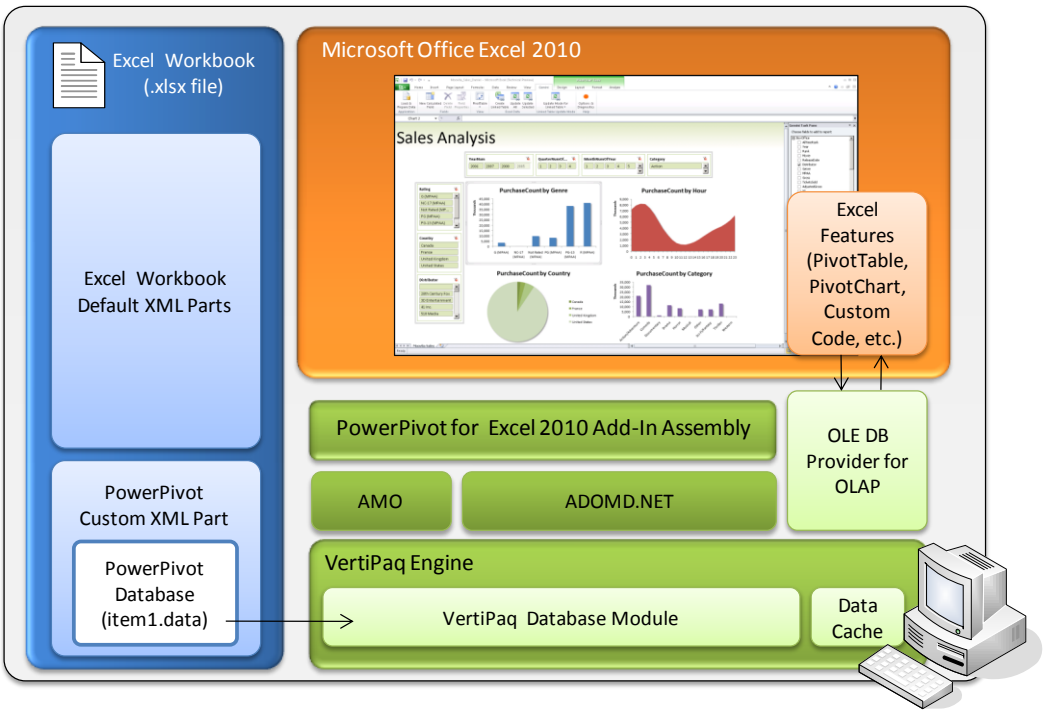

Figure 4: PowerPivot for Excel 2010 Architecture

Figure 4 shows how PowerPivot extends Excel 2010. Especially noteworthy is the new version of Microsoft OLE DB for Online Analytical Processing (OLAP), which PowerPivot adds to the client configuration. By leveraging the familiarity of the Office Fluent user interface, PivotTables, PivotCharts, and Excel formula syntax in DAX expressions, users can hit the ground running and get the answers they need in seconds.

PowerPivot for Excel 2010 supports intuitive authoring, analysis, and publishing by means of the following key features:

- **User interface customizations** PowerPivot implements its own assembly to enhance the Excel user experience through ribbon customizations and spreadsheet templates, and overrides the default PivotTable field list to implement its own task pane.
- **VertiPaq engine for advanced data analysis** VertiPaq makes the most of multi-core processors and gigabytes of memory to process enormous quantities of data with incredible speed. Processing millions of rows takes about the same time as thousands.
- **Column-based compression** VertiPaq compresses the data users import into a PowerPivot workbook with efficient column-based compression algorithms and maintains its database in a custom XML part directly in the Excel workbook.
- **Broad support for data sources** PowerPivot users can enjoy broad support of data sources to load and combine a great variety of data for massive analysis on the desktop, including relational databases, multidimensional sources, cloud services, data feeds, Excel files, text files, and data from the Web.
- **Data Analysis Expressions** By using DAX in addition to standard Excel features, PowerPivot users can quickly create advanced workbook applications. These applications can rely on data relationships between tables as in a database, include calculated columns and measures, and aggregate over billions of rows. In many cases, PowerPivot for Excel 2010 can establish the table relationships automatically.
- **SharePoint integration** PowerPivot users can share data models and analysis seamlessly and securely, and because the solutions are in SharePoint, server-based refresh cycles can be configured to ensure the data remains current automatically. The section “Facilitating Sharing and Collaboration” later in this white paper provides more details about publishing user-generated BI solutions in a SharePoint environment.

Note: Microsoft recommends using SharePoint as the business collaboration platform to publish self-service analysis solutions because SQL Server 2008 R2 integrates seamlessly with SharePoint 2010.

Interactive Slicing and Dicing

Excel PivotTables and PivotCharts are very effective tools for slicing and dicing, and in combination with PowerPivot for Excel 2010, users can slice and dice even the largest datasets in a matter of seconds without writing any complicated formulas. Slicing refers to a two-dimensional filtering process—the resulting data set only has two dimensions, such as products purchased based on geographical regions. Dicing is a filtering process that produces a multi-dimensional subset of the original data, such as products purchased by region, quarter, and customer age, which enables the user to look at the data from different dimensional

combinations with a specific focus. Slicing and dicing are closely related and enable the user to interact with the data, drill down into details, and infer insights that are not immediately apparent in the overall data set. With PowerPivot for Excel 2010, slicing and dicing is as easy as dragging horizontal and vertical slicers onto a spreadsheet, as illustrated in Figure 5.

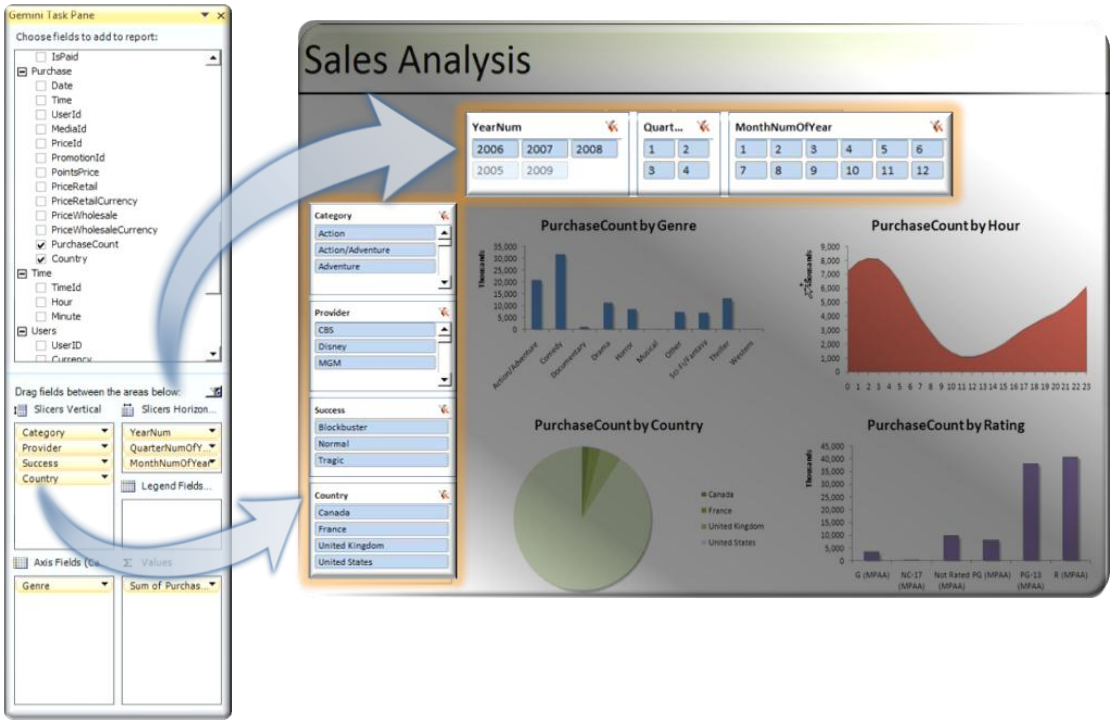

Figure 5: Interactive Slicing and Dicing with PowerPivot for Excel 2010

PowerPivot for Excel 2010 offers the following advantages for interactive slicing and dicing:

- **User interface familiarity** Users can use familiar PivotTable views, charts, and slicers for interactive analysis.
- **High scalability and performance** Users can sort, filter, and scroll through millions of rows in seconds.
- **Anywhere access** In a SharePoint environment, users can work seamlessly via Web browser and enjoy the same performance as in Excel 2010.

Note: Interactive slicers enable users to look at their data from multiple directions in Excel 2010 and in the browser through PowerPivot for SharePoint and Excel Services.

Accelerated Business Reporting with Rich Visualizations

Report Builder 3.0 accelerates report creation, facilitates sharing and collaboration, and helps to ensure reporting consistency by enabling users to create and share reusable report elements in a Shared Component Library. Shared components make it quick and easy to assemble comprehensive business reports in a professional-looking format. As Figure 6 illustrates, Report Builder 3.0 also supports “mashing up” business data with geographic information to get more

value out of every report. While most reports use relational and multidimensional databases as data sources, you can also use shared PowerPivot workbooks as Report Builder data sourcds

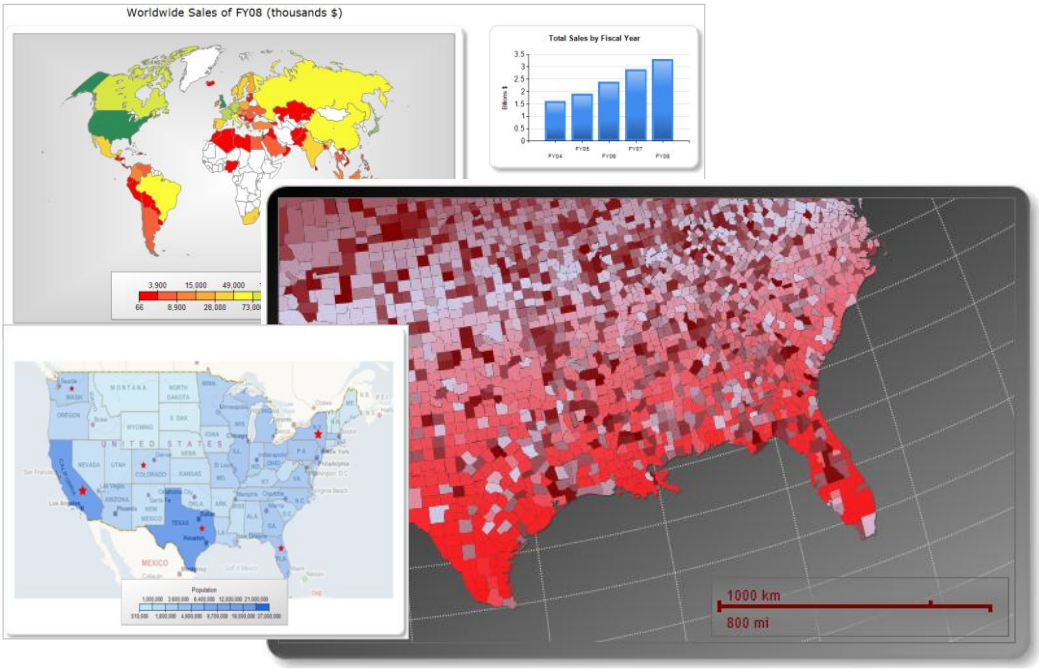

Figure 6: “Mashing Up” Business Information with Geographic Representation

SQL Server 2008 R2 Reporting Services and Report Builder 3.0 address the following productivity areas:

- **Intuitive Authoring** Report Builder 3.0 accelerates report creation by leveraging existing content objects, such as queries, tables, charts, maps, gauges, and logos.
- **Ad-hoc reporting** Users can interact with a report through run-time sorting and filtering, multiple sorting, grouping, as well as column and row group ordering on already rendered data to further analyze information.
- **Rich visualization** Mapping, routing, custom shapes, support for SQL spatial information, and integration with Bing Maps helps to get more value out of BI and increase user adoption.
- **Report sharing** Users can publish predefined queries, reports, and charts independently of IT, synchronize updates with published content objects, and take advantage of SharePoint-integrated mode.
- **Reuse of subcomponents** Reporting Services provides libraries of predefined queries, data, and report subcomponents. Their reuse helps to decrease report creation time. Existing reports can also be used as data sources for desktop analytics.
- **SharePoint integration** Seamless publishing via SharePoint enables business users to access reports from any location with network connectivity.

Note: IT organizations can take advantage of Report Builder 3.0 to encapsulate enterprise data sources by means of data feeds accessible through published reports in SharePoint.

Facilitating Sharing and Collaboration

There are at least three compelling reasons to use SharePoint 2010 in an enterprise BI environment to establish a business collaboration platform: Seamless sharing and collaboration with flexible security down to the individual item level; centralization of farm and infrastructure administration; and automated server-based processing through Windows services and SharePoint Timer jobs. Seamless sharing and collaboration with the ability to delegate control over individual site collections, sites, libraries and galleries, as well as over individual workbook applications provides the basis to bring all BI players together in a managed environment, as illustrated in Figure 7. Centralization of farm and infrastructure administration helps IT departments maintain the managed BI environment with operational efficiency, and server-based processing gives users the ability to access published BI solutions in a Web browser instead of Excel, while workbook owners can schedule fully automated data refresh cycles to ensure data and analysis remain current and accurate. Server-based processing also makes it possible to reuse published workbook applications and reports as data sources in additional self-service BI solutions.

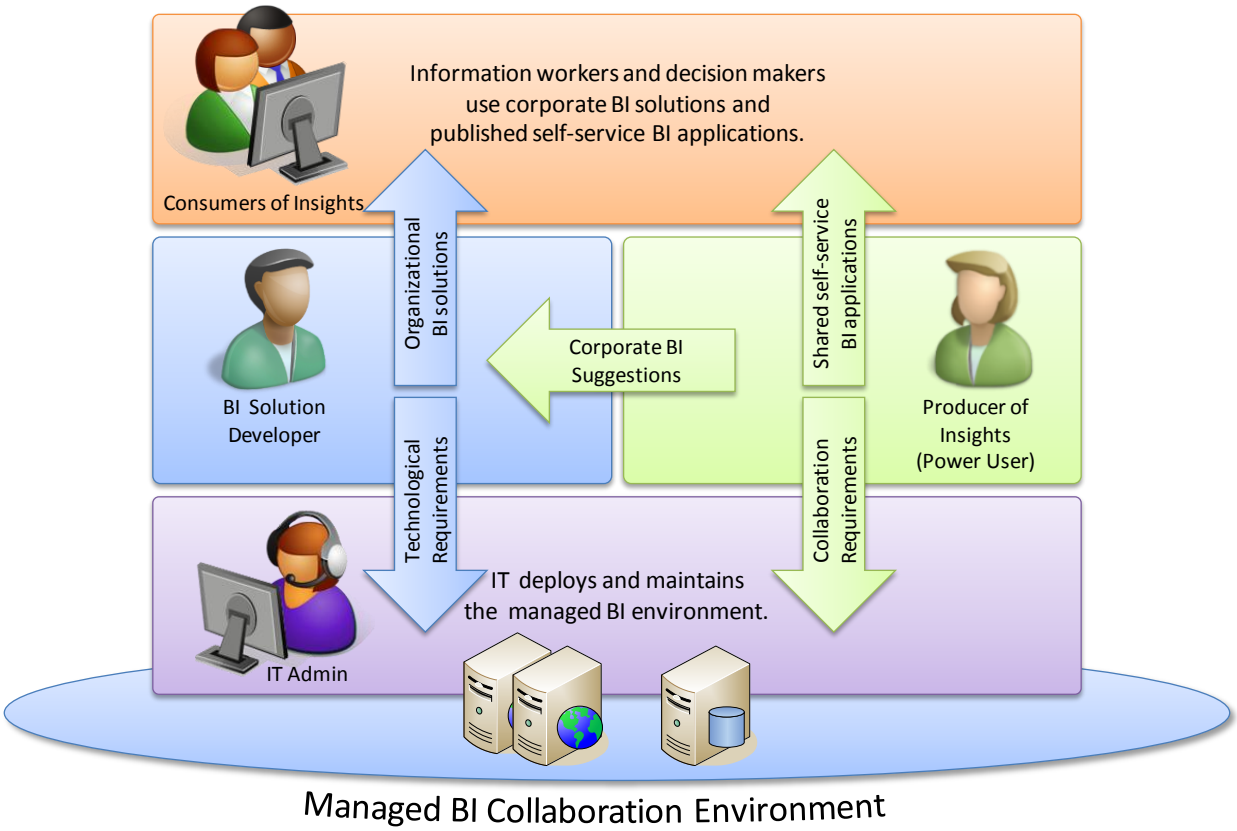

Figure 7: Bringing all BI Players Together in a Managed BI Collaboration Environment

Note: Managed self-service BI is about providing business insights to all employees. Heavy involvement of power users and business users in the design and creation of self-service BI solutions is therefore critical to the success of managed self-service BI initiatives.

Seamless and Secure Collaboration

As depicted in Figure 7, power users play an important role as producers of insights at the team and personal BI level. Complementing BI developers who create organizational solutions, power users create and share workbook applications and reports by using PowerPivot for Excel 2010 and Report Builder 3.0. Figure 8 shows the relationship between power users as producers and business users as consumers of insights in more detail.

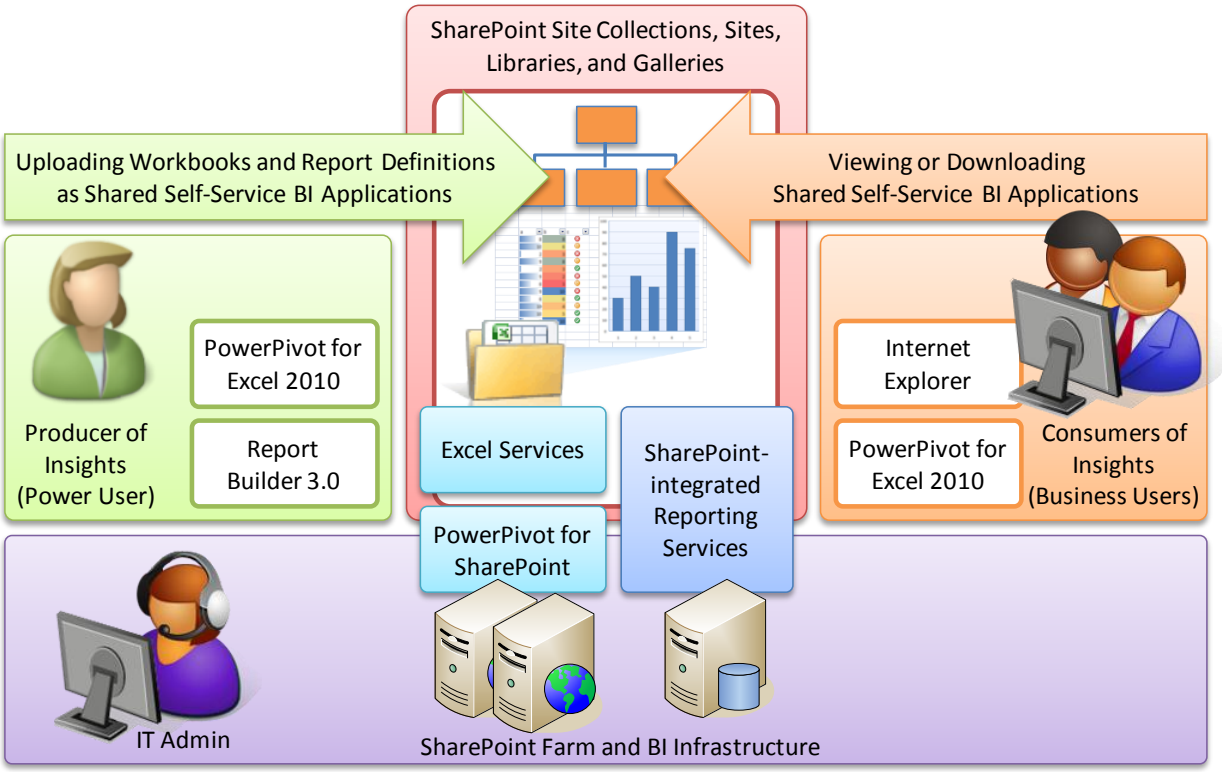

Figure 8: Collaboration between Producers and Consumers of Insights

Ultimately, power users decide whether to publish self-service BI solutions in SharePoint-based report libraries and PowerPivot galleries. To ensure they do, the managed BI collaboration environment must enable power users to publish their solutions effortlessly and securely. They must also be able determine security roles indicating who can access uploaded self-service BI solutions and who can modify these solutions with minimal dependency on IT. SharePoint 2010 fulfils these requirements by means of a flexible role-based security model that supports delegation of administrative control to groups and individual user accounts, as well as permission inheritance and explicit permission assignments. At any level in the site collection hierarchy, down to the individual workbook files, a privileged power user can disable permission inheritance and specify individual settings, such as view-only permissions to prevent business users from downloading a particular PowerPivot workbook to their workstations.

In general, business users do not need to download PowerPivot workbooks and do not need to install Office 2010 or PowerPivot for Excel 2010 on their workstations because these consumers of insights can access published self-service applications through a Web browser. PowerPivot

for SharePoint 2010 (in combination with Excel Services) and Reporting Services in SharePoint-integrated mode can render PowerPivot workbooks and online reports directly on a SharePoint server. This capability not only eliminates software and download requirements on the desktop, but makes it easy for business users to work together. It also boosts the productivity of project teams and business units because analysis and detailed business insights are accessible at any time, in any location, on any device.

By taking advantage of SharePoint 2010, SQL Server 2008 R2 enables producers and consumers of insights to collaborate seamlessly and securely in a managed BI environment:

- **SharePoint security model** All SharePoint-integrated technologies of SQL Server 2008 R2 leverage the role-based SharePoint security model to delegate administrative authority and apply group and user permissions at the site collection, site, library, gallery, and item level in a consistent way.

- **Excel Services** PowerPivot for SharePoint 2010 takes advantage of Excel Services to render PowerPivot workbooks directly on the application server. BI consumers can seamlessly access shared workbook applications directly in the browser without having to download all the data to their workstations.

- **Reporting Services in SharePoint-integrated mode** Report Builder 3.0 fully exploits the advantages of Reporting Services in SharePoint-integrated mode to store, manage, and render reports directly within the SharePoint collaboration environment. Uploaded report definitions automatically open in the Report Viewer Web Part, which supports page navigation, search, print, and export features. You can also connect the Report Viewer Web Part to a Filter Web Part or a Library Web Part in dashboards or site pages.

- **Standard SharePoint features** By using workflows, alerts, and version control, IT organizations and business units can coordinate how users share their solutions and streamline analysis. SharePoint also facilitates dynamic collaboration on user-generated contents with the ability to provide feedback and details about usage metrics.

Note: SQL Server 2008 R2 Reporting Services includes stand-alone and ClickOnce versions of Report Builder 3.0. ClickOnce in SharePoint-integrated mode means that users can use the New or Actions menu directly in a SharePoint library to start Report Builder 3.0, without having to install this tool directly on the local computer in a previous step.

Keeping Insights Up-to-Date

In addition to permission assignments, power users can also manage the data refresh settings for uploaded self-service BI solutions, including refresh schedule, user credentials for the update process, and the portions of the datasets that should be updated to ensure accurate analysis and decision-making. SharePoint 2010 then performs the data refresh automatically. As illustrated in Figure 9, SharePoint accomplishes this task based on a PowerPivot Data Refresh timer job, which the SQL Server 2008 R2 Setup program adds to the SharePoint configuration when installing PowerPivot for SharePoint 2010. This timer job runs every minute on the SharePoint server to determine if a data refresh job needs to be scheduled and executed.

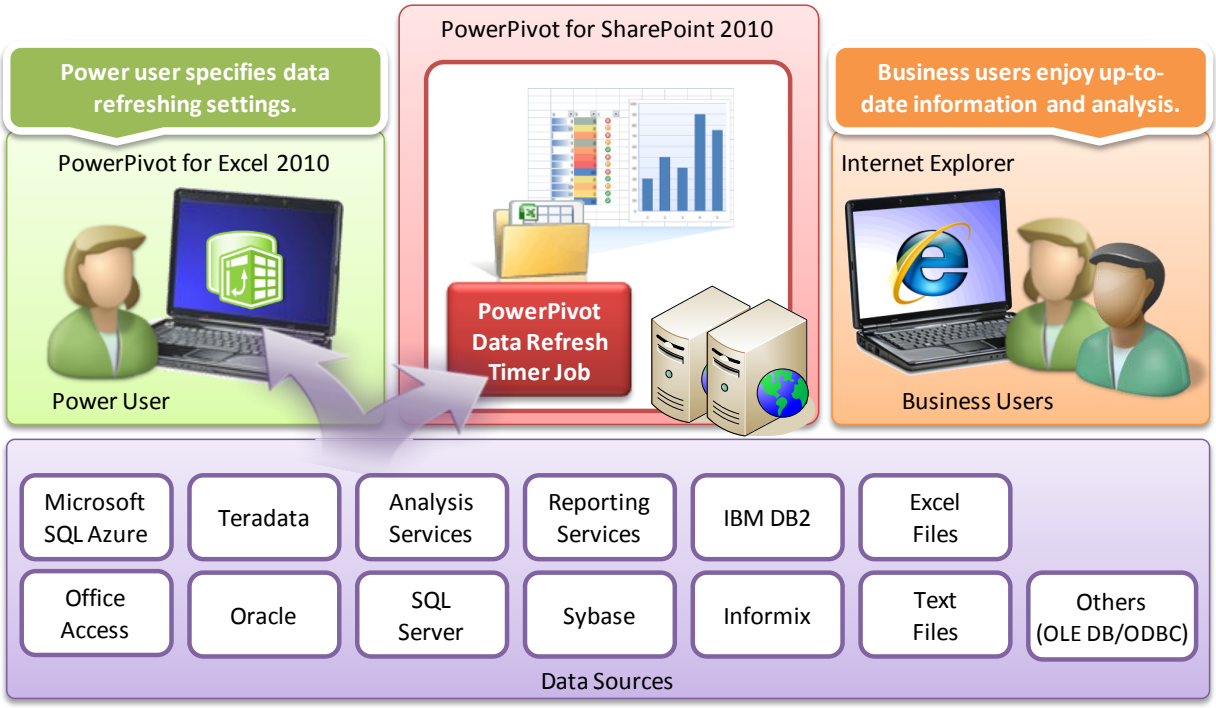

Figure 9: Specifying Data Sources and Keeping Data Up-To-Date

Automatic data refresh for published PowerPivot workbooks offers organizations the following advantages:

- **Decisions based on most recent data** Scheduled data refreshes ensure the data in managed self-service BI solutions remains current automatically, even over the Internet.
- **Centralized monitoring of update processes** The IT organization can use the PowerPivot Management Dashboard to monitor shared workbook applications and ensure they are always available and up-to-date. Among other things, the PowerPivot Management Dashboard enables IT administrators to analyze the data source information to see where the data in managed self-service BI solutions is coming from. The section “Increasing IT Efficiencies” later in this white paper covers the Management Dashboard in more detail.

Note: SharePoint can refresh the data from the specified data sources over the Web, in the cloud, from internal databases, Excel files, and any other location with network connectivity.

Capitalizing on Existing Workbooks and Reports

Automatic data refresh lessens the self-service BI maintenance burden once a solution has been created and published, but SQL Server 2008 R2 also streamlines the creation process itself. For example, Report Builder 3.0 lowers the barrier to entry for authoring customized reports by allowing users to start from modular components available in a Shared Component

Library, such as query objects, data regions, charts, and graphs. Figure 10 illustrates this concept. Constructing professional reports based on preexisting building blocks, created individually or as part of another report, dramatically accelerates the self-service BI solution delivery cycle, cuts development costs, facilitates timely decisions, and ultimately increases user adoption.

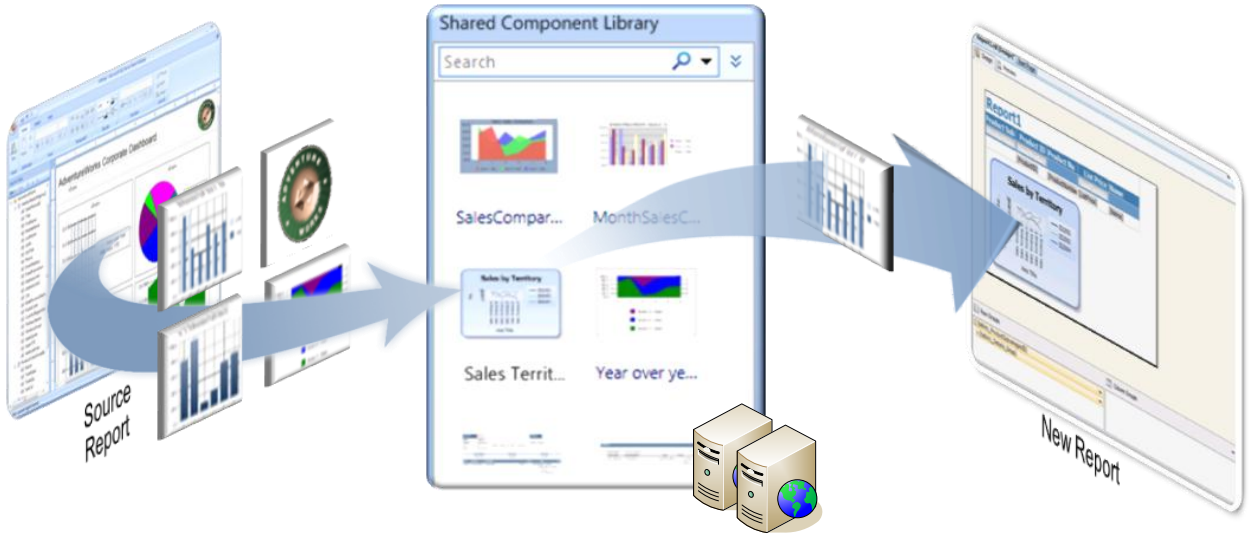

Figure 10: Reusing Report Components

SQL Server 2008 R2 and Report Builder 3.0 boost the productivity of report designers by means of the following features:

- **Shared Component Library** Reusing common report elements published in the Shared Component Library is the basis for “Grab and Go” reporting. It makes building up-to-date reports quick and easy.
- **Synchronization of updates** Automatic update of shared components ensures that reports remain current. Report designers do not need to implement update or synchronization logic manually.

Note: SharePoint provides the central location for sharing and editing report components and can automatically synchronize published content objects.

Maximizing Business Insight

Another innovative capability with impact on the relationship between power users and the IT department centers on the ability to reuse existing PowerPivot workbooks and Reporting Services-based reports as data sources in further analysis and reporting solutions. This helps to reduce the requirement for direct access to enterprise information systems and mitigates hindering dependencies on IT.

A power user with access to an enterprise information system can now create intermediate data sources in the form of PowerPivot workbooks and reports. By publishing these self-service BI

applications in SharePoint, other users without direct access can then reuse the published intermediary information in their own PowerPivot workbooks and reports—while SharePoint keeps the data automatically updated in all solutions. Figure 11 illustrates the relationship between PowerPivot, Reporting Services, and SharePoint in this scenario.

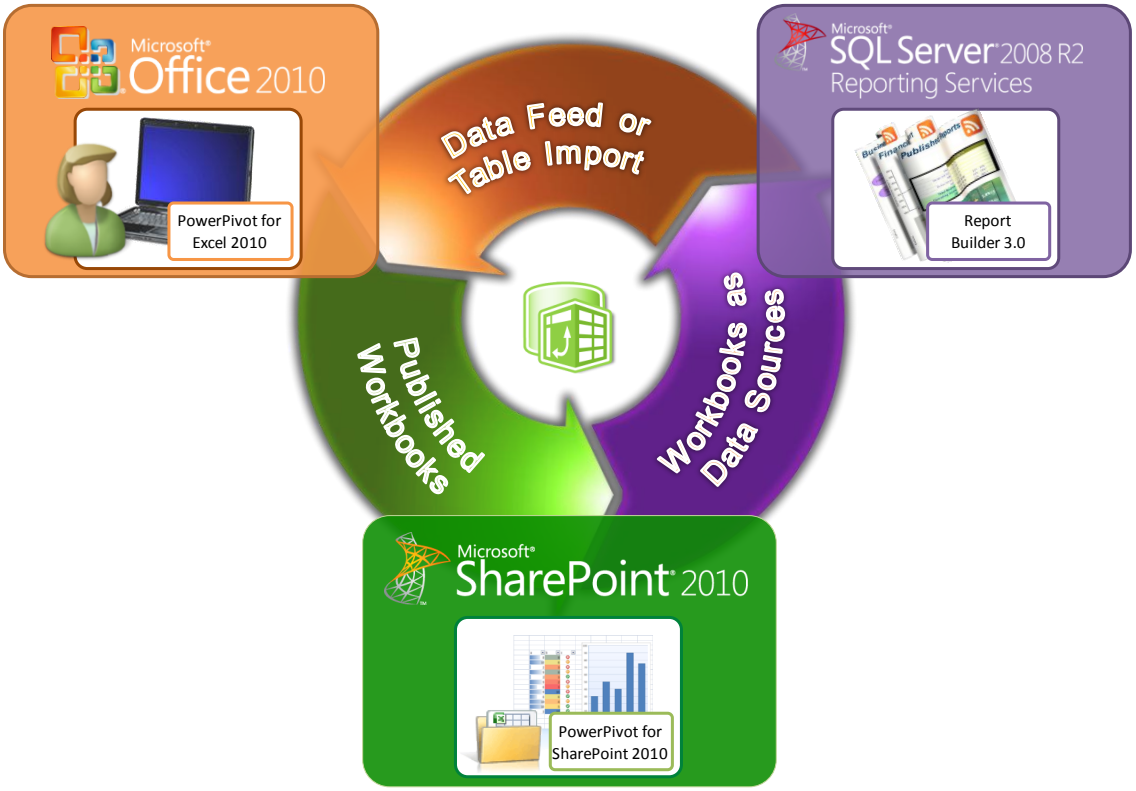

Figure 11: Workbooks and Reports as Data Sources

BI producers can use the following strategy to maximize business insight with minimal dependency on IT:

1. A power user imports data into PowerPivot through report-based data feeds or other means.
2. The power user publishes the resulting PowerPoint workbook in SharePoint, configures automatic data refresh settings, grants access permissions if necessary, and communicates the URL of the published workbook to other BI producers.
3. Other BI producers reference the URL of the published PowerPoint workbook as a data source in their own self-service BI solutions.

Increasing IT Efficiencies

SQL Server 2008 R2 provides two basic options to increase IT efficiencies: Streamlining processes associated with data and BI management across the enterprise, and centralizing

access to enterprise information in a managed BI environment. To help organizations streamline data and BI management processes, SQL Server 2008 R2 includes Master Data Services (MDS) and a PowerPivot Management Dashboard. For centralizing access to enterprise information, organizations can also rely on MDS or use Reporting Services-based reports, as explained later in this section.

Implementing Master Data Management

Master Data Services gives organizations all the tools they need to maintain and synchronize business data across all their source information systems so the individual pieces of the data puzzle always add up to a consistent, complete, and accurate picture, as indicated in Figure 12. By integrating the various source systems in the enterprise with a centralized MDS-based Master Data Management solution, organizations can ensure the accuracy of business-critical information, consistency of reporting, and compliance with laws and regulations.

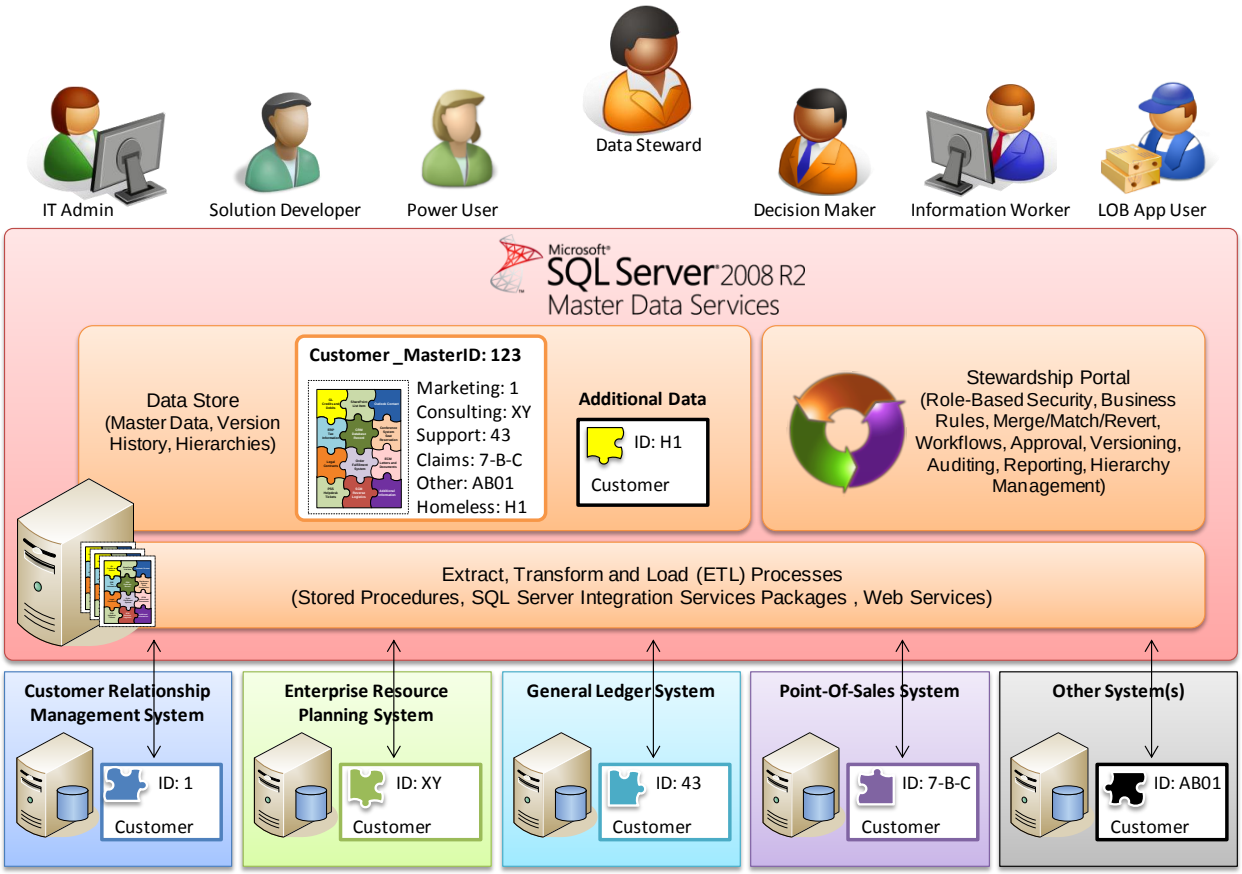

Figure 12: An MDM System based on Master Data Services

At the core, MDS implements a store to maintain master data and service client applications. Master data is business data that pertains to the nouns of the business, such as customers, stores, products, or contracts, or any other business-relevant items or concepts. The MDS store can also capture additional business data that is not stored in any other information system. MDS also implements an ETL pipeline to connect and synchronize the MDS system with the various source systems in the enterprise. As part of data synchronization, MDS can perform

data cleansing tasks and establish reliable associations between the data fragments hosted in each individual information system.

To facilitate business process optimization, MDS also incorporates a Stewardship Portal for secure, role-based Web access to master data for browsing, authoring, editing, approving, auditing, and reporting according to the business rules defined in the system. Stewardship Portal implements the interface to manage role-based security, master data hierarchies, approval workflows, and version histories. Data stewards can also merge and match replicated data attributes and revert incorrect changes back to the previous state.

An MDM solution based on Master Data Services provides the following capabilities:

- **Data governance and stewardship** By centrally maintaining business rules that the business data has to follow in all stages of its lifecycle, the MDS system has both a governance function to guarantee that the right controls are in place and a stewardship function to ensure that the controls are enforced. Organizations can establish a single, unified, clean, and authoritative “master” representation of relevant business data.

- **Data integration and synchronization** The MDS platform can act as the system of entry as well as the system of record for all other information systems in the enterprise.

- **Enterprise data encapsulation** MDS can act as a central data source for line-of-business (LOB) applications, OLAP tools, and self-service BI solutions, encapsulating enterprise information systems that might otherwise not be accessible.

- **Enhance business data** The MDS master data store can also host additional information that is not maintained elsewhere in the organization. As illustrated in Figure 12, it gives “homeless” data a home.

- **Facilitate collaboration across organizational boundaries** As a Web-based collaboration platform, MDS enables organizations to manage the process of change for business data securely and efficiently.

- **Tracking and auditing** MDS maintains a complete version history of all changes. It is easy to roll back incorrect changes, and if an auditor wants to know who was working on the data, there is a single authoritative place to find the answer.

- **Compliance with laws and regulations** By enabling a single, unified view of the truth, master data can help an organization comply with laws and regulations that mandate accuracy and completeness of business reports. Organizations can prove that reports are based on accurate and verifiable data.

- **Business planning** As a planning system, MDS enables business users to track relevant information even in the earliest brainstorming phases.

- **Hierarchy management** An MDS system can organize and classify business data in multiple explicitly or dynamically defined hierarchies that may or may not exist in the underlying data sources.

- **Proactive data profiling and reporting** MDS can scan source systems for violations of business rules, missing values in data records, incorrect values, duplicate records, and other data-quality issues. Reports can be created that show the number of rules violations detected, the number of manual interventions required, and the average latency of master data updates.

Note: The capabilities of Master Data Services go beyond the scope of business intelligence. MDS is a platform for implementing a comprehensive, reliable, and secure technological foundation for efficient MDM processes across organizational boundaries.

Centralizing BI and Data Management

Power users and business users view the managed BI environment primarily as a centralized collection of sites, libraries, and galleries that provide access to the BI applications they need and trigger alerts and workflows to facilitate collaboration. IT administrators, on the other hand, view the managed BI environment from a different perspective, as illustrated in Figure 13.

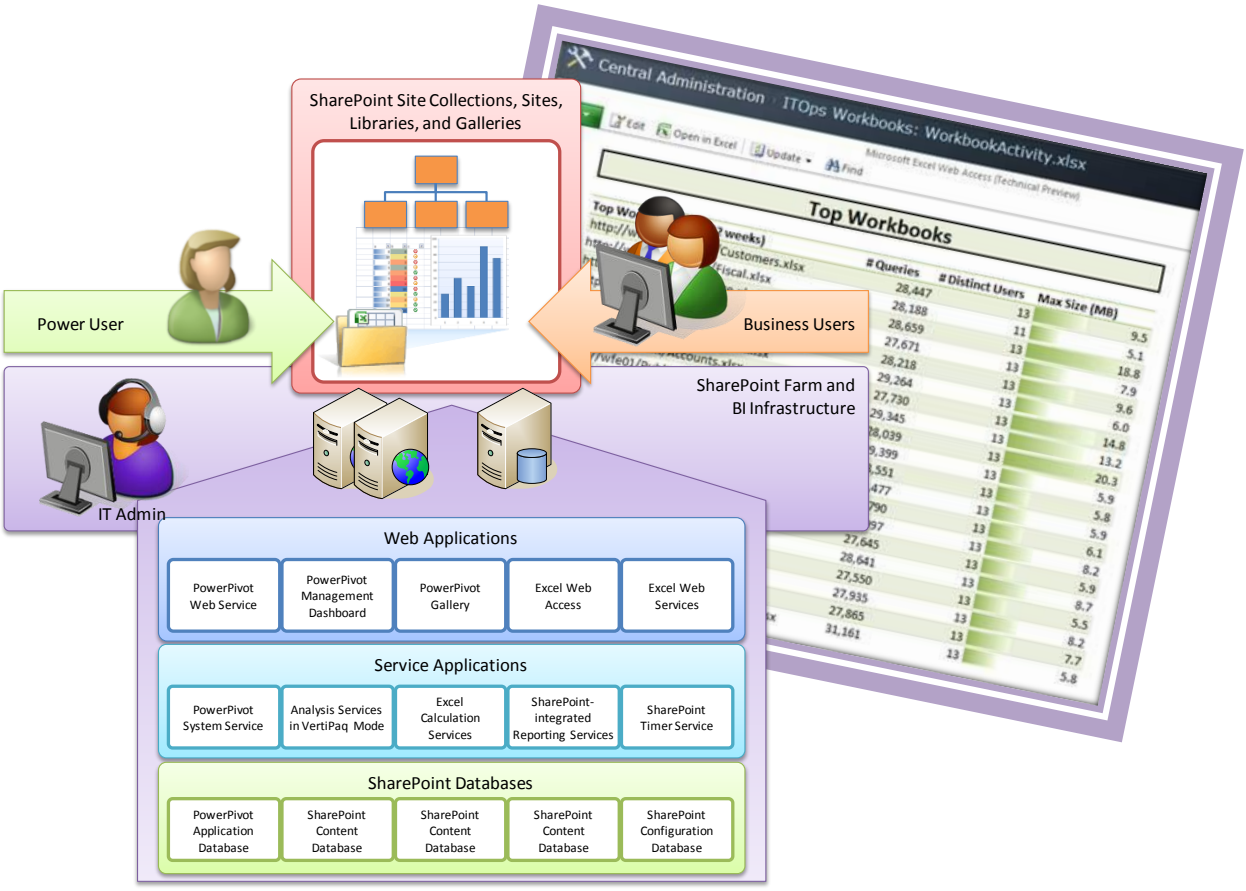

Figure 13: Tracking the Most Popular PowerPivot Workbooks in a Managed BI Environment

IT administrators primarily care about usage statistics for published workbook applications, as well as statistics regarding the availability and performance of their Web applications, service applications, and databases hosted on front-end servers, application servers, and database servers in the SharePoint farm. To provide this information, SQL Server 2008 R2 includes a customizable PowerPivot Management Dashboard that visualizes server and usage statistics with animated charts. The dashboard information helps IT administrators oversee their BI environments with operational efficiency, and it provides the basis to ensure that user-generated BI solutions are continuously available, up-to-date, and secure.

The PowerPivot Management Dashboard enables the following administrative tasks:

- **Discover mission-critical self-service BI applications** IT administrators can monitor activities and performance of shared workbook applications, track usage patterns over time, drill down to reveal hidden details, and detect solutions that have become mission-critical.
- **Ensure data quality, integrity, and security** The Operations Dashboard reveals the largest and most popular solutions, their data sources, top users, and query-performance per workbook, and helps in this way to ensure high availability, scalability, and reliability for mission-critical applications.
- **Track server status and ensure quality of service (QoS)** Server administrators can keep an eye on CPU and memory utilization, system capacity and performance per server, response times, and current server state to provision appropriate server resources to ensure high availability and performance according to QoS requirements.

Note: PowerPivot for SharePoint 2010 integrates with the SharePoint logging infrastructure based on Unified Logging Service (ULS). The PowerPivot Usage Data Import timer job collects this usage information from the PowerPivot components and imports it into the centralized SharePoint Usage Collection database. Other timer jobs process this information, as well as server health statistics, import the results into the PowerPivot application database, and then update the workbook of the PowerPivot Management Dashboard.

Encapsulating Enterprise Data Sources

Data feeds exposed through Reporting Services-based reports will play an important role in PowerPivot-based self-service BI scenarios for numerous reasons. Among other things, all reports created using Report Builder 3.0 and Reporting Services expose data feeds for importing the report data conveniently into PowerPivot for Excel 2010. Importing report data into PowerPivot is as easy as a clicking an orange button on the report's toolbar with the tooltip "Export to Data Feed." Doing so launches the data import wizard to add the feed to a PowerPivot workbook.

As mentioned earlier in the section "Maximizing Business Insight," power users can encapsulate PowerPivot workbooks and other data sources by means of report-based data feeds with minimal dependency on IT. In a similar way, the IT organization can use report-based data

feeds to encapsulate enterprise systems that are notoriously hard to get to, such as enterprise resource planning (ERP) systems and customer relationship management (CRM) systems. It is possible to encapsulate and consolidate heterogeneous data sources for analysis to accelerate common or complex analysis tasks and increase consistency. Figure 14 illustrates how an organization can take advantage of report-based data feeds to provide users with centralized, secure access to the mission-critical information they need.

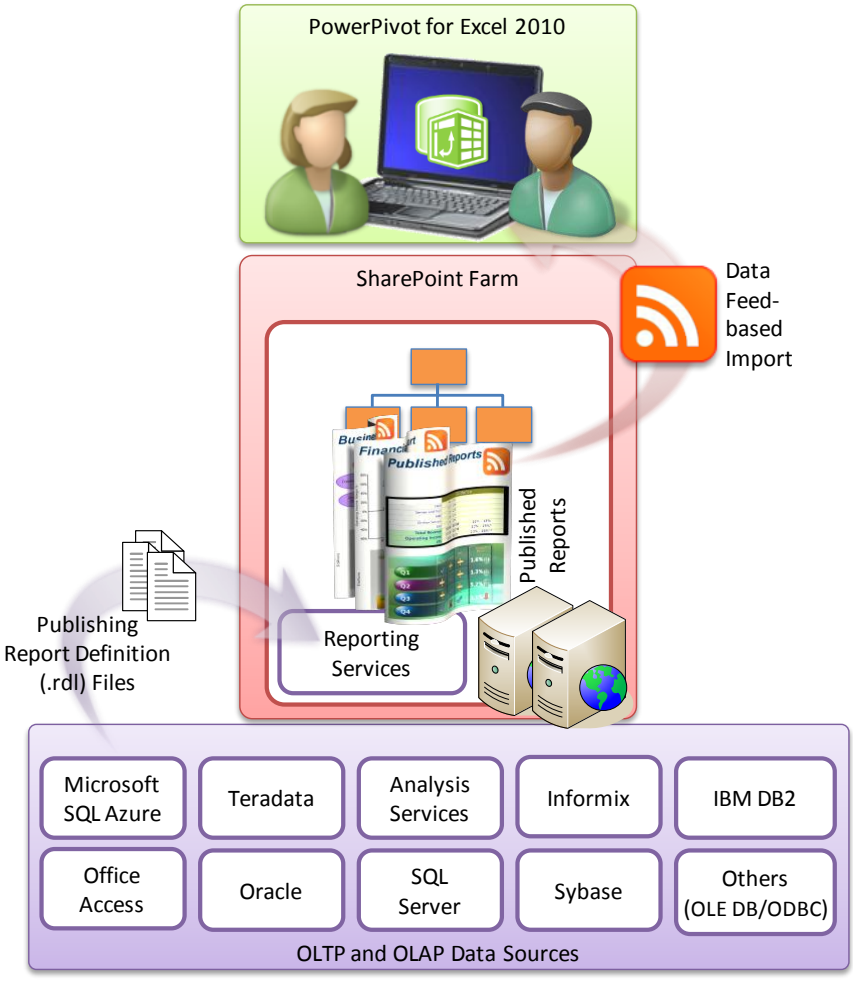

Figure 14: Encapsulating Data Sources through Report-Based Data Feeds

SQL Server 2008 R2 Reporting Services-based data feeds provide the following advantages:

- **Virtually unlimited data access** Users can get secure access to mission-critical information systems via server-based reports that access the source systems using a system account.
- **Consolidated heterogeneous data sources** Reporting Services supports a wide range of data sources in reports that can serve as data feeds for analysis. Consolidating and preparing data helps to decrease analysis complexity, increases consistency, helps to compress decision cycles, and contributes to more accurate business insights.

- **Increased power user productivity** With data-encapsulating and -consolidating reports readily available in the managed BI collaboration environment, users do not waste time importing data from a variety of internal and external sources.

Note: Data feed capabilities are provided out of the box in every report based on SQL Server 2008 R2 Reporting Services.

Conclusion

The groundbreaking new tools and technologies included in SQL Server 2008 R2 enable organizations to empower their users, facilitate seamless and secure sharing and collaboration on user-generated BI solutions, and help to increase IT and BI developer efficiencies. Tools, such as PowerPivot for Excel 2010 and Report Builder 3.0, and innovative technologies such as PowerPivot for SharePoint 2010, Analysis Services in SharePoint on VertiPaq™ or traditional storage modes, Reporting Services, and Master Data Services, not only tackle all typical BI challenges in the enterprise, they truly change the game of BI. The focus shifts from IT delivering organizational BI solutions to a managed BI collaboration environment that gives users the power to get timely and reliable information to make more relevant decisions.

The managed BI collaboration environment does not replace organizational BI but complements it with managed team and personal BI solutions. Power users can now assume the role of producers of insights, offloading work from organizational BI development teams where appropriate and otherwise communicating suggestions for organizational BI solutions to them. Heavy involvement of power users and business users in all areas of an organization's BI initiatives is crucial to the success of BI in the enterprise.

Power users, the producers of team and personal BI solutions, primarily work with PowerPivot for Excel 2010 and Report Builder 3.0 to create workbook applications and online reports. Both tools integrate seamlessly with SharePoint 2010 for secure sharing and collaboration with colleagues. Business users, the consumers of insights, primarily work with Internet Explorer® or any other supported Web browser to view shared applications and reports, rendered directly on the server. It is not necessary to download PowerPivot workbooks for analysis. Business insight is now readily available wherever and whenever a user needs it, on any browser-capable device.

Thanks to SQL Server 2008 R2 technology, it is becoming easier for business users to get accurate answers in seconds and to ask even more questions, drill down into details, discover new information, and new questions, and new answers. Built on the familiarity of Excel, PowerPivot vastly expands existing client capabilities with column-based compression, an in-memory BI engine, virtually unlimited data sources, and new Data Analysis Expressions in familiar formula syntax. PowerPivot users can process massive amounts of data in seconds, and data refresh through PowerPivot for SharePoint 2010 ensures that published PowerPivot workbooks remain up-to-date. Furthermore, Reporting Services data feeds can encapsulate enterprise systems that are otherwise not accessible and reuse shared PowerPivot workbooks

as data sources in new analyses. Another viable option to encapsulate enterprise systems is Master Data Services.

Master Data Services is an important technology for establishing sound Master Data Management processes in the enterprise and increasing an IT organization's data management efficiency. Among other things, MDS can help to drive direct stewardship to ensure data quality and compliance with laws and government regulations. Another key tool is the PowerPivot Management Dashboard, which enables IT to gain control and take proactive steps to avoid conflicting and outdated data in spreadmarts, which are main causes of misleading analysis, confusing results, and complications in decision-making. IT can now determine who is using shared BI applications, when, how often, and with what client. IT can also analyze data source information to see where users are importing their data from and obtain server health statistics.

SQL Server 2008 R2 redefines how organizations deliver and succeed with BI. It affects all areas, ranging from traditional organizational domains to team workspaces and personal BI. SQL Server 2008 R2 is the technology IT organizations need to reestablish confidence in their ability to deliver timely, reliable, relevant, and actionable information for sound business decisions.

For more information:

http://www.microsoft.com/sqlserver/: SQL Server Web site

http://technet.microsoft.com/en-us/sqlserver/: SQL Server TechCenter

http://msdn.microsoft.com/en-us/sqlserver/: SQL Server DevCenter

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