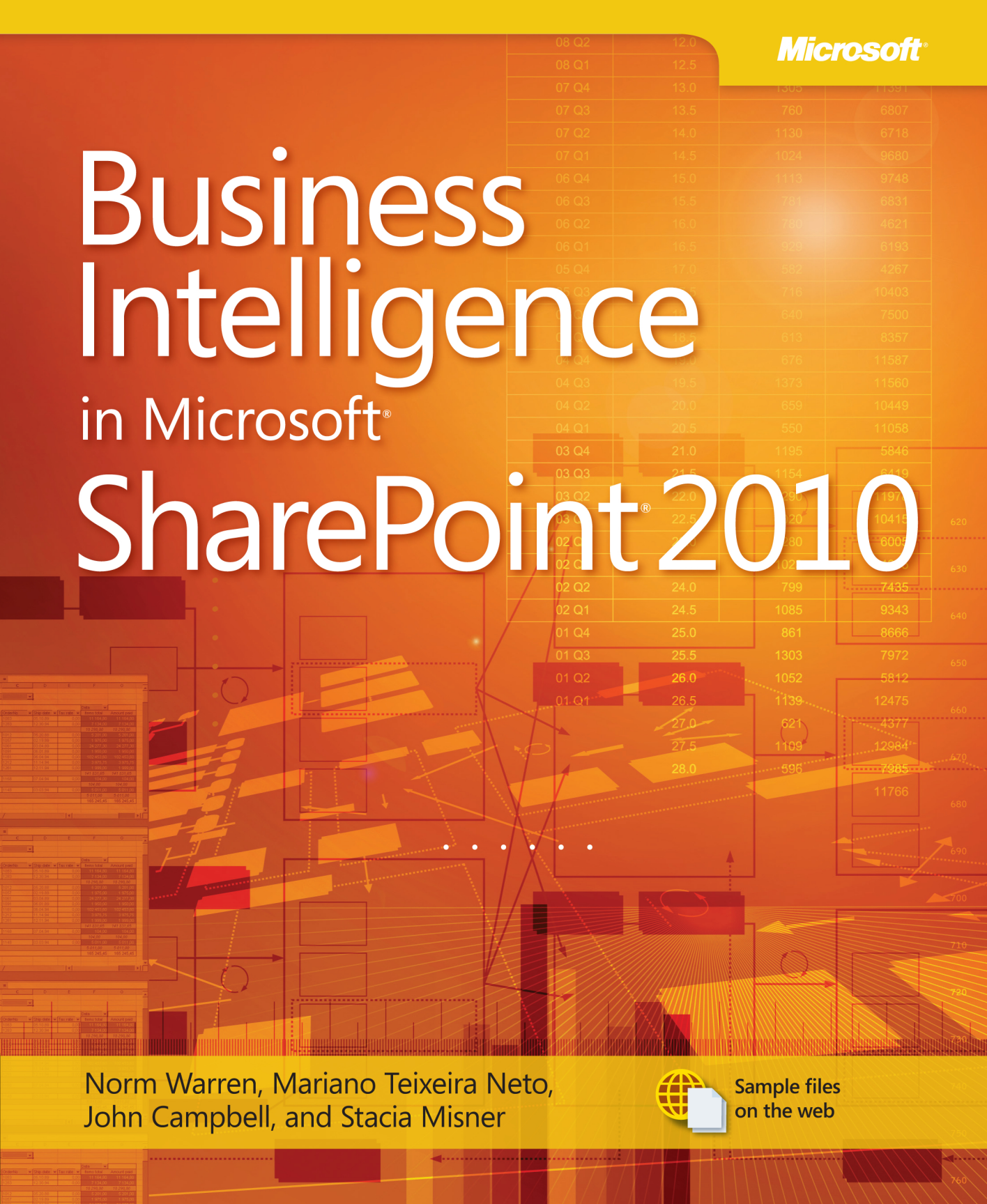
Microsoft
Business Intelligence in Microsoft® SharePoint® 2010
Norm Warren, Mariano Teixeira Neto, John Campbell, and Stacia Misner
Sample files on the web

Microsoft®

Business Intelligence in Microsoft® SharePoint® 2010

Norm Warren

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Cover: Karen Montgomery
Compositor: Octal Publishing, Inc.
Illustrator: Robert Romano

978-0-735-64340-6

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Introduction

Whether you are a SQL Server business intelligence (BI) developer or a SharePoint Administrator, this book shows you how Microsoft is delivering on its commitment to provide useful, usable BI to its customers. It provides a quick dive into new Microsoft SharePoint 2010 BI features and offerings as well as new SQL Server BI offerings.

The book provides a getting started guide for each of the SharePoint application services dedicated to BI. Additionally, the book introduces features for managing SQL Server 2010 Reporting Services reports and Excel 2010 PowerPivot add-in reports in SharePoint.

The SharePoint Server 2010 application services that provide self-service BI include:

- **Excel Services** A Microsoft SharePoint Server 2010 service application that you can use to manage, view, interact, and consume Microsoft Excel client workbooks on SharePoint Server.
- **PerformancePoint Services** A performance management service that you can use to monitor and analyze your business. This service provides flexible, easy-to-use tools for building dashboards, scorecards, reports, and key performance indicators (KPIs).
- **Visio Services** A service that allows users to share and view Visio diagrams on a SharePoint website. This service also enables you to refresh and update data-connected Microsoft Visio 2010 diagrams from a variety of data sources.
- **PowerPivot** A SharePoint 2010 application service (included in SQL Server 2008 R2) and an extension to Excel that adds support for large-scale data. It includes an in-memory data store as an option for Analysis Services. Multiple data sources can be merged to include corporate databases, worksheets, reports, and data feeds. You can publish Excel documents to SharePoint Server 2010.

SharePoint administrators, business users, and BI developers, as well as other users and consumers of BI, will want to understand each of these services and how they work together to bring BI to more people through SharePoint.

Which Tool Do I Use?

BI in SharePoint is less about a specific technology or product that meets the needs of a small percentage of users and more about a "buffet" of offerings for the customer who is trying to solve a specific problem. Customers complain that much of the documentation and content that is published is too product-specific. They need to see the big picture. More importantly, customers want to know which specific Microsoft BI tools can best meet their needs.

Perhaps one day the seven tools that each offer a product-dependent method to create KPIs will merge into a single dynamic BI product. But for now, customers need to know when they should choose SQL Server Reporting Services in SharePoint over PerformancePoint Services. Or why they would use the Excel 2010 PowerPivot add-in versus Excel or Excel Services. Each connects to a database and surfaces data from an OLAP cube.

BI Maturity Model

Whatever stage your company has reached in its ability to provide your business users with optimal decision-making data, this book can help you advance that capacity by providing a selection of "crawl, walk, and run" scenarios.

How Do the Tools Work Together to Help Me Solve My Needs for BI?

SharePoint 2010 (enterprise license) now offers several BI tools. We show how they work together in compelling ways.

This book's approach is unique in the following ways:

- The book clearly defines Microsoft BI tools in a matrix. It speaks to the different stages and problems that teams and companies are trying to solve by categorizing the tools according to the specialized BI services they provide and by presenting a maturity model.
- Rather than focusing on the BI features of a single product, the book uses the rich palette of available BI tools from Microsoft to create the big picture that a business enterprise needs to succeed in a competitive global marketplace. It discusses which Microsoft BI tool is best for different scenarios and what costs and products are associated with each.
- The book treats SharePoint-based BI tools both individually and as a whole to show how they work together to provide a complete solution. For example, it explains how you can use the SharePoint 2010 PerformancePoint Services as an aggregator for the other reporting tools such as Excel Services, SQL Server Reporting Services reports, and Microsoft PowerPivot for Excel.

Who Should Read This Book

While anyone interested in using advanced tools to gather and present BI can benefit from this book, it should prove especially valuable to the SharePoint administrators, business users, and BI developers.

SharePoint Administrator

Just as a SQL BI developer peeks into SharePoint 2010 products, we want SharePoint administrators to peek into the tasks involved in developing BI solutions and the inherent difficulty in getting to trusted data. A SharePoint administrator must be aware that you typically can't just "turn on" BI in SharePoint or in SQL Server. Instead, you follow a process. A SharePoint administrator should also be aware of the newest BI features and tools, as well as existing technologies, and have some idea of how to set them up. In this book, we give SharePoint administrators an overview of the latest available BI tools and how they work with SharePoint 2010. This book strives to give SharePoint administrators an understanding of the work and expertise required for an extensive range of possible BI implementations.

Business User

In this book, the term "business user" describes people who are eager to understand the technologies that can help them, their teams, and their organizations measure, analyze, forecast, and report on the most important aspects of the company's business data. A business user may also be a technical decision-maker, deciding which products work best for the individual, team, or organization. By understanding how technology and business needs meet through reporting, measuring, analyzing, and more, we hope that business users will see a return on investment through increased accountability and better alignment with organizational goals.

Using SharePoint 2010 and other stand-alone tools, business users can benefit from learning about the end-to-end process for surfacing and presenting insights to decision-makers. Business users know that trusted insights can change behavior and decisions, which can ultimately help to lead a company in the right direction.

Business users who can benefit from the integrated BI tools offered by Microsoft Office, SharePoint, and SQL Server include:

- Business analysts
- Business decision-makers
- Knowledge workers
- Line workers

Each of the preceding roles has its own unique accountabilities. For each role, we provide simple examples showing how to create BI end results such as the following:

- Reports
- A dashboard in PerformancePoint Services
- KPIs that can be presented using various tools
- PivotTables in Excel

End users may also want to know how to do some tricks in SharePoint, such as how to add a rating system in a SharePoint list, view a blog post, implementing collaborative decision-making in SharePoint 2010, or rating BI assets.

BI Developer

Put simply, the BI developer's task is to establish trusted data sources (tabular data and OLAP cubes) in SQL Server for the various services (Excel, Visio, PerformancePoint) and for PowerPivot and SQL Server Reporting Services. BI developers also help create connections to the trusted data sources and help ensure that the data is the right data.

Organizational BI begins by establishing a single source for trusted data. If users cannot trust the data that's in front of them to make decisions, they won't trust the tools that deliver the data. They will abandon those tools to seek some other way to get the right data, which likely means abandoning their considerable investment in those tools, in both time and money, to invest in new ones.

Data can come from a variety of sources, and in many cases, companies have spent lots of money and time to establish a repeatable ETL (Extract, Transform, and Load) process. This requires a BI developer who knows something about data warehouses (SQL Server), integrating data from various sources using SQL Server Integration Services, and developing T-SQL procedures. If a company decides that creating OLAP cubes is worth the effort, it will also hire (or train) SQL Server Analysis Services experts to do the job. Microsoft has provided the tools to tie all this data together, and this book can help you use them to get the best value from your data management tools.

Using the information in this book, BI developers can help decide which tools to use to surface the data. They can also communicate closely with the SharePoint Administrator in cases where trusted data must be shared.

In this book, the authors provide a discussion of SQL Server Analysis Services OLAP cubes because OLAP cubes are the ideal data sources for organizational BI using PerformancePoint Services, for data sources used by the other services (such as Excel Services, Visio Services, and others), and now for "personal BI" using PowerPivot for Excel and PowerPivot for SharePoint.

Scope of This Book

Before starting to write this book, the authors went back and forth over exactly what to include. For example, we chose not to include information about setting up all the various tools and databases—although we did include a synopsis of best practices for planning, deployment, and configuration. Because this book is aimed primarily at three different audiences—SharePoint administrators, business users, and BI developers—we were forced to sharpen our focus and choose only the most relevant BI products from Microsoft for these audiences.

Those products are:

- SharePoint Excel Services
- SQL Server 2008 R2 PowerPivot
- SharePoint Visio Services
- SharePoint PerformancePoint Services

Organization of This Book

The following sections provide a brief synopsis of what you can expect to learn from each chapter of this book, including the appendixes.

Chapter 1, Business Intelligence in SharePoint

BI is a difficult concept to pin down precisely, because it covers a wide range of products and technologies and thus means slightly different things to different people. This chapter discusses exactly what the authors mean by the term "business intelligence," the Microsoft approach to BI, and how SharePoint fits into the picture.

Chapter 2, Choosing the Right BI Tool

Customers often ask which tools they should use when trying to select among a variety of Microsoft offerings. They're often confused and need information as to why they might want to prefer SQL Server Reporting Services in SharePoint over PerformancePoint Services, or why they might use the Excel 2010 PowerPivot add-in instead of Excel or Excel Services. After all, each product connects to a database and surfaces data from an OLAP cube.

The difficulties of making such decisions are compounded because different teams and companies are at different stages in their ability to surface data to business users for optimal decision-making. Overall, this chapter attempts to answer questions about which tools to use, clarifying the purposes and capabilities of the various products, and helping you choose which ones are most appropriate for your situation.

Chapter 3, Getting to Trusted Data

This chapter discusses how a company can surface reliable data that business users can work with to author reports and make decisions. Historically, BI started in SQL Server, so we take you on a tour that starts with disparate data sources and then we provide step-by-step exercises showing how to create your own mini-data warehouse—and then show you how to create a multidimensional cube.

Chapter 4, Excel Services

Most business intelligence begins in Excel, which can be considered the most pervasive BI tool that exists. But sharing Excel files has always been a huge challenge. Excel Services not only provides the ability to share Excel-based content safely and securely—it also adds powerful management capabilities. Such features as the PivotTable, PivotChart, and Sparklines in Excel improve the look and feel of how data is presented. Among several hands-on examples, you'll see how to create a PivotTable, sparklines, and slicers to provide slice-and-dice capability on the screen for analysis, and how to add your pivot table to a simple dashboard webpage so that you can share it.

Chapter 5, PowerPivot for Excel and SharePoint

A PowerPivot workbook looks like an Excel workbook, and that's how it is supposed to look. The PowerPivot experience is designed to feel as seamless as possible to an Excel user. The difference is under the hood, where PowerPivot enhances Excel. Because PowerPivot uses the VertiPaq engine, it extends Excel so that you can work with millions of rows. Moreover, operations—even with huge volumes of data—are fast! Aggregations that might have taken a day to calculate in SQL Server Analysis Services take only seconds in PowerPivot. In this chapter, you'll see how to mash-up data from different sources, share that data securely via SharePoint, create Data Analysis Expressions (DAX) queries, and more.

Chapter 6, Visio and Visio Services

This chapter shows you how to create data-driven diagrams that provide interactive processes and context.

Chapter 7, PerformancePoint Services

One exciting solution that PerformancePoint Services offers is the ability to show a dashboard that reflects KPIs, such as the available disk space of managed servers. This chapter explains how to create a dashboard with scorecard, KPIs, reports, and connections to data sources.

Chapter 8, Bringing It All Together

In this chapter, you'll capitalize on the concepts and products discussed in all the preceding chapters by walking through the steps to create a dashboard that shows data from various sources, such as PerformancePoint Web Part, Visio Services, Excel Services, and PowerPivot.

Appendix A: Virtual Machine Setup and SharePoint Configuration

In this appendix, you'll find detailed setup instructions, including helpful screen captures, so that you can get up-and-running quickly to work through the book's exercises. We also provide some instruction for configuring SharePoint Server 2010, along with links to relevant sites.

Appendix B: DAX Function Reference

This appendix provides a reference to DAX, introduced in Chapter 5, "PowerPivot for Excel and SharePoint." DAX is an expression language based on Excel formula syntax and is designed to work with multiple tables of data. DAX includes functions that implement relational database concepts.

Appendix C: SharePoint As a Service—"Office 365"

This appendix discusses how Microsoft enables disparate businesses—from the smallest one-person home office to the largest enterprises—to experience the benefits of SharePoint without needing to know how to install, manage, deploy, patch, back up, scale out, or generally maintain the machines or software. The authors anticipate more breakthrough cloud features for BI in the future and encourage readers to get a better understanding of the relationship between the cloud and SharePoint.

Finding Your Best Starting Point in This Book

The different Microsoft tools cover a wide range of technologies associated with BI. Depending on your needs and your existing understanding of Microsoft data tools, you might want to focus on specific areas of the book. Use the following table to determine how best to proceed through the book.

If you are	Follow these steps
New to Microsoft business intelligence	Focus on Chapters 1 and 2.
New to SQL Server 2008 R2, data warehousing, and OLAP concepts	Focus on Chapter 3.
New to SharePoint 2010 services dedicated to BI	Read and perform exercises for Excel, Visio, and PerformancePoint services as well as PowerPivot in Chapters 4, 5, 6, and 7.
New to how the services dedicated to BI work together in dashboards	Read Chapter 8.
New to setting up the virtual machines you will need for this book	Refer to Appendix A.
New to DAX as the PowerPivot extension to the Excel formula language	Refer to Appendix B.
New to Office 365 and cloud-based BI services	Refer to Appendix C.

Many of the chapters in this book include step-by-step exercises so that you can try out the concepts discussed in a hands-on fashion. No matter which sections you choose to focus on, be sure to download and install the sample code on your system.

What's Not in This Book

While this book covers a wide range of products, it doesn't cover everything. We chose to concentrate instead on those technologies that we believe make up the core Microsoft BI tools. Three of the following BI tools are a part of SharePoint Server 2010 and one, Reporting Services, is part of the SQL Server 2008 R2 platform, offering strong reporting and report management features in SharePoint. All these are either up-and-coming or already adopted and in use by the BI community. This brief section explains which technologies we chose not to discuss, but if these technologies also suit your needs, you might consider how you can implement them.

Access Services

Microsoft Access is a relational database management system. Software developers and data architects can use Access to develop application software, and "power users" can use it to build individual and workgroup-level applications.

Access Services is a service application that lets you host Access databases within SharePoint Server 2010. Through Access Services, users can edit, update, and create linked Access 2010 databases, which are then both viewed and manipulated using either a web browser or the Access client. In other words, Access services extends "access" to Access, so that even users who don't have the Access client installed on their desktop can perform operations with the Access application through Access Services.

Access Services can also generate the RDL language used by SQL Server Reporting Services. This is important because it enables you to quickly and easily report on SharePoint data.

There is a self-service element to Access that lets users incorporate rapid application development principles (RAD) to more quickly create data-driven websites without coding in ASP.NET. This is attractive to smaller companies that have a small IT department—sometimes only one or two IT workers. Access and Access Services also become attractive to larger companies when projects are prioritized into already-full IT development schedules, or when users want to provide a very quick proof-of-concept data-driven website.

SQL Server 2008 R2 Reporting Services in SharePoint

SQL Server 2008 R2 Reporting Services with SharePoint integration has several new features, including support for multiple SharePoint Zones, support for the SharePoint Universal Logging service, a new data extension, and a query designer for SharePoint Lists as a data source. The SharePoint List data extension supports getting data from the following SharePoint technologies: SharePoint lists for SharePoint Foundation 2010, SharePoint Server 2010, Windows SharePoint Services 3.0, and Office SharePoint Server 2007.

SQL Server Reporting Services Report Builder 3.0 is a report-authoring tool that enables you to create ad-hoc reports quickly. The tool helps report creation, collaboration, and consistency by enabling business users to create and share report components that can be accessed via a shared component library.

We didn't quite omit this topic entirely; we did include a somewhat longer summary of what SQL Server Reporting Services is in Chapter 3, "Getting to Trusted Data."

Business Connectivity Services

Microsoft Business Connectivity Services (BCS), formerly named the Business Data Catalog, provides read/write access to external data from line-of-business (LOB) systems (such as Microsoft Dynamics, Oracle, or Siebel), web services, databases, and other external systems from within Microsoft SharePoint 2010. SharePoint 2010 has product features that can use external data directly, both online and offline. BCS enables tools such as Microsoft Visual Studio 2010 and Microsoft SharePoint Designer 2010 to help make connections to the external data.

How Is BCS Different from BDC in SharePoint 2007?

BCS lets users read and write external data into Microsoft SharePoint and into Microsoft Office applications. In contrast, BDC was designed to give users a read-only window into external systems. Using BCS, solution designers can now describe the structure of the external system as well as determine how that data should behave within SharePoint and Office.

Duet Enterprise

You may have asked, "How is Duet Enterprise different from BCS if it connects to ERP data?" Duet Enterprise is an application built on the SharePoint 2010 platform, and it uses BCS in conjunction with SAP data. Duet Enterprise was developed jointly by two companies: SAP and Microsoft. SAP is a German software company known primarily for its SAP Enterprise Resource Planning and SAP Business Objects products. Duet Enterprise enables all employees to consume and extend SAP applications and data through Microsoft SharePoint 2010 and Microsoft Office 2010. Duet Enterprise combines the collaboration and productivity supported by Microsoft SharePoint and Microsoft Office with the business data and processing functionality of SAP applications.

For SAP users, Duet reduces the learning curve and provides wider access to enterprise information and policies—resulting in greater user adoption. As a result, organizations can increase corporate policy compliance, improve decision-making, and save time and money. We mention the product here because there are a lot of SAP customers and a lot of SAP data; making that data available to many users was previously difficult or impossible.

Duet's plan is to continue developing interoperability between SAP and SharePoint in areas such as system management, single sign-on, and more. By blending the worlds of process and collaboration, end-to-end solutions will form as tools and feature extensions become available. To learn more, see *http://www.sap.com/solutions/duet/index.epx* or *http://www.duet.com/index.aspx*.

Web Analytics

Web Analytics helps you collect, report, and analyze usage data so that you can measure the effectiveness of your SharePoint Server 2010 deployment. The following is an overview of the new Web Analytics features:

- Traffic reports that provide the following metrics:
  - Number of Page Views: Track site usage and popularity.
  - Top visitors: Discover who is visiting your site.
  - Top Referrers: Determine how visitors arrive at your site.
  - Daily Unique Visitors, Top Destinations, Top Browsers, and so on.
- Search reports that provide insights into what users search for, including the following:
  - Number of Queries: Learn how many times users took advantage of search.
  - Top Queries: Identify the most-used search terms.
  - Failed Queries: Hone in on queries that fail for users.
  - Best Bet Usage, Search keywords, and so on.
- Inventory reports that display metrics about the inventory of your sites, such as the following:
  - Storage usage: See the total disk drive space consumed by each user.
  - Number of sites: Track how many sites exist.
  - Top Site Product Versions, Top Site Languages, and so on.

Conventions Used in This Book

This book presents information using the following conventions, which are designed to make the information readable and easy to follow:

- In most chapters, you'll see general concepts and explanations of the technology in that chapter.
- Some chapters contain hands-on exercises. Each exercise consists of a series of tasks, presented as numbered steps (1, 2, and so on) listing each action you must take to complete the exercise.
- Boxed elements, with labels such as "Note," provide additional information or alternative methods for completing a step successfully.
- Text that you type (apart from code blocks) appears in bold.
- A plus sign (+) between two key names means that you must press those keys at the same time. For example, "Press Alt+Tab" means that you hold down the Alt key while you press the Tab key.
- A vertical bar between two or more menu items (for example, File | Close) means that you should select the first menu or menu item, and then the next, and so on.

System Requirements

This book addresses several different types of audiences, not all of whom might want to install software and follow along. If you do want to perform the exercises, you should first read Appendix A, "Virtual Machine Setup and SharePoint Configuration."

Code Samples

Several chapters in this book include exercises that let you interactively try out concepts or techniques discussed in the main text. Some of these require setup and configuration or scripts to set up the example scenarios. Before working with the exercises, read Appendix A, and follow the download and configuration instructions carefully. The accompanying sample scripts are available for download from the book's page online, at http://aka.ms/643406/files.

Note In addition to the code samples, you should have SQL Server 2008 R2 installed as part of the virtual machine installation. The instructions below use SQL Server Management Studio 2008 R2 to set up the sample database used with the practice examples. If available, install the latest service packs for each product.

Installing the Code Samples

To install the code samples on your computer so that you can use them with the exercises in this book, unzip the file that you downloaded from the book's website.

Using the Code Samples

The folder contains several files:

- **Sample Database** Optional SQL scripts to build the sample database, NorthwindOrdersDW, and scripts to add dimension and fact tables if you don't want to create the tables manually.
- **SQL Scripts** Scripts for creating the underlying data for the NorthwindOrdersDW, which is the sample Northwind database that emulates a simplified transactional database.

Note To complete the exercise in Chapter 3, you must have the necessary permissions to create SQL engine and SSAS databases.

Acknowledgments

Norm Warren would like to first thank his wife, KarAnn, and children for their patience while writing the book. He would also like to thank the people that have helped contribute in one way or another to this book.

Kevin Donovan, Technical Reviewer of the whole book and Program Manager at Microsoft.

Trevor Dywer, Director at Avanade, Bruno Ferreira, BI Developer for Accenture, all who have offered chapter review and support.

Joe Hutchison, BI architect, who provided invaluable guidance for several areas of the book.

All the others who have helped provide support or information that made this book a reality.

John would like to thank Mark Kashman for his review of the SharePoint Online content as well as the other authors for their reviews and hard work. Most importantly, John would also like to thank his beautiful wife, AnnMarie, for her unending patience, love, and support.

Mariano would like to thank Kay Unkroth, program manager, and Lee Graber, developer, (both from Analysis Services team at Microsoft) for reviewing his chapter. And, most importantly, to thank his family—Bárbara, Sofia, and Miguel—for their support and love.

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Chapter 2

Choosing the Right BI Tool

After completing this chapter, you will be able to

- Differentiate between business communities that consume BI.
- Understand the typical progression of BI.
- Determine the best BI tools for your needs.

Introduction

As described in Chapter 1, "Business Intelligence in SharePoint," business intelligence (BI) is a general term used to describe the development of insights from one or more tools that allow information workers and decision-makers in a company to understand what has happened in the past and to compare past events to what is happening now. With these insights, they can set appropriate goals for the company, monitor ongoing progress towards those goals, and take corrective action whenever necessary. This chapter focuses on the reporting and analysis tools that make these insights possible. In turn, these tools rely on a supporting infrastructure of trusted data, described in Chapter 3, "Getting to Trusted Data."

If you're a business user, your primary interaction with a BI solution is with the presentation layer. However, the Microsoft stack includes a variety of tools with overlapping capabilities that can seem confusing at first glance. This chapter can help you understand how these tools support different scenarios, how your choice of which tool to use can change over time, and how to select the right tool for the task at hand.

If, on the other hand, you're a BI developer or SharePoint administrator, this chapter can help you develop and support a successful BI implementation. You need to understand the different ways that users can interact with data, now and in the future, and the implications of tool selection for the overall architecture.

This chapter starts by examining the analysis needs of business user communities and how the Microsoft reporting and analysis tools serve these communities. It then reviews the typical progression of competency with BI within a company and how that progression affects the mix of tools for business users. Finally, it provides a guide to selecting the right tool for the community and analytical requirements applicable to you.

Business User Communities

When it comes to BI, business users are likely to have different information needs, depending on their technical skills, the types of decisions they make, and how they need to save and share their insights. In several different ways, business users with common characteristics can be grouped into separate user communities. By understanding the needs of these business user communities from a variety of perspectives, you can select the tools that best support those needs.

Casual Users vs. Power Users

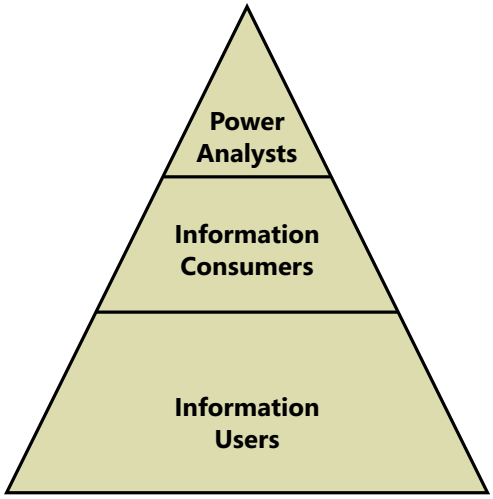
One common way to differentiate business users is to separate them into two communities—casual users and power users. Casual users might be department managers, executives, or even external stakeholders such as customers or suppliers. Casual users tend to be infrequent users of BI, perhaps once per week or less, whereas power users are often daily users of BI.

Because casual users spend less time with BI, their skill level with BI tools is much lower than that of power users. Therefore, the interfaces to such tools must be simple so that they can find the information they need on their own. For these users, a web-based reporting application works well. The tools that help a casual user interact with data and develop insights tend to be very simple and focused on specific sets of data.

But making tools simple for casual users often makes them too simple for power users, who typically require access to a wide variety of data and need more on-demand analytical capabilities. Power users spend enough time working regularly with BI tools that they develop advanced technical skills. These users, typically business analysts and analytical modelers, need tools that give them the ability to explore the data without restraint.

Another way to distinguish casual users and power users is by assessing their familiarity with the data. It's quite possible that a person can be quite knowledgeable about the data in his or her own department and thus qualify as a power user, requiring a more analytical BI tool for daily work. It's also possible that this same person has access to data in another department but is less familiar with that data. For that situation, this user needs a basic reporting tool that simplifies information access.

In their book *Business Intelligence: Making Better Decisions Faster*, Elizabeth Vitt, Michael Luckevich, and Stacia Misner break down the casual users down into two groups—information users and information consumers, as shown in the following illustration, in which the pyramid shows the relative size of all three groups of business user communities.



The largest community consists of information users, who rely on standard reports that BI developers publish to a central location. These reports may be accessible either online or in print, depending on the distribution mechanism that the report administrators implement. For this business user community, SQL Server Reporting Services is a good solution, either running as an independent application or integrated with SharePoint Server 2010. It provides a scalable online environment for viewing reports that administrators can secure, and it can deliver reports in a variety of formats on a scheduled basis via email or to a network file share.

Information consumers are the second community of casual users. They tend to explore the data more than the information users, but they lack the expertise necessary to query a database directly. They can get the information they need by working with interactive reports that include parameters for filtering and sorting or that include options to change the visibility of selected report elements. Interactive reports can also include the ability to drill down to more detail, either by displaying the details in the same report or by opening a separate report for the details. Again, Reporting Services is the best choice for meeting the needs of this community. With a proper understanding of information consumers' needs, a report author can incorporate a variety of interactive features into reports.

At the top of the pyramid, power analysts are the smallest community. Power analysts might use existing reports as a starting point for analysis, but they also need the ability to define and execute their own queries. In some cases, they might even build reports for the other communities. For example, a power user can use Report Builder 3.0 to create a report based on their own queries and then publish the entire report (or even individual elements of the report, called report parts) for the other user communities to access. Information consumers can build up a customized report from these report parts without knowing anything about how to construct a query or how to design the report part.

As flexible as Reporting Services is, it's still a reporting tool and has limited support for the type of ad hoc analysis that power analysts frequently perform. A more commonly used tool for analysis is Microsoft Excel 2010. A power analyst can group and filter data in a pivot table and create additional calculations to supplement analysis of the data. If analysis requires integrating data from multiple data sources, the power analyst can use PowerPivot for Excel.

Organizational Hierarchy

The position of a business user within the organizational hierarchy and the decision-making associated with that position often play a role in the type of information and the BI tool that the user requires. The higher the business user is in the hierarchy, the more likely that the user is an information consumer as described in the preceding section. Furthermore, the higher in the hierarchy a user is, the more likely it is that the information that user relies on is already cleansed and highly processed, is already compatible with data from different sources, and has been restructured for reporting and analysis.

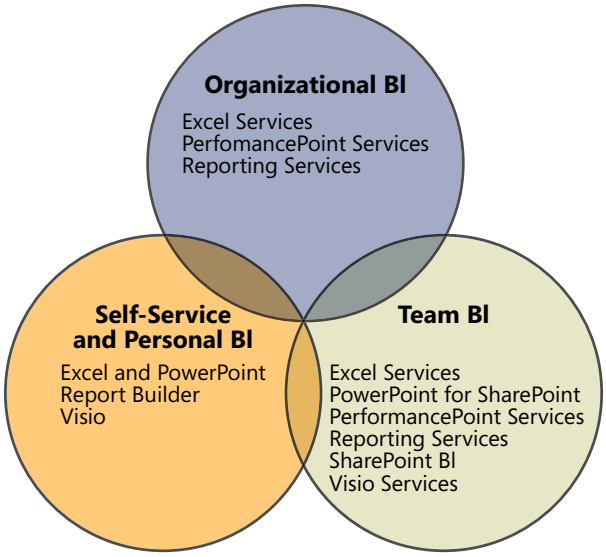
Because this information has long-term value and is vital to strategic planning, a solid BI infrastructure exists to automate the necessary cleansing and processing. Usually this information is provided to upper management in a summarized, structured format with limited analytical capabilities. Reporting Services can be useful as a delivery mechanism for this type of information online, in print, or via email. Other online viewing options include dashboards and scorecards in SharePoint Server 2010 or PerformancePoint Services.

As business users move closer to the operations of the business, their information needs diverge, depending on the type of work a user performs. People at this level of the organizational hierarchy can be information users, information consumers, or power analysts.

The information requirements of these users differ from those of upper management because these users often combine official corporate data from a BI system with other data either created manually or obtained from external sources. This combination of data might occur only occasionally or might be an ongoing exercise. Either way, this type of quick and dirty data mash-up typically has only short-term value, so it's not a candidate for a formal BI implementation. On the other hand, it's a perfect scenario for PowerPivot for Excel, which very easily accommodates this type of ad hoc data integration.

BI Communities

Microsoft has another way of grouping users, which focuses instead on how users work with BI and how much collaboration they require. These BI communities, and the BI tools designed for each community, are shown in the following illustration. As you can see in this diagram, some overlap of tools exists between communities.



Organizational BI

Some popular ways to deliver BI to all employees in a company are to provide access to metrics that show progress towards organizational goals or to compare a current state to historical trends. Ideally, users of organizational BI can break down this information to see how their individual departments contribute to current conditions. Because the intended audience of information is the entire company, you can anticipate that the audience consists largely of information users and information consumers. Therefore, an organizational BI solution needs to support only online viewing, with limited interaction.

Typically, this information comes from approved data sources that have been staged, transformed, and restructured into a data warehouse. Ideally, this data has also been incorporated into an Analysis Services cube to provide both faster reporting to all business users and more flexible analysis for the power analysts.

Whether the data is stored in a relational database or a cube, the three primary tools for consuming this data at the organizational level are Excel Services, PerformancePoint Services, and Reporting Services. Excel Services and PerformancePoint Services require a SharePoint Server 2010 installation, with scalability achieved by setting up a SharePoint farm to distribute the workload. Reporting Services can be integrated into a SharePoint farm or can run independently. All these services require IT support to install and configure the environment.

In organizational BI solutions, business users tend to be consumers of published content rather than contributors. Content contributors are usually BI developers, IT professionals, and, in some cases, power analysts. The prevailing concept in organizational BI is to centralize content by using defined standards for layout, naming conventions, and color schemes. This BI can be consumed as is or can be used as base components by power users, who aggregate these with other content suitable for a targeted audience.

Each of the tools discussed in this section solves specific problems for organizational BI, starting with the most commonly implemented tool. The following descriptions of each tool aren't intended to be comprehensive; they focus on the features that address specific challenges that organizations face when implementing BI.

Reporting Services Many organizations start with standard reports by implementing Reporting Services. If it's set up to run in SharePoint integrated mode, Reporting Services relies on the same security model and centralized storage that SharePoint uses, which makes it easier to administer. Report administrators can control how reports execute to balance performance against timeliness of data, either by setting up a report to run on-demand to view current data or to use caching to execute it in advance and minimize the wait time for viewing.

Having reports available in a SharePoint document library also makes it easier for business users to find information for online viewing. Users have only one place to go for all corporate information, whether that information is in the form of Reporting Services reports, Excel workbooks, or other content. The interface is simple for users to access because reports are stored like any other content on the SharePoint server, making it a good option for information delivery to a wide audience of casual users. (Even if you run Reporting Services in native mode—without SharePoint Server 2010—the interface remains easy to use.) As an alternative, reports can be sent directly to users via email as often as necessary.

Reporting Services is also popular for its ability to produce pixel-perfect reports. The report author, typically an IT professional, has a high degree of control over the appearance and behavior of report elements to produce just the right layout, whether users view the report online or export it to another format. Also, with some advance thought about the types of questions that a user might ask when viewing a report, the report author can build in parameters for filtering and can add interactive features that lead the user to additional answers.

Crossing over into the team and personal BI communities, Reporting Services also supports a variety of export formats, allowing any user to save the report in a print-ready format such as a Portable Document Format (PDF) file or to incorporate information into a Word document. Moreover, the user can reuse the information in a report simply by using a Web Part to include it in a dashboard. Users with more advanced skills can export report data for further analysis into Excel or can set up a report as a data feed for ongoing analysis with PowerPivot for Excel. In addition, BI developers can incorporate reports into PerformancePoint Services dashboards. And reusability doesn't stop there. In companies with mature BI implementations, application developers can embed Reporting Services content in custom analytical applications through application programming interfaces (APIs).

Excel Services Although Reporting Services can produce some reports with complex calculations, it is limited in what it can do. It isn't meant to be a replacement for Excel. On the other hand, Excel isn't meant to be a corporate reporting solution. Although it provides a lot of formatting options and can handle complex calculations, Excel does not support the same

control over formatting that's available in Reporting Services and it has limits on the amount of data that can be stored in a workbook. (If you're creating workbooks with PowerPivot for Excel, the limits are much higher.) However, sharing Excel workbooks through Excel Services can be a reasonable reporting alternative for organizations that aren't using Reporting Services.

Excel Services runs as a SharePoint Server 2010 service application. The advantage of using Excel Services is that organizations can take advantage of the SharePoint infrastructure to deliver information contained in workbooks to a wide audience, which is a much better approach than sending them to users through the email system. Users don't need to have Excel or any other type of application or plug-in installed on their computer; they just need to use a supported browser—Internet Explorer or Mozilla Firefox on a computer running a Windows operating system, or Safari on a non-Windows system. And because the workbooks are stored in SharePoint, the users need only to learn how to use one interface to access any corporate content.

Excel Services also provides a more secure and scalable approach than email distribution. Administrators and content owners can control whether users can only view a document online or whether they can download it. It's also possible to restrict viewing to certain sheets or selected items in the workbook when it's important to hide intellectual property or the detailed data behind a particular cell value. Furthermore, the Excel Services calculation engine handles all the complex calculations for multiple concurrent users, thus sparing hardware resources on the user's computer.

When an Excel workbook sources data from an Analysis Services cube, Excel Services supports drilling, filtering, and sorting data in a pivot table. Although the user cannot replace dimensions on the pivot table's rows, columns, or filter axes, the interactivity is still better than Reporting Services can support. For organizational BI, in which dissemination of information is a higher priority than supporting analysis, this limitation of Excel Services should not be an obstacle.

The workbook author can configure the report to accept parameters from the user for another type of interactivity. When the user views the workbook in Excel services, the user can type in the parameter values, which can in turn be input values for a calculation. This feature allows the user to dynamically change workbook content using a simple interface.

Another benefit of Excel Services is the reusability of information contained in workbooks for the team and personal BI communities. Users can reference cell values in an Excel workbook published to SharePoint to create status indicators, which are a very simple type of key performance indicator (KPI) having only three possible levels. Also, by using Excel Web Access Web Parts, more advanced users can use workbooks, in whole or in part, in dashboards. Parameters in the workbook can be connected to Filter Web Parts, allowing users to change content for multiple Web Parts on the same dashboard page with a single filter. In addition, an Excel workbook can provide source data for a Chart Web Part.

BI developers can take advantage of Excel workbooks in several ways. Data in a workbook can be a data source for various content types in PerformancePoint Services, while a workbook itself can display in a PerformancePoint Services dashboard. For customized web-based analytical applications, application developers can use the Excel Services REST API or the ECMAScript object model to display and interact with workbooks as described in Chapter 4, "Excel Services."

PerformancePoint Services Companies with a clearly defined performance management strategy use PerformancePoint Services to communicate progress towards established goals. The basic dashboard capabilities in SharePoint Server 2010 might be the first step that some companies take as they develop corporate performance analytics, but PerformancePoint Services is preferred for its advanced dashboard functionality. It also includes components such as scorecards, analytical reports, strategy maps, and filters that BI developers and power analysts can use with either PerformancePoint or SharePoint dashboards.

The best data source for PerformancePoint Services components is an Analysis Services cube, which delivers the best performance for viewing and interacting with content. With respect to the analytical grid, analytical charts, and decomposition tree, a cube is the only type of data source these reports can use. The analytical reports are the best way to support drilling and pivoting in a web browser environment. BI developers can structure dashboards to simplify the use of analytical reports for casual users who might feel overwhelmed by the functionality these reports provide, but the decomposition tree cannot be built in advance. Power analysts who fully understand the data source and the tool's capabilities will appreciate the support for ad hoc analysis in these report types.

Apart from the analytical components in PerformancePoint Services, dashboards and scorecards are simple enough for the casual user to explore. A benefit of using PerformancePoint content types to build dashboards and scorecards is the ability for the BI developer to integrate multiple data sources so that business users can see related content in one location. For example, rather than opening an Excel workbook to see the established organizational goals and then opening a Reporting Services report to see the current status from an operations data source, the user can instead see the goals and the status side by side in one report, no matter where the source data is actually stored.

Although plenty of advantages are gained by using PerformancePoint Services, some disadvantages must be pointed out: First, the formatting options are limited as compared to Reporting Services or Excel. Second, developers can use PerformancePoint Services dashboards to combine a lot of content built for other purposes and can reuse many PerformancePoint content types in SharePoint dashboards, but that's it. The only other way to reuse content built for PerformancePoint Services is to build custom applications by using the PerformancePoint Services API.

Team BI

An easy way to get started with BI is to focus on a single community within an organization, which might be preferable because it's faster to deliver initially than an organization-wide initiative. The target community might be an entire department or perhaps a small team within a department. Or it could be a project team in which multiple departments are represented, or it could even be a group of people external to the organization, such as customers.

The key differentiators between team BI and organization BI are the scope of the information provided to the target audience and a greater participation in the content development process by the team community. Consequently, the ideal BI infrastructure provides an opportunity for the team to use the information collaboratively as they work toward a common goal.

Like organizational BI, data for a team BI solution often comes from approved, cleansed, and processed sources and is quite possibly stored in an Analysis Services cube. However, the scope of the data tends to be more limited. For example, a data mart built from a single data source might be the primary data of interest for team BI.

Team BI solutions can use the same tools that are prevalent in organizational BI. In addition, team BI might also include SharePoint BI, Visio Services, and PowerPivot for SharePoint as additional options for creating and sharing content. Casual users can easily view content produced with any of these tools within SharePoint as part of a dashboard or as individual documents stored in a document library. Power analysts and BI developers typically share responsibility for creating and managing content for team BI.

Let's start by reviewing the three new tools added to the mix, and then we can revisit the other tools to learn how their usage changes when implemented for team BI communities.

SharePoint BI SharePoint Server 2010 includes several features that make it ideal for team BI, especially for teams without much existing infrastructure already in place. In fact, once IT has given a team access to a SharePoint site, power analysts on the team can manage content for consumption by the team BI community with relatively little effort. The ease of implementation translates to simple capabilities, but for teams that are new to BI, these simple capabilities might be all that casual users need.

Another benefit of SharePoint BI is the ability to combine content in a single location from team members who are using different tools. That way, no one is forced into learning a new tool for content creation or investing in the hardware, software, and processes necessary to support even a small data mart before the migration to a new tool or process is absolutely necessary.

To get started quickly, a SharePoint site collection owner can create a specialized site type called Business Intelligence Center. It includes a set of libraries and supports content types specific to BI, such as Excel workbooks and dashboards. It can also store reports if Reporting

Services is configured to run in SharePoint integrated mode. In addition, the Business Intelligence Center includes a special document library for data connections that power analysts and BI developers can use to create new workbooks, reports, Visio diagrams, and PerformancePoint content.

SharePoint BI also includes a special type of SharePoint list for storing status indicators which, as explained earlier in this chapter, are a simple type of KPI. Status indicators are simple enough for business users to use for reporting progress on activities just by updating fixed values manually or by finding a KPI stored in an Analysis Services cube. More adventurous users can also build a status indicator from an Excel workbook or a SharePoint list. It's important to note that these status indicators are really intended as a baby step into the world of performance management. Users can view them only in status indicator lists and dashboards. They can't be reused in any other tool that has a KPI capability.

We've already mentioned SharePoint dashboards as a way to present workbooks, reports, and PerformancePoint components. Dashboards can include all kinds of other content, such as status indicators, Visio Services diagrams, Chart Web Parts, and Filter Web Parts. They're supposed to be simple enough to enable anyone to build a dashboard page, but in reality, power analysts and BI developers are the creators of dashboards.

Chart Web Parts provide a way for more advanced users to display data visually if using a workbook or using Reporting Services isn't an option. It supports only a few data sources, but it can be a quick way to add a chart to a dashboard. The chart can display data from another Web Part on the same dashboard page or from a SharePoint list, a Business Data Catalog, or an Excel workbook. It's not reusable by any other tool.

Filter Web Parts on the dashboard make it easy to customize content on a dashboard page for each user. The same filter value can update multiple Web Parts on the same page. Working with dashboard pages is not difficult when merely adding a group of Web Parts. However, it can be a bit more challenging to configure correctly when attempting to link these Web Parts together for use with a filter, especially if the Web Parts come from different data sources. For this reason, constructing anything but the simplest of dashboards is usually a task assigned to a BI developer.

Visio Services Visio Services provides a whole new to way visualize data. It supports live connections to data sources for use in web-based Visio diagrams that display information ranging from a color-coded status about projects to the current state of processes, to the availability of servers, and so on. Conceptually, the purpose of a Visio diagram is similar to that of a dashboard because it helps business users see trends and outliers at a glance.

Visio diagrams are accessible in a document library or can be added to a SharePoint dashboard by using a Visio Web Access Web Part, so they are just as easy for users to consume as any other content available in SharePoint. Like Excel Services with workbooks, Visio Services

does not require users to have Visio installed on their computers before they can view a diagram published to SharePoint.

The development of Visio diagrams is in the realm of a specialist who understands how to build Visio diagrams and how to connect the data to the diagram properly by using the desktop application Visio 2010. Supported data sources for Visio Services include SQL Server, SharePoint lists, Excel Services, Access, and any source accessible with an OLE DB or ODBC provider. No other tool provides functionality like Visio Services, so the diagrams are not reusable for team BI outside of SharePoint unless the team develops a custom application.

PowerPivot for SharePoint PowerPivot for SharePoint is a service application that relies on Excel Services to execute queries and render PowerPivot for Excel workbooks on demand and includes management capabilities unique to PowerPivot workbooks. It requires a separate installation and configuration process on a SharePoint farm. Its purpose is to provide a link between self-service BI and team BI.

Business users, usually power analysts, can publish their PowerPivot for Excel workbooks to SharePoint, either in a standard document library or in a specialized document library that displays thumbnail images of workbooks to enable users to find the workbook they want without first opening it. Just as with Excel workbooks, administrators and workbook owners can control access and restrict users to online viewing only, thereby protecting the data contained in the workbook.

Beyond enabling the sharing of information with other team members and supporting concurrent access in a scalable environment, PowerPivot for SharePoint has several other benefits for business users. PowerPivot workbooks do not maintain live connections to the data sources, so a periodic refresh is necessary to keep the information as current as possible. PowerPivot for SharePoint can manage the data refresh process on a schedule and send out notifications if a problem occurs. In addition, PowerPivot for SharePoint can become a data source for another PowerPivot workbook, a Reporting Services report, and any other tool that can use Analysis Services as a data source.

PowerPivot for SharePoint has features for IT professionals as well. Often, any information that gets managed by users rather than IT can go undetected. A user might create a report to answer a one-time question, and then, under certain circumstances, the report suddenly can become a mission-critical application that IT knows nothing about. PowerPivot for Excel gives users the freedom to compile information as they see fit, while publishing the results to SharePoint allows IT to use management features in PowerPivot for SharePoint to maintain some oversight over the users' activities. IT can see what data sources are being used, which workbooks are popular, and how many server resources are necessary to render a report for the team community. When appropriate, IT can recommend a proper BI solution to take the place of a PowerPivot workbook.

Excel Services Excel Services can be just as important to a team BI community as it is to an organizational community, if not more so. To support this community and encourage power users to develop content, IT can supply a set of data source connection files in a data connections library.

Reporting Services As with Excel Services, a good strategy for IT (or power analysts) to adopt in support of team BI is to create and publish reusable content that users can access for team content development. In the case of Reporting Services, three types of content support this strategy: shared data sources, shared datasets, and report parts.

Shared datasets contain the query strings necessary to retrieve data from a data source and hide the technical details from the user who can take the dataset and build up a report completely from scratch, using the Report Builder 3.0 authoring tool. This tool is much simpler to use than the report designer used by BI developers, providing enough flexibility and freedom for power analysts to construct a report according to their needs but also providing wizards to guide less-technical users through the process of building simple report layouts.

The use of report parts is another option available to further simplify the report development process for users who might otherwise fall into the category of information user. Report parts, as mentioned earlier in this chapter, are individual elements in a report, such as a map, a chart, or a table, which can be published independently of the original report in which they were created. Report Builder 3.0 includes a Report Part Gallery that users can browse to locate items they would like to include in a report and arrange in any way they like. Everything necessary for the report part to work gets added to the report along with the report part, so the user doesn't need to know how to set up data sources, datasets, or parameters in order to build a report successfully by using report parts. If the user has enough technical skill to create a Word document, that user probably is capable of building a report entirely from report parts.

PerformancePoint Services A team BI community can use PerformancePoint Services for department-focused dashboards and scorecards. As with report parts, an IT professional or a designated power user can construct individual components, such as data sources, KPIs, filters, scorecards, and reports that users can use in a SharePoint dashboard, which would be easier to construct for the more advanced information user or power analyst than a PerformancePoint dashboard.

Self-Service and Personal BI

The whole point of building BI infrastructures that contain a data warehouse, data mart, or Analysis Services cube is to allow users to get information when they need it, on a self-service basis. But in many companies, users still rely on standard reports that have limited interactivity. The reports might have parameters that allow users to filter the reports, or they might allow the users to drill down into more detail. Regardless, these reports are typically built to

answer one question but not necessarily the next question that the user might have. So when these new questions arise, users wind up going back to IT to get those reports.

As an alternative, users start looking outside the approved sources because they need to get information to make decisions. They may get information from wherever they can find it internally; they may get it from external business partners; and maybe they'll find some data on industry trends that they can download from an Internet site. In short, they wind up manually compiling a lot of data. The bottom line is that the data they need for decision-making on a day-to-day basis is not getting integrated into the corporate system, and that's the problem that self-service BI is intended to solve.

Due to the overlap with organizational and team BI communities, we've already touched on the tools commonly used by this community: Excel, PowerPivot for Excel, Report Builder, and Visio. Casual users are more likely to use Excel and Report Builder, while power users may use any of these tools as applicable to the task at hand. A user can use any of these tools to create a document for personal reference or can share the document with a team BI community by publishing it to a SharePoint document library.

How would a user decide which tool to use? Let's review the characteristics of the documents produced by each tool.

Excel Excel is a tool commonly preferred by users of all skill levels for ad hoc reporting and analysis. Users can retrieve data from data sources and combine it with manual data. A user can import data and then manipulate the data by creating charts, sorting, filtering, and applying a wide range of calculations from simple to complex. Casual users might use Excel for simple summing and averaging of data, whereas power users might create complex forecasting models. Power users can also create PivotTables from raw data or from Analysis Services data sources for analysis using aggregate functions to summarize data grouped on rows and columns and using filters and slicers to focus on a subset of data. Although the creation of a PivotTable is generally a task for the power user, a casual user can easily explore a PivotTable that has already been created.

Excel is ubiquitous in many organizations, so most users already have a passing familiarity with this tool. Even if they don't create the workbooks themselves, they can access workbooks from SharePoint and, as long as they have the right permissions, download workbooks for personal use. Then they can apply calculations, filter the data, and make other changes to the data without affecting the original workbook.

PowerPivot for Excel As flexible as Excel can be, it can also be a challenge to combine data from multiple data sources for analysis and to keep the data refreshed. That's where PowerPivot for Excel comes in. It can also use reports as one of its data sources. As another plus, PowerPivot can handle much more data than Excel. Like standard Excel, it's good for interactive exploration of data.

Users don't need to understand relationships between tables created by drawing together data from disparate sources, and PowerPivot can recommend relationships based on its analysis of the contents of data from each source. Calculations can be added by using Data Analysis Expressions (DAX), as described in Chapter 5, "PowerPivot for Excel and SharePoint." This language is Excel-like, which makes it easier for users to create calculations if they're already comfortable with Excel functions. PowerPivot for Excel does make self-service BI easier, but primarily for power users. Casual users benefit most from PowerPivot for Excel when power users publish workbooks to SharePoint.

Report Builder Report Builder is a desirable tool for users who want to produce a specific type of report layout and also want to store reports in a centralized location, whether for personal use or for sharing with others. Even if a user creates a report for personal consumption, the user can subscribe to the report to receive a report with fresh data on a regular schedule.

Visio Visio is the only tool that provides data-driven diagrams. Of all the self-service BI tools, Visio is least likely to be used for personal consumption. For example, if a user is monitoring the status of a process, it's easier to build a simple report by using one of the other tools. It's more likely that a power user or BI developer will use Visio to create diagrams to publish to SharePoint for sharing with a team BI community.

The Progression of BI

The Microsoft vision for BI can be summarized simply as the delivery of the right information at the right time in the right format to users at all levels of a company. It's a noble goal, and the Microsoft tools can indeed help companies attain this goal, but not from day one. Instead, the democratization of BI across the organization occurs incrementally. The length of time required depends on many factors, such as the corporate culture overall, management's attitude towards BI, and a support system for users, among others.

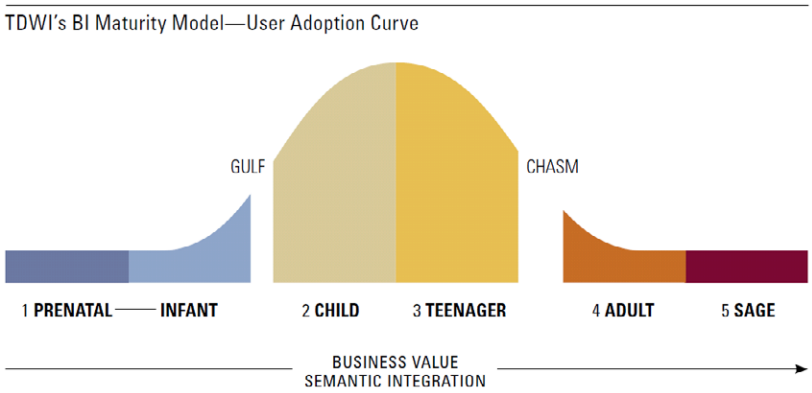
An understanding of the typical progression that many companies experience as they expand their use of BI can help in many ways. It can affirm that your company is moving in the right direction, and it can also show you the possibilities that remain for further progression. It can also help you determine which tools are best suited for your current stage and help you prepare for the next.

BI Maturity Model

Wayne Eckerson developed the Business Intelligence Maturity Model for The Data Warehousing Institute™ (TDWI) as a means for organizations to benchmark their deployments against other companies. At a high level, the model identifies six stages that mark the progression of BI from a cost center to a strategic asset. As shown in the following illustration, by

plotting the typical user adoption rate along the six stages of the model, Eckerson's research revealed a bell curve in most organizations in stages 2 and 3. It's important to understand that companies don't necessarily follow a linear progression from stages 0 to 5. Stages often overlap, and the length of time that a company remains in a particular stage can vary.

Note You can download a poster illustrating the Business Intelligence Maturity Model from *http://tdwi.org/pages/posters/business-intelligence-maturity-model.aspx*. You can also use TDWI's online assessment tool to benchmark your company's BI maturity by completing the survey at *http://tdwi.org/pages/assessments/benchmark-your-bi-maturity-with-tdwis-new-assessment-tool.aspx*.



Notable aspects of the model are the Gulf and the Chasm, which highlight the reality that BI implementations are not likely to proceed smoothly from one stage to another. As Eckerson discussed these findings with BI implementers, he discovered that the inclusion of these two obstacles in the model validated their experience that setbacks in BI implementations and flagging enthusiasm for pursuing pervasive BI are a normal part of the process. Perseverance pays off for teams that can stay focused on the steps necessary to expand the capabilities of their BI infrastructure.

Even within the same company, it's very likely that each department will mature at different rates. That's okay. The good news is that wherever people are, they have tools to support them, they can transition to higher levels of maturity over time, and the tools can adapt accordingly. Each successive step in the maturation process translates into greater business value.

In this section, we provide an overview of the characteristics of each stage of the BI Maturity Model and describe the tools that are useful in each stage.

Stage 0: Prenatal

In the prenatal stage, a company has yet to create a data warehouse to support information requirements. Instead, all reports are sourced from operational systems, with no consolidation of information across systems without special processes in place. That is, there are no formal Extract, Transform, and Load (ETL) processes. Financial applications often have the richest set of reports available in the company and are the primary source for management reports. At this point, the available reports are static and focus on historical events to help users understand what has happened. Any changes desired by users require customization by IT, but it's not uncommon for such requests to take weeks or months to fulfill.

To transition from the rigid reporting system typical of this stage to a formal BI solution, many companies start by reproducing their existing reports in Reporting Services. Although the problems associated with responding to requests for customization don't go away, with some forethought, parameterization of reports can enable users to make changes to the report content, which in some cases might forestall the need for one-off report development.

Stage 1: Infant

When users can't get what they need from the operational reports, they often develop their own solutions, which leads to a proliferation of reports based on spreadsheets or Microsoft Access databases that users have cobbled together. Such user-developed data collections are also described as spreadmarts, shadow systems, or skunkworks projects.

Executives often enlist analysts to compile briefing books based on these informal data collections. The focus begins to shift from trying to understand what has happened in the past to attempting to understand how past results might influence what happens in the future.

What starts as a compilation of official data for a specific need can grow into a mission-critical solution that people come to rely on, yet it's unmanaged, unsecured, and unauditable. It can take a lot of manual labor to gather and manipulate the data, leaving little time to analyze the data collected before a decision from the user is required. The concern of each user in this stage is to produce information that supports personal decision-making. Little regard is given to reconciling results with other users producing comparable information, and no official system of record exists to resolve results that disagree.

In this stage, Excel and Access are popular tools. For organizations that have yet to implement a formal BI environment, PowerPivot for Excel can simplify the effort of gathering and integrating data. But it doesn't solve the more serious problem resulting from a lack of IT oversight.

The Gulf

The Gulf is the first obstacle that must be overcome before moving into real BI. Prior to this obstacle, executives likely view any efforts to promote BI as just another variation of operational reporting. To progress, they need to understand how BI is necessary to improved business processes and decision-making at all levels of the organization. According to an Aberdeen Group study, one of the benefits of a collaborative BI environment is a 30 percent improvement in business processes as compared to other companies without such an environment. Executive support is critical to experiencing similar improvements.

Users need to understand how the next step in the BI progression can shift their workload from mundane data-gathering tasks to analysis tasks that are much more valuable in the long run to employers. If users remain unconvinced, a company can get stuck in the Gulf. Even after crossing the Gulf, companies find that spreadmarts are difficult to completely eradicate and often persist through into the Teenager stage.

To successfully cross the Gulf, BI developers should take an iterative and incremental approach, focusing on small projects that are easier to implement rather than trying to build a solution to be all things to all people. Ideally, the first effort should focus on a single source system that contains well-understood data sources. Frequent prototype reviews with users can help the team stay focused on the requirements of this first official BI project. BI developers must remain diligent to counteract scope-creep as user requests continue to outpace IT's ability to deliver new information.

Fortunately, the Microsoft platform can help here. It's very easy to prototype and develop solutions from those prototypes in an iterative fashion, working closely with the user community to get it right. One option is to build prototypes with Analysis Services to build a model and then use Excel to validate it with users. Another option is to let users model their data the way they want to see it using PowerPivot for Excel. In the latter case, IT can take the design and reproduce it in Analysis Services.

Stage 2: Child

At last, the company begins to demonstrate progress with BI, with the first project typically focused on a single subject area. Most companies in this stage have no previous experience with managing BI projects, so the early projects focus on building a data mart without attempting to align metrics with corporate objectives.

The novelty of BI in this stage can generate excitement among users, who are motivated to abandon their labor-intensive past for the new and improved way of finding answers to their questions. Power users who understand the business well can learn the new tools quickly so that they can drill into trends over time, to determine why things happened the way they did.

If an organization has yet to start with Reporting Services, this stage is a common place to introduce it to users. The first set of reports is usually based on department-level standard reports developed in earlier stages with parameterization and drilldown capabilities built in to enable casual users to successfully explore the data. Behind the scenes, the BI team builds a data mart and possibly an Analysis Services cube as data sources for these reports.

To support the ad hoc analysis requirements of power users, the BI team gives users access to cubes using Excel. In addition, these users continue to use PowerPivot for Excel to get answers to questions that can't be answered by the data mart.

Stage 3: Teenager

Having successfully implemented BI at a department level during the Child stage, many companies next take steps in an attempt to prevent each department from setting up its own data mart. In the Teenager stage, the company establishes a formal data warehouse not only to consolidate resources but also to bring consistency to BI processes and company metrics. By adding experienced BI practitioners to the team or by engaging consultants, the company begins to formalize BI across departments and to adopt best practices.

During this stage, the BI solution grows to accommodate more casual users, but this growth also results in an increased demand for standard parameterized reports that can be filtered and dashboards that can be tailored to specific audiences. Also during this stage, the use of BI expands to include KPIs to help management monitor progress towards goals.

Reporting Services continues to be a dominant technology in this stage, with greater emphasis on developing reports that can be used in multiple ways by the addition of parameters, including filters that tailor information to the user. Team BI communities also begin to emerge, with power users publishing shared datasets and report parts that enable casual users to build their own versions of reports. To promote collaboration, the BI solution expands to include the use of SharePoint for dashboards and possibly PerformancePoint Services for scorecards.

The Chasm

Unfortunately, the Chasm is a more challenging obstacle to cross than the Gulf. If the problem of spreadmarts and independent data marts across the company have not been addressed by this point, the next step in the maturation process might be exceedingly difficult to obtain. Any change in the company's business strategy can also pose problems for the BI team, but ironically, that's when the organization needs BI most of all.

To successfully move to the next stage, developing a flexible architecture for the company's BI solutions is mandatory. As difficult as it might be, the company must commit a key group of users to the development of a common glossary for terms and calculations used in reports, workbooks, and other BI-related documents. Support from the top down is necessary. One

characteristic of the Chasm is the inevitable struggle between team BI and organizational BI communities. In the end, corporate IT standards must prevail so that the departmental BI systems can properly align at the corporate level.

During this stage, self-service BI is perceived to be the goal by many users, but over-reliance on this approach to information management can lead to chaos, with unmanaged reports proliferating throughout the company. Reports developed by one person might be useful to another, but if that other user can't find what they need, time is wasted to develop a duplicate report.

To counteract this type of problem, the BI team needs to focus on building datasets, interactive reports, report parts, and dashboards that address the range of broad questions that users ask regularly. In particular, this is the very type of problem that the self-service BI features in Reporting Services and PowerPivot for SharePoint are intended to solve. These tools can be introduced during the Teenager stage, but they can't solve the unification problem, which is typically not a technical challenge but an organizational behavior challenge.

Stage 4: Adult

When a company can successfully define standards, a common set of terms, and consistent rules, it's ready to develop an enterprise data warehouse and move to the Adult stage, which yields several significant advancements in BI capabilities. The enterprise data warehouse transitions the use of BI from the support of departmental objectives to the support of organizational objectives. Performance management expands beyond the use of dashboards for monitoring processes to include scorecards that enable individuals to see how their respective decisions impact corporate performance.

The addition of real-time data feeds, as well as forecasting and modeling tools, enables users not only to analyze the past to better understand what happened but also to apply that knowledge to the current situation and to anticipate the future. This maturation of BI capabilities enables proactive management of the company based on predictive analytics as an alternative to the reactive management approach in earlier stages in which only historical analysis was possible.

Furthermore, the flexibility previously missing in the BI solution architecture finally arrives. Abstraction layers insulate users from changes to the underlying system as alignment of sources continues to occur. Users can now repurpose data and reports to suit their needs rather than wait for BI developers to respond to a new report request.

The Microsoft platform continues to support the BI requirements of a company in the Adult stage. The BI team can roll out PerformancePoint Services, if it hasn't already been implemented in an earlier stage, in support of the new performance management activities. In addition, Analysis Services supports the development of forecasting models, the results of which can be accessed in any of the self-service BI tools.

In terms of tool usage, most of the time casual users still want prepackaged content to monitor events or conditions relevant to their daily tasks. This can be accomplished through dashboards presenting a combination of scorecards, reports, and Excel workbooks. Each of these tools can present a view of the current state, support filtering to allow the user to focus on particular items of interest, and provide the ability to drill down to more detail. The enterprise search capability in SharePoint provides these users with another way to find relevant content. If users still need to create something themselves, they can use Report Builder to create data mash-ups from reusable components in Reporting Services, SharePoint lists, and PowerPivot workbooks published to SharePoint.

Stage 5: Sage

In the final stage, companies establish a BI center of excellence to promote and sustain best practices for the current platform, to support user adoption, and to drive innovation. Rather than maintain the centralized management of BI that emerged in the Adult stage, the company allows departments to assume control once again over BI processes with the mandate that these departmental-level projects adhere to the standards and best practices defined at the corporate level.

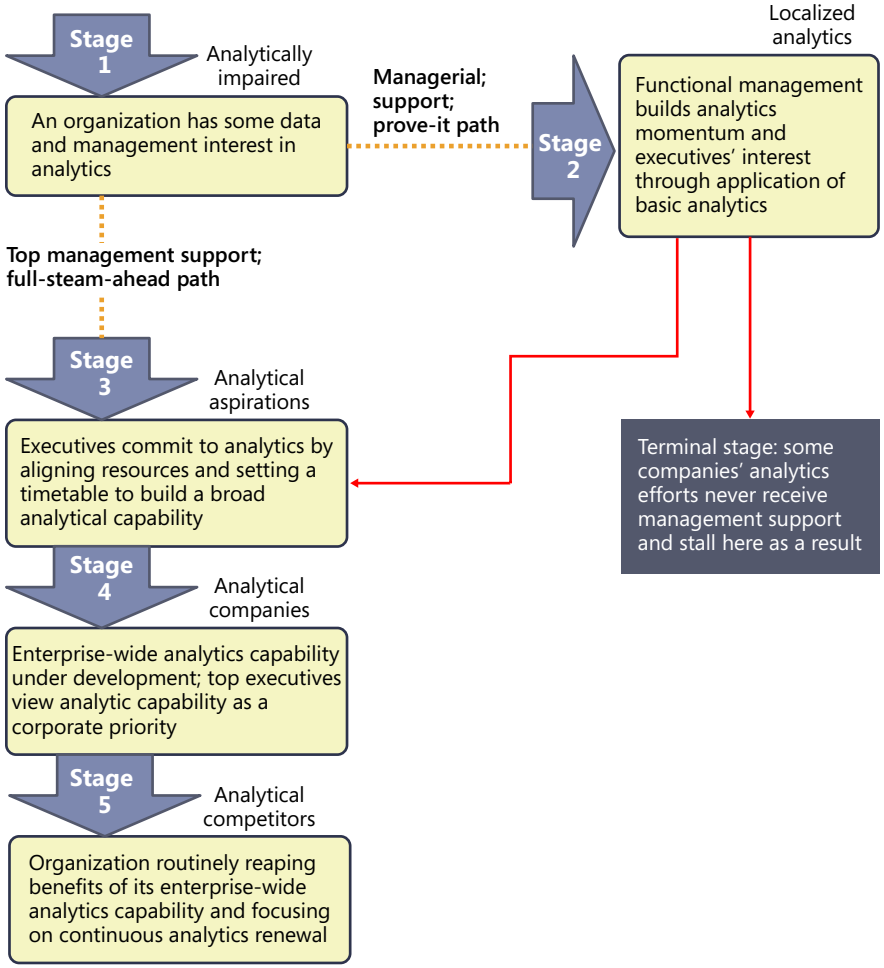
BI becomes a strategic asset in this stage as well and transitions to a service-oriented architecture. Developers can then use web services to embed BI into line-of-business applications. The provision of BI to external stakeholders can also become a revenue stream for the company. When this happens, the company continues to make large investments in BI to ensure high levels of service to the external stakeholders.

The entire Microsoft BI stack is in use by the time a company reaches this stage. In addition, the Microsoft platform is fully extensible. Developers can use APIs for any tool in the stack to enable customization at every point of the information management process and can embed that customization into applications. Even without customization and with no additional configuration necessary, Reporting Services can provide data feeds as a service to enable a company to surface data from cubes, mining models, or relational data warehouses.

Road Map to Analytical Competition

Another way to view the progression of BI is provided by a road map developed by Thomas H. Davenport and Jeanne G. Harris in their book *Competing on Analytics: The New Science of Winning*. The purpose of this road map is to provide a realistic view of the stages a company often experiences in its quest to derive value from analytics and to outline a strategy for successfully transitioning to higher stages. As shown in the following illustration, the analytics road map proposed by Davenport and Harris consists of five stages that follow a progression similar to the one in the maturity model described in the previous section, but one that's more compressed and leads to a more specific outcome. Whereas the maturity model views

the end state for BI as a pervasive technology and potential revenue stream, the road map assumes that the goal for BI is to produce a distinct competitive advantage.



Stage 1: Analytically Impaired

In the first stage, operational data is not ready for analysis. Reporting directly from operational data is fraught with problems and suffers from data quality issues. To progress to the next stage, management needs to be convinced that better decision-making results from access to better data. Meanwhile, some technically savvy business users begin compiling data for personal analysis. Excel is often the tool of choice at this stage.

Stage 2: Localized Analytics

The work begun by the independent analysts begins to show promise in this stage as they develop new insights that have value for the company. One of two things happens at this point: Either executive management agrees that it's time to start formally investing in BI, and the company moves to the next stage, or management remains unconvinced and needs more evidence of successful outcomes from analysis before making the commitment.

As a result, the focus of this stage is to gradually build out a BI infrastructure at a local level with minimal investment, such as a department-level single-subject data mart. Despite the lack of support from executive management, the BI team can use this stage to develop experience before tackling the more comprehensive projects in the next stage. In addition, the department making the investment in BI benefits from the business process improvements resulting from the better analytical capabilities. According to the analytics road map, a company could be in this stage from one to three years.

The BI components in the Microsoft stack are a good starting point for a department-level data mart that could also include a complementary cube to support analysis. Reporting Services can deliver standard reports to department users and provide data feeds for power users to use in PowerPivot for Excel for deeper analysis.

Stage 3: Analytical Aspirations

When a company is ready to commit to analytics at the corporate level, the focus shifts from the tactical BI solutions found at the department level to a company-wide performance management solution. The challenge at this stage is the integration of various tools and processes implemented across departments and to reach agreement regarding the metrics against which to measure progress. In general, the road map indicates the length of time for this stage can be a few months or up to two years.

In this stage, the Microsoft stack scales from a departmental deployment to an enterprise deployment. The Reporting Services platform remains in place for broad distribution of standard reports. SharePoint and PerformancePoint Services now become tools for monitoring and reporting performance management results. Power users can also now share PowerPivot for Excel workbooks by publishing them to SharePoint and thereby promote collaborative analysis.

Stage 4: Analytical Companies

To move into this stage, the company must establish analytics as a priority and the corporate culture must support an ongoing process of experimentation. Management encourages analysts to develop and test hypotheses and to discover new areas worth exploring. The purpose of analytics in this stage is to discover how to use information assets to differentiate the company from its competitors in the marketplace. During this stage, the tools for analysis become more advanced and developers are tasked with embedding analytics into business processes.

Here the BI team can exploit the full range of capabilities in the Microsoft BI stack, including the data mining features in Analysis Services. In addition, developers can integrate BI into the line-of-business applications.

Stage 5: Analytical Competitors

At this stage, analytics aren't just helping management run the company better, as evidenced by strong financial performance, but the insights derived from analytics also create a competitive advantage in the marketplace. The use of BI is now widespread across the company and executive management is fully committed to continued investment in BI technologies.

Additional tools are not a major factor in this stage. Instead, the implementation of the Microsoft tools in earlier stages can help foster an environment that enables business users at all levels of the organization to find the right information at the right time.

Tool Selection

Throughout this chapter, we've identified various characteristics of the user tools, including their appropriateness for different types of users and the suggested level of BI maturity at which each tool can be adopted. We've also pointed out some of the advantages and disadvantages of each tool to help you understand the implications of selecting a tool before you get started on a project. Now we'll summarize this information and provide some additional pointers so that you have a quick reference for all the tools in one convenient location.

The table that follows provides a summary of the tools, with a breakdown of the primary user of each tool by business user community and by BI community. Additionally, the table identifies whether the business user (who can be either a casual user or a power analyst), the power analyst, or the BI developer is responsible for creating content with the tool. Last, the table identifies where the content for the tool can be reused.

Tool	BI community	Content author	Reusability
Excel	Self-service and Personal BI	Business User	■ Excel Services ■ SharePoint BI ■ PerformancePoint Services
PowerPivot for Excel	Self-service and Personal BI	Business User	PowerPivot for SharePoint
Excel Services	■ Team BI ■ Organizational BI	Business User	■ SharePoint BI ■ PerformancePoint Services ■ Customized applications
PowerPivot for SharePoint	Team BI	Business User	■ Excel ■ Report Builder ■ SharePoint BI ■ PerformancePoint Services ■ Customized applications ■ Any tool that connects to Analysis Services
Report Builder (Reporting Services)	■ Self-service and Personal BI ■ Team BI	Business User	■ PowerPivot for Excel ■ SharePoint BI ■ PerformancePoint Services ■ Customized applications
Report Designer (Reporting Services)	■ Team BI ■ Organizational BI	BI Developer	■ PowerPivot for Excel ■ SharePoint BI ■ PerformancePoint Services ■ Customized applications
SharePoint BI	Team BI	■ BI Developer ■ Power User	Content not reusable in other tools
PerformancePoint Services	■ Team BI ■ Organizational BI	■ BI Developer ■ Power User	■ SharePoint BI ■ Customized applications
Visio	Self-service and Personal BI	BI Developer	Visio Services
Visio Services	Team BI	BI Developer	■ SharePoint BI ■ Customized applications

Note In the Content Author column in the preceding table, the BI Developer is omitted in some rows but can often be the primary content author with the respective tool. We've elected to identify the BI Developer in this table only when the BI Developer is most likely to have the primary role for creating the content.

Excel

Excel is a very popular tool, and many, if not most, analysts are already using it. Excel is familiar even to casual users and for this reason gets used for everything from simple To Do lists to complex financial analysis.

Use this tool to:

- Retrieve data from a source without having query language skills.
- Analyze data (that is, group, filter, drill down) containing fewer than one million records.
- Create pivot tables and charts with limited formatting options.
- Apply complex calculations to data.
- Publish workbooks to Excel Services to share insights.
- Store data for use in SharePoint:
  - Status indicator
  - Chart Web Part
  - Visio Web Drawing
  - PerformancePoint Services KPI or filter
  - Component in a SharePoint or PerformancePoint Services dashboard

PowerPivot for Excel

PowerPivot for Excel provides power users with a tool that uses familiar Excel features while supporting more advanced analysis.

Use this tool to:

- Analyze small or large amounts of data (millions of records).
- Integrate multiple data sources when no data mart exists or when analysis needs to incorporate data not found in the data warehouse.
- Create pivot tables and charts with limited formatting options.
- Apply complex calculations to data.

- Reproduce the analytical capabilities that Analysis Services supports without waiting for IT to build a cube.
- Publish workbooks to PowerPivot for SharePoint to share insights.
- Store data for use in SharePoint:
  - Status indicator
  - Chart Web Part
  - Visio Web Drawing
  - PerformancePoint Services KPI or filter
  - Component in a SharePoint or PerformancePoint Services dashboard

Chapter 5, "PowerPivot for Excel and SharePoint," provides more information about using this tool.

Excel Services

Excel Services is a SharePoint service application that enables users to share Excel workbooks in a secure, centralized location. The interface is simple for casual users to find and access information.

Use this tool to:

- Enable users to share large workbooks outside of email, even to users who don't have Excel installed.
- Display data in a dashboard-like layout using a familiar interface.
- Provide casual users with collaborative workbook editing and limited analysis capabilities in a browser environment.
- Protect intellectual property in Excel workbooks.
- Embed complex calculation capabilities in custom applications.

You can learn more about this tool in Chapter 4, "Excel Services."

PowerPivot for SharePoint

PowerPivot for SharePoint is another SharePoint service application that uses Excel Services to display PowerPivot for Excel workbooks and provides management oversight of activity related to these workbooks. Because PowerPivot for SharePoint relies on Excel Services, the familiar, simplified interface helps casual users interact easily with the workbooks and to use the workbooks as a data source using self-service BI tools such as Report Builder or Excel.

Use this tool to:

- Enable users to work collaboratively on analytical data compiled in a PowerPivot for Excel workbook.
- Automate the process of refreshing the data sources in a workbook.
- Provide users with a data source for self-service BI tools.
- Discover data sources used in workbooks and monitor workbook usage.

Refer to Chapter 5 to learn how to work with PowerPivot for SharePoint.

Reporting Services

Reporting Services is the best option for delivering standard report content to a wide audience either online or via email. When integrated with SharePoint, it relies on the same storage and security mechanisms but retains all the features available in native mode.

Casual users can easily access reports and, in some cases, might build their own reports. Power users can participate in the content development process.

Casual users can use Report Builder 3.0 to:

- Build reports from published report parts using drag-and-drop.
- Build reports from shared datasets (with no need to know the query details) and design a simple table, matrix, or chart by using a wizard.
- Apply basic formatting to a report.

Power users can use Report Builder 3.0 to perform the same tasks as casual users and to:

- Connect to data sources and create queries to retrieve data for a report.
- Create and publish shared datasets and report parts for use by casual users.
- Build reports using any of the same features supported in the Report Designer available in Business Intelligence Development Studio:
  - Pixel-perfect layout of table, matrix, list, or chart objects
  - Design for online viewing or print format
  - Geospatial mapping
  - Interactive features–sort, filter, drill down, drill through, document maps, tooltips
- Provide a data source of PowerPivot for Excel.

- Create an entire dashboard layout, displaying data from multiple sources on a single page when the following characteristics are desired:
  - Fine control over the appearance
  - Interactive features already available in Reporting Services
  - Distribution of dashboard in print or other formats
  - Support for subscriptions
- Create content with a specific layout or interactive features for use in a SharePoint or PerformancePoint Services dashboard or in a custom application.

BI developers can use Report Designer to perform the same tasks as power users. However, although Report Designer allows the BI developer to publish report parts, it does not provide access to published report parts to use when designing a new report. Report Designer also allows the Report Developer to work with multiple reports in the same session, whereas Report Builder allows users to work with only one report at a time.

Report consumers can access reports in SharePoint to:

- View and interact with a report online.
- Export a report to a variety of formats, including data feeds.
- Subscribe to a report for scheduled delivery by email or to a network file share.

SharePoint BI

SharePoint BI accommodates a variety of sources, which allows power users or BI developers to consolidate information in a single location even when a formal BI implementation is not yet in place and to change out content when the company eventually develops a data warehouse or Analysis Services cube.

Use this tool to:

- Set up status indicators to track performance using a simple interface and optionally to add to a dashboard.
- Develop Chart Web Parts to add data visualization to a dashboard if other tools are not preferred.
- Build a simple dashboard to display, and optionally filter, information from multiple sources on a single page (such as workbooks, reports, Visio Web Drawings, PerformancePoint Services content, and other content types).

Chapter 8, "Bringing It All Together," provides more information about working with SharePoint's BI features.

PerformancePoint Services

PerformancePoint Services is yet another SharePoint service application that supports the development of content types used in performance-management solutions that users access in SharePoint. BI developers typically produce the complete solutions using the Dashboard Designer tool, although power users might also use this stool to contribute content.

Use this tool to:

- Create data sources for use when developing KPIs, scorecards, reports, and filters.
- Develop both simple and advanced KPIs.
- Create scorecards to display KPIs in asymmetrical or hierarchical structures for use in either a SharePoint or a PerformancePoint dashboard.
- Build an analytic grid report or analytic chart report to support browser-based interactive pivoting, drilling, and filtering of data in an Analysis Services cube.
- Provide access to the decomposition tree visualization by creating a scorecard, analytic grid report, or analytic chart report.
- Build a strategy map as a supplement to a scorecard to illustrate relationships between objectives, goals, and KPIs.
- Design filters to use in a SharePoint or PerformancePoint Services dashboard.
- Develop a dashboard containing one or more pages by using PerformancePoint content types (scorecard, strategy map, analytic reports, and filters).

For more details, see Chapter 7, "PerformancePoint Services."

Visio Services

Visio Services is the final SharePoint service application that we cover in this book. It enables users to securely share Visio diagrams for viewing in a browser. Because designing data-driven Visio diagrams requires a solid understanding of Visio and the data sources, BI developers most likely will be responsible for content development rather than users.

Use Visio 2010 to:

- Produce web diagrams, optionally linked to a data source, to illustrate a business process, condition, or other scenario.
- Build a PivotDiagram as a data-visualization tool for hierarchical data.

Use Visio Services to:

- Enable users to share Visio diagrams with users who don't have Visio installed.
- Embed diagrams in custom applications.

See Chapter 6, "Visio and Visio Services," to learn more about these tools.

Summary

The goal of this chapter is to describe how the various BI tools can work separately or together in different scenarios, for different user communities, and at different stages of maturity with BI capabilities. Don't be overly concerned if you or business users in your company want to start using a certain tool before the maturity model or road map says you're ready for that stage. The whole point of BI is to empower users to access information in any way possible. Just make sure that users aren't trying to use a tool that requires greater technical skills than they possess. If they're willing to learn, support them in their efforts, but don't turn them loose without support, because they might simply give up on all BI out of frustration. For the same reason, don't implement a tool if the necessary infrastructure isn't yet in place or if it doesn't provide the specific functionality that you need. At this point, you should have a better understanding of how the tools available in the Microsoft BI stack work together to support your goals for delivering information to users at all levels of your company, and you should feel better prepared to select a tool. The next chapter explains what you need to do to establish the back-end infrastructure to better support many of these tools.

Chapter 5

PowerPivot for Excel and SharePoint

After completing this chapter, you will be able to

- Understand PowerPivot for Excel and PowerPivot for SharePoint.
- Understand how PowerPivot extends Excel functionality with Data Analysis Expressions.
- Create PowerPivot workbooks in Excel 2010.
- Publish PowerPivot workbooks to SharePoint 2010.
- Set up a periodic data refresh to a PowerPivot-enabled workbook in SharePoint 2010.

Introduction

As explained in Chapter 1, "Business Intelligence in SharePoint," you can understand business intelligence (BI) as activities and practices that use fact-based support systems to improve the business decision-making process. Traditionally, those fact-based support systems have often been data-driven analytics and reporting tools developed by database administrators (DBAs) and developers, such as standard reports, scorecards, and applications.

Clearly, the DBAs and developers from an IT department cannot handle all that demand. An IT department has only so many resources and must focus on the most important projects. It's likely that IT has been able to satisfy only a small fraction of the BI demand.

So, what happens with all that demand that does not make it onto IT's plate? Usually, those projects get done without involving IT at all. The users cobble up solutions themselves—and they can do a good job if they use the right tools. In other words, they are already performing self-service BI. Self-service BI is a way for business users to easily access the data that they need to create the necessary reports and analysis themselves, without involving IT personnel at their company.

While many tools exist that business or information workers can reach for to help meet their BI needs, it's Microsoft Excel that they use most often. A large number of today's business decisions are based on information stored in Excel workbooks. Unfortunately, this popular approach has a few caveats:

- It's fairly common to share those workbooks by email or in a file share. This can potentially raise security issues.
- It's hard to ensure that everybody working with a given workbook is using the same version, because access to such files is rarely monitored or controlled.

- Refreshing existing workbooks with new data can be a lot of work—and potentially, it's work that should be done often.
- Many times the data sources for those workbooks can be used without IT's knowledge.

As a consequence, a natural—and inevitable—tension exists between users, who want to get things done quickly, and the IT department, which wants control. There is nothing wrong with either side's approach; that's just how things are.

To address the needs from the business users, while simultaneously keeping the needs of the IT department in mind, Microsoft developed PowerPivot for Excel and PowerPivot for SharePoint. Together, these applications represent Microsoft's implementation of self-service Business Intelligence.

PowerPivot may not solve all the problems, but it is paradigm shift that gives powerful BI capabilities to business analysts that they can develop themselves. Here are a few such capabilities that PowerPivot brings to the table:

- Adding more powerful tools for the users in Excel Tasks that used to take hours now take only minutes (or even seconds), and some tasks that were simply impossible are now possible. For example, PowerPivot makes it possible to work with millions of rows in an Excel workbook.
- Scheduled, automatic report refresh You can configure the workbooks to refresh automatically and periodically without human intervention.
- Transparency for IT After a workbook has been published to a SharePoint location, everything happens within the realm of IT. That way, IT controls the security of the workbooks through SharePoint, can control which data sources are being used by the PowerPivot workbooks, and can learn which workbooks are actually being used and by whom, and so on.

PowerPivot for Excel is an add-in for Microsoft Excel 2010. It includes a modified version of the SQL Server Analysis Services engine. It plugs this powerful and fast data-crunching engine into Excel, greatly enhancing the capabilities of the most-used client available. Instead of dimensional modeling, users work with tables. Instead of Multidimensional Expressions (MDX) queries, users work with Data Analysis Expressions (DAX), a language that resembles Excel's Formulas language.

Note MDX is a powerful and complex query language for OLAP databases.

Similarly, PowerPivot for SharePoint integrates the SQL Server Analysis Services 2008 R2 engine with SharePoint 2010. PowerPivot for SharePoint gives users the ability to securely share, manage, and refresh workbooks stored in SharePoint, while giving IT the control necessary for managing security and learning about workbook usage.

A Brief History of PowerPivot

PowerPivot's history started with two internal Microsoft papers by Amir Netz in 2006, who was then an Architect in the SQL Server Analysis Team.

The first paper introduced the concept of a BI "sandbox," which was conceived as a product that would allow BI applications to be created in a much easier way—in a controlled environment that would include relational databases, multidimensional databases, and a reporting tool. While the paper helped to shape PowerPivot from concept to product, many of the original ideas changed. For example, in the original paper, Microsoft Access was the client application, not Excel, but nevertheless, many of Netz's ideas formed the essence of PowerPivot.

The second paper was about an in-memory BI engine. The business idea was to take advantage of the market trends in computer hardware (such as reduced RAM prices and increased adoption of multi-core processors) that would allow this in-memory engine to be feasible. In fact, the in-memory engine would make some of the ideas in the first paper possible.

Eventually, Microsoft created a small incubation team to explore the ideas in the papers. This incubation team spent the SQL Server 2008 R2 development cycle writing specifications, plans, code, and tests for the product that eventually became PowerPivot. PowerPivot for Excel 2010 and PowerPivot for SharePoint, currently in their first version, were released in May 2010 as part of the Microsoft SQL Server 2008 R2 release.

When Do I Use PowerPivot for Excel?

If you are considering using Excel 2010 to crunch data, you should use PowerPivot. It is a free download. PowerPivot for Excel enhances Excel's capabilities in many different ways:

- It provides the ability to work with complex data in a relational way, using tables.
- It uses the in-memory Analysis Services Engine, the VertiPaq engine, to work with huge amounts of data without the limitations of Excel.
- It offers many ways to acquire data. You can gather data from many different data sources—from relational databases such as SQL Server, Oracle, Teradata, cubes in SQL Server Analysis Services, text files, and data feeds, and you can even copy and paste! This data is then embedded into the workbook.
- It provides an easy way to work with the data embedded in the workbook by using DAX, which is a powerful expression language to define calculations. DAX is designed to be similar to Excel formulas, for ease of use, but adds greater processing power that can work with large amounts of data.

Note Appendix B, "DAX Function Reference," provides a list of DAX functions, along with brief explanations of each.

When Do I Use PowerPivot for SharePoint?

After you have created PowerPivot workbooks by using your desktop Excel application, you'll probably want to:

- Share them with other users in a secure and reliable way
- Refresh them periodically and automatically
- Make sure that all the workbook's users see its most current version
- Turn your workbook into a web-based BI application, viewing and interacting with it in the browser
- Empower the IT professionals with tools to assist with the management of the PowerPivot workbooks

PowerPivot for SharePoint is designed to meet the requirements of all the preceding scenarios, giving you a way to share, refresh, and update workbooks in a secure way that adheres to IT security policies while enabling users to interact with the content of the workbooks from their browsers.

Getting Started

PowerPivot for Excel 2010 is a managed Excel add-in that is part of the SQL Server 2008 R2 release. Microsoft offers it as a free download, available at *http://www.powerpivot.com/download.aspx*.

Installing PowerPivot for Excel

Starting with the 2010 release, Excel comes in two versions: a 32-bit version and a new 64-bit version. PowerPivot also comes in 32-bit and 64-bit versions—and your versions should match. So if you are using the 32-bit version of Excel, you should install the 32-bit version of PowerPivot, and if you are using the 64-bit version of Excel, install the 64-bit version of PowerPivot.

Note If you are working with large amounts of data, you should use the 64-bit version. The 32-bit version is limited to 2 GB of memory for Excel processes, and because PowerPivot runs within the Excel process, it would actually have somewhat less than 2 GB of available memory. The memory limit of the 64-bit version of both Excel and PowerPivot is essentially all the memory available on your computer.

To get started with PowerPivot and the examples in this chapter, perform the steps in the following procedure.

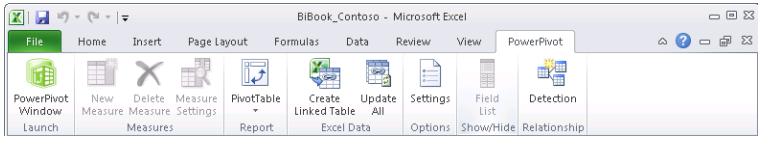
To get started with PowerPivot

1. Install Excel 2010 from the Office suite along with the Office Shared Features. The Office Shared Features include Visual Studio Tools for Office (VSTO) 4.0, which is a pre-requisite for using PowerPivot for Excel.
2. Download and install PowerPivot for Excel, available at *http://go.microsoft.com/fwlink/?LinkId=207852*.
3. Install SQL Server 2008 R2. You can use an existing SQL Server 2008 or 2008 R2 instance.

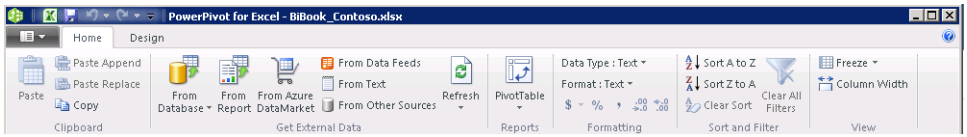
Note This is only needed to use the PowerPivot for SharePoint examples.

4. For the examples in this chapter, you will use the relational database from the "Microsoft Contoso BI Demo Dataset Retail Industry." You can download the Contoso sample database (ContosoBIDemoBAK.exe) from *http://go.microsoft.com/fwlink/?LinkId=214637*. After downloading the file, run it to extract the relational back-up file.
5. Open SQL Server Management Studio and connect to your SQL Server 2008 instance, and then restore the Contoso relational backup database that you downloaded and extracted in the preceding step.

After you have installed both Microsoft Excel 2010 and PowerPivot for Excel, you'll see a new PowerPivot tab on the Excel ribbon, as shown in the following illustration.



On the PowerPivot tab, click PowerPivot Window. A new window opens with the PowerPivot ribbon, as shown in the following illustration. Using the PowerPivot window, you can import data from various sources, manage relationships, filter, and create calculated columns with DAX.



Installing PowerPivot for SharePoint

PowerPivot for SharePoint must be installed by an IT professional because the installation requires administrative access to servers. Installing PowerPivot for SharePoint is potentially a very complex task, depending on the configuration of your SharePoint farm. Fortunately, some good white papers have been published, which describe the setup process in detail. These include:

- "PowerPivot for SharePoint—Single Server Installation" (*http://msdn.microsoft.com/en-us/library/ff963565.aspx*)
- "PowerPivot for SharePoint—Existing Farm Installation" (*http://msdn.microsoft.com/en-us/library/gg144594.aspx*)

Creating a PowerPivot Workbook

When you have successfully installed both Microsoft Excel 2010 and PowerPivot for Excel and have the Contoso relational database ready for use, you are ready to create a BI application with PowerPivot. The first step is to import the data.

Importing data

There are many places from which you might want to import data, including the following:

- A relational database (SQL Server, Oracle, Teradata, DB2, and so on)
- A cube (SQL Server Analysis Services database)
- A Reporting Services report
- A data feed
- Text files
- Windows Azure Marketplace DataMarket
- Data stored in your clipboard

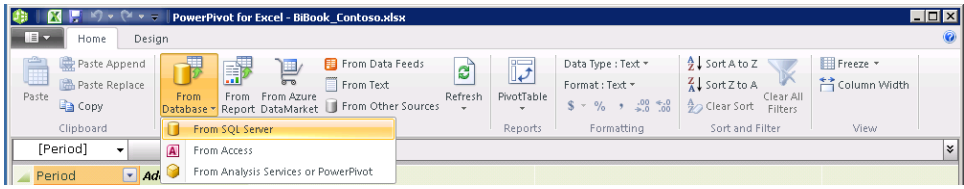
The following sections explore some of these methods in more detail.

Importing from a Relational Database

To import data from a relational database, you need to identify the database, make a connection to it, and select the data you want. You can practice these steps in the following procedure.

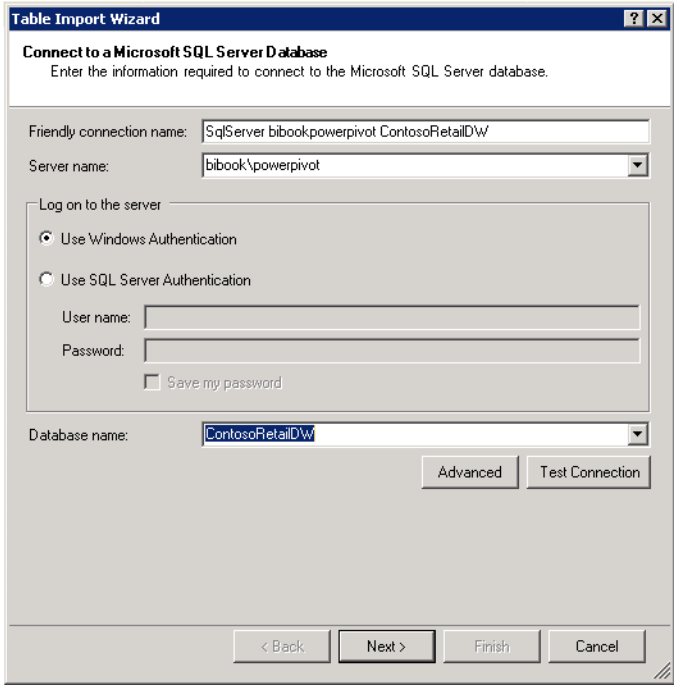
To import database data

1. On the Home tab of the PowerPivot window, click From Database, as shown in the following illustration, and then click From SQL Server.

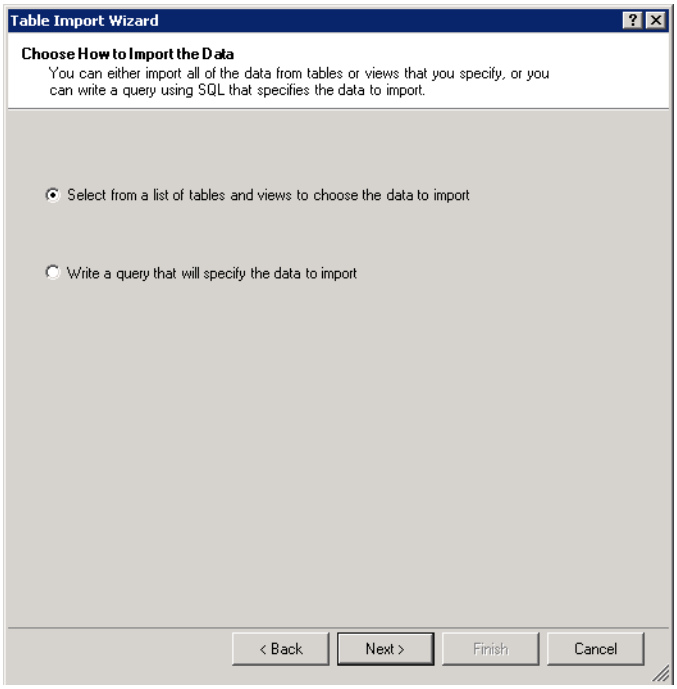


2. The Table Import Wizard starts. Fill in the Server Name field with the server name and instance of the SQL Server you want to access (or select a database from the drop-down list).

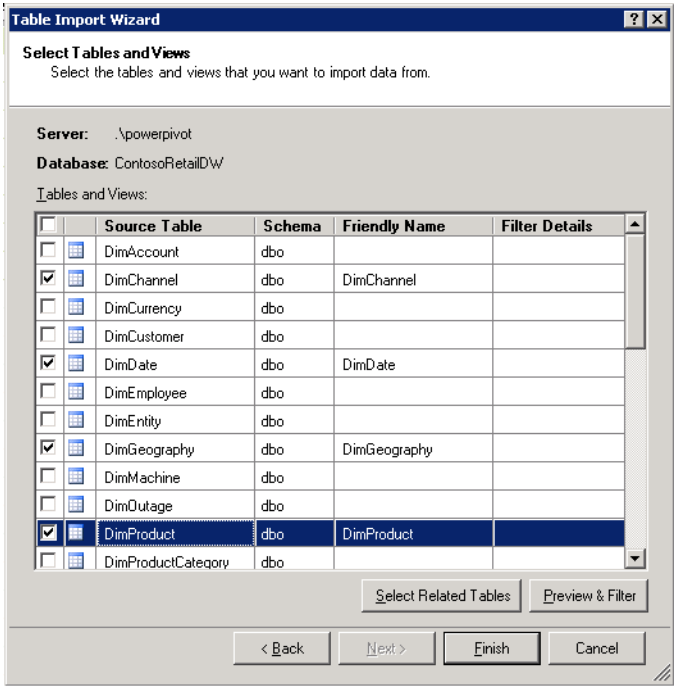
3. From the Database Name drop-down list, select the ContosoRetailDW database you installed earlier, as shown in the following illustration, and then click Next.



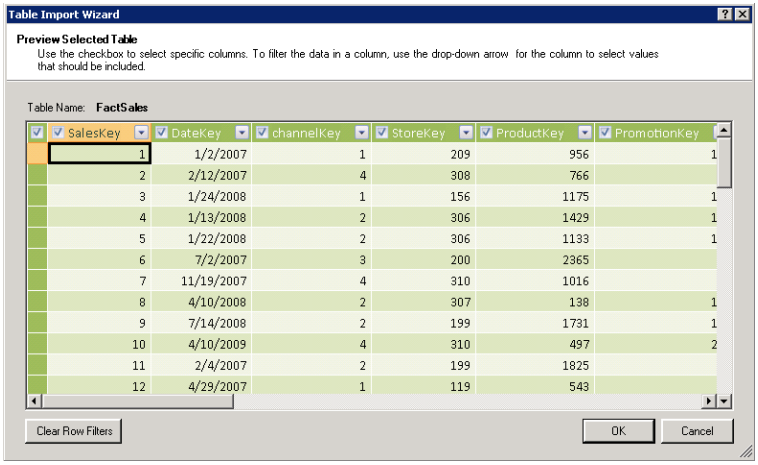
4. In the next wizard screen, to import data from the selected relational database, you can choose to either select from a list of tables and views or write a custom SQL query to retrieve the data. For this exercise, select the Select From A List Of Tables And Views To Choose The Data To Import option, as shown in the following illustration.



5. The Select Tables And Views page shows a list of tables. Select the check boxes next to the DimChannel, DimDate, DimGeography, DimProduct, DimProductCategory, DimProductSubcategory, DimPromotion, DimStore, FactInventory, and FactSales tables. You can see some of these tables selected in the following illustration.



6. On the Select Tables And Views page, you can also click either Select Related Tables or Preview & Filter. Clicking Select Related Tables selects tables that have relationships with the table or tables you have already selected; clicking Preview & Filter displays the first 50 rows of the currently selected table, looking similar to the following illustration. This view can be useful when you want to verify that a selected table is indeed the table you want to import. Selecting or deselecting the check boxes in the header row lets you select or exclude columns from this view.



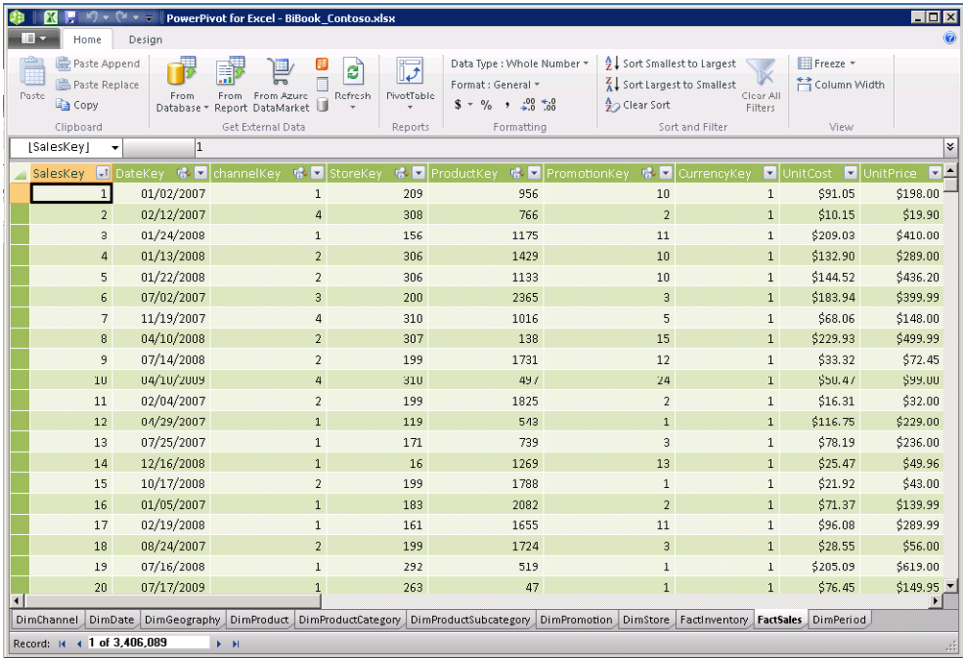
7. Close the Preview page shown in the preceding figure, if you opened it, and then, in the Select Tables And Views dialog box, click Finish.

   At this point, PowerPivot for Excel sends a command to the VertiPaq engine to create the PowerPivot data store, which is an Analysis Services in-memory database, retrieving the data you specified from the relational SQL Server data source you selected.

   After the import operation starts, you can see the quantity of rows imported as the VertiPaq engine processes the tables. PowerPivot for Excel also tries to import any existing relationships between the tables being imported.

8. When the operation completes, on the Import Summary dialog box, click Close.

Notice that the PowerPivot window fills with the data you imported, as shown in the following illustration. The tables are organized as separate tabs, each accessible from the bottom of the window just like a typical Excel worksheet.



Choose one of the sheets—that is, one of the tables—to see all its columns and rows. At the bottom of the PowerPivot for Excel window is a Records field, which shows you how many rows that particular table has loaded. The FactSales table, for example, has more than three million rows—and all that data is available. You can scroll through it seamlessly, thanks to the

VertiPaq engine, which uses a columnar technology to achieve high compression rates and processing power. When you scroll, apply filters, or perform calculations, PowerPivot for Excel sends queries in the background (known as tabular queries) to the VertiPaq engine, which retrieves the results amazingly fast.

Importing from Windows Azure Marketplace DataMarket

Released in October 2010, Windows Azure Marketplace DataMarket (referenced hereafter as Azure DataMarket, for simplicity) is a service with which developers and information workers can easily discover, purchase, and manage premium data subscriptions (some of these data subscriptions are free; some are not) that reside in the Windows Azure platform. By bringing data with a wide range of content from authoritative commercial and public sources together into a single location, Azure DataMarket is perfect for PowerPivot users who want to enrich their applications in innovative ways.

To accommodate this new service from Microsoft, PowerPivot for Excel was updated from its first version—partly to provide users with a better experience when using Azure DataMarket and partly to optimize connections to the Azure DataMarket data feeds. The changes implemented are relatively small but should make a significant difference for those of you who plan to work with data from Azure DataMarket data feeds.

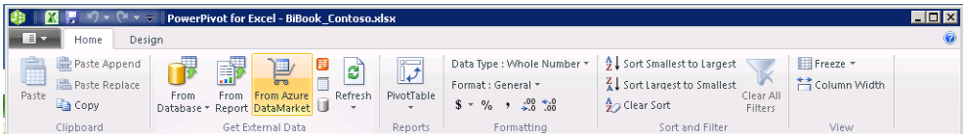
Note Even if you do not have the updated version of PowerPivot installed, you can still connect and use the Azure DataMarket data feeds by using the standard data feed user interface. It might just take a little more effort to use the feeds that way.

Before you can start using Azure DataMarket, you must have a registered account. You can register your Windows Live ID account for free here: *https://datamarket.azure.com/register/*.

To import data from Azure DataMarket, you can perform the steps in the next exercise.

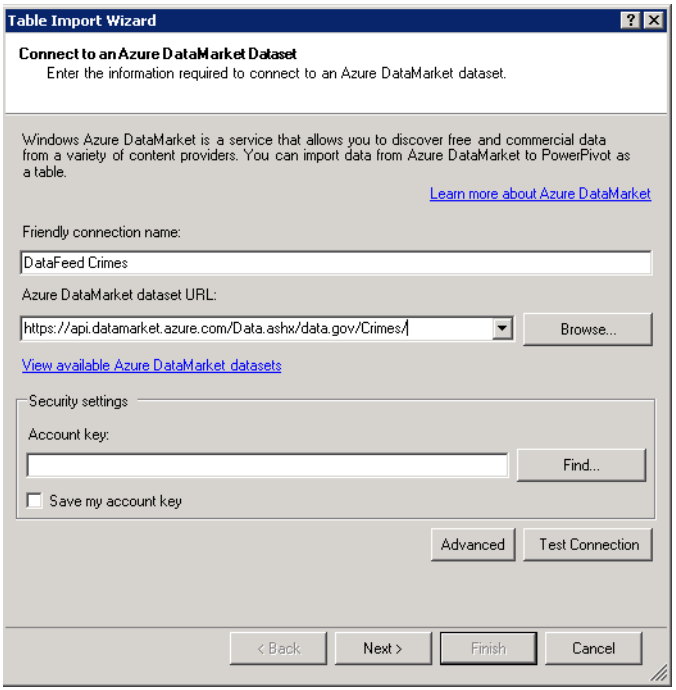
To import data from Azure DataMarket

1. On the Home tab of the PowerPivot for Excel window, click From Azure DataMarket, as shown in the following illustration.



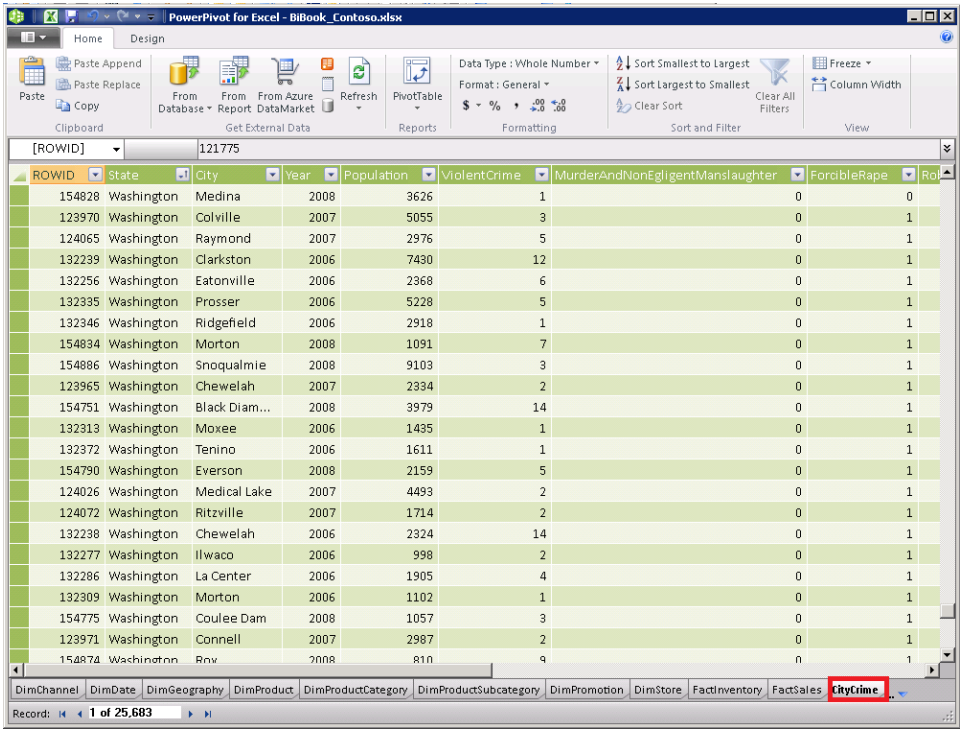
2. On the Connect To An Azure DataMarket Dataset page of the Table Import Wizard, fill in the Azure DataMarket Dataset URL field with the address for the dataset that you want to import data from. In the Security Settings box, copy your account key into the Account Key field. (Your account key is available at the My Data page, in the Account Keys section at the Azure DataMarket website, when you subscribe to a dataset.) For illustrational purposes, we will import data from the 2006–2008 Crime in the United States (Data.gov) dataset at *https//api.datamarket.azure.com/Data.ashx/data.gov/Crimes/*, as shown in the following illustration. The Crime dataset subscription is free of charge.

   Alternatively, from the Azure DataMarket Dataset webpage, you can elect to open a query in PowerPivot (from a drop-down menu). A dialog box appears that asks you to open or save the query. If you choose to save, PowerPivot saves an Atom file at a location you specify. The Atom file contains the query information; you can use it in the Azure DataMarket Dataset URL field in the Table Import Wizard by clicking Browse and navigating to the file's location.



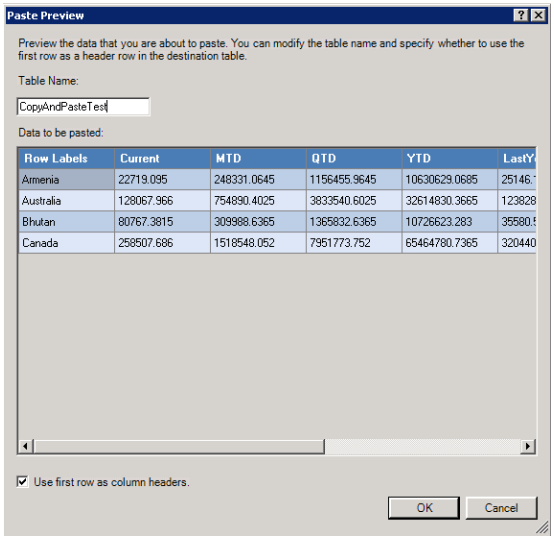
Note For security reasons, the Account Key field in the previous illustration was intentionally left blank.

3. PowerPivot imports the data from the Crime dataset and makes it available on a new tab in the PowerPivot window, as shown in the following illustration.



Pasting from the Clipboard

You can also import data into PowerPivot for Excel by pasting it from the clipboard. PowerPivot can use any data that is in a tabular format, which includes tables copied from a webpage. When you click Paste on the Home tab of the PowerPivot window, the Paste Preview dialog box opens, as shown in the following illustration. Paste Preview lets you view the data that will be copied as a new table. While still in Paste Preview, you can choose to use the values of first row as the columns headers.

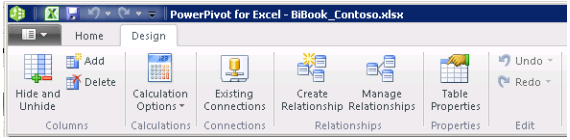


Enhancing and Analyzing the Data

After importing some data, you can start to enhance the data and get it ready for analysis. This section explores a few basic PowerPivot for Excel 2010 features, such as creating relationships and calculations with DAX.

Note The subjects of DAX and data analysis with PowerPivot are large topics and deserve their own book. A full explanation is out of scope for this book, but you can find a more complete and in-depth view of DAX and PowerPivot for Excel features in the book *PowerPivot for Excel 2010: Give Your Data Meaning* (Redmond: Microsoft Press, 2010), by Marco Russo and Alberto Ferrari.

PowerPivot for Excel was designed to look and work as much like Excel as possible, so if you're familiar with Excel, you will find actions such as sorting and filtering data and moving and renaming columns in the PowerPivot windows both natural and intuitive. You might also notice some differences. For example, the Design tab in the PowerPivot window provides more operations that you can perform on the table, such as refreshing the data in the table (or all tables), and hiding, adding or deleting columns, as shown in the following illustration. You can also create and manage relationships between tables, as discussed in the next section.

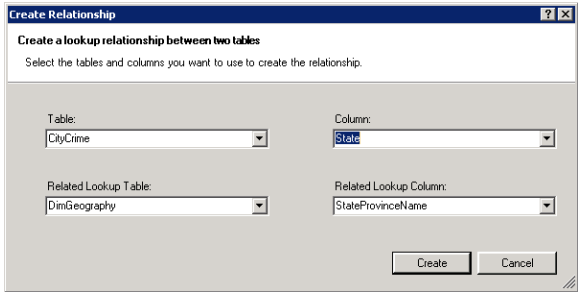


Relationships

A relationship is an association or a connection between two tables. When you create a relationship between two tables, you are defining a way to navigate from one table to another by connecting a single record in one table to one or more records in another table. Relationships are a fundamental concept of relational databases—but not a concept available in Excel. This is one of the key differences between PowerPivot workbooks and regular Excel workbooks: Excel does not offer a mechanism to relate different tables.

Depending on the data source used to acquire your data, PowerPivot can automatically get relationships (and related tables) for you. For example, if you connect to a relational database such as a SQL Server, PowerPivot can import related tables for you from that database. When PowerPivot cannot retrieve table relationships automatically (as when importing data from a Data Feed or a text file), PowerPivot for Excel provides ways for you to define them.

You can create a relationship between two tables as follows: Select the column in the table that contains the "many" side, and then right-click and select Create Relationship from the context menu. Also, you can define a relationship by selecting the column you want to use and clicking Create Relationship (see the preceding illustration) in the Relationships group on the Design tab of the PowerPivot window, as shown in the following illustration. This example creates a relationship between tables imported from Azure DataMarket on the web and data imported from a relational database.



Calculations with DAX

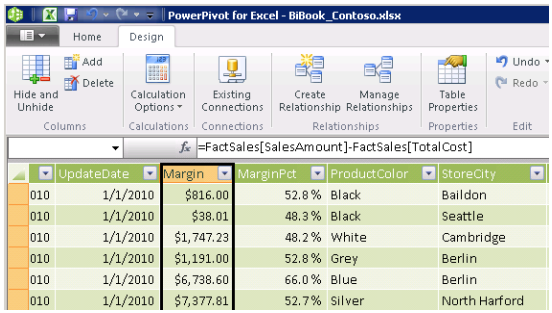
DAX formulas are designed to be as similar as possible to Excel formulas. Just as in Excel, all DAX formulas begin with an assignment operator, such as an equals sign (=), but DAX works with tables (as in a database) rather than with cells arranged in a tabular fashion. The main difference between Excel formulas and DAX is that DAX never uses cell coordinates (B2, C3, and so on). Also, DAX does not work with cell ranges. To work with ranges, you can use DAX functions to apply filters to narrow down the data you are interested in.

Here is a simple example of a DAX formula:

```
=FactSales[SalesAmount]-FactSales[TotalCost]
```

This calculation defines the Margin column in the sample workbook by subtracting the TotalCost column from the SalesAmount column, which yields a profit-margin value.

PowerPivot evaluates the DAX expression for each row of the FactSales table and populates the FactSales[Margin] column with the result, as shown in the following illustration.

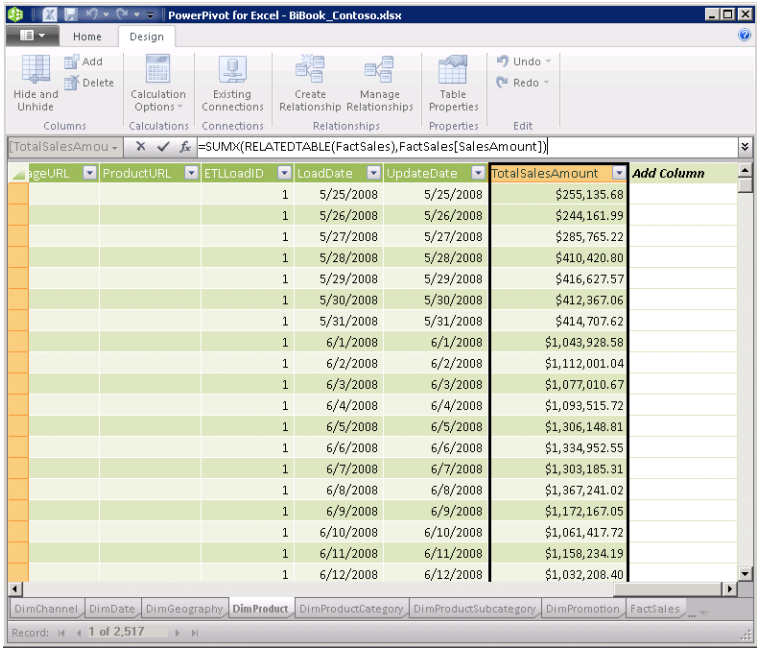


	UpdateDate	Margin	MarginPct	ProductColor	StoreCity
010	1/1/2010	$816.00	52.8 %	Black	Baildon
010	1/1/2010	$38.01	48.3 %	Black	Seattle
010	1/1/2010	$1,747.23	48.2 %	White	Cambridge
010	1/1/2010	$1,191.00	52.8 %	Grey	Berlin
010	1/1/2010	$6,738.60	66.0 %	Blue	Berlin
010	1/1/2010	$7,377.81	52.7 %	Silver	North Harford

Here's a slightly more complex DAX formula:

```
=SUMX(RELATEDTABLE(FactSales),FactSales[SalesAmount])
```

In the preceding formula, the DAX expression calculates a value for each row from the *DimProduct* table by scanning the rows in the *FactSales* for the current row, retrieving the *SalesAmount*, and performing a summation of the *SalesAmount*. In other words, this DAX formula filters the *FactSales* table that correnspond to the product of the current row at *DimProduct* table and aggregates the *SalesAmount* value, as shown in the following illustration.

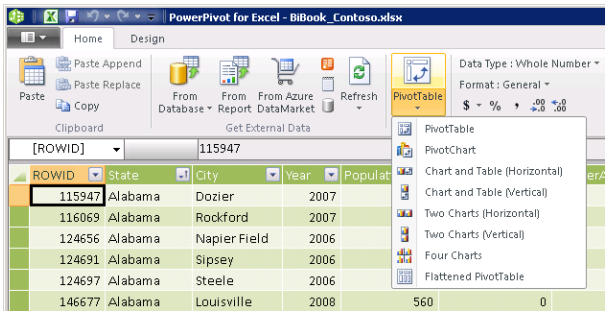


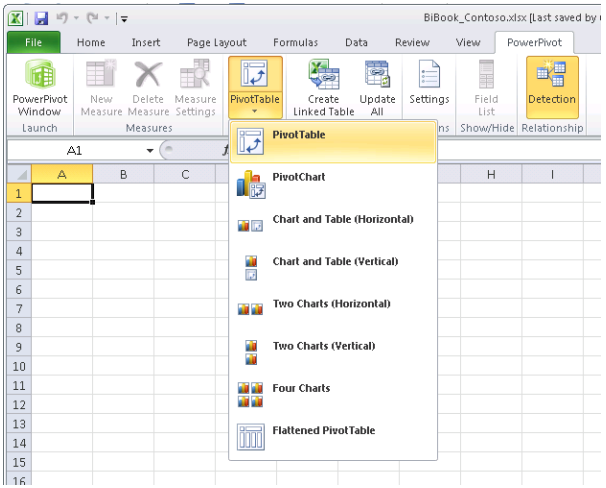
geURL	ProductURL	ETLLoadID	LoadDate	UpdateDate	TotalSalesAmount	Add Column
		1	5/25/2008	5/25/2008	$255,135.68	
		1	5/26/2008	5/26/2008	$244,161.99	
		1	5/27/2008	5/27/2008	$285,765.22	
		1	5/28/2008	5/28/2008	$410,420.80	
		1	5/29/2008	5/29/2008	$416,627.57	
		1	5/30/2008	5/30/2008	$412,367.06	
		1	5/31/2008	5/31/2008	$414,707.62	
		1	6/1/2008	6/1/2008	$1,043,928.58	
		1	6/2/2008	6/2/2008	$1,112,001.04	
		1	6/3/2008	6/3/2008	$1,077,010.67	
		1	6/4/2008	6/4/2008	$1,093,515.72	
		1	6/5/2008	6/5/2008	$1,306,148.81	
		1	6/6/2008	6/6/2008	$1,334,952.55	
		1	6/7/2008	6/7/2008	$1,303,185.31	
		1	6/8/2008	6/8/2008	$1,367,241.02	
		1	6/9/2008	6/9/2008	$1,172,167.05	
		1	6/10/2008	6/10/2008	$1,061,417.72	
		1	6/11/2008	6/11/2008	$1,158,234.19	
		1	6/12/2008	6/12/2008	$1,032,208.40	

Appendix B, "DAX Function Reference," provides a list of all available DAX functions along with a short description of each. For more information about DAX, see the "Data Analysis Expressions in PowerPivot for Excel 2010" white paper and sample workbook available for download at *http://www.microsoft.com/downloads/en/details.aspx?displaylang=en&FamilyID=1ae63bfb-c303-44e3-ae44-7413d499495d*.

PivotTables and PivotCharts with PowerPivot

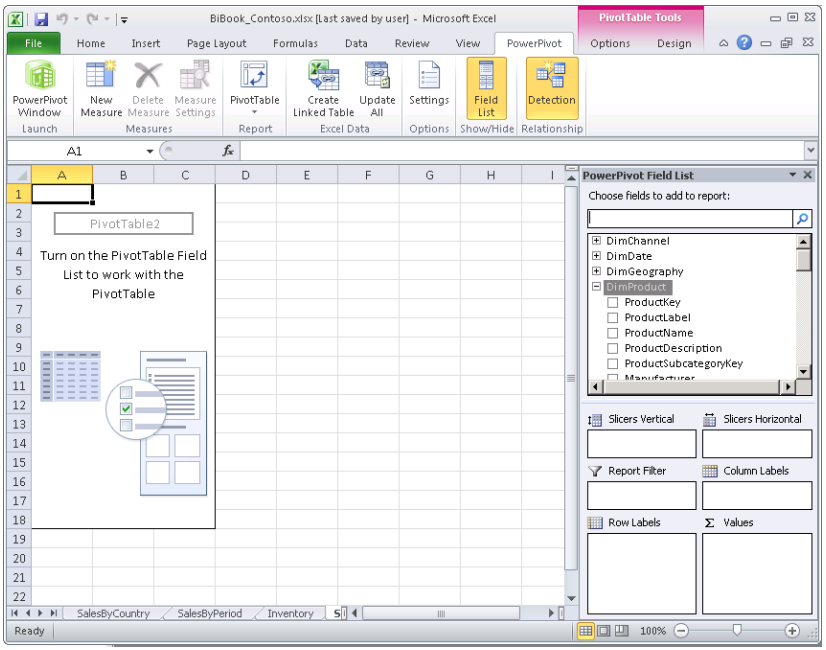
You can consider PivotTables and PivotCharts as the two features that make Excel an excellent BI client tool. Using these features, you can analyze large amounts of data in a quick and easy way—and PowerPivot takes advantage of both features. PowerPivot provides different ways to insert various combinations of PivotTables and PivotCharts into a workbook. You can access these features from the PowerPivot window or from the PowerPivot tab on the Excel ribbon as shown, respectively, in the following illustrations.



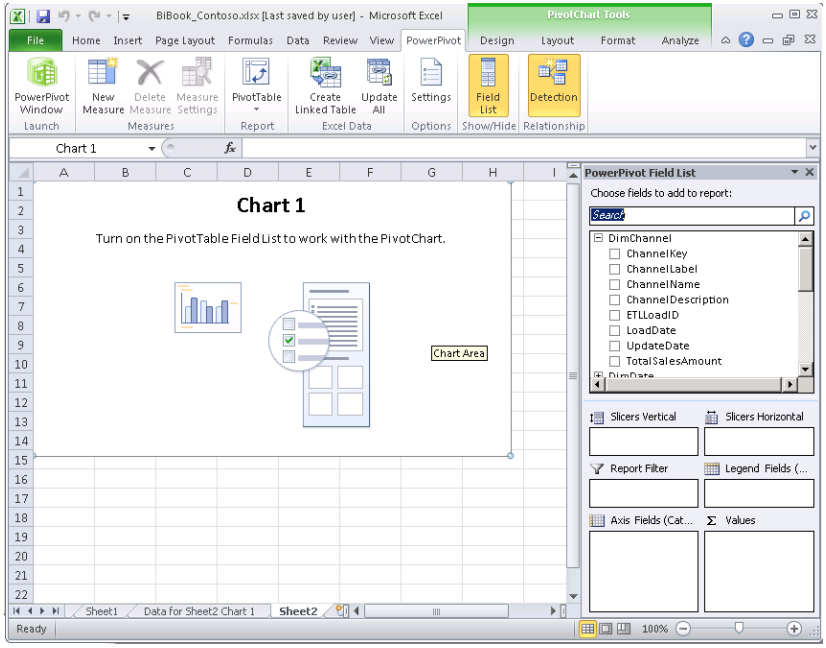


The options in those two menus provide easy and convenient ways to insert a single PivotTable, a single PivotChart, or a combination of PivotTables and PivotCharts into a PowerPivot workbook.

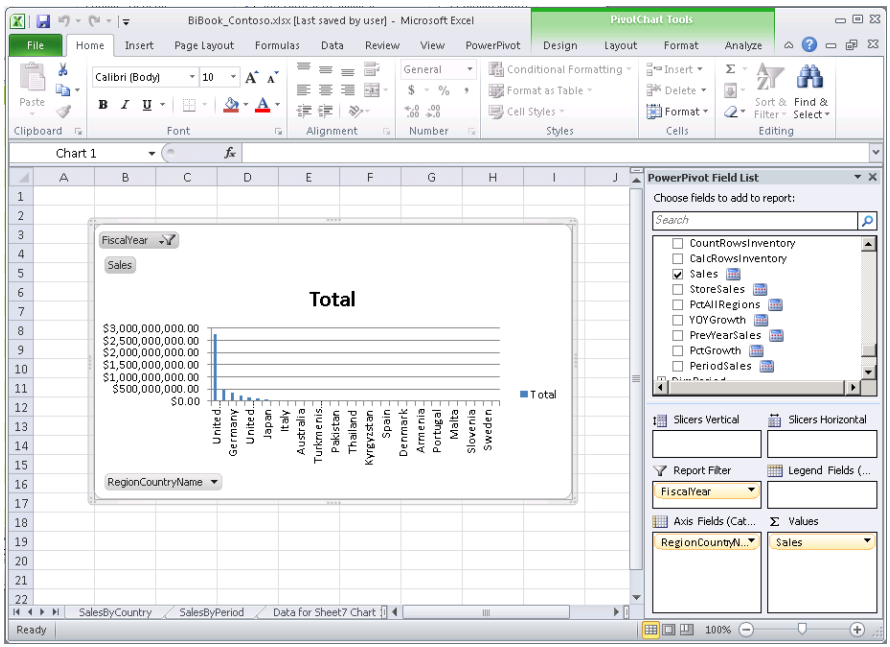
A single PivotTable is the most basic configuration. The following illustration shows a new PowerPivot PivotTable before adding any fields. Notice that, for the PowerPivot PivotTable and for the PowerPivot PivotCharts (in the succeeding illustration), the PowerPivot field list is shown instead of the standard Excel field list.



Selecting PivotChart inserts a single PivotChart in your workbook, as shown in the following illustration. PowerPivot also creates a PivotTable on a separate sheet that contains the data that the PivotChart uses. This additional sheet's name follows a standard naming convention: "Data for Sheet <x> Chart<y>." For this example, we inserted a PivotChart named Chart1 in the Sheet2 sheet, which created a new sheet named "Data for Sheet2 Chart1." (See the following illustration.) This naming scheme can help you browse from the PivotTable that contains the support data back to the PivotChart (as long as you neither rename the PivotChart's sheet nor move the PivotChart to a different sheet).



The following illustration shows a PowerPivot PivotChart displaying Total Sales By Country from the Contoso database.

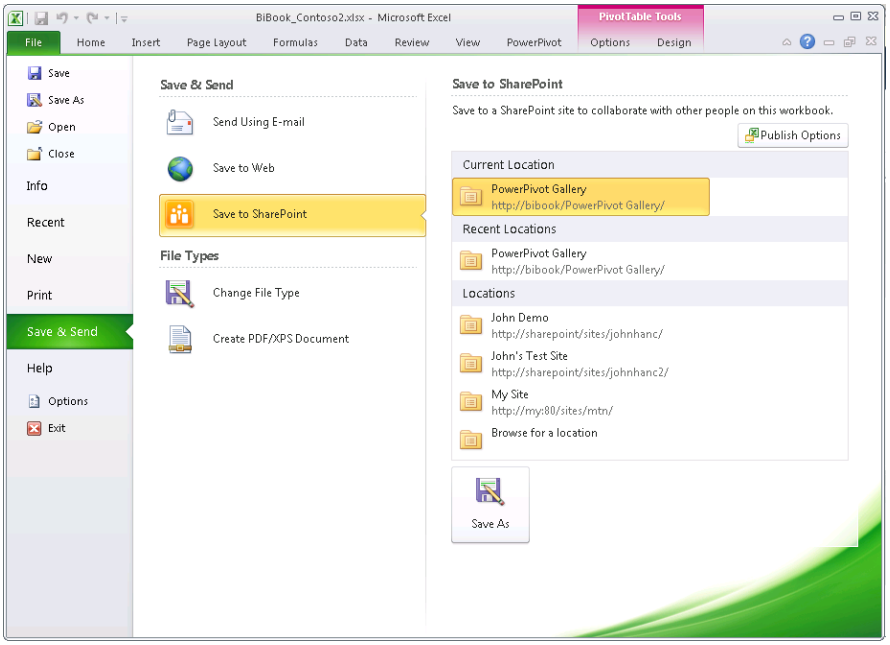


Publishing to SharePoint

After creating a PowerPivot workbook by using PowerPivot for Excel, you'll likely want to share it with others in your department or organization. Your workbook becomes much more useful when others can use it.

To publish your workbook

1. In Excel, click the File tab on the Excel ribbon.
2. Click Save & Send, as shown in the following illustration.

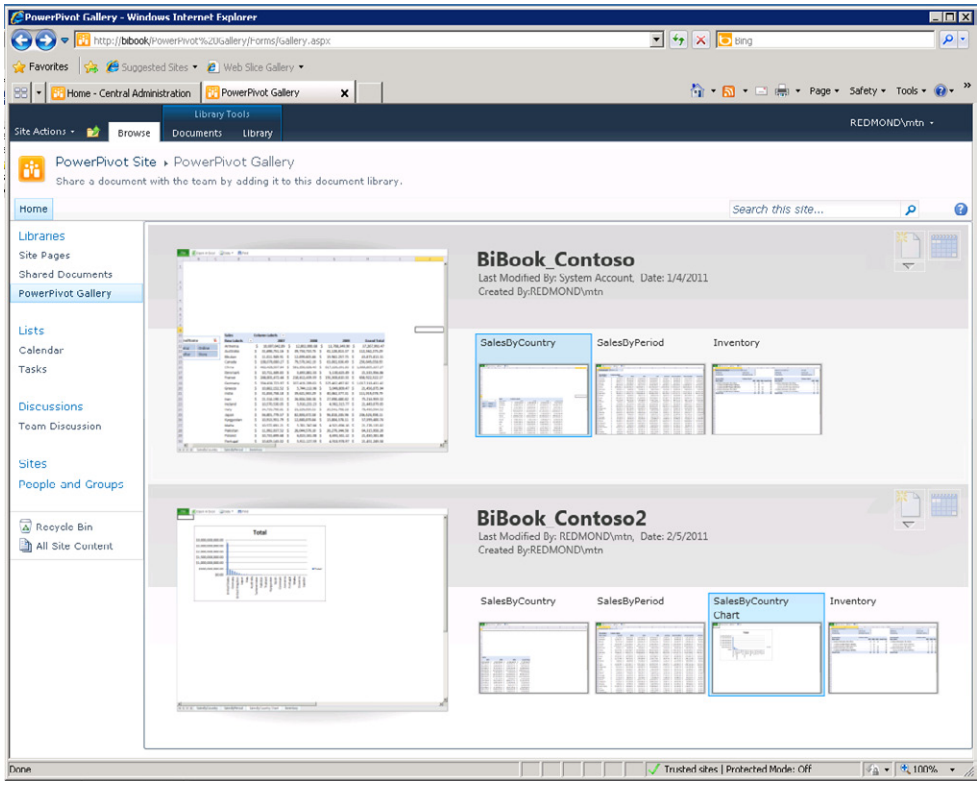


3. In the Save & Send section, click Save To SharePoint.

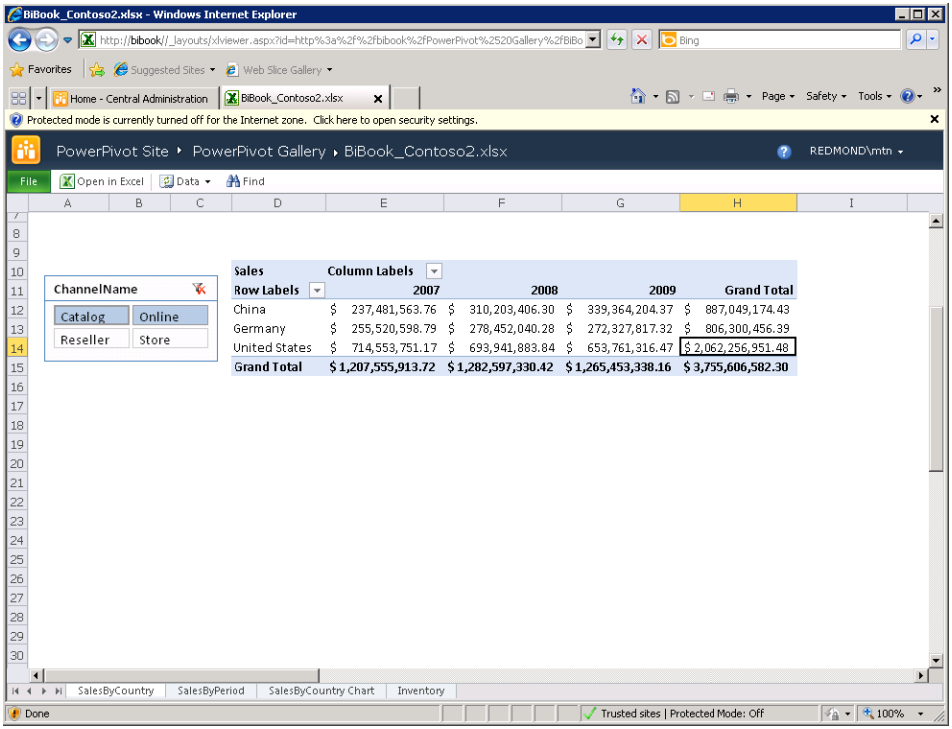
If you are publishing to a SharePoint site that has PowerPivot for SharePoint installed, you should publish it to the PowerPivot Gallery. The PowerPivot Gallery is a special PowerPivot-enabled SharePoint document library with additional functionality that goes above and beyond the features available in standard SharePoint 2010 document libraries.

PowerPivot Gallery

PowerPivot Gallery is a visually rich SharePoint document library installed with PowerPivot for SharePoint. Its enhanced visual presentation aids in interpreting the data in each sheet of PowerPivot workbooks in the Gallery, as shown in the following illustration.

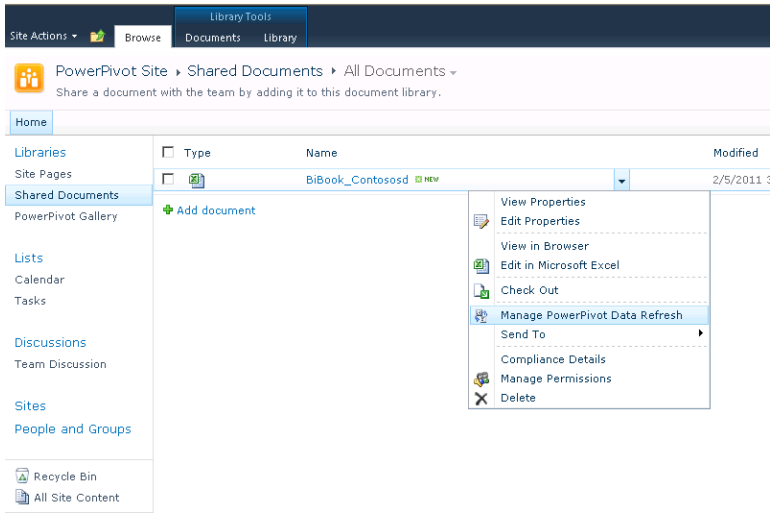


Clicking a specific sheet in a PowerPivot workbook opens the workbook in the browser, where you can analyze it further, as shown in the following illustration.



Scheduling Data Refreshes

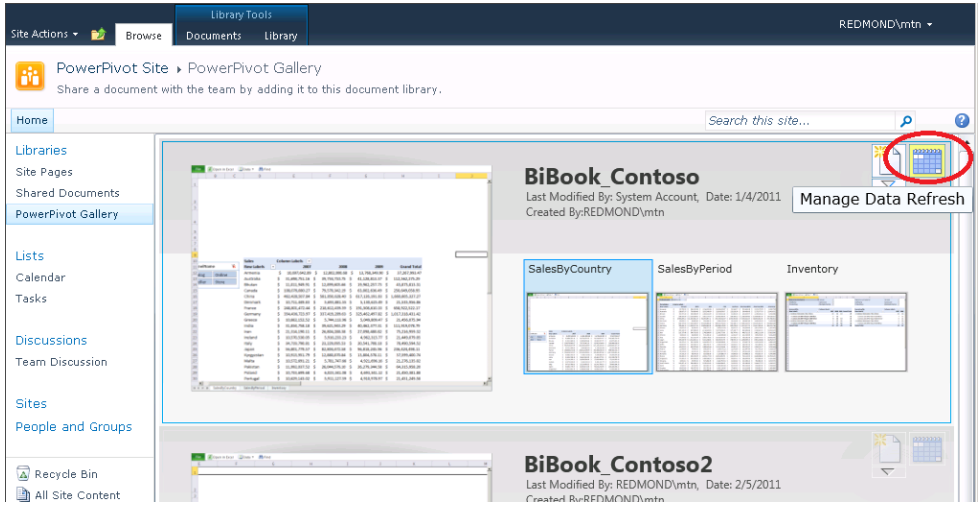
PowerPivot for SharePoint provides a data-refresh feature that can automatically retrieve updated data from the external data sources you used to build the workbook originally. Any PowerPivot workbook owner can schedule data refresh for workbooks saved to the PowerPivot Gallery or to any other PowerPivot-enabled SharePoint document library. The following illustration shows the drop-down menu that opens the data-refresh schedule page.



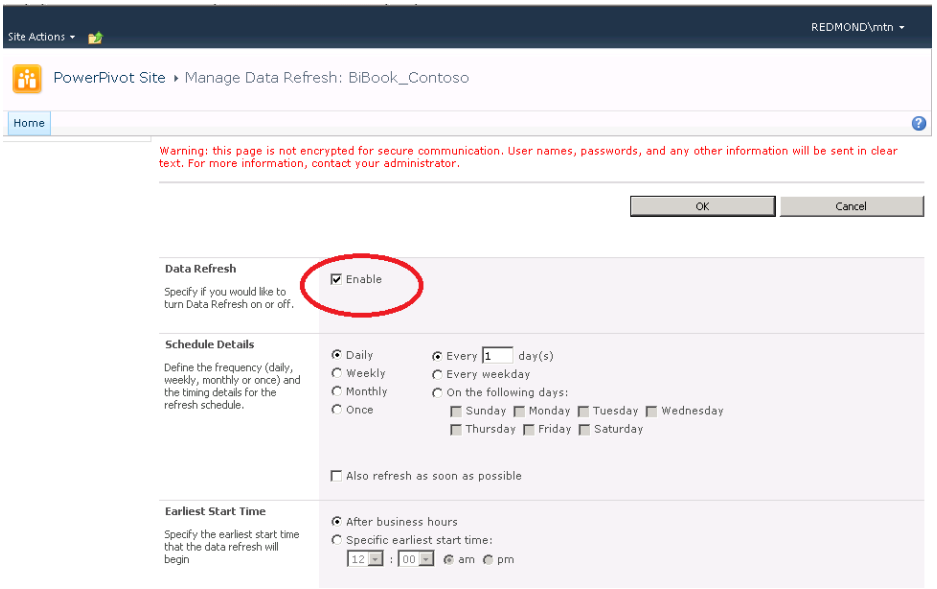
PowerPivot Gallery offers another way to get to the data-refresh feature: To schedule a data refresh through the PowerPivot Gallery, SharePoint users who have Contributor permission can click the Calendar icon shown for each workbook in a PowerPivot Gallery.

Note When a user does not have sufficient privileges on the workbook, the Calendar icon is not available on the page.

The following illustration shows the icon that opens the data-refresh schedule definition page.



The following illustration shows the initial view of the schedule definition page. To start setting up a data-refresh schedule, click Enable. This makes the page active so that you can fill in the values you want to use.



The Manage Data Refresh page has six sections, as described in the following table.

Section	General description
Data Refresh	Enable or disable a data-refresh schedule.
Schedule Details	Define the frequency and timing details of a data refresh.
Earliest Start Time	Specify the earliest start time for a data refresh.
E-mail Notifications	Specify email addresses of the users to be notified in the event of data-refresh failures.
Credentials	Provide the required credentials for refreshing data on your behalf.
Data Sources	Select which data sources should be automatically refreshed. You can also use this section to create custom schedules that vary for each data source or to specify credentials for connecting to the data source.

Data Refresh

To enable or disable a data-refresh schedule, select or clear the Enable check box on the Manage Data Refresh page. When Enable is selected, you can edit all parts of the data-refresh schedule. When Enable is not selected, the page is read-only and you're essentially freezing the data, meaning that after you click OK, subsequent data-refresh operations for that workbook cannot occur.

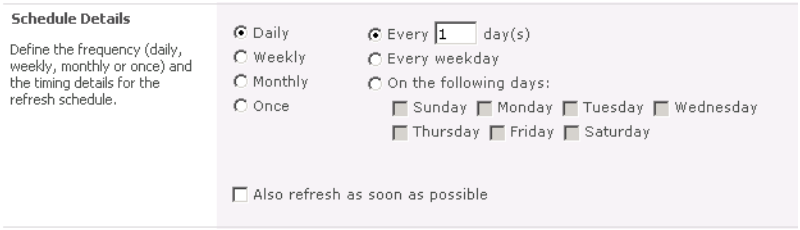
Schedule Details

In the Schedule Details section, you can specify the frequency and timing details of the data refresh by choosing one of the following options:

- Daily
- Weekly
- Monthly
- Once

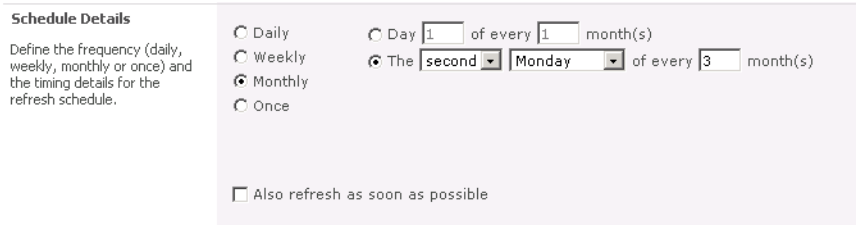
Using the Daily option, you can schedule a data refresh to occur every n day(s), every weekday, or on specific days of the week.

If you select the Also Refresh As Soon As Possible check box, data gets refreshed as soon as the server can process it. This refresh occurs in addition to the periodic data-refresh schedule and is available for periodic schedules only (that is, daily, weekly, and monthly schedules). Select this check box when you want to verify that the data refresh runs properly. For example, you might not know whether data credentials are configured correctly. This option provides a way to test the data refresh before its scheduled execution time. In short, checking the Also Refresh As Soon As Possible option refreshes the workbook as soon as possible once; subsequently, the workbook refreshes following your periodic schedule specification.

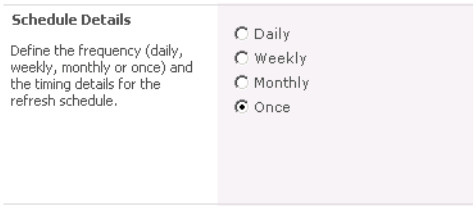


The Weekly option is for scheduling data refresh on a weekly basis, such as every n week(s) or on specific days of the week.

You can use the Monthly option data-refresh schedule to run either on a specific day of the month or on the first, second, third, or last specific day of the week every n month(s).

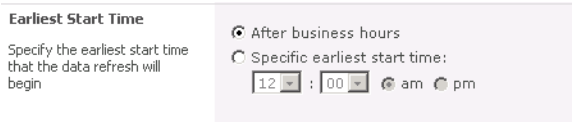


The Once option schedules a one-time data-refresh operation that runs as soon as the server can process the request. After the data refresh completes, the system disables this schedule. Notice that the Also Refresh As Soon As Possible check box is not available for this option.



Earliest Start Time

In the Earliest Start Time section, you specify details about when you prefer data refresh to occur. You can enter a specific time before which data refresh should not start, or you can choose to refresh data after business hours. This page does not determine the time at which the data refresh actually starts; instead, the schedule is queued and processed based on available resources. For example, if the server is busy with on-demand queries (which take precedence over data refresh jobs), the server waits to refresh your data until those queries have been processed. You can also choose to run a data-refresh operation after business hours. The administrator of the PowerPivot Service Application for your organization determines the definition of "business hours."



E-mail Notifications

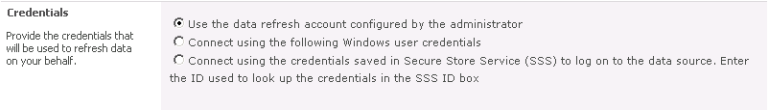
In this section of the page, you can specify email addresses for individuals or groups who should be notified when a data refresh fails. You can receive notifications of successful data-refresh operations through the regular SharePoint alerting system for email notification. (The basis of the alert would be a new file added to the target document library.)

Credentials

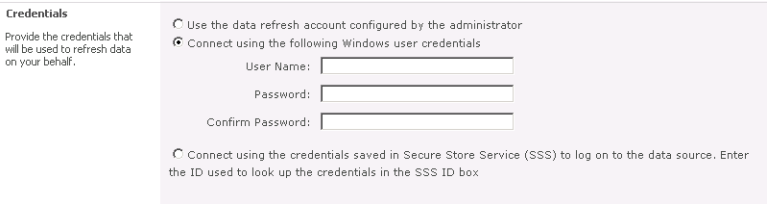
PowerPivot for SharePoint uses the SharePoint Secure Store Service to store any credentials used in data refresh. In the Credentials section of the schedule page, the schedule owner can specify the Windows credentials that are used to refresh data on his or her behalf. Any data source that uses trusted or integrated security is refreshed using these credentials. For the data refresh to succeed, the selected credentials should have access to the data sources for this workbook. You can choose from one of the following options:

- Use an account preconfigured by the administrator (the service application's unattended data-refresh account).
- Use a specific Windows user name and password.
- Use a predefined Secure Store Service target application ID that stores the Windows credentials you want to use.

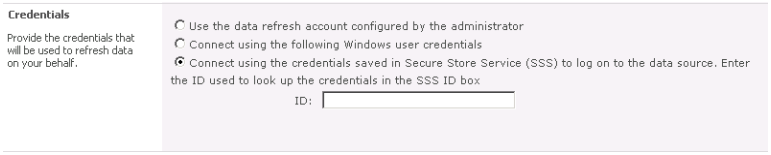
Both the PowerPivot unattended data-refresh account and the predefined Secure Store Service target application ID must be set up by a SharePoint administrator in Central Administration. Because these credentials are shared among all users, this option is typically used where additional credentials are required for data access. A good example is when all the data sources use SQL Server authentication (that is, the actual user names and passwords are on each data source). In this case, the unattended execution account can be a low permission service account. Due to the way data refresh uses Windows accounts, it is normally not a good idea to have the unattended execution account be someone's primary user account, because anyone can impersonate that user if he or she accesses data by using a trusted connection.



A schedule owner can also choose to type the Windows user credentials to be used on the data refresh. These credentials are securely stored in SharePoint's Secure Store Service.



The third option lets a schedule owner specify credentials previously saved in a Secure Store Service Target Application. To use this option, you must enter the Target Application ID used to look up the credentials in the Secure Store Service. The Target Application ID specified must be a group entry, and both the interactive user and the PowerPivot System service account must have read access.

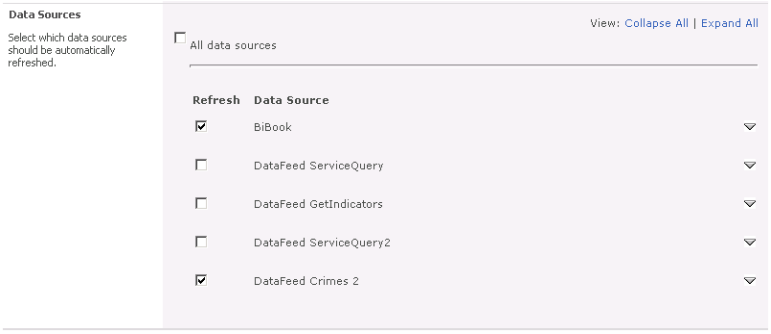


Note Setting up and maintaining Secure Store Service is outside the scope of this book. For more information about Secure Store Service, see the following TechNet and MSDN articles:

- "Configure the Secure Store Service (SharePoint Server 2010)" at *http://technet.microsoft.com/en-us/library/ee806866.aspx*
- "PowerPivot for SharePoint – Existing Farm Installation" at *http://msdn.microsoft.com/en-us/library/gg144594.aspx*

Data Sources

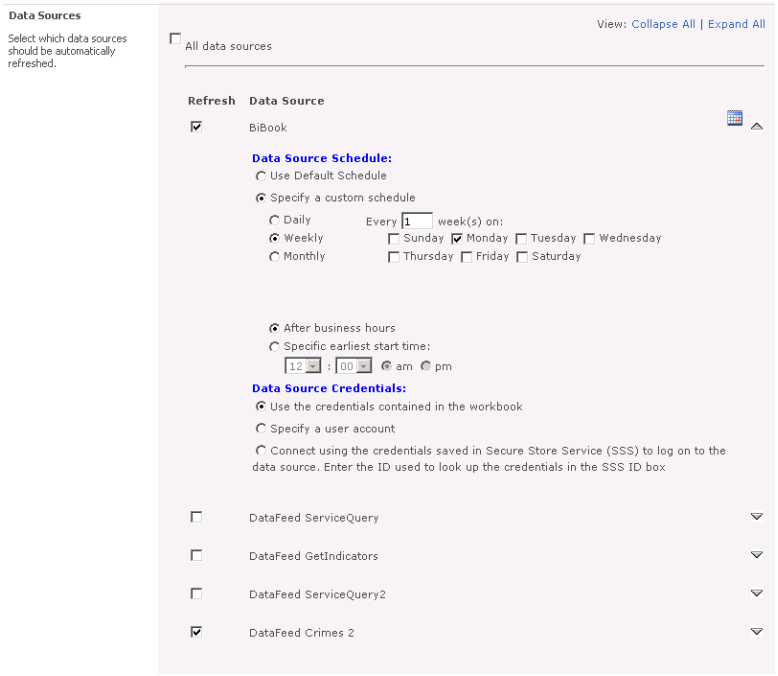
A workbook can have many data sources that have different characteristics. As shown in the following illustration, you can choose to create a data-refresh schedule using different options for each data source.



The schedule definition page provides options for choosing the data sources to be refreshed and when to refresh them. It also provides fields for specifying database credentials or other non-Windows credentials used on the database connection. You must select at least one data source to save the schedule. The data source's credentials are not used for impersonation but are instead included on the connection string as UserName and Password. These credentials override those used on the connection string for the original data import.

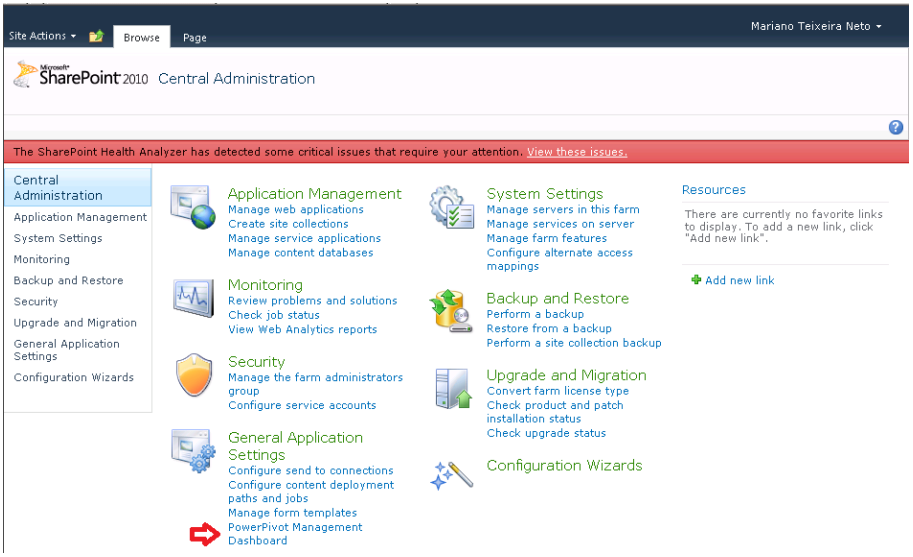
As shown in the following illustration, different settings are available for each data source. You can specify a custom schedule data source, or you can use the general schedule specified for the workbook.

Note The only modifiable elements in the connection string are the UserName and Password elements. To edit any of the other elements—for example, to change the source server name—you must download the workbook to your desktop, edit it using the PowerPivot Excel add-in, and then republish it to SharePoint.

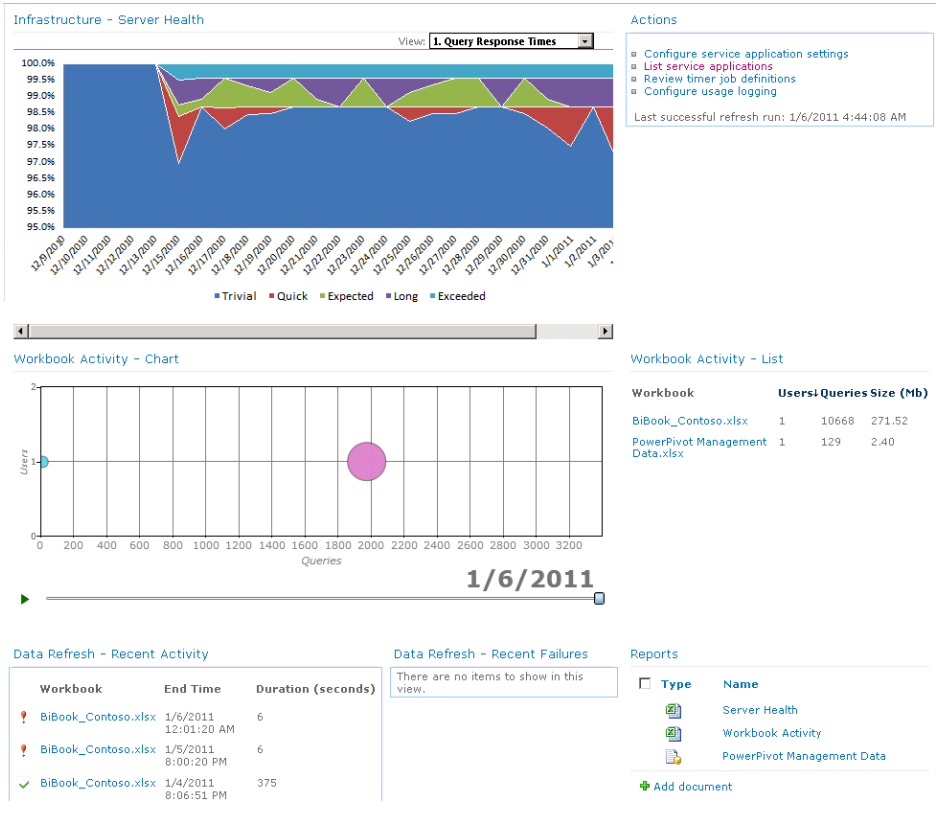


Monitoring with PowerPivot for SharePoint

The PowerPivot Management Dashboard provides administrators responsible for the server side of PowerPivot with the capabilities they need to understand usage patterns of the PowerPivot workbooks in SharePoint and to take appropriate actions. For example, the growing size of a particular workbook may indicate the need to acquire more memory. You can access the PowerPivot Management Dashboard by browsing to SharePoint's Central Administration and then clicking General Application Settings, as shown in the following illustration.



The Dashboard page appears as shown in the following illustration.



The PowerPivot Management Dashboard can be broken down into the main areas (Web Parts) described in the following table.

Web Part	Description
Infrastructure—Server Health	Provides information about infrastructure; it shows the CPU and memory usage for the PowerPivot Analysis Services service. It also contains a histogram of overall query response for the PowerPivot service application.
Workbook Activity	Provides a high-level representation of the number of users, the number of queries sent to a workbook, and the size of the workbook over time.
Actions	Allows an administrator to configure PowerPivot-specific settings within a SharePoint farm.
Data Refresh	Provides a breakdown of the recent activities and recent failures for PowerPivot data refresh in SharePoint.
Reports	Enables administrators to view source Excel workbooks and databases used by the PowerPivot Management Dashboard.

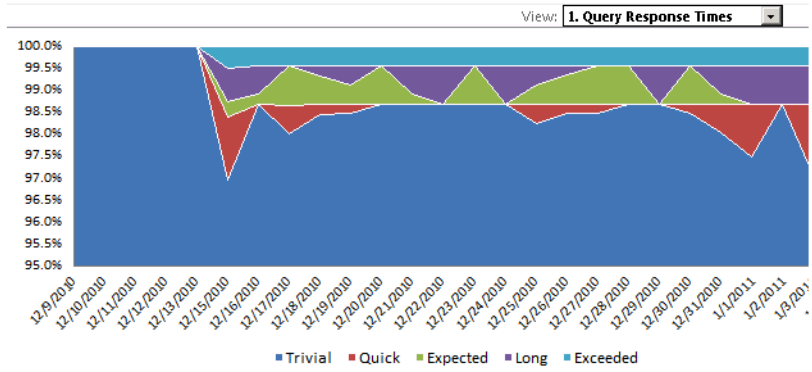
Infrastructure—Server Health

This section of the PowerPivot Management Dashboard provides indicators of the server's health. It does so through the following indicators:

- Query Response Times
- Average Instance CPU
- Average Instance Memory
- Activity
- Performance

Query Response Times

As shown in the following illustration, the Query Response Times view is the default view of the Server Health Web Part. The purpose of this chart is to provide a quick overview so that you can determine whether the majority of the queries are running as expected or whether they are running too slowly.



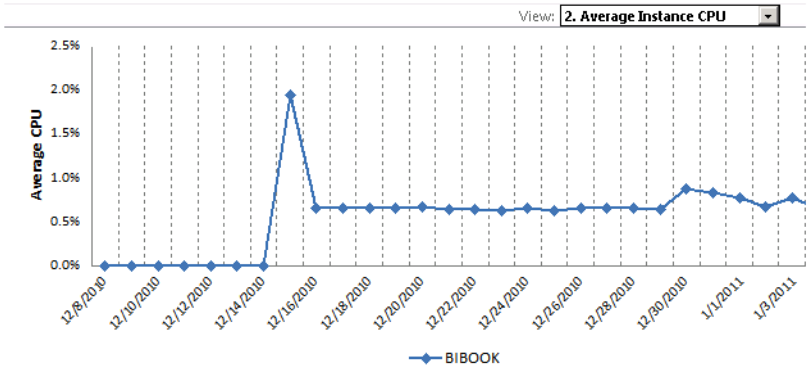
When query response time increases, you will want to determine which queries are running slowly, and why.

The following table summarizes the default query response time definitions. These definitions can be modified by selecting Central Administration | General Application Settings | PowerPivot | Configure Service Application Settings.

Category	Definition (in milliseconds)
Trivial	0 < time < 500
Quick	500 < time < 1000
Expected	1000 < time < 3000
Long	3000 < time < 10000
Exceeded	>= 10000

Average Instance CPU

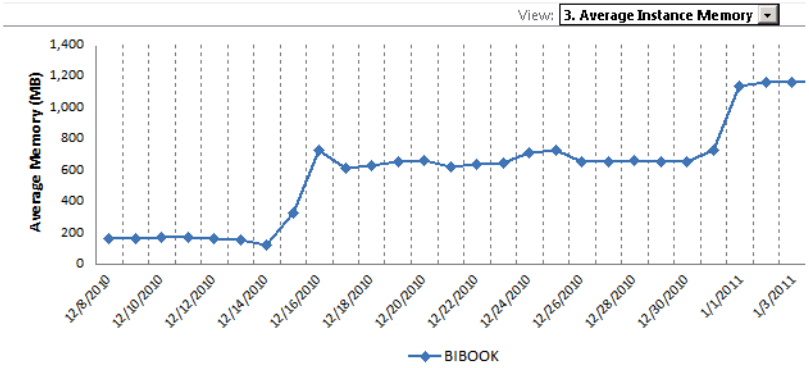
Switching to the Average Instance CPU view in the Server Health Web Part shows the CPU load on the SharePoint Application Server that has PowerPivot installed, as shown in the following illustration.



The preceding illustration shows that for this SharePoint Application Server, CPU load is not an issue because, on average, it's using less than one percent of the CPU's capacity.

Average Instance Memory

Memory can become a concern for your environment because the PowerPivot VertiPaq engine loads the workbook in memory. As the number of users and the size of their workbooks grow, they require an increasing portion of the server's memory. Taking a quick look at the Average Instance Memory view, you can easily see when more memory is being used over time, as shown in the following illustration.



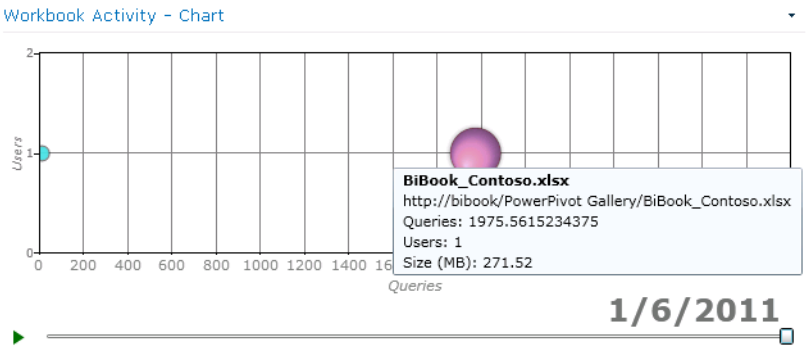
Activity and Performance

Although you can toggle between the Infrastructure—Server Health Activity and Performance views, you can get an even better view of this data by using the Workbook Activity and Server Health reports directly. To do that, click in either the Workbook Activity or the Server Health workbook located in the Reports area of the PowerPivot Management Dashboard. (See the second illustration in the section "Monitoring with PowerPivot for SharePoint.")

Workbook Activity

This area contains two parts: a Chart section and a List section.

Chart



This Chart Web Part is a Silverlight control that displays a bubble chart. The chart's axes represent the number of users and the number of queries sent to a workbook. A sliding bar indicates the date. As you move the pointer over each bubble, the name of the corresponding workbook and the number of users connected to that workbook display, along with the number of queries sent to the workbook. Also, as you move the date sliding bar, the bubble size indicates how the workbook has grown over time.

List

The Workbook Activity - List section provides a quick way to view the current activity attributes (workbook name, number of queries, users, and size) of the server, as shown in the following illustration.

Workbook Activity - List

Workbook	Users↓	Queries	Size (Mb)
BiBook_Contoso.xlsx	1	10668	271.52
PowerPivot Management Data.xlsx	1	129	2.40

Data Refresh

The PowerPivot data-refresh mechanism performs many activities in the background. In the PowerPivot Management Dashboard, you will find a section dedicated to reporting the recent data-refresh–related activities in the environment

Recent Activity

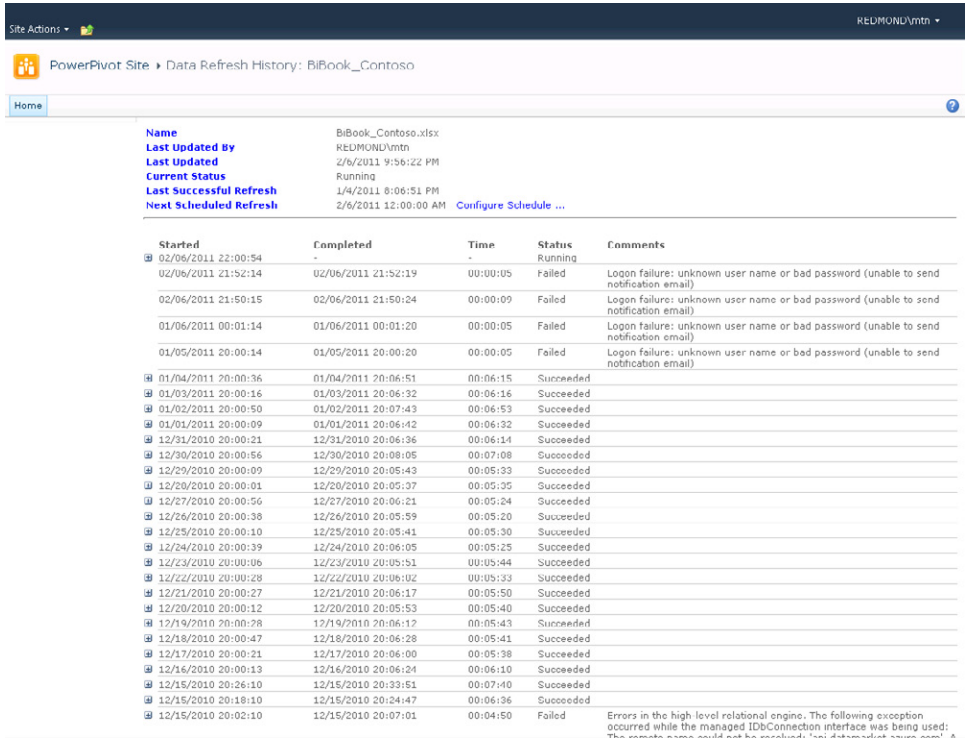
As the name suggests, this Web Part shows recent data-refresh activity in the environment. It reports the most recent PowerPivot workbook data refreshes, along with the time each refresh completed and its duration, as shown in the following illustration.

Data Refresh - Recent Activity

Workbook	End Time	Duration (seconds)
BiBook_Contoso.xlsx	1/6/2011 12:01:20 AM	6
BiBook_Contoso.xlsx	1/5/2011 8:00:20 PM	6
BiBook_Contoso.xlsx	1/4/2011 8:06:51 PM	375
BiBook_Contoso.xlsx	1/3/2011 8:06:32 PM	376
BiBook_Contoso.xlsx	1/2/2011 8:07:43 PM	413
BiBook_Contoso.xlsx	1/1/2011 8:06:42 PM	393
BiBook_Contoso.xlsx	12/31/2010 8:06:36 PM	375
BiBook_Contoso.xlsx	12/30/2010 8:08:05 PM	429
BiBook_Contoso.xlsx	12/29/2010 8:05:43 PM	334
BiBook_Contoso.xlsx	12/28/2010 8:05:37 PM	336

1 2 3

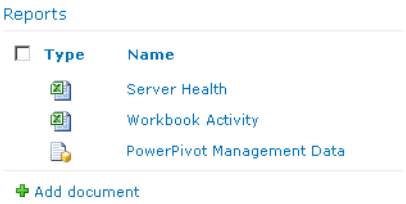
Clicking a workbook in the Recent Activity report redirects you to that workbook's data-refresh history page, where you can find details about the failure. The following illustration shows the data-refresh history page for the BiBool_Contoso.xlsx workbook.



Recent Failures

This Web Part focuses on reporting recent data-refresh failures. With this information in hand, you can go back to the Recent Activity Web Part and start investigating the underlying reasons for why a particular data refresh failed.

Reports



As shown in the preceding illustration, the Reports Web Part contains the Excel workbooks that are the source for the PowerPivot Management Dashboard charts. Clicking a workbook opens that workbook in the browser, and you can identify the charts shown in the PowerPivot Management Dashboard.

Summary

This chapter briefly introduces you to PowerPivot for Excel and PowerPivot for SharePoint. It provides guidance on creating a PowerPivot workbook, importing data from various data sources, and mashing them up using DAX. This chapter also demonstrates how to publish a PowerPivot workbook to SharePoint and how to schedule data refreshes, and it explains how IT professionals can manage PowerPivot for SharePoint by using the PowerPivot Management Dashboard. To learn more about PowerPivot, you can look for books dedicated to PowerPivot for Excel and to PowerPivot for SharePoint. You can also find more information by referencing the following resources:

- The official MSDN blog at *http://blogs.msdn.com/powerpivot*.
- Rob Collie's blog at *http://www.powerpivotpro.com* (for PowerPivot for Excel). Rob Collie was a Program Manager in the Analysis Services team that worked on PowerPivot for Excel.
- Dave Wickert's blog at *http://www.powerpivotgeek.com* (for PowerPivot for SharePoint). Dave Wickert is a Program Manager on the Analysis Services team, working on PowerPivot for SharePoint.

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