

Understanding **Microsoft Power BI**

Transform your data into rich visuals and create stunning interactive reports without writing any code – and do it in any browser or on any device

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It has been said that software is “eating the world.” It helps us communicate, collaborate, work, play, and travel. In some cases, software not only assists us with these activities but performs them without any human involvement. And through recent advances in machine learning and predictive analytics, software has even begun to help us predict the future.

The ubiquity of software in modern life has some interesting side effects, principal among them the proliferation of data as either a direct (expected output) or indirect (telemetry, audit logs, etc.) function of the software itself. But while this explosion of data offers opportunities to understand our problem domains, our world, and often ourselves in ways unimaginable even ten years ago, there exists the basic problem of how to harness this data in ways that ultimately lead to such insight.

More specifically:

- How can we collect data from multiple disparate sources into a single logical “view of the world”?
- How do we map schema and related metadata onto the data, and shape it from raw form into something suitable to our needs?
- How do we aggregate and query across this data, and visualize it in ways that surface meaningful insight?
- Finally, once we gain insight from data, how can we share it with others and allow them to benefit and/or build on it? How can we build an iterative process for all of this?

While modern commercial enterprise has only recently begun to tackle these issues, it has long been the nature of academic research to generate large volumes of data, with or without the assistance of “world-eating” software. Yet many of the same fundamental problems, and potential solutions, exist in both areas.

Microsoft Power BI

[Microsoft Power BI](#) is a product created to address the data explosion in commercial and academic organizations, the need to analyze that data by exploring structure and content, and the need for rich, interactive visuals to represent the data and reveal key insights. It contains a suite of tools that assist in the full life cycle of data analysis, from data discovery and collection, to data transformation and aggregation, to visualization, and finally to sharing and collaboration. Some of its most notable features include:

- Pre-built data connectors for a range of existing SaaS applications and data services
- Support for raw file formats and standard database connectivity
- A full-featured expression engine for custom aggregations, statistical analysis, and computed data fields

"Linking data for analyses was something we couldn't do before. With Power BI, it's simple. Power BI makes the hard things easy." – Philip Dean, Head of Department of Pharmacy and Quality Control, North Tees and Hartlepool National Health Services Trust

- A WYSIWYG editor to create sophisticated visualizations, including discrete data tiles, multi-page reports, and summary dashboards
- Publishing to a central, secured repository for dissemination of results to colleagues
- Support for "content packs" that act as building blocks for iterative data analysis
- Support for visualizing data on the Web or on mobile devices running iOS, Android, or Windows
- Support for embedding visualizations in your own Web or mobile apps

Figure 1 shows an interactive Power BI dashboard running on a range of devices. Individual metrics are represented by tiles on the dashboard, and tiles can be arranged however you like. The dashboard can be customized to fit your needs and configured to refresh at predetermined intervals. Content from Excel or SQL Server Reporting Services is easily pinned to the dashboard so that tapping that tile (or any other tile, for that matter) displays a report providing a deeper dive into the data. Of course, reports can come from many other sources as well.



Figure 1: Power BI dashboard viewed on a range of devices

Power BI consists of three key components: the SaaS-based Power BI service, the Power BI Desktop application, and the Power BI consumer experiences for mobile, Web, and embedded. These components are described in the sections that follow.

Power BI Service

The Power BI service is a Software-as-a-Service Web-based portal and report repository that acts as the hub for basic data consumption, analysis, and collaboration tasks in the Power BI ecosystem. It provides a canvas-based dashboard experience for exploring data imported from various data sources via content packs, read from discrete file types such as Excel and CSV, or retrieved from databases hosted in the cloud or on premises. Because it is accessed through a Web browser, it works entirely cross-platform. And the [Power BI Visuals Gallery](#) provides an assortment of custom visuals to give you a head start on creating rich, dynamic visuals.

From the Power BI portal, you can create live connections to a variety of cloud-based databases, including [Azure SQL Database](#), [Azure SQL Data Warehouse](#), and [Apache Spark for Azure HDInsight](#). You can also connect directly to on-premises SQL Server Analysis Services databases.

One of the key features of Power BI service is content packs, which provide pre-packaged connectivity and dashboard visualization for more than 50 SaaS-based data sources, including Microsoft Dynamics, Salesforce, Acumatica, GitHub, MailChimp, Zendesk, and many others. Figure 2 shows an interactive dashboard for Microsoft Dynamics NAV, created by connecting to the data source with the [Microsoft Dynamics NAV content pack for Power BI](#) and logging in with NAV credentials. Clicking a tile drills down into the corresponding metric and displays a detailed report.

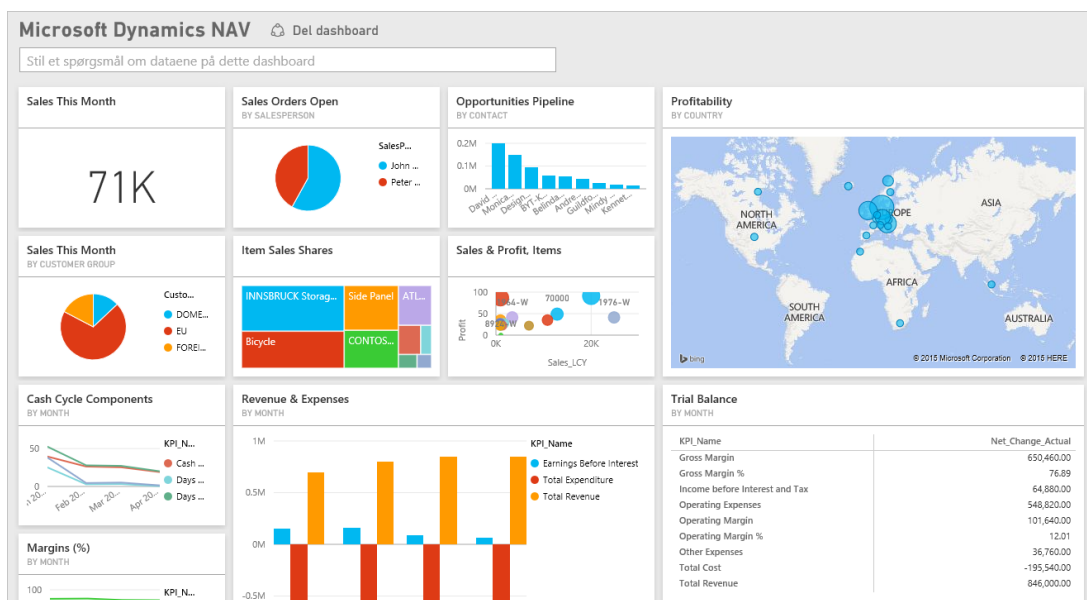


Figure 2: Interactive dashboard for Microsoft Dynamics NAV

Content packs that consume data from Google Analytics, Application Insights, Intelliboard, and Bing are especially useful in an academic context. You can also author your own content packs, for consumption by or to serve as analysis building blocks for others in your organization.

The Power BI portal makes it easy to share reports with other users (or groups of users) while limiting access to only those you grant it to, and offers the ability to send e-mail notifications to users to whom access has been granted. In addition, the recently introduced [Publish to Web](#) feature makes short work of sharing Power BI content publically in blog posts, social media, and other locations accessible from the Web. For more information and a guided tour showing how it works, see <https://powerbi.microsoft.com/en-us/documentation/powerbi-service-publish-to-web/>.

Power BI Desktop

[Power BI Desktop](#) runs on Windows and is the power user's data modeling and analytics tool. It provides advanced data import and query capability as well as rich customization options for data visualization, as shown in Figure 3.

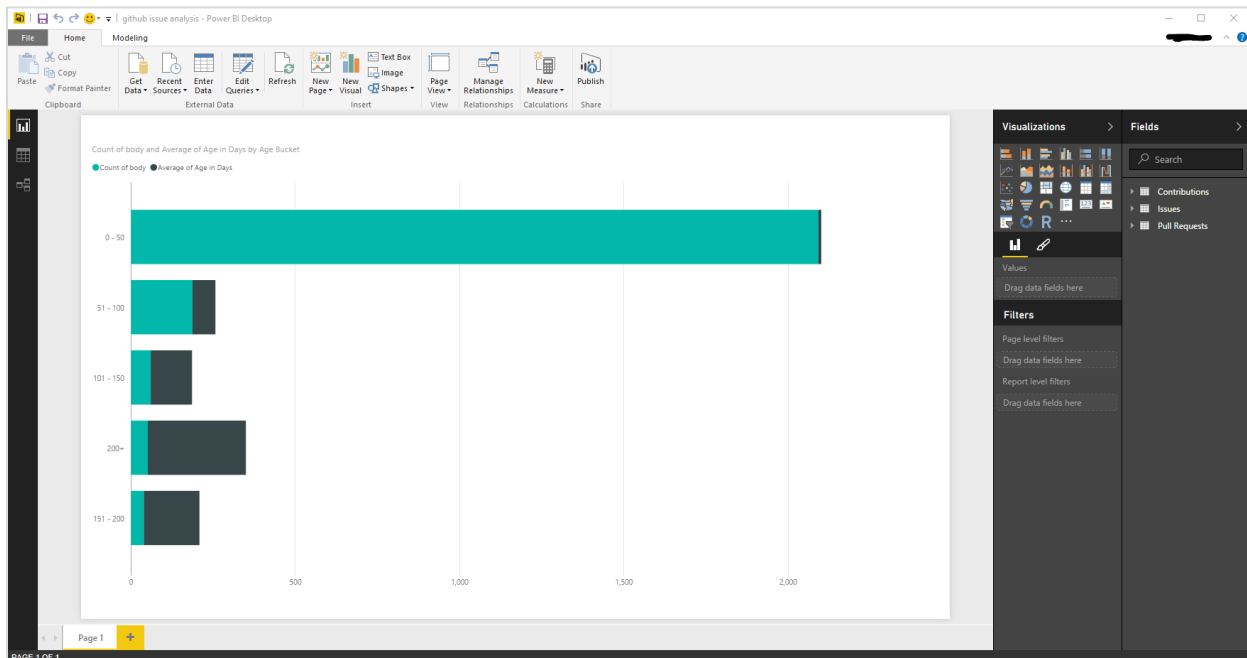


Figure 3: Power BI Desktop data visualization

Power BI Desktop supports a wide range of data connectivity options. The “Get Data” dialog, pictured in Figure 4, facilitates the loading of data from more than 65 types of data sources divided into five categories:

- **File** – Text files, Excel files, CSV files, XML files, JSON files, file-system folders, and SharePoint folders
- **Database** – SQL Server, Access, SQL Server Analysis Services, Oracle, IBM DB2, IBM Informix, MySQL, Postgres, Sybase, Teradata, SAP HANA, SAP Business Warehouse, Impala, and Amazon Redshift
- **Azure** – Azure SQL Database, Azure SQL Data Warehouse, Azure Marketplace, Azure HDInsight, Apache Spark on HDInsight, Azure Blob Storage, Azure Table Storage, Azure DocumentDB, and Azure Data Lake Store
- **Online Services** – SharePoint Online list, Microsoft Exchange Online, Dynamics CRM Online, Facebook, Google Analytics, Salesforce Objects, Salesforce Reports, appFigures, Azure Enterprise, comScore Digital Analytix, GitHub, MailChimp, Marketo, Planview Enterprise, QuickBooks Online, SparkPost, Smartsheet, SQL Sentry, Stripe, SweetIQ, Troux, Twilio, tyGraph, Webtrends, and Zendesk
- **Other** – Web (HTTP), SharePoint list, OData feed, Hadoop file system (HDFS), Active Directory, ODBC, R Script, Apache Spark, and Blank Query

Connecting to a data source is no more difficult than selecting it from the list and entering any required connection information, such as an access key for an Azure storage account or a URL. Power BI Desktop does the rest, loading the data from the data source and showing both its content and schema.

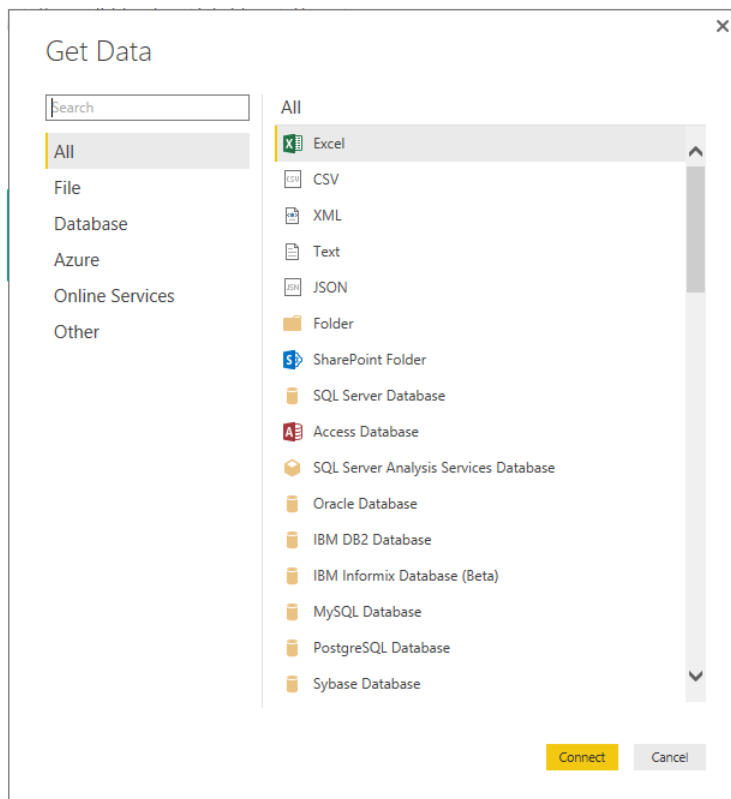


Figure 4: Power BI Desktop data connectivity options

Once data is loaded, it can be explored, transformed, and queried using the rich capabilities of Power BI Desktop. Through the Query Editor (Figure 5), you have the ability to define multiple queries for a given input data set. You can remove unused columns from a source data set, or add computed columns using the built-in expression editor. Duplicate rows and rows with erroneous data can be automatically detected and filtered. Column data types and formatting can be specified, including support for international locales. Output rows can be grouped by column values; you can also designate header rows to skip in your raw data set. It's important to realize that these query definition steps do not change the original source data; rather, they change the view Power BI uses to materialize the data for end-user consumption.

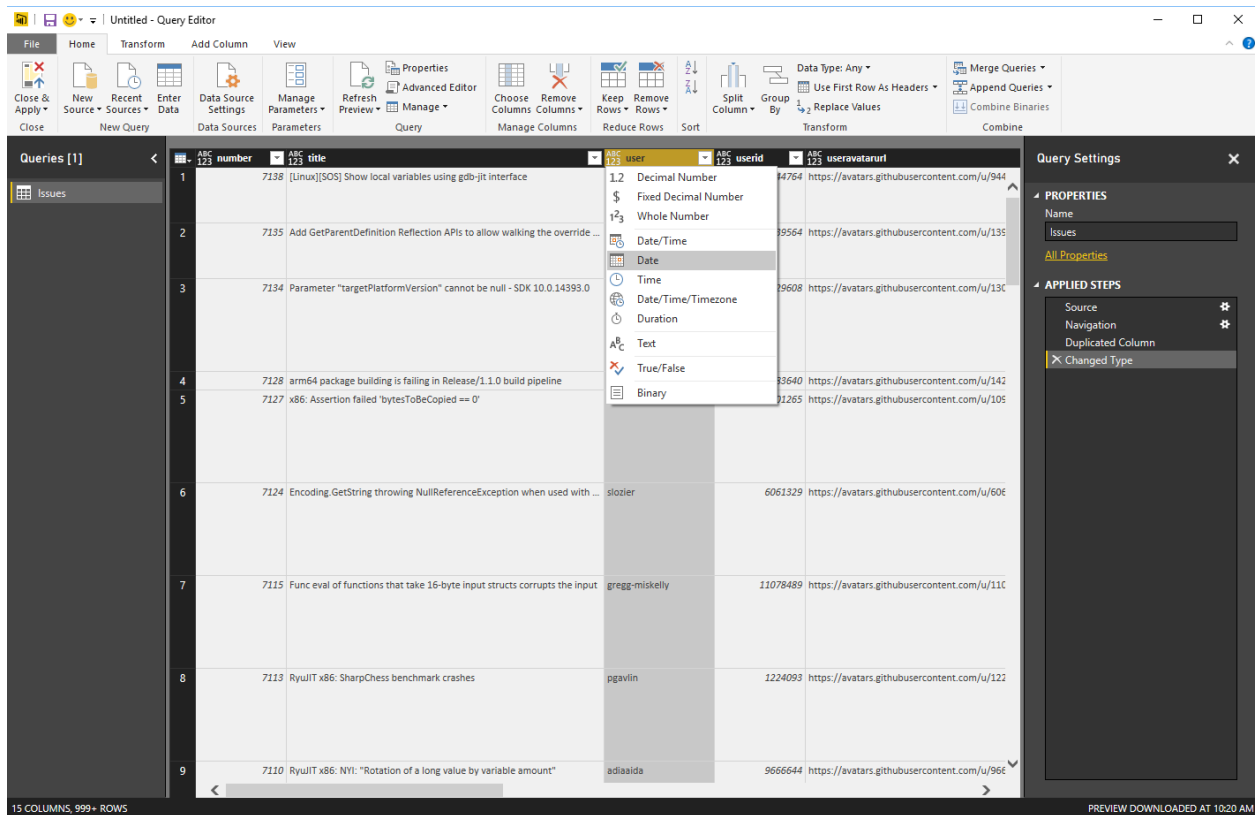


Figure 5: Power BI Desktop Query Editor

Another useful feature of the Query Editor is the Applied Steps view, which tracks the ordered sequence of query definition steps as you configure them. This makes it easy to understand not only what a query does, but *how* it does it. Query steps can be reordered and renamed to shape the query as needed and enhance understanding of the underlying logic.

Finally, Power BI Desktop grants you the ability to merge queries, which is similar to a JOIN in SQL. In Power BI, the output of two queries can be merged together using multiple merge types:

- Left Outer (all rows from first query output, matching rows from the second query output)
- Right Outer (matching rows from first query, all rows from second query)
- Full Outer (all rows from both queries)
- Inner (matching rows only from both queries)
- Left Anti (only rows appearing in the first query output)
- Right Anti (only rows appearing in the right query output)

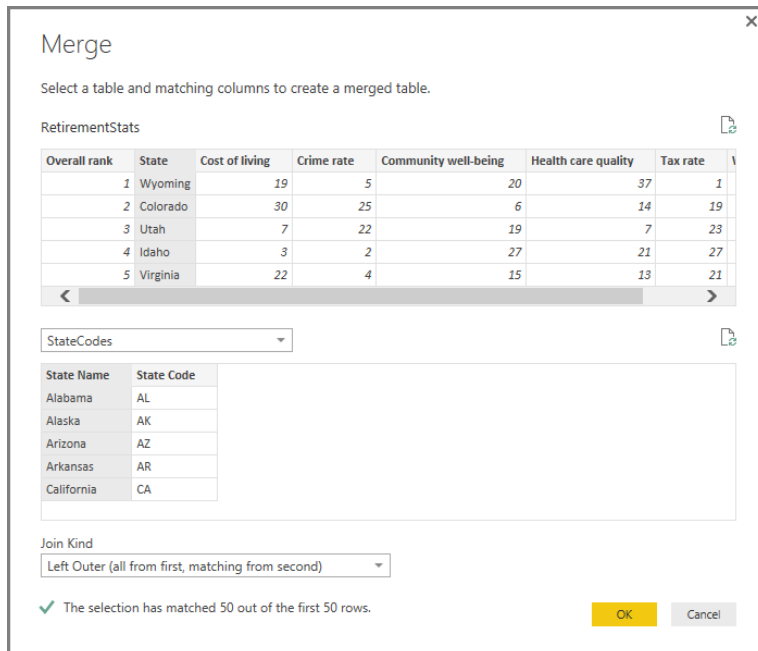


Figure 6: Merging data with Power BI Desktop

This ability to combine outputs from multiple queries allows you to join otherwise isolated data sets in new and interesting ways, and extract meaning where it might otherwise remain undiscovered.

Power BI Consumer Experiences

Power BI Desktop runs on Windows, but the ability to view and share content created with it isn't limited to Windows. Thanks to [Power BI Mobile](#), interactive reports created with Power BI can be viewed on mobile devices running iOS, Android, and Windows 10 Mobile, as well as the Apple Watch. The Android and iOS versions are pictured in Figure 7. Power BI Mobile gives you the ability to view and interact with the dashboards you create, share them with other users, open reports, annotate and share data via text messages and e-mail, and more.

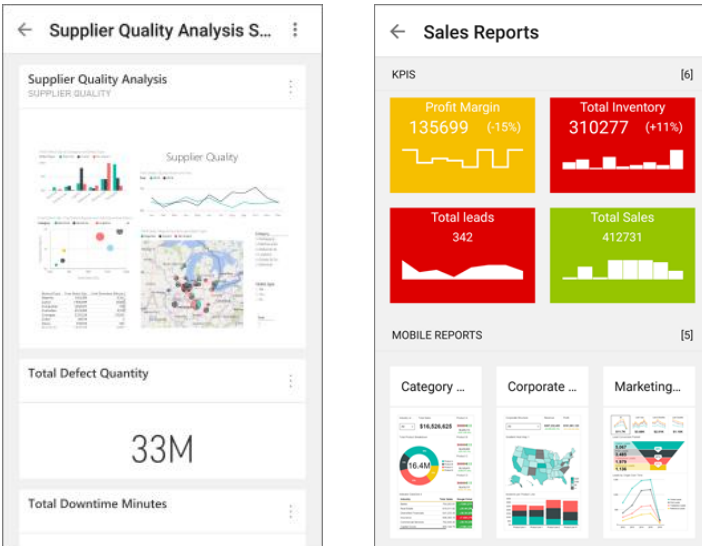


Figure 7: Power BI app for Android (left) and iOS (right)

[Power BI Embedded](#) extends Power BI's reach even further, enabling developers to integrate Power BI reports into Web pages and mobile apps of their own by embedding them securely in IFRAMEs (Figure 8). Reports created in Power BI Desktop and uploaded to Azure are referenced with embed URLs secured with hashed access tokens, allowing those reports to be displayed in any HTML5 browser or on any mobile device that supports HTML5. [REST APIs](#) provide a means for enumerating reports and performing other management-related tasks. Moreover, users who view the reports don't require a Power BI account of their own; charges go back to the reports' author.

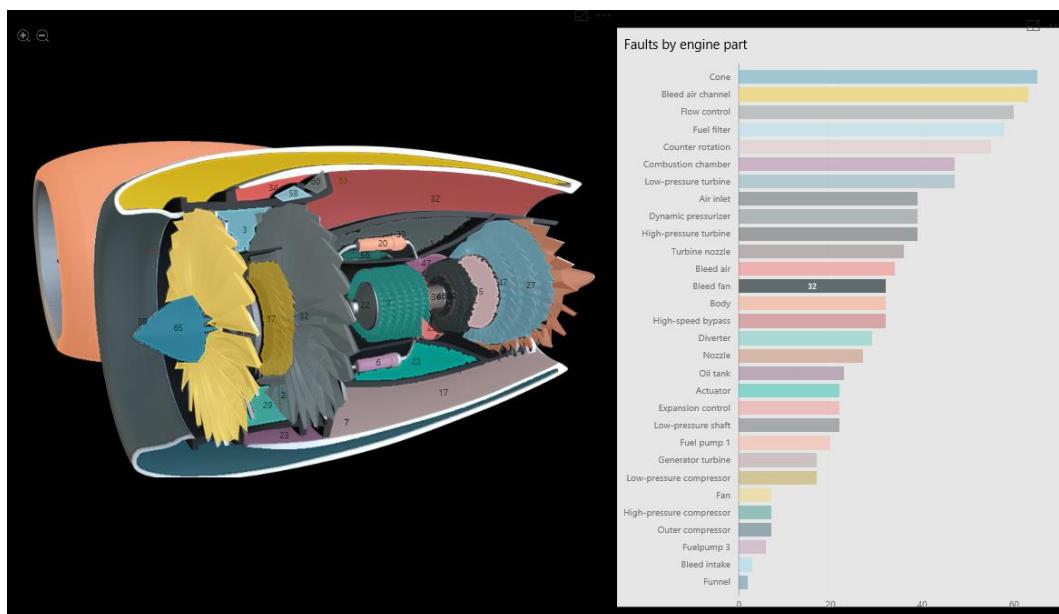


Figure 8: Interactive report embedded in a Web page with Power BI Embedded

Power BI at Work

Power BI is being used by numerous Microsoft partners and customers around the world to provide visual, interactive, and actionable insights on a wide range of data, from evaluating the effect of promotions on retail sales to analyzing portfolio returns. One of those partners is Dell, whose [Education Data Management](#) (EDM) system features dashboards and analytics built with Power BI to monitor and improve educational performance (Figure 9).



Figure 9: Student-Profile dashboard featured in Dell EDM

EDM is a decision-support system designed to meet and exceed institutional goals while addressing federal, state, district, college and university mandates. It enables better-performing education strategies, including recruitment and retention, fiscal management, compliance and reporting, PK-20 data monitoring and workforce readiness measurements. Dashboards and key performance indicators are used to improve student performance, monitor the efficiency of intervention programs, and help identify students at risk. Key metrics surfaced from the data include enrollment demographics, attendance, grades and assessments, discipline, college readiness, instructor and curriculum effectiveness, and student-success forecasting.

For more about how Dell EDM uses Power BI, see <https://powerbi.microsoft.com/en-us/partner-showcase/dell-edm/>. Additional case studies from a wide range of industries and partners are available at <https://powerbi.microsoft.com/en-us/partner-showcase/>.

Summary

The organizational mandate for efficient and effective data analysis is more important now than ever. So, too, is the need for a tool to help achieve this goal. Power BI provides a seamless, secure experience for connecting to data, massaging and shaping that data, visualizing it in ways that make sense to your consumers, and sharing the resulting insights with a larger community of stakeholders and interested parties.

To get started with Power BI yourself, navigate to <https://powerbi.microsoft.com> where you can learn more about the specific product offerings within the Power BI ecosystem, read case studies, follow a guided learning path, read about pricing, and sign up for a free trial account.

Need Help with Microsoft Power BI?

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