



Microsoft Power Platform Fundamentals

SECOND EDITION

Exam Ref PL-900

Craig Zacker

FREE SAMPLE CHAPTER |



Exam Ref PL-900 Microsoft Power Platform Fundamentals

Second Edition

Craig Zacker

Exam Ref PL-900 Microsoft Power Platform Fundamentals, Second Edition

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About the Author

CRAIG ZACKER is the author or coauthor of dozens of books, manuals, articles, and websites on computer and networking topics. He has also been an English professor, a technical and copy editor, a network administrator, a webmaster, a corporate trainer, a technical support engineer, a minicomputer operator, a literature and philosophy student, a library clerk, a photographic darkroom technician, a shipping clerk, and a newspaper boy.

Introduction

The Microsoft Certified: Power Platform Fundamentals certification is the initial entry point into a hierarchy of Microsoft Power Platform certifications. The PL-900: Microsoft Power Platform Fundamentals exam tests the candidate's knowledge of the components and capabilities of the four Microsoft Power Platform products: Power BI, Power Apps, Power Automate, and Power Virtual Agents, without delving deeply into specific programming and administration procedures.

With the Power Platform Fundamentals certification in place, candidates can then move on to the Microsoft Certified: Power Platform App Maker Associate certification (Exam PL-100: Microsoft Power Platform App Maker) and the Microsoft Certified: Data Analyst Associate certification (Exam DA-100: Analyzing Data with Microsoft Power BI). These two are specialist certifications covering more advanced areas of the Power Apps and Power BI products, respectively.

This book covers all the skills measured by the PL-900 exam, with each of the main areas covered in a separate chapter. Each chapter is broken down into individual skill sections, which cover all the suggested topics for each skill. It is recommended that you access trial versions of the Power Platform tools as you work your way through this book. Nothing can replace actual hands-on experience, and Microsoft provides fully functional evaluation platforms of Power Platform tools, all the components of which are accessible in the cloud and require no hardware other than a computer with internet access. Microsoft also provides a wealth of documentation for all the Power Platform tools at docs.microsoft.com. With these tools, as well as some time and dedication, you can prepare yourself for the PL-900 exam and the first step toward your certification path.

Organization of this book

This book is organized by the “Skills measured” list published for the exam. The “Skills measured” list is available for each exam on the Microsoft Learn website: <http://microsoft.com/learn>. Each chapter in this book corresponds to a major topic area in the list, and the technical tasks in each topic area determine a chapter's organization. If an exam covers six major topic areas, for example, as this one does, the book will contain six chapters.

Preparing for the exam

Microsoft certification exams are a great way to build your résumé and let the world know about your level of expertise. Certification exams validate your on-the-job experience and product knowledge. Although there is no substitute for on-the-job experience, preparation through study and hands-on practice can help you prepare for the exam. This book is not designed to teach you new skills.

We recommend that you augment your exam preparation plan by using a combination of available study materials and courses. For example, you might use the Exam Ref and another study guide for your “at home” preparation and take a Microsoft Official Curriculum course for the classroom experience. Choose the combination that you think works best for you. Learn more about available classroom training and find free online courses and live events at <http://microsoft.com/learn>. Microsoft Official Practice Tests are available for many exams at <http://aka.ms/practicetests>.

Note that this Exam Ref is based on publicly available information about the exam and the author’s experience. To safeguard the integrity of the exam, authors do not have access to the live exam.

Microsoft certifications

Microsoft certifications distinguish you by proving your command of a broad set of skills and experience with current Microsoft products and technologies. The exams and corresponding certifications are developed to validate your mastery of critical competencies as you design and develop, or implement and support, solutions with Microsoft products and technologies both on-premises and in the cloud. Certification brings a variety of benefits to the individual and to employers and organizations.

MORE INFO ALL MICROSOFT CERTIFICATIONS

For information about Microsoft certifications, including a full list of available certifications, go to <http://www.microsoft.com/learn>.

Check back often to see what is new!

Quick access to online references

Throughout this book are addresses to webpages that the author has recommended you visit for more information. Some of these links can be very long and painstaking to type, so we've shortened them for you to make them easier to visit. We've also compiled them into a single list that readers of the print edition can refer to while they read.

Download the list at *MicrosoftPressStore.com/ExamRefPL900/downloads*.

The URLs are organized by chapter and heading. Every time you come across a URL in the book, find the hyperlink in the list to go directly to the webpage.

Errata, updates & book support

We've made every effort to ensure the accuracy of this book and its companion content. You can access updates to this book—in the form of a list of submitted errata and their related corrections—at:

MicrosoftPressStore.com/ExamRefPL900/errata

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Identify the core components of Microsoft Power Platform

Microsoft Power Platform consists of primary applications such as Power BI, Power Apps, Power Automate, and Power Virtual Agents. However, there are also underlying technologies that all the applications can use, including the Microsoft Dataverse database, a collection of data connectors, and the AI Builder automation and intelligence engine, as shown in Figure 2-1.

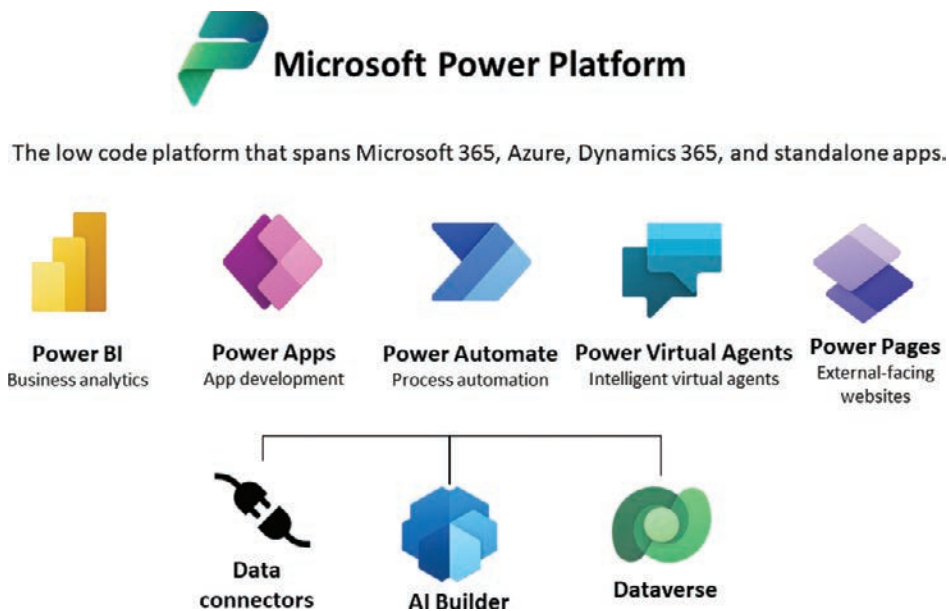


FIGURE 2-1 Microsoft Power Platform components

Skills covered in this chapter:

- Skill 2.1: Describe Microsoft Dataverse
- Skill 2.2: Describe connectors

Skill 2.1: Describe Microsoft Dataverse

Microsoft Dataverse is a cloud-based data storage solution that all the Power Platform applications can use to maintain their data in a secure, manageable environment. The Microsoft Dataverse was originally designed for use with Dynamics 365 applications, such as Sales and Customer Service. Therefore, Power Platform developers can use their existing Dynamics 365 business data, logic, and F0rules when creating new content in Power BI, Power Apps, and Power Automate.

This skill covers how to:

- Introduce Microsoft Dataverse
- Describe the difference between databases and Dataverse
- Describe the differences between Dataverse and Dataverse for Teams
- Describe tables, columns, and relationships
- Describe how to use common standard tables to describe people, places, and things
- Describe business logic uses, including business rules, real-time workflows, and actions
- Describe dataflows and their uses
- Describe solutions and their purpose

Introduce Microsoft Dataverse

Power Apps and the other Power Platform tools require data for developers to work with, and they are all able to connect directly to many different data sources, including local files, network resources, and cloud-based services.

Storing app data in Microsoft Dataverse

Depending on the nature of the app they are building, it is common for developers to connect to multiple data sources to gather the information they need. This can mean accessing multiple sites, authenticating with multiple accounts, and updating multiple data points at frequent intervals. Microsoft Dataverse can simplify this data gathering model by allowing developers to store the data from the different sources in a single protected place, in an integrated form. The data stored in Microsoft Dataverse is then available to any of the Power Platform tools, along with any Dynamics 365 data that is also stored there.

For example, when an organization relies heavily on data stored in many Excel workbooks, importing them one time into Microsoft Dataverse can be more convenient than connecting to each one repeatedly every time an app is revised or updated. When importing data into

Microsoft Dataverse, developers can model and transform the data using Power Query, just as they can when importing data using Power BI.

NEED MORE REVIEW? DATA MODELING AND TRANSFORMATION

For more information on data modeling and transformation, see “Skill 3.2: Connect to and consume data” in Chapter 3, “Describe the business value of Power BI.”

As with direct connections between apps and data sources, Microsoft Dataverse can synchronize with the data sources at regular intervals to keep the stored data updated. The apps that use the Microsoft Dataverse data can then be updated with the latest information as well.

Using Microsoft Dataverse with canvas and model apps

As mentioned in Chapter 1, “Describe the business value of Microsoft Power Platform,” Power Apps supports two basic app types for internal users: canvas and model apps. (A third type, portal apps, is intended to create websites for external users.)

Canvas apps are relatively simple and give the developer a great deal of control over the user experience the app provides. Power Apps offers canvas apps with standard functions such as read, write, search, and delete based on the structure of the data used by the app. Developers can use Power Platform connectors to access data sources directly, or they can use Microsoft Dataverse. It is possible to create more complex canvas apps, but the configuration process can become time-consuming for the developer.

Model apps are typically more complex than canvas apps, and they always use Microsoft Dataverse as a data source. Model apps also have less flexibility as far as the user experience is concerned; they use the Dynamics 365 framework. After the developer has created the data model, Power Apps generates a user interface that is appropriate for it. In fact, some of the Dynamics 365 Customer Engagement modules are essentially model-driven Power Apps. This makes it easier for developers to create more complex apps than it would be to manually create them from a blank canvas.

Describe the difference between databases and Dataverse

Microsoft Dataverse is frequently referred to as a database, in documentation and even in this book, but it is actually much more than that. Dataverse is often compared with SQL Server, as though the two are equivalents, but while the actual databases the two products create are similar in structure, Dataverse is fully integrated into Microsoft’s cloud infrastructure. Hosted by Microsoft Azure, Dataverse utilizes many of Azure’s services, not just to store data but also to provide data modeling, security, and integration with Microsoft 365 services. To implement in SQL Server what Microsoft Dataverse includes as standard features would require a substantial integration and development effort.

Figure 2-2 illustrates the many capabilities that Microsoft Dataverse provides to Power Platform developers and consumers.

Microsoft Dataverse: What's in the box

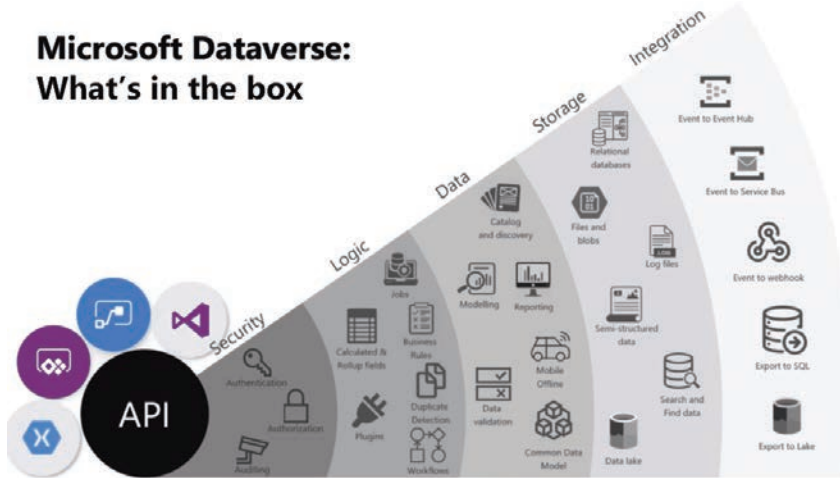


FIGURE 2-2 Microsoft Dataverse is fully integrated into the Azure cloud infrastructure

The diagram divides the Dataverse capabilities into five categories, as follows:

- **Security**—Azure Active Directory (AD) provides identity services, including authentication, authorization, and accounting, for Microsoft Dataverse and all of the Power Platform tools.
- **Logic**—Dataverse can apply business logic at the data level so that the rules are enforced no matter how users and apps are accessing the data.
- **Data**—Dataverse and Power Platform provide data modeling, transformation, and reporting tools, enabling users to alter the presentation of the data as needed.
- **Storage**—All Dataverse data is stored in the Azure cloud, with all of the security, protection, and fault tolerance that entails.
- **Integration**—Dataverse is integrated with the Microsoft 365 services hosted by Azure, including Office, SharePoint, Exchange, and OneDrive.

While SQL Server and other database management products might provide some of these services to a degree, none of them can provide the same capabilities as Microsoft Dataverse “out of the box.”

Describe the differences between Dataverse and Dataverse for Teams

When a user creates an app or flow within Microsoft Teams for the first time or installs an app from the app catalog, Teams creates a Dataverse for Teams environment to support it. Dataverse for Teams is a separate implementation of Microsoft Dataverse that performs the same basic functions for that particular team as the Dataverse does for a Power Platform environment. Dataverse for Teams stores the team’s data, apps, flows, and bots and makes them available to other team members. Dataverse for Teams is provided with most of the Microsoft 365 licenses that include Microsoft Teams

The environment that Microsoft Teams creates appears on the Environments page in the Power Platform admin center, as shown in Figure 2-3, with Microsoft Teams listed as its type. However, the apps and flows that users create in Teams do not appear in the Power Apps portal or the Power Apps mobile app.

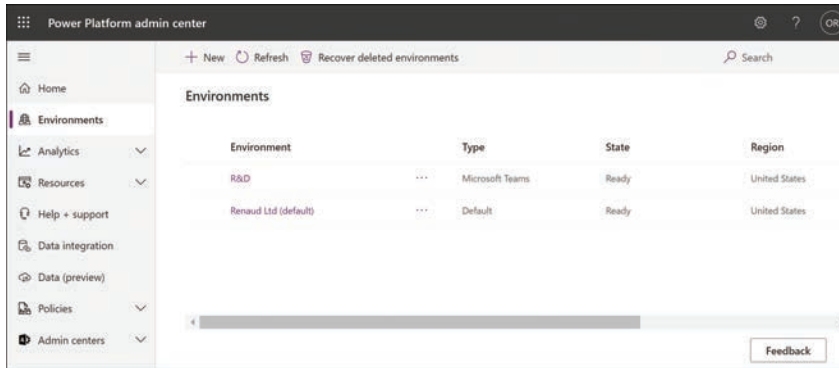


FIGURE 2-3 A Dataverse for Teams environment in the Power Platform admin center

The apps and flows stored in a Dataverse for Teams environment are accessible to team members using links from within Teams or, when outside of Teams, through a web browser, as long as the user has a standalone Power Apps license. Team members can also invite guests and provide them with the ability to discover and run the apps, flows, and bots in the Database for Teams environment. However, the guests cannot create or modify apps and flows.

The Dataverse for Teams environment has no application programming interface (API) access and is available only to apps, flows, and bots within that environment. Storage is limited to 2 gigabytes per team, with up to one million table rows. The license supports up to five teams, with one additional team for every 20 licenses purchased.

If API access is needed, or if the environment's storage limit is reached, or if users need to access the apps, flows, and bots using the standalone Power Platform tools, it is possible for a tenant admin to upgrade the Dataverse for Teams environment to a standard Microsoft Dataverse environment using the Power Platform admin center portal.

Describe tables, columns, and relationships

Microsoft Dataverse is a cloud-based data storage solution, which means it is available to any users with internet access and appropriate credentials. As with most of Microsoft's cloud-based products, Microsoft Dataverse uses Azure Active Directory (AAD) for user authentication and authorization. Organizations that are Microsoft 365 subscribers can use their same user accounts to access Microsoft Dataverse data; Dynamics 365 subscribers are already accessing their Microsoft Dataverse data with their AAD user accounts.

Power Platform developers can create multiple Dataverse database instances to accommodate the needs of various apps and users. Each database instance can support up to 4 terabytes of storage; additional storage is also available for purchase.



EXAM TIP

Since the publication of this book in its first edition, Microsoft has made substantial changes to the terminology used in Power Platform. What used to be called the Common Data Service is now Microsoft Dataverse, and the elements of the databases it creates have also been renamed, as follows:

What used to be called:	Is now called:
Common Data Service	Microsoft Dataverse
Entities	Tables
Fields	Columns
Records	Rows

While much of Microsoft's own documentation has already been updated with the new terminology, there are still a great many sources that have not. Candidates for the PL-900 exam should be conscious of these modifications when selecting preparation materials.

Using tables

When a developer creates a database instance in Microsoft Dataverse, it consists of a standard set of tables, with each table having a standard set of columns. A default Microsoft Dataverse instance has a base set of standard tables, some of which are shown in Figure 2-4, any of which the developer can select and populate with data from an outside source.

Table	Name	Type	Customiza...	Tags
Account	account	Standard	✓	Core
Address	customeraddress	Standard	✓	Standard
Appointment	appointment	Standard	✓	Productivity
Attachments	activitymimeattachment	Standard	✓	Productivity
Business Unit	businessunit	Standard	✓	Standard
Contact	contact	Standard	✓	Core
Currency	transactioncurrency	Standard	✓	Standard
Email	email	Standard	✓	Productivity
Email Template	template	Standard	✓	Standard
Fee	fee	Standard	✓	Productivity
Feedback	feedback	Standard	✓	KB
Letter	letter	Standard	✓	Productivity
Mailbox	mailbox	Standard	✓	Configuration
Organization	organization	Standard	✓	System
Phone Call	phonecall	Standard	✓	Standard
Position	position	Standard	✓	System
Recurring Appointment	recurringappointmentmaster	Standard	✓	Standard
Task	task	Standard	✓	Productivity

FIGURE 2-4 Standard tables in a Microsoft Dataverse instance

In addition to the standard tables created with every Microsoft Dataverse instance, developers can create custom tables to suit the requirements of specific business applications, assuming that none of the standard ones are suitable. It is possible to rename a standard table if that makes it more suitable to the application that will use it.

Creating a custom table is simply a matter of clicking the +New table button on the Tables screen in the Power Apps portal to open the dialog box shown in Figure 2-5 and supplying a name for the table. After expanding the More settings header, the developer can specify the table type and the ownership option. After the developer has created the new table in the Power Apps portal, they can create custom columns within it.

Aside from the Standard table type, the developer can also choose the Activity table type, which is a table that can manage tasks for which it is possible to create a calendar entry, such as appointments, phone calls, faxes, and emails.

The other option for the Standard table type is its ownership, which has the following options:

- *User or team*—Actions that developers can perform on this table’s records are controlled at the user level. User or team ownership is the only possible option for Activity tables.
- *Organization*—Access to the data stored in the table is controlled at the organization level.

The image shows a 'New table' dialog box with the following fields and options:

- Display name ***: An empty text input field.
- Plural display name ***: An empty text input field.
- Name ***: A text input field containing 'cr5fa_' with an information icon to its right.
- Primary Name Column**: A section header with an information icon.
- Display name ***: A text input field containing 'Name'.
- Name ***: A text input field containing 'cr5fa_ Name' with an information icon to its right.
- Enable attachments (including notes and files)**
- More settings** with a downward arrow.
- Create** and **Cancel** buttons at the bottom.

FIGURE 2-5 New table dialog box in the Power Apps portal

NOTE COMPLEX AND RESTRICTED TABLES

Apart from standard and custom tables, Microsoft Dataverse also supports two other types of tables: complex tables and restricted tables. Complex tables include real-time workflows, plug-ins, or other types of server-side business logic. Restricted tables typically contain configuration data for specific products. Neither of these table types is typically used by Power Apps citizen developers, and both have licensing requirements that go beyond the Power Apps/Power Automate Plan 1 license needed for standard and custom tables. For complex tables, users must have a Power Apps/Power Automate Plan 2 license. For restricted tables, users must have a license for the specific Dynamics 365 product that uses the table, such as Dynamics 365 Sales or Customer Service.

Using columns

Columns are the attributes within a table that contain specific types of data. Just as an entity in the Common Data Service is the equivalent of a table in Microsoft Dataverse, a field in an entity is the equivalent of a column in a table, which contains a particular data point for each record, represented by a row in the table. For example, every table has an Address column by default, which is configured with a data type called Multiline Text, indicating that every value for that column can consist of one or more lines of plain text. Other columns might have data types such as Whole Number, Date and Time, or Phone.

Just as a standard set of tables exists in every database instance, a standard set of columns exists in every table, as shown in Figure 2-6. Depending on the table, there can be just a few standard columns or over a hundred.

Display name	Name	Data type	Type	Custom...	Required	Searchable
Access Failed Count	adx_identity_accessfailedcount	Whole ...	Managed	✓	Optional	✓
Address 1	address1_composite	Multilin...	Managed	✓	Optional	✓
Address 1: Address Type	address1_addresstypecode	Choice	Managed	✓	Optional	✓
Address 1: City	address1_city	Text	Managed	✓	Optional	✓
Address 1: Country/Region	address1_country	Text	Managed	✓	Optional	✓
Address 1: County	address1_county	Text	Managed	✓	Optional	✓
Address 1: Fax	address1_fax	Text	Managed	✓	Optional	✓
Address 1: Freight Terms	address1_freighttermscode	Choice	Managed	✓	Optional	✓
Address 1: ID	address1_addressid	Unique ...	Standard	✓	Optional	✓
Address 1: Latitude	address1_latitude	Floating...	Managed	✓	Optional	✓
Address 1: Longitude	address1_longitude	Floating...	Managed	✓	Optional	✓
Address 1: Name	address1_name	Text	Managed	✓	Optional	✓
Address 1: Phone	address1_telephone1	Phone	Managed	✓	Optional	✓
Address 1: Post Office Box	address1_postofficebox	Text	Managed	✓	Optional	✓
Address 1: Primary Contact Name	address1_primarycontactname	Text	Managed	✓	Optional	✓
Address 1: Shipping Method	address1_shippingmethodcode	Choice	Managed	✓	Optional	✓

FIGURE 2-6 Standard columns in a Microsoft Dataverse table

Developers can often use the standard columns for most purposes, but when they cannot, it is possible to create customized columns. Clicking the +Add column button on a table page in the Power Apps portal opens the Column properties dialog box, as shown in Figure 2-7.

The image shows a 'Column properties' dialog box with the following fields and options:

- Display name ***: An empty text input field.
- Name ***: A text input field containing 'cr5fa_'. It includes an information icon (i).
- Data type ***: A dropdown menu set to 'Text'. It includes an information icon (i).
- Required ***: A dropdown menu set to 'Optional'. It includes an information icon (i).
- Searchable**: A checked checkbox with an information icon (i).
- Calculated or Rollup**: A section with an information icon (i) and a '+ Add' button with a dropdown arrow.
- Description**: An empty text area with an information icon (i).
- Advanced options**: A dropdown menu with a downward arrow.
- Buttons**: 'Done' and 'Cancel' buttons at the bottom.

FIGURE 2-7 Column properties dialog box in the Power Apps portal

Understanding relationships

Depending on the nature of the app a developer is creating and the data that it will use, it might be a good idea to create multiple tables to hold different types of data, rather than store many different data types in a single table.

For example, in the case of an order entry app, the developer might need to maintain a list of incoming invoices and a list of the products ordered on each invoice. The database for this app would therefore need—at minimum—records for the invoices and records for the products ordered. There would presumably also need to be records for customer information and records for an inventory of products. Storing all of this information in a single table would be complicated at best.

To better organize the data for the app, it would therefore be preferable to create multiple tables and establish relationships between them. If the developer creates separate tables for the invoices and the products ordered, there could be said to be a *one-to-many* (also called a parent/child or 1:N) relationship between the two tables. The invoice table would be the one (or the parent), and the products table could contain as many product records (or children) as are needed for each invoice.

In the same way, the invoice table can have a *many-to-one* (N:1) relationship to a table containing customer information. Each customer can have many invoices, but each invoice is associated with only one customer. This type of relationship between tables appears as a field type called a *lookup field*.

Microsoft Dataverse also supports *many-to-many* (or N:N) relationships between tables, in which many records in one table are associated with many records in another table, in what are known as *peer relationships*.

As mentioned earlier, the standard tables provided by Microsoft Dataverse are sufficient for the needs of most developers and their apps, and the relationships between the tables are already in place. Selecting any table in the Power Apps portal and selecting the Relationships tab displays the existing relationships and their types, as shown in Figure 2-8.

From this screen, it is also possible for developers to create new relationships by clicking the +Add relationship button and choosing Many-to-one, One-to-many, or Many-to-many, to open a dialog box like the one shown in Figure 2-9.

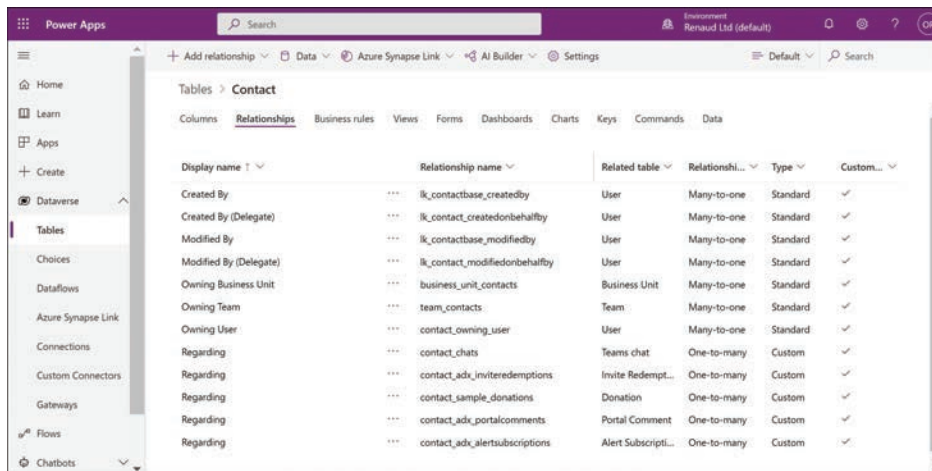


FIGURE 2-8 The Relationships tab for the Contact table in the Power Apps portal

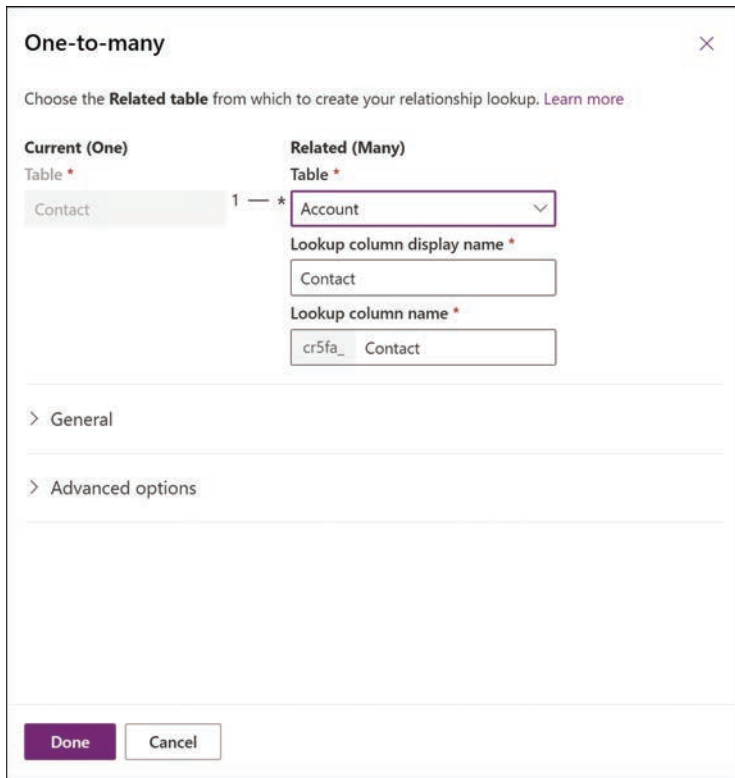


FIGURE 2-9 The One-to-many dialog box in the Power Apps portal

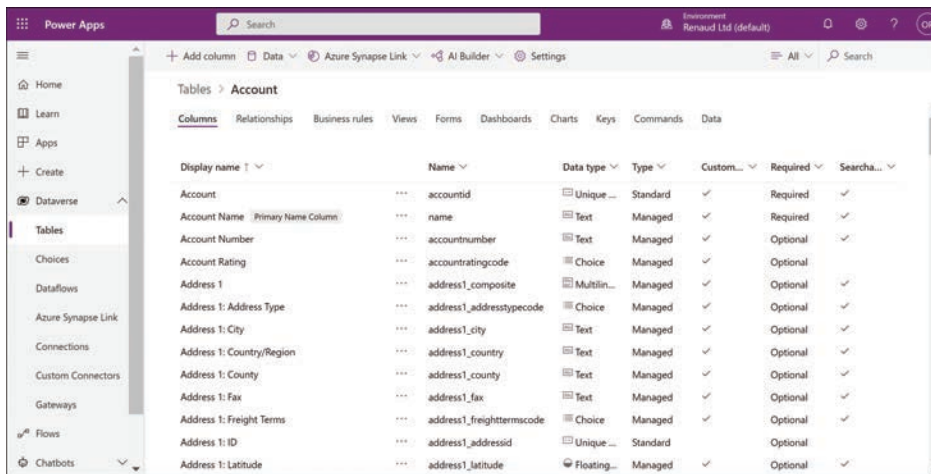
Describe how to use common standard tables to describe people, places, and things

As mentioned earlier in this chapter, creating a Microsoft Dataverse instance in an environment automatically populates the database with a collection of standard tables that are designed to support the most commonly used types of business data, including the following:

- Account
- Address
- Appointment
- Attachment
- Business Unit
- Contact
- Currency
- Email
- Feedback

- Letter
- Mailbox
- Organization
- Phone call
- Position
- Task
- Team
- User

These tables represent people, places, and things, elements that many businesses use on a daily basis when communicating both internally and outside the organization. Each table includes columns appropriate to its subject, as shown in Figure 2-10. The standard tables are all customizable, making it possible for developers to add new columns or modify existing ones as needed.



Display name	Name	Data type	Type	Custom...	Required	Search...
Account	accountid	Unique ...	Standard	✓	Required	✓
Account Name (Primary Name Column)	name	Text	Managed	✓	Required	✓
Account Number	accountnumber	Text	Managed	✓	Optional	✓
Account Rating	accountratingcode	Choice	Managed	✓	Optional	✓
Address 1	address1_composite	Multilin...	Managed	✓	Optional	✓
Address 1: Address Type	address1_addresstypecode	Choice	Managed	✓	Optional	✓
Address 1: City	address1_city	Text	Managed	✓	Optional	✓
Address 1: Country/Region	address1_country	Text	Managed	✓	Optional	✓
Address 1: Country	address1_country	Text	Managed	✓	Optional	✓
Address 1: Fax	address1_fax	Text	Managed	✓	Optional	✓
Address 1: Freight Terms	address1_freighttermscode	Choice	Managed	✓	Optional	✓
Address 1: ID	address1_addressid	Unique ...	Standard	✓	Optional	✓
Address 1: Latitude	address1_latitude	Floating...	Managed	✓	Optional	✓

FIGURE 2-10 Columns in the Account table in the Power Apps portal

NEED MORE REVIEW? STANDARD TABLES

For more information on standard tables, see “Describe tables, columns, and relationships,” earlier in this chapter.

Describe business logic uses, including business rules, real-time workflows, and actions

Power Apps provides several mechanisms that developers can use to implement business logic in their apps, including business rules, workflows, and actions. These mechanisms are described in the following sections.

Business rules

Business rules enable developers to implement business logic on data stored in the Microsoft Dataverse. Because the rules apply to the data, and not to a specific app, they take effect however the data is used. For example, if the value of the Country field in a table is entered as Canada, a business rule can enable a six-digit alphanumeric Postal Code field and hide the five-digit numeric Zip Code field used for US addresses.

Business rules consist of conditions and actions. *Conditions* are circumstances that must be met for the rule to apply, and *actions* are the procedures taken when the circumstances of the condition are met. When a developer opens a table in the Power Apps portal and selects New > Business Rule, a New business rule canvas appears, as shown in Figure 2-11.

As with a business process flow, developers can drag elements from the Components pane to the canvas. Selecting an element on the canvas causes the Properties interface for that element to appear in the right pane. The combination of conditions and actions creates an IF/THEN logic statement that appears in the Business Rule (Text View) box on the canvas.

For a condition, the developer configures one or more rules specifying when the actions should occur. In the figure, the condition calls for the Country field to have the value Canada. When that condition is met, the specified actions occur. The developer can then create actions that cause the US Zip Code field to be hidden and the Canadian-format Postal Code field to be shown.

Conditions can be more complex, with multiple rules that use Boolean AND/OR operators to specify whether both conditions, or either one of the conditions, must be met for the actions to apply. The rule can also include multiple actions that execute when the condition is met.

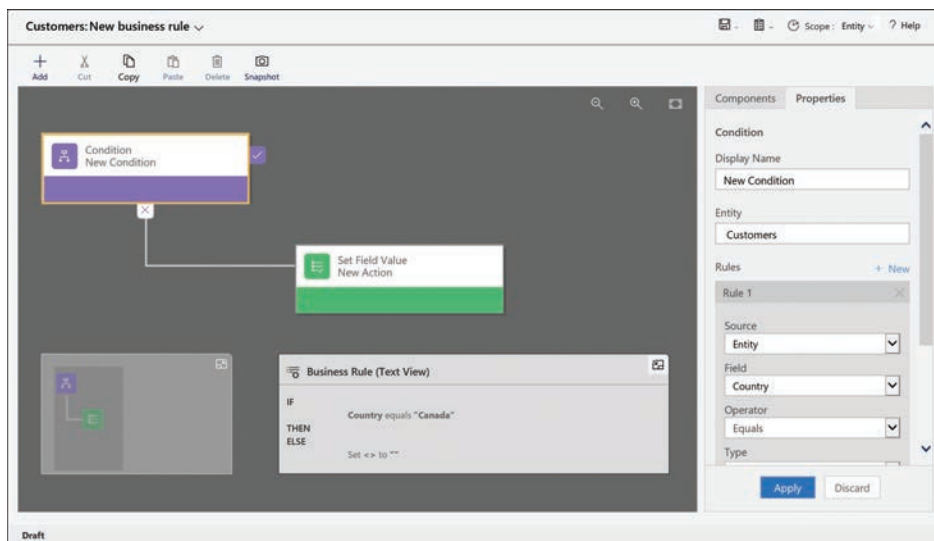


FIGURE 2-11 A New business rule canvas in the Power Apps portal

The most common functions of business rules are to simplify the process of supplying data for users and verify the accuracy of the data that users supply. To that end, developers can create rules that set values for fields, clear the values from fields, and validate the data entered into fields. In model-driven apps (only), business rules can also show, hide, enable, and disable fields. For example, when users are required to supply their annual income in a field, a rule can enable additional fields for verification if the income exceeds a specified amount.

Real-time workflows

Real-time workflows are a means of automating repetitive processes on tables that do not require user interaction. Workflows, like business processes, are organized into stages, each of which has a series of steps. The steps can cause the workflow to create, update, and assign table rows, as well as launch other workflows. Another type of workflow, the *background workflow*, is run by Power Automate.

Actions

Actions, also known as custom actions or custom process actions, are similar to real-time workflows in that they are divided into stages and steps and consist of conditions and actions. Custom actions expand the native capabilities of Power Platform by creating custom messages. Power Apps has built-in messages that use verbs such as Create, Update, and Delete. With custom actions, users can create additional messages that consist of multiple steps, resulting in new verbs, such as Approve, Escalate, or Convert.

Describe dataflows and their uses

Dataflows are Power Apps features that enable developers to gather data from multiple sources, combine and transform the data, and store it in a table, either in the Microsoft Dataverse or in Azure Data Lake Storage. Once stored, the data is accessible to Power Apps apps and refreshed according to a schedule specified by the developer. Other developers in the organization can then make use of the dataflow with assurance that it is up to date and organized into a useful form.

Describe solutions and their purpose

One of the basic design principles of the Microsoft Dataverse is the ability to customize the database to suit specific applications. The extensions that developers create, package, and deploy to the Dataverse are called solutions. A *solution* consists of all the customizations made to the Dataverse, including any modifications that developers might make to an existing solution. The entire solution is packaged as a single file that developers can distribute and import into other environments.

Solutions can contain a variety of components generated by the Power Platform tools, including Power Apps canvas apps and model-driven apps, Power Automate flows, custom connectors, and Dataverse tables. However, solutions do not contain any business data.

Developers can create two types of solutions, as follows:

- *Unmanaged*—Intended for development environments in which modifications are being made to the solution. Developers can export an unmanaged solution as either a managed or unmanaged solution. After a developer imports an unmanaged solution, deleting the solution causes the solution file to be deleted, but the customizations applied to the environment remain in place.
- *Managed*—Intended for nondevelopment situations, such as test and production environments. Developers cannot export a managed solution or edit the components in a managed solution directly; they must first add the components to an unmanaged solution, which is editable. Deleting a managed solution causes all of the customizations included in the solution to be removed from the environment.

The typical progression is for developers to create and refine an unmanaged solution in a development environment and then export it as a managed solution for deployment in a test environment and later a production environment, as shown in Figure 2-12.

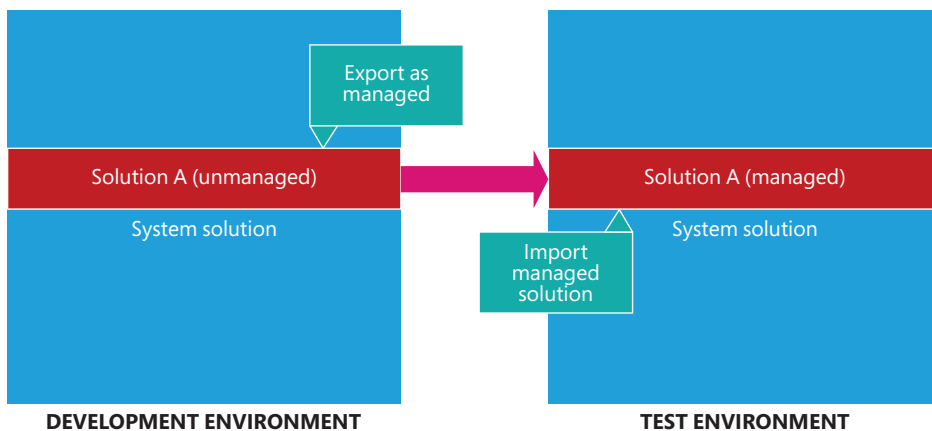


FIGURE 2-12 Development progression using unmanaged and managed solutions

To create a solution, a developer clicks the New solution button on the Solutions page in the Power Apps portal to open the dialog box shown in Figure 2-13. After the solution is created, the developer can then create components or add existing ones. Developers can employ solutions in a variety of use cases, including application lifecycle management and business process flows.

The image shows a 'New solution' dialog box. At the top left is the title 'New solution' and a close button (X). Below the title bar are four input fields, each with a red asterisk indicating it is required: 'Display name *', 'Name *', 'Publisher *', and 'Version *'. The 'Version' field contains the text '1.0.0.0'. To the right of the 'Display name' field is a 'Close' button. Below the 'Version' field is a link 'More options' with a downward arrow. At the bottom of the dialog are two buttons: 'Create' and 'Cancel'.

FIGURE 2-13 The New solution dialog box in the Power Apps portal

Skill 2.2: Describe connectors

Connectors are the Power Platform components that allow Power Apps and Power Automate to interact with outside applications, services, and data files and utilize their data. Hundreds of public connectors are available to Power Platform users, and for those applications and services that are not supported, it is possible for developers to create custom connectors.

A *connector* is a proxy wrapper that Power Platform tools use to access an application programming interface (API) provided by an application or service. Many applications and cloud services have the necessary APIs, and the Power Platform connectors function as *proxies*, or intermediaries between the outside APIs and the internal Power Platform tools. The

connector, in its role as a proxy, authenticates to the outside application or service and then provides Power Apps and Power Automate with access to its data.

This section covers how to:

- Describe triggers, including trigger types and where triggers are used
- Describe actions
- Describe licensing options for connectors, including standard or premium tier
- Identify use cases for custom connectors

Describe triggers, including trigger types and where triggers are used

Triggers are components in Power Automate that cause a flow to begin running. Some triggers can be schedule based, so that the flow launches at a specific date and time; others can be event based, so that the flow launches when a user performs a specific task, or even manual, in which a user launches a flow by clicking or tapping a button. However, there are also triggers associated with data connectors, so that changes involving a data source cause a flow to launch.

For example, the connector for SharePoint includes triggers that can launch a flow when an item is created, when an item is created or modified, or when a file is created in a folder, as shown in Figure 2-14.

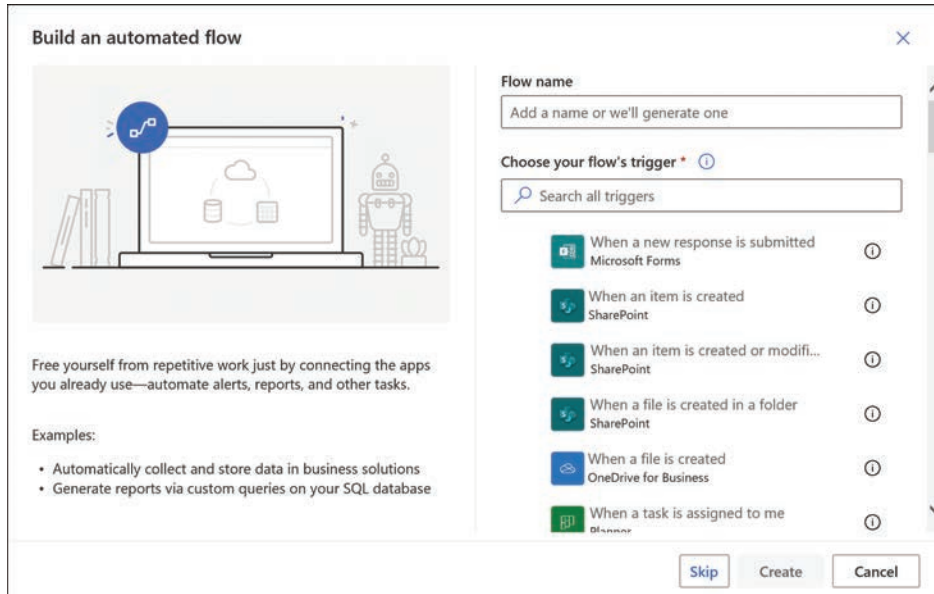


FIGURE 2-14 The Build an automated flow dialog box from the Power Automate portal

When a developer creates an automated flow—that is, a flow that is launched by an outside event—two types of triggers are available:

- *Polling triggers*—Connect to the outside data source at scheduled intervals to check for new data, launching the flow using that new data as input when it becomes available
- *Push triggers*—Listen at a server endpoint for notifications that a specific event has occurred on an outside application or service, launching the flow when the notification arrives

When developers create instant flows or scheduled flows, they still use triggers, but these triggers function autonomously. An instant flow uses a trigger that is tied to a button or other control in an app that requires user interaction to launch the flow. Scheduled flows use a trigger that the developer configures to activate at a specific date and time, using the interface shown in Figure 2-15.

Build a scheduled flow

Stay on top of what's important without the effort—you choose when and how often the flow runs.

Examples:

- Automate team reminders to submit expense reports
- Auto-backup data to designated storage on a regular basis

Flow name
Add a name or we'll generate one

Run this flow *

Starting 6/2/20 at 10:00 AM

Repeat every 1 Minute

This flow will run:
Every minute

Skip Create Cancel

FIGURE 2-15 The Build a scheduled flow dialog box from the Power Automate portal

Describe actions

Actions are specific modifications made to the data provided by an outside application or service. In Power Automate, actions are usually the result of a trigger, but developers can use them in Power Apps as well. For example, when a developer creates a manual trigger in a Power Automate flow, the next step is to select an action that will be the result of the trigger, as shown in Figure 2-16. Apps and flows can include multiple actions using different connectors to perform a sequence of tasks.

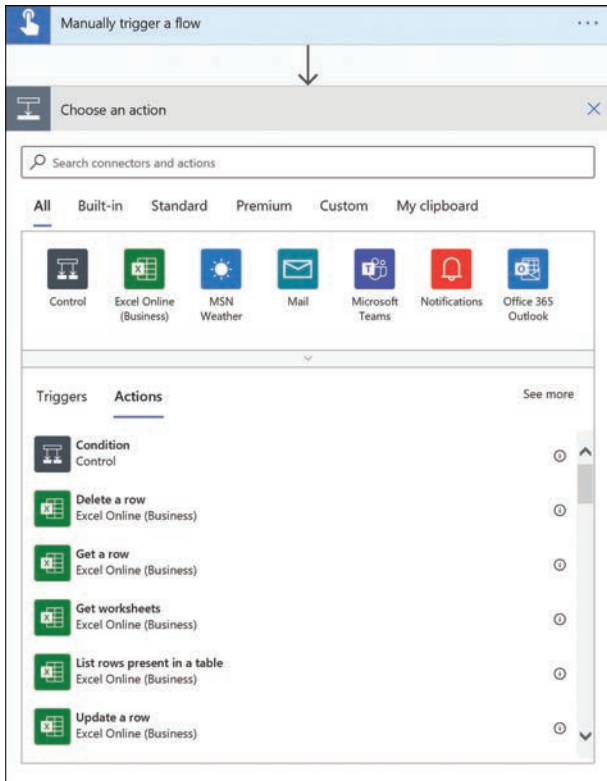


FIGURE 2-16 The Choose an action dialog box in the Power Automate portal

Actions can cause an application or service to perform a task, such as send an email, or modify the source data in some way. For example, Figure 2-17 contains the interface for an action that deletes a row from a specific Excel spreadsheet.

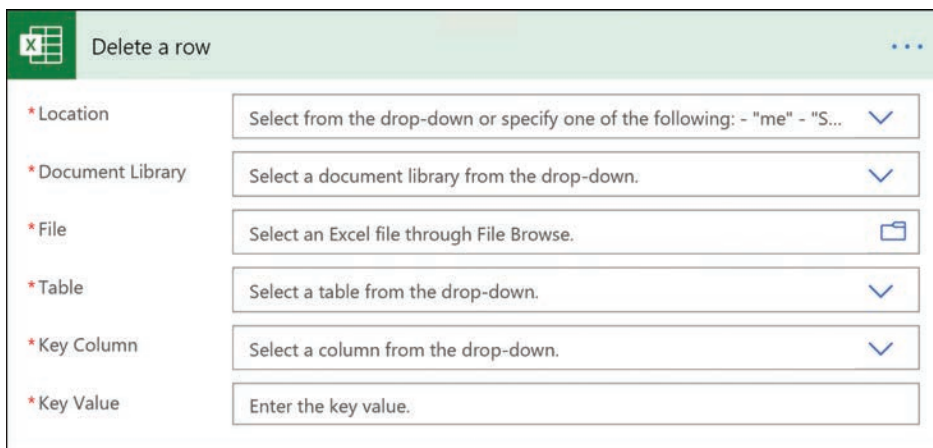


FIGURE 2-17 The Delete a row action for Excel in the Power Automate portal

The developer uses the interface to specify the location of the Excel file, identify the worksheet in the file on which the action will be performed, and specify the row to be deleted. Other actions for the Excel connector make it possible to get data from a worksheet or update a worksheet with new data supplied by the app or flow. The actions for the many other connectors depend on the capabilities of the application or service.

Describe licensing options for connectors, including standard or premium tier

As mentioned earlier, Power Platform provides connectors for over 200 applications and services, and Microsoft is regularly adding new ones. There are two classes of connectors, standard and premium, access to which is based on the Power Apps or Power Automate license in use.

Standard connectors are available to all licensees of Power Apps and Power Automate, regardless of the plan or product through which the user obtained the license. The standard connectors include those for many of the Microsoft 365 and Office 365 applications and services, as well as for popular social media services, a sampling of which is shown in Figure 2-18.

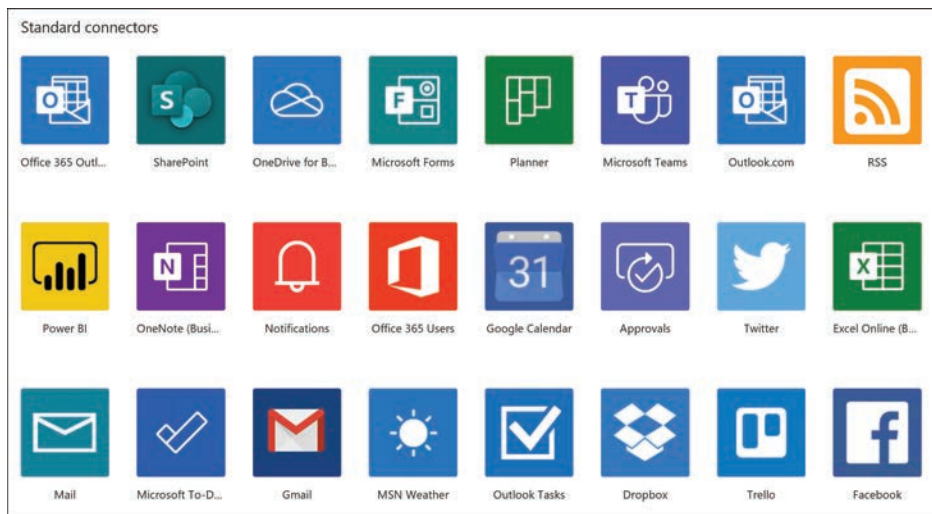


FIGURE 2-18 Sampling of standard connectors in Power Automate

The connectors designated as premium are available to licensed users of the standalone versions of Power Apps (both the per user and the per user, per app plans) and Power Automate (both the per user and per flow plans), as well as to Dynamics 365 users. The premium connectors feature those for many commercial Microsoft and third-party services, including SQL Server and Dynamics 365. A sampling of the premium connectors is shown in Figure 2-19.

Power Apps standalone licenses include Power Automate capabilities, as long as the Power Automate flows exist in the context of a Power Apps application. These contextual flows are permitted to use whatever standard and premium connectors are provided with the Power

Apps license. Standalone flows that are not part of a Power Apps application are not supported by the Power Apps license; a standalone Power Automate license is required.

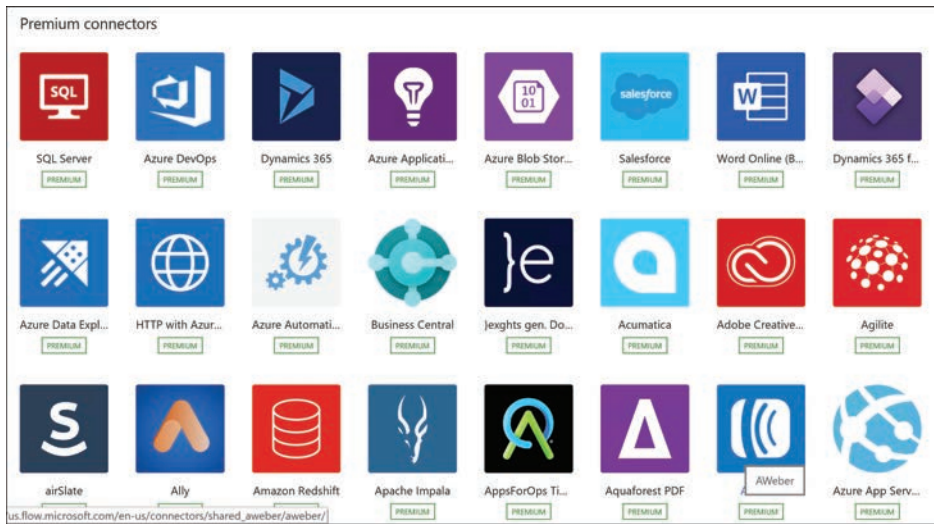


FIGURE 2-19 Sampling of premium connectors in Power Automate

Licensed Microsoft 365 and Office 365 users have access to the standard connectors in Power Apps and Power Automate, but they do not have access to premium connectors. To gain access to the premium connectors, they need a standalone Power Apps and/or Power Automate license as well.



EXAM TIP

Candidates for the PL-900 exam should be aware of the fact that, despite their being referred to by the single name Power Platform, the Power BI, Power Apps, Power Automate, and Power Virtual Agents tools are separate products, each requiring its own license and with its own licensing terms. For a full description of the licensing terms for Power Apps, Power Automate, and Power Virtual Agents, see the licensing guide available at <https://go.microsoft.com/fwlink/?linkid=2085130>.

Identify use cases for custom connectors

As mentioned earlier, a connector is a wrapper that surrounds a REST API supplied by the application or service that will be the data source. Power Platform provides connectors for a great many applications or services, but certainly not for every one. For developers who require access to data sources for which there are no public connectors available, it is possible for them to create their own custom connectors.

When a developer creates a custom connector, it is part of the current working environment and is usable only by the apps and flows operating in that same environment. It is also

necessary for consumers running apps or flows that use custom connectors to have their own credentials for authentication to the data source, if the data source requires them. Unlike with public connectors, there is no way for consumers of a shared app or flow using custom connectors to inherit credentials supplied by the developer.

Depending on the application or service for which the developer will create a custom connector, there might or might not be an existing API with which the connector can communicate. A third-party application or service might already have an API in place. If not, the developer might have to discuss with the third party the possibility of their creating one. For an internally developed application or service without an API, the developer might have to create one using a tool such as Azure Functions, Azure Web Apps, or Azure API Apps.

There are several ways in which a custom connector can communicate with the API. When a developer runs the Custom Connector Wizard, the following options are provided:

- Create from blank
- Create from Azure service
- Import an OpenAPI file
- Import an OpenAPI from URL
- Import a Postman collection

OpenAPI (formerly known as Swagger) and Postman are definition file formats that provide the communication information the custom connector needs. When creating a custom connector from scratch (using the Create from blank option), the developer is led by the wizard through four stages:

1. *General*—Prompts for an icon and color for the connector tile and the host name for the API, as shown in Figure 2-20

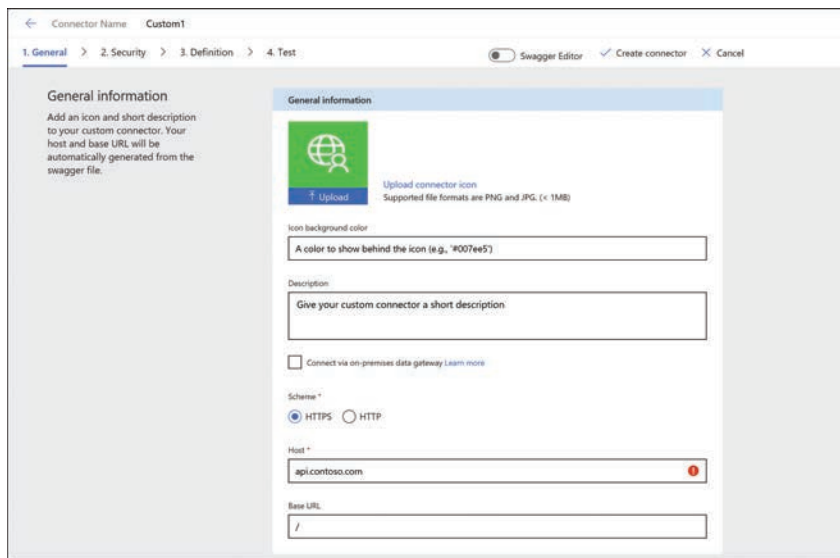


FIGURE 2-20 The General tab of the Custom Connector Wizard

2. *Security*—Prompts for the authentication method the connector should use to access the API: Basic authentication (as shown in Figure 2-21), API Key, or OAuth 2.0

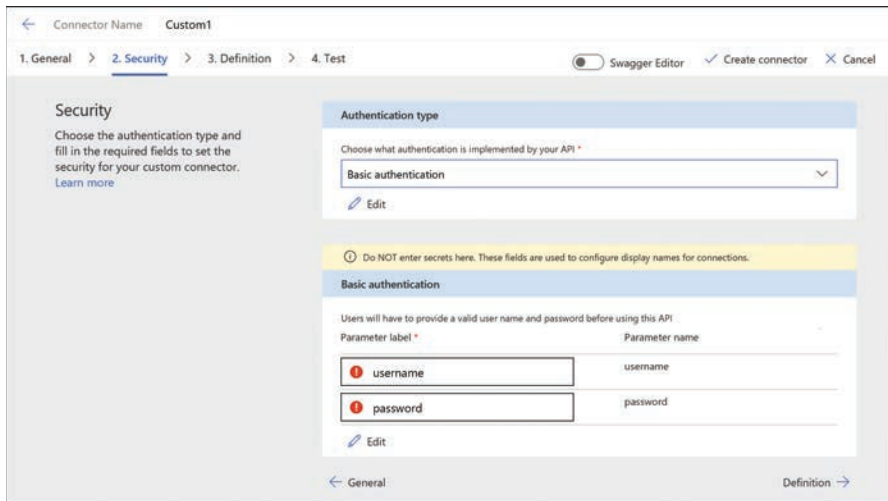


FIGURE 2-21 The Security tab of the Custom Connector Wizard

3. *Definition*—Provides the interface for creating the connector's actions, triggers, and policies, as shown in Figure 2-22

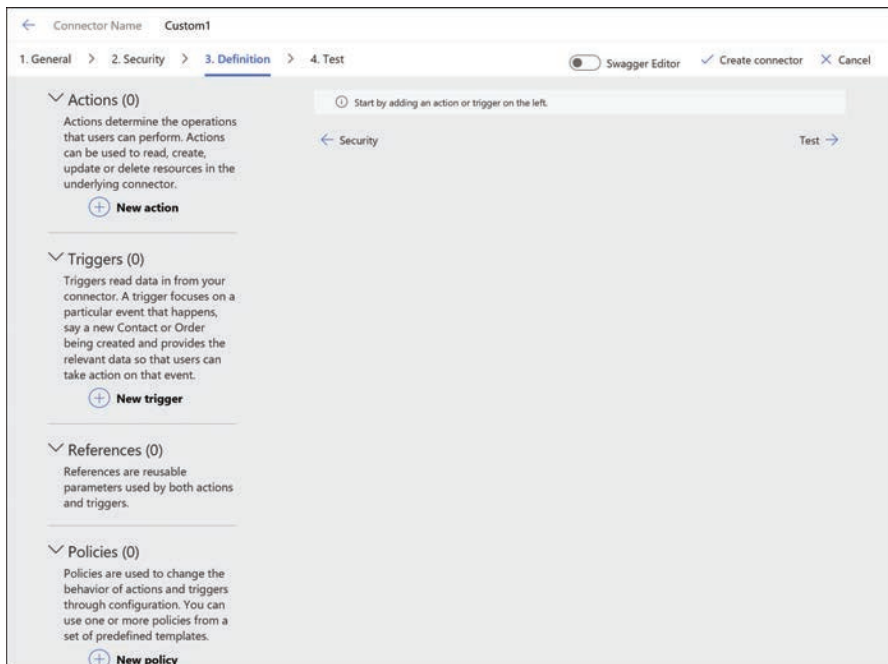


FIGURE 2-22 The Definition tab of the Custom Connector Wizard

4. *Test*—Provides a platform for testing specific operations in the custom connector, as shown in Figure 2-23

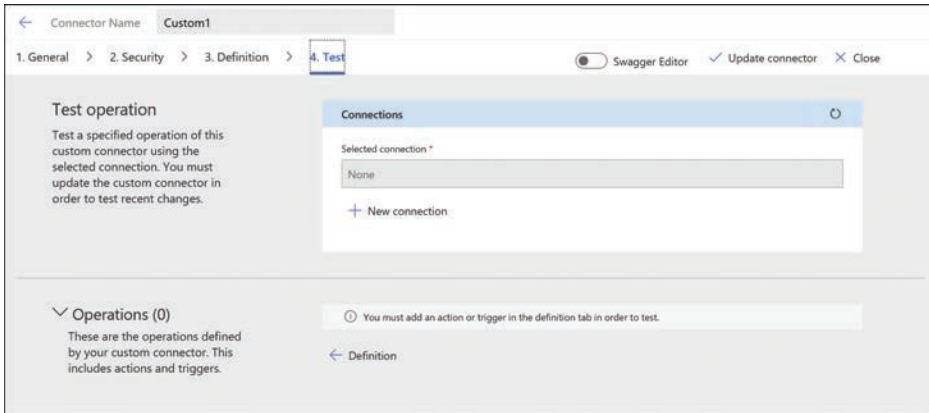


FIGURE 2-23 The Test tab of the Custom Connector Wizard

After developers have created custom connectors, they can share them with users inside their organization. Sharing an app or flow that uses a custom connector makes it accessible to the recipients of the share. Developers can also share their custom connectors with other users by selecting Invite other user from the Custom connectors page to display the interface shown in Figure 2-24.

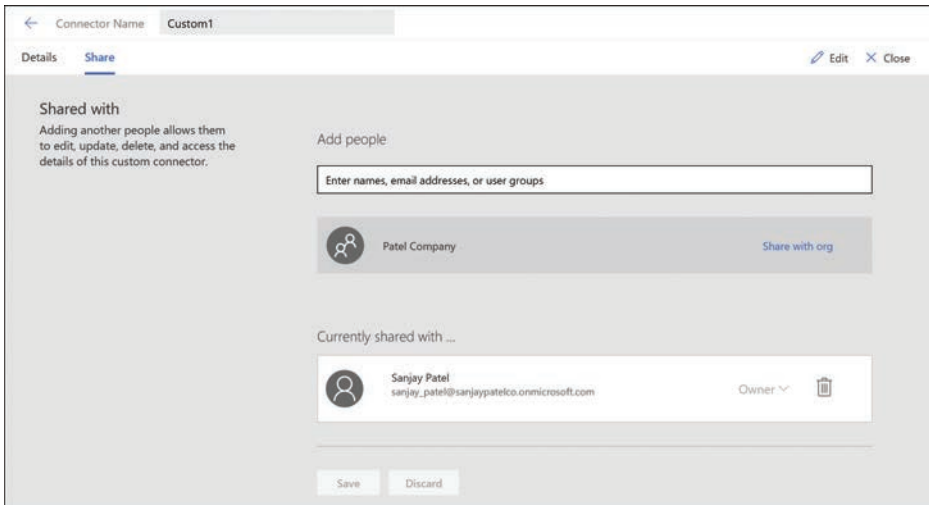


FIGURE 2-24 The Share tab of a custom connector

To share a custom connector with users outside of the organization, developers must submit it for certification by Microsoft, which validates the connector's functionality and content. The connector then undergoes a testing phase in a preview area, and when testing is complete,

it is deployed for public access. Connectors that are certified and published by Microsoft must be released as open source software.

Chapter summary

- Microsoft Dataverse is a cloud-based data storage solution that the Power Platform applications can use to maintain their data in a secure, manageable environment.
- The Power Platform tools are able to connect directly to many different data sources, including local files, network resources, and cloud-based services.
- A default Microsoft Dataverse instance has a base set of standard tables, which the developer can populate with data from outside sources.
- Columns are the attributes within a table that contain specific types of data. If an entity in the Common Data Service is the equivalent of a table in Microsoft Dataverse, then a field is the equivalent of a column in the table.
- An environment is a container for the apps and flows created in Power Apps and Power Automate, as well as the data they use.
- Connectors are Power Platform components that allow Power Apps and Power Automate to interact with outside applications, services, and data files and utilize their data.
- Triggers are components in Power Automate that cause a flow to begin running. Actions are specific modifications made to the data provided by an outside application or service.

Thought experiment

In this thought experiment, demonstrate your skills and knowledge of the topics covered in this chapter. You can find answers to this thought experiment in the next section.

Ralph is studying for the PL-900 certification exam and becoming increasingly confused at the terminology surrounding Microsoft Dataverse. Some of the sources he is consulting have conflicting information, and he is not sure which sources are correct. Eventually, Ralph finds a source that explains how the terminology has changed in recent years. For each of the following Microsoft Dataverse terms, specify the letter of the earlier term it replaced.

1. Microsoft Dataverse
2. Table
3. Column
4. Record
- a. Field
- b. Row
- c. Common Data Model
- d. Entity
- e. Common Data Service
- f. Relationship

Thought experiment answers

This section contains the solution to the thought experiment. Each answer explains why the answer choice is correct.

1. e. Microsoft Dataverse was originally called the Common Data Service.
2. d. The tables found in a Microsoft Dataverse database instance were formerly called entities in the Common Data Service.
3. a. The columns found in a Microsoft Dataverse database instance were formerly called fields in the Common Data Service.
4. b. The rows found in a Microsoft Dataverse database instance were formerly called records in the Common Data Service.

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