# Implementing ETL with SQL Server Integration Services

**[OnlineUA] DWBI\DQE Program 2020**

**Andrii Pavlish**

## FOR YOUR INFORMATION

- Please turn off the microphone.
- If you have questions, ask them in the chat.
- Duration: 3 hours
- Coffee break 15 minute

# Agenda

1. ETL PROCESSING
2. ETL PROCESSING WITH SSIS
3. SSIS DATA FLOWS
4. DEPLOYMENT AND TROUBLESHOOTING

# WHAT YOU WILL LEARN

- Creating an ETL script
- The design environment
- Control flows
- Data sources
- Data transformations
- Data destinations
- Precedence constraints
- Connection managers
- Execute SQL tasks
- Progress/execution results
- Data flows
- Data flow paths
- Error output paths
- Configuring data sources and destinations
- Executing SSIS packages
- Deploying SSIS packages

# Setting Up Your Environment

SQL SERVER DATA ENGINE(FREE DEVELOPER EDITION): HTTPS://WWW.MICROSOFT.COM/EN-US/SQL-SERVER/SQL-SERVER-DOWNLOADS

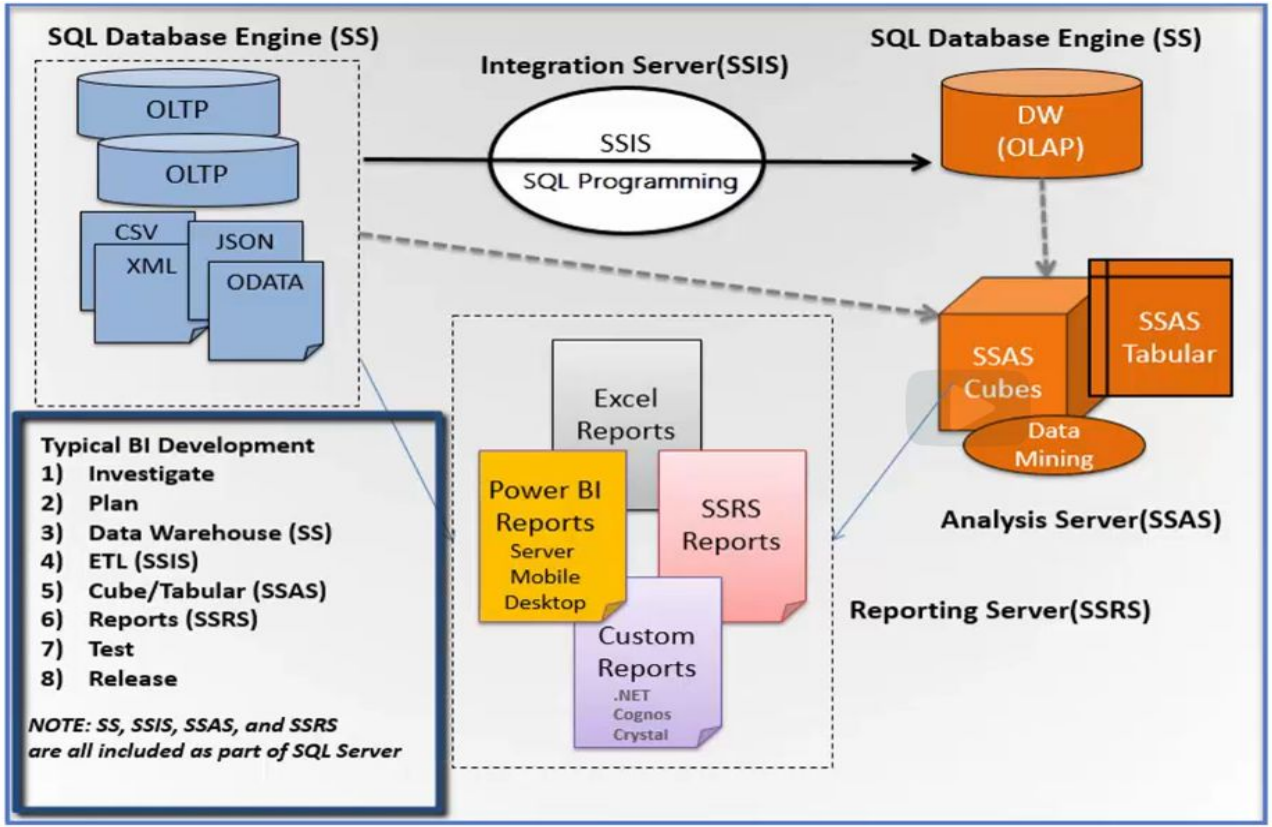
SQL SERVER MANAGEMENT STUDIO(SSMS 18.8) :

HTTPS://DOCS.MICROSOFT.COM/EN-US/SQL/SSMS/DOWNLOAD-SQL-SERVER-MANAGEMENT-STUDIO-SSMS?VIEW=SQL-SERVER-2017

SQL SERVER DATA TOOLS(SSDT FOR VISUAL STUDIO (VS) 2017) : HTTPS://GO.MICROSOFT.COM/FWLINK/?LINKID=2124319

# 1. ETL PROCESSING

# ETL process in typical BI Solution

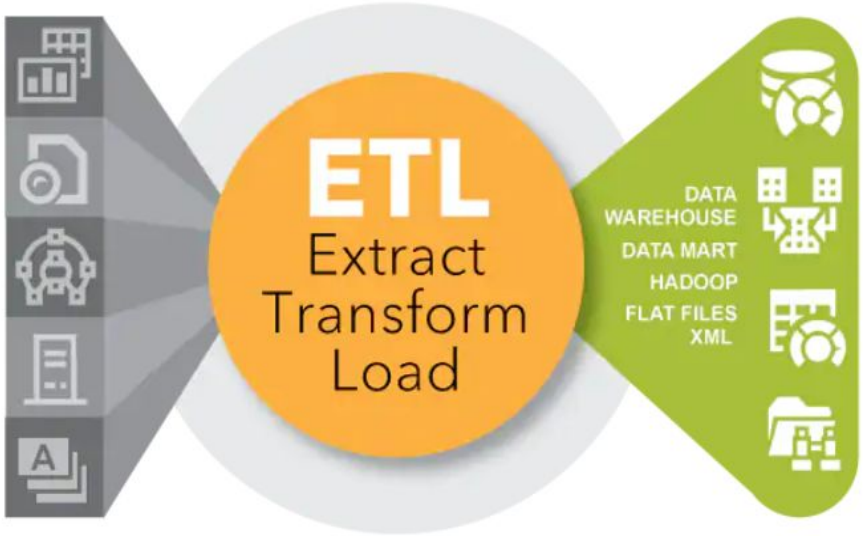


# What is ETL?

ETL is a type of data integration that refers to the three steps (extract, transform, load) used to blend data from multiple sources. It's often used to build a data warehouse. During this process, data is taken (extracted) from a source system, converted (transformed) into a format that can be analyzed, and stored (loaded) into a data warehouse or other system. Extract, load, transform (ELT) is an alternate but related approach designed to push processing down to the database for improved performance.

# Why ETL is Important

Businesses have relied on the ETL process for many years to get a consolidated view of the data that drives better business decisions. Today, this method of integrating data from multiple systems and sources is still a core component of an organization's data integration toolbox.




- When used with an enterprise data warehouse (data at rest), ETL provides deep historical context for the business.
- By providing a consolidated view, ETL makes it easier for business users to analyze and report on data relevant to their initiatives.
- ETL can improve data professionals' productivity because it codifies and reuses processes that move data without requiring technical skills to write code or scripts.
- ETL has evolved over time to support emerging integration requirements for things like streaming data. Organizations need both ETL and ELT to bring data together, maintain accuracy and provide the auditing typically required for data warehousing, reporting and analytics.

# DEMO 1.
# ETL with SCRIPTING

# ETL Tools

- **SQL Server Management Studio**

**SSMS is not designed specifically as a ETL processing application, however, it is still a great choice for this purpose. As shown earlier, BI professional can create and test transformation code within SSMS. Once this code is tested it can then be encapsulated into views and stored procedures which save the code within the database. From SSMS, you can also access and configure automations using SQL Server Agent.**

- **Visual Studio**

**Visual Studio itself is only an application for hosting development tools. These tools, plug into visual Studio providing a custom development environment. SQL Server Integration Services (SSIS) and SQL Server Data Tools (SSDT) are the two most common developer tool installed for ETL processing. The SSDT also includes advanced development tools for programming SQL Server Integration Server (SSIS) ETL packages, SQL Server Analysis Server (SSAS) Cubes, and SQL Server Reporting Server (SSRS) reports**

# Data Sources and Destinations Files

In order for a SSIS package to perform ETL Processing, you must configure its data sources and destinations. Each source and destination needs a connection and there are different kinds of connections.

- text files.

They're common because they are easy to generate and can be used on most operating systems without additional software (CSV, XML, JSON)

- databases

Most database applications provide data validation, data constraints, mapped relationships between sets of data, tools for automating common tasks, programing constructs (like views and stored procedures), and ways to access and change the data from a dedicate GUI. Because of this, using a database to store data is considered a better choice in comparison to text files.

- Web Services

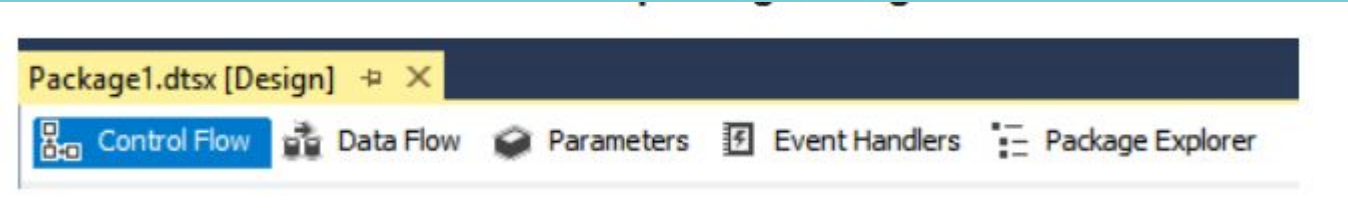
In many cases the purpose of a given service is to return text data when requested. This text data may then be stored in a local text file or imported into a database

# 2. ETL PROCESSING WITH SSIS

# DEMO 2.
# SSIS OVERVIEW

# Creating SSIS Project and Packages

- The Integration Services Project template uses one starter SSIS package that contains the programming instructions for your ETL process
- One or more SSIS packages can make up an SSIS project.
- SSIS packages are literally code files, and the code within an SSIS package is programmed using a designer user interface (UI).
- The designer is organized into 5 tabs.
- The Control Flow and the Data Flow tabs are used most often.



# The Control Flow Tab

The control flow is created by dragging se

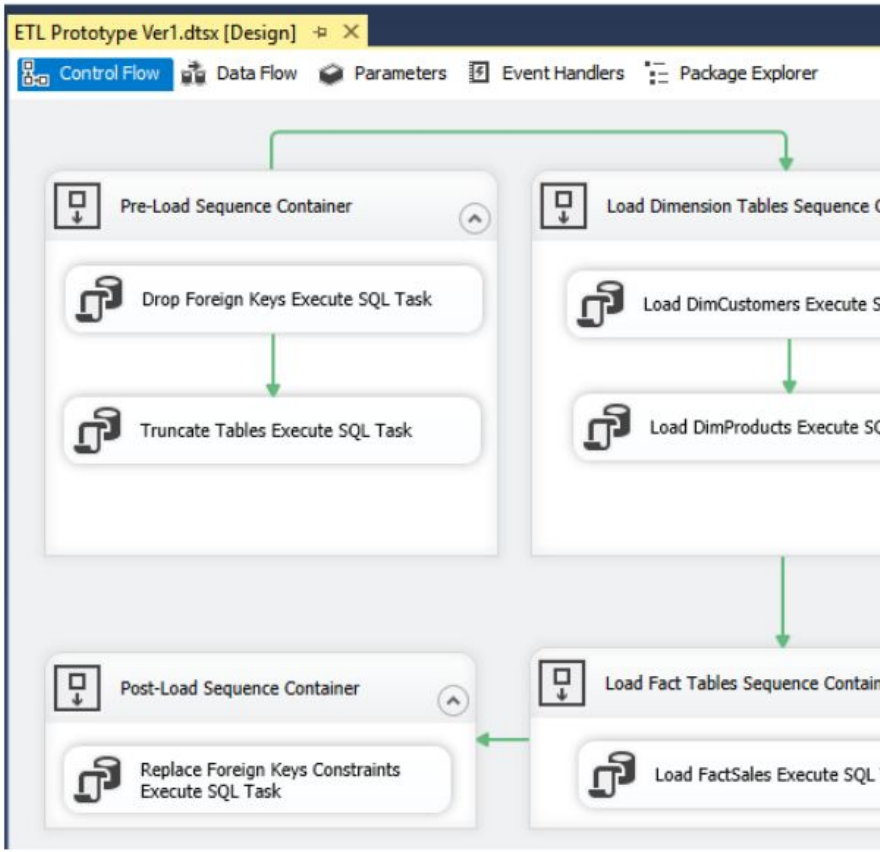
tasks from the SSIS toolbox onto the desig

as the name implies, lets you control the f

The most common control flow tasks are

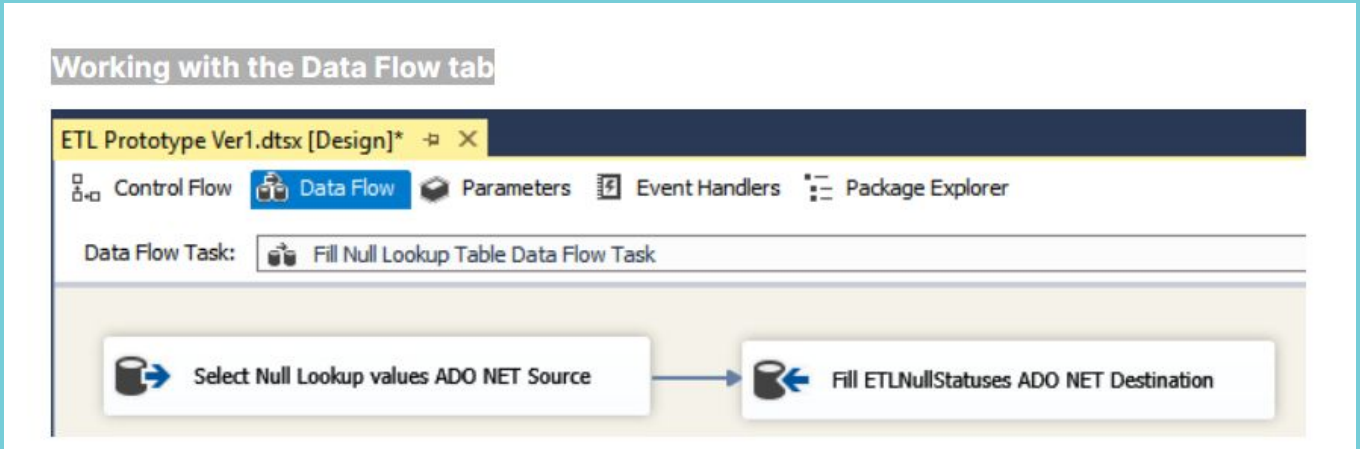
- *Annotations*: Text blocks that contain no
- *Data Flow Task*: Moves data between so
- *Execute SQL Task*: Runs the statement o
- *Sequence container*: Groups tasks togeth

**Working with the control flow tab**



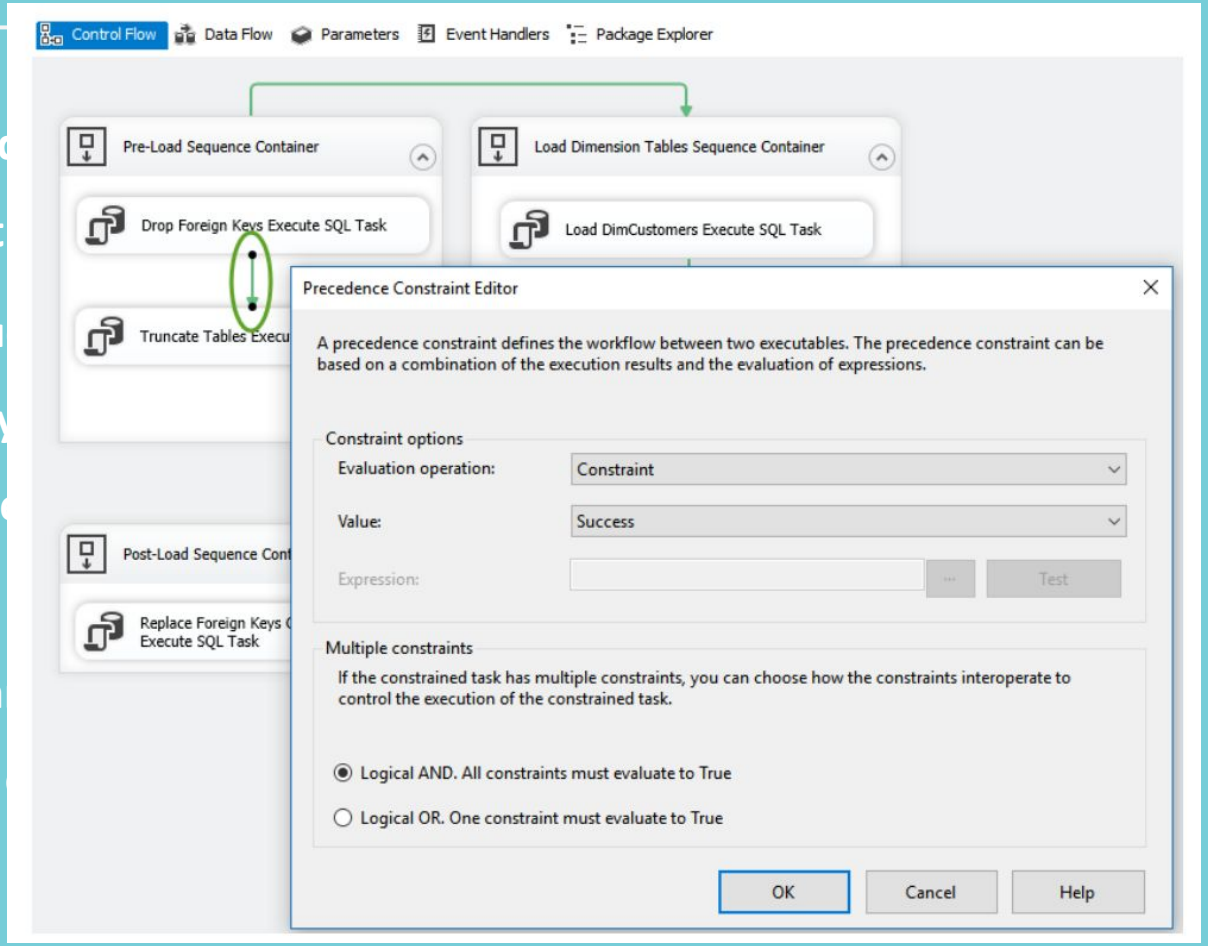
# The Data Flow Tab

- Data flows are the only task that have their own tab.
- Data flow tasks encapsulate the data flow engine
- Are specialized for transferring data from one location to another.



# Sequence Containers and Precedent Constraints

- Sequence Containers are used
(f.e. dimension tables, or fact
- Naming conventions for sequ
identify their purpose. Once y
containers, they can then be c
configurations.
- The precedence constraints a
logic such as success, failure,



# SSIS Connections

Connections are added from the C

The three most frequently used ar

- The OLE DB connection mana

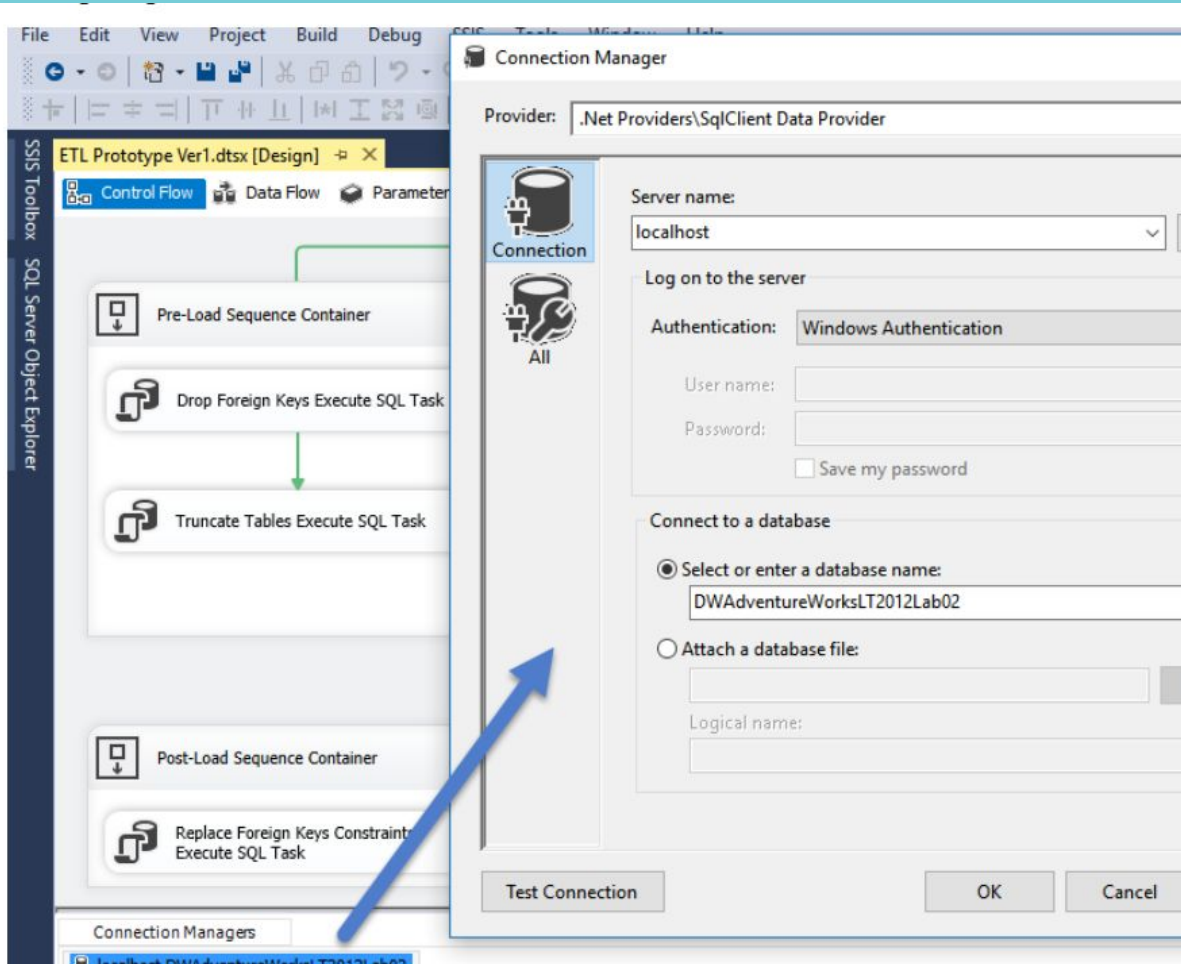
The OLE DB connection manager is
easier than other connection types

- The ADO.NET connection ma

The ADO.NET connection manager
It features increased performance
types are based on the .NET standa

- The File Connection Manage

The file connection manager ca

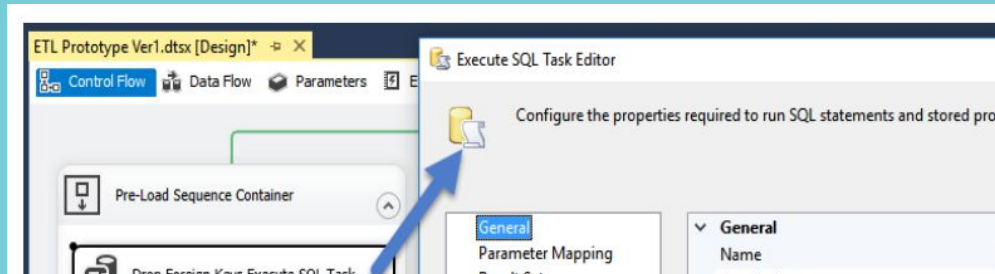


# Configuring Execute SQL Tasks

Execute SQL task allows you to run SQL code or stored procedures from a package on a connected database. The task can run a single statement, or multiple sequential statements.

The Execute SQL tasks can be used for the following:

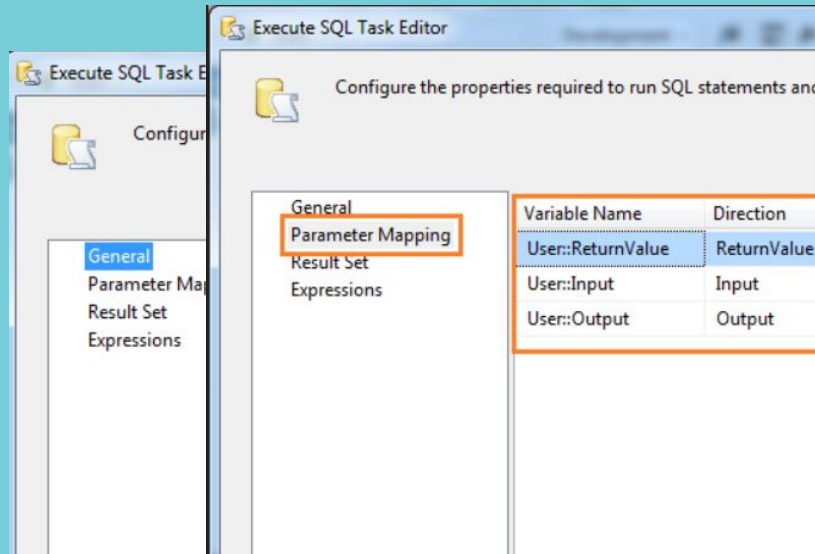
- Drop foreign key constraints
- Re-create fact and dimension tables
- Modify database tables and views by creating, altering, or dropping them
- Truncate a table's data
- Run stored procedures
- Save returned rowset objects into a variable



# Using Stored Procedures from SSIS

When using stored procedures in SSIS you will need to consider the following:

- What types of connections you will you use?
- Does the stored procedure have parameters?
- Will the stored procedure return data?



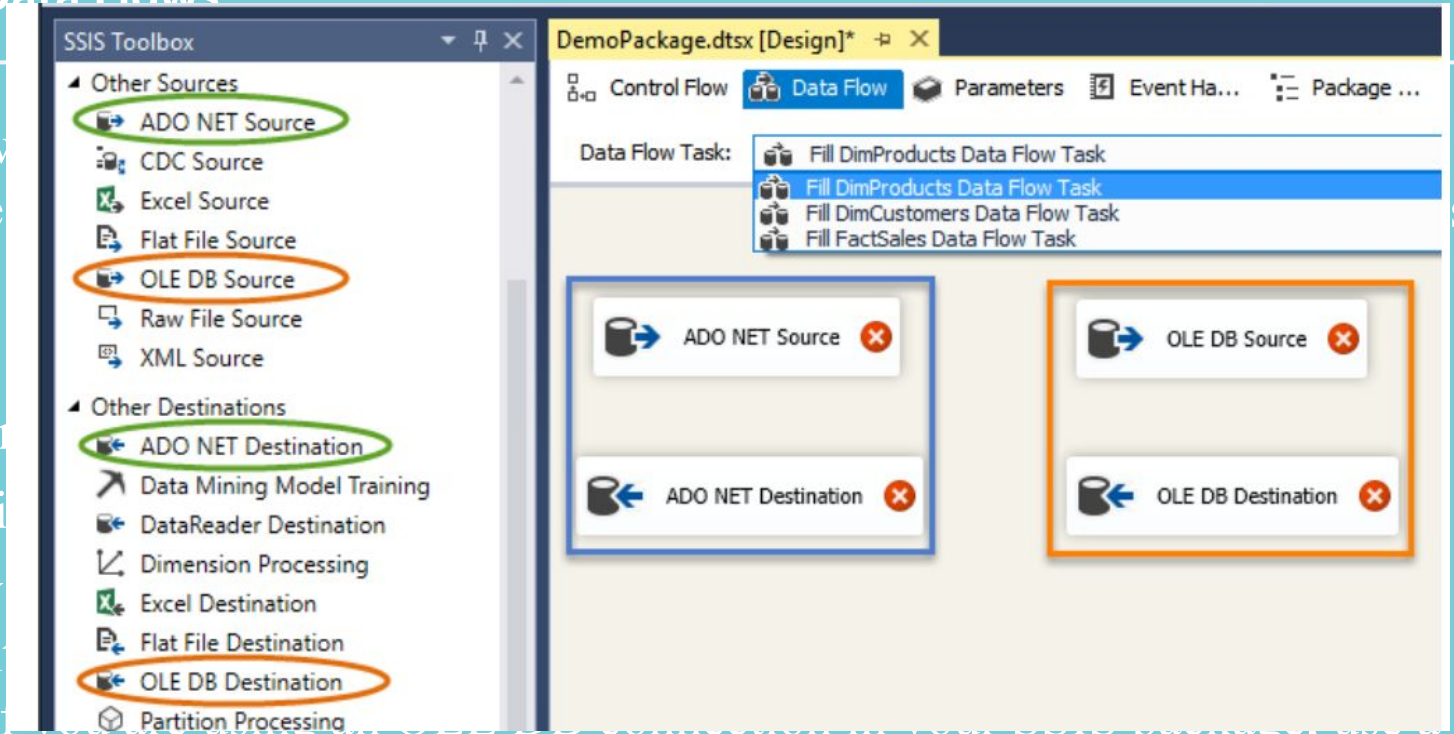
# DEMO 3.
# Control flows and Data flows.
# Containers and Precedence constraints
# Connection Manager.
# Execute stored procedure in SQL task

# 3. SSIS DATA FLOWS

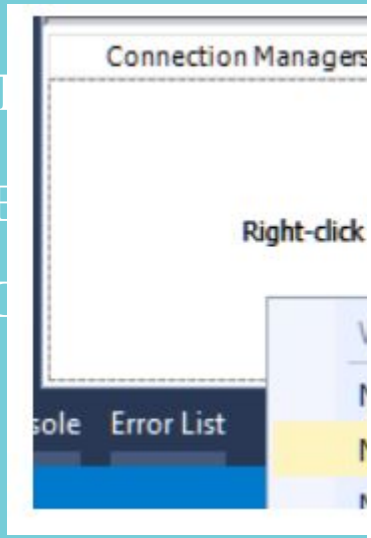
# Creating Data Flows

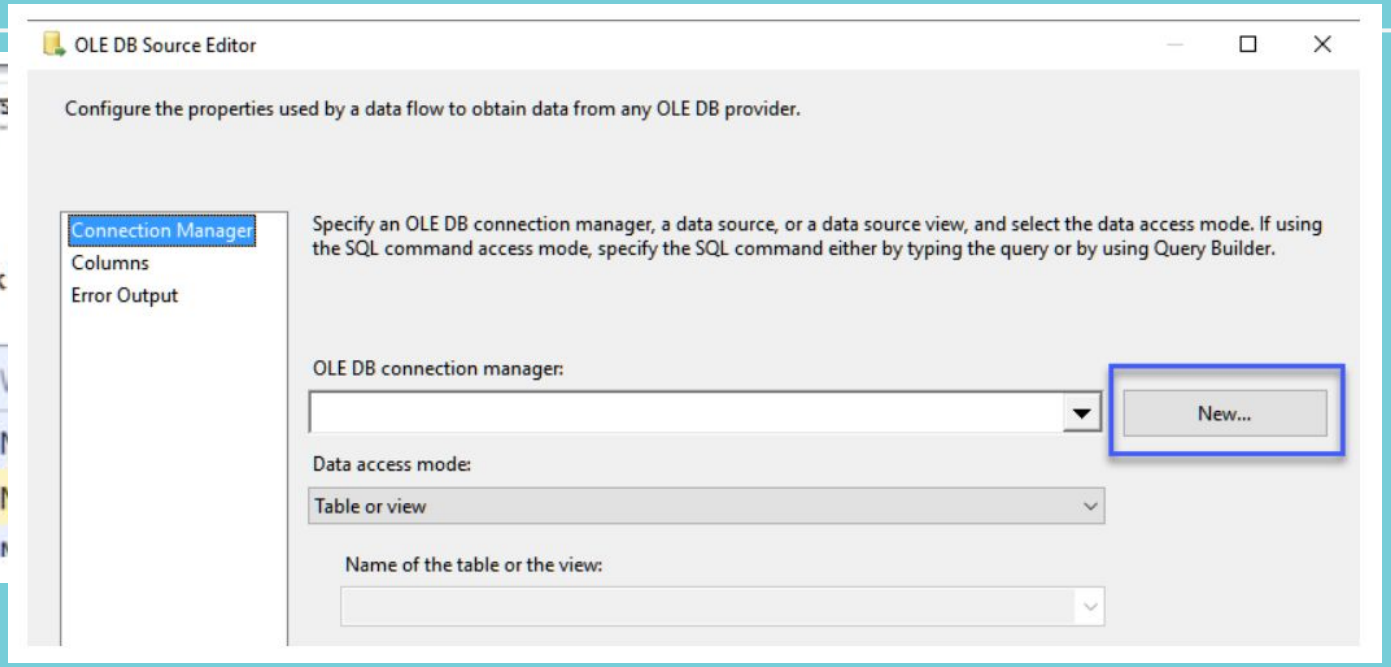
- Data flow
  least one
  made up
- Sources:
- Transfor
- Destinati

Data Flow
componen
package. If you are using an OLE DB connection in your SSIS package, use a corresponding OLE DB Source component.



# The OLE DB (Source) Connection Manager Page



# Data Access Mode

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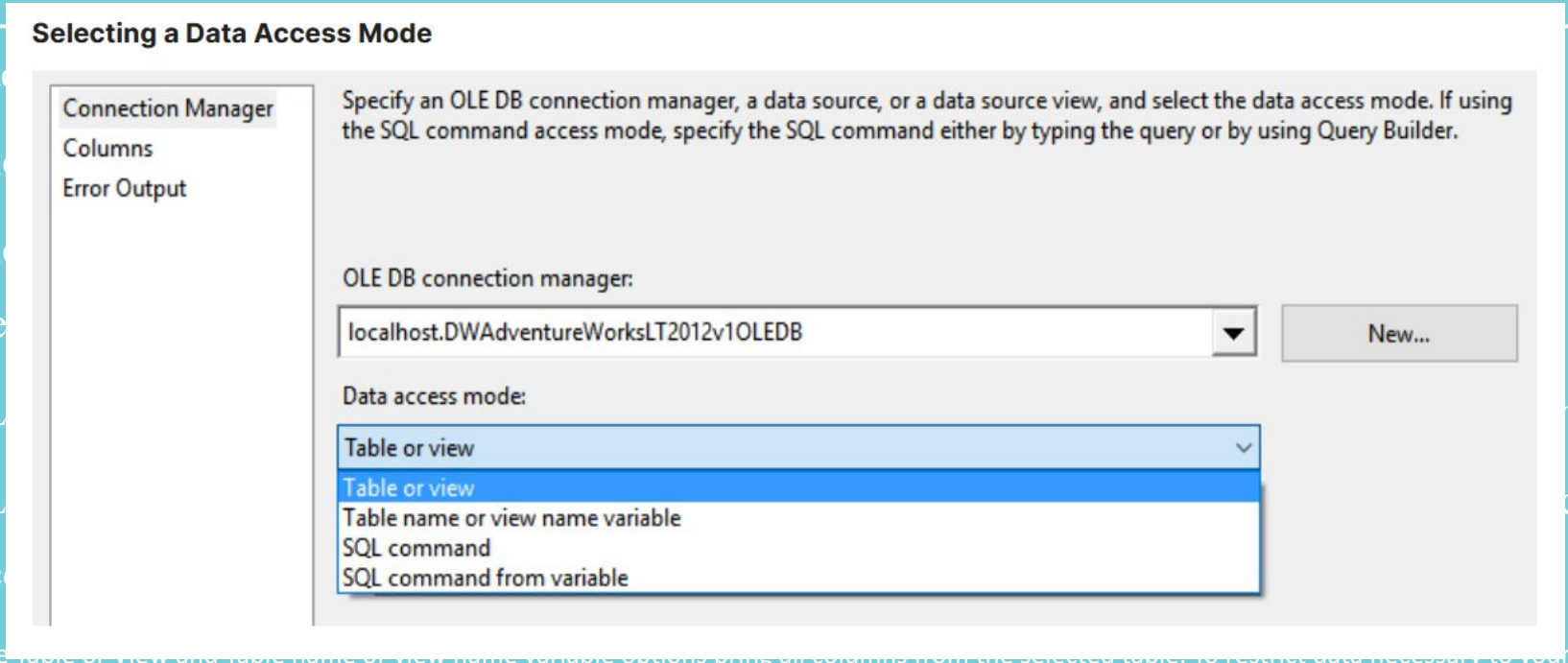



**Note**: The Table or View and Table name or View name variable options bring all columns from the selected table. To restrict data necessary to your ETL process, we recommend using the SQL command or SQL command from variable Data access modes in combination with SQL programming statements.

# Data Flow Paths

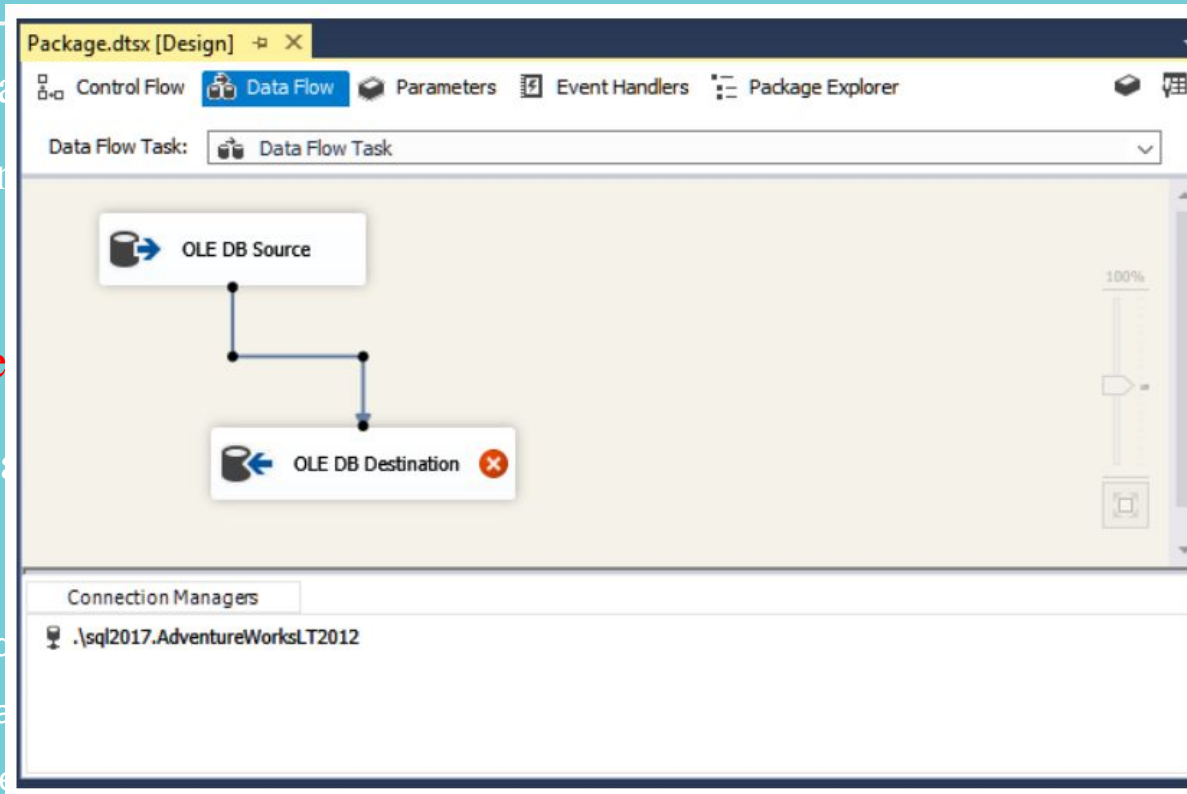
- Data flow paths are represented a
  destination has been added (but r
  components.

**Important**: Be sure to connect the

**Configure the source data flow ta**

**arrows.**

A **blue line** (representing the data flow), and
allow for conditions to be configured, such a
and transformation components onto the de



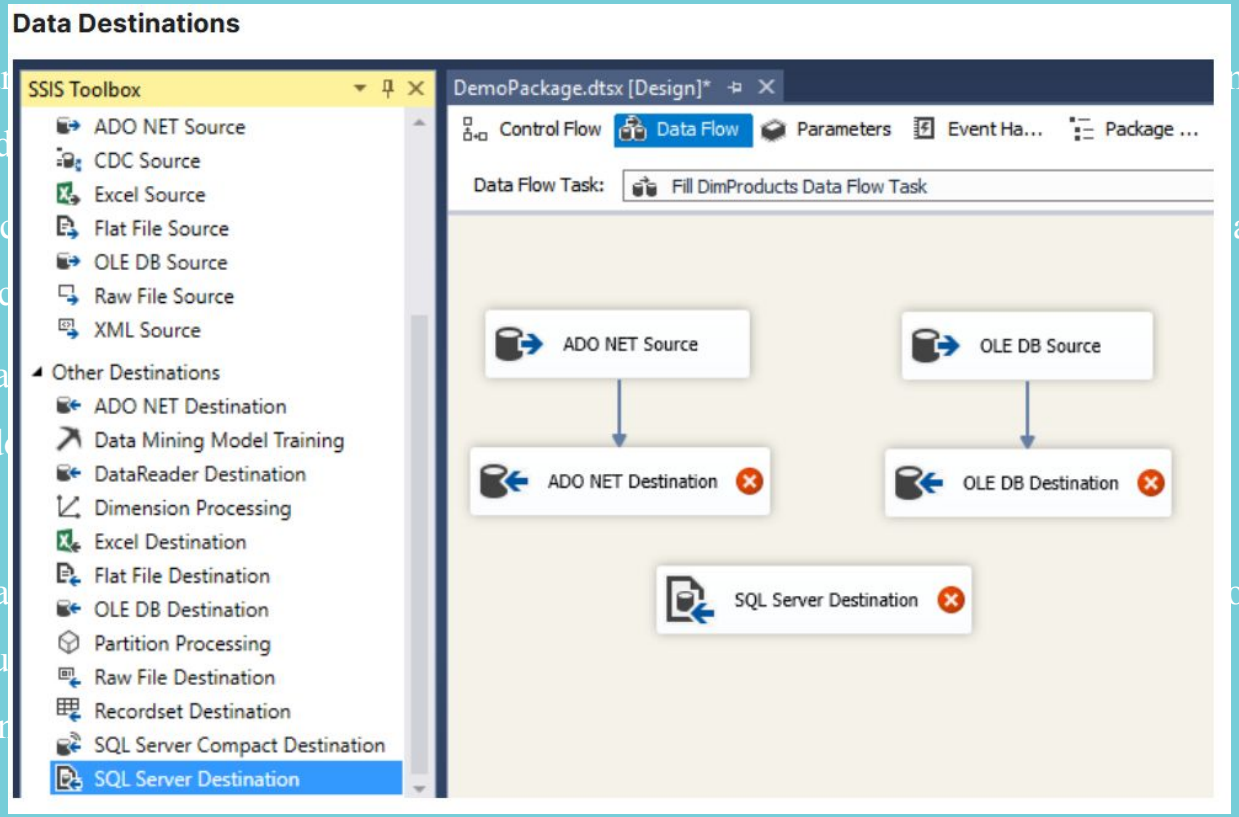
# Data Destinations

You must have an un-configu nce
the data flow path has been ad

**OLE DB destination** (most a
database table, view, or SQL v

**ADO.NET destinations** are a DB
destinations. However, they d
conversions.

For best performance, you ma osoft
SQL Server database. When u
incurring data type conversion

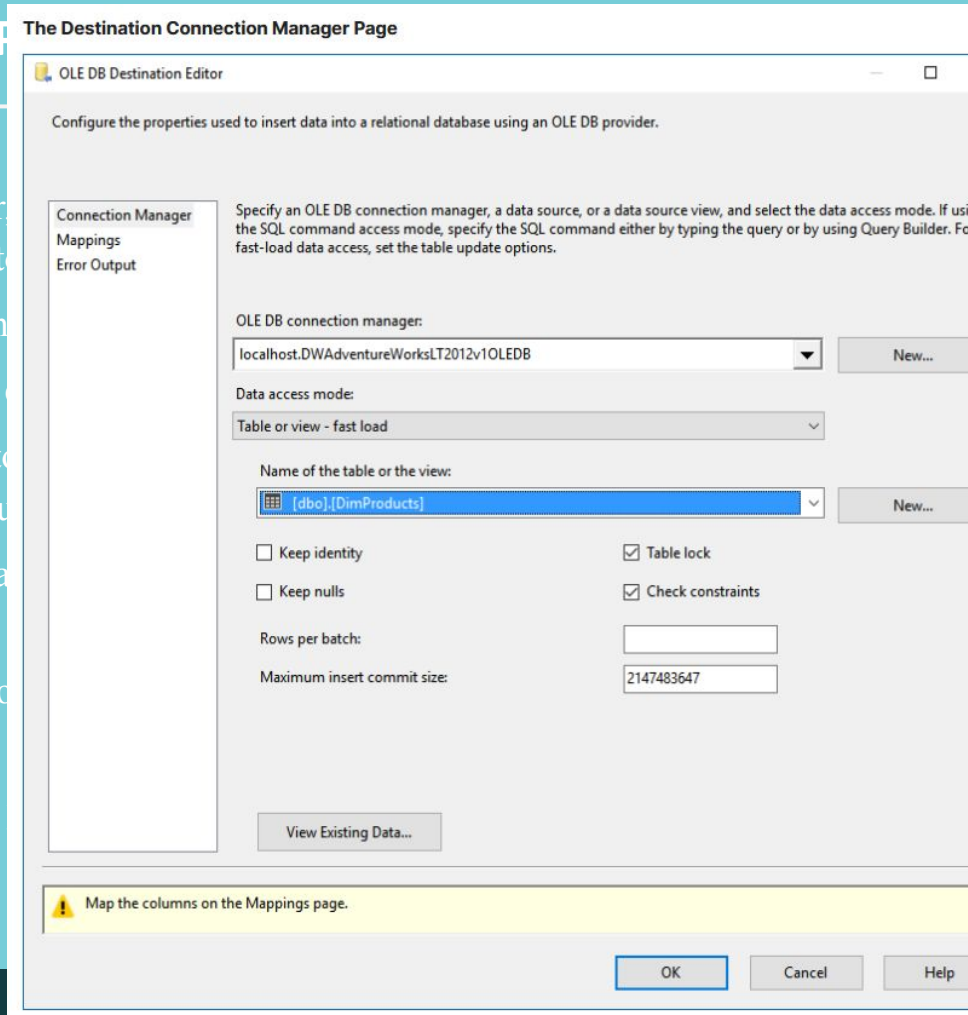


# The (Destination) Connection Manager P

On the Connection Manager page of the Destination Editor
box to select an existing connection or use its New button t

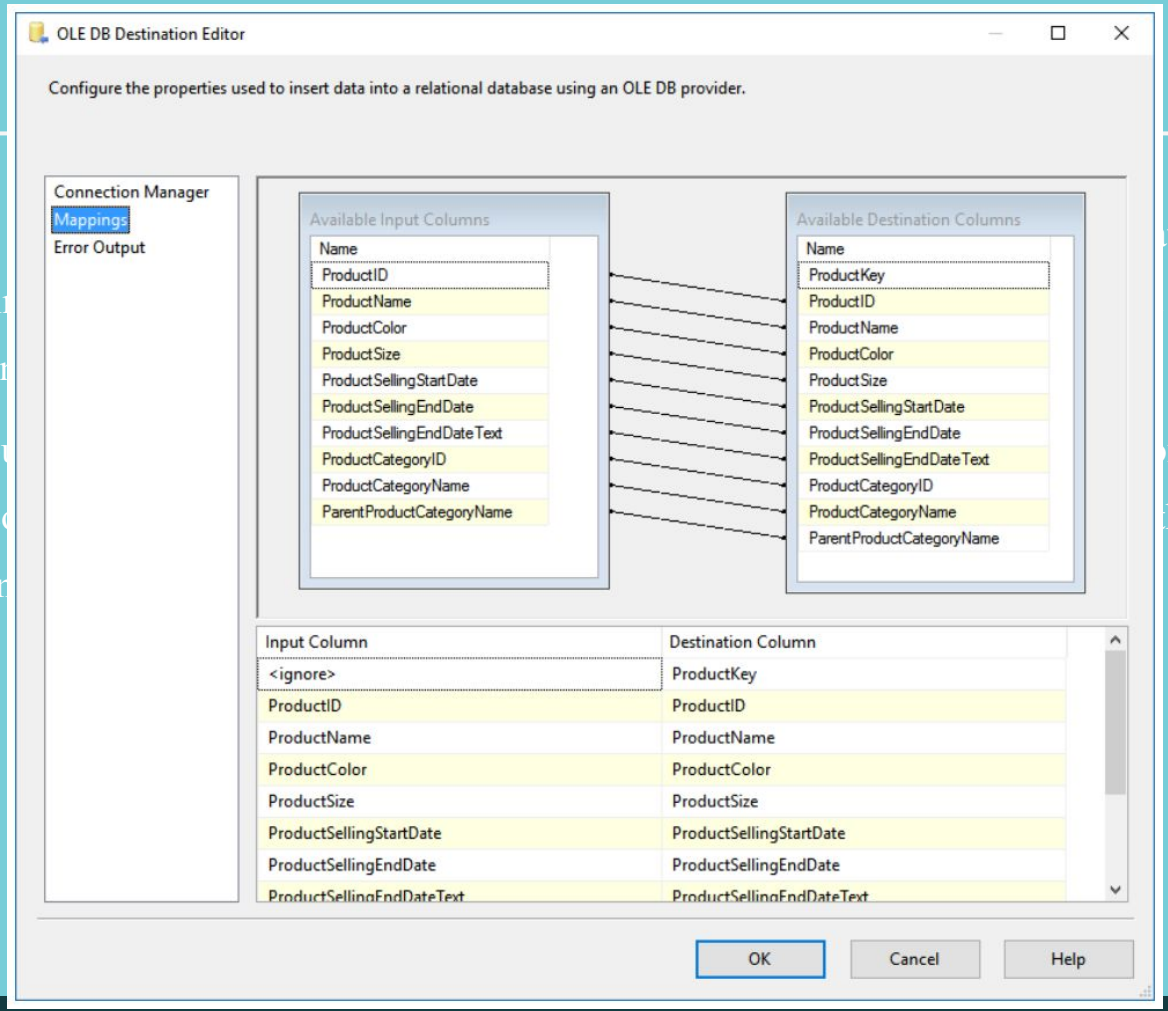
Next, Use the Data access mode dropdown box to select on

- **Table or view**: allows you to insert values into a new or
- **Table or view – fast mode**: allows you to bulk insert int
provides additional configuration options and is easy to u
- **Table name or view name variable**: allows you to use a
or view.
- **Table name or view name variable fast load**: allows yo
through an SSIS variable.
- **SQL command**: allows you to enter a SQL statement to



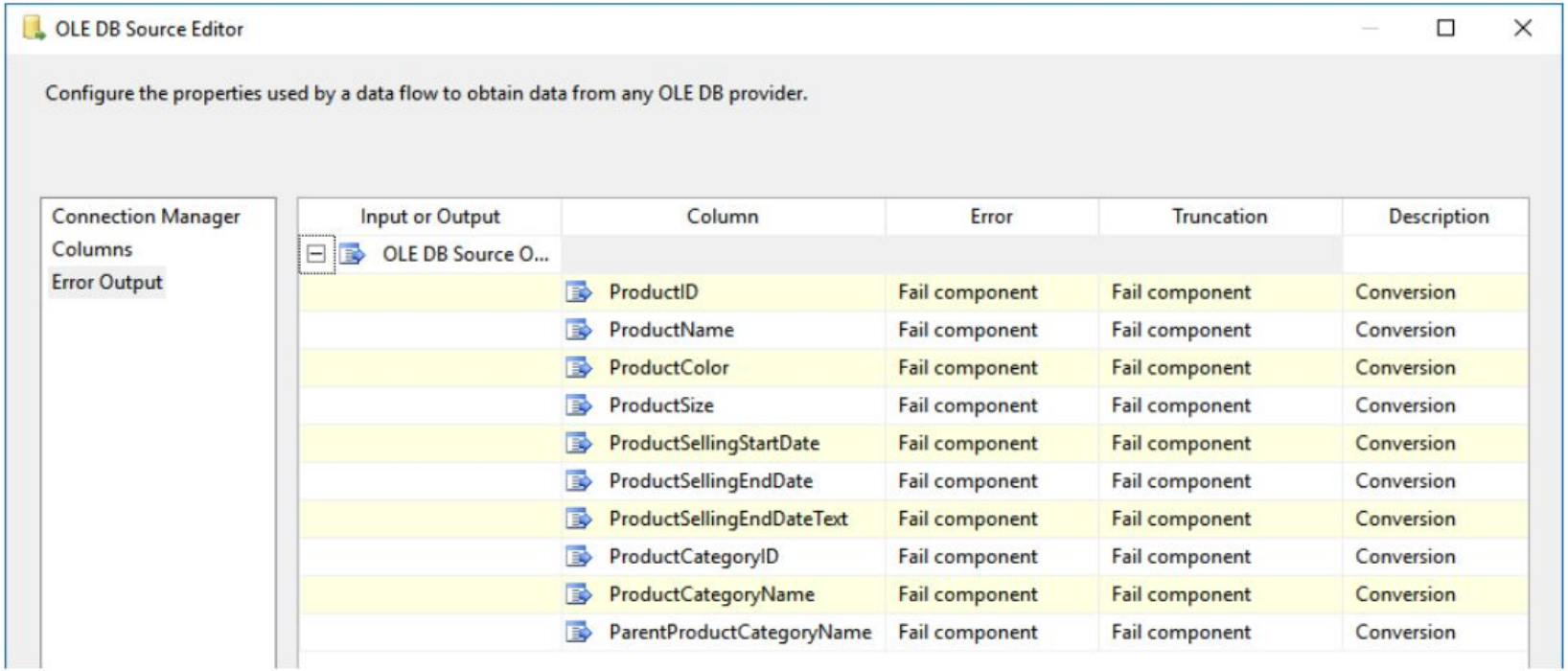
# The Mappings Page

- The Mappings page allows you ation column names match (when usi and destinations for you. If they do r
- Drag and drop the available inpu x can also be used to select an input c he output by setting the input colur



# The (

## The Error Output Page

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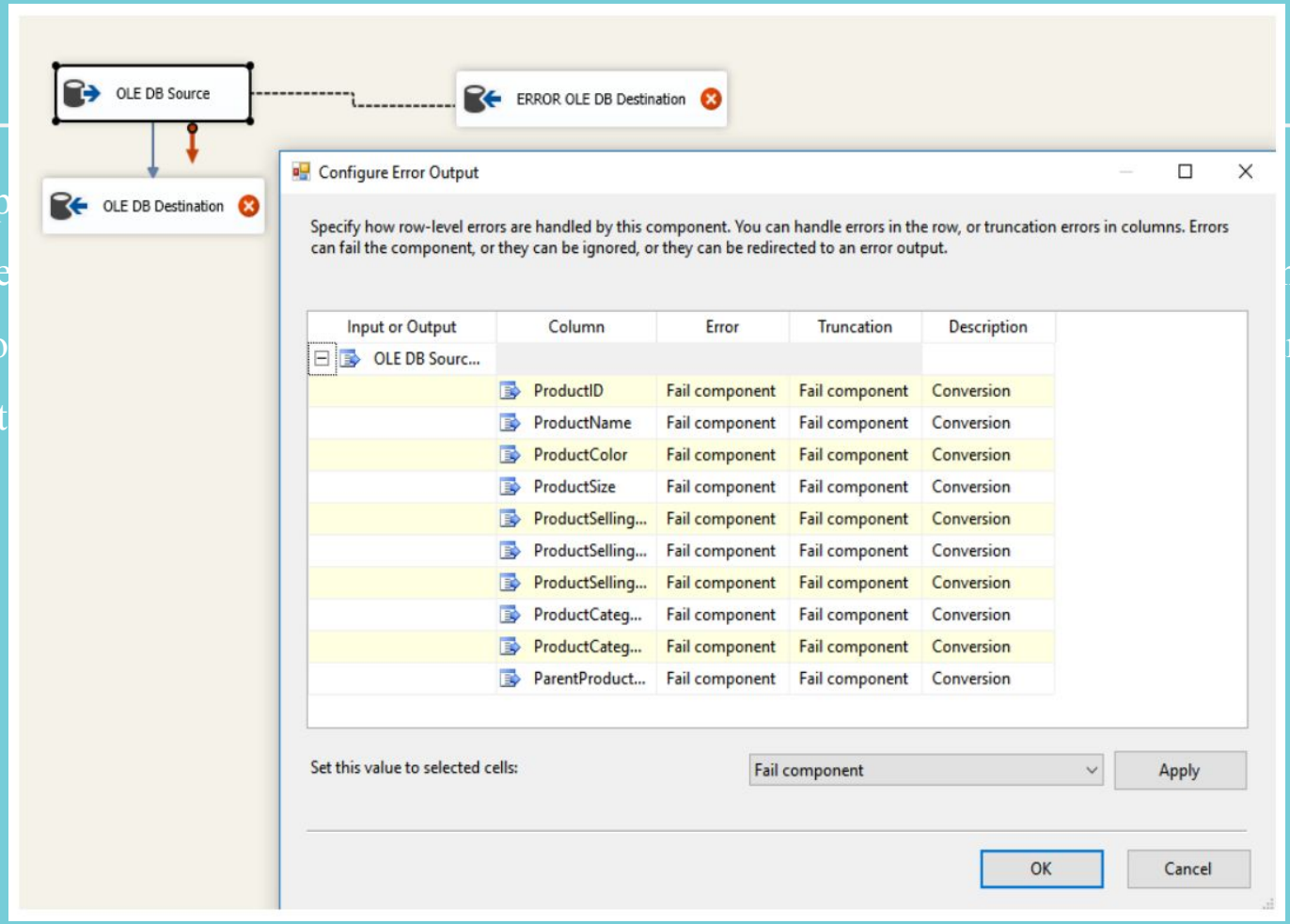
# Error Flows

- The Error Outp
component, the
Configure Erro
path to redirect



# DEMO 4.
# DATA FLOWS OWERVIEW.
# DATA FLOW SOURCE.
# DATA FLOW PATH

# Data Flow Transformations

Transformations are the third and final component to consider when working with data flows. The following are types of data flow transformations:

- **The Sort transformation**: performs single or multiple (numbered) sorts on input data,
- **The Data Conversion transformation**: converts input column data to a different data type and inserts it into a new output column.
- **The Aggregate transformation**: performs aggregate functions and calculations to column values (or values that have been grouped using a GROUP BY clause, and copies the results to the output.
- **The Derived Column transformation**: creates new column values or replaces existing values by applying expressions that can contain any combination of variables, functions, operators and columns.
- **The Lookup transformation**: performs lookups by joining data in input columns with columns in a reference dataset. You use the lookup to access additional information in a related table that is based on values in common columns.
- **The Union All transformation and The Merge transformation**: combines multiple inputs into a single output. The Merge transformation (included for backward compatibility) acts like the Union All transformation, but is limited to two inputs, and it requires those inputs to be sorted.
- **The Merge Join transformation**: joins two sorted datasets using a FULL, LEFT, or INNER join before copying to the output.
- **NOTE**: When possible, it is recommend performing these transformations in the Data Flow's data sources .

# DEMO 5.
# Sort, Data conversion, Derived Column.

# Tuning Data Sources

SSIS is a powerful tool that can perform many different tasks, but that flexibility comes at a cost in performance. You can create more efficient code to manipulate data in files or database, using languages like Python or SQL, at the cost of losing the visual workflow of your ETL process.

- **Avoid pulling all the data** from the source if you only need a part of it. This makes a big difference when working with tables or files containing sequential data. For example, a web server's log file would have new entries each day, but existing entries might not ever be updated. Therefore, it will increase performance by restricting data to only be loaded from updated columns.
- **Use Sequence containers** to process data in parallel, which will help to reduce overall ETL execution time at the cost of the computers resources (RAM and CPU).
- **Avoid transforming large amounts of data directly from a fil**e. Often it is faster to import data into a temporary (staging) table and then use SQL transformation code to complete your ETL process.
- **Avoid using SSIS Events to track progress**. Each event handler is a performance drain on the ETL execution. Instead consider using logging tables in combination with ETL stored procedures.
- **Consider removing indexes on the destination tables before loading it**. If the source data is not sorted before it is inserted, it may be best to drop indexes on a table before loading its data, and re-create the indexes after loading completes. Then let the database engine shuffles the data into its correct location as needed.
- **Avoid implicit conversion**. Instead, convert data outside of SSIS's own expression language runtime environment. For example, use the SQL language for data in a database, or use C# or Python for data in a file.

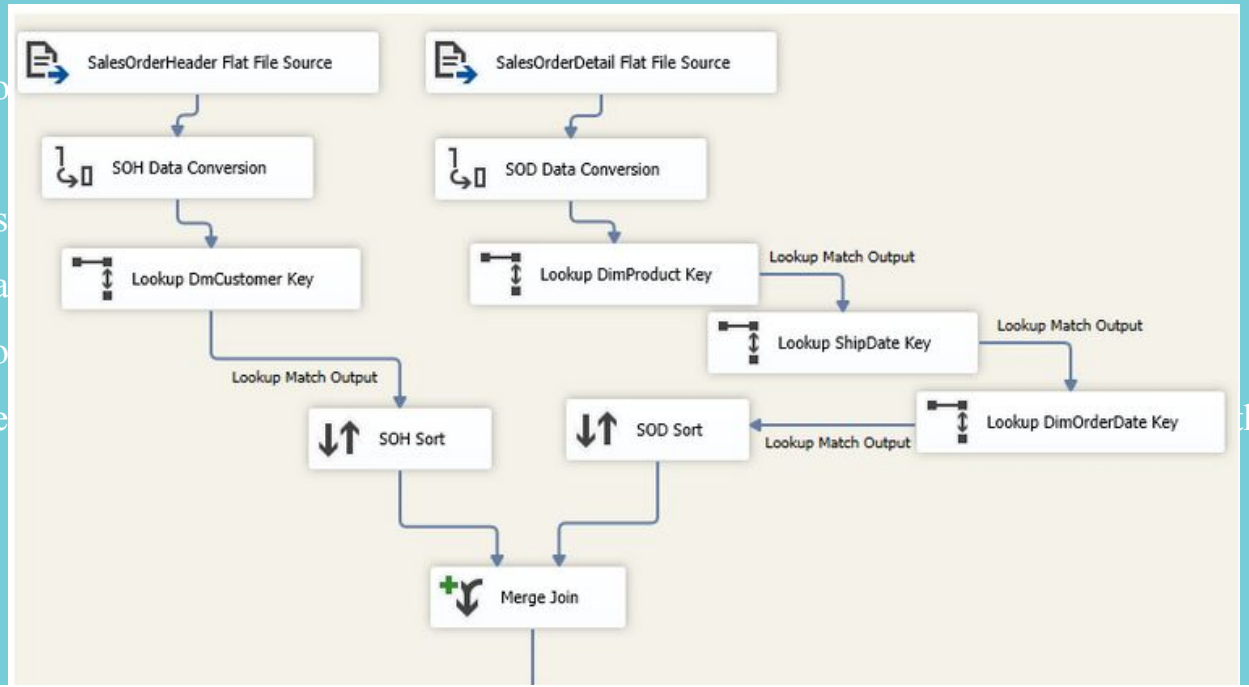
# Staging Tables

One common part of ETL pro

This can be done in two ways

- The first is to import the da
- the second is to import it to

Although the first sounds like he initial setup cost.



# 4. DEPLOYMENT AND TROUBLESHOOTING

# Troubleshooting Errors

Good ETL creation includes error handling and troubleshooting.

Microsoft includes a number of features in both SSIS and SQL Server that can help you troubleshoot ETL processing:

- using SSIS Error Paths and Event handlers,
- setting up ETL logging,
- different ways to deploy SSIS packages,
- automate ETL processing using SQL Server Agent.

# Handling Data Flow Errors with Error Paths

Error paths are represented as red connecting lines between data flow components. Rows of

data that hav

all data flo

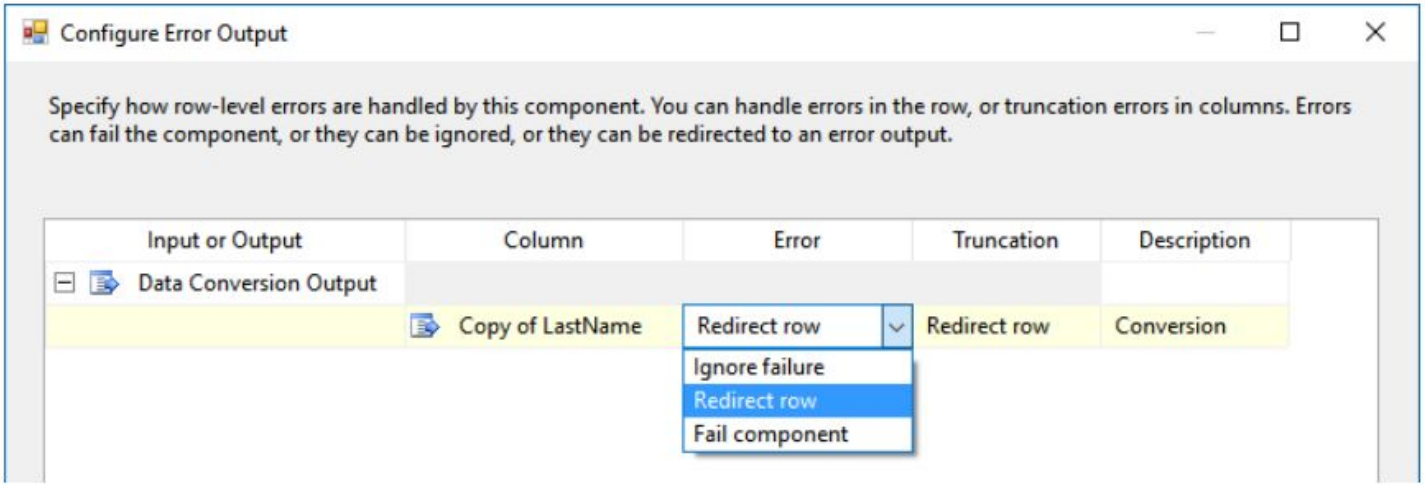
without a p

Configurin

- Fail Com
- Ignore Fa

  its outpu
- Redirect Ro

**Data Flow and Error Paths**



# Troubleshooting Data Flow Issues with Data Viewers

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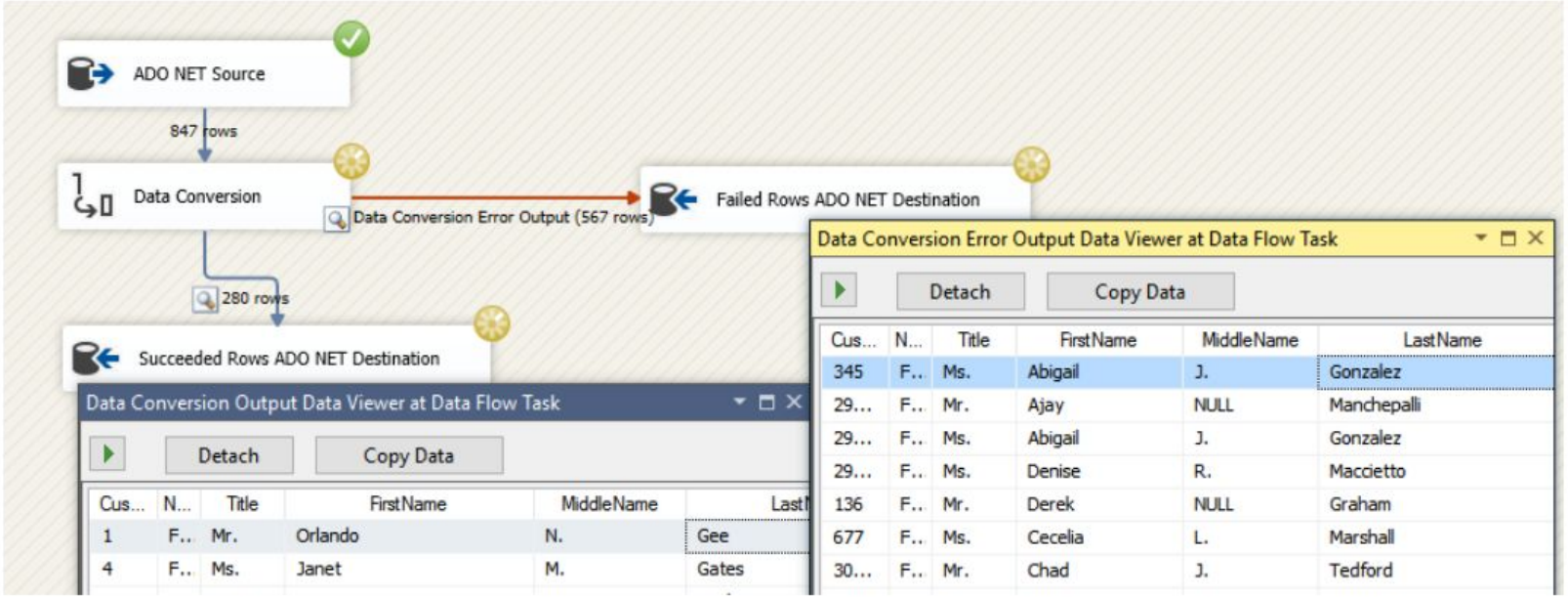
Bot

## Using Data Viewers



# Event Handlers

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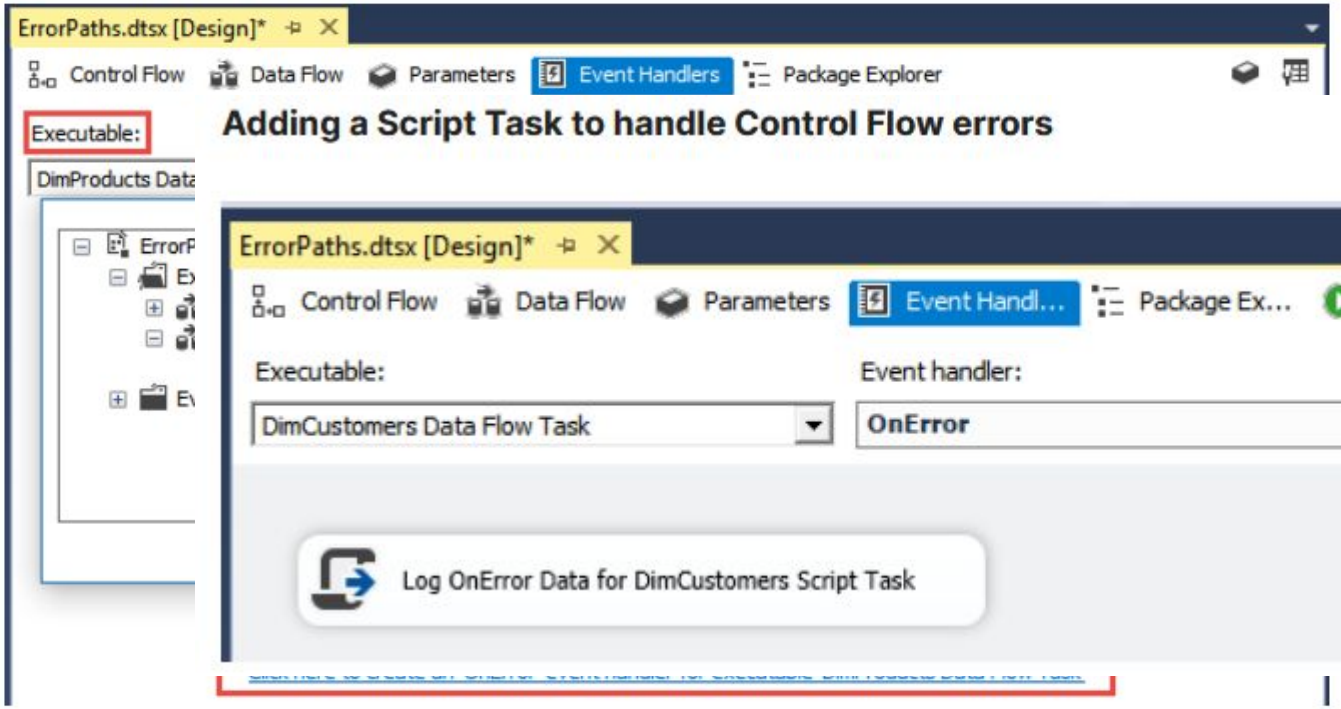
To a…

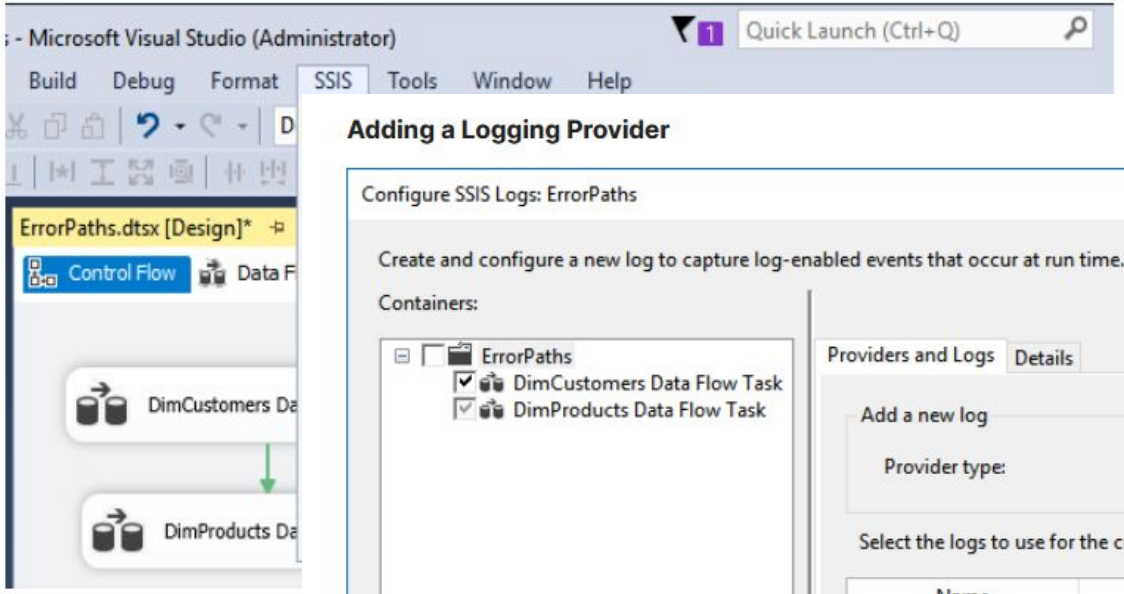
1. S…
2. S…
3. S…
4. C…

**Adding an Event Handler**



# Logging SSIS Packages

**Adding logging to a SSIS package**



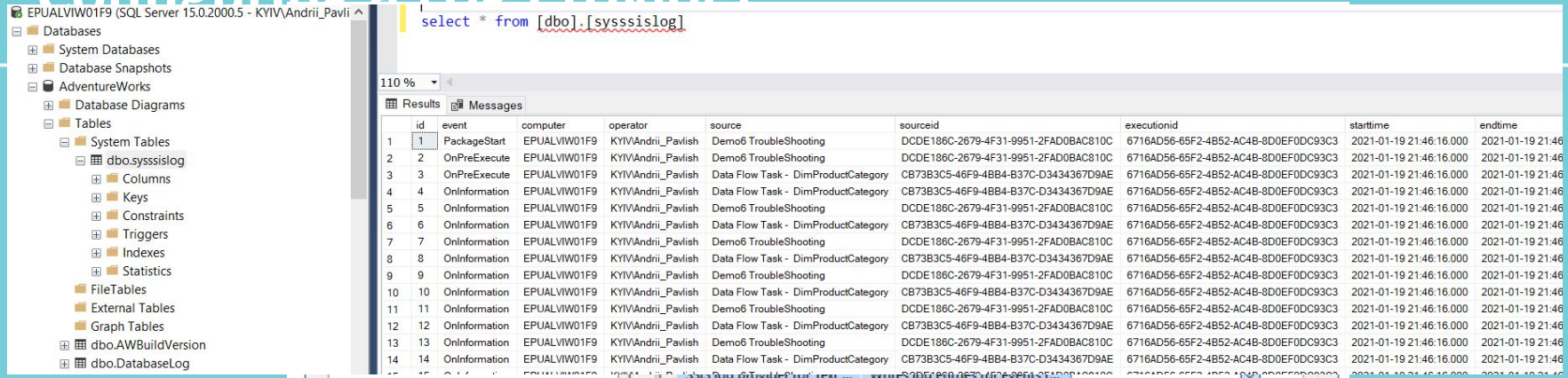

ents on packages,

**Adding a Logging Provider**




Visual Stud

# Configuring a Log Provider




| | id | event | computer | operator | source | sourceid | executionid | starttime | endtime |
|---|---|---|---|---|---|---|---|---|---|
| 1 | 1 | PackageStart | EPUALVIW01F9 | KYIV\Andrii_Pavlish | Demo6 TroubleShooting | DCDE186C-2679-4F31-9951-2FAD0BAC810C | 6716AD56-65F2-4B52-AC4B-8D0EF0DC93C3 | 2021-01-19 21:46:16.000 | 2021-01-19 21:46 |
| 2 | 2 | OnPreExecute | EPUALVIW01F9 | KYIV\Andrii_Pavlish | Demo6 TroubleShooting | DCDE186C-2679-4F31-9951-2FAD0BAC810C | 6716AD56-65F2-4B52-AC4B-8D0EF0DC93C3 | 2021-01-19 21:46:16.000 | 2021-01-19 21:46 |
| 3 | 3 | OnPreExecute | EPUALVIW01F9 | KYIV\Andrii_Pavlish | Data Flow Task - DimProductCategory | CB73B3C5-46F9-4BB4-B37C-D3434367D9AE | 6716AD56-65F2-4B52-AC4B-8D0EF0DC93C3 | 2021-01-19 21:46:16.000 | 2021-01-19 21:46 |
| 4 | 4 | OnInformation | EPUALVIW01F9 | KYIV\Andrii_Pavlish | Data Flow Task - DimProductCategory | CB73B3C5-46F9-4BB4-B37C-D3434367D9AE | 6716AD56-65F2-4B52-AC4B-8D0EF0DC93C3 | 2021-01-19 21:46:16.000 | 2021-01-19 21:46 |
| 5 | 5 | OnInformation | EPUALVIW01F9 | KYIV\Andrii_Pavlish | Demo6 TroubleShooting | DCDE186C-2679-4F31-9951-2FAD0BAC810C | 6716AD56-65F2-4B52-AC4B-8D0EF0DC93C3 | 2021-01-19 21:46:16.000 | 2021-01-19 21:46 |
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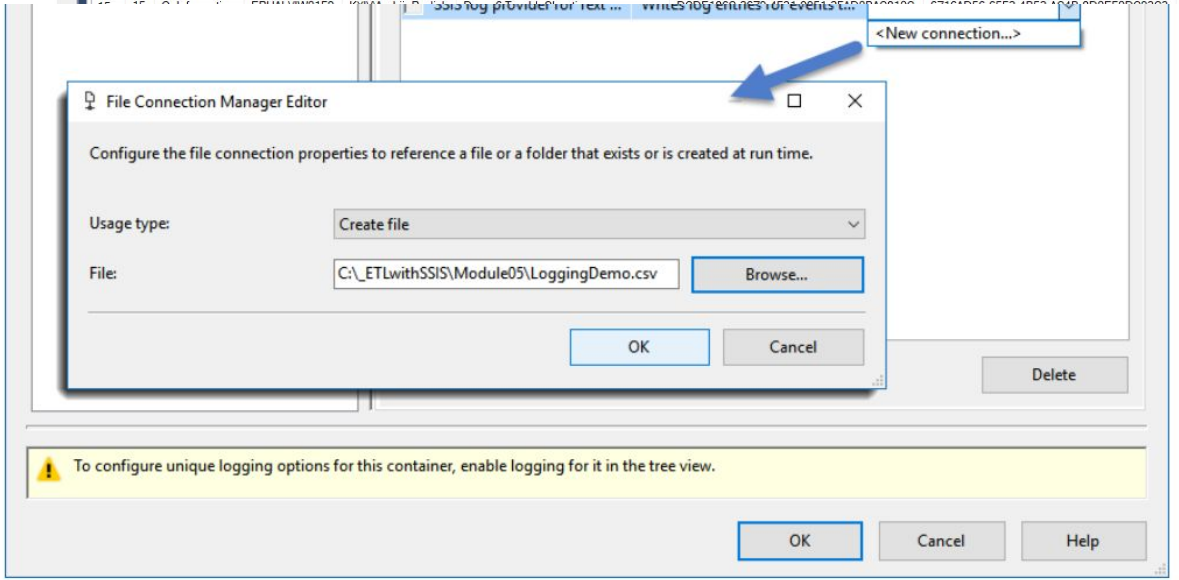
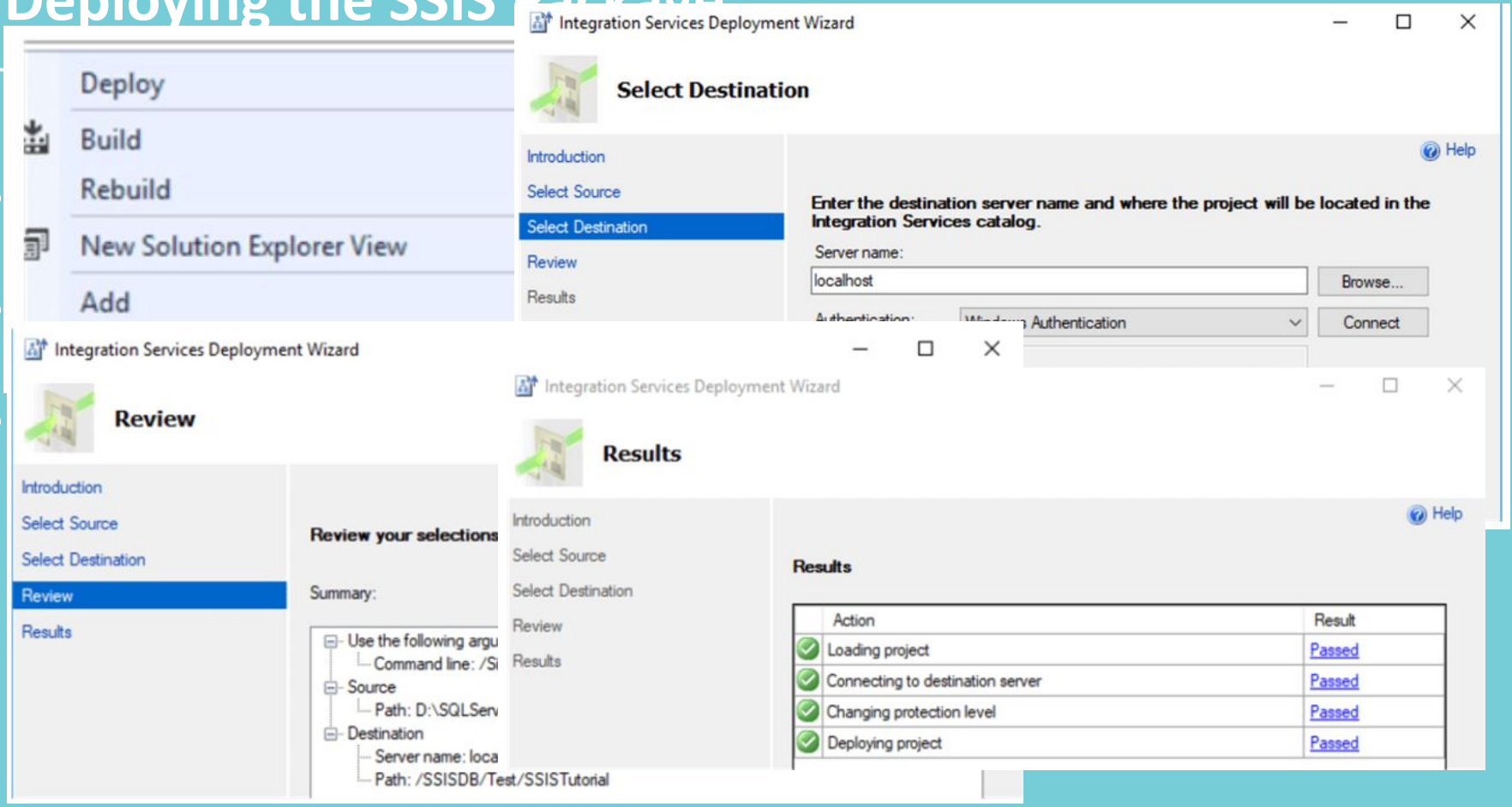
| 10 | 10 | OnInformation | EPUALVIW01F9 | KYIV\Andrii_Pavlish | Data Flow Task - DimProductCategory | CB73B3C5-46F9-4BB4-B37C-D3434367D9AE | 6716AD56-65F2-4B52-AC4B-8D0EF0DC93C3 | 2021-01-19 21:46:16.000 | 2021-01-19 21:46 |
| 11 | 11 | OnInformation | EPUALVIW01F9 | KYIV\Andrii_Pavlish | Demo6 TroubleShooting | DCDE186C-2679-4F31-9951-2FAD0BAC810C | 6716AD56-65F2-4B52-AC4B-8D0EF0DC93C3 | 2021-01-19 21:46:16.000 | 2021-01-19 21:46 |
| 12 | 12 | OnInformation | EPUALVIW01F9 | KYIV\Andrii_Pavlish | Data Flow Task - DimProductCategory | CB73B3C5-46F9-4BB4-B37C-D3434367D9AE | 6716AD56-65F2-4B52-AC4B-8D0EF0DC93C3 | 2021-01-19 21:46:16.000 | 2021-01-19 21:46 |
| 13 | 13 | OnInformation | EPUALVIW01F9 | KYIV\Andrii_Pavlish | Demo6 TroubleShooting | DCDE186C-2679-4F31-9951-2FAD0BAC810C | 6716AD56-65F2-4B52-AC4B-8D0EF0DC93C3 | 2021-01-19 21:46:16.000 | 2021-01-19 21:46 |
| 14 | 14 | OnInformation | EPUALVIW01F9 | KYIV\Andrii_Pavlish | Data Flow Task - DimProductCategory | CB73B3C5-46F9-4BB4-B37C-D3434367D9AE | 6716AD56-65F2-4B52-AC4B-8D0EF0DC93C3 | 2021-01-19 21:46:16.000 | 2021-01-19 21:46 |

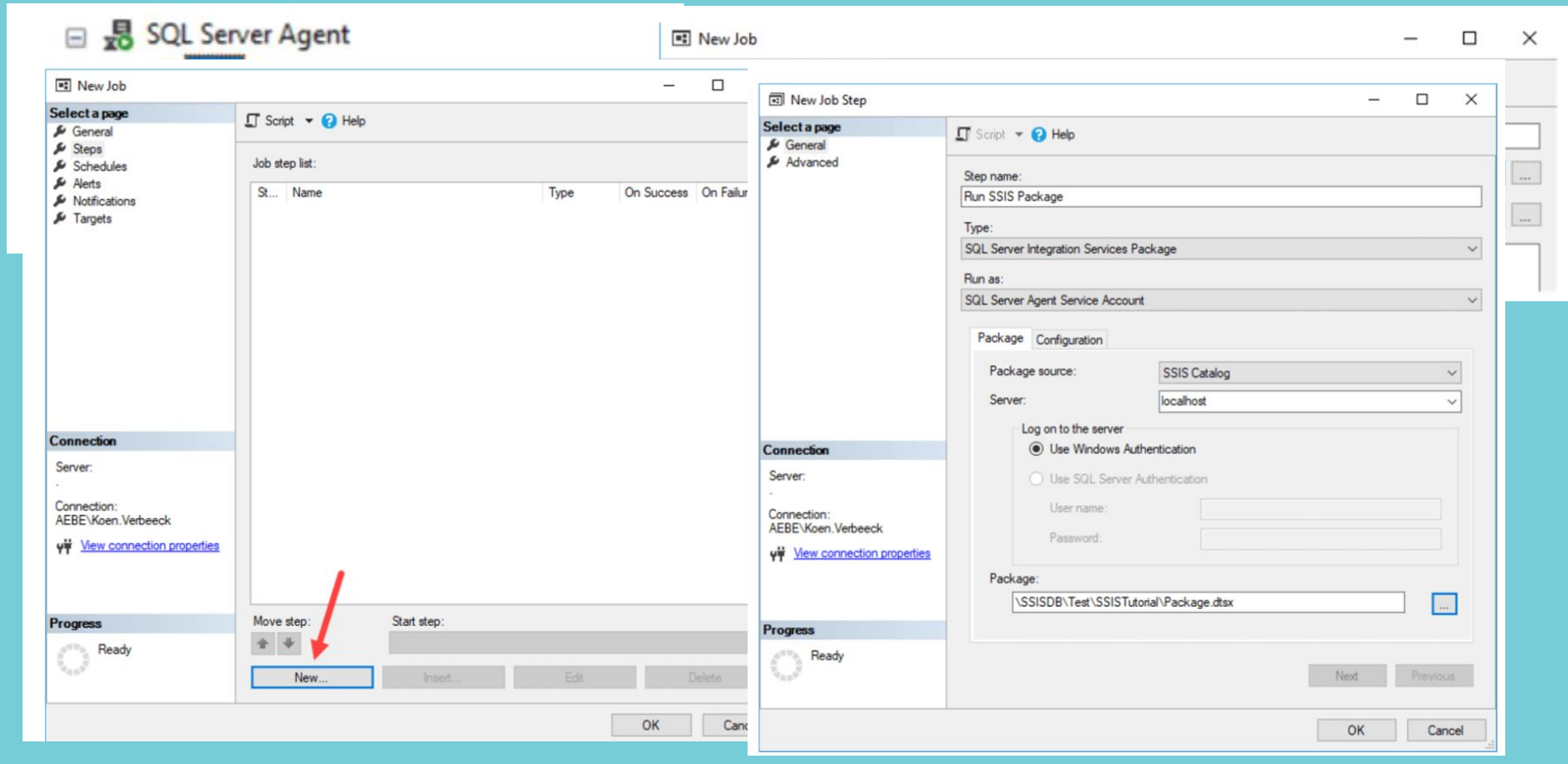
view, then the l… …that are to be logged.



# Deploying the SSIS Package



# ETL Automation using SSIS Jobs



# DEMO 6.
# Troubleshooting and error handling.

# Hometask

# THANK YOU!