Microsoft

Azure Data Warehouse
In-A-Day

Steve Young - Data & AI CSA
Rebecca Young - Data & AI CSA

Agenda

Agenda:

Time	Topic	Description	Materials
09:00am - 09:15am	Introductions & Logistics (15min)	Welcome	N/A
09:15am - 10:00am	Datawarehouse Patterns in Azure & SQL DW Overview (45min)	Slide Deck 01	N/A
10:00am - 10:45am	SQL DW Gen2 New Features & Planning Your Project Build (45min)	Slide Deck 02	N/A
10:45am - 11:00pm	Break (15min)	Please take a break	N/A
11:00am -12:00pm	Demo & Lab 01 (60 Min)	Setting up the LAB environment	Lab 01
12:00pm -1:00pm	Lunch (60 Min)	Lunch and complete lab 01	N/A
01:00pm -1:30pm	SQLDW Loading Best Practices (30 Min)	Lecture	N/A
01:30pm -02:15pm	Lab 02/03: User IDs & Data loading scenarios and best practices (45min)	Loading different scenarios	Lab 02/03
02:15am - 2:30pm	Break (15min)	Please take a break	N/A
02:30pm -3:00pm	SQLDW Operational Best Practices (30 Min)	Lecture	N/A
03:00pm -03:45pm	Lab 04: Performance Tuning best practices (45min)		Lab 04
03:45pm -4:15pm	Lab 05: Lab 3: Monitoring, Maintenance and Security (30min)		Lab 05
4:15pm -5:00pm	Q&A and Wrap-up (45min)	final remarks or takeaways/next steps	Survey

Azure SQL Data Warehouse Gen 2 - Performance Features

Data Movement

https://azure.microsoft.com/en-us/blog/smarter-faster-safer-azure-sql-data-warehouse-is-simply-unmatched/

Data Movement - Instant Data Movement (IDM)

Instant Data Movement (IDM) - extremely efficient movement between data warehouse compute nodes.

At the heart of every distributed database system is the **need to align two or more tables**

That are partitioned on a different key to produce a final or intermediate result set.

Distributed Data Movement

ProductSales

	AccountID	SalesAmt	…
Node 1:	47	$1,234.36	…
Node 2:	36	$2,345.47	…
Node 3:	14	$3,456.58	…
Node 4:	25	$4,567.69	…
Node 5:	48	$5,678.70	…
Node 6:	37	$6,789.81	…
	…	…	…

SalesAccountTerritory

SATerritoryID	AccountID	…
444	37	…
333	25	
111	36	…
222	47	…
445	14	
334	48	…
…	…	…

Shuffle

SATName	TotalSales
North	$6,789.81
South	$5,678.70
NorthEast	$4,567.69
SouthWest	$3,456.58
East	$2,345.47
West	$1,234.36

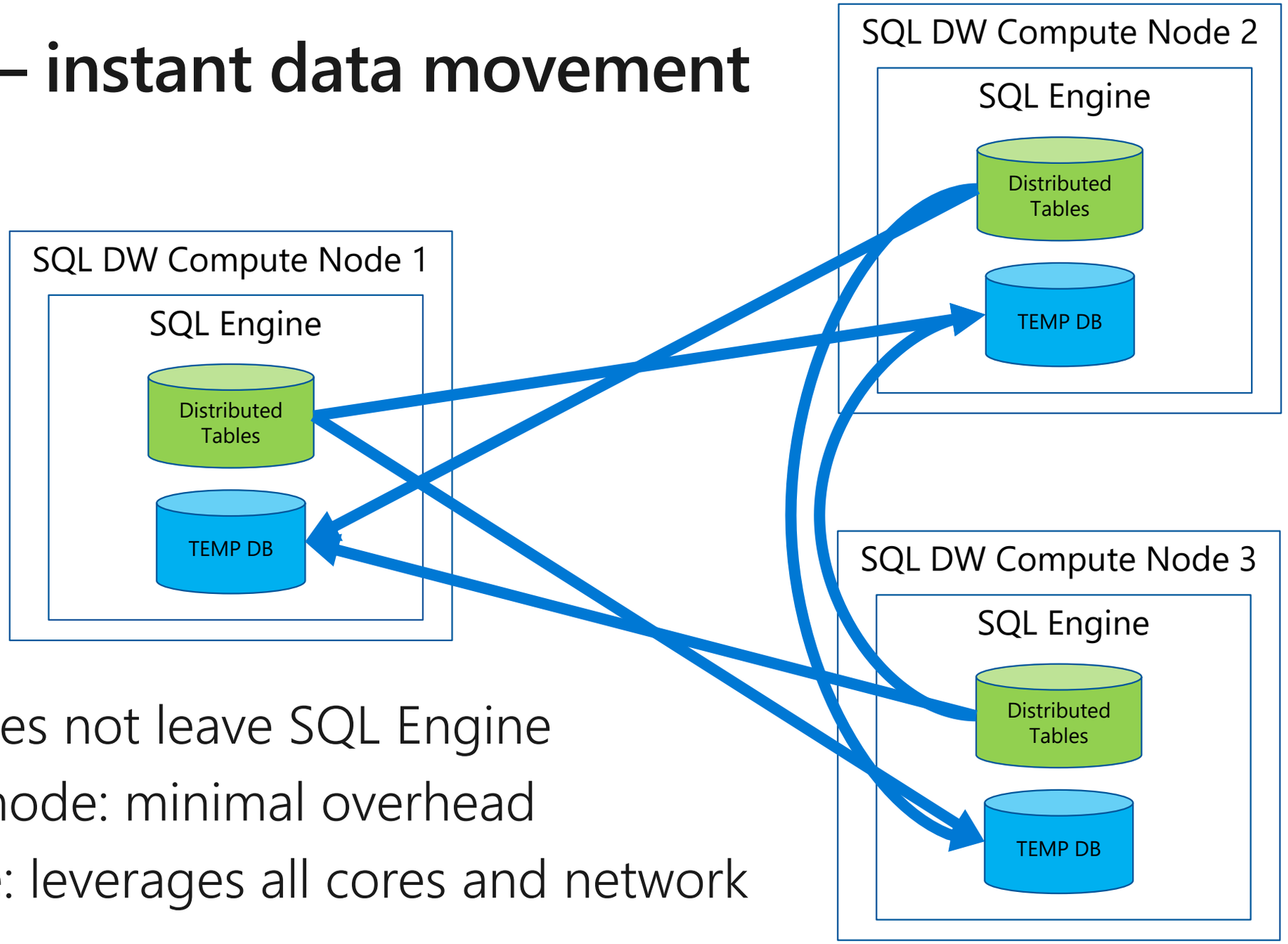
	SATName	…
	West	…
	East	
	SouthWest	…
	NorthEast	…
	South	
	North	…
…	…	…

```
CREATE TABLE ProductSales
WITH (DISTRIBUTION=HASH(AccountID))
AS...

CREATE TABLE SalesAccountTerritory
WITH (DISTRIBUTION=HASH(SATerritoryID))
AS...

SELECT TOP 25 a.SalesAccountTerritoryName
      ,TotalSales = SUM(p.SalesAmt)
FROM ProductSales p
JOIN SalesAccountTerritory a
ON   a.AccountID = p.AccountID
GROUP BY a.SalesAccountTerritoryName
ORDER BY 2 DESC
```

Gen2 – instant data movement



Data does not leave SQL Engine

Batch-mode: minimal overhead

Scalable: leverages all cores and network

Distribution Column

Choose a distribution column that minimizes data movement

To get the correct query result queries might move data from one Compute node to another. Data movement commonly happens when queries have joins and aggregations on distributed tables. Choosing a distribution column that helps minimize data movement is one of the most important strategies for optimizing performance of your SQL Data Warehouse.

To minimize data movement, select a distribution column that:

- Is used in `JOIN`, `GROUP BY`, `DISTINCT`, `OVER`, and `HAVING` clauses. When two large fact tables have frequent joins, query performance improves when you distribute both tables on one of the join columns. When a table is not used in joins, consider distributing the table on a column that is frequently in the `GROUP BY` clause.
- Is *not* used in `WHERE` clauses. This could narrow the query to not run on all the distributions.
- Is *not* a date column. WHERE clauses often filter by date. When this happens, all the processing could run on only a few distributions.

What to do when none of the columns are a good distribution column

If none of your columns have enough distinct values for a distribution column, you can create a new column as a composite of one or more values. To avoid data movement during query execution, use the composite distribution column as a join column in queries.

Once you design a hash-distributed table, the next step is to load data into the table. For loading guidance, see Loading overview.

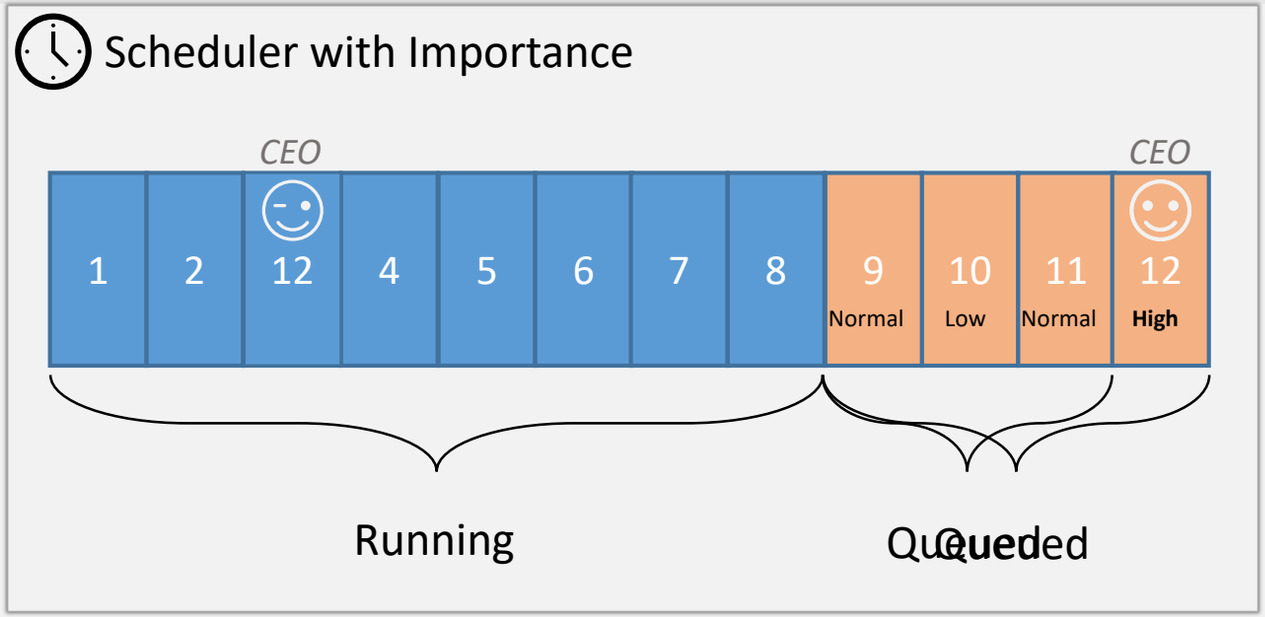
Workload Management

WORKLOAD IMPORTANCE –IMPORTANCE

Overview

Workload importance allows you to prioritize the queries that get access to resources.

It helps ensure that high-business value work is executed first on a busy data warehouse.



WORKLOAD CLASSIFICATION

Overview

Allows you to map a query to an allocation of resources via pre-determined rules

Use this in combination with workload importance to effectively share resources across different workload types

```
CREATE WORKLOAD CLASSIFIER classifier_name
WITH
(
    [WORKLOAD_GROUP = '<Resource Class>' ]
    [IMPORTANCE = {    LOW             |
                       BELOW_NORMAL    |
                       NORMAL          |
                       ABOVE_NORMAL    |
                       HIGH
                  }
    ]
    [MEMBERNAME = ‘security_account’]
)
```

WORKLOAD ISOLATION (PREVIEW)

Overview

Isolation allocates fixed resources to workloads within a data warehouse. These limits are strictly enforced for memory, and only enforced under load for CPU and IO.

```
CREATE WORKLOAD GROUP group_name
WITH
(
    [ MIN_PERCENTAGE_RESOURCE = value ]
    [ CAP_PERCENTAGE_RESOURCE = value ]
    [ MAX_CONCURRENCY = value ]
)
```

Resource classes are implemented by assigning users to database roles. When a user runs a query, the query runs with the user's resource class

EXEC sp_addrolemember 'largerc', 'loaduser’;

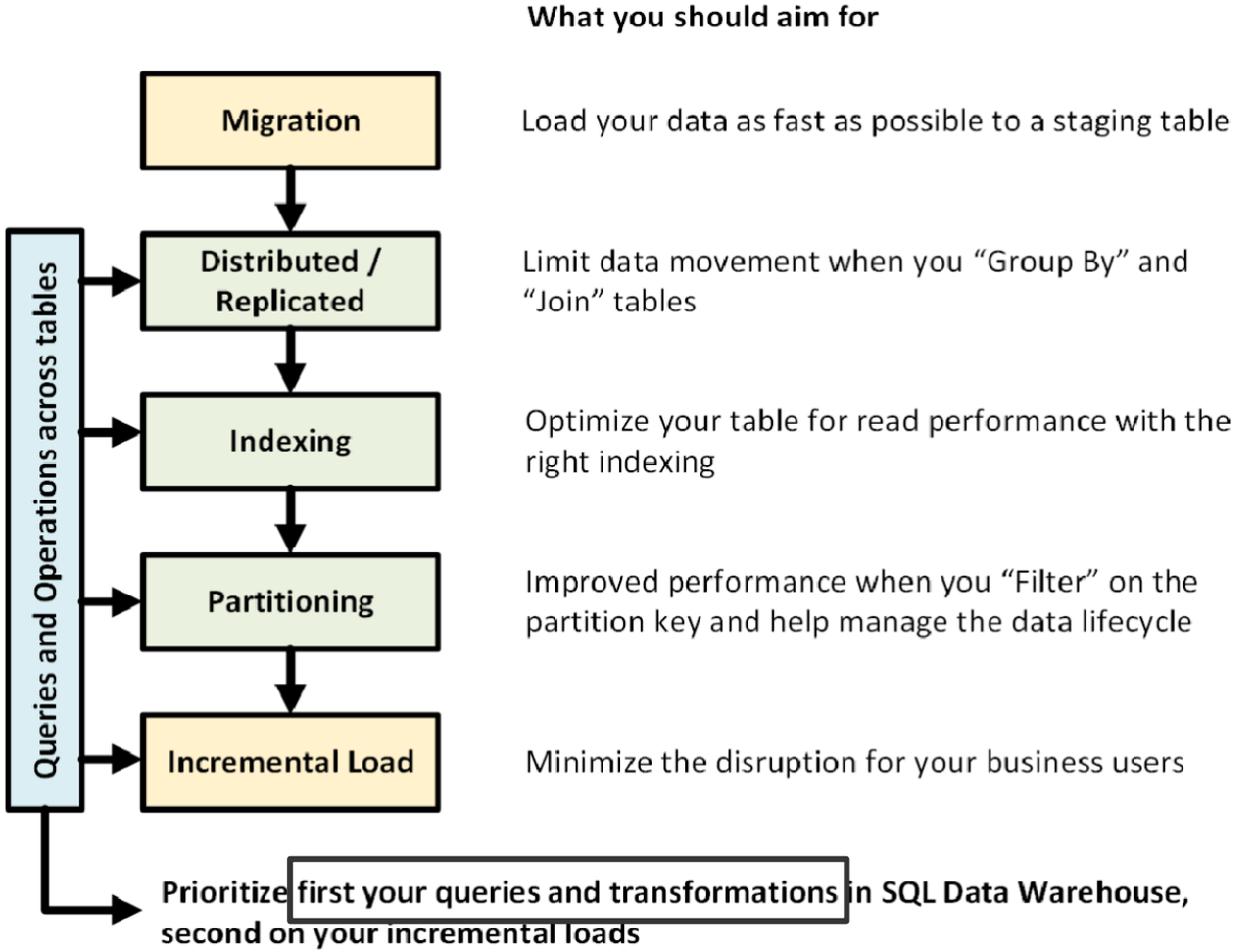
EXEC sp_droprolemember 'largerc', 'loaduser';

https://docs.microsoft.com/en-us/azure/sql-data-warehouse/sql-data-warehouse-workload-classification

DW Creation Framework Architecture Decisions

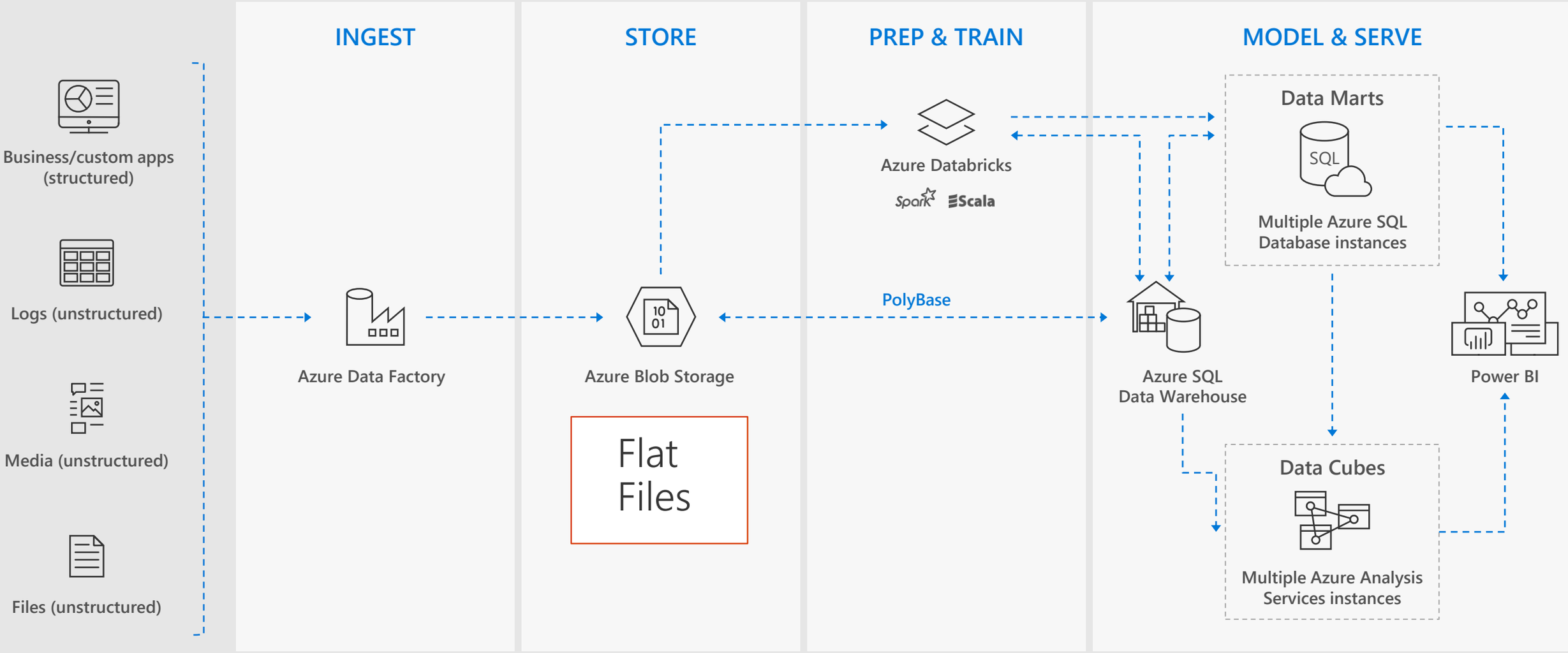
DW Creation Framework Architecture Decisions

"Improve your probability of Success!!!!!"



https://docs.microsoft.com/en-us/azure/sql-data-warehouse/cheat-sheet

Hub & Spoke Architecture for Analytics (BI)

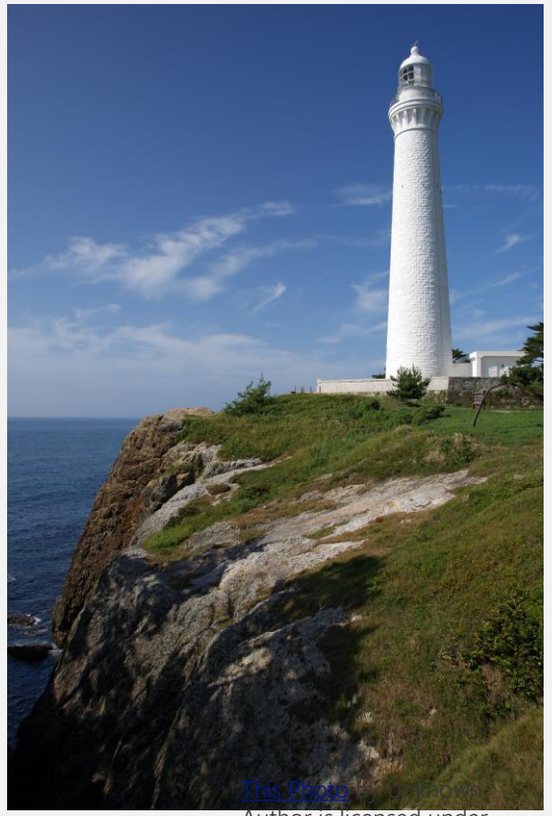


Microsoft Azure supports other services like Azure HDInsight and Azure Data Lake in various layers to allow customers a truly customized solution.

Choose a Light House Project

Don’t let your first project be your last !!!

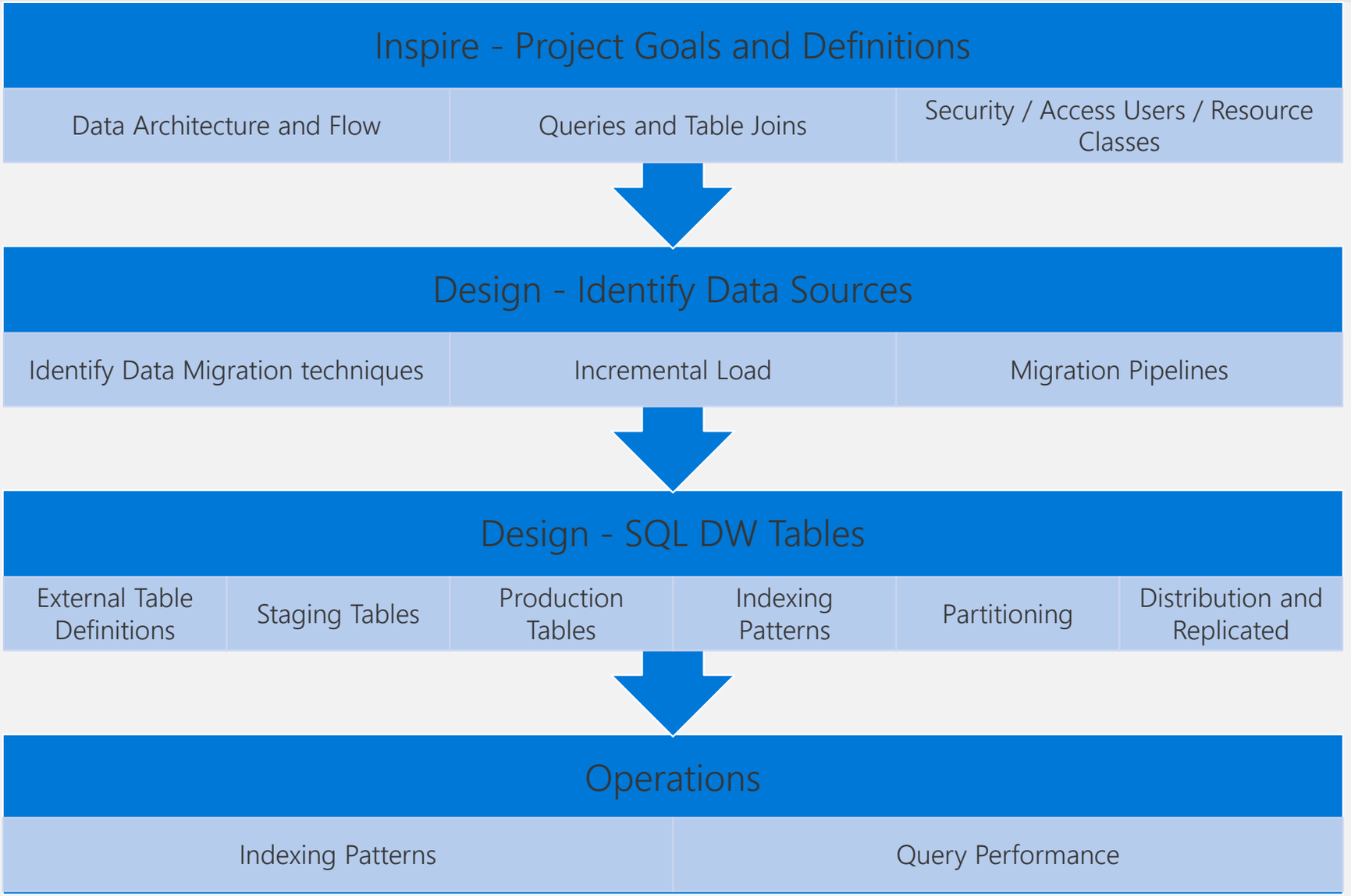
- Get Comfortable with the technology – Kick the tires
- Take a smaller project, treat like a production roll out.
- Provides insights not only about the technology, but the organization’s maturity in being able to do a data project
  - Can the Input Files be generated, Tested, Errors traced
  - Handle change management
  - If you don’t measure, how do you know if you succeeded? Failed?



This Photo by Unknown Author is licensed under CC BY-SA

DW Creation Framework

DATA WAREHOUSE DESIGN WORKFLOW



WORKFLOW – PROJECT GOALS AND DEFINITIONS

Imagine a future state solution and develop use cases and query patterns

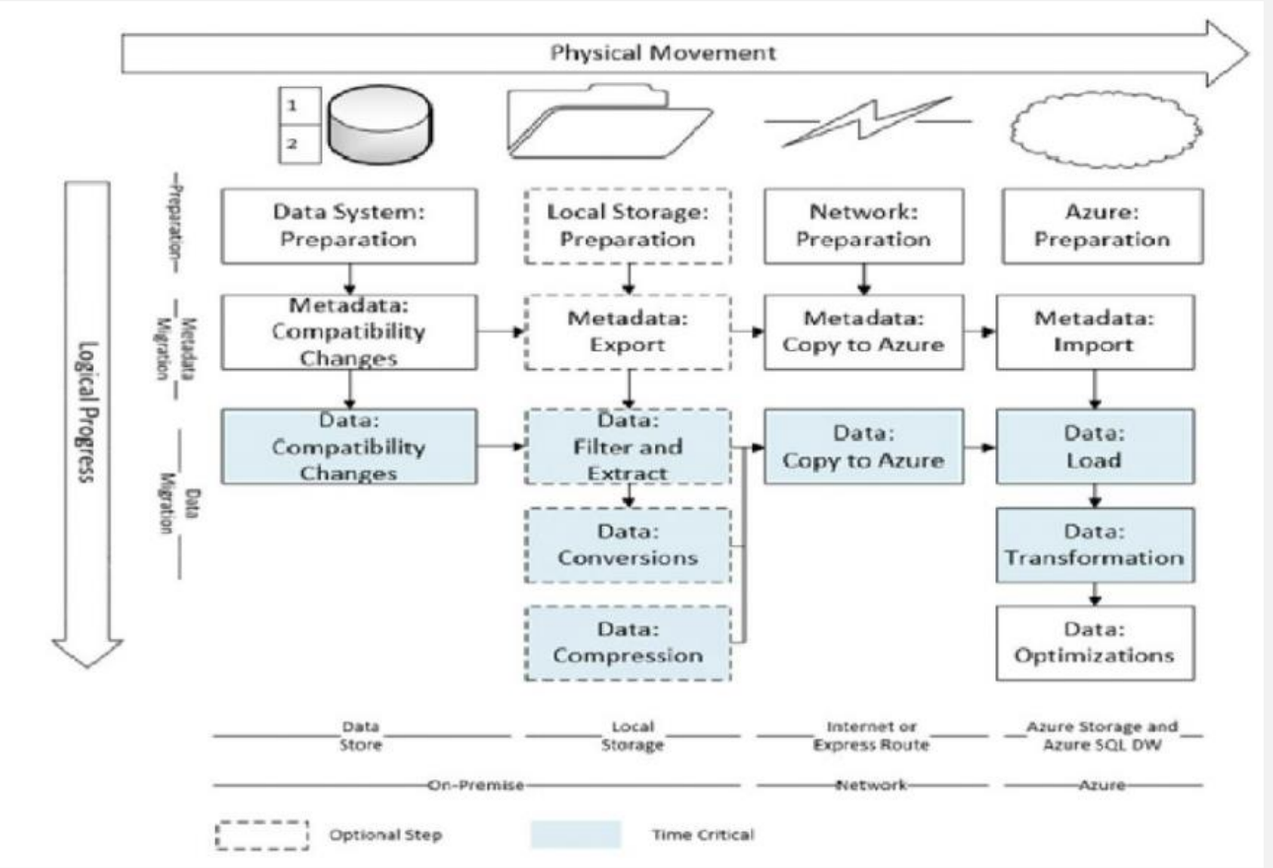
- Data Architecture and Flow - Identification
  - What sources are to be used
  - What format should they take
  - What is the update pattern (Incremental, One Time, Reload)
  - Does “history” change?
- Queries and Table Joins
  - Capture existing queries, reports and ad-hoc analysis
  - What queries are important?
  - Priorities (Resource Classes)
- Security / Access Users

This Photo by Unknown Author is licensed under CC BY-SA-NC

WORKFLOW – IDENTIFY DATA SOURCES

Imagine a future state solution and develop use cases and query patterns

- Identify Data Migration tasks
  - File formats
  - Update schedule
- Incremental Load
  - Are these required?
- Migration Pipelines
  - Azure Data Factory
  - Azure Data Lake / Blob storage



https://blogs.msdn.microsoft.com/sqlcat/2016/08/18/migrating-data-to-azure-sql-data-warehouse-in-practice/
→ https://blogs.msdn.microsoft.com/sqlcat/2017/05/17/azure-sql-data-warehouse-loading-patterns-and-strategies/
https://techcommunity.microsoft.com/t5/DataCAT/Azure-SQL-Data-Warehouse-loading-patterns-and-strategies/ba-p/305456

WORKFLOW – IDENTIFY DATA SOURCES

Imagine a future state solution and develop use cases and query patterns

Using CTAS to load initial data

Then you can use a CTAS (CREATE TABLE AS SELECT) operation within SQL Data Warehouse to load the data from Azure Blob Storage to SQL Data Warehouse:

```
CREATE TABLE orders_load
WITH (CLUSTERED COLUMNSTORE INDEX, DISTRIBUTION = HASH(o_orderkey),
     PARTITION (o_orderdate RANGE RIGHT FOR VALUES ('1992-01-01','1993-01-01','1994-01-01','1995-01-01')))
 as select * from orders_ext;
```

CTAS creates a new table. We recommend using CTAS for the initial data load. This is an all-or-nothing operation with minimal logging.

Using INSERT INTO to load incremental data

For an incremental load, use INSERT INTO operation. This is a full logging operation when inserting into a populated partition which will impact on the load performance. Furthermore, the roll-back operation on a large transaction can be expensive. Consider breaking your transaction into smaller batches.

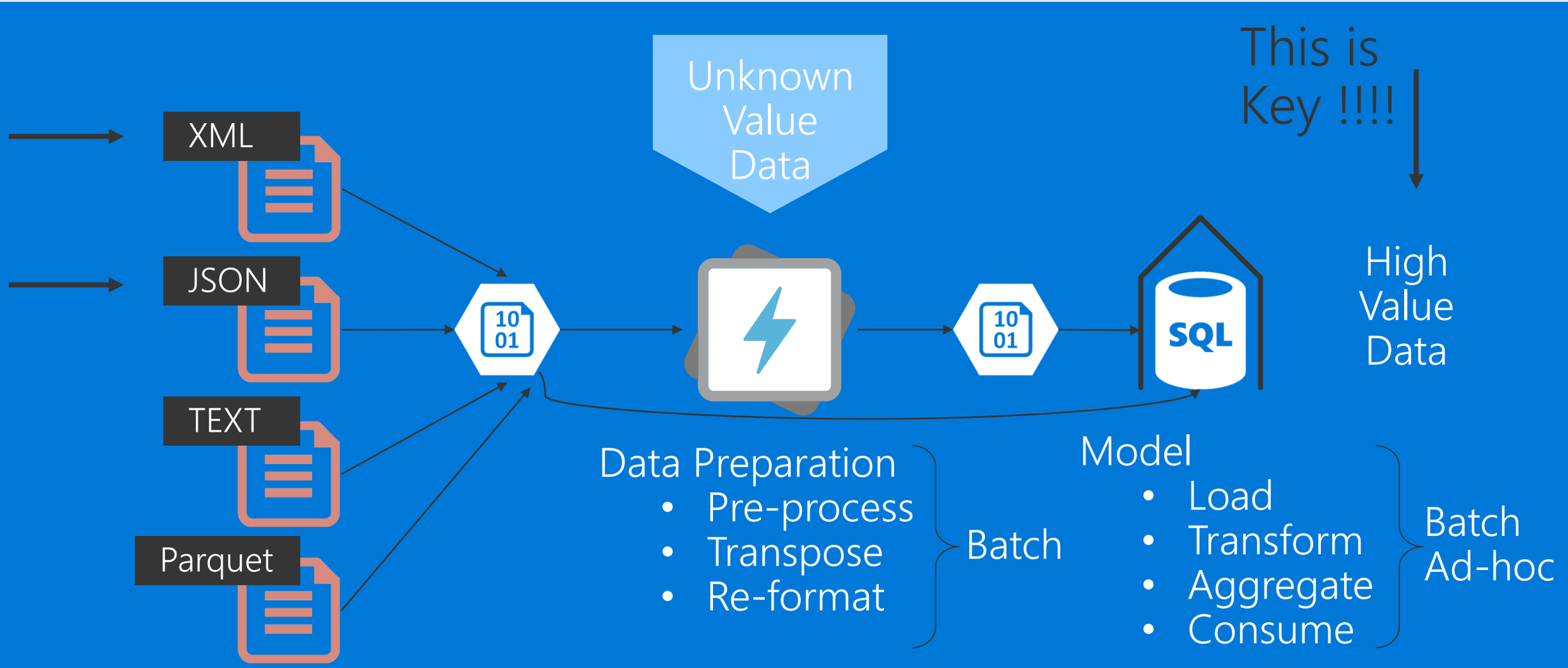
```
INSERT INTO TABLE orders_load
select * from orders_current_ext;
```

Note The source is using different external table, orders_current_ext. This is the external table defining the path for the incremental data on ASB.

Another popular pattern is to load into a partitioned aligned stage table via CTAS, then partition switch into the final table.

https://techcommunity.microsoft.com/t5/DataCAT/Azure-SQL-Data-Warehouse-loading-patterns-and-strategies/ba-p/305456

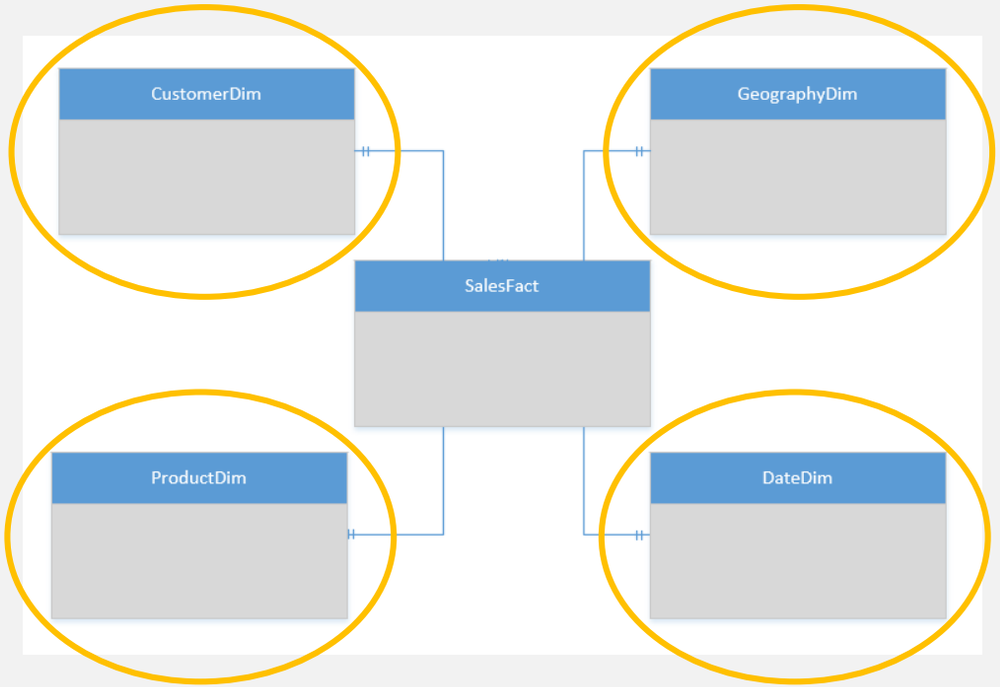
WORKFLOW – IDENTIFY DATA SOURCES



WORKFLOW – DESIGN SQL DW TABLES

Imagine a future state solution and develop use cases and query patterns

- External Table Definitions
- Staging Tables
- Production Tables
- Indexing Patterns
- Partitioning
- Distribution and Replicated




```
-- Create a database master key if one does not already exist, using your own password. This key is used to encrypt the
CREATE MASTER KEY ENCRYPTION BY PASSWORD = 'S0me!nfo'
;

-- Create a database scoped credential with Azure storage account key as the secret.
CREATE DATABASE SCOPED CREDENTIAL AzureStorageCredential
WITH
     IDENTITY   = '<my_account>'
,    SECRET     = '<azure_storage_account_key>'
;

-- Create an external data source with CREDENTIAL option.
CREATE EXTERNAL DATA SOURCE MyAzureStorage
WITH
(    LOCATION   = 'wasbs://daily@logs.blob.core.windows.net/'
,    CREDENTIAL = AzureStorageCredential
,    TYPE       = HADOOP
)
;
```

```
CREATE TABLE dbo.DimCustomer
(    CustomerKey           int             NOT NULL
,    GeographyKey          int             NULL
,    CustomerAlternateKey  nvarchar(15)    NOT NULL
,    Title                 nvarchar(8)     NULL
,    FirstName             nvarchar(50)    NULL
,    LastName              nvarchar(50)    NULL
,    BirthDate             date            NULL
,    Gender                nvarchar(1)     NULL
,    EmailAddress          nvarchar(50)    NULL
,    YearlyIncome          money           NULL
,    DateFirstPurchase     date            NULL
)
WITH
(    CLUSTERED COLUMNSTORE INDEX
,    DISTRIBUTION = REPLICATED
)
```

WORKFLOW – OPERATIONS

Imagine a future state solution and develop use cases and query patterns

- Indexing Patterns
- Query Performance
- Data Management Views

Microsoft

Q&A

MICROSOFT CONFIDENTIAL – INTERNAL ONLY