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SINGLE STATEMENT, MANY CHANGES

**How One Statement Can
Modify Multiple Tables**

Deborah Melkin
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WHO AM I?




- 20 years as a DBA
- Mainly work with SQL Server
- Mainly work with OLTP.
- Data Platform WIT UG co-leader
- WITspiration co-founder
- Redgate Community Ambassador
- Microsoft MVP – Data Platform

Random facts:

- I'm a longtime alto in my choir.
- I go to bluegrass jams regularly.
- I've been learning guitar and now mandolin.
- I am a bit of a musical theater geek.

AGENDA

- EXPLICIT CHANGES
- IMPLICIT CHANGES
- AFTER THE TRANSACTION



EXPLICIT CHANGES

CHANGES THAT ARE INCLUDED
DIRECTLY IN THE STATEMENTS

INSERTED \ DELETED

- Internal System Tables that exist during a transaction to store the data as existed before the change and as it will exist after the transaction is committed.
 - The table structure matches the table.
 - You cannot modify the inserted or deleted tables.
 - They are stored in memory.

OUTPUT INTO

- Part of the DML statement
- Directs the output to variables, table variables, tables
- Limitations:
 - Cannot insert into a table that is any part of a foreign key constraint
 - Cannot insert into a table that has a trigger on it
 - Some restrictions with replication
 - Target cannot be a remote table, view or common table expression
 - Will always use a serial plan
 - Target table not eligible for parallelism

OUTPUT INTO

```
UPDATE Alter_Ego
SET Person_ID = Person.Person_ID
    OUTPUT inserted.Person_ID, deleted.Person_ID
    INTO #Superhero_Changeover (New_Secret_ID, Old_Secret_ID)
FROM Person
WHERE First_Name = 'Deborah'
AND Last_Name = 'Melkin'
AND Alter_Ego.Alter_Ego_Name = 'Wonder Woman'
;
```

TRIGGERS

- Stored Procedures attached to a table or view executed as part of the data change
 - After the change
 - Instead of the change
 - Part of the same transaction as the data change statement
- Can be assigned to execute for INSERT, UPDATE or DELETE
- Can have multiple triggers for the same or different actions on a single table
 - Can assign trigger to be the first or last trigger fired but no control in between

TRIGGERS

```
CREATE TRIGGER TR_Alter_Ego_Insert
    ON Alter_Ego
    FOR UPDATE
AS BEGIN

    DECLARE @corp_id int;

    -- Get Batman's Company ID
    SELECT @corp_id = Corporation_ID
    FROM Corporation
    WHERE Corporation_Name = 'Wayne Enterprises';

    INSERT INTO Employment
        (Person_ID, Corporation_ID, Corporate_Position_ID, From_Date)
    SELECT ins.Person_ID, @corp_id, cp.Corporate_Position_ID, getdate()
    FROM Corporate_Position cp
        JOIN inserted as ins ON cp.Corporate_Position_Name = ins.Alter_Ego_Name;

END
GO
```

TRIGGERS

```
CREATE TRIGGER TR_Alter_Ego_Insert
    ON Alter_Ego
    INSTEAD OF UPDATE
AS BEGIN

    DECLARE @corp_id int;

    SELECT @corp_id = Corporation_ID
    FROM Corporation
    -- (tstark) Forget Batman, use Iron Man's company
    WHERE Corporation_Name = 'Stark Industries';

    INSERT INTO Employment
        (Person_ID, Corporation_ID, Corporate_Position_ID, From_Date)
    SELECT ins.Person_ID, @corp_id, cp.Corporate_Position_ID, getdate()
    FROM Corporate_Position cp
        JOIN inserted as ins ON cp.Corporate_Position_Name = ins.Alter_Ego_Name;

END
GO
```



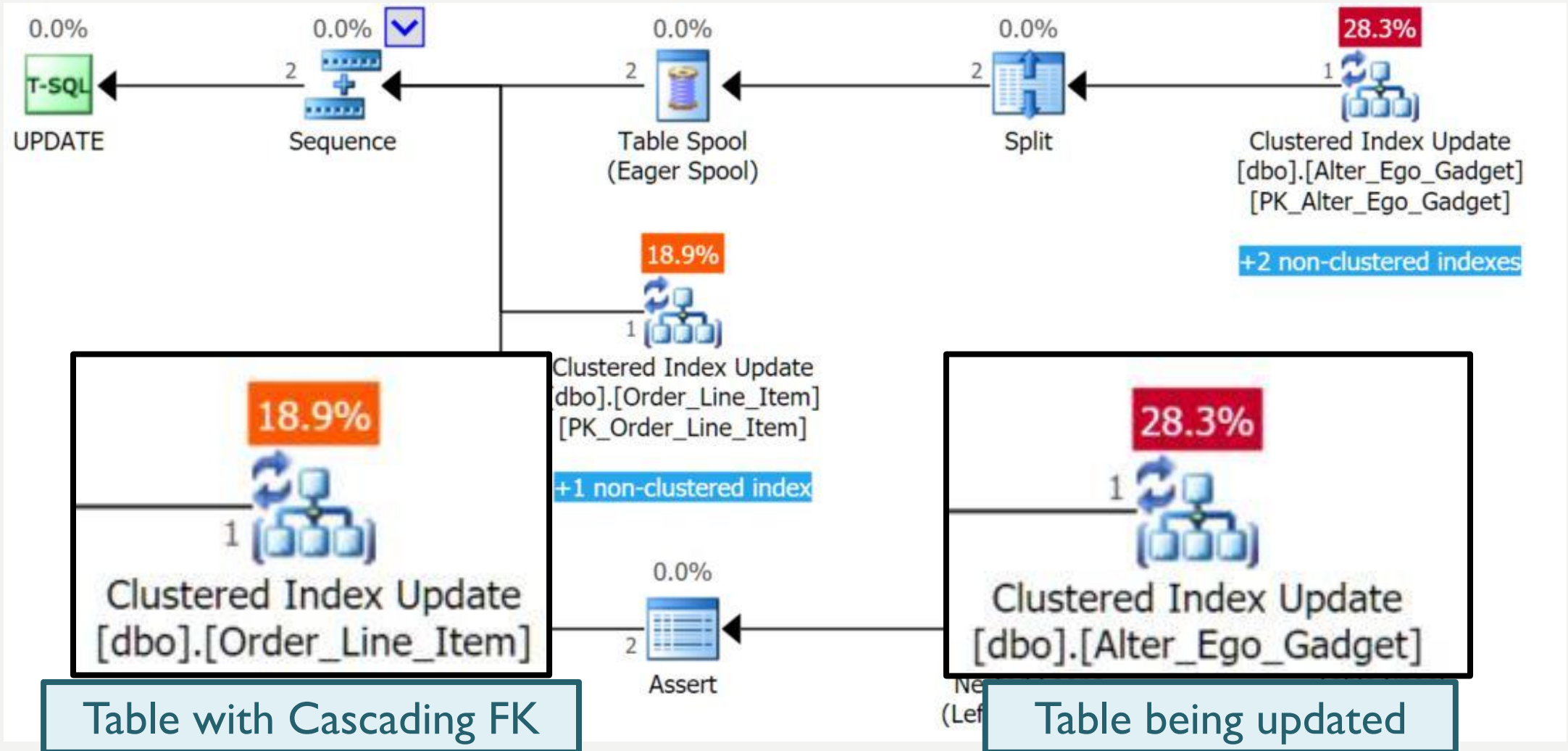
IMPLICIT CHANGES

CHANGES THAT ARE BUILT INTO THE
DATABASE SCHEMA

CASCADING FOREIGN KEYS

- Defines actions that should be taken on the referencing columns when the referenced column is updated or referenced row is deleted
 - SET NULL
 - Sets the referencing column to NULL
 - SET DEFAULT
 - Sets the referencing column to a default value
 - CASCADE
 - Updates the referencing column to the same value as the referenced column
 - Deletes the referencing record when the referenced record is deleted
 - NO ACTION

CASCADING FOREIGN KEYS



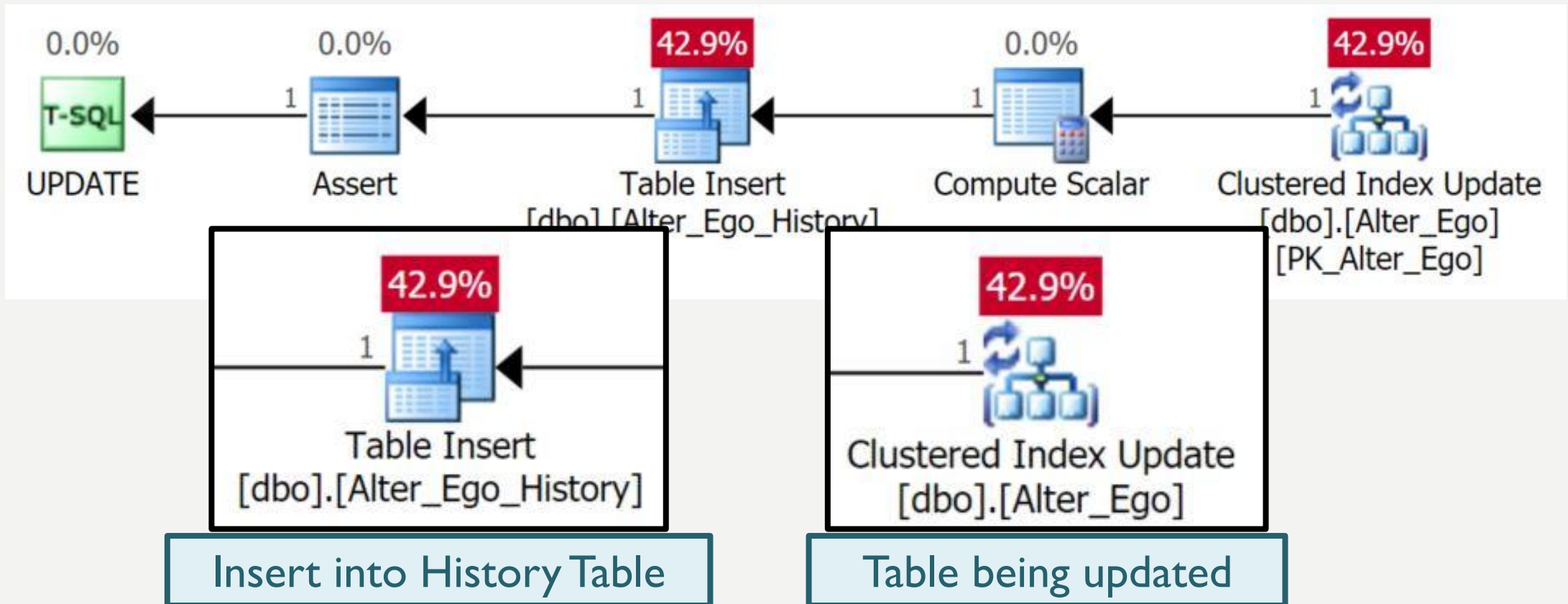
TEMPORAL TABLES

- Creates system version of the changes to a table
 - Only records UPDATES and DELETES
- Versioning is managed by the system
- History table can be created automatically by SQL Server or it can be specified
- Retention for data in the history table can be specified start with SQL 2017
- Limitations:
 - The history table must exist in the same database
 - Cannot manually modify the system date columns on the table being versioned.
 - No direct data modification of the history table
 - Some restrictions with Replication

TEMPORAL TABLES

- Can query the table to return the data as it existed at a point in time
- Options for querying data:
 - AS OF
 - FROM
 - BETWEEN
 - CONTAINED IN
 - ALL

TEMPORAL TABLES



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AFTER THE TRANSACTION

CHANGES THAT HAPPEN BECAUSE OF
THE CHANGE

LOG READERS

Results Messages							
	Current LSN	Operation	Context	Transaction ID	LogBlockGeneration	Tag Bits	Log Re
6	00000032:00001390:0001	LOP_PREP_XACT	LCX_NULL	0000:00001479	0	0x0000	64
7	00000032:00001398:0001	LOP_COMMIT_XACT	LCX_NULL	0000:00001479	0	0x0000	80
8	00000032:000013a0:0001	LOP_MODIFY_ROW	LCX_SCHEMA_VERSION	0000:00000000	0	0x0000	62
9	00000032:000013a0:0002	LOP_BEGIN_XACT	LCX_NULL	0000:0000147a	0	0x0000	76
10	00000032:000013a0:0003	LOP_INSERT_ROWS	LCX_CLUSTERED	0000:0000147a	0	0x0000	62
11	00000032:000013a0:0004	LOP_COMMIT_XACT	LCX_NULL	0000:0000147a	0	0x0000	80
12	00000032:000013a8:0001	LOP_BEGIN_XACT	LCX_NULL	0000:0000147b	0	0x0000	76
13	00000032:000013a8:0002	LOP_INSERT_ROWS	LCX_CLUSTERED	0000:0000147b	0	0x0000	62
14	00000032:000013a8:0003	LOP_COMMIT_XACT	LCX_NULL	0000:0000147b	0	0x0000	80

Query executed successfully.

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REPLICATION

- Data changes in the publication database are sent to one or more subscription databases
- The distribution database stores metadata and history data for all types of replication, and transactions for transactional replication
- Tables can be part of multiple subscriptions
- Uses SQL Server Agent jobs to run the various tasks needed for Replication

REPLICATION

- Multiple types of replication
 - Snapshot
 - Transactional
 - Peer-to-Peer
 - Merge
- Subscriptions can be Push or Pull

CHANGE DATA CAPTURE (CDC)

- “Before” and “After” data are written to system created tables for future use
- Limitations
 - Cannot rename the objects or schemas
 - Default retention policy

OTHER TRANSACTION LOG READERS

- Database Change Tracking
 - “lightweight” version of CDC
- Availability Groups
 - Full replicas of the database
 - Synchronous and Asynchronous
 - The transaction log records of the primary database are sent to the secondary replicas
- New with SQL Server 2025
 - Change Event Streaming (CES)
 - Database Mirroring

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DEMOS

Single Statement, Many Changes | [@dgmelkin](#)

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LET'S REVIEW

Single Statement, Many Changes | @dgmelkin

TAKE-AWAYS

- Not all data modifications can be seen by traces
- Not all data modifications occur in the same database
- The amount of data that changes affects more than just the table but everything having to do with the transaction logs
- Troubleshooting data modifications may not have to do with the initial update but changes that occur because of the updates

ADDITIONAL RESOURCES

- OUTPUT

- <https://tinyurl.com/output-clause-transact-sql>
- <https://tinyurl.com/insert-data-returned-output>
- <https://www.erikdarlingdata.com/2020/01/an-unfortunate-side-effect-of-output/>
- <https://www.sql.kiwi/2020/07/a-bug-with-halloween-protection-and.html>

- Temporal Tables

- <https://docs.microsoft.com/en-us/sql/relational-databases/temporal-tables?view=sql-server-ver15>
- <https://www.erikdarlingdata.com/sql-server/tracking-row-changes-with-temporal-columns/>

ADDITIONAL RESOURCE (CONT'D)

- CDC
 - <https://tinyurl.com/about-change-data-capture>
 - <https://www.sqlshack.com/change-data-capture-for-auditing-sql-server/>
- Database Change Tracking:
 - <https://www.sqlshack.com/creating-a-sql-server-audit-using-sql-server-change-tracking/>
 - <https://tinyurl.com/about-change-tracking>

ADDITIONAL RESOURCES (CONT'D)

- Replication
 - <https://jesspomfret.com/dbatools-repl-setup/>
 - <https://jesspomfret.com/dbatools-repl-remove/>
- Change Event Streaming
 - <https://learn.microsoft.com/en-us/sql/relational-databases/track-changes/change-event-streaming/overview?view=sql-server-ver17>

MORE QUESTIONS? LET ME KNOW!

- **Email:** dgmelkin@gmail.com
- **Bluesky:** @dgmelkin.bsky.social
- **Blog:** DebtheDBA.wordpress.com
- **GitHub:**

<https://tinyurl.com/SingleStatmentManyChanges>





Thanks for coming!

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