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1) **Slowly Changing Dimension Data Modeling Solutions Depend on the Situation** :
    1. Slowly Changing Dimension Data Modeling Solutions are varied and depend on the situation.
    2. As a result, there is not just one typical solution.
    3. We will look at the situation where employees are placed on different teams over and we need to analyze the amount of sales for each team over time.
2) **Slowly Changing Dimensions REALLY means "Changing Attributes for a Dimension"** :
    1. What is a Dimension?
        1. A Dimension is category or condition/criteria (like Employee) used to filter facts or measured events (like Sales) in ways that provide useful information.
        2. Here is the Fact Table with Employee as a Dimension (Foreign Key):

DateKey	EmployeeKey	Sales
01/04/2020	6	100
01/04/2020	1	400
01/06/2020	1	450
01/11/2020	1	300
01/14/2020	4	450
01/16/2020	4	150
01/17/2020	3	400
01/31/2020	9	450
02/10/2020	6	200

        3. Here is a Dimension Table with Employee:

EmployeeKey	Employee
1	Sioux
2	Tyrone
3	Abdi
4	Chantel
5	Jojo
6	Gigi
7	Desiree
8	Miki
9	Hien

        4. We can use the Employee as a Dimension to filter the Fact Table and make a measurement like Totals Sales for each Employee.
    2. What is an Attribute for a Dimension?
        1. Both the Dimension and "Attributes for that Dimension" are categories used to filter facts or measured events (like Sales) in ways that provide useful information.
        2. Imagine Each employee was on a Team, so that Team became an Attribute for the Employee, as seen here:

EmployeeKey	Employee	Team
1	Sioux	Team A
2	Tyrone	Team A
3	Abdi	Team A
4	Chantel	Team B
5	Jojo	Team B
6	Gigi	Team B
7	Desiree	Team C
8	Miki	Team C
9	Hien	Team C

        3. We can use both Employee and Team to filter the Fact Table and make a measurement like Totals Sales for each Employee and for each Team.

3.   What is a Slowly Changing Dimension?
1.   First: Slowly Changing Dimensions REALLY means "Changing Attributes for a Dimension"
2.   For example, what would happen if Employees changed Teams over time?
3.   This would mean that the Employee, the Dimension, would have an Attribute that changes over time.
4.   As a result, the Dimension is not changing over time, but rather the Team Attribute changes over time.
5.   The term that Data Warehousing and Data Analysis People use is "Slowly Changing Dimension", but it really should be: "Changing Attributes for a Dimension".
6.   Here is an example of a table we could set up to show how the Teams change over time:

Team	Member 1	Member 2	Member 3	StartDate	EndDate
Team A	Sioux	Chantel	Desiree	01/01/2020	01/31/2020
Team A	Sioux	Jojo	Miki	02/01/2020	03/31/2020
Team B	Tyrone	Gigi	Hien	01/01/2020	03/31/2020
Team C	Abdi	Jojo	Miki	01/01/2020	01/31/2020
Team C	Abdi	Chantel	Desiree	02/01/2020	03/31/2020

7.   In the above picture you can see that the employees for Team A are Sioux, Chantel, Desiree for the period 01/01/2020 to 01/31/2020, but then change to Sioux, Jojo, Miki for the period 02/01/2020 to 03/31/2020.

3)   **Goal of Reporting is to show How the Sales for the Team and Employees Change Over Time** :

TeamKey	2020-01-Jan	2020-02-Feb	2020-03-Mar	Total
⊟ **Team A-1**	**1,750**			**1,750**
Chantel	600			600
Desiree				
Sioux	1,150			1,150
⊟ **Team A-2**			**50**	**50**
Jojo			50	50
Miki				
Sioux				
⊟ **Team B-1**	**550**	**1,500**	**850**	**2,900**
Gigi	100	750	350	1,200
Hien	450	750	350	1,550
Tyrone			150	150
⊟ **Team C-1**	**400**			**400**
Abdi	400			400
Jojo				
Miki				
⊟ **Team C-2**		**50**	**1,800**	**1,850**
Abdi		50	350	400
Chantel			500	500
Desiree			950	950
Total	**2,700**	**1,550**	**2,700**	**6,950**

OR

	A	B	C	D	E	F
1	Total Sales ($)		Year Month ▾			
2	Team ▾	Employee ▾	2020-01-Jan	2020-02-Feb	2020-03-Mar	Grand Total
3	⊟Team A-1	Chantel	600			600
4		Desiree				
5		Sioux	1,150			1,150
6	Team A-1 Total		1,750			1,750
7	⊟Team A-2	Jojo			50	50
8		Miki				
9		Sioux				
10	Team A-2 Total				50	50
11	⊟Team B-1	Gigi	100	750	350	1,200
12		Hien	450	750	350	1,550
13		Tyrone			150	150
14	Team B-1 Total		550	1,500	850	2,900
15	⊟Team C-1	Abdi	400			400
16		Jojo				
17		Miki				
18	Team C-1 Total		400			400
19	⊟Team C-2	Abdi		50	350	400
20		Chantel			500	500
21		Desiree			950	950
22	Team C-2 Total			50	1,800	1,850
23	Grand Total		2,700	1,550	2,700	6,950

4) **Data Modeling is Required to Transform the Grain of both the Dimension and Fact Table** :
   1. Data Modeling is Required :
      1. If our goal is to show the Total Sales Amount for the Teams Over Time, then we need to transform the grain of the Dimension and Fact Table to Employee-Team, rather than simply Employee.
   2. Dimension Table Before and After
      1. Team Table **Before** with the grain of "Team":
         -

TeamKey	Team	Member 1	Member 2	Member 3	StartDate	EndDate
Team A-1	Team A	Sioux	Chantel	Desiree	01/01/2020	01/31/2020
Team A-2	Team A	Sioux	Jojo	Miki	02/01/2020	03/31/2020
Team B-1	Team B	Tyrone	Gigi	Hien	01/01/2020	03/31/2020
Team C-1	Team C	Abdi	Jojo	Miki	01/01/2020	01/31/2020
Team C-2	Team C	Abdi	Chantel	Desiree	02/01/2020	03/31/2020

      2. Employee Table **Before** with the grain of "Employee":
         -

EmployeeKey	Employee
1	Sioux
2	Tyrone
3	Abdi
4	Chantel
5	Jojo
6	Gigi
7	Desiree
8	Miki
9	Hien

      3. Employee-Team Table **After** transformation with the correct grain of Employee-Team as seen in video MSPTDA #33:
         -

TeamEmployeeKey	TeamKey	Team	Employee	EmployeeKey	StartDate	EndDate
Team A-1-Sioux	Team A-1	Team A	Sioux	1	01/01/2020	01/31/2020
Team A-2-Sioux	Team A-2	Team A	Sioux	1	02/01/2020	03/31/2020
Team A-1-Chantel	Team A-1	Team A	Chantel	4	01/01/2020	01/31/2020
Team B-1-Tyrone	Team B-1	Team B	Tyrone	2	01/01/2020	03/31/2020
Team A-1-Desiree	Team A-1	Team A	Desiree	7	01/01/2020	01/31/2020
Team C-1-Abdi	Team C-1	Team C	Abdi	3	01/01/2020	01/31/2020
Team A-2-Jojo	Team A-2	Team A	Jojo	5	02/01/2020	03/31/2020
Team A-2-Miki	Team A-2	Team A	Miki	8	02/01/2020	03/31/2020
Team B-1-Gigi	Team B-1	Team B	Gigi	6	01/01/2020	03/31/2020
Team B-1-Hien	Team B-1	Team B	Hien	9	01/01/2020	03/31/2020
Team C-1-Jojo	Team C-1	Team C	Jojo	5	01/01/2020	01/31/2020
Team C-1-Miki	Team C-1	Team C	Miki	8	01/01/2020	01/31/2020
Team C-2-Abdi	Team C-2	Team C	Abdi	3	02/01/2020	03/31/2020
Team C-2-Chantel	Team C-2	Team C	Chantel	4	02/01/2020	03/31/2020
Team C-2-Desiree	Team C-2	Team C	Desiree	7	02/01/2020	03/31/2020

      4. Employee-Team Table **After** transformation with the correct grain of Employee-Team as seen in video MSPTDA #34:
         -

dEmployeeTeam = Team-Employee Table

EmployeeTeamKey	TeamKey	Employee
1	Team A-1	Sioux
2	Team A-2	Sioux
3	Team A-1	Chantel
4	Team B-1	Tyrone
5	Team A-1	Desiree
6	Team C-1	Abdi
7	Team A-2	Jojo
8	Team A-2	Miki
9	Team B-1	Gigi
10	Team B-1	Hien
11	Team C-1	Jojo
12	Team C-1	Miki
13	Team C-2	Abdi
14	Team C-2	Chantel
15	Team C-2	Desiree

3. Fact Table Before and After
    1. Fact Table **Before** with the grain of "Employee":

DateKey	123 EmployeeKey	123 Sales
1/4/20	6	100
1/4/20	1	400
1/6/20	1	450
1/11/20	1	300
1/14/20	4	450
1/16/20	4	150
1/17/20	3	400
1/31/20	9	450
2/10/20	6	200
2/14/20	6	450

   2. Fact-Team Table **After** transformation with the correct grain of Employee-Team as seen in video MSPTDA #33:

DateKey	123 EmployeeKey	123 Sales	ABC TeamEmployeeKey
1/4/20	6	100	Team B-1-Gigi
1/4/20	1	400	Team A-1-Sioux
1/6/20	1	450	Team A-1-Sioux
1/11/20	1	300	Team A-1-Sioux
1/14/20	4	450	Team A-1-Chantel
1/16/20	4	150	Team A-1-Chantel
1/17/20	3	400	Team C-1-Abdi
1/31/20	9	450	Team B-1-Hien
2/10/20	6	200	Team B-1-Gigi
2/14/20	6	450	Team B-1-Gigi

    3. Fact-Team Table **After** transformation with the correct grain of Employee-Team as seen in video MSPTDA #34:

fSales = Fact Table with Sales

DateKey	Sales	EmployeeTeamKey
1/4/20	400	1
1/6/20	450	1
1/11/20	300	1
1/14/20	450	3
1/16/20	150	3
3/23/20	150	4
1/17/20	400	6
3/23/20	50	7
1/4/20	100	9

4. Grain changes from Employee to Employee-Team
    1. With both the Dimension Table and Fact Table at the same grain, we can make a model and build a relationship:
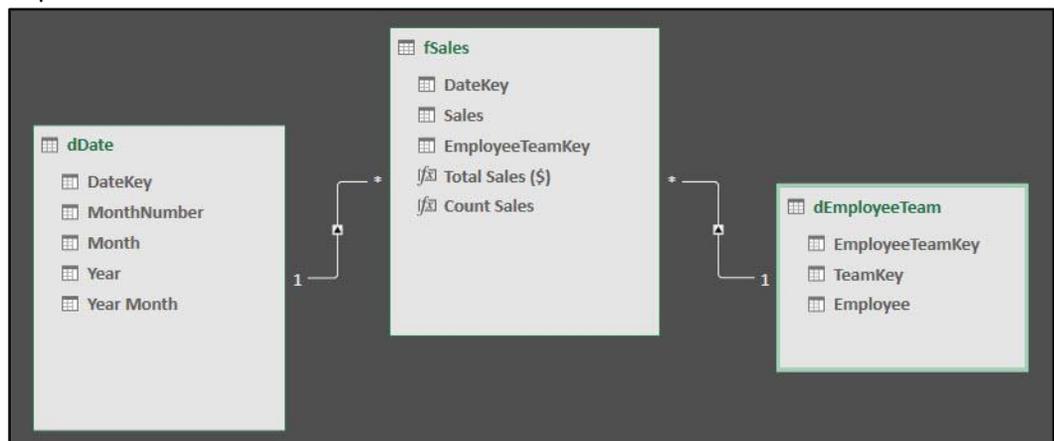
5) **Examples of Slowly Changing Dimensions** :
    1. The Dimension "Customer" may have the Changing Attribute of "Address", where we need to make calculations for each Address over time. In this case we would have to transform the grain of the Customer Dimension Table and Fact Table to "Customer-Address".
    2. The Dimension "Manager" may have the Changing Attribute of "Employee", where we need to make calculations for each Employee over time. In this case we would have to transform the grain of the Manager Dimension Table and Fact Table to "Manager-Employee".
    3. The Dimension "Professor" may have the Changing Attribute of "Dean", where we need to make calculations for each Dean over time. In this case we would have to transform the grain of the Professor Dimension Table and Fact Table to "Professor-Dean".
    4. The Dimension "Parts" may have the Changing Attribute of "Supplier", where we need to make calculations for each Supplier over time. In this case we would have to transform the grain of the Parts Dimension Table and Fact Table to "Parts-Supplier".
6) **Quickly Changing Dimensions** :
    1. If your attribute for your dimension changes quickly, you may want to incorporate the changing attribute into the Fact Table, for example a quickly changing price for a product or even a calculated column that calculates the age of a customer based on the birth day in the customer table.
7) **Power Query Transformation to Create Correct Grain for Employee-Team Dimension Table** :
    1. See video 33,34,35 for full details.

8) **Formula for 3-Way Lookup in Worksheet, Power Query and DAX** :
   1. We are Filtering with 3 conditions:
      1. Employee in Sales Table = Employee in Lookup Table
      2. Sales Date >= Team Start Date
      3. Sales Date < = Team End Date
   2. **Worksheet Formula** to do a 3-Way Lookup to pull Employee-Team Dimension Table Key into Fact Table and Provide the Correct Grain for the Sales Numbers (Facts) :

```
=FILTER(dTeam8[Team],(([@Employee]=dTeam8[Employee])*
([@Date]>=dTeam8[StartDate])*([@Date]<=dTeam8[EndDate])))
```

   3. **Power Query M Code Formula** (Power Pivot and Power BI Desktop) to do a 3-Way Lookup to pull Employee-Team Dimension Table Key into Fact Table and Provide the Correct Grain for the Sales Numbers (Facts) :

```
= Table.AddColumn(ChangedType, "EmployeeTeamKey", (OT) => Table.SelectRows(BufferedLT, (IT) => OT[EmployeeKey]
    =IT[EmployeeKey] and OT[DateKey]>=IT[StartDate] and OT[DateKey]<=IT[EndDate]){0}[EmployeeTeamKey])
```

   4. **DAX Formula** (Power Pivot and Power BI Desktop) to do a 3-Way Lookup to pull Employee-Team Dimension Table Key into Fact Table and Provide the Correct Grain for the Sales Numbers (Facts) :

```
EmployeeTeamKey =
CALCULATE (
    VALUES ( disLookup[EmployeeTeamKey] ),
    FILTER (
        disLookup,
        fSales[EmployeeKey] = disLookup[EmployeeKey]
            && fSales[DateKey] >= disLookup[StartDate]
            && fSales[DateKey] <= disLookup[EndDate]
    )
)
```