Power BI Development Process

A Roadmap to Excellent Solutions

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QR code is download link for this slide deck:
https://raw.githubusercontent.com/MartinBubenheimer/powerbi-training/main/Community%20of%20Practice/Process%20House/Power%20BI%20Process%20House.pdf

Process - from requirements to report

Why solutions fail

Patterns for common challenges

Implementing facts at different grain
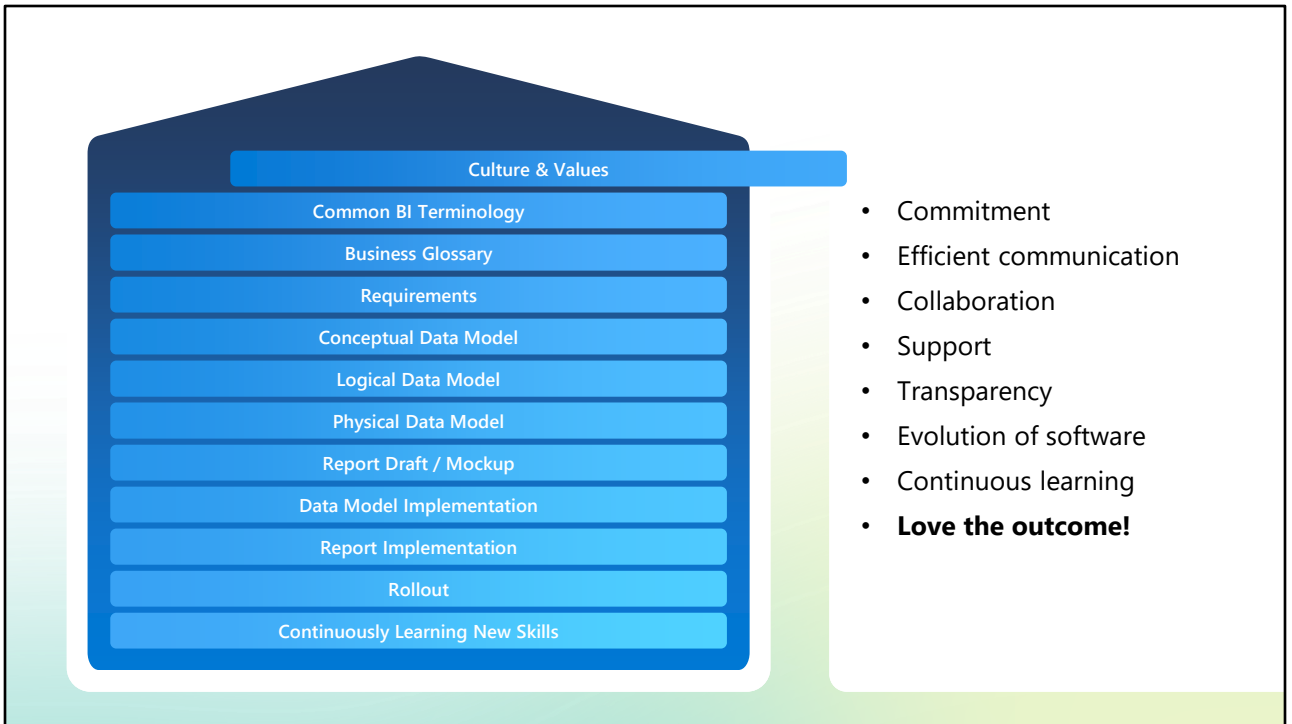
Agenda
Why this presentation?

Although there is so much training material and so many YouTube channels out there, I still frequently see report creators struggle with applying the concepts to real life solutions.

Solutions fail despite people having basic knowledge of star schema.
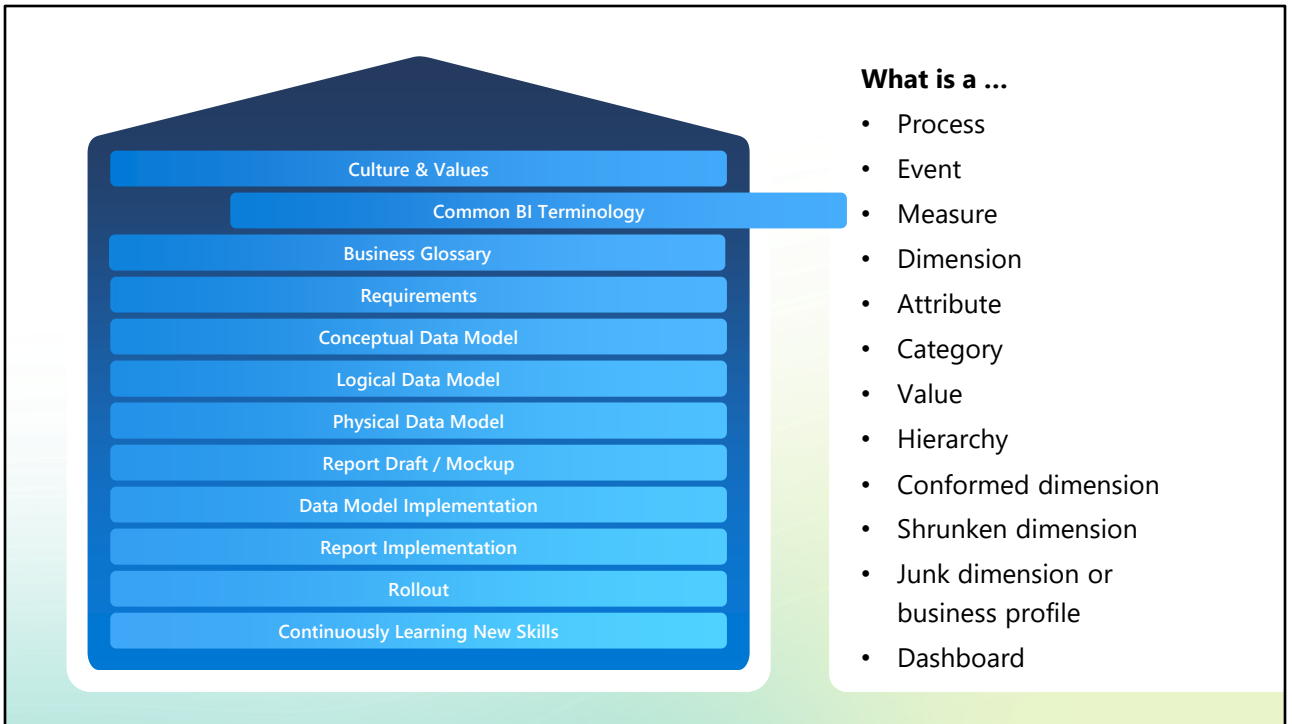We will explain what grain is and how to implement it in Power BI.

Process House

Culture & Values
Common BI Terminology
Business Glossary
Requirements
Conceptual Data Model
Logical Data Model
Physical Data Model
Report Draft / Mockup
Data Model Implementation
Report Implementation
Rollout
Continuously Learning New Skills

- Commitment
- Efficient communication
- Collaboration
- Support
- Transparency
- Evolution of software
- Continuous learning
- **Love the outcome!**

Business stakeholders' availability and involvement is crucial.

You can see whether a report is created with love, passion and commitment:
- Objects are named in the selection pane.
- Tables and fields in the semantic model have descriptions.
- Tables and fields have clear, natural language names,
- Unnecessary fields are removed or hidden.
- Model view is nicely arranged.
- DAX code is formatted and commented where reasonable
- PowerQuery steps are named specifically.
- PowerQueries and measures are arranged in folders in larger models

What is a …

- Process
- Event
- Measure
- Dimension
- Attribute
- Category
- Value
- Hierarchy
- Conformed dimension
- Shrunken dimension
- Junk dimension or business profile
- Dashboard

The diagram on the left shows stacked layers:
- Culture & Values
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E.g., in data warehousing "measure" usually refers to a values column in a fact table, whereas in Power BI it refers to a calculation on the data.

Is a dashboard a report, an overview page in a report, or a Power BI Dashboard, technically?

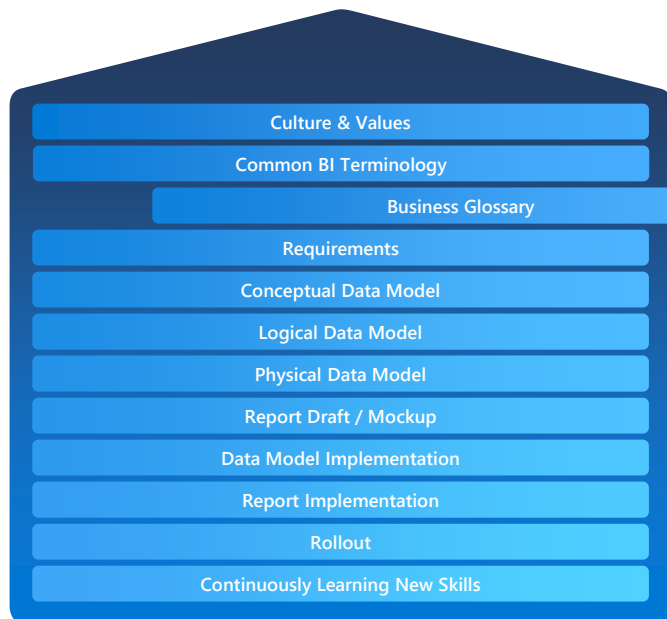Also define terms like "good", "goal", or "success" for your project.

What is success?

- A nice report?
- Correct numbers?
- Users frequently using the report?
- Users spending a lot of time in the report?
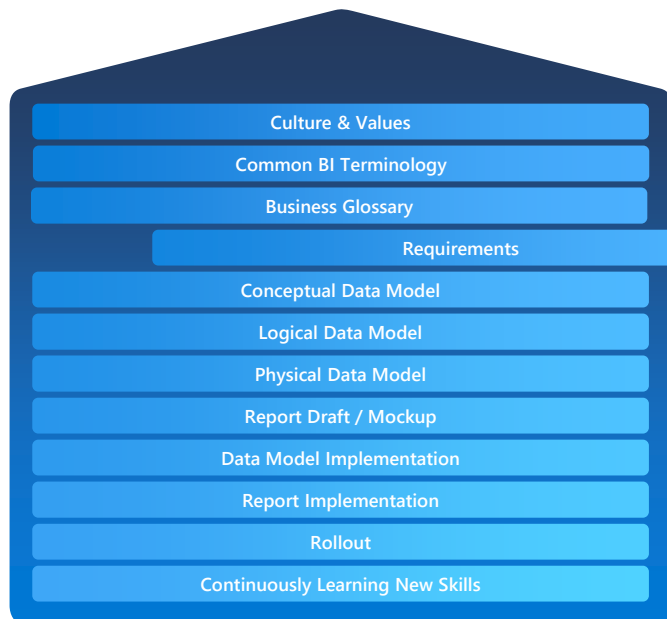
Or is it the impact coming from the insights:

- Increased revenue
- Increased profit
- Increased market share
- Reduced carbon footprint

… whatever is the goal of the report.

The diagram shows a house-shaped stack of layered boxes:

- Culture & Values
- Common BI Terminology
- **Business Glossary** (highlighted)
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- Business terms
- Performance indicators
- KPI
- In **natural language**, always
- With formula, if applicable
- Example:

  Customer acquisition rate measures the % of new customers acquired in a given period.

The slide shows a house-shaped diagram with stacked layers:

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- Functional requirements / business requirements
- Non-functional requirements / technical requirements
- Use a template, e.g., KPI canvas
- Document
  - Task board, e.g., Jira
  - Word document
- Complete and clear wording
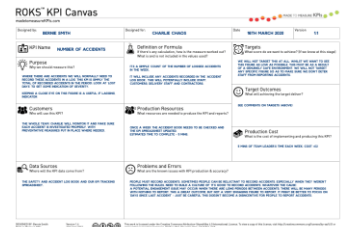
"Requirements" includes all levels of requirements specification:

- Goal: What shall the report be used for? What shall be achieved? How do you measure success of the report?
- Scope: What is part of the report – and what not?
- Personas: Who are the users? What are their expectations? What are their skills?
- Process: How will the report be used? How does report usage embed in daily business? What is the relevance of the report? Describe interaction scenarios.
- KPI definitions: If new KPIs are defined for this report, specify them. Otherwise copy or reference definition of existing KPIs.
- Functional requirements: Features of the report, pages, filters, visuals, etc.
- Non-Functional requirements: Expected amount of data, when to cut off historic data, performance requirements, security requirements, etc.

Document for later use, think about the next developer who should change something in a year or two.

Bernie Smith, KPI canvas: How to define KPIs with our free KPI format sample template (madetomeasurekpis.com) *https://madetomeasurekpis.com/free-kpi-definition-template/*

Requirements templates resources: Power Bi dashboard requirement gathering template - Microsoft Fabric Community *https://community.fabric.microsoft.com/t5/Desktop/Power-Bi-dashboard-requirement-gathering-template/td-p/1092633*

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- High level perspective
- Ensures that business users will get what they need
- Easy to understand language
- Processes
- Entities
- How they correlate
- Enterprise **bus matrix** in dimensional modelling

The conceptual data model helps in communication with business.

- Helps identifying requirements

- Helps clarifying taxonomy

Don't use database object names, camel case wording, abbreviations, technical terms, etc. in conceptual data model.

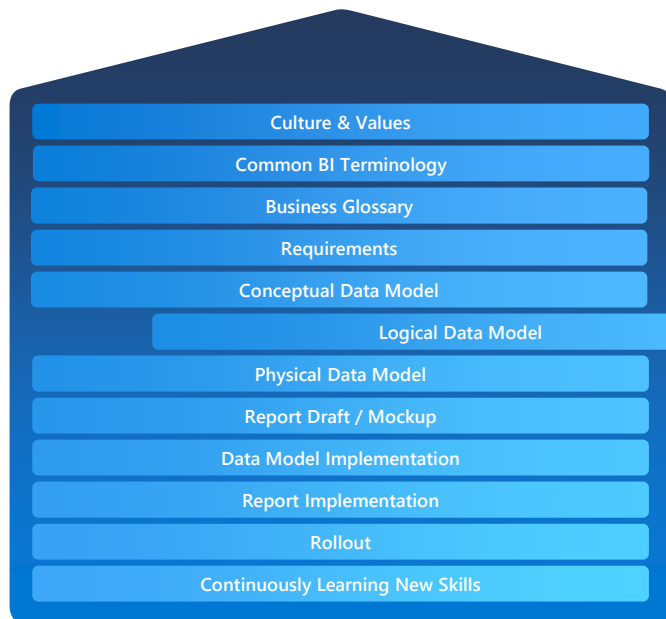The conceptual data model is technology agnostic.

Data modeling articles:
Data Modeling for Mere Mortals - Part 1: What is Data Modeling?! - Data Mozart (data-mozart.com) *https://data-mozart.com/data-modeling-for-mere-mortals-part-1-what-is-data-modeling/*
What Are Conceptual, Logical, and Physical Data Models? | Vertabelo Database Modeler *https://vertabelo.com/blog/conceptual-logical-physical-data-model/*
Enterprise Data Warehouse Bus Architecture - Kimball Group *https://www.kimballgroup.com/data-warehouse-business-intelligence-resources/kimball-techniques/kimball-data-warehouse-bus-architecture/*

The slide diagram contains the following stacked layers (from top to bottom):

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Bullet points:

- Defines what data structures are needed, based on the requirements
- Blueprint for implementation
- **Star schema** for Power BI semantic models
- Relationships
- Cardinalities
- Hierarchies
- Candidate keys

Defines what data is needed for the requirements, not what data is there in the source systems.

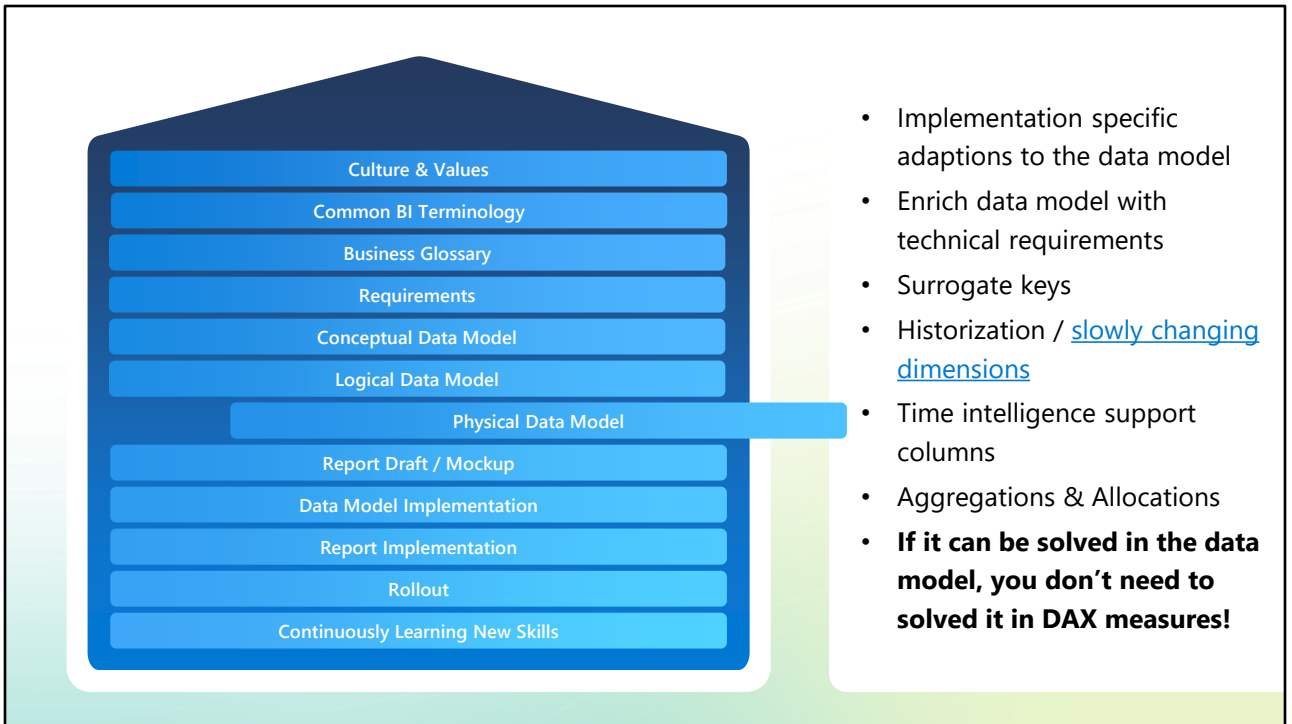Prevents you from getting lost in the complexity of data sources.

The logical data model is technology agnostic.

Entity-relationship diagrams tool recommendation: dbdiagram.io - Database Relationship Diagrams Design Tool *https://dbdiagram.io/*

Data modeling recommended reading:

Power BI star schema documentation: Understand star schema and the importance for Power BI - Power BI | Microsoft Learn *https://learn.microsoft.com/en-us/power-bi/guidance/star-schema*

Ralph Kimball, The Data Warehouse Toolkit: The Data Warehouse Toolkit, 3rd Edition - Kimball Group *https://www.kimballgroup.com/data-warehouse-business-intelligence-resources/books/data-warehouse-dw-toolkit/*

- Implementation specific adaptions to the data model
- Enrich data model with technical requirements
- Surrogate keys
- Historization / slowly changing dimensions
- Time intelligence support columns
- Aggregations & Allocations
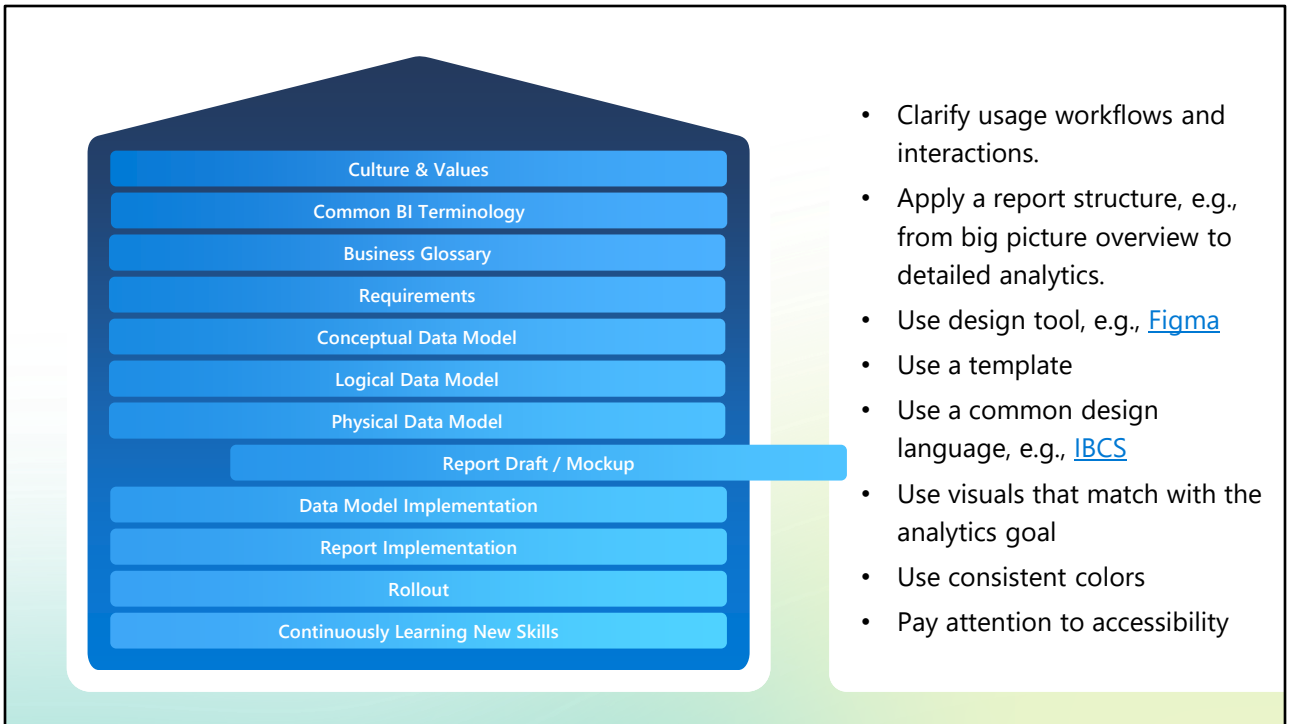- **If it can be solved in the data model, you don't need to solved it in DAX measures!**

Don't hesitate to introduce transformations and additional fields on the source data if this makes the data model more efficient.

E.g., Power BI cannot deal with composite (multi-column) relationships and needs surrogate keys to implement them.

The physical data model is technology specific.

Slowly changing dimensions article: Slowly Changing Dimensions - Kimball Group
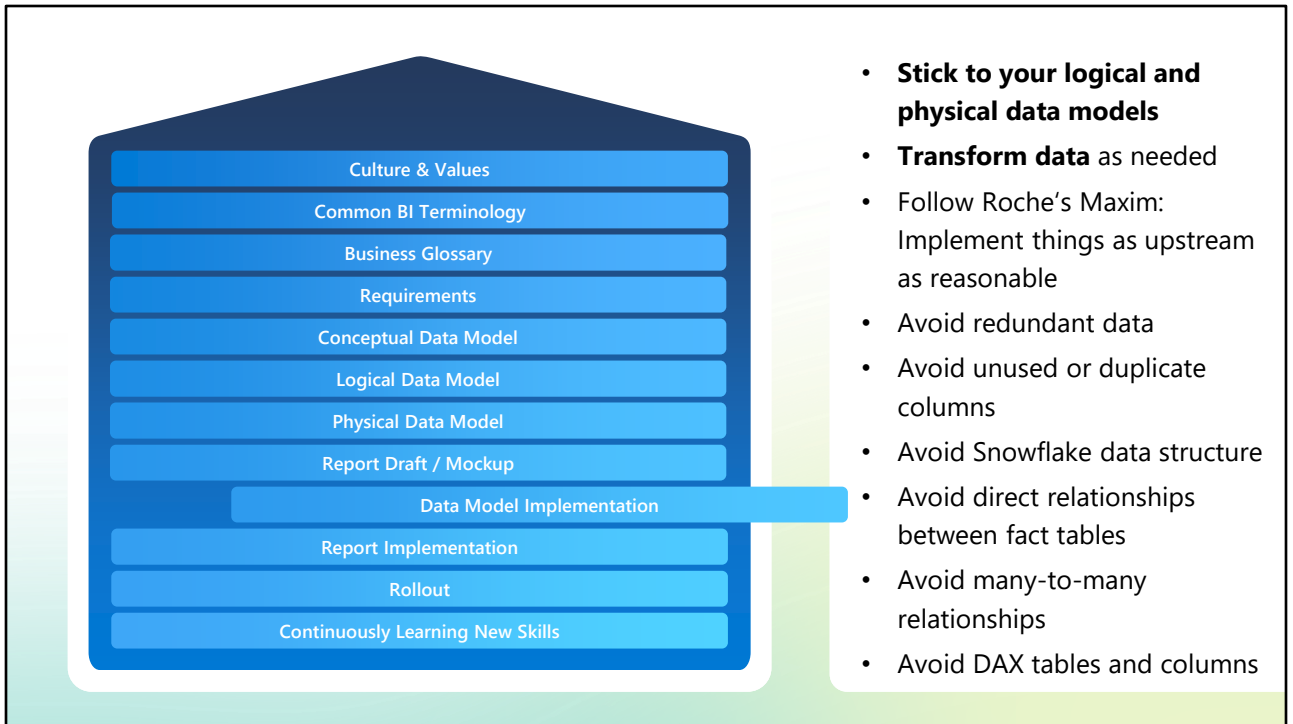*https://www.kimballgroup.com/2008/08/slowly-changing-dimensions/*

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- Clarify usage workflows and interactions.
- Apply a report structure, e.g., from big picture overview to detailed analytics.
- Use design tool, e.g., Figma
- Use a template
- Use a common design language, e.g., IBCS
- Use visuals that match with the analytics goal
- Use consistent colors
- Pay attention to accessibility

Use consistent colors in all reports, e.g., for good, bad, same product group shown in same color everywhere. In Power BI, colors can be loaded as attributes in dimension tables.

Figma design tool: Figma: The Collaborative Interface Design Tool *https://www.figma.com/*
IBCS visual language: IBCS - International Business Communication Standards *https://www.ibcs.com/*

Report design process on YouTube:
1. Design Thought Process for Power BI Reporting (with Miguel Myers) (youtube.com)
   https://www.youtube.com/watch?v=dhHL0Uo3Wgs
2. Report Design Framework - Season 6 Ep.1 (youtube.com)
   https://www.youtube.com/watch?v=Jx6uvvT2QMI
3. PowerBI Visual Evolution - Lunch and Learn - Everyone (youtube.com)
   https://www.youtube.com/watch?v=hs1irtM3PR8&list=PLMGL7BRUz8sypmPOgTft-lvn1yqvYaRv

The diagram shows a house/pyramid structure with the following layers from top to bottom:

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- **Stick to your logical and physical data models**
- **Transform data** as needed
- Follow Roche's Maxim: Implement things as upstream as reasonable
- Avoid redundant data
- Avoid unused or duplicate columns
- Avoid Snowflake data structure
- Avoid direct relationships between fact tables
- Avoid many-to-many relationships
- Avoid DAX tables and columns

This is the first step that must be done in Power BI.

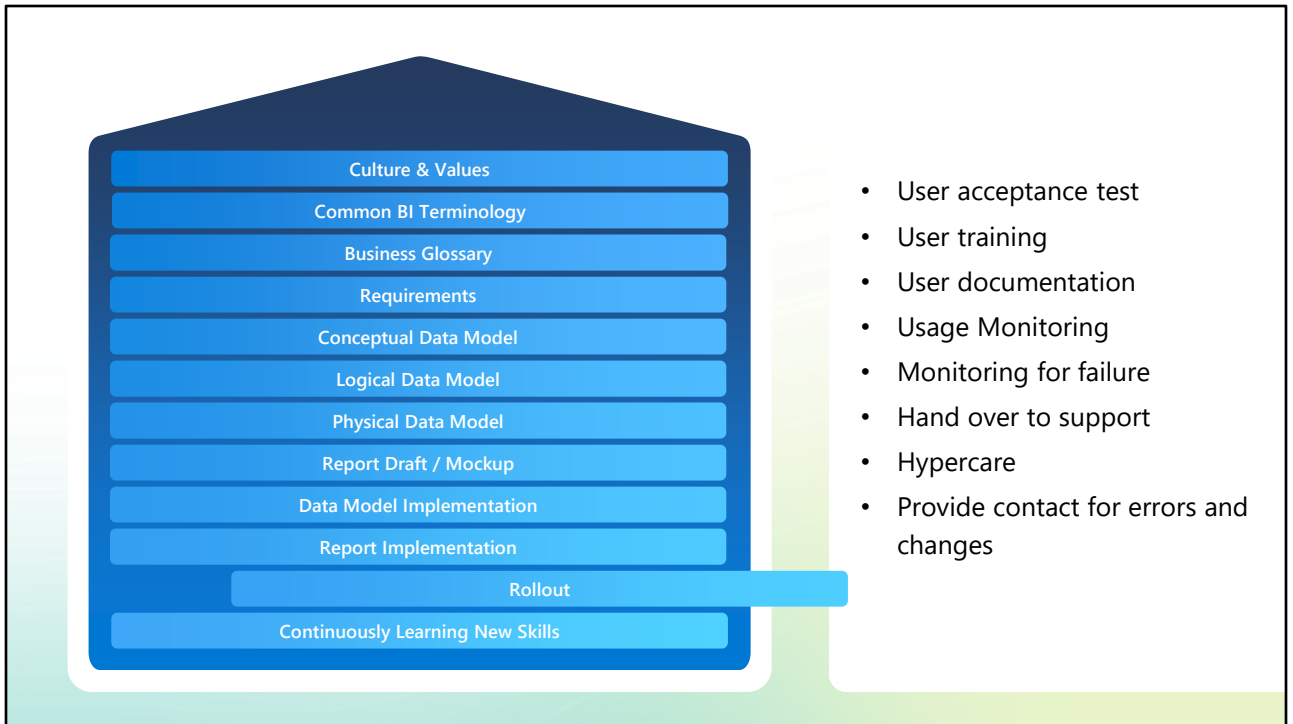Data model implementation includes DAX measures implementation.

Follow Roche's Maxim: Implement things as upstream as reasonable, e.g., don't fix things on measures or with weird relationships that you can fix in Power Query

Roche's Maxim on YouTube: Roche's Maxim of Data Transformation (youtube.com)
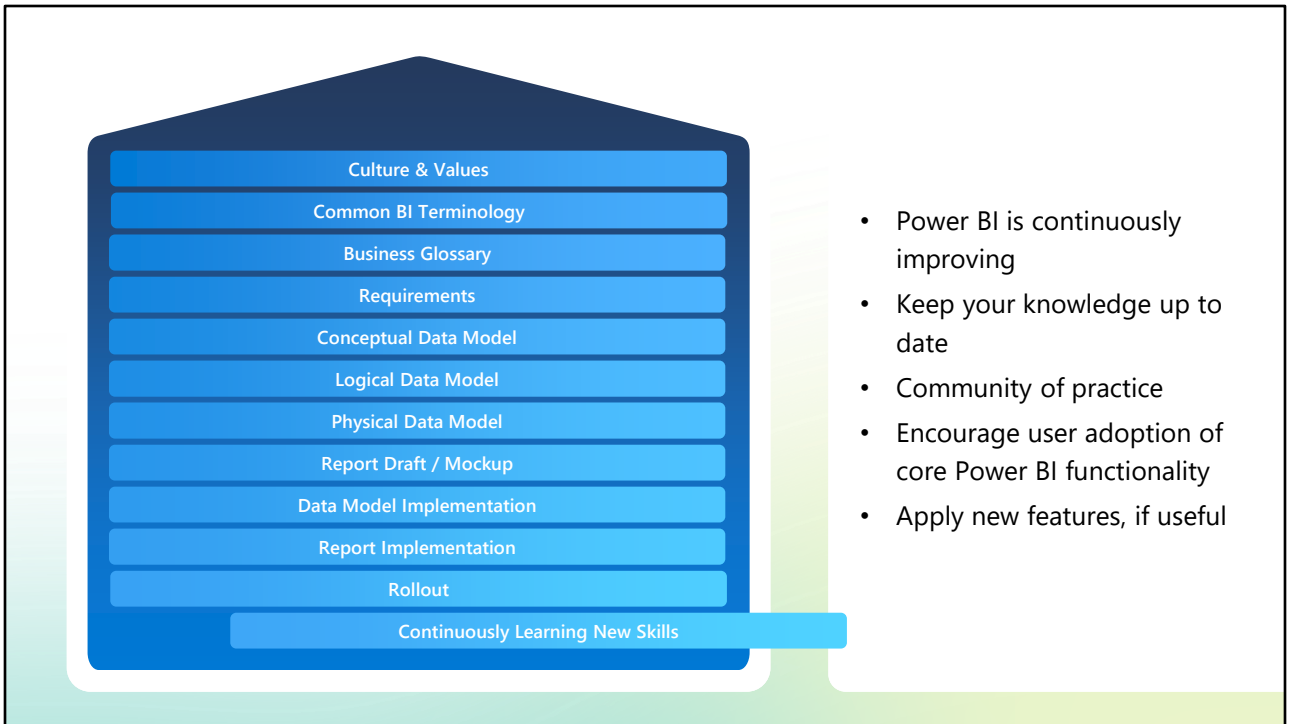*https://www.youtube.com/watch?v=n_8U-9eblXM*
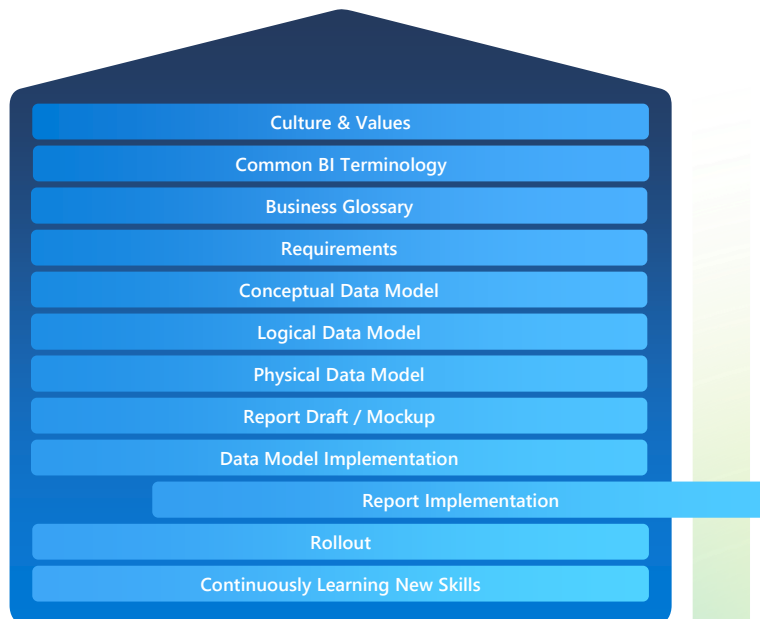
- Stick to Power BI standards as often as possible, e.g., use filter pane
- Implement for performance, e.g., reduce number of visuals or avoid scrollable one-page reports
- Implement for maintainability, e.g., chose calculation groups over bookmark navigation
- Avoid unwanted interactions, e.g., don't offer filter options that shouldn't be used, turn off cross-filtering that doesn't work anyway, etc.

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- Do reviews.
- Use guideline, e.g.,
  - Power BI Checklists — DATA GOBLINS (data-goblins.com) https://data-goblins.com/checklists
  - Power BI Dataset Checklist — DATA GOBLINS (data-goblins.com) https://data-goblins.com/power-bi/dataset-checklist

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- User acceptance test
- User training
- User documentation
- Usage Monitoring
- Monitoring for failure
- Hand over to support
- Hypercare
- Provide contact for errors and changes

Hypercare: Increased user support resources and awareness during the first weeks after rollout.

Learning = Consuming content (listen, read, watch) + Practicing + Feedback / Reviews

Core Power BI functionality = Filter pane, reset filters, user bookmarks, apps, standard visuals, focus mode, dashboards, drill-through including cross report drill-through, create reports from shared semantic models, analyze in Excel, featured tables, embed in PowerPoint, etc.

Before starting with the implementation in Power BI, some conceptual work needs to done to get a good, simple and working Power BI solution.

How can you enable the transfer of good conceptual work to a successful Power BI solution that implements the requirements and concepts as designed?

Why solutions fail

	Why star schema & how to query		Many-to-many relationships
	Lack of transformation & data cleansing		Bidirectional relationships
	All facts are merged into one fact table		Filters on fact tables
	Hierarchies in separate tables		Fact tables at different grain

Typical, frequently seen anti-patterns:

Why star schema & how to query
Artifacts:
- Unnecessary, non-compliant relationships
- Inefficient DAX code
Solution:
- Learn: Read books, attend classes
How to query star schema effectively and efficiently is not part of this session.

Lack of transformation
Some people seem to be afraid of transforming the source tables or adding useful additional columns, like surrogate keys or time intelligence support columns in the date dimension.
Artifacts:
- Unnecessarily complex data models, e.g., snowflake pattern
- Inappropriate fact table structure, e.g., not transforming balances into transactional data
- Inefficient DAX code from missing support columns
- Many-to-many relationships
Solution:
- Create logical data model based on requirements before implementing anything in Power BI.
- Transform data to match with star schema pattern and reporting needs.
- Cleanse data before loading.

All facts are merged into one fact table
Artifacts:

- Any facts at any grain, in any structure – e.g., transactional, snapshot, cumulating – is combined in one fact table.

Solution:

- A fact table represents a process and data describes events in this process.
- It's totally fine to have multiple fact tables in one data model.
- Create separate fact tables for different processes.
- Create separate fact tables at different grain.
- Create separate fact tables with different structure, e.g., transactional and snapshot.

In simple reports it's OK to have only one fact table, of course, if data is appropriately simple.

Hierarchies in separate tables

Artifacts:

- Hierarchy tables attached to dimension tables in snowflake pattern

Solution:

- Merge tables: Hierarchies are part of a dimension table

Many-to-many relationships

Many-to-many relationships are not wrong in general, but they are used way more often than appropriate.

Artifacts:

- Users select more data than expected, e.g., by selecting a product in a filter, data of the whole product group is included in the calculation, resulting in unexpected numbers.
- Many-to-many relationships between dimension tables and fact tables (1)
- Many-to-many relationships between different fact tables (2)
- Many-to-many relationships between dimension tables (3)

Solution:

- (1) Use proper grain (shrunken) dimension tables and use one-to-many relationships.
- (1) With low cardinality dimension fields, add all existing combinations to dimension table and use one-to-many.
- (1) With high cardinality dimension fields, split dimension table and relate each to the fact table using one-to-many – do not create direct relationships between the dimension tables.
- (2) Use conformed dimension tables instead, i.e., dimension tables that relate to both of the fact tables.
- (3) Consider relating each of the dimension tables directly to the fact tables, instead of directly relating dimension tables..

Keep in mind that the fact table is a relation between the related dimension tables.

Bidirectional relationships

Artifacts:

- Slow calculations
- Unexpected results

Solution:

- Activate bidirectional filtering in measures using CROSSFILTER only if needed.
- Put a visual-level measure-based filter on slicers if you want to reduce the options by other filter's selection.

In some row-level security scenarios, bi-directional relationships are necessary.

Filters on fact tables

Artifacts:

- Ambiguous field selection: Report creators don't know which field to use, e.g., which date.
- Filters and cross-filtering not working on all visuals.

Solution:
- Hide fields in fact tables.
- Turn degenerate dimensions into dimension tables (technology-specific recommendation for Power BI).
- In DAX code, apply filter expressions to dimension tables.
- In visuals only use fields from dimension tables and measures.

Some measures are more efficient using filters on fact table columns, especially date related or using flag columns. In any case, consider filters on dimension tables first. In visuals, aim to avoid filters on fact table columns.

Exception: Your data model has only one table.

Fact tables at different grain

Fact tables at different grain exist and are OK in a data model. Nevertheless, consider avoiding them in the first place by transforming source tables into the same level of grain for each common dimension. This makes the data model and the measures much simpler.

Artifacts:
- Many-to-many relationships
- Incorrect numbers
- Filters not working as expected

Solution:
- Use conformed, shrunken dimensions.
- Add surrogate keys to fact tables on common grain level.
- Aggregate or allocated fact data before loading.
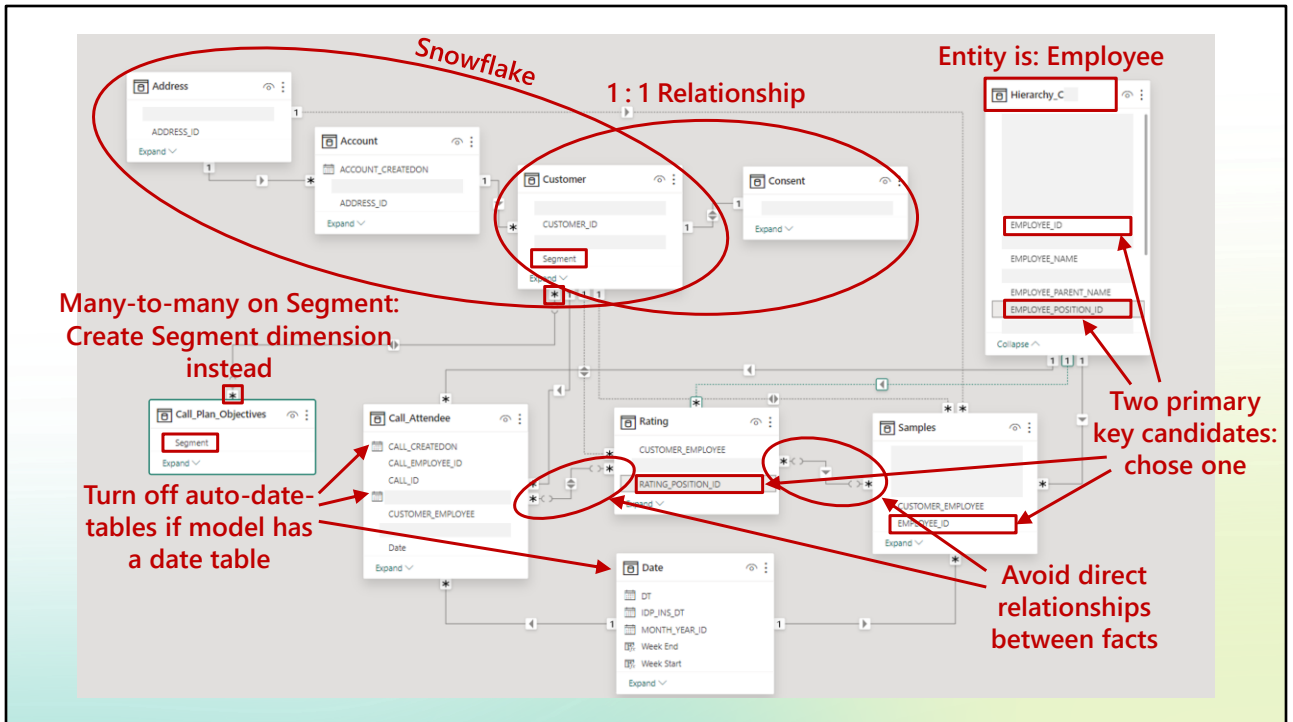
Findings

- 1 : 1 Relationship in dimensions
- Snowflake structure in dimensions
- Many-to-many relationship between dimension and facts
- Entity named "Hierarchy"
- Fact-to-fact relationship
- Auto-data-table
- More than one primary key for the same record
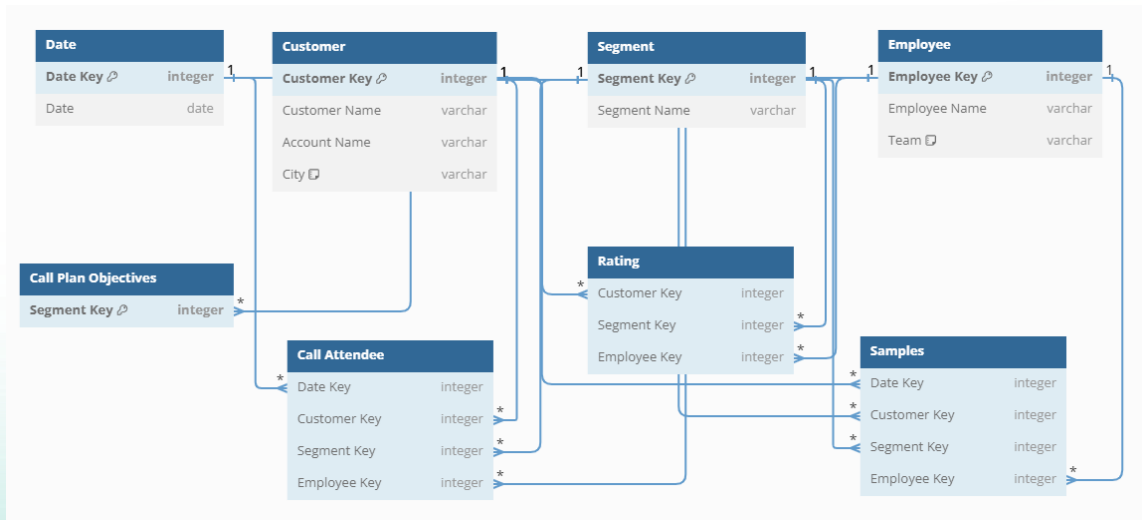
Simplified Model

This model allows to answer all the same business questions and calculate the same measures as the previous one.

Segment is a shrunken dimension of Customer.

City represents address attributes.

Team represents employee hierarchy levels.

Fact tables at different grain

Facts at different grain

What is grain & why care?
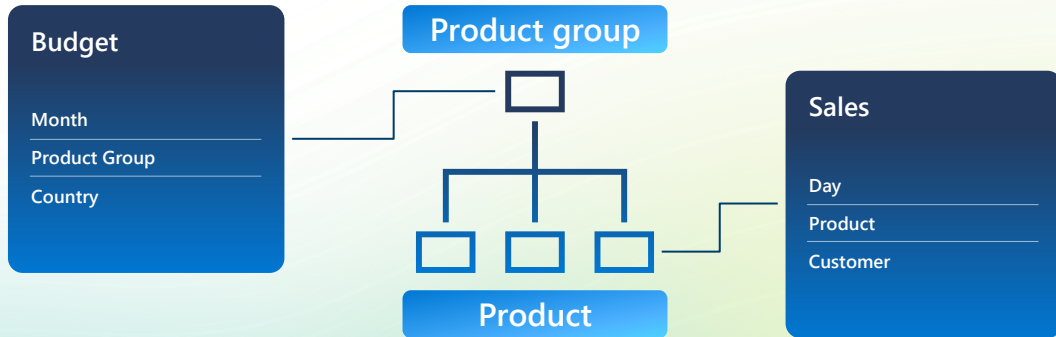
Aggregation & allocation

Shrunken dimensions

Implementation demo

Facts at different grain

What is Grain & Why Care?

**"Grain" defines the level of detail of each fact table,
e.g., product vs. product group, date vs. month.**

Budget

Month
Product Group
Country

Product group

Product

Sales

Day
Product
Customer

Grain becomes relevant when comparing data that is available at different level.

Aggregation & Allocation

Aggregation = Summarize values by lower grain
Allocation = Distribute values to lower grain

Low grain = few large aggregates

Aggregation
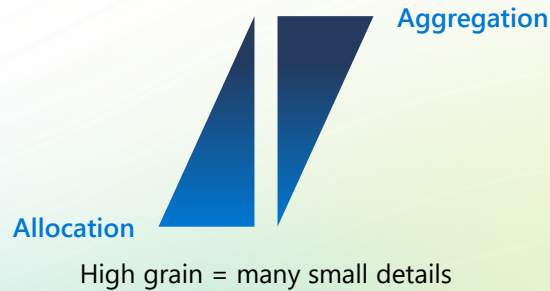
Allocation

High grain = many small details

Allocation requires a definition of allocation rules.

Allocation artificially splits values into small values for a higher grain category.

Allocation requires allocation rules – they don't come naturally. Align with business on allocation rules, e.g., even distribution, proportional distribution, seasonal distribution, no allocation to weekends, etc.

Make sure you are aligned on the wording within your organization or project:
- Low grain = Low level of detail = High level overview= Bird's eye view
- High grain = High level of detail = Low level from manager's perspective = operational view

Shrunken Dimensions

A shrunken dimension is a summarized dimension table at a lower grain.
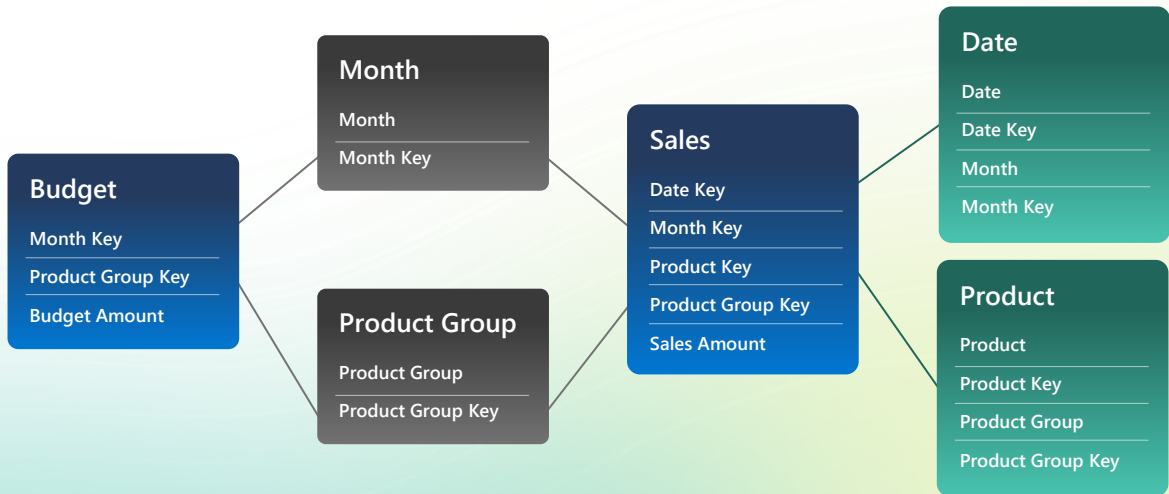
Data model example: Star schema with fact tables at different grain
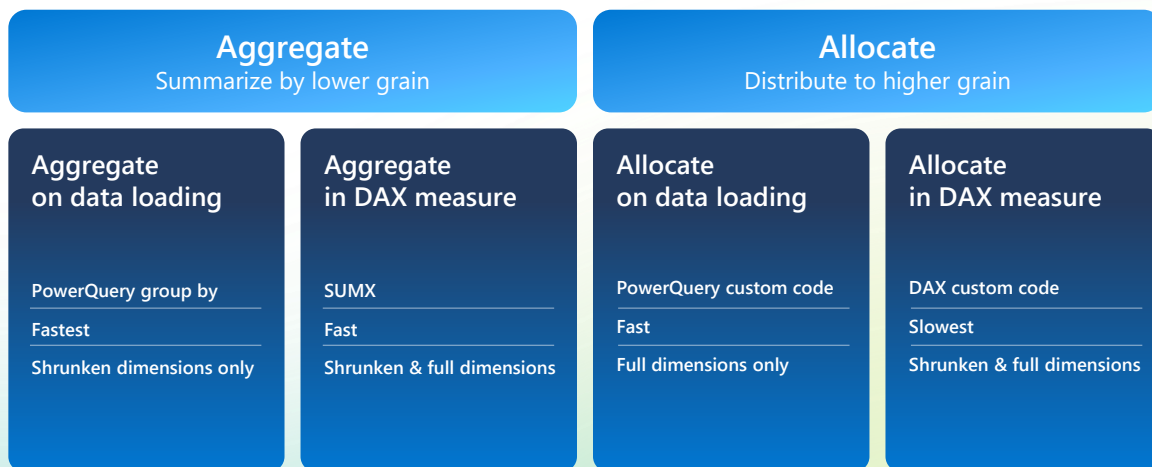
Month: Shrunken dimension of Date

Product Group: Shrunken dimension of Product

Often the lower grain keys need to be added to the higher grain fact tables. If the lower grain key is part of the higher grain dimension table and not only part of the lower grain dimension table, then this makes merging the lower grain keys on the higher grain fact tables easy.

The grain of each fact table is documented in the bus matrix. Enterprise Data Warehouse Bus Architecture - Kimball Group *https://www.kimballgroup.com/data-warehouse-business-intelligence-resources/kimball-techniques/kimball-data-warehouse-bus-architecture/*

Aggregation & Allocation – Implementation Options

Aggregate Summarize by lower grain		**Allocate** Distribute to higher grain	
Aggregate on data loading	**Aggregate in DAX measure**	**Allocate on data loading**	**Allocate in DAX measure**
PowerQuery group by	SUMX	PowerQuery custom code	DAX custom code
Fastest	Fast	Fast	Slowest
Shrunken dimensions only	Shrunken & full dimensions	Full dimensions only	Shrunken & full dimensions

Allocate in DAX measure custom code typically requires use of virtual tables.

Implementation demo

Fact tables at different grain – implementation demo
- Allocation in DAX measure, tips for showing/hiding fields
- Allocation in PowerQuery
Documentation in table and field description what belongs together and what works together in a report.