

Московский городской педагогический университет

Платформы Data Engineering '25

Лабораторная работа 2.1. Построение аналитических витрин  
и внедрение продвинутых dbt-концепций

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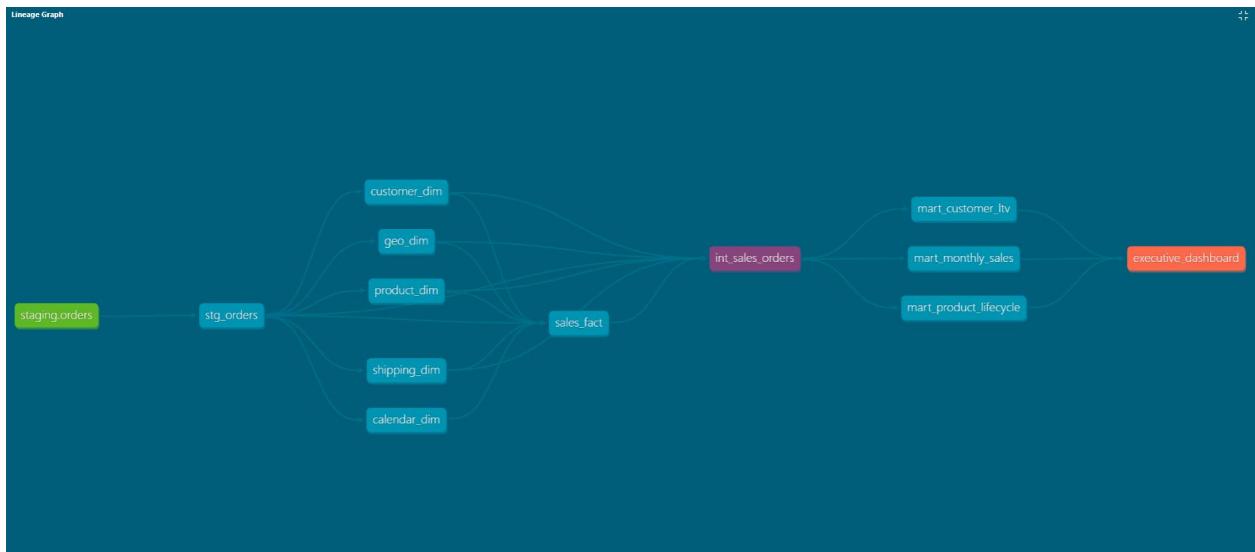
Москва - 2025

## Архитектура проекта

Проект реализует многоуровневую архитектуру DWH с использованием dbt:

- Staging-слой - очистка и подготовка исходных данных
- Intermediate-слой - денормализованные модели с инкапсулированной бизнес-логикой
- Marts-слой - специализированные аналитические витрины для бизнес-пользователей
- Snapshots - отслеживание исторических изменений данных

## Скриншот графа зависимостей



### Промежуточная модель (`int_sales_orders`)

- Создана в папке: `models/intermediate/`
- Материализована как: `view`
- В схеме: `dw_intermediate`
- Содержит: денормализованные данные (объединение фактов + измерений)

Витрины используют промежуточную модель

- `mart_monthly_sales` → `ref('int_sales_orders')`
- `mart_customer_ltv` → `ref('int_sales_orders')`
- `mart_product.lifecycle` → `ref('int_sales_orders')`

## Ключевые фрагменты кода

### 1. Промежуточная модель int\_sales\_orders.sql

```
{ { config(materialized='view') } }
```

```
SELECT
    -- Ключи
    f.order_id,
    -- Измерения из customer_dim
    c.customer_id,
    c.customer_name,
    c.segment as customer_segment,
    -- Измерения из product_dim
    p.product_id,
    p.product_name,
    p.category,
    p.subcategory,
    -- Измерения из geo_dim
    g.city,
    g.state,
    g.region,
    -- Измерения из shipping_dim
    s.ship_mode,
    -- Даты
    o.order_date,
    o.ship_date,
    -- Метрики из sales_fact
    f.sales,
    f.profit,
    f.quantity,
    f.discount
```

```

FROM {{ ref('sales_fact') }} AS f
LEFT JOIN {{ ref('stg_orders') }} AS o ON f.order_id = o.order_id
LEFT JOIN {{ ref('customer_dim') }} AS c ON f.customer_id_key =
c.customer_id_key
LEFT JOIN {{ ref('product_dim') }} AS p ON f.product_id_key =
p.product_id_key
LEFT JOIN {{ ref('shipping_dim') }} AS s ON f.shipping_id = s.shipping_id
LEFT JOIN {{ ref('geo_dim') }} AS g ON f.geo_id = g.geo_id

```

## 2. Индивидуальная mart-модель mart\_product\_lifecycle.sql

```

{{ config(materialized='table') }}

SELECT
    product_id,
    product_name,
    category,
    subcategory,
    MIN(order_date) as first_sale_date,
    MAX(order_date) as last_sale_date,
    (MAX(order_date) - MIN(order_date)) as days_between_sales,
    COUNT(DISTINCT order_id) as total_orders,
    SUM(quantity) as total_quantity_sold,
    SUM(sales) as total_sales
FROM {{ ref('int_sales_orders') }}
GROUP BY product_id, product_name, category, subcategory
ORDER BY days_between_sales DESC

```

## 3. Кастомный тест test\_is\_positive.sql

```

%% test is_positive(model, column_name) %%
SELECT *

```

```
FROM {{ model }}
```

```
WHERE {{ column_name }} < 0
```

```
{% endtest %}
```

#### 4. Применение кастомного теста в schema.yml

```
# models/marts/schema.yml
```

```
- name: mart_product_lifecycle
```

```
  description: "Анализ жизненного цикла продуктов"
```

```
  columns:
```

```
    - name: total_quantity_sold
```

```
      tests:
```

```
        - not_null
```

```
        - is_positive
```

```
    - name: total_sales
```

```
      tests:
```

```
        - not_null
```

```
        - is_positive
```

```
    - name: days_between_sales
```

```
      tests:
```

```
        - not_null
```

```
        - is_positive
```

#### 5. Снимок данных snapshot\_product\_dim.sql

```
{% snapshot snapshot_product_dim %}
```

```
{{
```

```
  config(
```

```
    target_schema='dw_snapshots',
```

```
    strategy='check',
```

```
    unique_key='product_id_key',
```

```
    check_cols=['category', 'subcategory'],
```

```
)  
}}  
SELECT product_id_key, product_id, category, subcategory  
FROM {{ ref('product_dim') }}  
{% endsnapshot %}
```

## 6. models\marts\exposures.yml:

```
version: 2  
  
exposures:  
  - name: executive_dashboard  
    type: dashboard  
    maturity: high  
    owner:  
      name: "Sales Department"  
      email: "sales@superstore.com"  
    depends_on:  
      - ref('mart_monthly_sales')  
      - ref('mart_customer_ltv')  
      - ref('mart_product_lifecycle')
```

## Результаты

Скриншот выполнения dbt run

```
(dbt-env) C:\pde_magistr\superstore_dwh>dbt run --select int_sales_orders
15:15:15  Running with dbt=1.10.15
15:15:15  Registered adapter: postgres=1.9.1
15:15:16  Unable to do partial parsing because a project config has changed
15:15:17  [WARNING][MissingArgumentsPropertyInGenericTestDeprecation]: Deprecated
functionality
Found top-level arguments to test `relationships`. Arguments to generic tests
should be nested under the `arguments` property.
15:15:17  Found 10 models, 22 data tests, 1 source, 448 macros
15:15:17
15:15:17  Concurrency: 1 threads (target='dev')
15:15:17
15:15:18  1 of 1 START sql view model dw_intermediate.int_sales_orders ..... [RUN]
15:15:18  1 of 1 OK created sql view model dw_intermediate.int_sales_orders ..... [CREATE VIEW in 0.16s]
15:15:18
15:15:18  Finished running 1 view model in 0 hours 0 minutes and 1.00 seconds (1.00s).
15:15:18
15:15:18  Completed successfully
15:15:18
15:15:18  Done. PASS=1 WARN=0 ERROR=0 SKIP=0 NO-OP=0 TOTAL=1
15:15:18  [WARNING][DeprecationsSummary]: Deprecated functionality
Summary of encountered deprecations:
- MissingArgumentsPropertyInGenericTestDeprecation: 3 occurrences
To see all deprecation instances instead of just the first occurrence of each,
run command again with the `--show-all-deprecations` flag. You may also need to
run with `--no-partial-parse` as some deprecations are only encountered during
parsing.

(dbt-env) C:\pde_magistr\superstore_dwh>dbt run --select mart_monthly_sales mart_customer_ltv mart_product_lifecycle
15:17:00  Running with dbt=1.10.15
15:17:00  Registered adapter: postgres=1.9.1
15:17:01  Found 13 models, 22 data tests, 1 source, 448 macros
15:17:01
15:17:01  Concurrency: 1 threads (target='dev')
15:17:01
15:17:02  1 of 3 START sql table model dw_test.mart_customer_ltv ..... [RUN]
15:17:02  1 of 3 OK created sql table model dw_test.mart_customer_ltv ..... [SELECT 793 in 0.28s]
15:17:02  2 of 3 START sql table model dw_test.mart_monthly_sales ..... [RUN]
15:17:02  2 of 3 OK created sql table model dw_test.mart_monthly_sales ..... [SELECT 426 in 0.17s]
15:17:02  3 of 3 START sql table model dw_test.mart_product.lifecycle ..... [RUN]
15:17:03  3 of 3 OK created sql table model dw_test.mart_product.lifecycle ..... [SELECT 1894 in 0.27s]
15:17:03
15:17:03  Finished running 3 table models in 0 hours 0 minutes and 1.43 seconds (1.43s).
15:17:03
15:17:03  Completed successfully
15:17:03
15:17:03  Done. PASS=3 WARN=0 ERROR=0 SKIP=0 NO-OP=0 TOTAL=3
```

## Скриншот выполнения dbt test

```
(dbt-env) C:\pde_magistr\superstore_dwh>dbt test
15:23:04  Running with dbt=1.10.15
15:23:04  Registered adapter: postgres=1.9.1
15:23:05  Found 11 models, 31 data tests, 1 snapshot, 1 source, 1 exposure, 450 macros
15:23:05
15:23:05  Concurrency: 1 threads (target='dev')
15:23:05
15:23:06  1 of 31 START test is_non_negative_interval_mart_product_lifecycle_days_between_sales [RUN]
15:23:06  1 of 31 PASS is_non_negative_interval_mart_product_lifecycle_days_between_sales [PASS in 0.22s]
15:23:06  2 of 31 START test is_positive_mart_customer_ltv_number_of_orders ..... [RUN]
15:23:06  2 of 31 PASS is_positive_mart_customer_ltv_number_of_orders ..... [PASS in 0.18s]
15:23:06  3 of 31 START test is_positive_mart_customer_ltv_total_sales_lifetime ..... [RUN]
15:23:06  3 of 31 PASS is_positive_mart_customer_ltv_total_sales_lifetime ..... [PASS in 0.18s]
15:23:06  4 of 31 START test is_positive_mart_monthly_sales_number_of_orders ..... [RUN]
15:23:06  4 of 31 PASS is_positive_mart_monthly_sales_number_of_orders ..... [PASS in 0.06s]
15:23:06  5 of 31 START test is_positive_mart_monthly_sales_total_sales ..... [RUN]
15:23:06  5 of 31 PASS is_positive_mart_monthly_sales_total_sales ..... [PASS in 0.17s]
15:23:06  6 of 31 START test is_positive_mart_product_lifecycle_total_orders ..... [RUN]
15:23:07  6 of 31 PASS is_positive_mart_product_lifecycle_total_orders ..... [PASS in 0.18s]
15:23:07  7 of 31 START test is_positive_mart_product_lifecycle_total_quantity_sold ..... [RUN]
15:23:07  7 of 31 PASS is_positive_mart_product_lifecycle_total_quantity_sold ..... [PASS in 0.17s]
15:23:07  8 of 31 START test is_positive_mart_product_lifecycle_total_sales ..... [RUN]
15:23:07  8 of 31 PASS is_positive_mart_product_lifecycle_total_sales ..... [PASS in 0.18s]
15:23:07  9 of 31 START test not_null_calendar_dim_date_key ..... [RUN]
15:23:07  9 of 31 PASS not_null_calendar_dim_date_key ..... [PASS in 0.07s]
15:23:07  10 of 31 START test not_null_customer_dim_customer_id ..... [RUN]
15:23:07  10 of 31 PASS not_null_customer_dim_customer_id ..... [PASS in 0.19s]
15:23:07  11 of 31 START test not_null_customer_dim_customer_id_key ..... [RUN]
15:23:07  11 of 31 PASS not_null_customer_dim_customer_id_key ..... [PASS in 0.18s]
15:23:07  12 of 31 START test not_null_geo_dim_geo_id ..... [RUN]
15:23:08  12 of 31 PASS not_null_geo_dim_geo_id ..... [PASS in 0.18s]
15:23:08  13 of 31 START test not_null_mart_customer_ltv_total_sales_lifetime ..... [RUN]
15:23:08  13 of 31 PASS not_null_mart_customer_ltv_total_sales_lifetime ..... [PASS in 0.17s]
15:23:08  14 of 31 START test not_null_mart_monthly_sales_total_sales ..... [RUN]
15:23:08  14 of 31 PASS not_null_mart_monthly_sales_total_sales ..... [PASS in 0.18s]
15:23:08  15 of 31 START test not_null_mart_product_lifecycle_days_between_sales ..... [RUN]
15:23:08  15 of 31 PASS not_null_mart_product_lifecycle_days_between_sales ..... [PASS in 0.06s]
15:23:08  16 of 31 START test not_null_mart_product_lifecycle_total_quantity_sold ..... [RUN]
15:23:08  16 of 31 PASS not_null_mart_product_lifecycle_total_quantity_sold ..... [PASS in 0.18s]
15:23:08  17 of 31 START test not_null_mart_product_lifecycle_total_sales ..... [RUN]
15:23:08  17 of 31 PASS not_null_mart_product_lifecycle_total_sales ..... [PASS in 0.19s]
15:23:08  18 of 31 START test not_null_product_dim_product_id_key ..... [RUN]
15:23:09  18 of 31 PASS not_null_product_dim_product_id_key ..... [PASS in 0.07s]
15:23:09  19 of 31 START test not_null_sales_fact_customer_id_key ..... [RUN]
15:23:09  19 of 31 PASS not_null_sales_fact_customer_id_key ..... [PASS in 0.07s]
15:23:09  20 of 31 START test not_null_sales_fact_geo_id ..... [RUN]
15:23:09  20 of 31 PASS not_null_sales_fact_geo_id ..... [PASS in 0.06s]
15:23:09  21 of 31 START test not_null_sales_fact_order_id ..... [RUN]
15:23:09  21 of 31 PASS not_null_sales_fact_order_id ..... [PASS in 0.06s]
15:23:09  22 of 31 START test not_null_sales_fact_product_id_key ..... [RUN]
15:23:09  22 of 31 PASS not_null_sales_fact_product_id_key ..... [PASS in 0.06s]
15:23:09  23 of 31 START test not_null_shipping_dim_shipping_id ..... [RUN]
15:23:09  23 of 31 PASS not_null_shipping_dim_shipping_id ..... [PASS in 0.05s]
15:23:09  24 of 31 START test relationships_sales_fact_customer_id_key_customer_id_key_ref_customer_dim_ [RUN]
15:23:09  24 of 31 PASS relationships_sales_fact_customer_id_key_customer_id_key_ref_customer_dim_ [PASS in 0.06s]
15:23:09  25 of 31 START test relationships_sales_fact_geo_id_geo_id_ref_geo_dim ..... [RUN]
15:23:09  25 of 31 PASS relationships_sales_fact_geo_id_geo_id_ref_geo_dim ..... [PASS in 0.19s]
15:23:09  26 of 31 START test relationships_sales_fact_product_id_key_product_id_key_ref_product_dim_ [RUN]
15:23:09  26 of 31 PASS relationships_sales_fact_product_id_key_product_id_key_ref_product_dim_ [PASS in 0.08s]
15:23:09  27 of 31 START test unique_calendar_dim_date_key ..... [RUN]
15:23:09  27 of 31 PASS unique_calendar_dim_date_key ..... [PASS in 0.06s]
15:23:09  28 of 31 START test unique_customer_dim_customer_id_key ..... [RUN]
15:23:09  28 of 31 PASS unique_customer_dim_customer_id_key ..... [PASS in 0.18s]
15:23:10  29 of 31 START test unique_geo_dim_geo_id ..... [RUN]
15:23:10  29 of 31 PASS unique_geo_dim_geo_id ..... [PASS in 0.18s]
15:23:10  30 of 31 START test unique_product_dim_product_id_key ..... [RUN]
15:23:10  30 of 31 PASS unique_product_dim_product_id_key ..... [PASS in 0.06s]
15:23:10  31 of 31 START test unique_shipping_dim_shipping_id ..... [RUN]
15:23:10  31 of 31 PASS unique_shipping_dim_shipping_id ..... [PASS in 0.06s]
15:23:10
15:23:10  Finished running 31 data tests in 0 hours 0 minutes and 4.95 seconds (4.95s).
15:23:10
15:23:10  Completed successfully
15:23:10
15:23:10  Done. PASS=31 WARN=0 ERROR=0 SKIP=0 NO-OP=0 TOTAL=31
```

Скриншот выполнения dbt snapshot

```
(dbt-env) C:\pde_magistr\superstore_dwh>dbt snapshot
15:24:01  Running with dbt=1.10.15
15:24:01  Registered adapter: postgres=1.9.1
15:24:02  Found 11 models, 31 data tests, 1 snapshot, 1 source, 1 exposure, 450 macros
15:24:02
15:24:02  Concurrency: 1 threads (target='dev')
15:24:02
15:24:02  1 of 1 START snapshot dw_snapshots.snapshot_product_dim ..... [RUN]
15:24:03  1 of 1 OK snapshotted dw_snapshots.snapshot_product_dim ..... [SELECT 1894 in 0.17s]
15:24:03
15:24:03  Finished running 1 snapshot in 0 hours 0 minutes and 1.00 seconds (1.00s).
15:24:03
15:24:03  Completed successfully
15:24:03
15:24:03  Done. PASS=1 WARN=0 ERROR=0 SKIP=0 NO-OP=0 TOTAL=1
(dbt-env) C:\pde_magistr\superstore_dwh>
```

## Скриншот данных из mart\_product\_lifecycle

Данные из mart\_product\_lifecycle:

			product_name	category	subcategory	first_sale_date	last_sale_date	days_between_sales	total_ords
ers		total_quantity_sold	total_sales						
14		119.0	17057.341	Ibico Hi-Tech Manual Binding System	Office Supplies	Binders	2014-01-06	2017-12-30	1454 days
				GBC Binding covers	Office Supplies	Binders	2014-01-06	2017-12-30	1454 days
14		119.0	17057.341	Acco Four Pocket Poly Ring Binder with Label Holder, Smoke, 1"	Office Supplies	Binders	2014-01-07	2017-12-24	1447 days
6		76.0	350.150	Xerox 225	Office Supplies	Paper	2014-01-06	2017-12-10	1434 days
9		105.0	620.784	Newell 327	Office Supplies	Art	2014-01-20	2017-12-21	1431 days
4		69.0	152.490	Memorex Micro Travel Drive 8 GB	Technology Accessories		2014-01-09	2017-12-07	1428 days
8		66.0	743.600	Avery Metallic Poly Binders	Office Supplies	Binders	2014-01-13	2017-12-10	1427 days
6		70.0	317.442	Acco Pressboard Covers with Storage Hooks, 9 1/2" x 11", Executive Red	Office Supplies	Binders	2014-01-20	2017-12-17	1427 days
9		133.0	447.294	Rogers Handheld Barrel Pencil Sharpener	Office Supplies	Art	2014-01-06	2017-12-02	1426 days
7		84.0	215.364	GE 30524EE4	Technology	Phones	2014-01-06	2017-12-02	1426 days
9		119.0	19481.406						

Всего записей в таблице: 1894

## Выводы

Преимущества использования промежуточных моделей и витрин:

- 1) Инкапсуляция бизнес-логики - сложные JOIN и преобразования вынесены в промежуточный слой, что предотвращает дублирование кода
- 2) Упрощение витрин - аналитические модели становятся простыми агрегациями над готовыми денормализованными данными
- 3) Повторное использование - одна промежуточная модель может использоваться в нескольких витринах
- 4) Облегчение тестирования - бизнес-логика тестируется в одном месте
- 5) Улучшение производительности - оптимизированные промежуточные модели ускоряют построение витрин

- 6) Специализация витрин - каждая витрина решает конкретную бизнес-задачу и содержит только необходимые данные
- 7) Упрощение сопровождения - изменения в бизнес-логике вносятся в одном месте (intermediate-модели)
- 8) Лучшая документация - четкое разделение ответственности между слоями улучшает понимание архитектуры

По сравнению с работой напрямую с единой таблицей фактов, предложенная архитектура обеспечивает лучшую масштабируемость, поддерживаемость и соответствие бизнес-потребностям.