

DW Project Week 2: Multidimensional Design

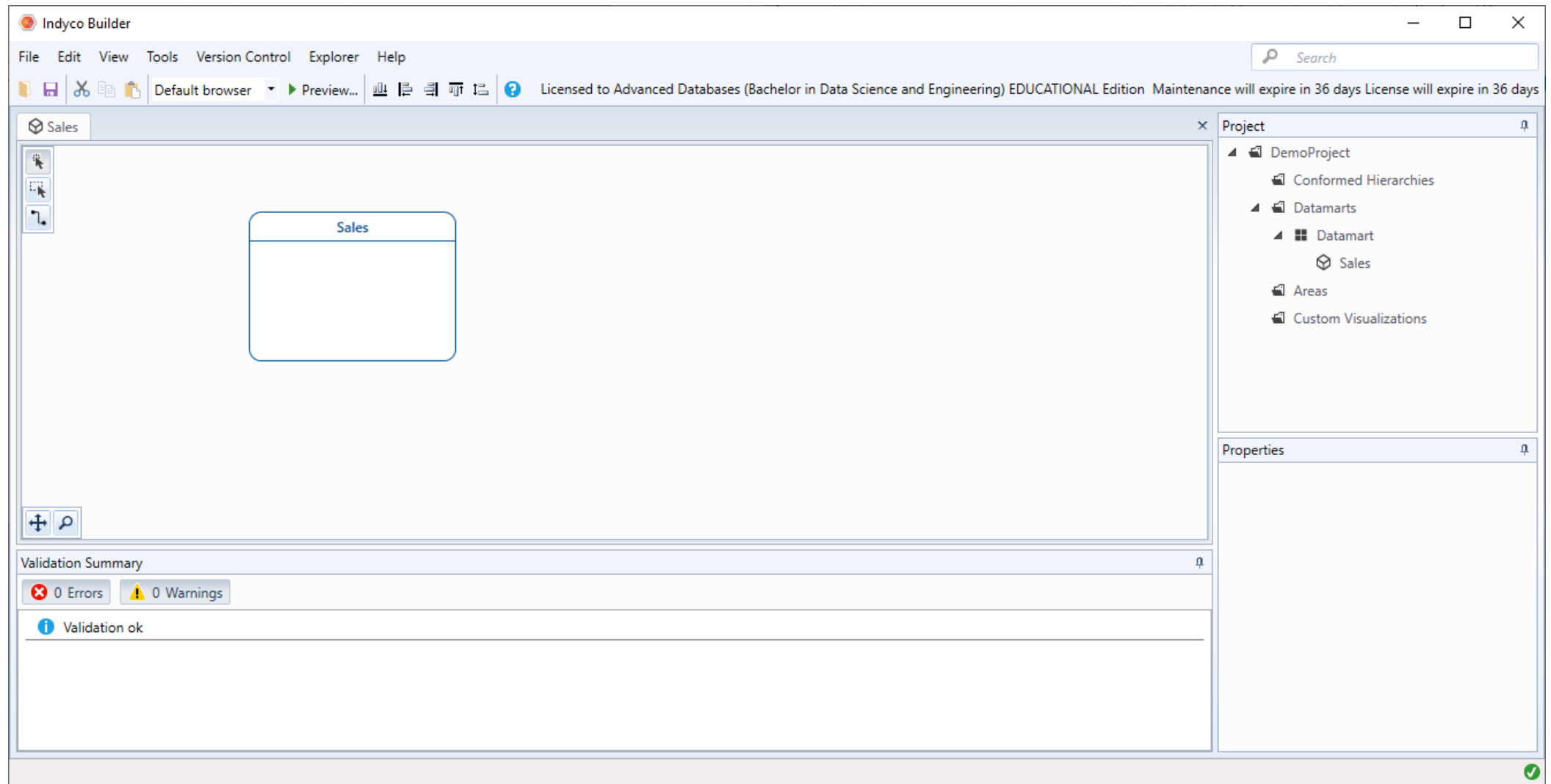
Design a multidimensional model in Indyco Builder

Week 2: Multidimensional modeling

Prerequisites

- Connect to PostgreSQL using DBeaver (Week 1)
 - You will find two databases: AMOS and AIMS
 - Understand the domain
- Install Indyco Builder (Week 2)
 - Only for Windows
 - Follow the steps provided in LearnSQL
- Tutorial on Indyco Builder (Week 2)
 - Learn how to model with Indyco Builder using the tutorial provided in LearnSQL

Demo: Indyco Builder



Week 2: Multidimensional modeling

LAB ON MULTIDIMENSIONAL MODELING FOR THE ACME-FLYING USE CASE

You must create a multidimensional model, potentially consisting of different stars, that allow to easily retrieve the **KPIs about aircraft utilization** (namely FH, TO, ADIS, ADOS, ADOSS, ADOSU, DU, DC, DYR, CNR, TDR and ADD) and logbook reporting (namely RRh, RRc, PRRh, PRRc, MRRh and MRRc). All these metrics would be obtained from the available data in AIMS and AMOS, that can be complemented with the following sources:

- A file containing for every aircraft registration code, its manufacturer registration code, the aircraft model and manufacturer.
- Another file containing for the maintenance personnel, their identifier and the code of the airport where they work.

Finest temporal granule for flight hours and cycles is the day, while the ADIS and ADOS are calculated per month or year, like the DYR, CNR, TDR, ADD, and all Report Rates. The latest can also be analysed per person and airport of the reporting person (just in case of MAREP), as well. Thus, required queries are:

- Give me FH and TO per aircraft (also per model) per day (also per month and per year).
- Give me ADIS, ADOS, ADOSS, ADOSU, DYR, CNR, TDR, ADD per aircraft (also per model) per month (also per year).
- Give me the RRh, RRc, PRRh, PRRc, MRRh and MRRc per aircraft (also per model and manufacturer) per month (also per year).
- Give me the MRRh and MRRc per airport of the reporting person per aircraft (also per model).

Check the slides of the ACME use case to see how KPIs are calculated:

- FH – Flight hours
- TO – Flight cycles
- ADOS – Aircraft Days Out of Service
- DU – Daily utilization
- DC – Daily cycles
- DYR – Delay rate
- CNR - Cancellation rate
- TDR – Technical Dispatch Reliability
- ADD – Average Daily Duration

aircraft-manufacturerinfo-lookup.csv

maintenance-personnel-airport-lookup.csv

Check the slides of the ACME use case to see how KPIs are calculated:

RRh – Report Rate per hour

RRc – Report Rate per cycle

PRRh – PIREP rate hours

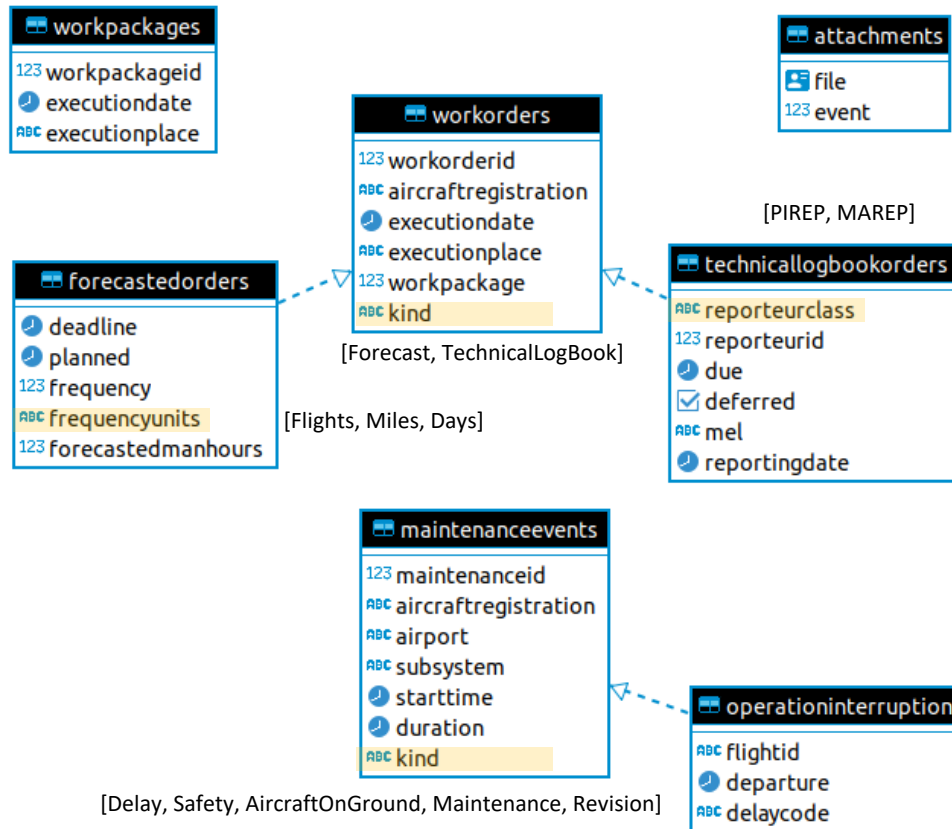
PRRc – PIREP rate cycles

MRRh – MIREP rate hours

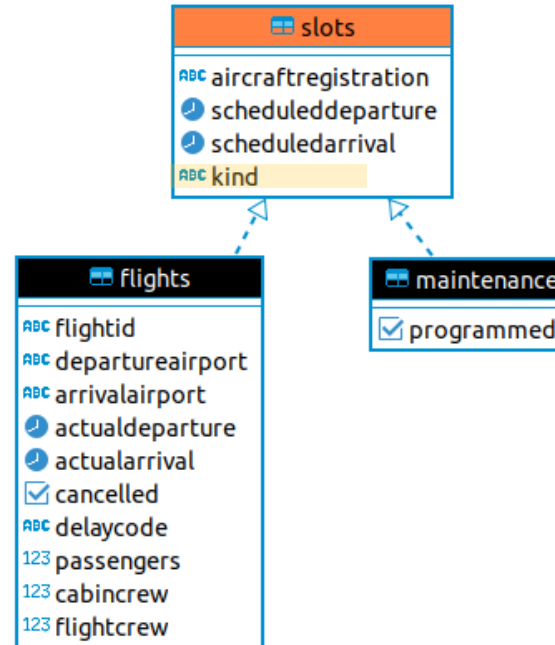
MRRc – MIREP rate cycles

Data sources

AMOS Aircraft Maintenance Operation System



AIMS Air Information Management System



aircraft-manufacturer-lookup.csv

aircraft_reg_code
manufacturer_serial_number
aircraft_model
manufacturer

maintenance-personnel-lookup.csv

reporteurid
airport

Data sources

	123 workorderid	ABC aircraftreg	ABC executiondate	ABC executionplace	123 workpackageid	ABC kind	ABC reporteurid	123 reporteurclass	ABC due	ABC deferred	ABC mel	ABC reportingdate
1	734,056	XY-ALV	2015-01-01	STN	20,561	TechnicalLogBook	MAREP	2,308	2015-03-15	[]	D	2014-12-31

workpackages
123 workpackageid
ABC executiondate
ABC executionplace

attachments
file
123 event

slots
ABC aircraftregistration
ABC scheduleddeparture
ABC scheduledarrival
ABC kind

aircraft-manufacturer-lookup.csv
aircraft_reg_code
manufacturer_serial_number
aircraft_model
manufacturer

forecastedorders
ABC deadline
ABC planned
123 frequency
ABC frequencyunits
123 forecastedmanhours

workorders
123 workorderid
ABC aircraftregistration
ABC executiondate
ABC executionplace
123 workpackage
ABC kind

technicallogbookorders
ABC reporteurclass
123 reporteurid
ABC due
ABC deferred
ABC mel
ABC reportingdate

flights
ABC flightid
ABC departureairport
ABC arrivalairport
ABC actualdeparture
ABC actualarrival
ABC cancelled
ABC delaycode
123 passengers
123 cabincrew
123 flightcrew

maintenance
ABC programmed

maintenance-personnel-lookup.csv
reporteurid
airport

maintenanceevents
123 maintenanceid
ABC aircraftregistration
ABC airport
ABC subsystem
ABC starttime
ABC duration
ABC kind

	ABC aircraftreg	ABC scheduleddeparture	ABC scheduledarrival	ABC kind	ABC flightid	ABC departure	ABC arrival	ABC actualdeparture	ABC actualarrival	ABC cancelled
1	XY-ALV	2014-12-01 04:36:14	2014-12-01 06:17:27	Flight	011214-STN-RMU-3228-XY-ALV	STN	RMU	[NULL]	[NULL]	[v]

ABC flightid
ABC departure
ABC delaycode

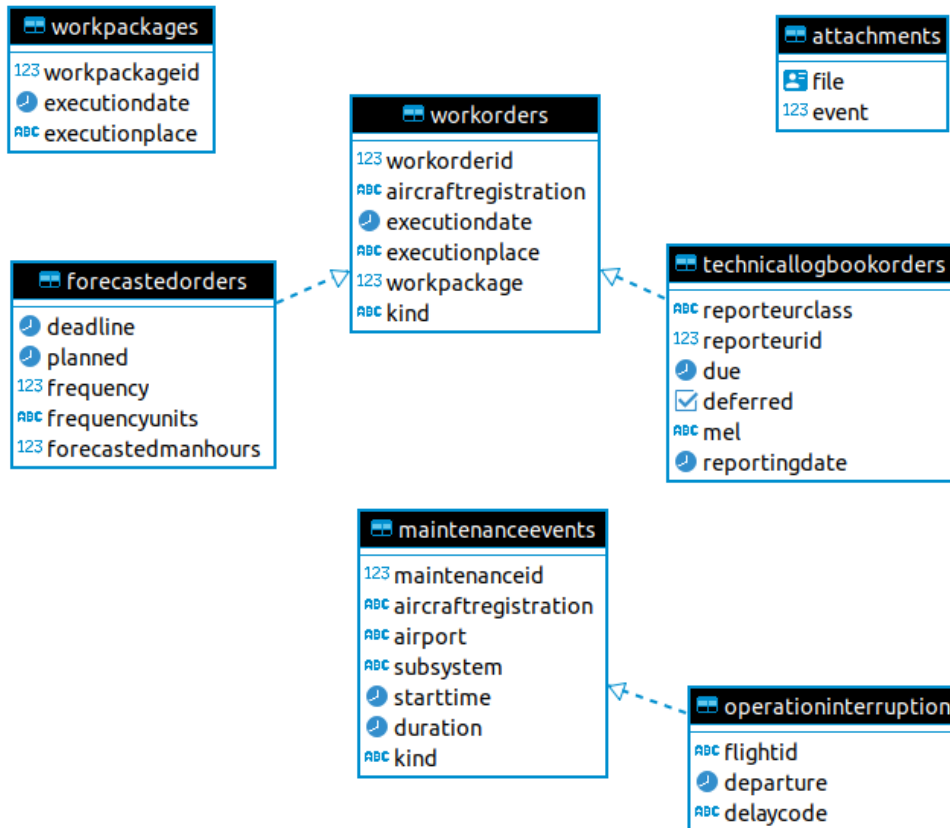
[Delay, Safety, AircraftOnGround, Maintenance, Revision]

	123 maintenanceid	ABC aircraftregistration	ABC airport	ABC subsystem	ABC starttime	ABC duration	ABC kind
1	1,080,092	XY-ALV	STN	1820	2014-12-01 04:36:14	10:48:18.897336	AircraftOnGround

Data sources

AMOS

Aircraft Maintenance Operation System



KPIs (see slides)

Flight hours (FH)

Flight cycles (TO) – number of take offs

Aircraft days out of service

- ADOSS – scheduled maintenance [days]
- ADOSU – unscheduled maintenance [days]

...

Requirements / Queries (see Statement)

1. Give me FH and TO per aircraft (also per model) per day (also per month and per year)
2. Give me ADIS, ADOS, ADOSS, ADOSU, DYR, CNR, TDR, ADR per aircraft (also per model) per month (also per year)

...

Week 2 | Activity 1.1

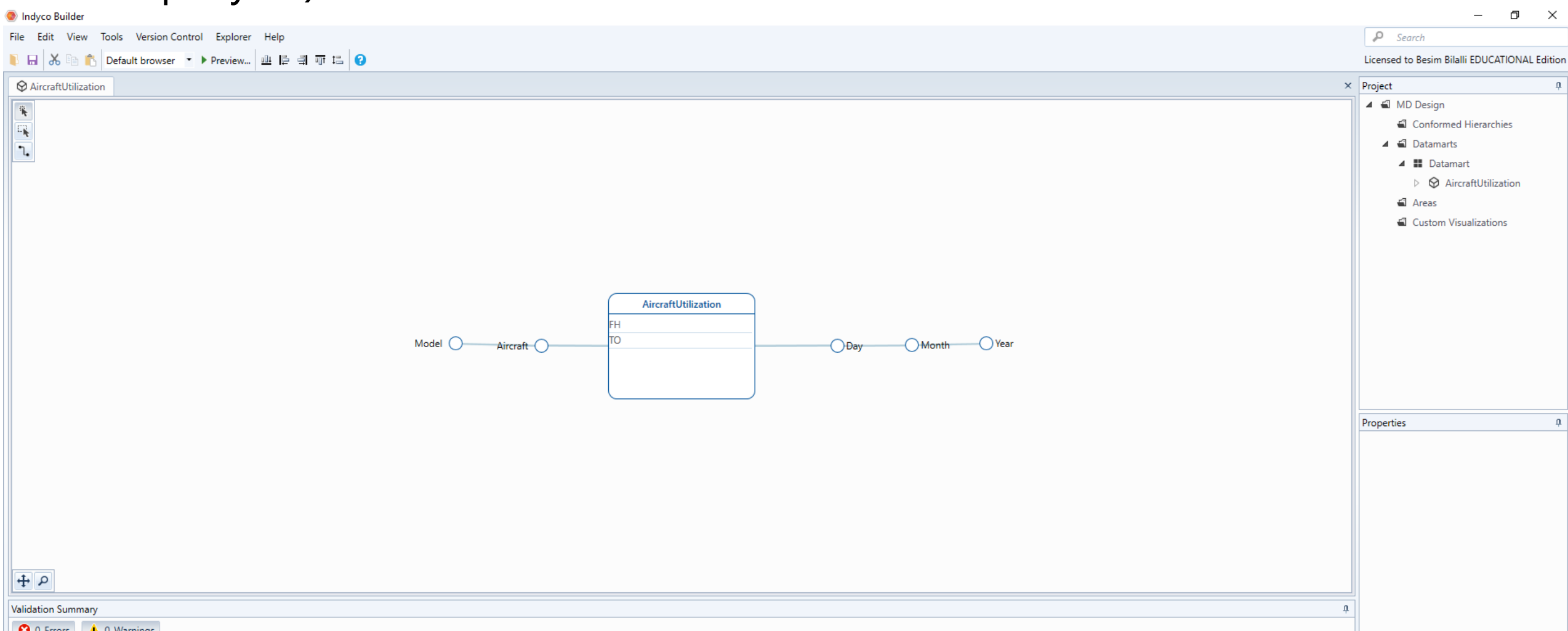
- Given the required KPIs and queries, **create independent MD schemas, in the Indyco Builder tool**, that satisfy (i.e., that can answer) these information requirements.

For instance,

- KPIs: FH and TO
- Req1: Give me FH and TO per aircraft (also per model) per day (also per month and per year)
 - Can I compute these KPIs using the data sources I have?
 - Do I have the required dimensions and do they satisfy the multidimensional modeling constraints?

Week 2 | Activity 1.1 | Independent MD schema

- Req1: Give me FH and TO per aircraft (also per model) per day (also per month and per year)



Week 2 | Activity 1.2

- a) Give me FH and TO per aircraft (also per model) per day (also per month and per year).
- b) Give me ADIS, ADOS, ADOSS, ADOSU, DYR, CNR, TDR, ADD per aircraft (also per model) per month (also per year).
- c) Give me the RRh, RRC, PRRh, PRRc, MRRh and MRRc per aircraft (also per model and manufacturer) per month (also per year).
- d) Give me the MRRh and MRRc per airport of the reporting person per aircraft (also per model).

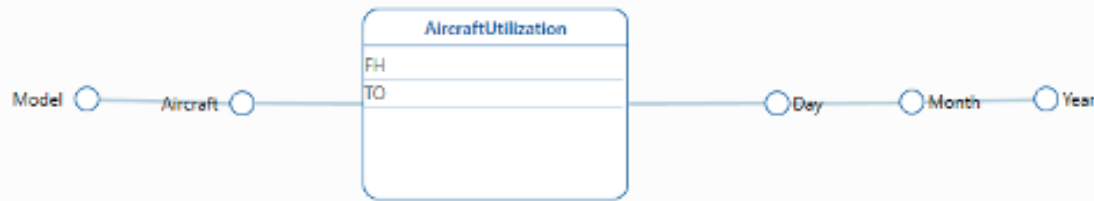
- Given the required MD schemas, **consider integrating them**:
 - i. you obtain a unified MD schema that satisfies all information requirements at once, and
 - ii. the unified MD schema has the minimal structural complexity (regarding the number of classes, attributes, and relationships).
- Do fact tables share any dimensions?
- Can I compute a galaxy schema out of the independent MDs?

Week 2 | Activity 2

- Given a simple multidimensional (i.e., the previously created galaxy) schema:
 - i. Propose a logical database schema (i.e., a set of CREATE TABLE statements) corresponding to that multidimensional schema.
- How do I physically store the designed model?
- Do I use only Tables or maybe also Views?

Week 2 | Activity 2 | Logical Schema

- Propose a logical database schema (i.e., a set of CREATE TABLE statements) corresponding to that multidimensional schema.



```
CREATE TABLE AircraftDimension (  
  ID CHAR(6),  
  model VARCHAR2(100) NOT NULL,  
  manufacturer VARCHAR2(100) NOT NULL,  
  PRIMARY KEY (ID)  
);
```

```
CREATE TABLE AircraftUtilization (  
  aircraftID CHAR(6),  
  timeID DATE,  
  flightHours NUMBER(2),  
  flightCycles NUMBER(2),  
  PRIMARY KEY (aircraftID, timeID),  
  FOREIGN KEY (aircraftID) REFERENCES AircraftDimension(ID),  
  FOREIGN KEY (timeID) REFERENCES TemporalDimension(ID)  
);
```

```
CREATE TABLE TemporalDimension (  
  ID DATE,  
  month CHAR(7) NOT NULL,  
  year NUMBER(4) NOT NULL,  
  PRIMARY KEY (ID),  
);
```

Deliverables

Deliverables:

- 1) Indyco folder (in a single zip file) with all the files of the conceptual design
- 2) Commented SQL file with the CREATE TABLE statements and auxiliary views (if any) in Postgres
- 3) PDF file (**one single A4 page, 2.5cm margins, font size 12, inline space 1.15**) with all assumptions made and justifying the decisions you made (if any)

Assessment criteria:

- i) Conciseness of explanations (only first page will be considered in the evaluation)
- ii) Understandability
- iii) Coherence
- iv) Soundness

Evaluation:

- 60% Deliverables
- 40% Exercises related to the project done individually in the day of the partial exam