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DWH Project delivery

1-State the modelling process

We are going to follow Kimbal's approach in designing our DWH for the following reasons:

- 1- The data integration requirement is focused on individual business areas (Marketing, Finance, Customer care)
- 2- It occupies less space compared to Inmon.
- 3- It's quicker and cheaper to set up compared to Inmon.
- 4- Requires less ETL work, therefore has faster loading.

In Kimbal's approach we follow the bottom-up methodology where ***we will first model 3 independent data marts, one for each department (Marketing, Finance & customer care) & then we will join them together to construct our DWH.***

We have 5 business processes namely:

Business Process	Granularity
Flight activity	Daily
Flyer miles redemption	Detailed (Per transaction)
Flyer promotions responsivity	Daily
Reservation	Daily
Customer care handling	Detailed (Per report)

2-Logical data models

2-1-Marketing data mart

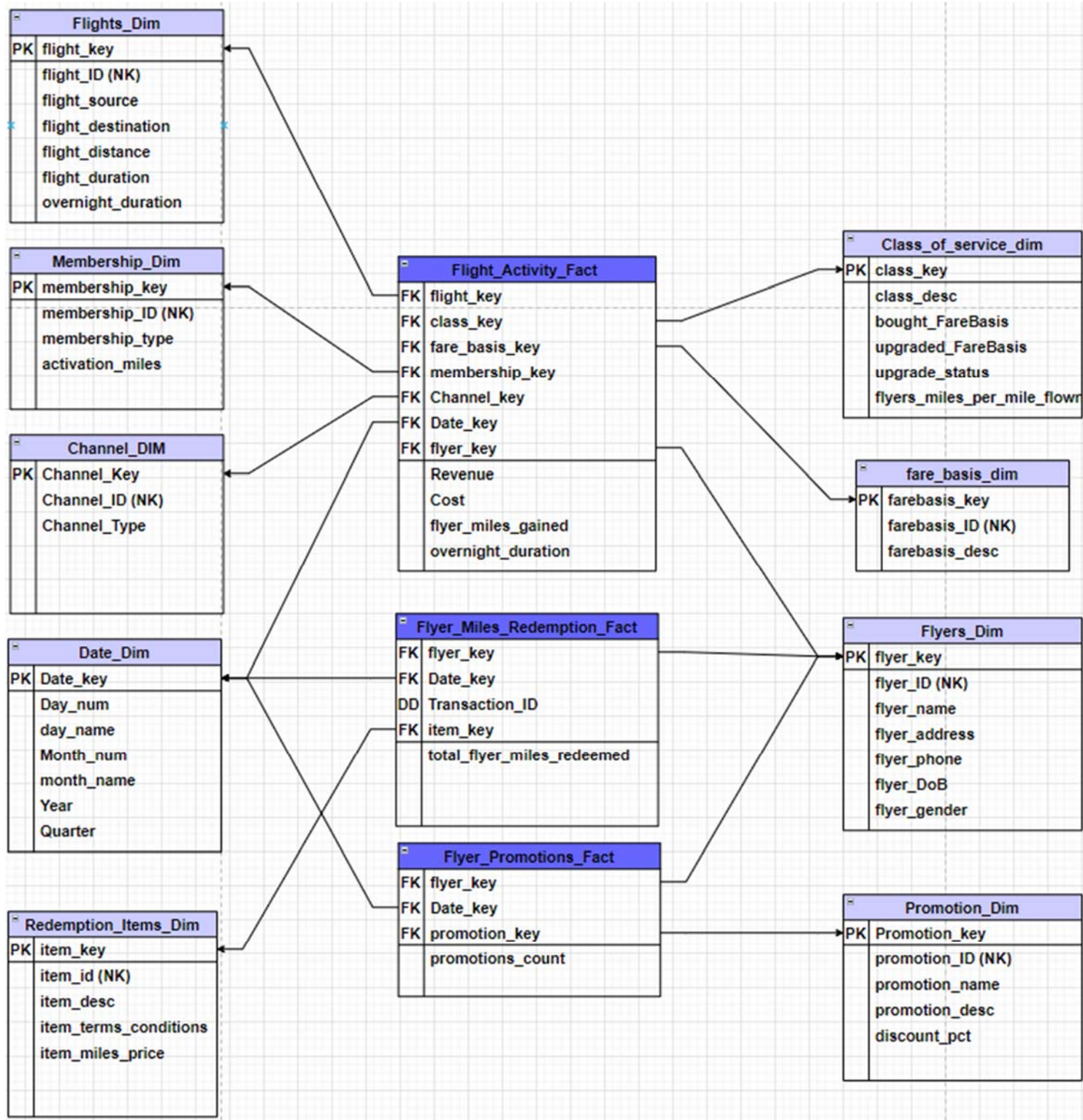
The marketing team is interested in modelling 3 different business processes:

First is the flight activity which measures the number of flights and the flyer miles gained per flight, per flyer, per fare basis, per program membership (will be explained later).

It also measures the total overnight duration spent in the airport (as a transit) per flyer.

Second is the flyer miles redemption activity which measures how many flyer miles are redeemed per flyer, per redemption item.

Third is the flyer promotions responsivity which measures how many promotions have been received per flyer, per promotion type.





Explaining the dimensions:

Looking at the operational source system we find these attributes:

- Flight_ID
- Flight_source
- Flight_destination
- Flight_duration
- Overnight_duration

Flights_Dim	
PK	flight_key
	flight_ID (NK)
	flight_source
	flight_destination
	flight_distance
	flight_duration
	overnight_duration

We also added a final attribute which is the flight_distance which helps in calculating how many flyer miles our frequent flyers earn per flight. We believe this attribute is also available in the source systems, and if not it can be easily googled and added.

FLIGHT	FROM	TO	DURATION
 TK695 <i>flight_ID</i> Turkish Airlines Airbus A321 Narrow-body	21:25 Cairo (CAI) Cairo International Airport <i>flight_source</i>	00:45 Tuesday, February 1 Istanbul (IST) Istanbul Airport <i>flight_destination</i>	2h 20m <i>flight_duration</i>
Layovers & Connecting Flights for Istanbul, Turkey Istanbul Airport			13h 5m <i>overnight_duration</i>
 TK9 Turkish Airlines Boeing 777-300ER Wide-body	13:50 Tuesday, February 1 Istanbul (IST) Istanbul Airport	16:45 Tuesday, February 1 Los Angeles (LAX) Los Angeles International Airport	13h 55m

Source: <https://www.turkishairlines.com/>

Flyers_Dim	
PK	flyer_key
	flyer_ID (NK)
	flyer_name
	flyer_address
	flyer_phone
	flyer_DoB
	flyer_gender

- These attributes are found in the source systems that oversee flyers registration.
- The flyer_ID here will be the flyer's passport number.

Membership_Dim	
PK	membership_key
	membership_ID (NK)
	membership_type
	activation_miles

This dimension is a small lookup table that enables our airline company to keep track of it's frequent or loyal flyers. All Flyers start as normal flyers "white status", and the more total miles they fly with our airline company the better their status becomes therefore becoming frequent flyers.

The following table demonstrates the idea:

<i>Status</i>	<i>Activation miles</i>	<i>Status</i>
<i>White</i>	0	Non frequent
<i>Gold</i>	50,000	Frequent
<i>Platinum</i>	300,000	Frequent
<i>Titanium</i>	600,000	Frequent

EGYPTAIR PLUS CARDS

BLUE

SILVER

GOLD

ELITE

PLATINUM



Activation miles

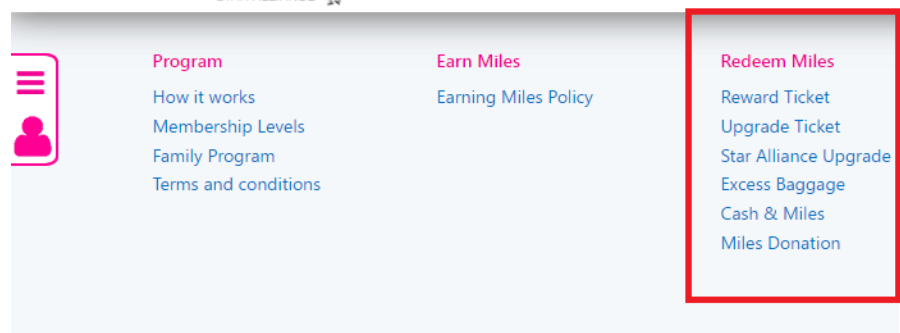
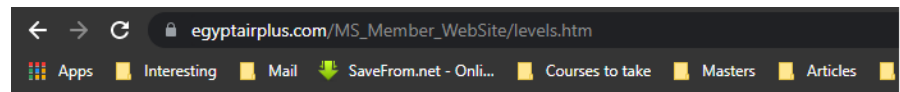
When your account reaches a total of **5,000** Tier Miles or 6 sectors earned from EGYPTAIR flights, or Star Alliance Member Carriers, Your Blue Membership Card will be issued and sent to your mailing address registered in your membership.

Source: https://www.egyptairplus.com/MS_Member_WebSite/levels.htm

Redemption_Items_Dim	
PK	item_key
	item_id (NK)
	item_desc
	item_terms_conditions
	item_miles_price

This table holds the items or services that can be redeemed as a reward using the frequent flyer miles, examples include:

- Get Excess baggage
- Upgrade your fare basis
- Donate to charities



Instead of the class_of_service dimension we could have had two dimensions namely:

- 1- Four rows in the class dimension table to indicate first, business, premium economy, and economy classes.
- 2- The upgrade indicator dimension also would have just three rows in it, corresponding to upgrade, downgrade, or no class change.

Because the row counts are so small, you can elect instead to combine the dimensions into a single class of service dimension as follows.

Class_of_service_dim	
PK	class_key
	class_desc
	bought_FareBasis
	upgraded_FareBasis
	upgrade_status
	flyers_miles_per_mile_flowr

Class of Service Key	Class Purchased	Class Flown	Purchased-Flown Group	Class Change Indicator
1	Economy	Economy	Economy-Economy	No Class Change
2	Economy	Prem Economy	Economy-Prem Economy	Upgrade
3	Economy	Business	Economy-Business	Upgrade
4	Economy	First	Economy-First	Upgrade
5	Prem Economy	Economy	Prem Economy-Economy	Downgrade
6	Prem Economy	Prem Economy	Prem Economy-Prem Economy	No Class Change
7	Prem Economy	Business	Prem Economy-Business	Upgrade
8	Prem Economy	First	Prem Economy-First	Upgrade
9	Business	Economy	Business-Economy	Downgrade
10	Business	Prem Economy	Business-Prem Economy	Downgrade
11	Business	Business	Business-Business	No Class Change
12	Business	First	Business-First	Upgrade
13	First	Economy	First-Economy	Downgrade
14	First	Prem Economy	First-Prem Economy	Downgrade
15	First	Business	First-Business	Downgrade
16	First	First	First-First	No Class Change

Source: The data warehouse toolkit-3rd ed-Ralph Kimball

This simplifies the queries required to analyze activity based on whether there was an upgrade, downgrade or no change in the fare basis.

We added to this table the “flyers_miles_per_mile_flown” column which indicates how many flyer miles rewards are earned for every one mile flown, this depends on the upgraded_farebasis (class flown) column

Snapshot of our filled class_of_service_dim table:

Table: YOUSSEF.CLASS_OF_SERVICE_DIM

CLASS_OF_SERVICE_DIM: Created: 1/27/2022 9:44:26 PM Last DDL: 1/28/2022 3:10:37 PM

Columns Indexes Constraints Triggers Data Script Grants Synonyms Partitions Subpartitions Stats/Size Referential Used By Policies Auditing

☐ Sort by Primary Key ☐ Desc
☐ Read Only ☐ Auto Refresh

CLASS_KEY	CLASS_ID	CLASS_DESC	BOUGHT_FAREBASIS	UPGRADE_FAREBASIS	UPGRADE_STATUS	FLYER_MILES_PER_MILE_FLOWN
1	1	economy-economy	economy	economy	no change	0.25
2	2	economy-prem economy	economy	prem economy	upgrade	0.5
3	3	economy-business	economy	business	upgrade	0.75
4	4	economy-first	economy	first	upgrade	1
5	5	prem economy-economy	prem economy	economy	downgrade	0.25
6	6	prem economy-prem economy	prem economy	prem economy	no change	0.5
7	7	prem economy-business	prem economy	business	upgrade	0.75
8	8	prem economy-first	prem economy	first	upgrade	1
9	9	business-economy	business	economy	downgrade	0.25
10	10	business-prem economy	business	prem economy	downgrade	0.5
11	11	business-business	business	business	no change	0.75
12	12	business-first	business	first	upgrade	1
13	13	first-economy	first	economy	downgrade	0.25
14	14	first-prem economy	first	prem economy	downgrade	0.5
15	15	first-business	first	business	downgrade	0.75
16	16	first-first	first	first	no change	1

Row 1 of 16 total rows

YOUSSEF@XE

fare_basis_dim	
PK	farebasis_key
	farebasis_ID (NK)
	farebasis_desc
	fare_type

This Dimension holds the classes fare basis and determines whether the ticket has a discount on it or is full paid.

The “fare_type” column has one of two values: full fare or upgraded

Code	Description
F	First Class
P	Premium, usually first class
A	First class, discounted
R	First class suites (A380)
J	Business class, full fare
C	Business class, full fare
D	Business class, discounted
I	Business class, discounted
Z	Business class, discounted
Y	Coach, full fare, upgradeable
Q	Coach, discounted, non-upgradeable
B, M	Coach, discounted, upgradeable, restricted dates
O, T	Coach, no upgrade, no refunds
W, X	Coach, charters, frequent flyer award
S	Coach, extended economy

Source: <http://craignow.blogspot.com/2010/08/airline-fare-basis-codes-explained.html>

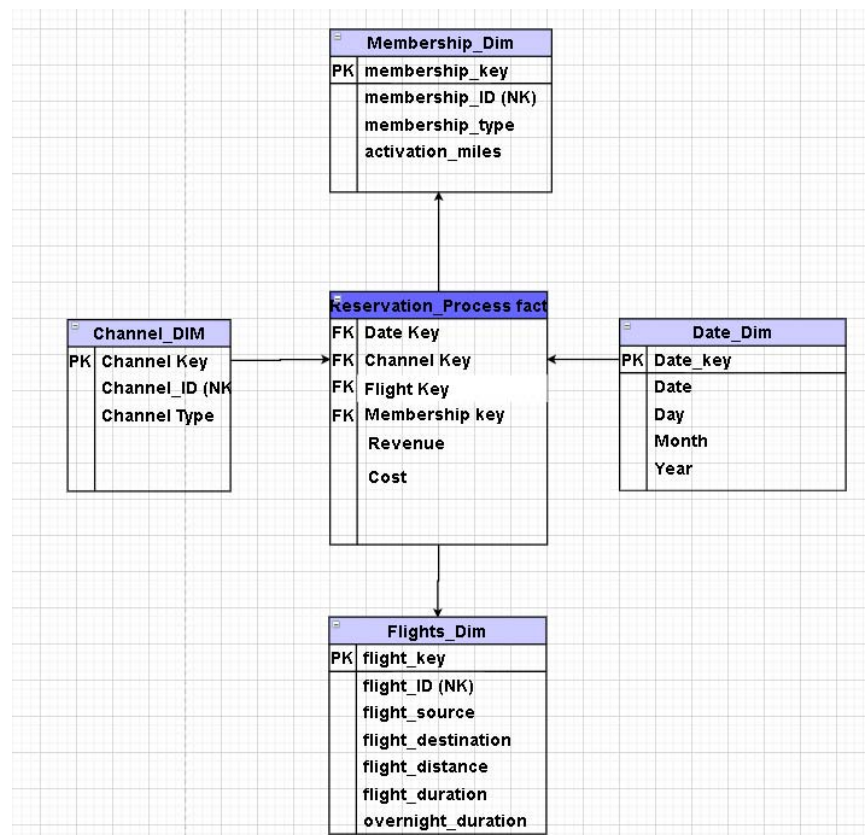
Promotion_Dim	
PK	Promotion_key
	promotion_ID (NK)
	promotion_name
	promotion_desc
	discount_pct

This dimension is filled by extracting and loading data from CMS (Campaign management system). It determines how many promotions has each flyer received whether this promotion was redeemed or not.

To know if a promotion was redeemed we can check the fare_type from the fare basis to see if the ticket had a discount or not.

2-2-Finance data mart

The finance team will be interested in analyzing the company profit which will be measured by the subtraction of the total revenues earned and total cost paid.



Explaining the dimensions:

Channel_DIM	
PK	Channel Key
	Channel_ID (NK)
	Channel Type

This dimension is a lookup table that enables our airline company to keep track of its reservation processes and the type each reservation takes. This dimension contains different channels the flyer can use in his reservation and here is an example of these channels (airline website, directly going to the airport, travel agency, airline application,)

Explaining the fact:

Reservation_Process fact	
FK	Date Key
FK	Channel Key
FK	Flight Key
FK	Membership key
	Revenue
	Cost

This fact contains 2 measures (revenue and cost) that come from the source system which enables me to measure the company total profit by subtracting these 2 measures

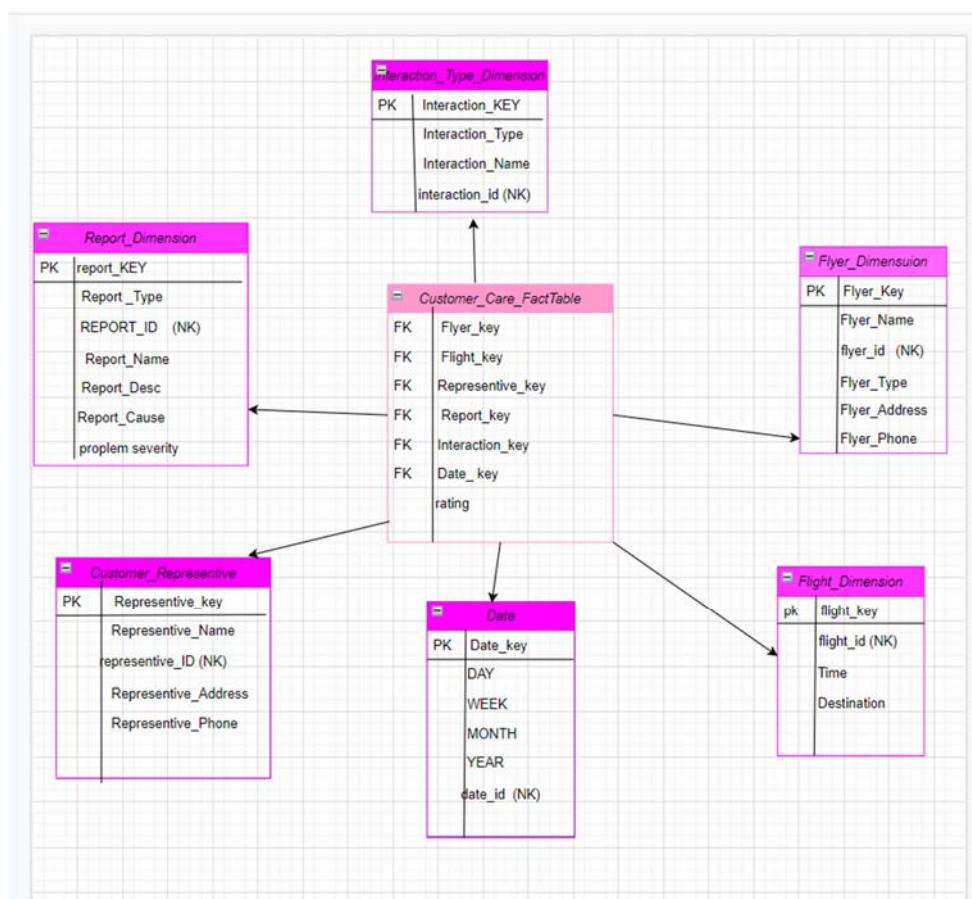
- Profit can be measured per channel (application, directly....) or per membership (gold, platinum.....) or per flight.

2-3 customer care data mart

The customer care team manage people's affairs takes care of their questions, and takes feedback from them and handle customer inquiries, complaints and keep their feedback for business enhancements.

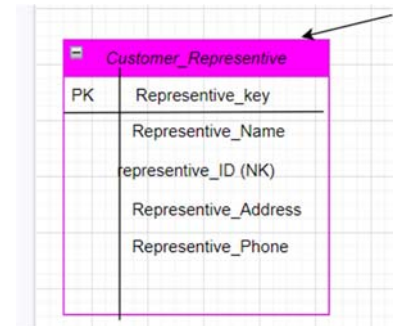
My assumptions level of gurnality per report to handle their questions each day receive people feedback and inquiries about trip or anything within or after trip, assume customer representative team receive all inquiries and complaints of customers for each trip or any problem in system so my assumptions we have 1 fact table and 6-dimension table

And measure quality per representative or per any one of dimension measure it.



Explaining the dimensions:

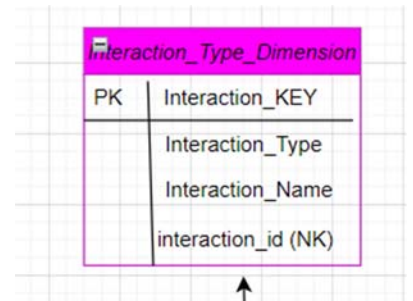
1) **customer_representative dimension:** assume we have representative employee and he handle and solve problem and care about customer feedback, so I suppose we have dimension called customer representative get info of it from sources like name, id, address, and phone



Customer_Representative	
PK	Representative_key
	Representative_Name
	representative_ID (NK)
	Representative_Address
	Representative_Phone

2) **interaction type dimension:** it determine type of customer contact with our company, they have many types like via email, phone, chatbot ,application, customer care office

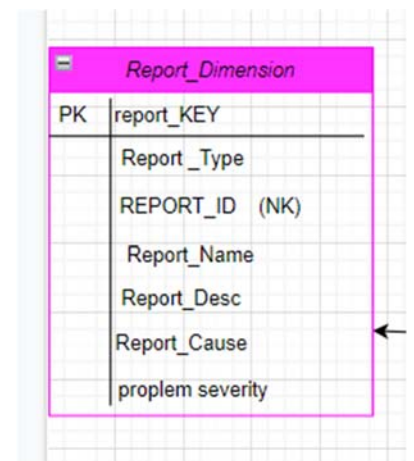
In this dimension table: attributes: interaction, interaction name, interaction type gets all from source system



Interaction_Type_Dimension	
PK	Interaction_KEY
	Interaction_Type
	Interaction_Name
	interaction_id (NK)

3) **report _dimension:** in this dimension I measure complaints, feedback and inquires of customer to enhance services, I suppose three in one dimension because it shares same measures

We search on website of EGYPTAIR, and we found care team and we can ask or give feedback or complaints about something from form in website as we do dimension flyer contain information about customer and on which flight on dimension flight then on report dimension, we make we contain report type consist of feedback or inquires or complaints



Report_Dimension	
PK	report_KEY
	Report_Type
	REPORT_ID (NK)
	Report_Name
	Report_Desc
	Report_Cause
	proplem severity



Title *

First Name

Last Name

Ticket no./ Reservation no.

Email *

Frequent Flyer number

Category *

Sub Category *

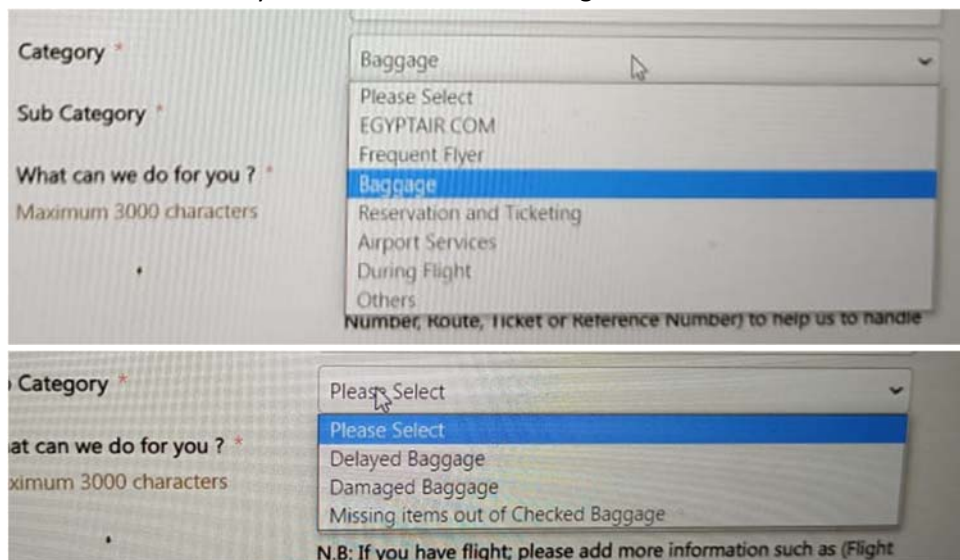
What can we do for you ? *
 Maximum 3000 characters

N.B: If you have flight; please add more information such as (Flight Number, Route, Ticket or Reference Number) to help us to handle your case.

Upload Attachments No file chosen
 Maximum file Size 5 MB
 Allowed Types [jpg_jpg_jpeg_png_png_docx_doc_pdf]

Figure1 :

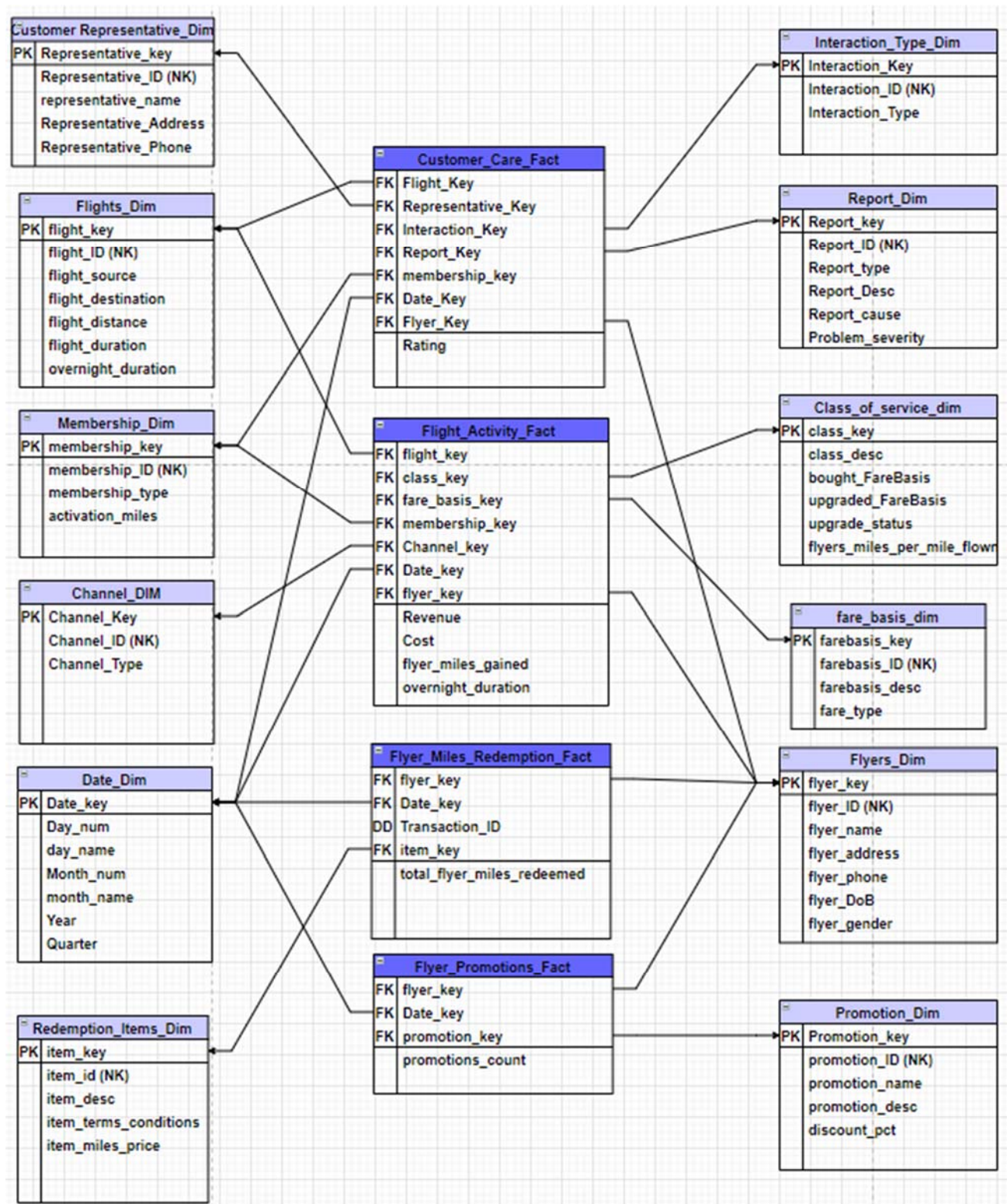
And also report dimension contain report cause attributes and report desc I take this idea also from EGYPTAIR website category contain types of report description and in sub category contain cause of it so I do this 2 attributes in my dimension as we see in figure 2



And we simulate that in our logical and physical design

2-4- Integrating data marts

After constructing the 3 independent data marts we integrate them all together to construct our DWH. We have a lot of common dimensions that can be shared



3-Indexes we used:

A Bitmap index is the index we used the most. It creates a matrix of all possible values of a field with every row of that field. In this matrix, a value of 1 or 0 is stored, the value is a 1 if the value of this database field = the value of the matrix column.

i.e.: Let's take the membership_dim as our example, possible values are only white, gold, platinum, titanium.

Let's say there are 4 flyers, Youssef, Salma, Jessica, Malk.

The Bitmap index will look like this:

white, gold, platinum, titanium.

Youssef : 1 | 0 | 0 | 0

Salma : 0 | 1 | 0 | 0

Jessica : 0 | 0 | 1 | 0

Malk : 0 | 0 | 0 | 1

That is a Bitmap index. When the index gets activated (i.e. you want all Platinum flyers), the database engine will only look into the Platinum column of the membership and return rows that = 1. This is much faster compared to a B-tree whereas you have to traverse the tree, find the node, compare all letters of the membership field to realize yes indeed Jessica is a platinum flyer.

On a table with one million rows, a column with 10,000 distinct values is a candidate for a bitmap index. A bitmap index on this column can outperform a B-tree index, particularly when this column is often queried in conjunction with other indexed columns.

In ad hoc queries and similar situations, bitmap indexes can dramatically improve query performance. **AND** and **OR** conditions in the **WHERE** clause of a query can be resolved quickly by performing the corresponding Boolean operations directly on the bitmaps before converting the resulting bitmap to rowids. If the resulting number of rows is small, the query can be answered quickly without resorting to a full table scan.

4-SQL queries:

1-What flights the company's frequent flyers take?

```
select flight_id, flight_source, flight_destination, count(flight_id) number_of_freq_flyers
FROM flight_activity_fact natural join flight_dim
natural join membership_dim
where membership_type != 'White'
group by (flight_id, flight_source, flight_destination)
order by 4 desc
```

E - Editor]

Session Database Debug View Utilities Window Help

SQL <No name>

```

1 select flight_id, flight_source, flight_destination, count(flight_id) number_of_freq_flyers
2 FROM flight_activity_fact natural join flight_dim
3 natural join membership_dim
4 where membership_type != 'White'
5 group by (flight_id, flight_source, flight_destination)
6 order by 4 desc

```

Data Grid

FLIGHT_ID	FLIGHT_SOURCE	FLIGHT_DESTINATION	NUMBER_OF_FREQ_FLYERS
4	Sharm El Sheikh	Hurghada	3
1	Cairo	Los Angeles	3
3	cairo	Toronto	1
2	Alexandria,Borg Elarab	Bahrain	1

83 msec Row 1 of 4 total rows YOUSSEF@XE Modified

Table: YOUSSEF.FLIGHT_ACTIVITY_FACT

FLIGHT_ACTIVITY_FACT: Created: 1/27/2022 11:03:10 PM Last DDL: 1/27/2022 11:03:10 PM

Subpartitions	Stats/Size	Referential	Used By	Policies	Audit
Columns	Indexes	Constraints	Triggers	Script	Grants
FLIGHT_KEY	FAREBASIS_KEY	MEMBERSHIP_KEY	CHANNEL_KEY	DATE_KEY	FLYER_KEY
REVENUE	COST				

Sort by Primary Key Desc
Read Only Auto Refresh

FLIGHT_KEY	FAREBASIS_KEY	MEMBERSHIP_KEY	CHANNEL_KEY	DATE_KEY	FLYER_KEY	REVENUE	COST
1	1	1	1	30012022	1	1000	750
1	2	1	3	30012022	2	1250	800
1	8	3	2	30012022	3	2000	1350
2	7	4	3	2022022	3	1750	1200
2	15	1	4	25022022	2	2100	1600
3	10	1	1	16062022	1	2000	1300
4	9	3	4	16082022	3	1700	1000
4	1	1	1	1012023	1	1200	750
4	1	4	3	1022023	1	1100	800
4	2	3	2	1022023	2	1050	650

Table: YOUSSEF.MEMBERSHIP_DIM

MEMBERSHIP_DIM: Created: 1/27/2022 8:49:04 PM Last DDL: 1/27/2022 8:49:04 PM

Subpartitions	Stats/Size	Referential	Used By	Policies	Audit
Columns	Indexes	Constraints	Triggers	Script	Grants
MEMBERSHIP_KEY	MEMBERSHIP_ID	MEMBERSHIP_TYPE	ACTIVATION_MEMBERSHIP		

Sort by Primary Key Desc
Read Only Auto Refresh

MEMBERSHIP_KEY	MEMBERSHIP_ID	MEMBERSHIP_TYPE	ACTIVATION_MEMBERSHIP
1	4	titanium	300000
2	3	platinum	100000
3	2	gold	10000
4	1	White	0

non frequent flyers have white membership

2- How frequent do frequent flyers upgrade their fare basis?

To solve this we first get the no of upgraded flights for each frequent flyer

```

SELECT flyer_name, count(flyer_id) no_of_upgraded_flights
FROM flight_activity_fact
NATURAL JOIN class_of_service_dim
NATURAL JOIN flyers_dim
NATURAL JOIN membership_dim
WHERE membership_type != 'White'
AND upgrade_status = 'upgrade'
GROUP BY flyer_name

```

```

1 SELECT flyer_name, count(flyer_id) no_of_upgraded_flights
2 FROM flight_activity_fact
3 NATURAL JOIN class_of_service_dim
4 NATURAL JOIN flyers_dim
5 NATURAL JOIN membership_dim
6 WHERE membership_type != 'White'
7 AND upgrade_status = 'upgrade'
8 GROUP BY flyer_name

```

Data Grid

FLYER_NAME	NO_OF_UPGRADED_FLIGHTS
jessy	2
salma	1

Then we get the total no of flights for each frequent flyer

```

SELECT flyer_name, count(flyer_id) total_no_of_flights
FROM flight_activity_fact
NATURAL JOIN flyers_dim
NATURAL JOIN membership_dim
WHERE membership_type != 'White'
GROUP BY flyer_name

```

```

1 SELECT flyer_name, count(flyer_id) total_no_of_flights
2 FROM flight_activity_fact
3 NATURAL JOIN flyers_dim
4 NATURAL JOIN membership_dim
5 WHERE membership_type != 'White'
6 GROUP BY flyer_name

```

Data Grid

FLYER_NAME	TOTAL_NO_OF_FLIGHTS
youssef	3
jessy	3
salma	2

Then we divide those by each other to get the frequency (percentage) of upgrades for each frequent flyer

```
select flyer_name,
       (SELECT count(flyer_id) no_of_upgrades
        FROM flight_activity_fact
        NATURAL JOIN class_of_service_dim
        NATURAL JOIN flyers_dim
        NATURAL JOIN membership_dim
        WHERE membership_type != 'White'
        AND upgrade_status = 'upgrade'
        AND flyer_name = fl.flyer_name) /
       (SELECT count(flyer_id) no_of_flights
        FROM flight_activity_fact
        NATURAL JOIN flyers_dim
        NATURAL JOIN membership_dim
        WHERE membership_type != 'White'
        AND flyer_name = fl.flyer_name) upgrade_pct
FROM flight_activity_fact f
NATURAL JOIN flyers_dim fl
GROUP BY flyer_name
```

The screenshot shows a SQL query editor with the following query:

```
1 select flyer_name,
2   (SELECT count(flyer_id) no_of_upgrades
3    FROM flight_activity_fact
4    NATURAL JOIN class_of_service_dim
5    NATURAL JOIN flyers_dim
6    NATURAL JOIN membership_dim
7    WHERE membership_type != 'White'
8    AND upgrade_status = 'upgrade'
9    AND flyer_name = fl.flyer_name) /
10  (SELECT count(flyer_id) no_of_flights
11   FROM flight_activity_fact
12   NATURAL JOIN flyers_dim
13   NATURAL JOIN membership_dim
14   WHERE membership_type != 'White'
15   AND flyer_name = fl.flyer_name) upgrade_pct
16 FROM flight_activity_fact f
17 NATURAL JOIN flyers_dim fl
18 GROUP BY flyer_name
```

Below the query is a 'Data Grid' showing the results:

FLYER_NAME	UPGRADE_PCT
youssef	0
jessy	0.6666666666666666
salma	0.5

3- How frequent flyers earn their frequent flyer miles?

```
SELECT flyer_name, sum(flight_distance*flyer_miles_per_mile_flown) flyer_miles_gained
FROM flight_activity_fact
NATURAL JOIN flyers_dim
NATURAL JOIN flight_dim
NATURAL JOIN class_of_service_dim
NATURAL JOIN membership_dim
WHERE membership_type != 'White'
GROUP BY flyer_name
```

The screenshot shows a SQL query editor with the following query:

```
1 SELECT flyer_name, sum(flight_distance*flyer_miles_per_mile_flown) flyer_miles_gained
2 FROM flight_activity_fact
3 NATURAL JOIN flyers_dim
4 NATURAL JOIN flight_dim
5 NATURAL JOIN class_of_service_dim
6 NATURAL JOIN membership_dim
7 WHERE membership_type != 'White'
8 GROUP BY flyer_name
```

Below the query is a 'Data Grid' showing the results:

FLYER_NAME	FLYER_MILES_GAINED
youssef	4771
jessy	5113.25
salma	7594

4- How frequent flyers redeem their frequent flyer miles?

```
SELECT item_desc, count(item_key) no_of_times_redeemed
FROM flyer_miles_redemption_fact
NATURAL JOIN redemption_items_dim
GROUP BY (item_desc)
ORDER BY 2 DESC
```

The screenshot shows a SQL query editor with the following query:

```
1 SELECT item_desc, count(item_key) no_of_times_redeemed
2 FROM flyer_miles_redemption_fact
3 NATURAL JOIN redemption_items_dim
4 GROUP BY (item_desc)
5 ORDER BY 2 DESC
```

Below the query is a 'Data Grid' showing the results:

ITEM_DESC	NO_OF_TIMES_REDEEMED
Excess baggage	4
Upgrade farebase	2
Charity	2

5- Which flights receive the most complaints?

```
SELECT flight_id, flight_source, flight_destination, count(flight_key) no_of_complaints
FROM customer_care_fact
NATURAL JOIN flight_dim
NATURAL JOIN report_dim
WHERE report_type='complaints'
GROUP BY (flight_id, flight_source, flight_destination)
ORDER BY 4 DESC
```

SQL <No name>			
1	•	SELECT flight_id, flight_source, flight_destination, count(flight_key) no_of_complaints	
2		FROM customer_care_fact	
3		NATURAL JOIN flight_dim	
4		NATURAL JOIN report_dim	
5		WHERE report_type='complaints'	
6		GROUP BY (flight_id, flight_source, flight_destination)	
7		ORDER BY 4 DESC	
Data Grid			
<div> <div>Data Grid</div> <div>Auto Trace</div> <div>DBMS Output (disabled)</div> <div>Query Viewer</div> <div>CodeXpert</div> <div>Explain</div> </div> <div>Cancel</div>			
		FLIGHT_ID	FLIGHT_SOURCE
		FLIGHT_DESTINATION	NO_OF_COMPLAINTS
▶		1 Cairo	Los Angeles
		4 Sharm El Sheikh	Hurghada
		2 Alexandria,Borg Elarab	Bahrain
		3 cairo	Toronto

6- What is the profit per channel for gold& titanium members?

```
SELECT channel_type, membership_type, sum(revenue-cost) profit
FROM flight_activity_fact
NATURAL JOIN membership_dim
NATURAL JOIN channel_dim
WHERE membership_type IN ('gold', 'titanium')
GROUP BY (channel_type, membership_type)
ORDER BY 2, 3
```

SQL ▶		SELECT channel_type, membership_type, sum(revenue-cost) profit	
		FROM flight_activity_fact	
		NATURAL JOIN membership_dim	
		NATURAL JOIN channel_dim	
		WHERE membership_type IN ('gold', 'titanium')	
		GROUP BY (channel_type, membership_type)	
		ORDER BY 2, 3	
Data Grid			
<div> <div>Data Grid</div> <div>Auto Trace</div> <div>DBMS Output (disabled)</div> <div>Query Viewer</div> <div>Cc</div> </div> <div>Cancel</div>			
		CHANNEL_TYPE	MEMBERSHIP_TYPE
		PROFIT	
▶		Airline Application	gold
		Directly	gold
		Airline Application	titanium
		Airline WebSite	titanium