

## Lab 2 – Star Schema

### Overview

*TPC* is ready to implement its first data mart. In this lab, you will analyze the user requirements for this data mart, design it using dimensional modeling techniques, and implement the schema design in your database.

### After completing this lab exercise, you should be able to:

- ☐ Translate user information requirements into a design for a data mart.
- ☐ Identify the data needs and potential data sources for a data mart.
- ☐ Implement the design for a data mart in a database schema.

### To do this lab you will need the following:

- 1) Your copies of the *TPC* case study, business rules, and ERD.
- 2) Access to a computer running MySQL and MySQL Workbench.

### Deliverables

Submit the following to MyCourses as a single .zip file with the following name –  
*YourLastName\_Lab2\_201.zip*:

- 1) Answers to the questions in this specification in a separate document (MS Word or .pdf).
- 2) An ER diagram showing your Star Schema, developed in MySQL Workbench and pasted into a MS Word or .pdf document.
- 3) A screenshot of your tables from MySQL Workbench.
- 4) Your MySQL Workbench model *YourLastName\_201.mwb* file
- 5) A *YourLastName\_201.sql* file that contains the dumping your database

## Business Scenario

TPC management has identified financial control and analysis as their top current issue. After talking with the users in the TPC central office in Stratford who are involved with financial control, you find out the following:

- ☐ Although each of the three divisions is responsible for financial control (increasing sales and decreasing costs), the Financial Director in Stratford is primarily responsible for overall company performance.
- ☐ The three divisions will provide data to the data warehouse in different forms. You will have access to OLTP database for TPC-E. This will provide you with sales data for TPC-E. Since you have access to the developers, they can help you with the data in the OLTP system.
- ☐ TPC-W is similar in operation to TPC-E and TPC-W will provide a feed of data for you to use. The data will be similar to that which you have access to for TPC-E. An initial feed will be provided from TPC-W and a monthly feed will be provided with updates each month.
- ☐ The data from PEC will be different. There will be a customer and a product feed, but the cost will have to be calculated from manufacturing cost data that will be provided. Formulas for calculation will be provided later.
- ☐ Since sales can be made from TPC-E and TPC-W to PEC and from PEC to TPC-E and TPC-W, there will need to be allowances when sales and costs are calculated at the total company level. Sales from one unit to another, although considered as sales for the first unit, are not considered sales for the total company (You can't count sales to yourself). You will need to identify these customer records.
- ☐ There may be overlap in customers among the three company units.
- ☐ The company financial performance is measured on an annual, quarterly, monthly and weekly basis. Quarters are based on the normal annual quarters for comparison against other companies. (e.g. Quarter 1 is January, February and March ...). The company's fiscal year (financial reporting and tax year), however, goes from April 1 through March 31. The fiscal quarters conform to the fiscal year (e.g. Fiscal quarter 1 is April, May and June ...). As an example, fiscal 2011 will extend from April 1, 2011 through March 31, 2012.
- ☐ Invoice numbers are not unique across the three divisions, so it will be necessary to keep track of the division responsible for the sale.
- ☐ PEC sometimes requires special shipping for the products they manufacture. The options are "Train", "Truck", "Air", "N/A" (not available or applicable). Sales that have no special requirements are coded as 0 on the invoice. The other divisions do not provide this information.
- ☐ PEC also provides data on the sales feed about the ordering method. The options are "Internet", "phone", "email" or "mail". The values are stored as text. This information is not provided by the other divisions.
- ☐ Since PEC manufactures equipment, in addition to the sale date, there is also an order date. The time between order and sale can be used to measure the performance of the organization's manufacturing process. The other divisions do not provide this information since they normally ship from stock.
- ☐ Payment method is also provided by PEC on the sales feed. The three valid methods are "COD", "charge" or "cash". Again, this is stored as text. It is not provided by the other divisions.
- ☐ After the initial load feeds, there will be similar feeds for monthly updates.

The company would like a data mart that would allow them to investigate their financial performance at the gross profit (margin) level historically so as to more effectively manage

financial performance. They are interested in having a flexible system that will ultimately allow them to optimize sales (to maximize sales) while keeping costs down. In addition, they want to be able to better manage the relationships with their suppliers. Some of the initial queries and reports they would like are:

- ☐ A report that shows the sales, and costs associated with each customer or customer type on an annual, quarterly, monthly or weekly basis.
- ☐ A similar report showing top customers.
- ☐ A similar report as above at the product level / product type/ business unit.
- ☐ The average time in days needed to fulfill an order from PEC.
- ☐ The number of orders that are not shipped within 10 days of order from PEC.
- ☐ The average number of products and sales per invoice (keep in mind that invoice number is not unique across divisions).
- ☐ What are the average number / maximum number of different shipping methods on each invoice?
- ☐ The average cost of shipping for a particular product by different methods.
- ☐ The percentage of invoices that are COD.
- ☐ The most frequent method of ordering a product from PEC.
- ☐ What is the average number of products supplied by each supplier?
- ☐ Show the total cost of products for each supplier.
- ☐ Show sales from one division to another.
- ☐ Comparisons should be able to be done from year-to-year, quarter-to-quarter, month-to-month, same month or quarter compared to last year, ... . This should be able to be done on a calendar year basis or a fiscal year basis.
- ☐ Sales by type of customer, by state, by product type, by business unit.
- ☐ The sales by supplier state to customer state. This would be useful to see if suppliers should ship directly to customers.
- ☐ All reports should be able to report sales, costs and gross profit (sales minus costs).

## Part #1. Requirements Gathering – Fill Out an Information Package

NOTE: Record your answers to the questions below in a separate MS Word or .pdf document that will be submitted for grading.

### Step #1-1: Identify the Process

Remember the focus of a data mart is *one* key business process that is important to company success.

*Question:* Which business process will be the focus of this data mart development?

Financial control and analysis

*Define:* Write a statement that defines the scope – i.e. universe of discourse – of this data mart.

This data mart covers the performance measures that is relevant to optimizing sales and lowering the costs and also manage relationships with the suppliers. It also manages to keep a track of shipping cost with respect to time and cost.

*Question:* Assuming that the *TPC-E* ERD and other data sources cover various business activities and data systems within the company, what are the source data system(s) that are relevant to this development? Fill out **Table 1** with the details.

Table 1. Business Activities & Relevant ERD Tables

Business Activity	Relevant ERD Table(s) or other data source(s)
Sales	Customer, Product
Manufacturing	Shipping, product, payment method, cost
Operations	Sales, invoice data

## **Step #1-2: Choose the Grain**

*Question:* What grain options do you see in the scenario?

Time (Year, Quarter, Month, Day) – Calendar/Fiscal, Order date, Sales date, date

Address (Street, city, state, country, zip)

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*Question:* What level of detail do you propose for this data mart? Why?

The number of product sold per day, month, quarter or year. It would be easy to perform aggregations and summarizations based on time.

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## **Step #1-3: Identify the Dimensions**

*Question:* What business dimensions are relevant to the scenario?

Sale date, order date, date, Customer, Supplier, Product, Sales

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*Question:* Will you have any degenerate dimensions in your model? Explain.

Yes, degenerate dimensions such as Invoice number and order number.

These are not measures or metrics or facts and are neither facts nor dimensional attributes.

These values are just included in the fact table. They can be used to access information since they were a part of the primary key. It does not have the same grain level as the important process transactions.

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*Question:* Will you have any role-playing dimensions in your model? Explain.

Yes. Role playing dimensions: Sale Date and Order Date.  
These dates are used to measure performance of the organizations manufacturing process.  
These dimensions appear several times in the fact table

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*Question:* Will you have any junk dimensions in your model? Explain.

Yes, Junk dimensions are present in this model.  
Payment method, Shipping type, and ordering method.  
These attributes are not a part of any dimensional or fact table.

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### **Step #1-4: Identify the Facts**

*Question:* What are the key performance metrics needed by the users?

Total number of sales, total number of cost, maximum gross profit,  
Total number of orders processed w.r.t day, week, month, and year

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*Question:* What type of fact table schema will this be? (Refer to the Week #4 lecture discussion of schema types.) Explain your reasoning.

The fact table schema could be Periodic snapshot.  
We can get information of the orders processed based on day, month, quarter and year.  
A quick status of the performance measurements can be obtained

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Fill in **Table 2** with the information about the facts that are relevant to this process. Include in your description the reason *why* a given fact is included (i.e. for what will it be used?).

Table 2. Data Mart Fact Group Details

Fact Group: <u>Financial sales</u>		
Fact Name	Fact Description	Default Aggregation Rule
Total sales	Total amount of sales for the product sold	Sum
Total cost	Total cost price for the product	Sum
Gross profit	The profit earned after the product was sold from the original cost value.	Sum
Number of days	Number of days to complete the order	Sum

### Step #1-5: Complete the Process Information Package

Fill in the Information Package chart in **Appendix A** for this process.

**Question:** Did you identify any hierarchies within the dimensions? If so, list them here.

Yes, hierarchies are present in this dimension.

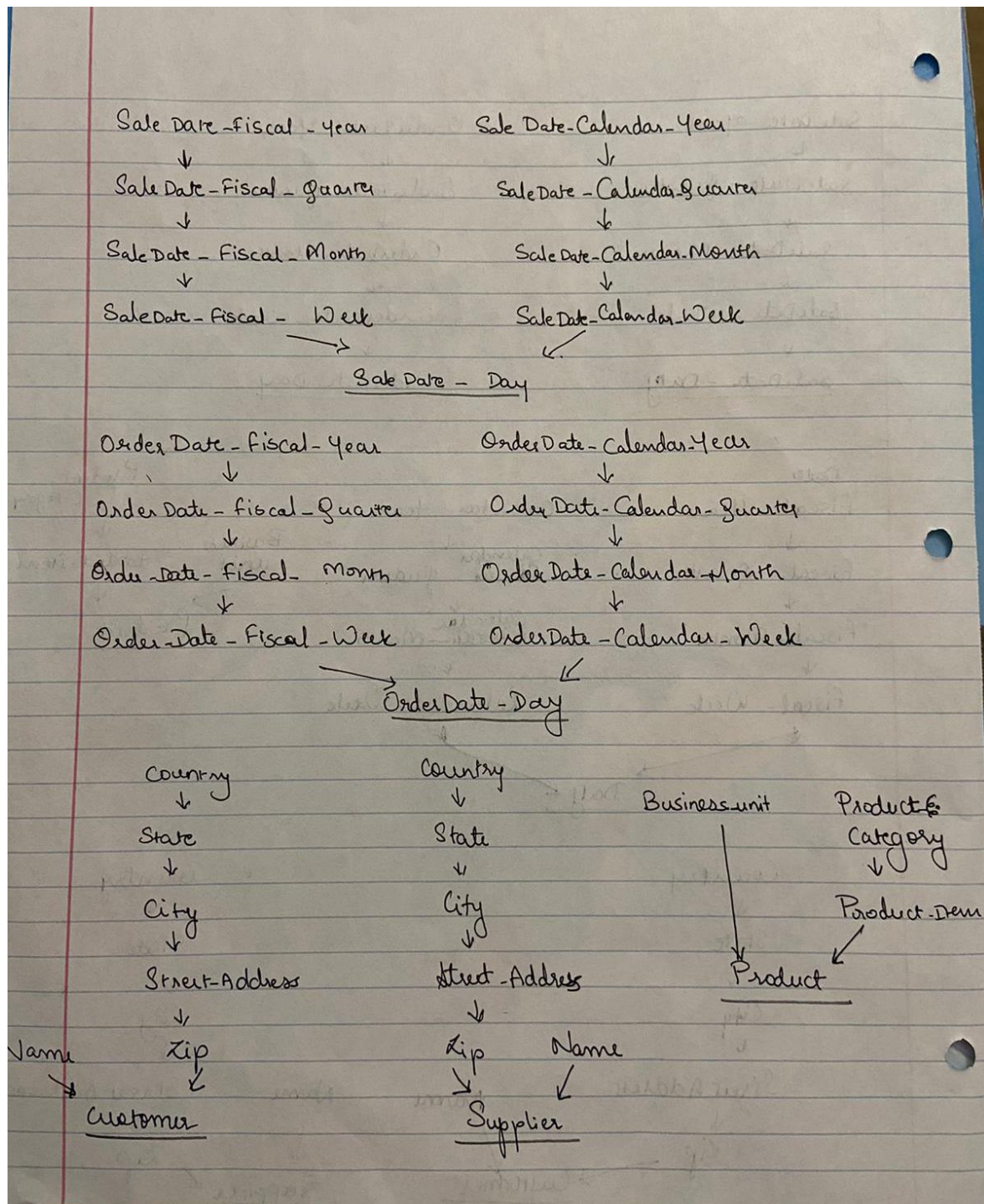
Sale Date -> Year, Quarter, Month Week, Day(Both in fiscal and calendar)

Order Date -> Year, Quarter, Month Week, Day(Both in fiscal and calendar)

Customer Address-> Country, State, City, Street, zip

Supplier Address-> Country, State, City, Street, zip

Draw a dimensional table detail diagram (refer to Week #4/5 Practice Exercise #3) for your dimension(s). Put the attribute for the lowest grain level at the bottom. Surround it with the other time items (attributes) and show relationships with arrows. Clearly delineate any hierarchies.





## Part #2. Dimensional Modeling

### Step #2-1: Design Your STAR Schema

Using the information that you have gathered, design a STAR schema for this process. Use MySQL Workbench to formally draw your model. Define tables, attributes, attribute data types, and relationships (with cardinality and participation). Save (paste) your STAR schema in an MS Word or .pdf document and save it to the MyCourse dropbox.

### Step #2-2: Implement the STAR Schema

Create a MySQL database called YourLastName\_FinancialDM that will contain your data mart. This will be similar to what you did in Lab #1 using MySQL Workbench.

Implement your STAR schema in your YourLastName\_FinancialDM data mart. You should save your SQL generated from MySQL Workbench.

You may define your constraints (PK, FK, etc.) and indexes in your model now but you can wait to implement them in your database until after you've loaded the data.

Question: Why would you want to wait?

Constraints are needed to limit the type of data that is being loaded in the database. It prevents data being duplicated across tables thereby ensuring accuracy and reliability in the tables. The action is aborted in case if there is violation of any constraint and the action of the data.

Fill in **Table 3** for the tables that you defined.

Table 3: Data Mart Tables

Table Name	Fact or Dimension?
Customer	Dimension
Sales Date	Dimension
Order Date	Dimension
Financial Sales	Fact
Product	Dimension
Supplier	Dimension
Sales Method	Dimension

## Appendix A: Information Package

Process Name: TPC - Financial control sales and analysis

Sale Date	Order Date	Customer	Product	Supplier	Sales method (Junk dimension)
Sale_Date_Fiscal_Year	Order_Date_Fiscal_Year	Customer_Name	Business_Unit	Supplier_Name	Payment_Method
Sale_Date_Fiscal_Quarter	Order_Date_Fiscal_Quarter	Customer_Country	Product_Category	Supplier_Country	Order_Method
Sale_Date_Fiscal_Month	Order_Date_Fiscal_Month	Customer_State	Product_Item	Supplier_State	Shipping_Type
Sale_Date_Fiscal_Week	Order_Date_Fiscal_Week	Customer_City		Supplier_City	
Sale_Date_Fiscal_Day	Order_Date_Fiscal_Day	Customer_Street-Address		Supplier_Street_Address	
Sale_Date_Calendar_Year	Order_Date_Calendar_Year	Customer_Zip		Supplier_Zip	
Sale_Date_Calendar_Quarter	Order_Date_Calendar_Quarter				
Sale_Date_Calendar_Month	Order_Date_Calendar_Month				
Sale_Date_Calendar_Week	Order_Date_Calendar_Week				
Sale_Date_Calendar_Day	Order_Date_Calendar_Day				

**Measured facts:** Total sales, total cost, gross profit, total days

Part/Step	Q#	Max Pts.	Pts. Earned	Comments
1-1	1	5		
	2	5		
	Table 1	10		
1-2	1	5		
	2	5		
1-3	1	5		
	2	5		
	3	5		
	4	5		
1-4	1	5		
	2	5		
	Table 2	10		
1-5	1	5		
	2	5		
2-1	1	15		
	2	5		
	3	5		
2-2	1	15		
	2	10		
	3	5		
	Table 3	5		
Appendix	Info Package	10		
	<b>Total</b>	150		