

Database Systems Assessment 1: Group Presentation

CASE STUDY: LINCOLN COMPUTER SURGERY (LCS)

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NOTE, WILL HICKS HAS NOT PARTICIPATED AND SO RECEIVES 0%.

Functional Requirements

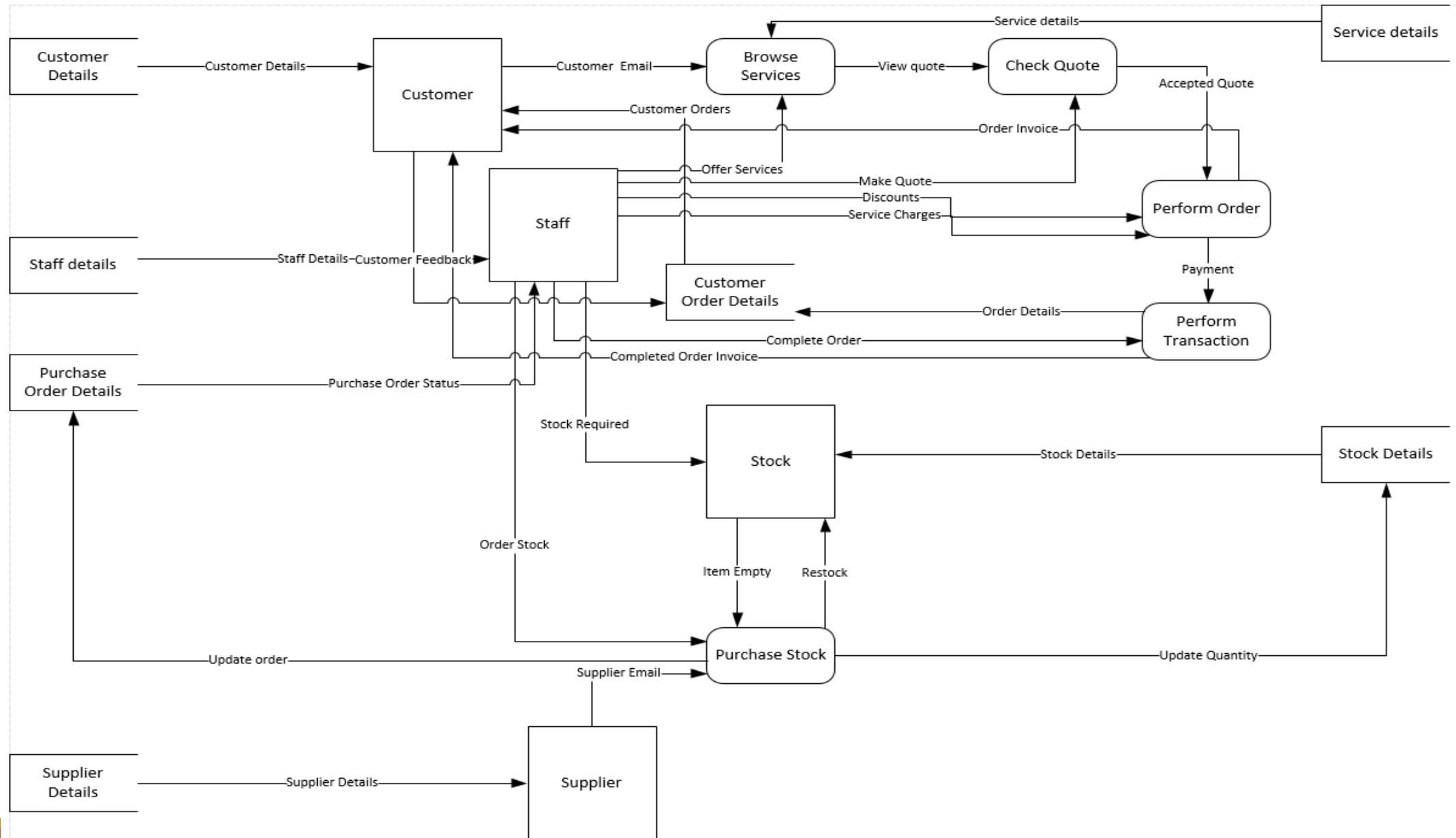
Functional Requirements are User defined operations/transactions, retrievals and updates

- Store Customer information such as their Name, Address, Telephone Number, and Email Address
- Allow customers to place orders for various services
- Keep a record of Customer Orders which can then be used to produce Quotes and Invoices
- Store information about the offered services such as the name, and price, etc.
- Store information about the company's Staff such as their names and telephone numbers, etc.
- Keep a record of Purchase Orders sent to Third-Party suppliers with information such as the item names, quantity of each item, price, etc.
- Keep a record of the company's stock with information such as item names and quantity
- Store information about third-party suppliers such as names, emails, etc.

Data Requirements

- Customer: Name, Address, Email, Telephone, Feedback
- Customer Order: Order Date, Order Time, Delivery Address, Order Status, Total Price, Service Name(s), Quantity of each Service, Price by Service, Discount, Additional Charge, Location
- Service: Service Name, Service Description, Price
- Staff: Name, Address, Email, Telephone
- Stock: Item Name, Item Description, Quantity of each Item
- Purchase Order: Order Date, Order Time, Supplier Name, Item Name(s), Quantity of each Item, Total Price, Price per Item, Order Status, Date order received, Date payment sent
- Supplier: Name, Address, Email, Telephone

Data flow diagram



Identifying the Nouns

The company sell services such as upgrading, hardware fault repairs, software errors, networking, internet, training, backup, antivirus, maintenance, etc. It needs to keep track of their customers, services and staff in addition to their stock. Your database solution should offer the opportunity for customers to place order(s) for various services through their ordering system. The Customer Order consists of the customer's name, the staff name who is dealing with the order, the order date and time, the delivery address, the order status (e.g. pending, confirmed, dispatched, paid), and the total price. The Customer Order also contains further detail that is required: the service name(s), the quantity of each service (if applicable), price by service, discount and total price by service. The requested services could be undertaken at the company labs or at the customer location, with the latter having an additional charge. The staff should check the customer order and provide a quote; if the customer accepted the quote then an invoice should be issued with the date and time of completing the customer order. The pricing should consider the location where the requested services will be undertaken, and any discount. After the customer has completely paid the invoice, the Customer Order is then sent to the technical department. The technical department complete the order and send it to the customer, along with a copy of the paid invoice. This is shortly followed by a timely request for customer feedback. The company has a stock of items they can use when undertaking their services. When items for stock are required a Purchase Order is raised from a third-party supplier, which consists of the supplier's name, the supplier's address, the description of the stock items required, the quantity of each stock item required, the order date, the order status (e.g. pending, sent, received, paid), the total cost, the date the order was received, and the date the payment was sent. The Purchase Order is then sent to a Supplier who then sends the stock items to LCS. To be able to process Customer Orders and Purchase Orders, the LCS ordering system also needs to store information (e.g. email, address, names, age, telephone number(s) etc.) about Customers, Suppliers and their Staff.

Listing the Nouns

| | | | | | | |
|------------------------|---------------------------------|---|------------------------|-----------------------------|------------------------|---------------------------|
| Company | Stock | Service Name(s) | Invoice | Items for stock | Supplier | Address (Staff) |
| Services | Orders | Quantity (of each service) | Date (of order) | Purchase Order | <i>Stock Items</i> | Address (Customer) |
| Upgrading | <i>Services</i> | Price (by service) | Time (of order) | Third-Party Supplier | LCS | <i>Address (Supplier)</i> |
| Hardware Fault Repairs | Ordering System | Discount | Pricing | Supplier's Name | <i>Customer Orders</i> | Name (Staff) |
| Software Errors | Customer Order | Total Price (by service) | Location (of services) | Supplier's Address | <i>Purchase Orders</i> | <i>Name (Customer)</i> |
| Networking | Customer's Name | Requested Services | Technical Department | Description of items | <i>Supplier</i> | <i>Name (Supplier)</i> |
| Internet | Staff name (dealing with order) | Company Labs | <i>Order</i> | Quantity (of item) | <i>Stock Items</i> | |
| Training | Order Date | Customer Location | <i>Customer</i> | Order Date (stock) | <i>LCS</i> | Age (Staff) |
| Backup | Order Time | Additional Charge (for customer location) | Copy of paid invoice | Order Status (stock) | LCS Ordering System | Age (Customer) |
| Antivirus | Delivery Address | <i>Staff</i> | Request for feedback | Total Cost (stock) | Information | Age (Supplier) |
| Maintenance | Order Status | <i>Customer Order</i> | Customer Feedback | Date order received (stock) | Email (Staff) | Telephone (Staff) |
| Customers | Total Price | Quote | <i>Company</i> | Date payment sent (stock) | Email (Customer) | Telephone (Customer) |
| <i>Services</i> | <i>Customer Order</i> | <i>Customer</i> | Stock of items | | Email (Supplier) | |
| Staff | Detail | <i>Quote</i> | <i>Services</i> | <i>Purchase Order</i> | | Telephone (Supplier) |

Removing Repeated Nouns

| | | | | | | |
|------------------------|---------------------------------|---|------------------------|-----------------------------|---------------------|----------------------|
| Company | Staff | Detail | Invoice | Third-Party Supplier | Supplier | Address (Staff) |
| Services | Stock | Service Name(s) | Date (of order) | Supplier's Name | Stock Items | Address (Customer) |
| Upgrading | Orders | Quantity (of each service) | Time (of order) | Supplier's Address | LCS | Name (Staff) |
| Hardware Fault Repairs | Ordering System | Price (by service) | Pricing | Description of items | LCS Ordering System | Age (Staff) |
| Software Errors | Customer Order | Discount | Location (of services) | Quantity (of item) | Information | Age (Customer) |
| Networking | Customer's Name | Total Price (by service) | Technical Department | Order Date (stock) | Email (Staff) | Age (Supplier) |
| Internet | Staff name (dealing with order) | Requested Services | Copy of paid invoice | Order Status (stock) | Email (Customer) | Telephone (Staff) |
| Training | Order Date | Company Labs | Request for feedback | Total Cost (stock) | Email (Supplier) | Telephone (Customer) |
| Backup | Order Time | Customer Location | Customer Feedback | Date order received (stock) | | Telephone (Supplier) |
| Antivirus | Delivery Address | Additional Charge (for customer location) | Stock of items | Date payment sent (stock) | | |
| Maintenance | Order Status | | Items for stock | | | |
| Customers | Total Price | Quote | Purchase Order | | | |

Making Assumptions

Order can mean the same as both the Customer Order and Purchase Order, but the Customer Orders and Purchase Orders are different

'Price' 'Price by Service' and 'Pricing' all mean the same thing, but the 'Total Price' is different as this is affected by discounts, quantity and additional charges

'Stock' and 'Stock of Items' are the same thing, but these differ from 'Stock Items' which means the same as 'Items'

The details/status of orders are not necessarily the same thing, because some will refer to Customer Orders and some will refer to Purchase Orders

'Third-Party Supplier' and 'Supplier' mean the same thing

'LCS' is the same as 'Company' because it is the name of the company

Personal details such as emails, addresses etc. may be repeated several times because they are required for customers, suppliers, and staff

Technical Department does not need to be considered because we do not know of any other departments, so this is basically another word for the Company Location, we are using the entity "Staff" instead.

Invoice and quote do not need to be considered as entities as they are a physical implementation of the orders and don't need to be stored as separate entities/attributes in the database.

Nouns after considering assumptions

| | | | | | |
|------------------------|---------------------------------|---|------------------------|-----------------------------|----------------------|
| Company | Staff | Detail | Date (of order) | Supplier's Name | Information |
| Services | Stock | Service Name(s) | Time (of order) | Supplier's Address | Email (Staff) |
| Upgrading | Ordering System | Quantity (of each service) | Location (of services) | Description of items | Email (Customer) |
| Hardware Fault Repairs | Customer Order | Price (by service) | Copy of paid invoice | Quantity (of item) | Email (Supplier) |
| Software Errors | Customer's Name | Discount | Request for feedback | Order Date (stock) | Address (Staff) |
| Networking | Staff name (dealing with order) | Total Price (by service) | Customer Feedback | Order Status (stock) | Address (Customer) |
| Internet | | Requested Services | Items for stock | Total Cost (stock) | Name (Staff) |
| Training | Order Date | Company Labs | Purchase Order | Date order received (stock) | Age (Staff) |
| Backup | Order Time | Customer Location | Third-Party Supplier | Date payment sent (stock) | Age (Customer) |
| Antivirus | Delivery Address | Additional Charge (for customer location) | | | Age (Supplier) |
| Maintenance | Order Status | | | | Telephone (Staff) |
| Customers | Total Price | | | LCS Ordering System | Telephone (Customer) |
| | | | | | Telephone (Supplier) |

Choosing Nouns that are Candidates for Entities (and sorting between strong & weak)

- **Services** is a strong entity because it is the key focus of the company and it will have many important attributes such as service names which will need to be stored in a table
- **Customers** are a strong entity because their existence is independent of the company and attributes such as customer names will need to be recorded
- **Staff** is a strong entity because a company will need staff regardless of what it's doing. Important attributes such as the names of the staff are necessary information to be stored in the database
- **Stock** is a strong entity because most of its information/attributes is unique to it and therefore does not heavily rely on the existence of information provided by other entities.
- **Supplier** is a strong entity because they are an independent company which would exist regardless of the LCS. Information about the supplier will need to be stored such as their email address.
- **Customer Order** is an entity because it will have many unique attributes that need to be stored such as the date of the order, however it is a weak entity because it depends on the existence of the services in order to place an order for them.
- **Purchase Order** is also a weak entity for the same reason as above, however it differs from the customer order because it relates to the company placing orders for items from suppliers rather than customers ordering the company's services, so these two order types must be stored separately.

A strong entity can exist by itself, so its existence does not rely on another entity. Order and Quote are weak entities because they rely on other entities to exist e.g. service, price etc.

Choosing Nouns that can be Attributes

| | | | |
|------------------------------|---|-----------------------------|----------------------|
| Order Date(customer) | Total Price (by service) | Description of items | Address (Staff) |
| Order Time(customer) | Additional Charge (for customer location) | Quantity (of item) | Address (Customer) |
| Delivery Address | Location (of services) | Order Date (stock) | Address (Supplier) |
| Order Status(purchase order) | Customer Feedback | Order Status (stock) | Name (Customer) |
| Total Price | Items | Date order received (stock) | Name (Staff) |
| Service Name(s) | | Date payment sent (stock) | Name (Supplier) |
| Quantity (of each service) | | Email (Staff) | Telephone (Staff) |
| Price (by service) | | Email (Customer) | Telephone (Customer) |
| Discount | | Email (Supplier) | Telephone (Supplier) |

Identifying the Verbs

The company sell services such as upgrading, hardware fault repairs, software errors, networking, internet, training, backup, antivirus, maintenance, etc. It needs to keep track of their customers, services and staff in addition to their stock. Your database solution should offer the opportunity for customers to place order(s) for various services through their ordering system. The Customer Order consists of the customer's name, the staff name who is dealing with the order, the order date and time, the delivery address, the order status (e.g. pending, confirmed, dispatched, paid), and the total price. The Customer Order also contains further detail that is required: the service name(s), the quantity of each service (if applicable), price by service, discount and total price by service. The requested services could be undertaken at the company labs or at the customer location, with the latter having an additional charge. The staff should check the customer order and provide a quote; if the customer accepted the quote then an invoice should be issued with the date and time of completing the customer order. The pricing should consider the location where the requested services will be undertaken, and any discount. After the customer has completely paid the invoice, the Customer Order is then sent to the technical department. The technical department complete the order and send it to the customer, along with a copy of the paid invoice. This is shortly followed by a timely request for customer feedback. The company has a stock of items they can use when undertaking their services. When items for stock are required a Purchase Order is raised from a third party supplier, which consists of the supplier's name, the supplier's address, the description of the stock items required, the quantity of each stock item required, the order date, the order status (e.g. pending, sent, received, paid), the total cost, the date the order was received, and the date the payment was sent. The Purchase Order is then sent to a Supplier who then sends the stock items to LCS. To be able to process Customer Orders and Purchase Orders, the LCS ordering system also needs to store information (e.g. email, address, names, age telephone number(s) etc.) about Customers, Suppliers and their Staff.

List of verbs

Sell

Needs

Keep Track

Offer

Place

Order

Consists

Dealing with

Contains

Required

Requested

Undertaken

Having

Check

Provide

Consider

Accepted

Issued

Complete

Send

Copy

Followed by

Request

Has

Use

Undertaking

Raised

Sent

Process

Store

| Noun | Verb | Noun |
|----------------------|------------------------------|---|
| Company | Sells | Services |
| Company | Needs to Keep Track of | Customers, Services, Staff, Stock |
| Customers | Place | Orders |
| Customer Order | Consists of/Contains | Customer’s Name, Staff Name, Order Date, Order Time, Delivery Address, Order Status, Total Price. Service Names, Quantity of each Service, Price by Service, Discount, Total Price by Service |
| Staff | Dealing with | Order |
| Services | Undertaken | Company Labs, Customer Location |
| Customer Location | Has | Additional Charge |
| Staff | Check | Customer Order |
| Staff | Provide | Quote |
| Pricing | Should Consider | Location where Service will be Undertaken |
| Customer | Accepts | Quote |
| Invoice | Issued | |
| Customer | Paid | Invoice |
| Customer Order | Sent to | Technical Department |
| Technical Department | Complete | Order |
| Technical Department | Send Order & Invoice to | Customer |
| | Followed by | Request for Customer Feedback |
| Company | Has | Stock of Items |
| Company | Uses (to Undertake Services) | Items |
| Purchase Order | Raised from/Sent to | Third-Party Supplier |
| Purchase Order | Consists of | Supplier’s Name, Supplier’s Address, Description of Items, Quantity, Order Date, Order Status, Total Cost, Date Order Received, Date Payment Sent |
| Supplier | Sends to Company (LCS) | Items |
| LCS Ordering System | Processes | Customer Orders & Purchase Orders |
| LCS Ordering System | Needs to Store | Email, Address, Name, Age, Telephone Numbers |

Preliminary design of Entities and Attributes

- KEY: Primary Key, Simple, {Composite}, [derived] *Multi-value*
- Customers (Email, Name {f_name, s_name}, Address, Telephone)
- Staff (Email, Name {f_name, s_name}, Address, Telephone)
- Supplier (Name, Email, Address, Telephone)
- Services (Name, Price, Item_Required, Description)
- Stock (Name, Price, Quantity, Description)
- Customer Order (Customer_Name, Order Date, Delivery_Address, *Location*, Service_Name, Quantity, [Total_Price], Additional_Charge, Feedback, Discount, *Status*)
- Purchase Order (Supplier_Name, Order_Date, Item_Name, Quantity, [Total_Price], *Status*, Date_Received, Date_Paid)

Preliminary Design of relationship types(M:N)

- Many staff can handle different customer orders
- Staff-Customer order(M:N)
- All customer details participate in this relationship
- All staff participate in this relationship

Preliminary Design of relationship types(1:1)

- A service requires stock
- Services-Stock (1:1)
- All services participate in this relationship
- some stock order participate in this relationship

Preliminary Design of relationship types(1:M)

- The supplier will handle different purchase orders

- Supplier-Purchase order (1:M)

- All supplier participate in this relationship
- All purchase order participate in this relationship

- A Customer can buy many things for their order

- Customer-Customer Order (1:M)

- All customer details participate in this relationship
- All customer order participate in this relationship

- Purchase order provides the LCS with certain stock

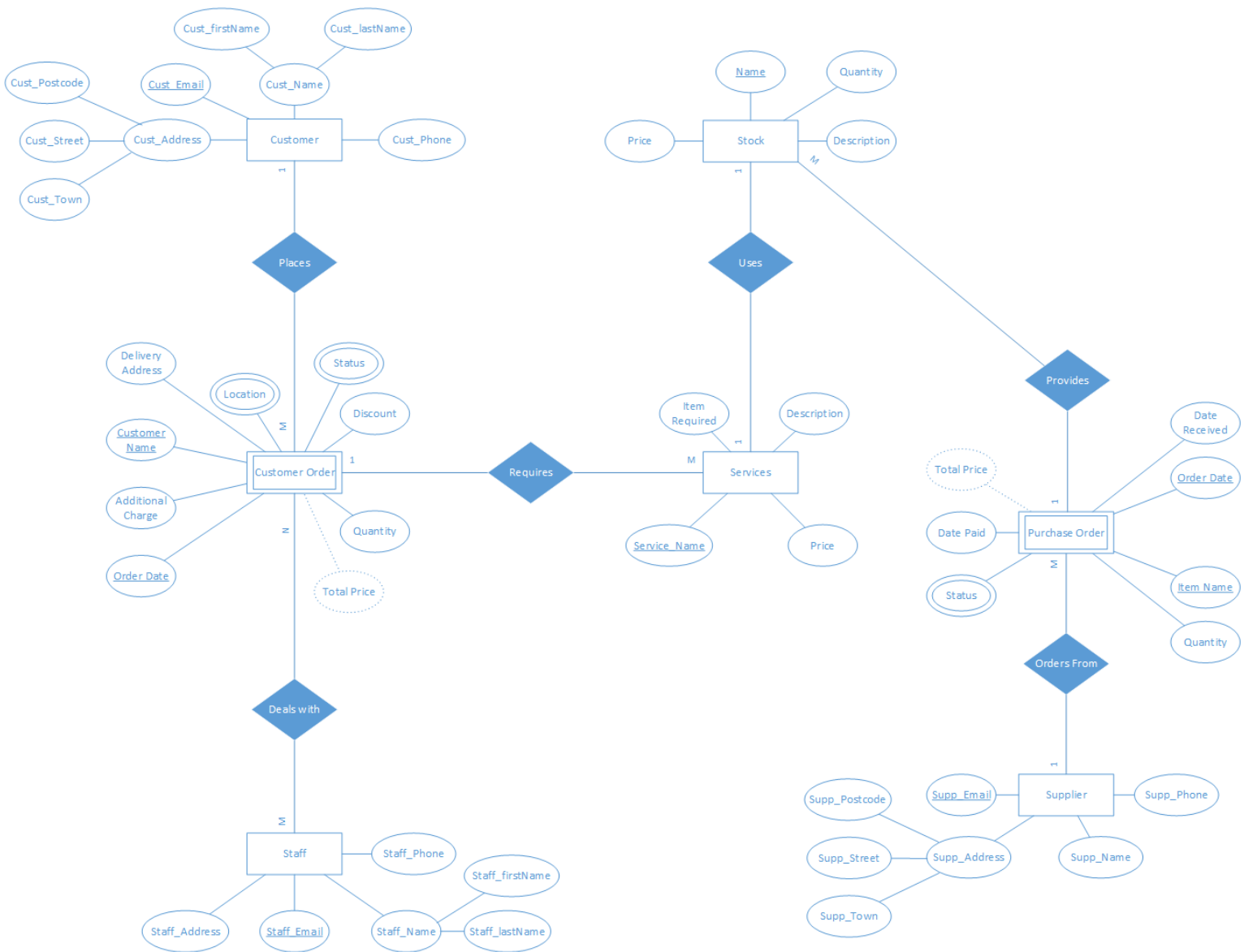
- Purchase order-Stock(1:M)

- All stock participate in this relationship
- Some purchase order participate in this relationship

A customer order can require different services

• - Customer order-Services(1:M)

- - All customer details participate in this relationship
- - All services participate in this relationship



Complete ER Diagram

Mapping ER Model - First Step

- Regular entity types

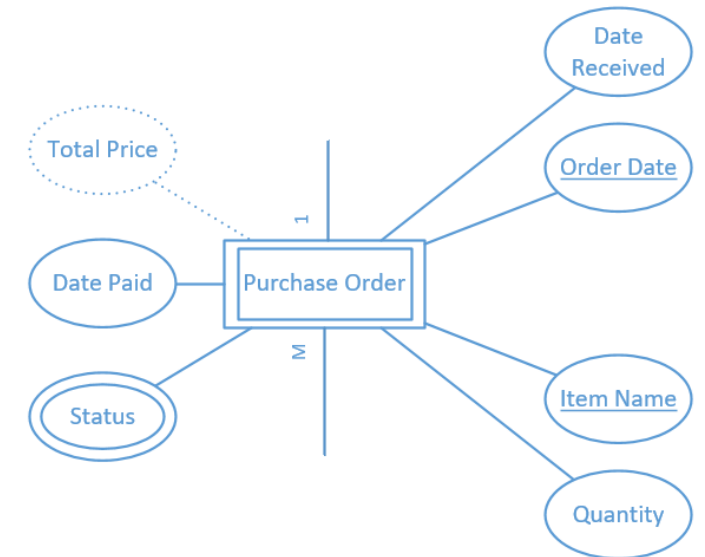
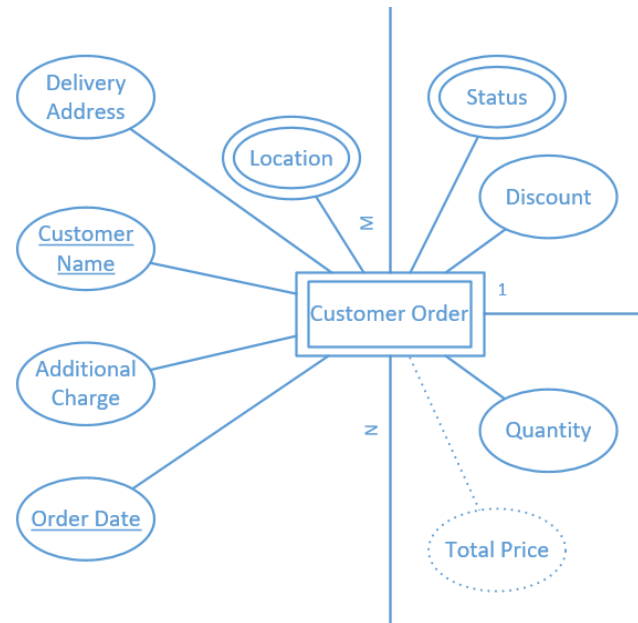
- Customers (Email-Address, Telephone)
- Supplier (Name, Email, Address, Telephone)
- Services (Name, Price, Item_Required, Description)
- Stock (Name, Price, Quantity, Description)

Mapping ER Model - Second Step

Mapping weak entity types

Customer order

Purchase order

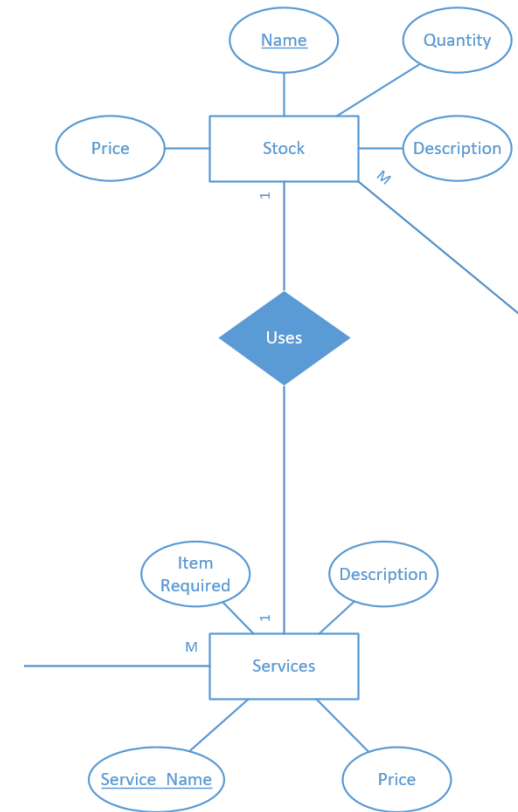


Mapping ER Model - Third Step

Mapping 1:1 relationship types

-Services-Stock (1:1)

- Services (item required, description, name, price, stock-name)



Mapping ER Model - Fourth Step

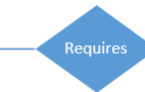
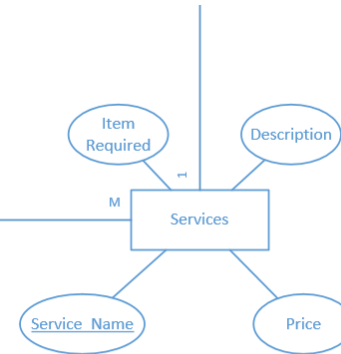
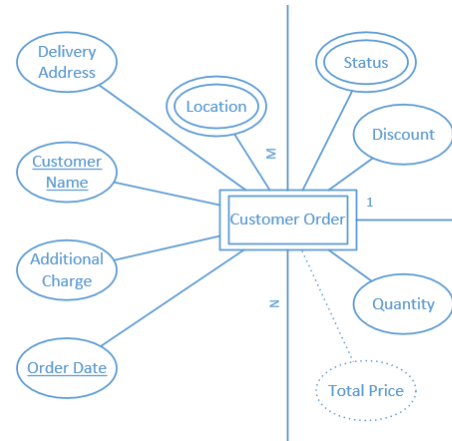
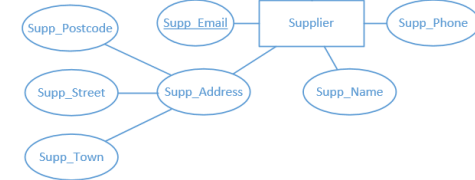
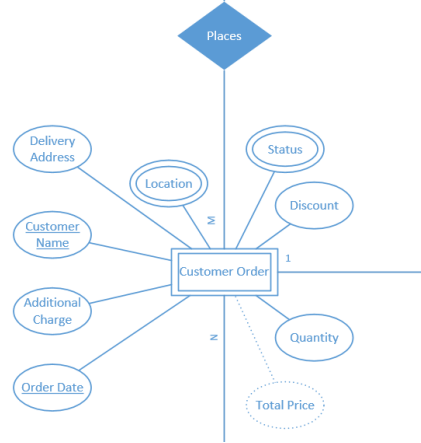
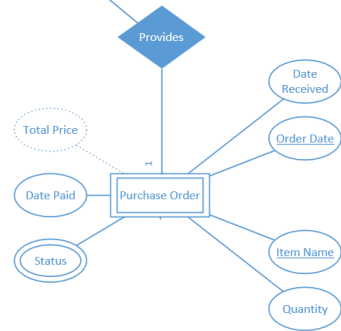
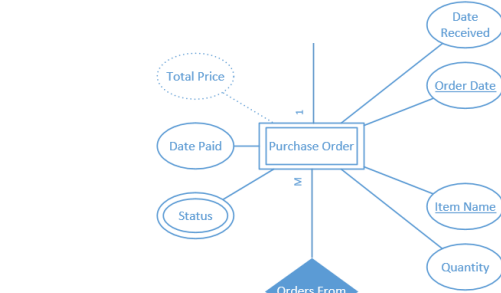
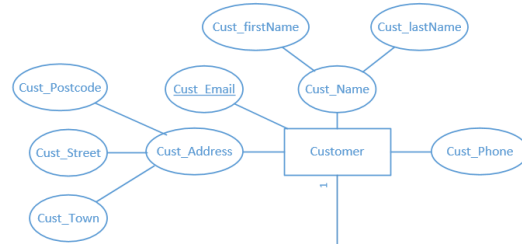
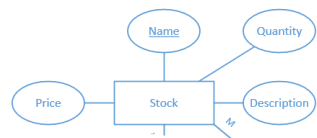
Mapping 1:M relationship types

- Purchase order-Stock(1:M)
 - Stock(description, name, price, quantity, PO- item name)

- Customer-Customer Order (1:M)
 - Customer order (Name, Quantity, delivery address, additional charge, order date, discount, C-name)

- Supplier-Purchase order (1:M)
 - Purchase order(item name, date paid, quantity, date received, Supp-Email)

- Customer order-Services (1:M)
 - Services (Service_name, item required, price, description, CO_CustomerName)

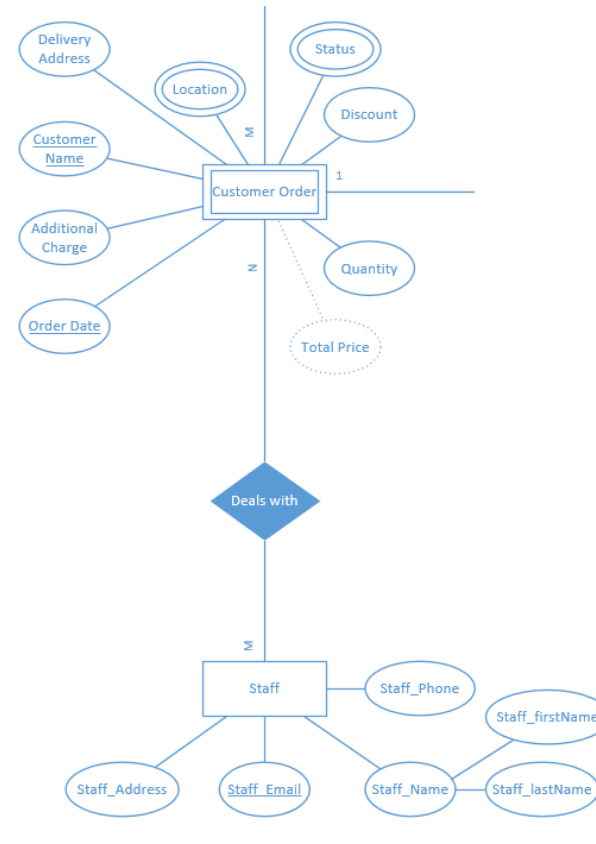


Mapping ER Model – Fifth Step

Mapping M:N relationship types

- Staff-Customer order(M:N)

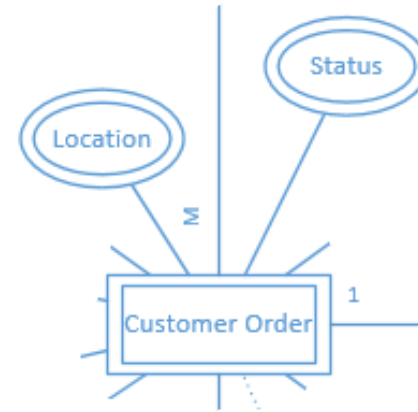
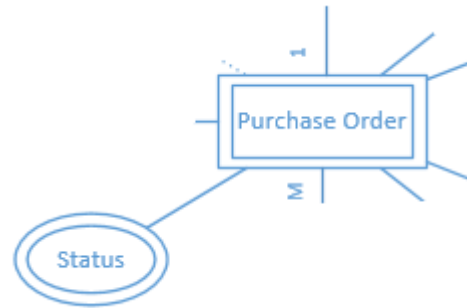
Deals with(Staff-email, Customer-name)



Mapping ER Model - Sixth Step

Mapping multi-valued attributes

- Customer order (Location, status)
- Purchase order (Status)



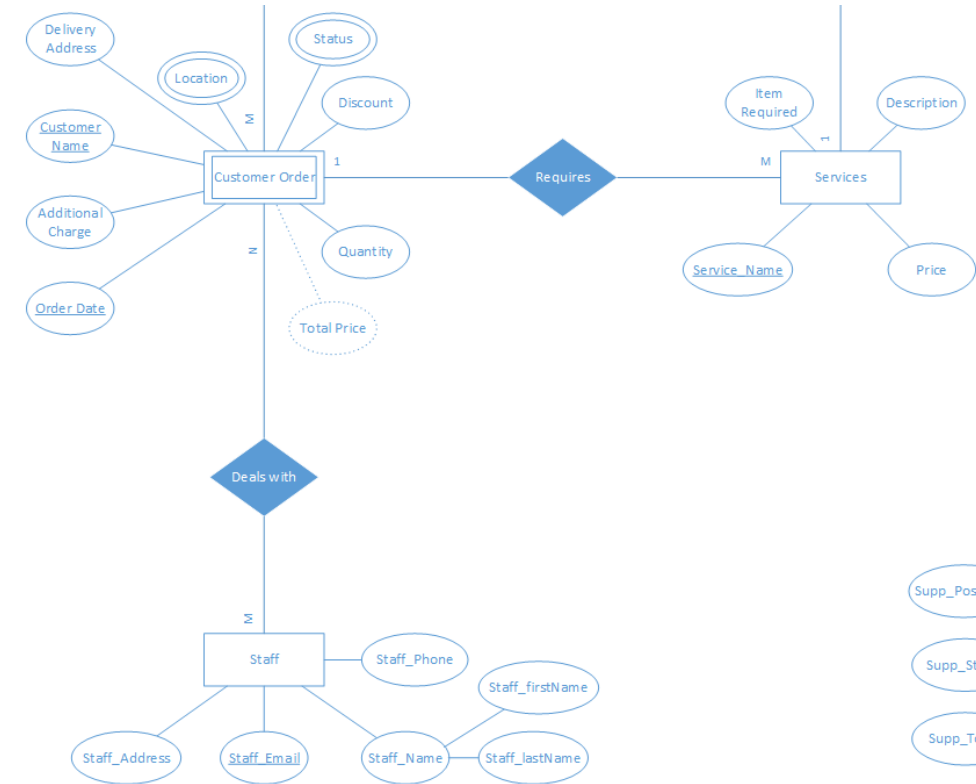
Mapping ER Model - Seventh Step

N-ary relationship type

M:N --> Staff-Customer order - Services

Deals with (Staff-email, customer-name, Service-name)

In an n - ary relationship, the n shows the number of entities in the relationship



Questions

Based on the following assumption you need to answer a set of questions and address the following section of this assignment (Normalisation).

Assume that one of your relation is Item-Detail: {Order-Date/time, Staff-Name (Staff-Firstname, Staff-Lastname), Staff-Email, {Staff-Qualifications}, Customer-Name (Customer-Firstname, Customer-Lastname), Customer-Email, Customer-Address (House-No/Name, Post-Code, City, County, Country), Customer-Age, Service-Type, Item-Description, Service-Name, Service-Price, Discount, Quantity, Service-Total-Price, Order-Price}.

Please answer the following questions:

- I. Identify two candidate keys then choose a primary key
- II. Identify four functional dependencies in the Item-Detail relation

Candidate keys – {Order-Date/time, Service-Name}, {Customer-Email}

Justification: Both Order-Date/Time and Customer-Email are unique and is able to uniquely identify each tuple in the relation.

Primary Key – {Order-Date/time, Service-Name} – Reason: Number of attributes is small.

functional dependencies –

FD 1- {Service-Name} → (Service-Type, Item-Description, Service-Price)

FD 2- {Staff-Email} → (Staff-Firstname, Staff-Lastname, staff qualifications)

FD 3- {Customer-Email} → (Customer-Firstname, Customer-Lastname , customer-Age, House-no/Name, Postcode, City, County, Country)

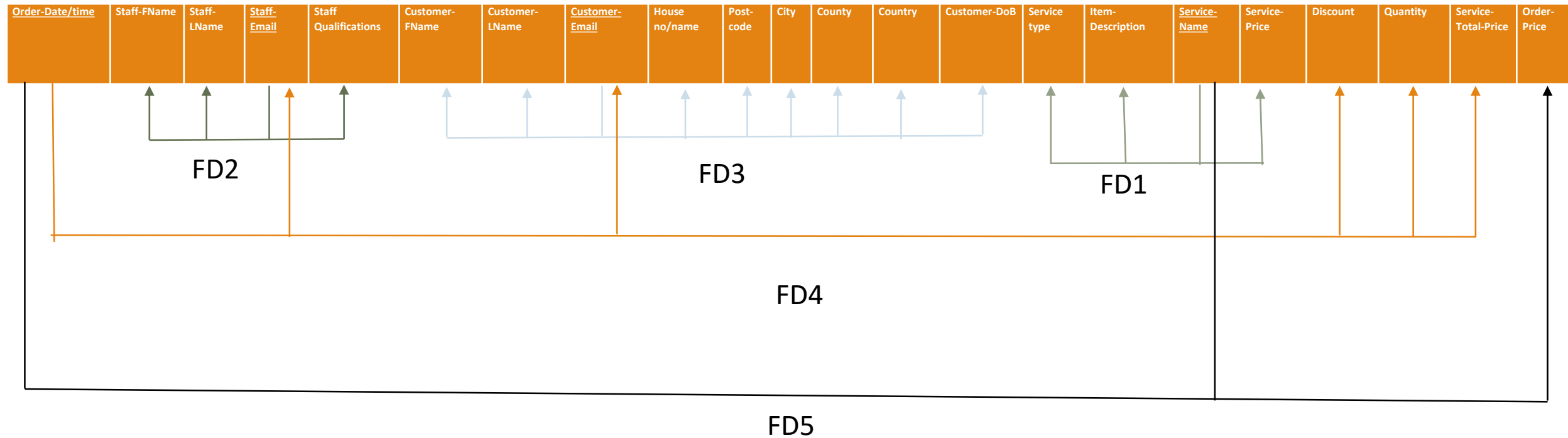
FD 4-{Service-Name, Order-Date/Time} → (Service-Name, Quantity , Service-Price, Service-Total-Price,)

FD 5- {Order-Date/Time} → (Order-Price)

FD 6 – {Customer-Email, Order-Date/Time ,Staff-Email, Service-Name} → (Quantity, Discount, Customer-Firstname, Staff-Firstname, Service-Total-Price)

Normalisation of Item-detail

First Normal Form: Primary key{Order-Date/time, Service-Name}



| <u>Order-Date/time</u> | Staff-FName | Staff-LName | <u>Staff-Email</u> | Staff Qualifications | Customer-FName | Customer-LName | <u>Customer-Email</u> | House no/name | Post-code | City | County | Country | Customer-DoB | Service type | Item-Description | <u>Service-Name</u> | Service-Price | Discount | Quantity | Service-Total-Price | Order-Price |
|------------------------|-------------|-------------|--------------------|----------------------|----------------|----------------|-----------------------|---------------|-----------|------|--------|---------|--------------|--------------|------------------|---------------------|---------------|----------|----------|---------------------|-------------|
|------------------------|-------------|-------------|--------------------|----------------------|----------------|----------------|-----------------------|---------------|-----------|------|--------|---------|--------------|--------------|------------------|---------------------|---------------|----------|----------|---------------------|-------------|

Normalisation of Item-detail

Second Normal Form and Third Normal Form
 Primary key{Order-Date/time, Service-Name}

| <u>Order-Date/Time</u> | {Customer-Email} | {Service-Name} | {Staff-Email} | Quantity | Discount | Total |
|------------------------|------------------|----------------|---------------|----------|----------|-------|
|------------------------|------------------|----------------|---------------|----------|----------|-------|

| <u>Customer-Email</u> | Customer-FName | Customer-SName | House-No | Post-code | City | County | Country | Customer-DoB |
|-----------------------|----------------|----------------|----------|-----------|------|--------|---------|--------------|
|-----------------------|----------------|----------------|----------|-----------|------|--------|---------|--------------|

| <u>Service-Name</u> | Item-Description | Service-Price | Service-type | Item-description |
|---------------------|------------------|---------------|--------------|------------------|
|---------------------|------------------|---------------|--------------|------------------|

| <u>Staff-Email</u> | Staff-Fname | Staff-LName | Staff-qualifications |
|--------------------|-------------|-------------|----------------------|
|--------------------|-------------|-------------|----------------------|