

# Database Analysis and Design

Design and implementation of a database system for  
an event organizing company

Module: Introduction to Web and Database Concepts

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25 April 2023

# I. Introduction

This report aims to summarise the design and implementation of a database system for the fictitious Northern Lights private Ltd event organising company.

Creating a Database System requires careful examination of the user requirements and the structure of the company or other institution the system is being designed for.

After studying the description of the company, I identified the necessary entities and relationships required for the system as well as the type of users that will be using the ready product. In the following sections I will give a detailed explanation of the findings that helped me to build a logical design and implementation with the help of the learnt design techniques (1). Subsequently I show evidence of the working database system with interconnecting form and report outputs.

## II. Initial findings

After careful examination of the task description, I concluded the entity types for the data model. As the database system is built for an event management company, I decided Staff should be one of the entity types. The task description also mentioned that the company is expanding and opening two new branches. This indicated that Branch should also be an entity type, with a location attribute that will be characteristic for the branch. The branches have a branch manager and multiple departments. Each department has a head that leads a team of staff. The branch manager also supervises all staff that works in the same branch with them. This information suggests that although a branch manager and department heads are also employees, their role differ from a regular employee. However, they still share several attributes with a regular employee, for instance personal information (name, date of birth, address, email, etc.). The focus of the company is customer service and organizing events. Thus, Event and Patron are also entities. The departments work with suppliers to obtain everything needed for organizing a successful event, therefore I decided Supplier should also be an entity. The staff order products, services from the suppliers, which then will be delivered by the suppliers. Therefore, Order and Product will be entities as well. The events take place at a venue that the company books in advance, there is a selection of them in a city, therefore Venue also will be an entity.

### II. A. Identifying user views

An important consideration for the database design is what type of users will have access to the data. For the Northern Lights company, I found three types of users with different access levels:

1. *Patron*: The customers have the lowest access level. They should have the ability to check ongoing and past events they ordered and view and edit their personal/contact information. They should also be able to book new events.

2. *Staff*: The staff has higher access level than the patrons. They should also be able to access ongoing and past events, orders, and their own personal information.
3. *Manager*: managers should hold the highest privilege level amongst the employees which would grant them access to employee information in their department/branch and to ongoing and past events. They can place orders and add new employees to database or remove current ones from it.

Identifying the views that will be required in the final product helps to determine the entities and relationships to setup the database. For instance, based on the different access levels that are required, I decided to create a Job Type entity type that will indicate the privileges a certain staff member holds instead of creating a Manager and Department Head specialization of the Staff entity. I decided this way in order to keep the access levels in one table and reduce repeating information in records.

## II. B. Entity-Relationship Diagram (ERD)

Built on the previously detailed requirements, the final ERD that shows the database components was produced and is depicted in Figure 1.

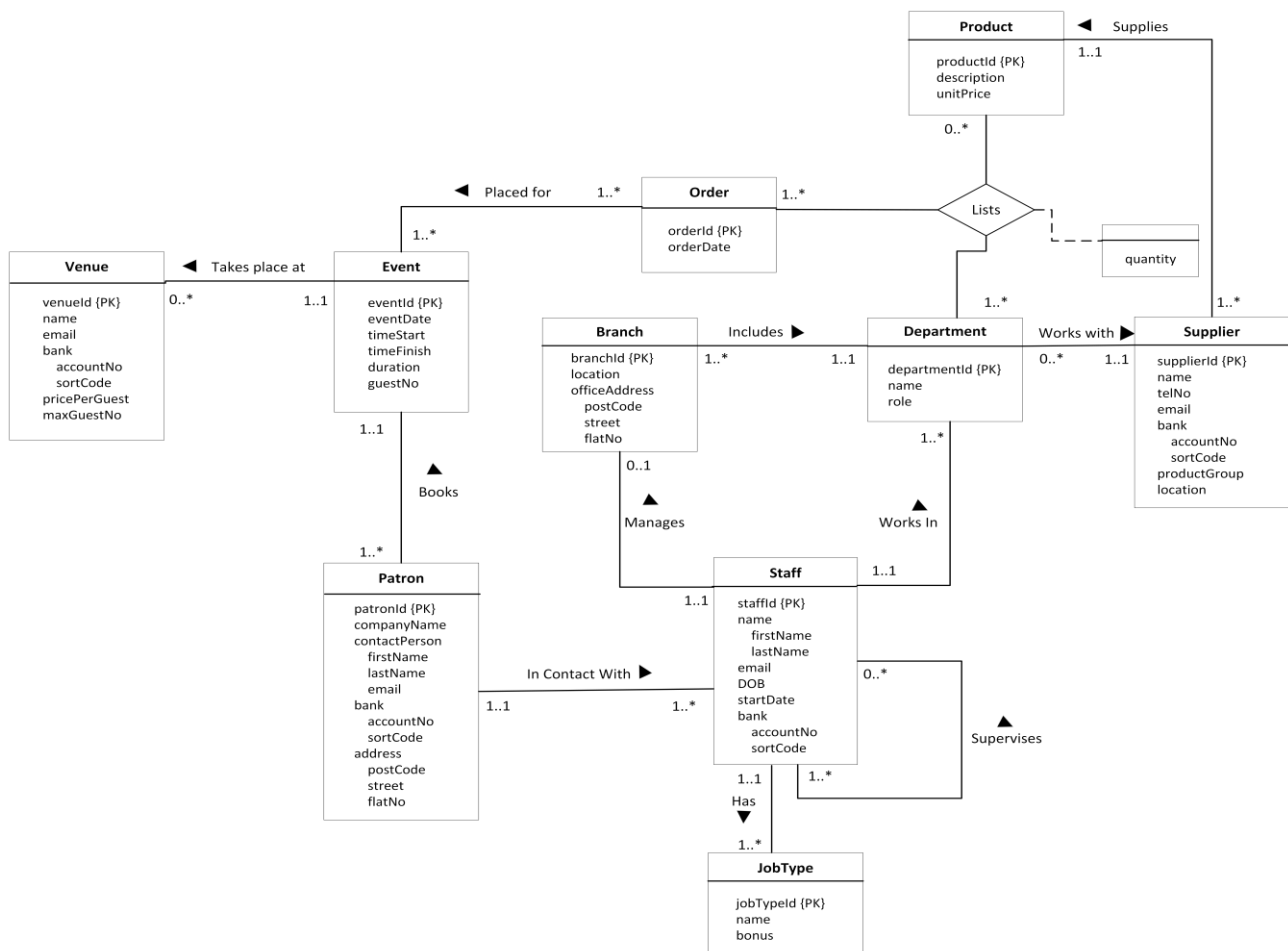


Figure 1.: ERD for the Northern Lights event management company.

## II. C. Deriving relations from the ERD

The following set of relations were created from the ERD after merging One-to-Many relations into the entities on the many sides. The primary keys are underlined, and the foreign keys are italicised.

### Entities:

**Branch** (branchId, address.postCode, address.Street, address.FlatNo, location, *staffId*)

**Department** (departmentId, name, role, *branchId*)

**Staff** (staffId, name.firstName, name.lastName, email, dob, startDate, bank.accountNo, bank.sortCode, *departmentId*, *jobTypeId*)

**JobType** (jobTypeId, jobType, bonus)

**Event** (eventId, date, timeStart, timeFinish, duration, guestNo, *venueId*, *patronId*)

**Order** (orderId, date, *staffId*)

**Patron** (patronId, companyName, contact.firstName, contact.lastName, contact.email, bank.accountNo, bank.sortCode, address.postCode, address.Street, address.FlatNo, *staffId*)

**Product** (productId, description, unitPrice, *supplierId*)

**Supplier** (supplierId, name, telNo, email, bank.accountNo, bank.sortCode, productGroup, location, *departmentId*)

**Venue** (venueId, name, email, bank.accountNo, bank.sortCode, pricePerGuests, maxGuestNo, address.postCode, address.Street, address.FlatNo)

### Many-to-Many relations:

**OrderDetail** (orderDetailId, *orderId*, *productId*, *deptId*, quantity)

**EventOrder** (orderId, *eventId*)

**Supervising** (supervisorStaffId, *staffId*)

## II. D. Normalisation

Subsequent to the identification of the relations for the database it is important to examine the functional dependencies and which level of normal form they attain.

Firstly, by removing the multi-valued attributes the relations only contain atomic attributes, therefore the relations fulfil the rules of 1NF.

Secondly, there is not any relation with composite primary key, therefore the relations are automatically in 2NF.

Thirdly, the relations must be analysed for transitive dependencies. There were transitive dependencies in those relations that contained address attributes. The post code depends on the primary key and the street and flat number depend on the post code. These dependencies break the rule of 3NF, therefore a new AddressBook relation was created:

*AddressBook* (id, post code, street, flat number).

The modified existing relations:

*Branch* (branchId, location, *addressBookId*, *staffId*)

*Venue* (venueId, name, email, bank.accountNo, bank.sortCode, pricePerGuests, maxGuestNo, *addressBookId*)

*Patron* (patronId, companyName, contact.firstName, contact.lastName, contact.email, bank.accountNo, bank.sortCode, *addressBookId*, *staffId*)

With removing the dependencies, the relations fulfil the rules of 3NF.

### III. Database creation

Using the relations, which were now in 3NF, I created the database with MS Access.

The created tables: **Branch**, **Department**, **Staff**, **JobType**, **Event**, **Patron**, **Venue**, **Supplier**, **Product**, **Order**, **OrderDetail**, **Supervising** (bridge table), **EventOrder** (bridge table) and **AddressBook**. The tables and the relations between them are shown in Figure 2. The relations were either created in the Relationship tool of MS Access or as a lookup field in certain tables. Data integrity were enforced, with cascading update and restricted deletes except for the bridge table where the deletes are also cascading.

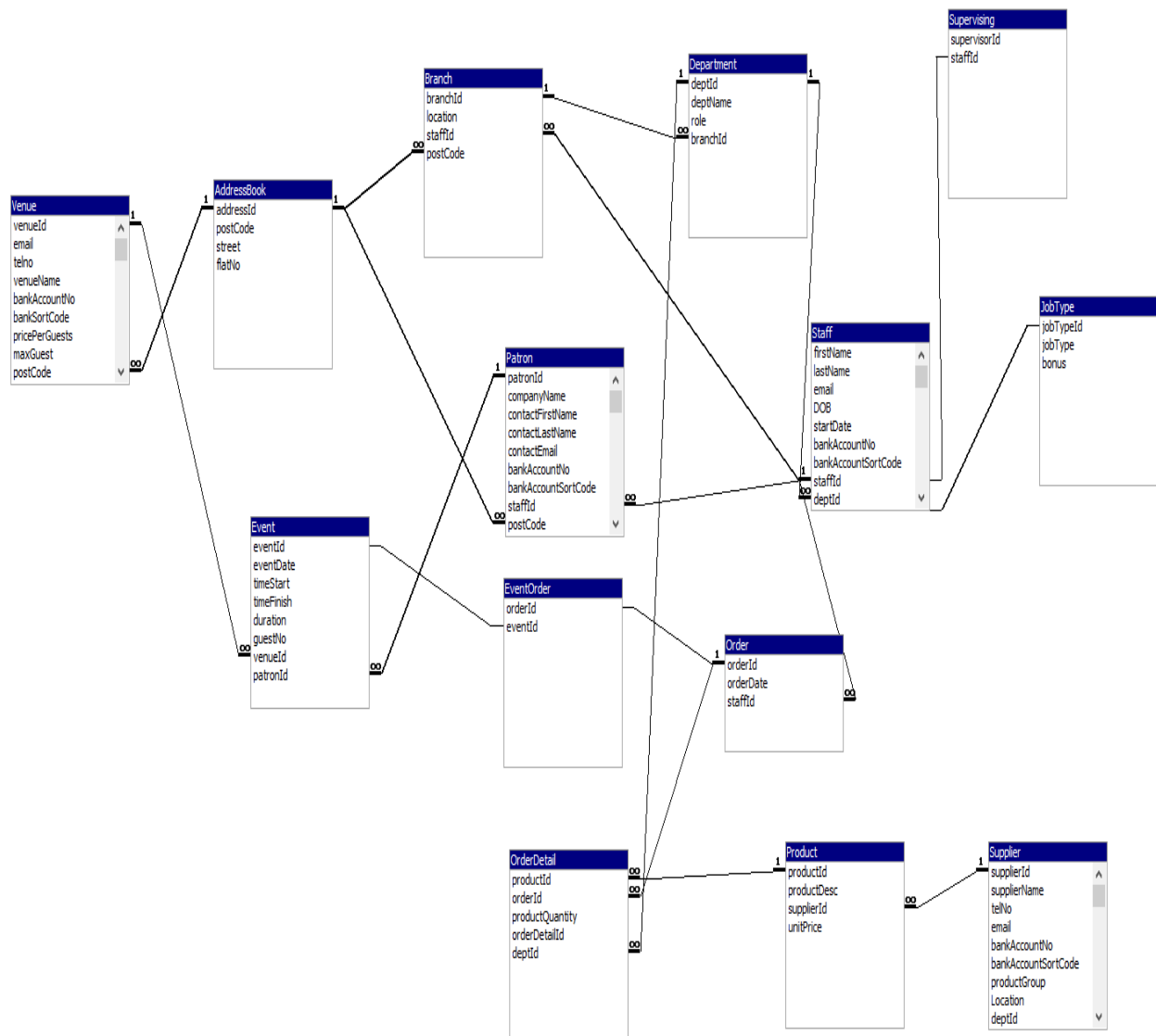


Figure 2.: Northern Lights database tables and relationships.

## IV. User Guide for the database and form outputs

As mentioned before, this database system is designed to allow different functionalities based on the access level of the user. Therefore, after opening the database, an Autoexec macro runs, and a dialog window pops up which prompts the user to select their login level. The user can choose from Patron, Employee, Manager options (Figure 3.). If the user chooses the ‘Patron’ option, they will be able to select their company (Figure 4.) and view their past and current booked events as well as their company information. They are also able to book new events and edit their personal information (Figure 5A.).

The screenshot shows a window titled 'login\_form' with a close button in the top right corner. Inside the window, there is a light green header bar with the text 'Login in as'. Below the header, there are three radio button options stacked vertically: 'Patron', 'Employee', and 'Manager'. Each option is followed by an empty radio button circle.

Figure 3.: The login form

Clicking on the event detail button they can view the details for that particular event. That form also contains a button that will generate the invoice for the event (Figure 5B. and 5C.).

The screenshot shows a window titled 'patron\_qry\_form' with a close button in the top right corner. Inside the window, there is a light green header bar with a document icon and the text 'Select Your Company'. Below the header, there is a 'Company Name' label followed by a dropdown menu. Below the dropdown menu, there is a green button with the text 'My Details'. At the bottom of the window, there is a footer bar containing record navigation controls (Record: 1 of 3), a filter icon with the text 'No Filter', and a search input field with the text 'Search'.

Figure 4. Patron company selector

Patron

patronId 1

**Contact Information**

Company Name Titan Electronics

**Contact Information**

First Name John

Last Name Neumann

Email jneumann@titan.co.uk

**Company Address**

Post Code SA1 79T

Street Bootham Crescent

Flat/Building No. 55

Book Event

**Banking**

bankAccountNo 49351450

bankAccountSortCode 88-82-45

**Contact manager**

staffId 1

First Name John

Last Name Smith

**Event history**

| Date       |               |
|------------|---------------|
| 19/03/2015 | Event Details |
| 30/04/2023 | Event Details |
| 26/05/2023 | Event Details |
| 02/04/2023 | Event Details |

Figure 5A: Patron information and booked event history.

event\_mainf

**Event Details**

eventId 1

Date: 19/03/2015

Start time: 18:00:00

End time: 22:00:00

Duration: 04:00:00

Number of guests: 30

Venue: Celebration Station

Generate Invoice

◀ ▶

Figure 5B: Pop up event details after clicking of 'Event Details' button

event\_invoice\_report

Event Invoice

25 April 2023  
12:20:45

eventid1

Customer: Titan Electronics  
Number of guests: 30

Venue Information:  
Name: Celebration Station  
price per quest: £10.00

| Order ID | orderDate  | Product/Service      | Quantity | Unit price | Total price | Order placed by: | Manager ID: |
|----------|------------|----------------------|----------|------------|-------------|------------------|-------------|
| 1        | 01/03/2015 | cleaning crew        | 1        | £100.00    | £100.00     | John Smith       | 1           |
| 1        | 01/03/2015 | party food selection | 30       | £2.50      | £75.00      | John Smith       | 1           |
| 1        | 01/03/2015 | beverage selection   | 30       | £3.00      | £90.00      | John Smith       | 1           |
| 2        | 02/03/2015 | beverage selection   | 5        | £3.00      | £15.00      | John Smith       | 1           |
| 1        | 01/03/2015 | audio setup          | 1        | £50.00     | £50.00      | John Smith       | 1           |

Order Total: £330.00  
Venue Total: £300.00  
**Grand Total: £630.00**

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Figure 5C. Macro generated invoice for a certain event after clicking on ‘Generate Invoice’ button

Opting for the ‘Employee’ radio button, the staff can select their name and ID from the drop-down list (Figure 6A). After that they will be able to view their own personal information by clicking on the ‘My Details’ button. They are also able to view events by clicking on the ‘View events’ button (Figure 6B).

staff\_qry\_form

Select Your ID

staffId

My Details

View Events

Figure 6A. Employee ID selector form

The 'Employee Details' form is divided into several sections:
 

- Personal Information:** First Name (Zachary), Last Name (Stewart), DOB (27/09/1999).
- Employment Information:** Email (zacharystewart@northern.com), Start Date (06/05/2014), Department (3).
- Banking:** Account No. (82679133), Sort Code (02-16-91).
- Department:** deptId (3), deptName (Hospitality), branchId (1).
- Branch:** branchId (1), location (Swansea).

 At the bottom are navigation buttons: Home, Previous, Next, and Logout.

The 'Select Your ID' dialog box (staff\_qry\_form) shows a dropdown menu for 'staffId' with a value of 1. It contains two buttons: 'My Details' and 'View Events'.

Figure 6B.: Employees can view and edit their details after selecting their ID.

Choosing the third option on the login form, namely the 'Manager' radio button will give the user the most access to the data in the database. Selecting that option will open a manager selector drop-down list. By selecting their IDs, they will be able to view their details in the same way as employees can. However, they will also be able to open a form to the manager operations (Figure 7.).

The 'Main' menu is a green bar at the top. Below it is a grid of buttons:
 

- Patron List, Company Order History
- Staff list, Branch Information
- Supplier list, New Order
- New Event, New Employee

The 'Select Your ID' dialog box (manager\_qry\_f) shows a dropdown menu for 'staffId1' with a value of 1. It contains two buttons: 'My Details' and 'Manager Operations'.

Figure 7. After manager ID selection the 'Manager Operations' button opens the form shown on the left-hand side.

The Manager Operations include listing all Patrons, Staff and Suppliers (Figure 8.) and Branch information (Figure 9.) as well as buttons for creating new Orders, Staff, Event (Figures 10A., 10B., 10C., respectively). The new Order form is based on a query that contains the OrderDetail and Event tables as well. Entering a new order automatically updates orderId in 'Select Products' and 'Select Event' subforms. The 'Company Order History' button generates a report listing all orders placed in the company and the total price (Figure 11A. and 11B.).

 **Supplier Information**

|                |                                                 |
|----------------|-------------------------------------------------|
| supplierId     | <input type="text" value="1"/>                  |
| Name           | <input type="text" value="Becker Inc"/>         |
| Tel. number    | <input type="text" value="01792 496 0407"/>     |
| Email          | <input type="text" value="admin@becker.co.uk"/> |
| Account number | <input type="text" value="81341769"/>           |
| Sort code      | <input type="text" value="88-82-45"/>           |
| Product Group  | <input type="text" value="Food and Beverages"/> |
| Location       | <input type="text" value="Swansea"/>            |

Figure 8. Supplier Information List

 **Branch**

|          |                                        |
|----------|----------------------------------------|
| Location | <input type="text" value="Swansea"/>   |
| postCode | <input type="text" value="SA1 1AU"/>   |
| street   | <input type="text" value="Ings Lane"/> |
| flatNo   | <input type="text" value="78"/>        |

**Branch Manager**

|           |                                                     |
|-----------|-----------------------------------------------------|
| firstName | <input type="text" value="John"/>                   |
| lastName  | <input type="text" value="Smith"/>                  |
| email     | <input type="text" value="johnsmith@northern.com"/> |

Figure 9.: Branch Information form. The form updates when selecting location from the drop-down menu




**Event Details**

eventId (New)

Date:

Start time:

End time:

Duration:

Number of guests:

Patron:

Venue:

Save Event

Figure 10C.: New event form

| Northern Lights Ltd Order History |            |               |                      |                  |            |          | 25 April 2023<br>12:13:12 |
|-----------------------------------|------------|---------------|----------------------|------------------|------------|----------|---------------------------|
| Order ID                          | Date       | Department    | Product/Service      | Supplier         | Unit Price | Quantity | Price                     |
| 1                                 | 01/03/2015 |               |                      |                  |            |          |                           |
|                                   |            | 3 Hospitality | party food selection | Becker Inc       | £2.50      | 30       | £75.00                    |
|                                   |            | 3 Hospitality | beverage selection   | Becker Inc       | £3.00      | 30       | £90.00                    |
|                                   |            | 1 Equipments  | audio setup          | Reichert Group   | £50.00     | 1        | £50.00                    |
|                                   |            | 3 Hospitality | cleaning crew        | Kuhlman and Sons | £100.00    | 1        | £100.00                   |
|                                   |            |               |                      |                  |            |          | <b>£315.00</b>            |
| 2                                 | 02/03/2015 |               |                      |                  |            |          |                           |
|                                   |            | 3 Hospitality | beverage selection   | Becker Inc       | £3.00      | 5        | £15.00                    |
|                                   |            |               |                      |                  |            |          | <b>£15.00</b>             |
| 3                                 | 01/04/2015 |               |                      |                  |            |          |                           |
|                                   |            | 3 Hospitality | party food selection | Becker Inc       | £2.50      | 28       | £70.00                    |
|                                   |            | 3 Hospitality | cleaning crew        | Kuhlman and Sons | £100.00    | 1        | £100.00                   |
|                                   |            | 3 Hospitality | beverage selection   | Becker Inc       | £3.00      | 28       | £84.00                    |
|                                   |            | 1 Equipments  | audio setup          | Reichert Group   | £50.00     | 1        | £50.00                    |
|                                   |            |               |                      |                  |            |          | <b>£304.00</b>            |
| 7                                 | 05/04/2023 |               |                      |                  |            |          |                           |
|                                   |            | 3 Hospitality | beverage selection   | Becker Inc       | £3.00      | 5        | £15.00                    |

Figure 11A.: Company Order History (1)

|             |            |   |             |                      |                  |         |                  |
|-------------|------------|---|-------------|----------------------|------------------|---------|------------------|
| 10          | 11/04/2023 |   |             |                      |                  |         |                  |
|             |            | 3 | Hospitality | party food selection | Becker Inc       | £2.50   | 10               |
|             |            |   |             |                      |                  |         | £25.00           |
|             |            |   |             |                      |                  |         | <b>£25.00</b>    |
| 11          | 19/04/2023 |   |             |                      |                  |         |                  |
|             |            | 3 | Hospitality | party food selection | Becker Inc       | £2.50   | 23               |
|             |            |   |             |                      |                  |         | £57.50           |
|             |            |   |             |                      |                  |         | <b>£57.50</b>    |
| 12          | 19/04/2023 |   |             |                      |                  |         |                  |
|             |            | 3 | Hospitality | cleaning crew        | Kuhlman and Sons | £100.00 | 1                |
|             |            |   |             |                      |                  |         | £100.00          |
|             |            | 3 | Hospitality | beverage selection   | Becker Inc       | £3.00   | 1                |
|             |            |   |             |                      |                  |         | £3.00            |
|             |            |   |             |                      |                  |         | <b>£103.00</b>   |
| 13          | 19/04/2023 |   |             |                      |                  |         |                  |
|             |            | 5 | Equipments  | audio and dj setup   | Stehr LLC        | £65.00  | 1                |
|             |            |   |             |                      |                  |         | £65.00           |
|             |            |   |             |                      |                  |         | <b>£65.00</b>    |
| 14          | 22/04/2023 |   |             |                      |                  |         |                  |
|             |            | 1 | Equipments  | audio setup          | Reichert Group   | £50.00  | 1                |
|             |            |   |             |                      |                  |         | £50.00           |
|             |            |   |             |                      |                  |         | <b>£50.00</b>    |
| Grand Total |            |   |             |                      |                  |         | <b>£1,079.50</b> |

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Figure 11B.: Company Order History (2)

There is also a possibility to see department information and check the order history relevant to the particular department (Figure 12A.). When clicking on the ‘See Order History’ button on the ‘Department Information form a new form opens that shows the suppliers that the selected department placed an order with (Figure 12B.). The user can move between suppliers with the next/previous buttons. Also, on the right-hand side of the form, the placed orders are listed as well, and the user is able to generate invoices for all orders separately by clicking on the ‘Generate Invoice’ button (Figure 12C.).


**Department Information**

deptId

deptName

role

location

See order history

Figure 12A.: Department Information form

**Supplier Order History**

**Select Supplier:**

**supplierId**
3

**Supplier Name**
Reichert Group

<
>

**Order List**

**orderId**
1

Generate Invoice

**orderDate**
01/03/2015

**orderId**
3

Generate Invoice

**orderDate**
01/04/2015

**orderId**
9

Generate Invoice

**orderDate**
03/04/2023

**orderId**
14

Generate Invoice

**orderDate**
22/04/2023

Figure 12B.: Supplier order history filtered by department

| Invoice for supplier |            |                |                 |          |            |            | 25 April 2023 |
|----------------------|------------|----------------|-----------------|----------|------------|------------|---------------|
| Order ID             | Order Date | Supplier       | Product/Service | Quantity | Unit price | Department | Price         |
| 1                    | 01/03/2015 | Reichert Group | audio setup     | 1        | £50.00     | Equipments | £50.00        |
| Total                |            |                |                 |          |            |            | £50.00        |

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Figure 12C.: Invoice generated for a certain order.

## V. Conclusion

Designing a database system requires careful consideration of many details such as user views and accommodations to the requirements of the company. However, it should not compromise efficiency and obedience to data integrity rules.

It should allow the user to view and edit records through forms and to generate reports. They should be able to do this without being aware of the macros running and executing complex queries with different criteria in the background when the buttons are clicked. This is also evident in generated reports containing data from multiple tables.

In conclusion, by using the Northern Lights event management company, I was able to create a database system that allows access for multiple types of users and based on their privilege level they can view different datasets. I demonstrated ways to create a functional database system that obeys data integrity requirements, interconnected, and allows for multiple access level views where they can generate complex reports and view filtered forms.

## VI. References

- (1) Connolly, T., Begg, C., 2015, Database Systems: A Practical Approach to Design, Implementation and Management, 6th Edition, Addison Wesley