**A list of data on a computer

Description automatically generated with medium confidence**

# 

# Introduction

The creation of a relational database system is essential to addressing significant real-world problems in the data-driven world of today. This project uses a methodical process that goes through several phases, from "Design" to "Maintenance."

The 'Design' phase lays the groundwork for using an appropriate design tool to build an effective database system. We examine important topics such Entity-Relationship Diagrams (ERD), data normalisation methods, and UI design throughout this phase. In addition, we carry out a thorough assessment to make sure the design meets the goals of the project.

Going forward, we implement the specified design to bring the database system to life during the 'Implementation' phase. According to the current system design, this entails creating tables, forms, and queries.

The project thereafter moves into the 'Testing' phase, during which the system is put through a thorough review process that compares it to both user and system requirements. This stage evaluates the entire implementation and testing procedure in addition to making sure the database operates in line with the specified standards.

Finally, the creation of technical and user documentation, which offers crucial resources to administrators and users, completes the 'Maintenance' phase. To guarantee the system's continued efficacy and efficiency, we assess database maintenance operations concurrently.

We guarantee the development and ongoing efficacy of a relational database system to meet significant real-world difficulties by adhering to this comprehensive strategy."

# Design: Use an appropriate design tool to design a relational database system for a substantial problem (LO1)

## In Microsoft Access, a primary key function as a unique ID for each record in a table. There can be no two records with the same ID since it must be unique.

## The key points are:

## Uniqueness: A record's ID can never be the same twice. A unique student ID is required for each pupil.

## Help with searches: It facilitates finding and organising data in the table more quickly.

* It can be one or more fields: Your primary key could consist of only one field, such as the student ID, or it could consist of a combination of fields, such as the student's first and last names.
* Microsoft Access assists you in setting up and enforcing the primary key, ensuring that IDs are distinct.
* Maintains Data Accuracy: When there are relationships between two tables, it's critical to maintain data accuracy as well as to connect the two tables.

The system requirements are:

* An alphabetized list of all customers, complete with phone numbers and email addresses to facilitate communication.
* A list of newly released goods, special offers, and additional services.
* For the product's purchase location and time to be reflected on the aftersales receipt, the system needs to be sufficiently reliable, secure, and scalable.

This is the schema of the four tables that needs to be implemented:

1. Customer table: **CustomerID,** Title, First name, Surname, Gender, Date of birth, Address, Postcode, Phone number, Email, where CustomerID is a primary key
2. Order Table: **OrderID**, Order date, Delivery date, Payment type, Order type, CustomerID, Branch Store, where orderID is a primary key.
3. Ordertype table: **OrdertypeID**, ProdID, OrderID, Quantity, where OrdertypeID is a primary key.
4. Product table: **ProductID**, ProductName, Price, Stocklimit, Supplier, Description, where ProductID is a primary key.

## ERD

A web-based diagramming tool called Lucidchart enables users to graphically collaborate on creating, editing, and sharing charts and diagrams to enhance organisational structures, systems, and processes. It is created by the American company Lucid Software Inc., which has its headquarters in Utah. and was co-founded by Ben Dilts and Karl Sun. Companies like Google, GE, NBC Universal, and Amazon use Lucidchart, (Wikipedia Contributors, 2023)

A screenshot of a diagram

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## Normalisation

The normalization process is typically divided into several normal forms, with each successive normal form addressing specific issues in the data structure. The most common normal forms are:

* First Normal Form (1NF):

Eliminates duplicate rows by ensuring that each table has a primary key.

Columns contain only atomic (indivisible) values.

Customer table is an example of 1NF.

* Second Normal Form (2NF):

Meets the requirements of 1NF.

All non-key attributes are functionally dependent on the entire primary key. Order table is an example of 2NF.

* Third Normal Form (3NF):

Meets the requirements of 2NF.

Eliminates transitive dependencies, which means that non-key attributes are not dependent on other non-key attributes.

Product table is an example of 3NF.

Each subsequent normal form further refines the data structure to minimize redundancy and dependency issues. The goal of normalization is to improve data integrity, reduce data duplication, and make it easier to maintain and update the database.

Normalization helps prevent data anomalies, such as insertion, update, and deletion anomalies, that can occur when data is not properly organized. It also simplifies query and reporting operations on the database.

## User Interface Design

UI macros in Microsoft Access are defined as macros that are attached to user interface (UI) items like command buttons, text boxes, forms, and reports. They differ from data macros, which are attached to tables, because of this. You may automate a variety of processes using (UI) macros, including opening more objects, using filters, beginning export operations, and performing many other functions.

Macros can be embedded within the event attributes of forms, reports, or controls, where they are sometimes referred to as standalone macros. Embedded macros are integrated into the object or control they are placed in. Embedded macros are hidden; macro objects are displayed in the Navigation Pane under Macros.

One or more macro actions make up each macro. Some macro actions might not be usable depending on the situation. (to, 2021)

A screenshot of a computer

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To see the rest of the forms please check the appendix.

## **Evaluation of Design**

Several aspects will be covered in order to assess the design's efficacy in light of user and system requirements. A few data types that have been used in the tables are Auto numbers, currency, short and long dates, short and long texts, input masks for postcodes, phone numbers, and validation data.A screenshot of a computer

Description automatically generated

Data types that are included on the design:

* Auto number: is for CustomerID because is a primary key, the number is increasing when a new customer is added.
* Short text: Is been used in Title, first name, Last name and post code because is a short text.
* Date/Time: is used in DOB (Date of birth) because it shows a small calendar to put the date of birth.
* Long text: is used in Address because usually an address contains numbers and names.
* Large number: is used for telephone number because is a long number.
* Hyperlink: is used for email because it creates a hyperlink and it can be recognized when you put the mouse at the top of it and you can see a hand.

# Implementation: Develop a fully functional relational database system, based on existing system design (LO2)

In Microsoft access to create a query the following steps needs to be followed:

1. **Navigate to the Query Design View:**
   * Click on the "Queries" tab in the left sidebar to open the Queries tab.
   * Click the "Design View" button to open the Query Design view.
2. **Select Tables:**
   * In the Query Design view, you'll see a list of all the tables in your database. Select the tables from which you want to retrieve data by double-clicking on them. They will appear in the query design grid.
3. **Specify Fields:**
   * In the Query Design view, you can specify the fields (columns) you want to include in your query by double-clicking them from the tables you've added. These fields will also appear in the query design grid.
4. **Run the Query:**
   * Save the query by clicking the "Save" button on the Query Design view toolbar and provide a name for the query.
   * To view the results, click the "Run" button on the Query Design view toolbar. This will execute the query and display the results in Datasheet view.
5. **Save the Query**
6. **Close the Query Design View**

To see an implementation of a Query check the appendix

To create a user form in Microsoft Access the next steps need to be followed:

1. **Navigate to the Form Design View:**
   * Click on the "Forms" tab in the left sidebar to open the Forms tab.
   * Click the "Design View" button to open the Form Design view.
2. **Select a Data Source:**
   * In the Form Design view, you'll need to specify the data source for your form. You can choose a table or query as the source of your form.
   * Click on the "Property Sheet" button in the Design tab to open the Property Sheet.
3. **Design the Form:**
   * In the Form Design view, you can design your form by adding various controls such as text boxes, labels, buttons, and more. These controls are available in the "Design" tab.
   * Drag and drop controls onto the form to create fields for data entry and labels to describe those fields.
   * You can set the properties of each control using the Property Sheet to specify things like field source, captions, and formatting.
4. **Add a Title (Optional):**
   * You can add a title or a header to your form by using the "Label" control and positioning it at the top of your form.
5. **Set Tab Order (Optional):**
   * If you want to specify the order in which the controls are selected when users press the Tab key, use the "Tab Order" option in the Design tab.
6. **Save the Form:**
   * Save your form by clicking the "Save" button in the Design view and give it a name.
7. **Preview the Form:**
   * To view and interact with your form, switch to the Form view. Click the "View" button in the Design view toolbar and choose "Form View." This allows you to see how your form looks and functions.
8. **Close and Save**
9. **Use the Form**

To see an implementation of a Form please check the appendix.

To create a validation rule in Microsoft Access the next steps need to be followed:

1. **Open the Table in Design View:**
   * Locate the table in the Navigation Pane, right-click on it, and choose "Design View."
2. **Select the Date of Delivery Field:**
   * In the Table Design view, find and select the Date of Delivery field by clicking on its name.
3. **Set the Validation Rule:**
   * In the Field Properties section at the bottom of the Table Design view, locate the "Validation Rule" property. To create a validation rule for a Date of Delivery field, you can use an expression that checks if the date is after the current date (today). For example, to require that the Date of Delivery must be in the future, you can set the validation rule as follows:

>= Date()

This rule ensures that the Date of Delivery must be greater than or equal to the current date.

1. **Set the Validation Text (Optional):**
   * Optionally, you can set a custom validation message to inform users about the rule. Use the "Validation Text" property. For example, you can enter a message like "Date of Delivery must be a future date."
2. **Save Your Changes:**
   * After setting the validation rule and, if desired, the validation text, save your changes to the table design.
3. **Test the Validation Rule:**
   * To test the validation rule, try to enter a Date of Delivery that doesn't meet the specified rule, such as a date in the past. Access will display your custom validation message, and you won't be able to save the record until you enter a valid date in the future.

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Description automatically generated

The term "database implementation" describes the actual actions carried out to activate a database management system (DBMS). This involves building database architecture, configuring the DBMS, and adding data to it.

A screenshot of a computer screen

Description automatically generated

From the screenshot of the main screen of the database, it is possible to see a bottom to create a new customer, to see all customers, to create a new product, and to see all transactions.

To implement Security with password encryption is easy as going to File>Options>Encrypt with password.

**Password Security:**

**A screenshot of a computer

Description automatically generated**

**A screenshot of a computer

Description automatically generated**

**Backup of the database:**

To set up backup of the database go to File> Save as> Backup database.

**A screenshot of a computer

Description automatically generated**

**SQL view:**

To see a SQL view

Select a query and press SQL view.

**A screenshot of a computer

Description automatically generated**

Transaction query is being used to assess whether the meaningful data has been extracted thought the use of query tool to produce appropriate management information.

A screenshot of a computer

Description automatically generated

A screenshot of a table

Description automatically generated

# Testing: Test the System Against User and System Requirements (LO3)

|  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- |
| **Test No:** | **Purpose:** | **Test Data:** | **Expected Result:** | **Actual Result:** | **Pass/Fail:** |
| 1 | Create a new user | Name: John  Surname: Malkovich  Gender: M  DOB:9/12/1952  Adress: 35 Leggings close  Phone number:(+44) 3256723445  Email: j.malk@gmail.com | Add a new user to the database | A new user has been added successfully. | Pass |
| 2 | Create a new product | Product name: Macbook Pro  Price: 999$  StockLimit: 3  Supplier: Apple  Description:Macbook Pro 17 inch | Add a new product to the database | A new user has been added successfully | Pass |

Data types that are included on the design of User table:

* Auto number: is for CustomerID because is a primary key, the number is increasing when a new customer is added.
* Short text: Is been used in Title, first name, Last name and post code because is a short text.
* Date/Time: is used in DOB (Date of birth) because it shows a small calendar to put the date of birth.
* Long text: is used in Address because usually an address contains numbers and names.
* Large number: is used for telephone number because is a long number.
* Hyperlink: is used for email because it creates a hyperlink and it can be recognized when you put the mouse at the top of it and you can see a hand.

Data types that are included on the design of Product table:

* Auto number: is for ProductID, is the primary key, the number is increasing when a new product is added.
* Short text: Is used in Product name and supplier.
* Long text: Is used in Description.
* Currency: Is used for Price.
* Number: Is used for Stock Limit.

## Evaluation of Implementation and Testing

To evaluate a database and identify improvements needed to ensure its continued effectiveness, you should consider various aspects of the database system. Here's a comprehensive checklist to help you assess the system and determine what improvements might be necessary:

* Performance:
* Evaluate query performance and response times. Identify slow-running queries and optimize them.
* Consider indexing strategies to improve query performance.
* Check the hardware and infrastructure for bottlenecks and consider hardware upgrades if necessary.
* Review the database design for normalization and denormalization opportunities.
* Scalability:
  + Assess the current and projected data growth. Ensure the database can scale accordingly.
  + Consider shading or partitioning for large databases.
  + Evaluate clustering and load balancing to distribute the workload effectively.
* Security:
  + Review user access and permissions to ensure data security.
  + Keep the database software and underlying operating system up to date with security patches.
  + Implement encryption for data in transit and at rest.
* Backup and recovery:
  + Check the database backup strategy and frequency. Ensure backups are regularly tested for restoration.
  + Evaluate disaster recovery plans and procedures.
* Disaster recovery:
  + Evaluate referential integrity and constraints.
  + Implement foreign keys to maintain data consistency.
* Maintenance:
  + Regularly perform database maintenance tasks, such as index reorganization and statistics updates.
  + Schedule routine database health checks
* Future road map:
  + Plan for the long term. Consider the evolving needs of the organization and how the database can support those needs.

# Maintenance: Produce technical and user documentation (LO4)

Data management is becoming more and more important. In today's data-driven world, databases are essential as information stores for numerous applications, enterprises, and organisations. We must investigate two essential facets of databases: user implementation and technical implementation, in order to properly understand them.

Building, maintaining, and managing this infrastructure are all related to the technical implementation of a database. The main elements and procedures are as follows:

* **Database design:** Consider database design as the initial stage of the plan. We make decisions on the structure, organisation, and interrelationships of the data. This is an important phase since it establishes the framework for all subsequent steps.
* **Database Management System (DBMS):** A database is controlled by software, which is what the DBMS does. A DBMS should be chosen based on the particular requirements of the project, just as different tools are chosen for different jobs.
* **Infrastructure and Hardware:** The number of servers, storage devices, and network configurations.
* **Installation and Configuration**: After obtaining all the tools, it is necessary to configure them. Installing and optimising the selected database management system (DBMS) is the task of this stage. In addition, it covers system optimisation, security features, and user account setup.
* **Data ingestion**: This process makes ensuring the database has the data it requires, whether it is manually entering data, migrating from current systems, or integrating data from multiple sources.
* **Backup and Recovery**: It guarantee that all data data is safe and that it can be recovered in the event of unforeseen problems.
* **Performance Optimisation:** To get the best possible performance out of the database, it needs to be done somey adjustments. It is analogous to performing routine building maintenance to guarantee smooth and effective operation.
* **Security**: It needs to be protected from potential threats, illegal access, and data breaches. This includes encrypting confidential information and configuring user access controls.

The user experience is taken consideration in the user implementation aspect, which includes tasks like data input, data retrieval, and user interfaces:

* **Data input**: This is the process by which users enter data into the database, such as system administrators or data entry clerks.
* **Reports and Queries**: Users are looking for particular data. They search for particular items or information using queries and report generation.
* **User interfaces**: give users a method to interact with the database through desktop programmes, mobile apps, or web applications.
* **User Training**: In order for users to utilise the database efficiently, they must receive training. This entails knowing how to create queries, generate reports, and input data.
* **Access Control:** Access control systems make sure users can only access content that they are permitted to access. This protects confidential information and limits access according to roles and permissions.

To see Technical and User documentation chech appendix B.

## Evaluation of Database Maintenance:

A database's continuous efficiency, dependability, and security are ensured by a number of factors that must be taken into account while assessing database maintenance.

Record-keeping:

* + Examine the user and technical documentation for availability and completeness.
  + Make sure that all of the documentation—including the schema, configurations, and procedures—is current.

Replication and Backup:

* + Evaluate the processes for backup and recovery.
  + Make sure backups are done correctly and on a frequent basis.
  + To ensure the restoration process is reliable, test it.

Tuning Performance:

* Analyse the system's responsiveness and query execution times as well as the database's overall performance.
* Determine any areas where performance is constrained and evaluate the actions done to improve performance.

Security and Management of Access:

* Check the permissions and access rights of the user.
* Verify that sensitive data is protected by security mechanisms in place.
* Examine how user accounts and password policies are managed.

Patch Administration:

* Examine the database management system and its supporting infrastructure for upgrades and patches.
* Make sure that updates are installed on time in order to fix security flaws and boost efficiency.

Observation and Warnings:

* Evaluate how well real-time alerting and monitoring systems work.
* Make sure that important events are tracked and that alarms are set off when problems occur.

Data purging and archiving:

* Examine data cleansing and archiving techniques to handle old or seldom used data.
* Make sure the data integrity is maintained and these tactics are effective.

Regulations and Compliance:

* Analyse the database's adherence to data protection laws and industry-specific rules.
* Verify the existence and efficacy of auditing and compliance procedures.

User Opinion:

* Get opinions about the database's usability and performance from stakeholders and end users.
* For continuous improvements, take into account consumer feedback and concerns.

Resource Efficiency

* Examine the distribution of resources, including the price of cloud services, software licences, and hardware.
* Find ways to optimise costs and make adjustments to the allocation of resources.

Data Accuracy:

* Analyse data integrity safeguards like data validation and referential integrity.
* Verify the accuracy and consistency of the data.

Upgrades and Migrations of Databases:

* Evaluate the procedure for switching to a new platform or updating the database management system.
* Make sure that plans for upgrades or migrations are established and regularly evaluated.

Recovery from Disasters:

* Plan for business continuity and catastrophe recovery, and review and update them.
* Make sure that in the case of catastrophic failures, data may be restored.

Instruction and Development of Skills:

* Examine the database administrators' and developers' training and skill-building initiatives.
* Verify that the group has the expertise needed to properly manage and optimise the database.

Future Schedule:

* Talk about and make plans for the organization's changing demands and how the database will eventually serve them.

# References

to, I. (2021). *Create a user interface (UI) macro - Microsoft Support*. [online] Microsoft.com. Available at: https://support.microsoft.com/en-au/office/create-a-user-interface-ui-macro-12590d3b-b326-4207-bfe5-19234f53f08b [Accessed 11 Oct. 2023].

Wikipedia Contributors (2023). *Lucidchart*. [online] Wikipedia. Available at: https://en.wikipedia.org/wiki/Lucidchart [Accessed 11 Oct. 2023].

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# Appendix A: Screenshots from populated Tables

**Tables:**

Customer table:

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Order table:

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Ordertype table:

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Product table:

A screenshot of a computer

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**Queries:**

Numcust: Number of customers

A screenshot of a computer

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Transactions:

A screenshot of a computer

Description automatically generated

**Forms:**

Customer Form: A screenshot of a computer

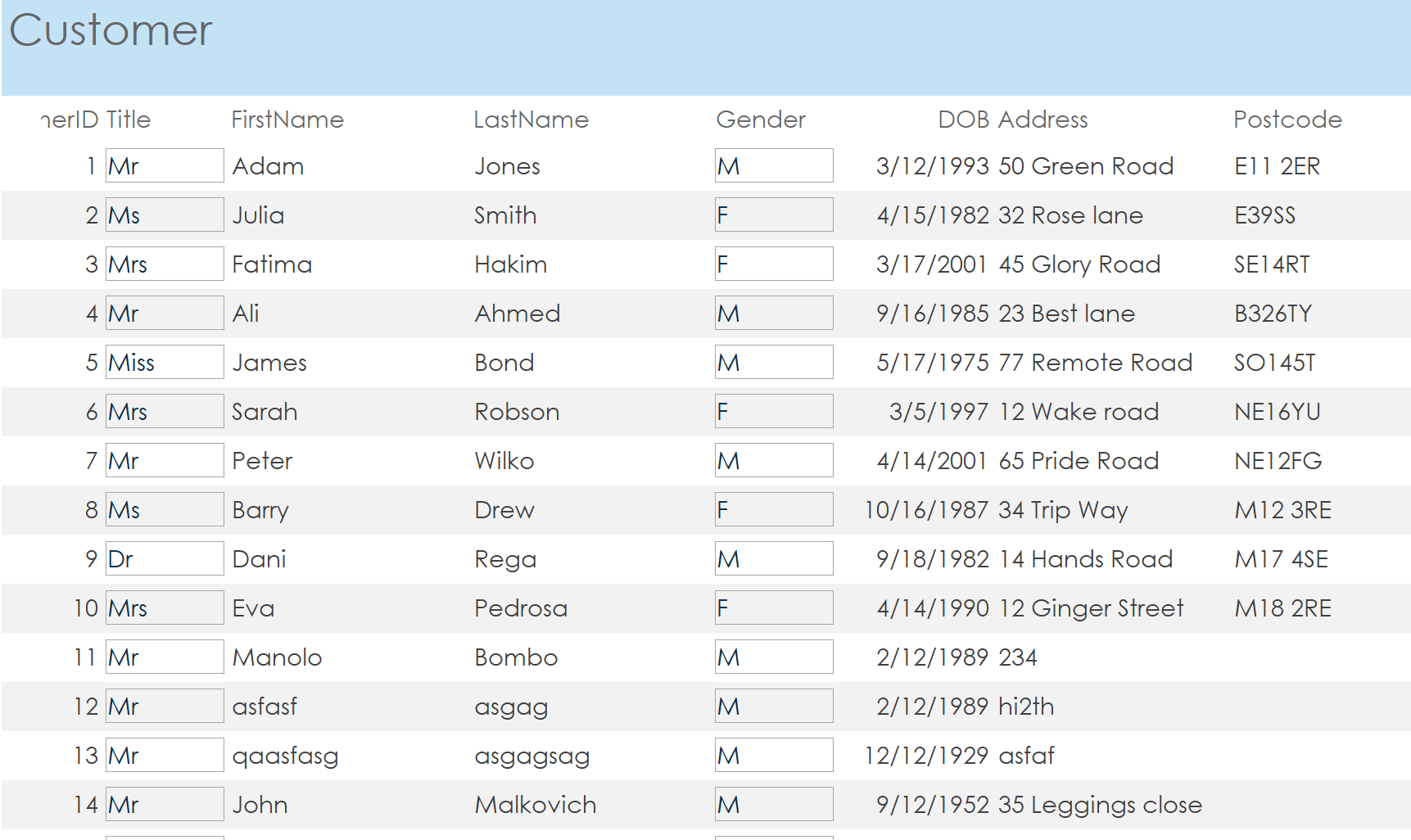
Description automatically generated

Product Form:

A screenshot of a computer

Description automatically generated

**Reports:**

Customer Report: 

A screenshot of a computer

Description automatically generated

Product Report:

A screenshot of a table

Description automatically generated

# Appendix B : User and technical documentation

DBL Database

Version: 1.0

Technical Document

Revision History

|  |  |  |  |
| --- | --- | --- | --- |
| Date | Version | Description | Author |
| 07.11.2022 | 0.1 | DBL Technical Document | Sergio Gomez Ortiz |
|  |  |  |  |
|  |  |  |  |

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# Introduction

The DBL Database project aims to modernize the DBL company by creating a database, and develop a order processing application and access the data. The new design changes implemented to the DBL Database would provide a more efficient data system both for reporting and retrieving data derived from transactions online and on site into the database.

## System Overview

| System Overview | Details |
| --- | --- |
| System name | Sergio Mac |
| System type | Mac OS |
| Operational status | Active |
| Database Name | DBL Database |

## Acronyms and Abbreviations

| Acronym / Abbreviation | Meaning |
| --- | --- |
| PK | Primary Key |
| FK | Foreign Key |
| ERD | Entity relationship Diagram |
| DB | Database |
| DBA | Database Administrator |

## Points of Contact

| Role | Name | Email | Telephone |
| --- | --- | --- | --- |
| Data Manager | Sergio Gomez | [sergio.gomez@ymparisto.fi](mailto:sergio.gomez@ymparisto.fi) | +358 29 525 1317 |
| Application Developer | Alexander Sokolov | alexander.sokolov@su.se | +46 8 674 7586 |

# System Architecture

The DBL system has been developed as a standalone application.

In this database there are four tables:

* Customer table
* Order table
* Ordertype table
* Product table

In this database there are seven forms:

* Main
* Customer
* Order
* Product
* Number of customers
* Total sales
* Transactions

The DBL Database is developed in MS ACCESS. The figure below shows the architecture of the DBL Application for running on webserver in future.

DBL firewall

Future improvement

Connect to

Web browser

HTML 5

CSS 3

JavaScript

Application server

Web server

daily backup

Database server

e.g. MS SQL Express

Admin machine

MS SQL Server

Management

DBL Database

Figure 1: Architecture Diagram

## .1 Database and Application Software Utilities

| Vendor | Product | Version | Comments |
| --- | --- | --- | --- |
| Microsoft | MS-ACCESS | --------------------- | Relational Database Management System |
| Microsoft | Windows OS | --------------------- | Operating System |

Table 1: Database Software Utilities

## .1 Database Properties and Relationships

Database Tools Tab > click on Database Documenter > Current Database

Graphical user interface, text, application

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Select Properties and Relationships, then press OK.

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# Database Specifications

## Physical Design

Below is the entity relationship diagram, which shows the physical design of the database

A screenshot of a diagram

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[Figure 2. Entity relationship diagram](#_Toc443315131)

# User Manual for DBL Database

## How to add a new customer

Open customer from, Do not enter customer ID, system will automatically add a new unique number. Select Title form the list, enter First name, Surname. Select Gender from the list M for Male and F for Female.

Enter DOB or use the calendar, enter the first line of address, Post code, telephone number with city code, enter email. Go to next record will insert the data into Customer table inside the database.

## A screenshot of a computer Description automatically generated

## How to add a new Product

Open product from, do not enter ProductID, system will automatically add a new unique number. Insert the product name, price, Stocklimit, supplier and description and press the bottom of New Product.

## A screenshot of a computer Description automatically generated