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Project on

A Database Management System (DBMS) project on Ethiotelcom

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LIST OF ACRONYM

DBMS: - Database Management System

SQL: - Structured Query Language

ER: - Entity-Relationship

CHAPTER ONE

1.1. INTRODUCTION

The Database Management System (DBMS) project on "Ethiotelecom" in general is introduced in this chapter. The circumstances or motivations behind the authors' decision to develop this project will be discussed next. Additionally, the goal and the holes this initiative will address will be discussed. A summary of the approach will be given. The project's Thematic and scope will be explained in order, followed by the use of the outcome.

One of the oldest public telecommunications companies was founded in 1894 in Ethiopia, the second-most populated country in Africa with 110 million people. Ethiopian telecommunications is still among the least advanced in the world, despite its antiquity. The ITU reports that 20% of people have Internet access and 39% of people had mobile cellular subscriptions (per 100). Two kbits/s was the average international transmission speed per Internet user as of June 2018. Numerous studies generally agree that without telecommunications services, no contemporary economy can grow. Ethiopia's economy is portrayed as one of the poorest in the world, which is understandable. This study pinpoints the reasons behind Ethiopia's incredibly subpar telecommunications performance and makes suggestions for immediate enhancements.

In the quickly evolving field of telecommunications, effective handling of enormous volumes of data is essential. Creating a reliable Database Management System (DBMS) for Ethio Telecom, the top telecom provider in Ethiopia, is the main goal of this project. The goal is to guarantee data security, enhance service delivery, and simplify data handling procedures.

In this project, we will design an Entity-Relationship (ER) diagram and a corresponding table database management system for Ethio Telecom. The aim is to efficiently manage customer data, service details, billing information, and employee records. This system will streamline operations and provide a robust framework for data management.

But running a company that size has its challenges, especially when it comes to managing the massive volumes of data that are produced every day. The volume and complexity of data, ranging from billing and complaints to customer information and service subscriptions, necessitate a centralized and effective system. Inaccuracies and inefficiencies can make it more difficult for the company to provide seamless services and uphold customer happiness in the absence of a strong data management system.

This project suggests designing and implementing a complete Database Management System (DBMS) that is suited to the operational requirements of Ethiopian telecom in order to address these issues. This DBMS will guarantee accurate and real-time data accessibility, minimize redundancy, and streamline data processing. The system seeks to improve customer happiness, facilitate decision-making, and guarantee that Ethio Telecom stays at the forefront of Ethiopia's digital transition by automating crucial tasks like billing and complaint resolution.

1.2. Challenges in Database Management System at Ethio Telecom

Ethio Telecom, one of Ethiopia's top telecom providers, has a number of difficulties in maintaining its database systems. Both their operational effectiveness and the caliber of services they offer clients may be impacted by these difficulties. The following are some major issues with Ethio Telecom's database management system (DBMS):

1.2.1. Data Volume and Scalability

Ethio Telecom manages large data volumes daily, requiring efficient DBMS to handle large transaction volumes without compromising speed or performance to maintain service quality.

1.2.1.2. Data Security and Privacy

Data security is crucial for private client data, requiring robust encryption, access controls, and regular security assessments to safeguard against cyber-attacks and breaches.

1.2.2. Data Integration

Ethiopian Telecom offers various services, including mobile, internet, and fixed-line phone, which require seamless data integration for better analytics, informed decision-making, and personalized services.

1.2.3. System Downtime and Reliability

Database outages can negatively impact revenue and customer satisfaction, so ensuring high availability and dependability of the DBMS through reliable backup and recovery systems and redundancy measures is crucial.

1.2.4. Performance Optimization

As data grows, maintaining efficiency becomes challenging, potentially impacting customer experience. To ensure quick data processing, indexing techniques, frequent database maintenance, and ongoing performance optimization are necessary.

1.2.5. Skilled Workforce

Ethiopian Telecom must invest in personnel development to maintain a competent workforce with database technology knowledge to effectively manage a complex DBMS.

1.3. Objectives

The primary objectives of the project are:

- To create and deploy a dependable database management system specifically for Ethiopian Telecom
- To improve the speed and accessibility of data retrieval
- To provide precise data analysis to aid in decision-making
- To provide precise data analysis to assist in decision-making
- To maximize the distribution and administration of resources

1.4. Requirements Analysis for a Database Management System in Ethio Telecom

When considering the development or enhancement of a Database Management System (DBMS) for Ethio Telecom, it is crucial to conduct a comprehensive requirements analysis. This process will ensure the system is tailored to the specific needs of the organization, supporting its operational, analytical, and strategic objectives.

1.5. Understanding Ethio-Telecom's Needs

1.5.1. Organizational Overview

Ethio Telecom is the primary telecommunications provider in Ethiopia, offering a wide range of services including mobile, fixed line, and internet. The organization serves millions of customers across the country, necessitating robust data management solutions.

1.5.2. Key Objectives

- 1. Improved Data Management:** Efficient storage, retrieval, and management of vast amounts of data generated by customer interactions and internal processes.
- 2. Scalability:** The system must accommodate current data volumes and be scalable to handle future growth.
- 3. Reliability and Security:** Ensuring data integrity and protecting sensitive information is paramount.

4. **Enhanced Decision-Making:** Providing insights through data analysis to support strategic planning and operational decisions.

1.6. Functional Requirements

A) Data Storage and Retrieval

- ❖ Efficient Storage Solutions: Implementing a system that can handle structured and unstructured data.
- ❖ Quick Retrieval: Optimized queries to ensure fast data access for both customers and employees.

B) User Management

- ❖ Role-Based Access Control: Defining user roles and permissions to ensure secure access to data.
- ❖ User-Friendly Interface: Providing an intuitive interface for both technical and non-technical users.

C) Data Backup and Recovery

- ❖ Automated Backups: Regular and automated backups to prevent data loss.
- ❖ Disaster Recovery Plan: A robust plan to recover data in case of system failure.

1.7. Non-Functional Requirements

A) Performance

- High Availability: Ensuring the system is operational 24/7 with minimal downtime.
- Latency: Minimizing response times for data queries.

B) Security

- Encryption: Implementing encryption for data at rest and in transit.
- Compliance: Adhering to local and international data protection regulations.

C) Scalability and Flexibility

- Horizontal and Vertical Scaling: Ability to scale the system as the user base and data volume increase.
- Adaptability: Flexibility to integrate with other systems and technologies.

1.8. Stakeholder Involvement

A) Key Stakeholders

- Internal IT Team: Responsible for implementation and maintenance.
- Data Analysts and Scientists: Users who require access to data for analysis.
- Customer Service Representatives: Frontline staff who interact with the system for customer inquiries.

B) Stakeholder Input

- Conducting interviews and surveys to gather input from various stakeholders to ensure the system meets their needs and expectations.

1.9. Purpose of a Database Management System in EthioTelecom

EthioTelecom, Ethiopia's largest telecom company, relies on effective data management through a Database Management System (DBMS) to support operations and strategic goals.

a) Efficient Data Management

EthioTelecom utilizes a DBMS for efficient data management, ensuring easy access to billing records, client information, and service data, thereby maintaining high service standards.

b) Improved Data Integrity and Security

Telecom companies prioritize data security and integrity through DBMS, which implements constraints, secures data, and provides strong security features to protect private client data from breaches and illegal access.

c) Enhanced Data Analysis and Reporting

EthioTelecom utilizes a DBMS for data analytics, enabling strategic planning, customer satisfaction enhancement, and service delivery streamlining, thereby enhancing consumer behavior and making informed business decisions.

d) Scalability and Flexibility

EthioTelecom's growth necessitates increased data management, which a DBMS offers for flexibility and scalability, ensuring efficient service delivery to its expanding clientele.

e) Streamlined Operations

EthioTelecom streamlines operating procedures using a DBMS, improving departmental cooperation, eliminating redundancy, and automating repetitive data processes, allowing for increased innovation, customer satisfaction, and reduced operating expenses.

In addition, database management systems are essential to EthioTelecom's operations. It facilitates sophisticated data analysis, provides scalability, ensures data security and integrity, facilitates efficient data administration, and streamlines processes. By employing a robust DBMS, EthioTelecom can maintain its position as Ethiopia's leading telecom provider, enhance service quality, and encourage business growth.

CHAPTER TWO

2. Methods and Materials

2.1. Introduction

Document review, interviews, internet source and observation were used to collect requirements. As one of four transformation objectives to address the quality and equitable distribution of Ethio telecom service delivery for everyone, Ethiopia is currently working to improve the Database Management System (DBMS) project on Ethio telecom.

2.1.1. Questionnaires

- The project was used questionnaires to collect data from all respondents in the selected sample.

2.1.2. Key Informant Interview

2.1.3. Focus Group Discussion

- Focus groups was used in this study to collect data on the Ethio telecom with the surrounding Telecom area and the environment.

2.1.4. Field Observation

- Field observation was conducted to collect data and verify the findings of the interviews.

2.2. Definition of Entity Design

Entity design is a crucial concept in database management, software engineering, and systems analysis, involving the creation and organization of entities to facilitate efficient data storage and manipulation.

A) Key Components of Entity Design

- 1. Entities:** Entities are distinct objects or concepts within a system, such as customers, products, orders, or employees, each with attributes describing their properties.
- 2. Attributes:** Attributes are data elements that define an entity's characteristics, such as a "Customer" entity having attributes like Name, Address, Email, and Phone Number.

3. Relationships: This aspect outlines the interactions between entities, ranging from one-to-one to many-to-many, depending on the nature of the association, like a "Customer" having a one-to-many relationship with "Orders."

4. Primary Keys: A primary key is a unique identifier for an entity, ensuring each instance can be uniquely identified, like "CustomerID" for the "Customer" entity.

5. Foreign Keys: Attributes, such as foreign keys, establish connections between two entities, ensuring data integrity and facilitating relationships between them.

C) Importance of Entity Design

- **Data Integrity:** Properly designed entities help maintain data integrity by minimizing redundancy and ensuring consistency across the database.
- **Scalability:** Well-structured entities allow for scalable systems that can grow and adapt to changing data requirements over time.
- **Efficiency:** Efficient entity design improves the performance of data operations, making data retrieval and manipulation faster and more reliable.
- **Clarity and Maintainability:** Clear entity design offers better understanding and maintainability of the system, making it easier for developers and analysts to work with the data structure.

D) Applications of Entity Design

- **Database Design:** Entity design is crucial in the creation of relational databases where entities are mapped to tables.
- **Software Development:** In object-oriented programming, entities often correspond to classes with attributes and methods.
- **Information Systems:** Systems analysts use entity design to create clear and effective data models that support business processes.

2.3. Implementation Details

a) Data Security

- ⊕ Implement encryption protocols for sensitive data
- ⊕ User authentication and access control measures
- ⊕ Regular data backups and disaster recovery plans

b) Data Retrieval and Reporting

- ⊕ Use of SQL queries for efficient data retrieval
- ⊕ Generation of reports for sales, service usage, and customer feedback

c) User Interface

- Develop a user-friendly web-based interface
- Dashboards for real-time analytics and visualization

2.4. Testing and Evaluation

- Conduct unit testing for individual database components
- Perform integration testing to ensure seamless interaction between modules
- Gather user feedback to refine and optimize the system

2.5. Data Analysis Methods

Data analysis is an essential part of every database management system (DBMS) project that guarantees efficient data organization, storage, retrieval, and manipulation. This calls for an organized strategy that combines a number of techniques to guarantee the accuracy and usefulness of the data. An example of the approaches commonly used in a DBMS project is provided below: Figure 3.1 below

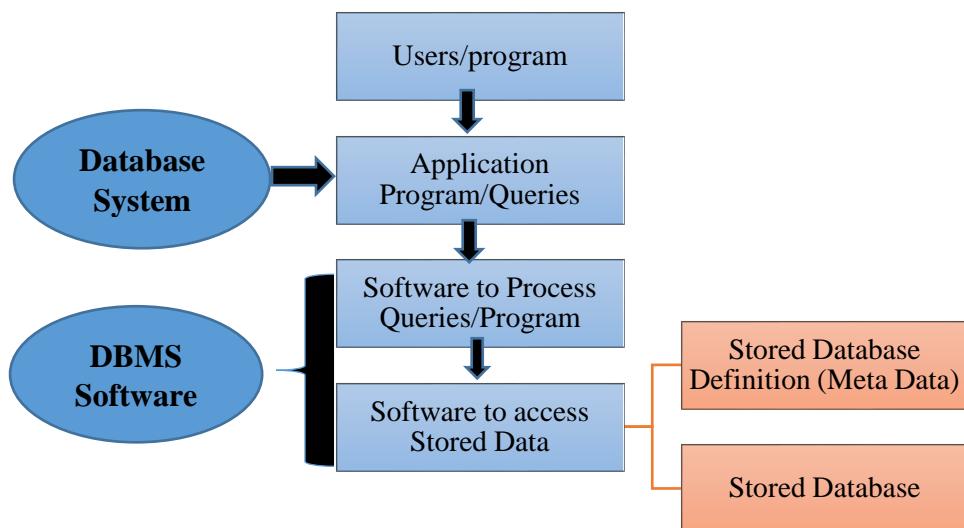


Figure 2. 1: Technological scheme of the project by Author,2024

2.6. Software used for project

Database software and operating system programming languages are examples of software requirements. For data extraction and data analysis preparation, Microsoft Office (Word, Excel, and PowerPoint) tools.

2.7. Attributes for Each Entity in Ethiotelecom's DBMS Project

In a database management system (DBMS) for Ethiotelecom, each entity has specific attributes that define and store its related data. These attributes are essential for organizing, managing, and retrieving data efficiently.

1. Customer

The **Customer** entity represents the individuals or organizations using Ethiotelecom services.

Key Attributes:

Customer ID: A unique identifier for each customer (e.g., C001).

Name: The full name of the customer (e.g., John Doe).

Address: The residential or office address of the customer.

Phone: The contact number of the customer.

Email: The email address for communication and notifications.

Purpose: To store customer details and track service usage, complaints, and billing.

2. Employee

The **Employee** entity represents Ethiotelecom's workforce responsible for operations and support.

Key Attributes:

Employee ID: A unique identifier for each employee (e.g., E001).

Name: The full name of the employee (e.g., Ahmed Ali).

Role: The job title or position of the employee (e.g., Customer Support, Technician).

Salary: The monthly salary of the employee.

Department: The department the employee belongs to (e.g., Customer Support, Technical).

Purpose: To manage staff details, including work assignments and roles in handling complaints.

3. Service

The **Service** entity represents the various services offered by Ethiotelecom.

Key Attributes:

Service ID: A unique identifier for each service (e.g., S001).

Type: The type of service (e.g., Mobile, Internet, Landline).

Cost: The monthly or one-time cost of the service.

Activation Date: The date the service was activated for the customer.

Purpose: To track details about the services subscribed to by customers.

4. Bill

The Bill entity represents billing information for customers

Key Attributes:

Bill_ID: A unique identifier for each bill (e.g., B001).

Amount: The total amount due for the billing cycle.

Date: The date by which the bill must be paid.

Status: The payment status of the bill (e.g., Paid, Unpaid).

Purpose: To manage customer billing and payment tracking.

5. Complaint

The Complaint entity records issues raised by customers.

Key Attributes:

Complaint ID: A unique identifier for each complaint (e.g., CMP001).

Customer ID: The ID of the customer who raised the complaint.

Description: A brief description of the complaint (e.g., Internet outage).

Date: The date the complaint was filed.

Status: The current status of the complaint (e.g., Resolved, Pending).

Purpose: To track customer complaints and monitor their resolution progress.

6. Payment

The Payment entity represents customer payments for their bills.

Key Attributes:

Payment ID: A unique identifier for each payment (e.g., P001).

Bill ID: The ID of the bill for which the payment was made.

Payment Method: The mode of payment (e.g., Credit Card, Cash).

Date: The date the payment was made.

Amount: The amount paid.

Purpose: To store payment details and associate them with bills for accurate financial tracking

2.8. Entities

The first step in ER Model is to identify the Entities of system or organization that we are;

The entity in any real-world object interest in having independent existence an entity can be person, place or concept.

The Six (6) main entities associated with the Ethiotelecom are:

1. Customer

The **Customer** entity represents individuals or organizations using Ethiotelecom's services. This entity stores customer-specific information like personal details, contact information, and identification for managing service subscriptions, billing, and complaints.

Example Table Structure

Customer ID	Name	Address	Phone	Email
C001	John Doe	Addis Ababa	0912345678	john@example.com
C002	Jane Smith	Hawassa	0923456789	jane@example.com

- ✓ Attributes: Customer ID, Name, Address, Contact Number, Email
- ✓ Primary Key: Customer ID
- ✓ Purpose: To store customer details and track service usage

2. Service

The **Service** entity represents the types of telecom services Ethiotelecom offers (e.g., mobile, internet, land line). It stores details like the service type, cost, and activation date for managing subscriptions.

Example Table Structure

Service ID	Type	Cost	Activation Date
S001	Mobile	100 ETB	2025-01-01
S002	Internet	300 ETB	2025-01-02
S003	Landline	50 ETB	2025-01-03

- ✓ Attributes: Service ID, Service Name, Description, Cost
- ✓ Primary Key: Service ID
- ✓ Purpose: To maintain data about the services offered by Ethiotelecom.

3. Billing

The **Billing** entity manages billing information, including the amount charged, due date, and payment status. It ensures accurate billing and tracks whether customers have settled their payments.

Table 2. 1: Example Table Structure for Billing

Bill ID	Customer ID	Amount	Due Date	Status
B001	C001	500 ETB	2025-01-15	Paid
B002	C002	300 ETB	2025-01-20	Unpaid

- ✓ Attributes: Billing ID, Customer ID, Service ID, Amount, Billing Date
- ✓ Primary Key: Billing ID
- ✓ Foreign Keys: Customer ID (references Customer), Service ID (references Service)
- ✓ Purpose: To track billing and payment statuses.

4. Employee

The **Employee** entity represents staff members responsible for providing services, handling complaints, and managing operations. This entity tracks information such as employee roles, departments, and salaries.

Table 2. 2: Example Table Structure for Employee

Employee ID	Name	Role	Salary	Department
E001	Ahmed Ali	Customer Support	10,000 ETB	Support
E002	Fatima Hassan	Technician	12,000 ETB	Operations

- ✓ Attributes: Employee ID, Name, Position, Department, Contact Number
- ✓ Primary Key: Employee ID
- ✓ Purpose: To record employee information and their roles in operations.

5. Complaint

The **Complaint** entity tracks customer grievances related to services, billing, or other issues. It helps prioritize and manage customer issues effectively to maintain satisfaction.

Table 2. 3: Example Table Structure for Complaint

Complaint ID	Customer ID	Description	Date	Status
CMP001	C001	Internet outage	2025-01-05	Resolved
CMP002	C002	Incorrect billing	2025-01-07	Pending

- ✓ Attributes: Complaint ID, Customer ID, Description, Date, Status.
- ✓ Primary Key: Complaint ID
- ✓ Foreign Key: Customer ID
- ✓ Purpose: To log customer complaints and monitor resolution progress.

6. Payment

The **Payment** entity records customer payments against bills. It includes details about the payment method, date, and amount, ensuring transparency in revenue collection.

Table 2. 4: Example Table Structure for Payments

Payment ID	Bill ID	Payment Method	Date	Amount
P001	B001	Credit Card	2025-01-10	500 ETB
P002	B002	Cash	2025-01-15	300 ETB

- ✓ Attributes: Payment ID, Bill ID, Payment Method, Date, Amount.
- ✓ Primary Key: Payment ID
- ✓ Foreign Key: Bill ID
- ✓ Purpose: To manage payment details and link them to bills. Complaint

2.9. Relationships

- Each **Customer** can subscribe to multiple **Services** (One-to-Many).
- Each **Service** can be offered to multiple **Customers** (Many-to-One)
- Each **Customer** receives multiple **Billings** for services (One-to-Many).
- Each **Employee** can manage multiple **Customers** (One-to-Many)
- Each **Customer** can file multiple **Complaints** (One-to-Many)
- Each **Payment** is associated with one **Bill** (Many-to-One)

CHAPTER THREE

3. Result and Discussion

Project ER Diagram and Table Database Management System (DBMS) for Ethio Telecom

3.1 Introduction

We will create an Entity-Relationship (ER) diagram and a database management system for Ethiopian Telecom in this project. Efficient management of employee records, billing information, service details, and custodial data is the goal. In addition to streamlining operations, this system will offer a strong foundation for data management.

3.1.1. Database Management System

Based on the ER diagram, we can create a relational database with the following tables:

Table 3. 1: Customer Table

Column Name	Data Type	Constraints
Customer ID	INT	PRIMARY KEY
Name	VARCHAR(100)	NOT NULL
Address	VARCHAR(101)	
Contact Number	VARCHAR(102)	NOT NULL, UNIQUE
Email	VARCHAR(103)	UNIQUE

Table 3. 2: Service Table

Column Name	Data Type	Constraints
Service ID	INT	PRIMARY KEY
Service Name	VARCHAR(100)	NOT NULL
Description	Text	
Cost	DECIMAL(10,2)	NOT NULL

Table 3. 3: Billing Table

Column Name	Data Type	Constraints
Billing ID	INT	PRIMARY KEY
Customer ID	INT	FOREIGN KEY
Service ID	INT	FOREIGN KEY
Amount	DECIMAL(10,2)	NOT NULL
Billing Date	DATE	NOT NULL

Table 3. 4: Employee Table

Column Name	Data Type	Constraints
Employee ID	INT	PRIMARY KEY
Name	VARCHAR(100)	NOT NULL
Position	VARCHAR(101)	
Department	VARCHAR(102)	
Contact Number	VARCHAR(103)	NOT NULL

Table 3. 5 : Complaint Table

Attribute	Data Type	Constraint
Complaint ID	INT	PRIMARY KEY
Customer ID	INT	FOREIGN KEY (FK)
Description	TEXT	NOT NULL
Date	DATE	NOT NULL
Status	VARCHAR(20)	CHECK (Status IN ('Open', 'Resolved'))

Table 3. 6: Payment Table

Attribute	Data Type	Constraint
Payment ID	INT	PRIMARY KEY
Bill ID	INT	FOREIGN KEY (FK)
Payment Method	VARCHAR(50)	CHECK (Payment Method IN ('Cash', 'Card', 'Online'))
Date	DATE	NOT NULL
Amount	DECIMAL(10,2)	NOT NULL

3.1.2 ER Diagram

The ER diagram is a blueprint for the database structure, illustrating the relationships between different entities. Here's an outline of the key entities and their relationship

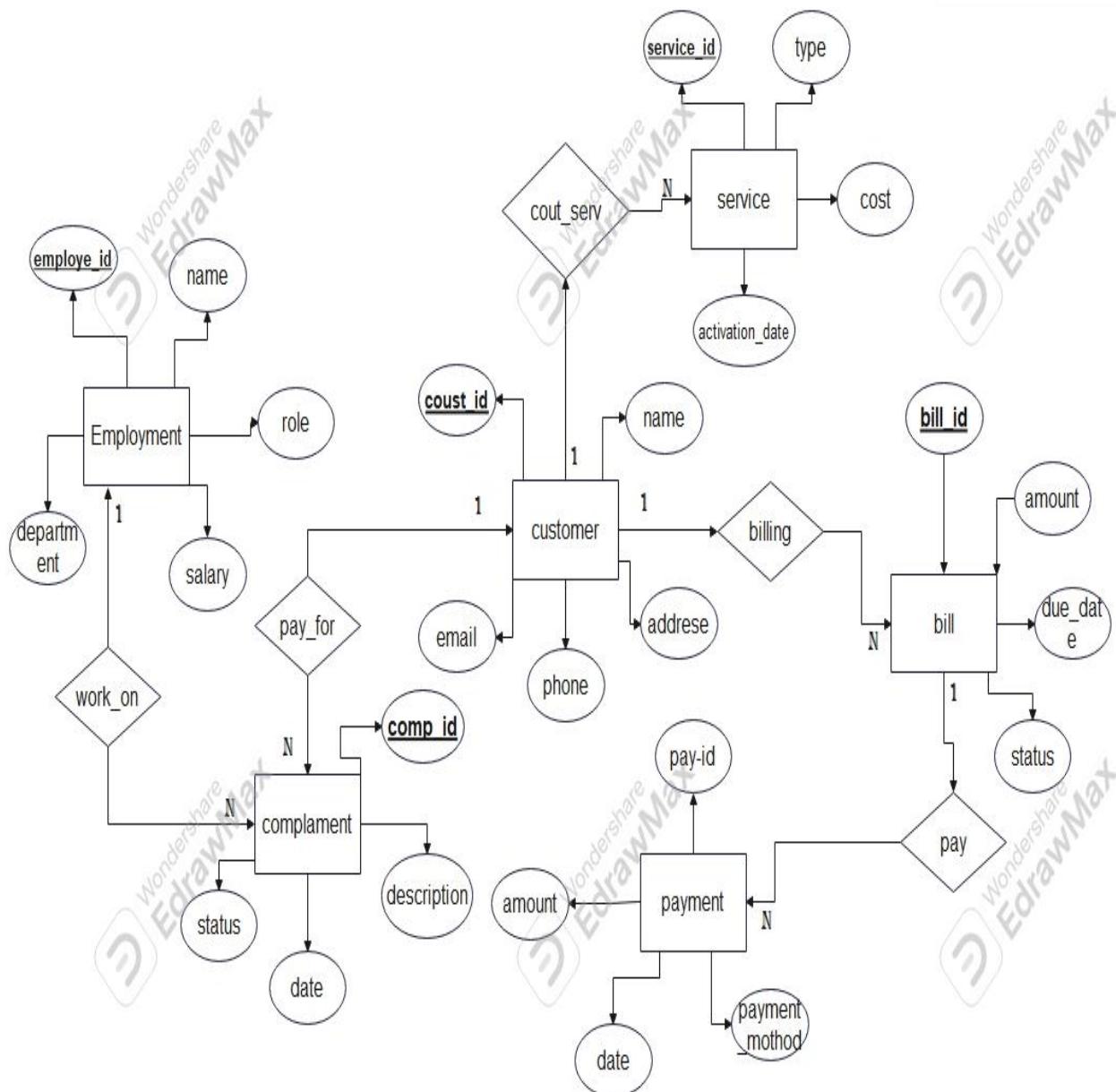


Figure 2. 2: Technological ER Diagram scheme of the project by EdrawMax

CONCLUSION

In conclusion, as entity design establishes the framework for data organization, storage, and access, it is an essential stage in the creation of any data-driven system. The effective deployment of a database management system will transform EthioTelecom's capacity to handle data. It will offer a safe and scalable platform that improves operational effectiveness and customer happiness. EthioTelecom can keep its competitive advantage in the telecom sector by utilizing the potential of a well-designed DBMS.

To solve these problems, a methodical strategy is required, one that includes investing in state-of-the-art technologies, training employees, and enhancing security protocols. By overcoming these challenges, Ethio Telecom can enhance its database management abilities and improve customer happiness and service delivery.

The creation of an effective, safe, scalable, and user-friendly system must be the main goal of the requirements study for Ethio Telecom's DBMS. Ethio Telecom can make sure that its data management system advances its service delivery and supports its goal by attending to both functional and non-functional criteria.

For Ethio Telecom, the ER diagram and table structures offer a thorough method of data management. Ethio Telecom will be able to handle massive volumes of data with ease thanks to this system's scalable and reliable structure, which guarantees effective data management, retrieval, and storage. This will boost operational efficiency and customer satisfaction.