LOW LEVEL DESIGN (LLD)

DELOITTE CASE STUDY

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Contents

1. **Introduction** 4
    1.1 What is a Low-Level Design Document? 4
    1.2 Scope 4
2. **Architecture** 4
3. **Architecture Description** 6
    3.1 Data Description 6
    3.2 Data Transformation 8
    3.3 Power BI Configuration 8
    3.4 Deployment 9

1. Introduction

1.1 What is a Low-Level Design Document?

The Low-Level Design (LLD) document is a comprehensive technical blueprint detailing the internal structure, logic, and implementation processes of the system. It provides a granular breakdown of the Expenditure Data Analysis dashboard, ensuring accurate translation of high-level designs into functional and operational code. This document incorporates detailed class diagrams, relationships, methods, and specifications to support developers in both coding and deployment stages.

1.2 Scope

The LLD acts as a step-by-step guide for structuring data, developing the system architecture, writing source code, and optimizing performance. It refines the data organization established during the requirement analysis phase, aligning it with design objectives to deliver a scalable, robust solution.

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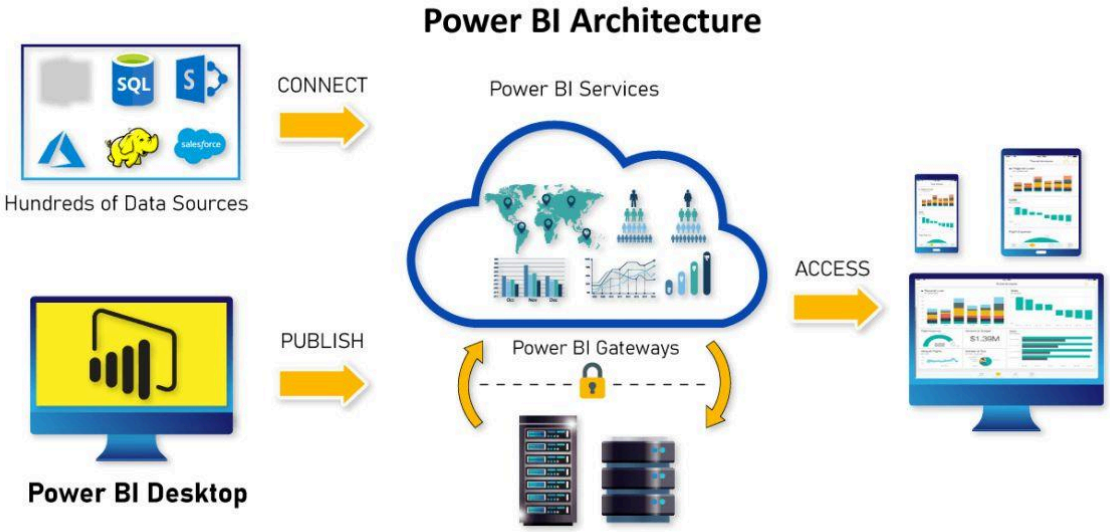
2. Architecture

Power BI Architecture

Power BI's functional architecture outlines the end-to-end workflow of data processing and visualization. Key components include:

1. **Data Sources**:
    - Data is sourced from The World Bank and includes datasets on CPI (Consumer Price Index), Exchange Rates, and Exports spanning 200 countries.
2. **Data Ingestion**:
    - Raw data is imported into the system for preprocessing and organization.
3. **Data Transformation**:
    - Data undergoes cleaning, structuring, and enrichment to prepare it for analysis.
4. **Data Warehouse**:
    - A centralized repository stores structured data optimized for querying and reporting.
5. **Semantic Models**:
    - Relationships and calculations are defined to enable advanced analytics and visualizations.

6. **Interactive Dashboards**:
    - Power BI dashboards provide visual representations of trends, KPIs, and comparative analyses.
7. **End Users**:
    - Stakeholders, such as analysts and decision-makers, access actionable insights through interactive dashboards.



Microsoft Power BI Desktop is a companion desktop application to Power BI.

With Power BI Desktop, you can:

1. **Data Discovery:**

The Power BI Desktop simplifies data exploration. You can import data from various sources and shape it to suit your analysis and reporting requirements.

2. **Data Relationships and Enrichment:**

When importing multiple tables, you often need to establish relationships between them. The Power BI Desktop offers the Manage Relationships dialog and the Relationships view. You can use Autodetect to let the software find and create relationships, or you can manually create them. Additionally, you can easily create your own measures, calculations, and customize data formats and categories to enhance your data for deeper insights.

3. **Report Creation:**

The Power BI Desktop provides the Report View, where you can select the fields you want, apply filters, and choose from a wide range of visualizations. You can format your reports with custom colors, gradients, and other options, similar to the tools available on PowerBI.com.

4. **Report Saving:**

Save your work as a Power BI Desktop file (.pbix extension) to preserve your progress.

5. **Report Upload and Publishing:**

Upload your reports created and saved in the Desktop to your Power BI site or publish them directly from the Power BI Desktop.

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3. Architecture Description

3.1 Data Description

The data used for this project is sourced from The World Bank and includes time-series data on CPI (Consumer Price Index), Exchange Rates, and Exports (in millions) for 200 countries. The data is provided in an unstructured format, meaning it requires significant preprocessing to make it usable for analysis and visualization.

Key characteristics of the data:

- **Consumer Price Index (CPI)**: The Consumer Price Index data measures the average change over time in the prices paid by urban consumers for goods and services.

- **Exchange Rates**: The exchange rate represents the value of one currency in relation to another. It determines how much of one currency is required to buy a unit of another currency, often benchmarked against the US Dollar.

- **Exports**: Exports refer to goods or services produced in one country and sold to another. It is a critical component of international trade and a measure of economic growth.

- **Inflation:** Inflation refers to the rate at which the general price level of goods and services rises over time, reducing the purchasing power of money. It is typically measured using indices like the Consumer Price Index (CPI) or the Wholesale Price Index (WPI).

Formula for Inflation Rate:

$$\text{Inflation Rate} = \frac{\text{Current CPI} - \text{Previous CPI}}{\text{Previous CPI}} \times 100$$

- **Year-over-Year (YoY):** YoY is a method of comparing data points for a specific period with the same period in the previous year. It is commonly used to assess trends in financial and operational performance over time, eliminating seasonal effects.

Formula for YoY Growth:

$$\text{YoY Growth} = \frac{\text{This Year Value} - \text{Last Year Value}}{\text{Last Year Value}} \times 100$$

- **Compound Annual Growth Rate (CAGR):** CAGR represents the mean annual growth rate of an investment, revenue, or value over a specified period, assuming the growth occurs at a steady, compounded rate. It is a critical financial metric used for comparing the performance of investments or analyzing business growth over time.

Formula:

$$\text{CAGR} = \left(\frac{\text{EV}}{\text{BV}}\right)^{\frac{1}{n}} - 1 \times 100$$

Where:

- **EV** = Ending Value
- **BV** = Beginning Value
- **n** = Number of years

3.2 Data Transformation

Data transformation refers to the process of converting raw data into a clean, structured format suitable for analysis. The following steps will be followed in the data transformation process:

1. **Data Cleaning**:
    - Identify and handle missing or incorrect data (e.g., NULL values).
    - Remove duplicate records and irrelevant data.
    - Standardize the data (e.g., ensuring that all time periods are represented consistently).
2. **Data Structuring**:
    - Organize the data by country and time period.
    - Create separate datasets for each variable (CPI, Exchange Rate, Exports) to make it easier for analysis and visualization.
    - Convert the data into time-series format, where each row represents a specific country and time period.
3. **Data Aggregation**:
    - Aggregate the data into relevant time periods (monthly, quarterly, yearly) depending on user selection.
    - Ensure that the data can be dynamically updated based on the slicer filters.

3.3 Power BI Configuration

Power BI will be used to create the financial analysis dashboard. The following steps describe the configuration process:

1. **Data Import**:
    - Import the transformed data into Power BI using Power Query.
    - Create relationships between the different datasets (CPI, Exchange Rate, Exports) to ensure they can be analyzed together.
2. **Slicer Configuration**:
    - Add slicers for country and time period to allow users to filter the data. These slicers will dynamically update the visualizations based on the user's selections.
3. **Visualization Creation**:
    - Create visualizations for the key metrics (CPI, Exchange Rate, Exports) using Power BI's graphing tools, such as line charts, bar charts, and scatter plots.
    - Implement trend analysis by showing historical changes in these variables for each country.
    - Ensure that each visualization updates in real-time based on the slicer settings.

4. **Advanced Analysis Configuration**:
    - Implement calculations for YoY (Year-over-Year) growth and CAGR (Compound Annual Growth Rate) within Power BI.
    - Use DAX (Data Analysis Expressions) formulas to calculate these metrics dynamically based on the selected time period and country.

3.4 Deployment

Once the dashboard is created and configured, it will need to be deployed for access by users. The deployment process involves:

1. **Environment Setup**:
    - Deploy Power BI reports on Power BI Service or an on-premises Power BI report server.
    - Ensure the environment is configured to handle the data size and user traffic.
2. **Access Control**:
    - Set up access permissions to ensure only authorized users can access the dashboard.
    - Configure roles for users to control what data and features they can view.
3. **Monitoring and Maintenance**:
    - Regularly monitor the system to ensure it is working correctly, checking for performance issues or errors.
    - Set up automatic data refresh to keep the dashboard up to date with the latest data from The World Bank.
4. **User Training**:
    - Provide training to users on how to use the dashboard effectively.
    - Create user documentation and tutorials to help users understand the functionality and the types of analyses they can perform.