Business Intelligence

Unit 1

Syllabus Contents:

Business Intelligence Introduction, BI Cycle, BI Architecture, Opportunities, Benefits of BI. Role of Mathematical model, Factors Responsible for successful BI Project, Obstacle to Business Intelligence in an Organization.

Business Intelligence Introduction

The advent of **low-cost data storage technologies** and the **wide availability of Internet connections** have made it easier for individuals and organizations to **access large amounts of data.** Such data are **often heterogeneous** in **origin, content and representation**.

Their accessibility **opens up promising scenarios and opportunities, and raises a question?**

Is it possible **to convert such data into information and knowledge** that can then be **used by decision makers to aid and improve** the governance of enterprises and of public administration?

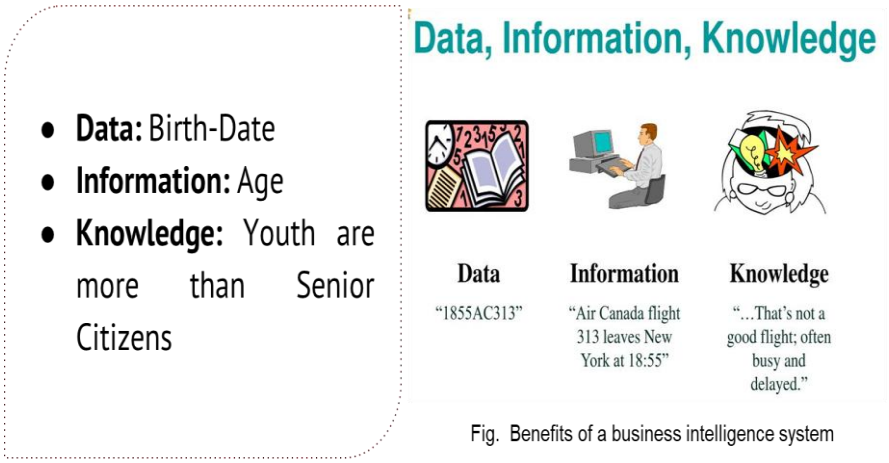


Fig. Benefits of a business intelligence system

Data

• A **structured codification of single primary entities**, as well as of **transactions involving two or more primary entities**.

For example: for a retailer data refer to primary entities such as **customers, points of sale and items, while sales receipts represent the commercial transactions.**

Information

• Information is the **outcome of extraction and processing activities carried out on data**, and it **appears meaningful** for those who receive it in a specific domain.

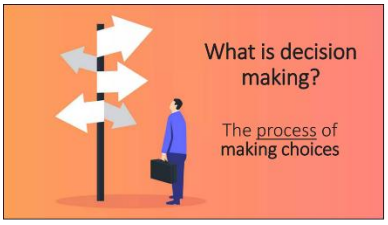
For example, to the sales manager of a retail company, the **proportion of sales receipts in the amount of over 100 per week**, or the number of **customers holding a loyalty card who have reduced by more than 50%** the monthly amount spent in the last three months, represent meaningful pieces of information that can be extracted from raw stored data.

Knowledge

Information is transformed into knowledge when it is used to make decisions and develop the corresponding actions.

• Therefore, we can think of knowledge as consisting of information put to work into a specific domain, enhanced by the experience and competence of decision makers in tackling and solving complex problems.

• For a retail company, a sales analysis may detect that a group of customers, living in an area where a competitor has recently opened a new point of sale, have reduced their usual amount of business.

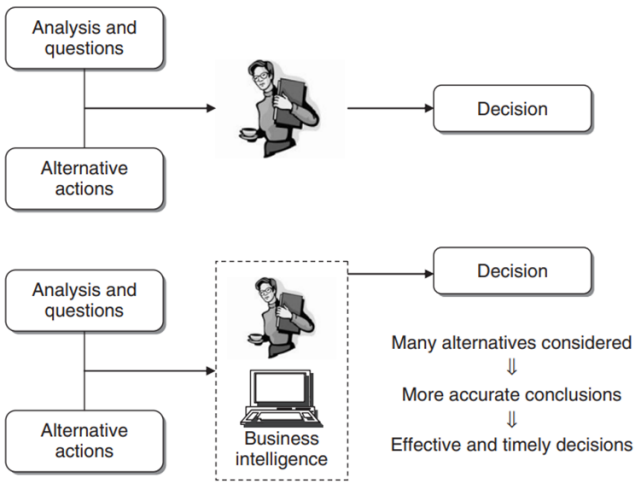


Business Intelligence (BI) is the **process of transforming raw data into actionable insights** that **inform strategic and tactical business decisions**.

Strategic decisions focus on long-term goals and overall direction, while tactical decisions concentrate on the short-term actions needed to implement those strategies

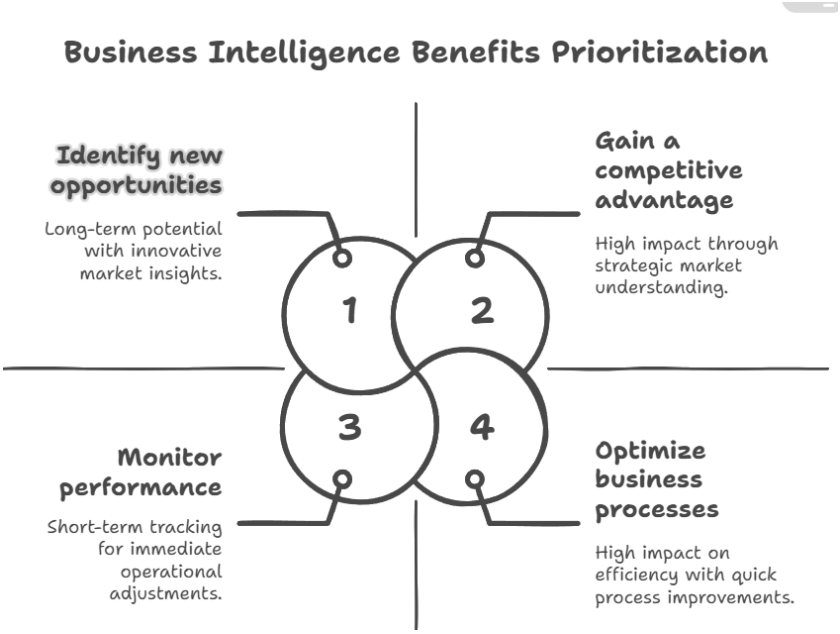
It encompasses the technologies, applications, and practices used to **collect, integrate, analyze, and present business information.**

Think of it as a system that helps businesses understand **what happened, why it happened, what is happening now, and what might happen in the future.**



Instead of relying **on gut feelings or anecdotal evidence**, BI provides data-driven insights that enable organizations to:

- **Improve decision-making:** By providing **accurate and timely information**, BI helps managers make **informed decisions based on facts rather than assumptions**.
- **Identify new opportunities: Analyzing data can reveal hidden trends and patterns** that point to **new market opportunities or areas for innovation.**
- **Optimize business processes:** BI can help **identify bottlenecks and inefficiencies** in business processes, **leading to improvements in productivity and cost savings**.
- **Gain a competitive advantage**: By understanding **their customers, markets, and competitors better, organizations can gain a significant competitive edge**.
- **Monitor performance:** BI dashboards and reports **provide a real-time view of key performance indicators (KPIs), allowing managers to track progress towards goals and identify potential problems** early on.



Traditional BI Vs Modern BI

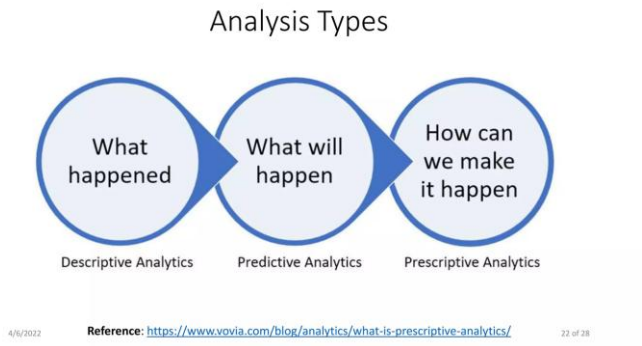
Traditional BI	Modern BI
Traditional BI often **depended on IT teams** to access data, which **made it harder for business users to get the results they needed**.	Modern BI **makes it easy for business users by giving them access to data and the tools** they need, especially AI tools, to **quickly achieve the desired results.**
Traditional BI, business users **often had to wait for reports**, which could mean the information **was outdated by the time they received it.**	With modern BI, business users can access accurate, **up-to-date information whenever** they need it.
Traditional BI is **time-consuming and involves delays.**	Modern BI allows **quick access to data**.
Traditional BI often results in **inconsistent data usage, which can create confusion and errors.**	Modern BI **ensures consistent data use**, so everyone has access to the **same reliable information.**
Traditional BI platforms mostly focused on giving users **detailed historical reports and user-friendly ad-hoc analysis tools.**	Modern BI focuses on **real-time data analysis and advanced tools for in-depth insights and predictive analytics.**
Traditional BI often required access from **specific locations or devices**, making it	Modern BI makes it **easy for your team to access data and insights from anywhere,**

harder to get data on the go.	on any device.

S. No.	Factor	Data Science	Business Intelligence
1.	Concept	It is a field that uses **mathematics, statistics and various other tools to discover the hidden patterns in the data.**	It is basically a **set of technologies, applications and processes that are used** by the enterprises for business data analysis.
2.	Focus	It focuses **on the future.**	It focuses on the **past and present.**
3.	Data	It deals with **both structured as well as unstructured data**.	It mainly deals only with **structured data**.
4.	Flexibility	Data science is much more **flexible as data sources can be added as per requirement**.	It is **less flexible as in case of business intelligence data sources need to be pre-planned.**
5.	Method	It makes use of the **scientific method.**	It makes use of the **analytic method.**
6.	Complexity	It has a **higher complexity** in comparison to business intelligence.	It is **much simpler** when compared to data science.
7.	Expertise	It's **expertise is data scientist**.	It's expertise is the **business user.**
8.	Questions	It deals with the **questions of what will happen and what if**.	It deals with the **question of what happened.**
9.	Storage	The data to be used is **disseminated in real-time clusters**.	Data warehouse is utilized **to hold data**.
10.	Integration of data	The ELT (Extract-Load-Transform) process is generally used for the integration of data for data science applications.	The ETL(Extract Transform-Load) process is generally used for the integration of data for business intelligence applications.
11.	Tools	It's tools are **SAS, BigML, MATLAB, Excel, etc**.	It's tools are InsightSquared Sales Analytics, Klipfolio, ThoughtSpot, Cyfe, TIBCO Spotfire, etc.
12.	Usage	Companies can **harness their**	Business Intelligence helps

S. No.	Factor	Data Science	Business Intelligence
		potential by anticipating the future scenario using data science in order to reduce risk and increase income.	in performing **root cause analysis on a failure** or to understand the current status.
13.	Business Value	Greater business value is achieved with data science in comparison to business intelligence as it anticipates future events.	Business Intelligence has lesser business value as the extraction process of business value carries out statically by plotting charts and KPIs (Key Performance Indicator).
14.	Handling data sets	The technologies such as Hadoop are available and others are evolving for handling understanding Its large data sets.	The sufficient tools and technologies are not available for handling large data sets.

Three major types of data analysis **used in Business Intelligence and Data Science**



1. Descriptive Analytics

Question Answered: *"What happened?"*

Explanation: Descriptive analytics focuses **on summarizing historical data** to understand changes that have occurred in a business. It uses **data aggregation and data mining techniques to give insight into the past.**

Examples:

- Monthly sales reports
- Website traffic summaries
- Customer satisfaction trends
- Financial statements analysis
- Number of products sold last year

2. Predictive Analytics

Question Answered: "What will happen?"

Explanation:

Predictive analytics uses **statistical models and machine learning techniques on historical data to predict future outcomes.** It identifies trends, correlations, and likely scenarios.

Examples:

- Forecasting sales for the next quarter
- Predicting customer churn
- Risk assessment in insurance
- Demand forecasting in supply chain
- Predicting equipment failure in manufacturing

3. Prescriptive Analytics

Question Answered: *"How can we make it happen?"*

Explanation:

Prescriptive analytics goes beyond predicting future outcomes by suggesting actions to achieve desired outcomes. It often involves optimization and simulation algorithms.

Examples:

- Recommending the best marketing campaign to increase conversions
- Suggesting inventory levels to minimize storage cost and avoid stock-outs
- Route optimization for delivery trucks
- Personalized recommendations in e-commerce platforms
- Dynamic pricing strategies for airlines or hotels

Summary Table

Analysis Type	Focus	Key Question	Example Use Case
Descriptive Analytics	Past Data	What happened?	Sales report for Q1
Predictive Analytics	Future Trends	What will happen?	Forecast next month's customer demand
Prescriptive Analytics	Decision-Making	How can we make it happen?	Optimize staffing levels during peak seasons

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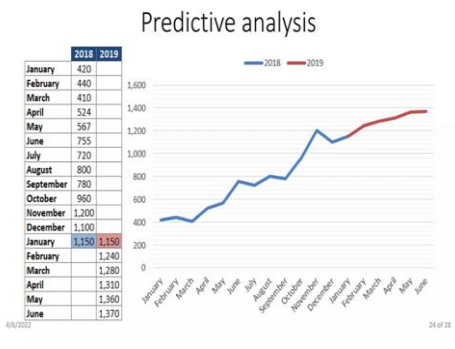
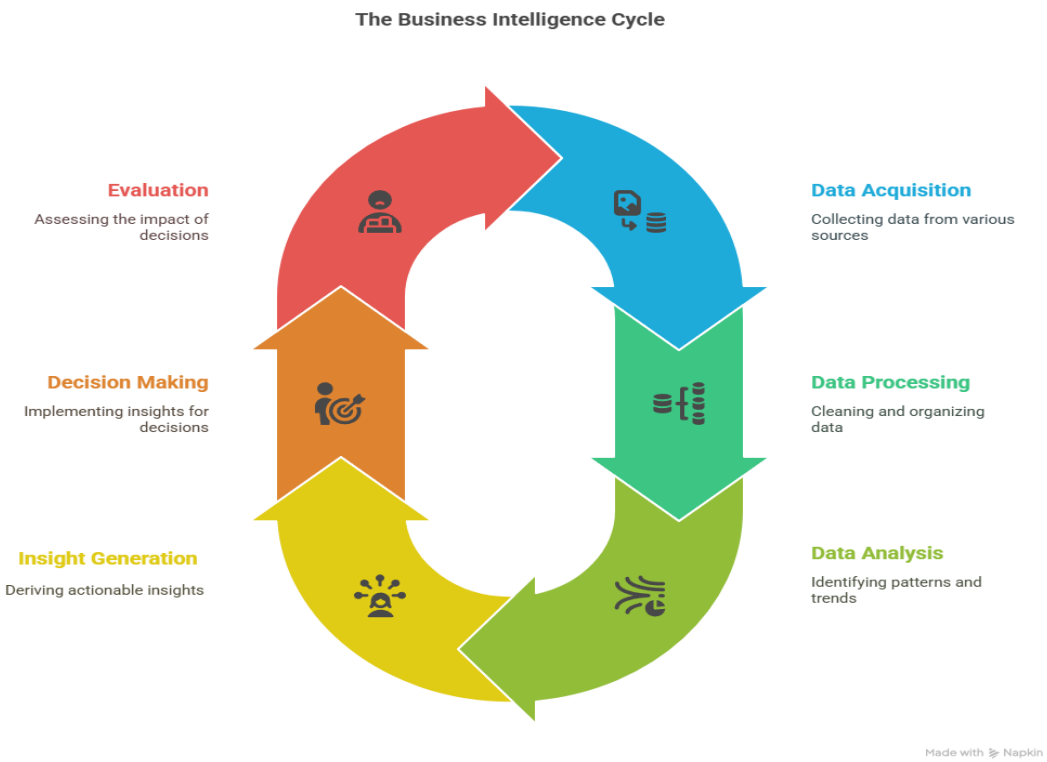
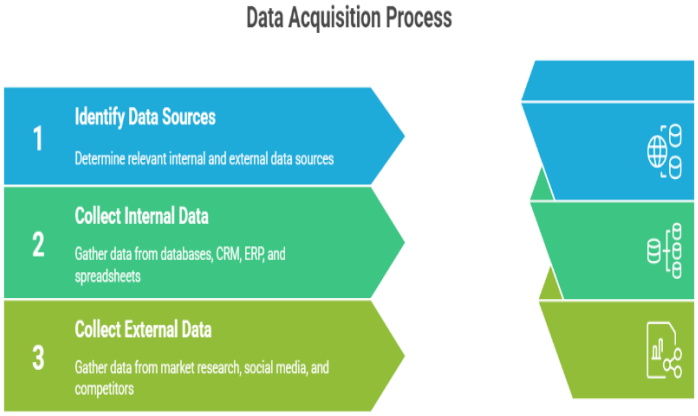


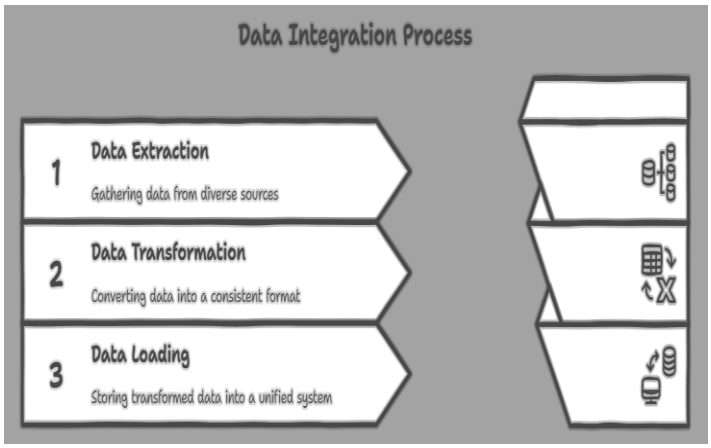
What is the Business Intelligence Cycle?

The Business Intelligence cycle is a continuous process that involves several key stages, each contributing to the overall goal of transforming data into actionable insights? These stages are:

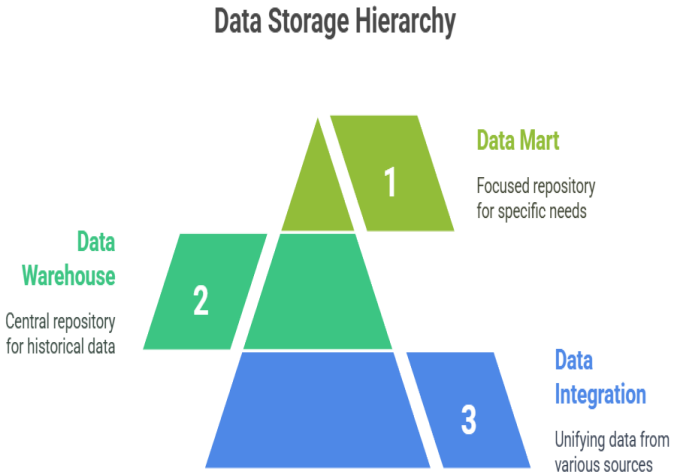




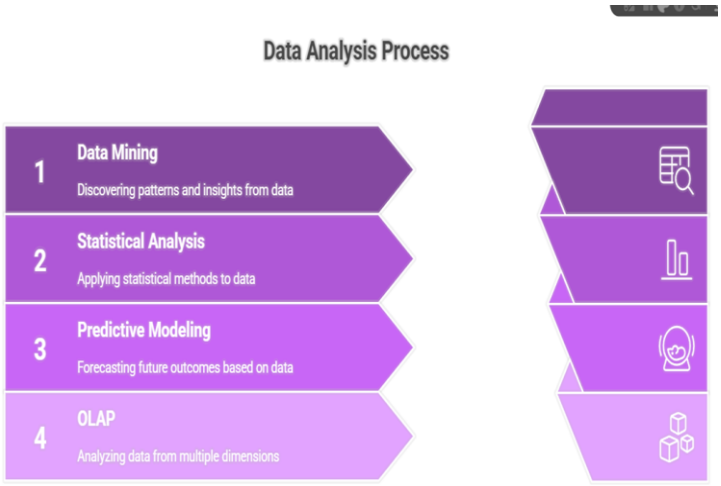
This stage involves **identifying and collecting data** from various sources, both **internal and external.** Internal sources may include **databases, CRM systems, ERP systems, and spreadsheets.** External sources can **include market research reports, social media feeds, and competitor data.**



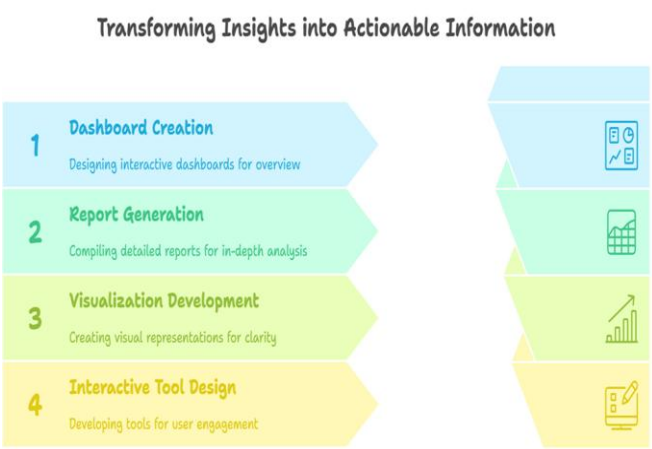
Once the data is acquired, it needs to be **integrated into a unified format.** This involves **cleaning, transforming, and consolidating** data from different **sources to ensure consistency and accuracy**. **ETL (Extract, Transform, Load)** processes are commonly used in this stage.



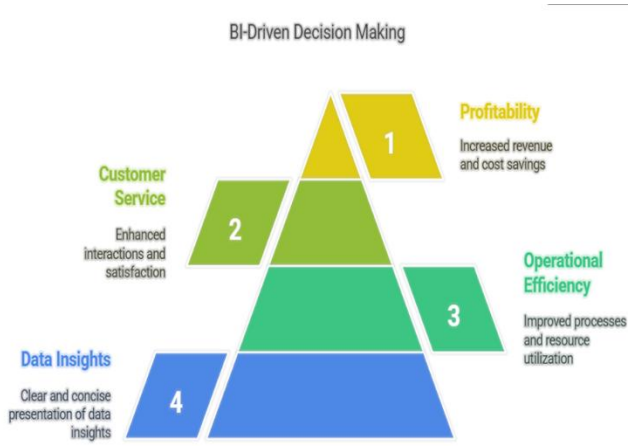
The **integrated data** is then **stored in a data warehouse or data mart.** A **data warehouse is a central repository for storing large volumes of historical data**, while a **data mart is a smaller**, more **focused repository that caters to the specific needs of a particular department or business unit**.



This stage involves using various **analytical techniques** to extract **meaningful insights from the data**. These techniques may include **data mining, statistical analysis, predictive modeling, and OLAP (Online Analytical Processing).**

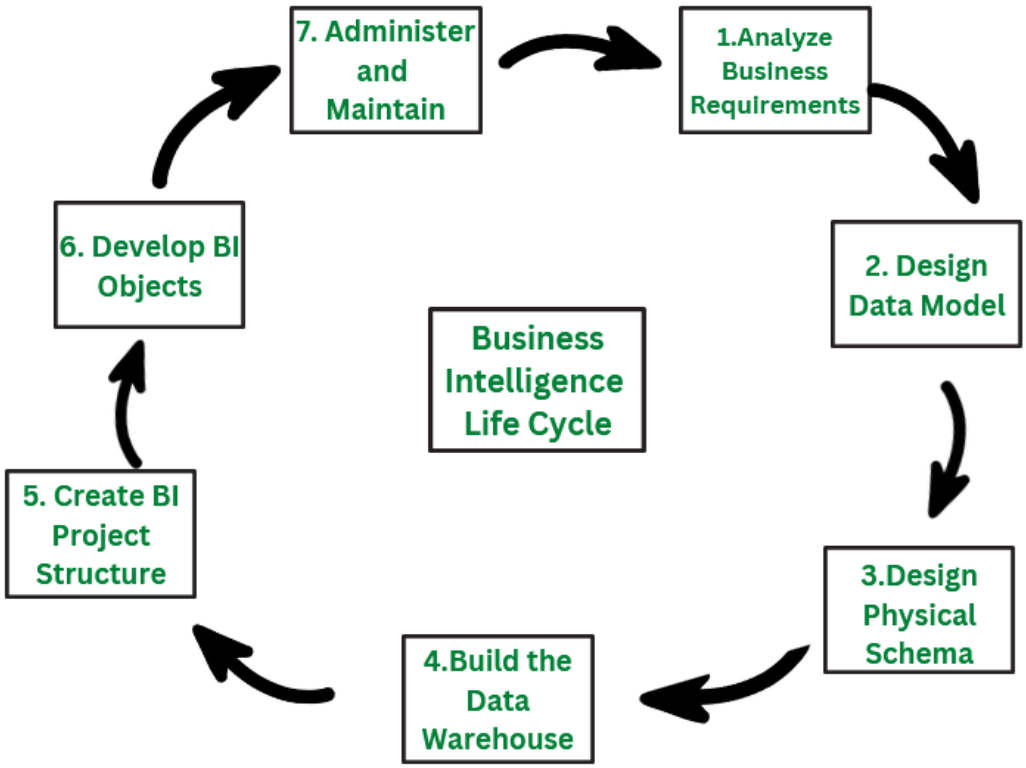


The insights derived from data analysis are then presented **to users in a clear and concise format.** This can be done through **dashboards, reports, visualizations, and other interactive tools.**



Finally, the insights **are used to inform decision-making at all levels** of the organization. This can lead to **improved operational efficiency, better customer service, and increased profitability.**

Phases of Business Intelligence Life Cycle



Business Intelligence Life Cycle

Phase 1: Analyze Business Requirements

The user **identifies the business requirements in order to determine the type of analysis** that the user then needs to perform.

Phase 2: Design Data Model

Once the requirements are identified the user needs to design the logical model according to the requirements. This **logical model helps the user to analyse the relationships that exist within the data entities.**

Phase 3: Design the Physical Schema

Once the **logical model is prepared the next step is to design the physical schema** using the data model. The physical schema **describes the structure and the content of the data warehouse.**

For example, in any retail company, physical schema consists of sales-related facts, product-customer relationships, and the sales transactions

Phase 4: Build the Data Warehouse

The **design of a data warehouse depends on the physical and logical schema**. After the design of the data warehouse, the **data and the content from the source system are loaded into the data warehouse for further steps.**

For example, for the retail system, designing the data warehouse consists of developing a database that would store the details of customers, products, and other requirements for the business.

Phase 5: Create the Project Structure (Metadata)

The next step after designing the data warehouse is to create a project structure also known as metadata. With the help of **this created project structure, the mapping of the tables and data in the data warehouse is easier.** Creating the project structure describes the further **steps and types that need to be implemented.**

For example, The project structure of the retail company consists of the attributes of the data, the design, and the working flow of the system. This project structure or metadata gives a brief idea about the working of the system.

Phase 6: Develop the BI Objects

The next step is to develop the BI objects such as **metrics, attributes, dashboards, reports, and facts**. For example, the retail company can **develop reports and statistics charts** that can describe the **profit and loss margins.**

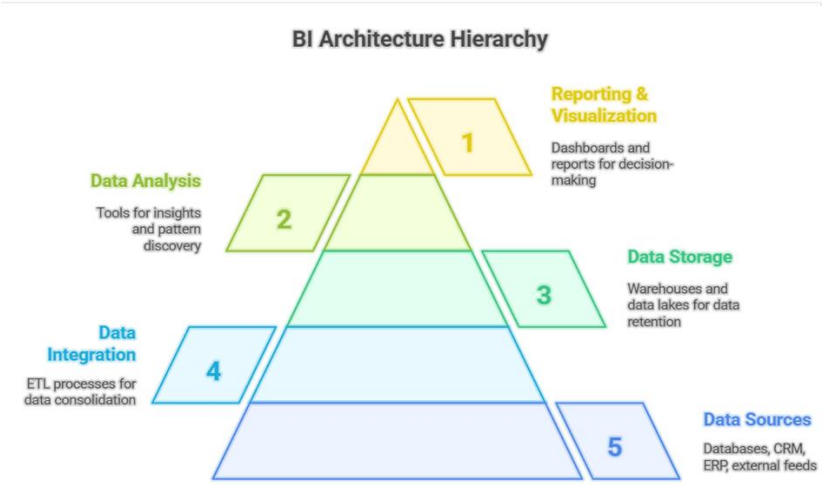
Phase 7: Administer and Maintain the Project

The last step is to **administer and maintain the project continuously as it undergoes changes**. The project needs to be monitored to **maintain the changes, security, and performance of the system.**

For example, the retail company needs to monitor the reports and statistics accordingly to increase the profit of the sales.

BI Architecture:

A typical BI architecture consists of several key components that work together to support the BI cycle. These components include:



There's no one-size-fits-all approach to BI architecture. What works for one organization might not work for another.

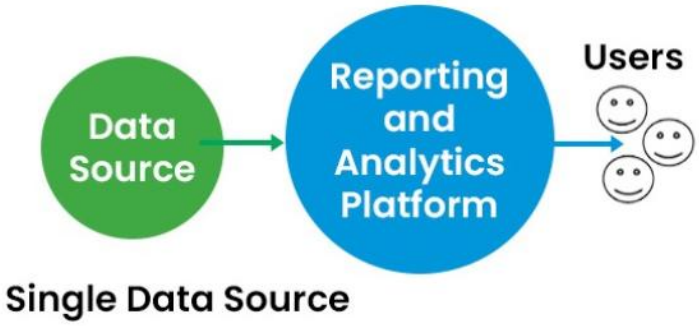
Architecture Categories

These architectures typically fall into two categories −

- Data-in-place BI Architectures − Where data is analyzed where it resides.
- Data Repository-based BI Architectures − Where data is moved to a central repository for analysis.

Architecture 1

In this architecture, **there is only one data source**, and the data source supplies the data in **the form of static reports to the next step which is the reporting and analytics platform**.



A Reporting and Analytics Platform (RAP) offers a more robust solution. It supports various types of outputs including static reports, accurate pixel-perfect reports, data analysis, and dynamic visualizations.

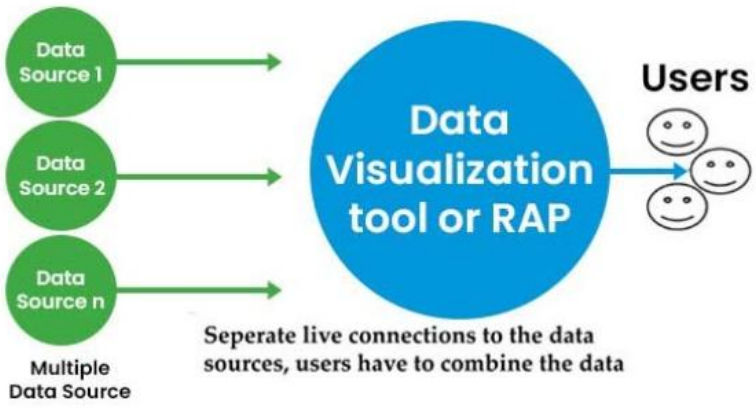
RAP also provides multiple ways to deliver these reports, such as via email, FTP/SFTP or through a portal. It also includes features like role-based access just to ensure the right people see the right data and offers different tools made for both developers and end-users.

Example

A sales team might receive a monthly PDF report with sales figures while a data analyst could use the RAP to create and explore custom visualizations based on real-time data.

Architecture 2

In the earlier architectures, we focused on using just one data source. In Architecture 2, while there are **multiple data sources**, the data from these **sources isn't merged together**. Different **users might access these separate data sources using the same frontend tool** but **if they need to combine data from different sources they have to do it themselves**.

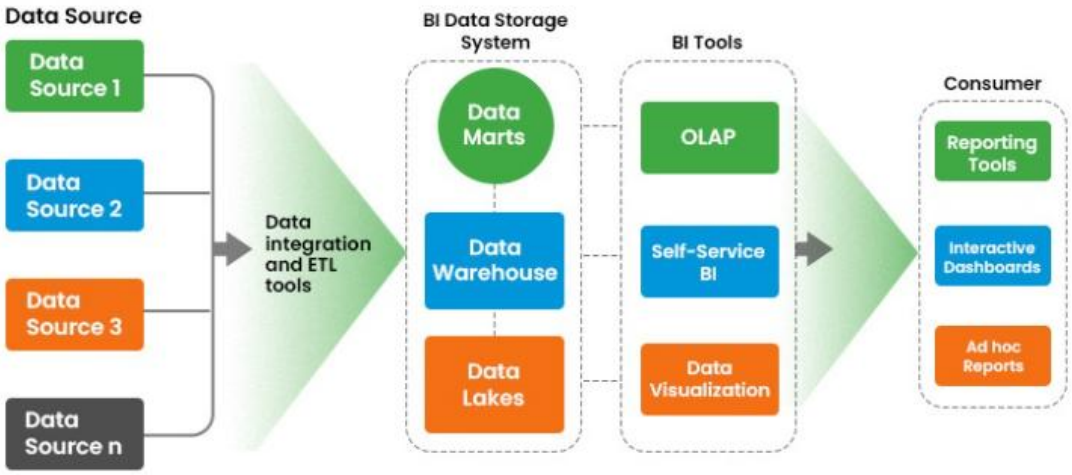


Example

A marketing team might pull customer data from one source and sales data from another using the same dashboard but they'd need to manually combine this information to get a complete view.

Architecture 3

The BI architecture given above consists of multiple components working together to turn raw data into useful information. The core systems that hold operational and transactional data are known as data sources. This data is cleaned and prepared for analysis with the aid of data integration tools, especially ETL. After all the data is prepared the data is kept in operational data stores, data lakes, and data warehouses.



After that BI tools evaluate and present the data to assist users in identifying patterns and reaching choices. Tools for information distribution make it easy to work with this data giving you access to real-time information and in-depth views.

Opportunities with BI Architecture

- **Data-Driven Decision Making:**

BI architecture enables organizations **to move away from relying on gut feeling** and **towards making decisions based on facts and insights** derived from data.

- **Improved Efficiency:**

By automating data collection, processing, and reporting, BI can streamline workflows, reduce manual effort, and save time.

- **Enhanced Collaboration:**

BI platforms can facilitate collaboration among different teams and departments by providing a shared view of data and insights.

- **Increased Scalability:**

BI architecture can be designed to scale with the growing needs of an organization, accommodating increasing data volumes and user demands.

- **Competitive Advantage:**

By identifying trends, patterns, and opportunities, BI can help organizations gain a competitive edge by responding to market changes and customer needs more effectively.

- **Better Customer Service:**

BI can provide insights into customer behavior and preferences, enabling organizations to provide better customer service and build stronger customer relationships.

- **Risk Mitigation:** BI can help organizations identify and mitigate potential risks, such as fraud and compliance violations.

Benefits of BI Architecture:

- **Faster Insights:**

BI architecture enables faster access to data and insights, allowing for quicker decision-making and response times.

- **Improved Data Quality:**

BI tools can help identify and correct data errors, improving the accuracy and reliability of information.

- **Reduced Costs:**

By streamlining processes and optimizing resource allocation, BI can help reduce operational costs and improve profitability.

- **Enhanced Customer Satisfaction:**

Understanding customer behavior and preferences through BI can lead to improved products and services, ultimately enhancing customer satisfaction.

- **Increased Agility**: BI enables organizations to respond quickly to changing market conditions.

- **Better Risk Management:**

BI can help identify potential risks and vulnerabilities, allowing organizations to take proactive measures to mitigate them. In essence, a well-designed BI architecture empowers organizations to leverage their data assets for strategic advantage, operational efficiency, and improved decision-making.

Role of Mathematical Models in BI

Mathematical models play a crucial role in business intelligence (BI) by enabling data-driven decision making through analysis, prediction, and optimization. Successful BI projects hinge on factors like data quality, user adoption, and effective project management. Obstacles to BI implementation include data silos, lack of skilled personnel, and inadequate infrastructure, hindering the realization of its full potential within an organization.

These models can be used to:

- Identify patterns and relationships in data.
- Forecast future trends.
- Optimize resource allocation.
- Simulate different scenarios.
- Support decision-making.

Factors Responsible for Successful BI Projects:

- **Clear Objectives and Vision:**

Defining specific, measurable, achievable, relevant, and time-bound (SMART) goals for the BI project is crucial.

- **Data Quality:**

Ensuring data accuracy, completeness, and consistency is paramount for reliable analysis and decision-making.

- **User Adoption:**

Promoting user engagement and providing adequate training on BI tools is essential for effective utilization of the system.

- **Scalability and Flexibility:**

The BI system should be able to adapt to evolving business needs and handle growing data volumes.

- **Integration:**

Seamless integration with existing IT infrastructure and data sources is vital for a smooth implementation.

- **Data Governance:**

Establishing clear guidelines and policies for data management and access ensures data integrity and security.

- **Project Management:**

Employing robust project management methodologies, such as Agile, can help ensure timely delivery and successful implementation.

- **Top Management Support:**

Visible support and commitment from senior management are critical for driving BI adoption and resource allocation.

Obstacles to Business Intelligence in an Organization:

- **Data Silos:**

Difficulty in accessing and integrating data from disparate systems can hinder comprehensive analysis.

- **Data Quality Issues:**

Inaccurate or incomplete data can lead to flawed insights and poor decision-making.

- **Lack of Skilled Personnel:**

Organizations may struggle to find and retain data scientists, analysts, and BI specialists.

- **Insufficient Infrastructure:**

Inadequate hardware, software, and network capacity can impede BI performance and scalability.

- **Resistance to Change:**

Organizational culture and resistance to adopting new technologies can hinder user adoption of BI tools.

- **High Costs:**

Implementing and maintaining a BI system can be expensive, requiring significant upfront investment and ongoing maintenance costs.

- **Lack of Clear ROI:**

Measuring the return on investment (ROI) of BI initiatives can be challenging, making it difficult to justify further investments.

- **Poor Data Visualization:**

Inadequate or unclear data visualizations can hinder understanding and effective decision-making.