UNIT - 1

Introduction to Decision Support Systems & Business Intelligence

★ System:

- a group of interacting or interrelated entities that form a unified whole.
- It can refer to physical objects or abstract concepts.
- It can range from single organism to a global network of interconnected components.
- composed of inputs, processes, outputs & feedback mechanisms which together enable the system to achieve intended purpose or function.
- can be studied using various disciplines such as system theory, engineering, biology, sociology & economics.

★ Representation of Decision-making process.

1) Identify the problem/decision to be made.
- recognize that a decision needs to be made & clearly define the problem or situation that requires a decision.

2) Gather information.
- once problem is identified, gather relevant information about the problem, including ~~avail~~ available options, potential outcomes & risk associated with each option.

3) Evaluate alternatives
Evaluate different options & alternatives based on the information gathered, & consider pros & cons of each option.

4) Make a decision
After consideing all available options, make a decision

about which option to choose.

5) Take action.
Implement the decision & take action to carry it out.

6) Evaluate the results
- Evaluate the results of the decision & ~~access~~ assess whether the desired outcome has been achieved.
- if not, repeat the process from beginning, making necessary adjustments.

* Evolution of Information Systems.

1) Manual systems.
- prior to advent of computers, information systems were largely manual.
- used paper-based processes to record & store data.

2) Mainframe era.
- in 1950's & 1960's
- large mainframe computers
- helped organizations to automate processes such as accounting & payroll.

3) Personal computer era.
- In 1970's & 1980's
- made computing power accessible to individuals & small businesses

4) Client-Server era.
- In 1990's (more pop)
- allowed more distributed processing & access to information across networks.

5) Internet era.
- spread of internet in 1990s & 2000s led to development of web-based information system.
- allowed greater information sharing & collaboration.

Timeline: 1950-60 Manual | 1970-80 Mainframe | 1990 Personal | 1990-2000 Client server era | 2010 Internet | Cloud computing | Big data

6) Cloud Computing era.
- In 2010's & beyond
- allows organizations to access data & store it over internet without need of on-premises infrastructure.

7) Big Data era.
- with exponential growth of data, particularly unstructured data from social media & IOT, big data technologies have emerged to store, manage & analyze large volumes of data.

* Decision Support System.

- computer-based information system that supports decision-making activities within an organization.
- it is ~~used~~ designed to help users analyze data, identify trends & patterns, & provide insights that can help inform decisions
- it is model-based.
- a collection of integrated software & hardware which is the backbone of decision making process of an organization.
- It can be utilized by one or more users at multiple locations through web connections.
- Components:

1) Database.
- collection of data that is organized in a way that allows users to access & analyze the information easily.
- foundation of DSS & contains data from variety of sources, internal data & external sources.

2) Model Base.
- contains mathematical & statistical models that are used to analyze the data in database.
- can be used to predict future outcomes, identify trends & patterns & simulate different scenarios.

3) User interface.
- front end of the DSS.
- allows users to interact with the system & access the data & models.
- can be a GUI or command line interface depending on system design.

* For a DSS to be successful, it should be
1) simple
2) Accomodative
3) Robust
4) Active
5) Easily controllable
6) Flexible
7) Easily communicative.

* Features.

A) Flexibility.
- DSS are designed to be flexible & ~~adpa~~ adaptable to changing business needs, allowing users to add new data & models to the system as needed.
- ~~it is user-friendly, with easy & insightful interface methods~~

B) Effectiveness.
- assist knowledge workers to make more effective decisions.
- primary component of BI architecture

C) Interactive.
- DSS are interactive systems that allow users to manipulate data & models to analyze complex problems & ~~solve~~ explore different scenarios.

d) User-friendly.
- DSS have user-friendly interfaces that allow users to access & analyze data easily, without requiring technical knowledge.

e) Analytical.
- DSS are analytical systems that use mathematical & statistical models to analyze data & provide insights that can inform decision making.

f) Collaborative
- supports collaboration among multiple users allowing them to share data, models & insights to make better decisions.

g) Data-driven
- rely on data to drive insights & decision making, making it difficult / critical to ensure that data used in the system is accurate, timely & relevant.

h) decision-oriented.
- designed to support decision-making activities, providing users with information & insights they need to make infomed decisions.

* Advantages.

1) Improved decision-making.
- help users to make better decisions by providing access to relevant data, analytics & insights.
- decision makers can evaluate different scenarios & identify the best course of action based on the data & analytics.

2) Increased efficiency.
- DSS can automate ø many of the data analysis task which save time & increase efficiency.
- enables organizations to make decisions quickly.

3) Better collaboration.
- DSS enables better collaboration ~~by~~ among team members by allowing them to share data, models & insights.
- can help to break down silos & enable better communication.

4) Better data management.
- helps organizations to manage data efficiently by providing centralized database that contains all relevant information needed for decision making.
- helps to ensure data accuracy & consistency.

5) Improved risk management.
- helps organizations identify potential risks & mitigate them before they become major issues.
- by analyzing trends & patterns, decision makers can take proactive steps to mitigate risks & avoid costly mistakes.

6) Competitive advantage
- provide competitive advantage by enabling them to make better decisions & respond quickly to changes in the market.

7) Decrease Decision Process Expenses.

8) Encourage Decision making Learning

* Limitations

1) Dependence on data quality.
- DSS relies on accurate & reliable data to provide accurate insights & inform decision making.
- Poor data quality can lead to inaccurate results & potentially harmful decisions.

2) Expensive to develop & maintain
- can be expensive to develop & maintain, especially if they require customized models & interface.

3) Limited Scope.
- designed to support specific types of decisions which can limit the scope.

- may not be able to provide insights or support for decisions that fall outside their predefined scope.

4) Technical knowledge required:
- although DSS has user-friendly interfaces, they still require technical knowledge to operate effectively.

5) Resistance to change.
- some users may be resistant to using a DSS or may prefer to rely on their own experience or intuition while making decisions.
- can limit the adoption & effectiveness of the system.

6) Incomplete data.
- DSS provides data based on the data provided.
- If imp data is incomplete, the system may not be able to provide accurate insights or inform decision-making effectively.

* Development of DSS.

1) Define the problem.
- first step is to clearly define the problem that the system will address.
- involves identifying the decision that needs to be made, the data which is needed to inform that decision & stake-holders involved.

2) Determine the data requirements
- once problem is defined, next step is to determine the data needed to make the decision.
- it involves identifying sources of data, format of data, & any preprocessing or cleaning that may be required.

3) Develop the model.
- next step is to develop the models that will be used to

analyse the data & provide insights.
- involves dereloping statistical models, predictive models etc

4) Design the interface.
- user interface is an important element as it allows user to ~~interfa~~ interact with the system & analyse data.
- designed with the needs of the stakeholders in mind.
- it should be user-friendly.

5) Implement the system.
- once models ~~are developed~~ & user interface are developed the next step is to implement the system.
- involves integrating DSS with other systems or dbs & ensuring the the system is capable of handling large amount of data & is scalable

6) Test & validate the system.
- Before deployment, it is very important to test & validate the system to ensure its accurate working.
- involves running simulations & conducting pilot tests with small group of users.

7) Deploy & maintain the system.
- once system is tested & validated, it can be deployed and made available to users.
- It is important to monitor the system & ensure it is maintained & updated over time.

★ Four stages of Simon's decision-making process.

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1) Intelligence
- In this stage, decision-maker recognizes that a decision has to ~~a~~be made.
- They recognize the problem, gathers information related to the decision.

- stage is characterized by information search, scanning the environment & identifying relevant factors to make an informed decision.

2) Design
- In this stage, the decision-maker generates possible solutions & evaluates their potential outcomes.
- This stage involves generating ideas, considering alternatives & evaluating the feasibility of each option based on the info gathered in intelligence stage

3) Choice
In this stage, the decision maker selects the best alternative based on evaluating alternatives generated in the design stage
- involves making decisions & taking action based on the selected alternative.

4) Implementation
- In this stage, the decision-maker puts the chosen alternative into action.
- The implementation stage involves executing the plan, monitoring the outcome & making necessary adjustments to ensure the desired outcome is achieved.

- The stages are iterative & may be revisited multiple times before a decision is made.
- Simon's decision making process is often represented as a cycle, with each stage leading to the next.
- Cycle continues until decision maker achieves desired outcome.

* Common strategies & approaches of decision-makers.

1) Rational decision making.
- involves taking the time to carefully analyse all available information, considering all possible outcomes & selecting the best option based on logic & objective criteria.
- step-by-step process where we weigh the pros & cons of each alternative before making a decision.

2) Intuitive decision making.
- approach involves taking decisions based on your personal experience, expertise & intuition.
- just like-going with your gut feeling or using past experience to make a quick decision.

3) Behavorial decision making
- approach takes into account the psychological & emotional factors that may influence decision making such as emotions & social norms

4) Group decision making.
- involves multiple stakeholders in the process of decision making to ensure diverse pesspectives are considered & consensus is reached.
- like getting input & feedback from other people before making a decision.

5) Risk-based decision making.
- involves assessing potential risks & benefits of each option & selecting option with highest reward & lowest risk

6) Scenario planning.
- involves considering various scenarios ~~before~~ & dereloping plans to address each one.
- anticipating & preparing for different possible outcomes

of a decision.

7) Cost-benefit analysis

- involves weighing the cost of & benefits of each alternative & selecting the option with highest benefit with relatively low cost.

BUSINESS INTELLIGENCE

★ Business Intelligence

- defined as the process of collecting & processing business information to derive insights & make proper decisions
- involves collecting, analyzing & presenting data in a way that helps the organization to make proper decisions.
- Steps:

i) Data collection

BI begins with gathering data from different sources such as databases, spreadsheets & other sources.

ii) data analysis.

- once data is collected, it needs to be ~~identified to~~ analyzed to identify patterns, trends & insights.
- can be done using various tools such as data mining & statistical analysis.

iii) Data visualisation

- BI involves presenting data in way that is easy to understand & interpret.
- can be done using charts, graphs etc.

iv) Reporting.

- Once data is analysed & visualized, it needs to be presented to stakeholders in the organization.
- done using reports, dashboards etc.

Importance of BI.

1) Gather actionable insights.
   - BI is transforming business-oriented raw data into useable information
   - BI provides the organization actionable comprehensive analysis of data to identify pain points or opportunities which can be used to devise more ~~to~~ customer-centric strategies.
2) In-depth understanding of the organization.
   - It is difficult to understand the business as a whole if we don't know each component.
   - BI enables organization to identify each component
3) Achieve sales & marketing targets
   - It is difficult to achieve sales & marketing targets if company does not understand target audience & market.
   - BI provides in depth analysis to boost the performance.
4) Anticipate buyes behavior & trends.
   - Customer engagement is very important in business.
   - Hence ~~drawing insights~~ BI helps companies to build customer profiles based on feedbacks.

~~Components~~ Architecture of BI.

1) Data Source Layer

- includes various business data sources.
- includes operational, past & external data & internal data
- data may be in structured or unstructured format
- structured data can be spreadsheets & tables.

2) ETL Layer

- focuses on 3 mains operations - Extraction, Tranformation & Loading.

- Extraction → Identifying & collecting data from various sources
- Transformation → process of converting data using business rules into consistent formats for analysis.
- Loading → data in staging area are/is loaded into the data repository.

3) Data Warehouse layer.

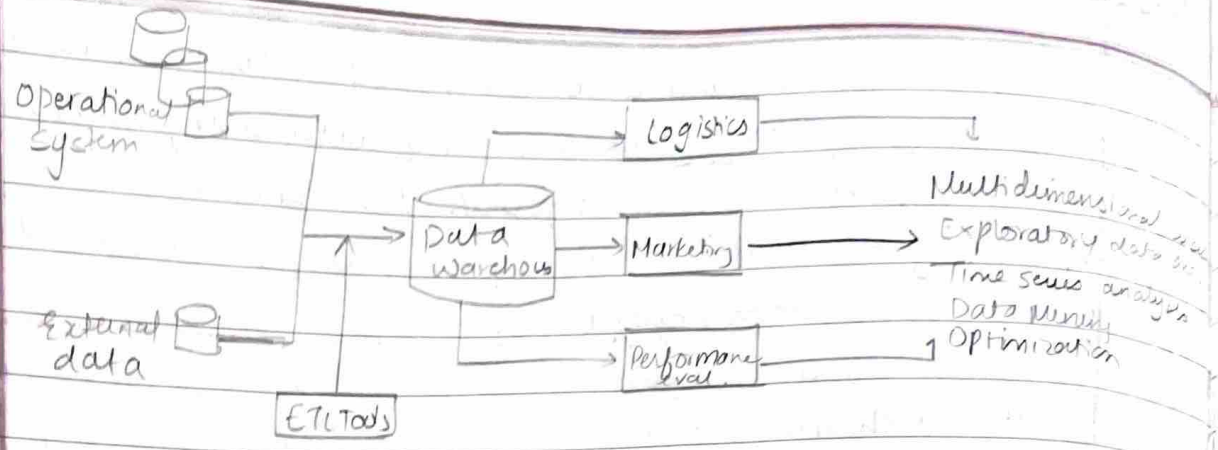
- centralized data storage
- form of single data house / multiple data marts or both.
- 3 components : operational data store, data warehouse & data marts.
- Data flows from op. data store → data warehouse & subsequently to data marts.
- Op. data store is used to integrate data from ETL & load it into data warehouse

4) Metadata layer.

- metadata → data about data.
- describes where data is being used & stored, source of data, changes made in the data, how one piece of data is related to another.
- Metadata rep. → used to store business rules & data definitions.
- management of metadata can lead to reduced development time.

5) End user layer

- contain tools that display information in different formats.



BI Architecture

Components of BI.

1) OLAP.

- OLAP stands for On Line Analytic Processing.
- It is an important element of BI.
- allows users to analyse data (large volumes) in real time.
- stores pre-aggregated data in multidimensional cubes
- provides a way to identify trends & patterns.
- helps to make informed business decisions.

2) Data Sources

- involves various forms of stored data.
- taking raw data & using software applications to make useful data sources
- data can be put into large spreadsheets, pie charts, graphs etc.
- first component of BI.
- sources can be internal, external, structure or unstructured.

3) Data Warehousing:

- Warehouse - central storage where all structured data is stored

- data is optimized for fast querying & analysis.
- in the form of single data warehouse or multiple data marts.

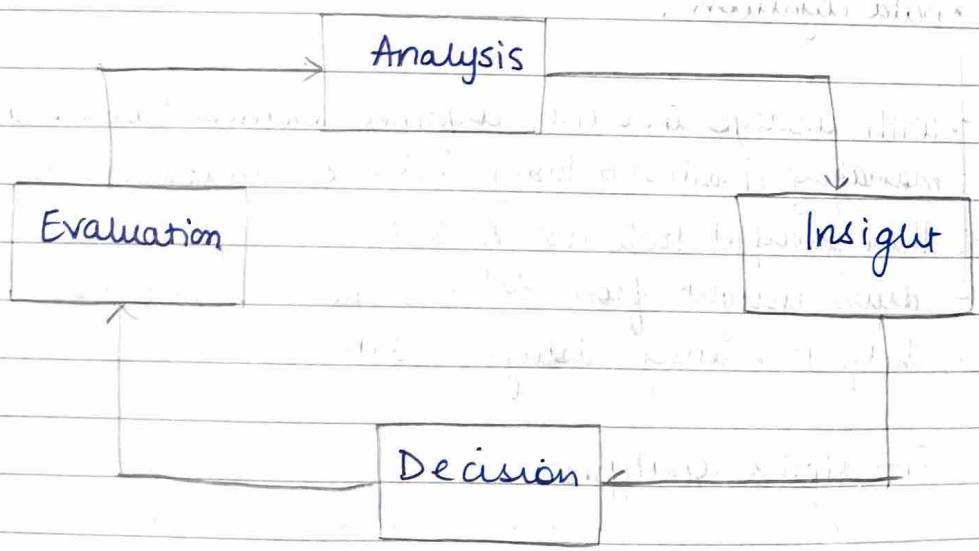
4) Advanced analytics.

- uncover the underlying trends & traits & insights of data.
- ~~dat~~ the stored data from the warehouse is analysed.
- involves tools such as business dashboards, reports to visualise data & provide insights.

5) Real Time BI.

- collecting, analysing & reporting data as it happens, in real time.
- data is available for analysis & decision making immediately.
- allows to respond quickly to business environment changes, identify trends etc.

Cycle of Business Intelligence Analysis



1) Analysis

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Future of BI.

1) Data Governance

- will become top priority for organisations, big or small.
- enable organizations to clearly understand the requirements of the enterprise.

2) NLP.

- using NLP, businesses will analyse customer sentiments, determine how positive/negative social media buzz around them is.

3) BI as a service

- enable organizations to get business solution in no time while freeing their IT staff from carrying out complex analysis task.

4) Data cognition.

- with insurge in data, cognitive engines promise a way of managing it without losing insight of what's important.
- these powerful tools use AI & ML
- draw insights from data & identify patterns.
- help to manage deluge of data

5) Prescriptive analysis.

- relatively new field.
- focuses on providing recc. to businesses based on data.
- using this companies can decide what actions to take.

- recommend specific actions businesses should take
- involves studying & analyzing the data & finding underlying patterns in it.

6) Identifying Existing Issues
7) Compare data with competitors
8) Spot Market trends.
9) Identify ways to Increase profit.

End-user Assumptions.

- BI end-user – decision maker who does not necessarily have IT skills, they just use business data & info from BI soln to make decisions
- true test of a usability of BI solution is with non-technical user.
- success that BI-soln will have on propelling the organization forward depends on ~~the~~ how it is recieved by end-users.
- Adoption makes or breaks a BI project.
- Adoption is dependent on ease of use, usefulness & cost.
- BI goal is to help end users to solve problems, eliminate inefficiency etc.
- conditions of Adoption:

1) Ease of use
- New technologies make new users nervous.
- If the BI soln is complex ~~to~~ learn & use, many end users will be reluctant to adopt it.

2) - even if initially adopted, a BI soln will quickly lose its following if it does not provide real soln for the end users.

Setting up Data for BI.

- Preparing data for BI can be very tedious & time consuming
- users want data to turn into best reports.
- But data needs a lot of processing & handling before user can approach results
- its essential to make sure data is distributed across all the whole organization.
- Collecting data is integral part of business's success.
- enables using data's accuracy, completness etc.
- collecting data enables organization to derive insights from data & keeps them informed on what needs to be change
- data may contain lot of anomalies & duplications.
- It requires redundancy removal, normalization across diffuent data sources.
- challenge to get data ready for everyone, not business owner & developer but also key decision-makers.
- Steps:

1) Collect & load data
2) Transform data to be BI ready.
3) Test system & manual queries
4) Build the reports.

Data, Information & Knowledge

1) Data.

- collection of facts & figures which relay something specific
- they are not organized in any way.
- can be numbers, words, measurements, observations or even

- just descriptions of things.
- data is raw material in production of information.
- eg. salary sheet, student attendance
- data is raw

2) Information. simply exists & has no significance beyond existence.

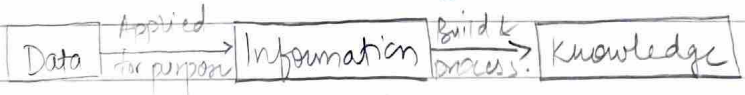
- can exist in any form usable or not.
- does not have meaning in itself.
- computer stores data in 0s & 1s. This is called digital data.
- Data is a building block.

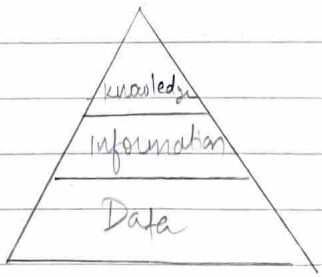
2) Information.

- outcome of extraction & processing activities carried out on data.
- gives meaning & context.
- subjective & meaningful interpretation of data

3) Knowledge.

- information builds knowledge
- collection of all that is known.
- application of info using rules.
- info is transformed to knowledge when decisions are needed





Unit 2
The Architecture of DW & BI

Business Architecture.

- term used to describe standard policies for organizing data with the help of computer based techniques that create BI tools for visualisation, reporting & analysis.
- main goal is to provide a clear understanding of overall structure of the business & enable effective decision-making.
- helps to identify areas of improvement.
- process of designing & organizing structure of business to achieve its strategic goals & objectives

* Framework.

1) Data collection.
   - first step.
   - involves collection of relevant data from various external / internal sources which can be db, ERP/CRM systems, flat files etc
2) Data integration.
   - data collected is integrated into a centralized system using ETL processes
   - data is cleaned & prepared for analysis.
3) Storage of data
   - this is where data warehousing comes into the picture.
   - warehouse → place where structured data is stored.
   - makes it available for querying (analysis
4) Data analysis.
   - after data is collected, processed, stored & cleaned it is ready to be analyzed.
   - appropriate tools are ~~used for~~ data visualisation & used for strategic decision-making.

5) Distribution of data
- data which is now in the form of charts & graphs is distributed in different formats.
- can be online reporting, dashboarding etc.

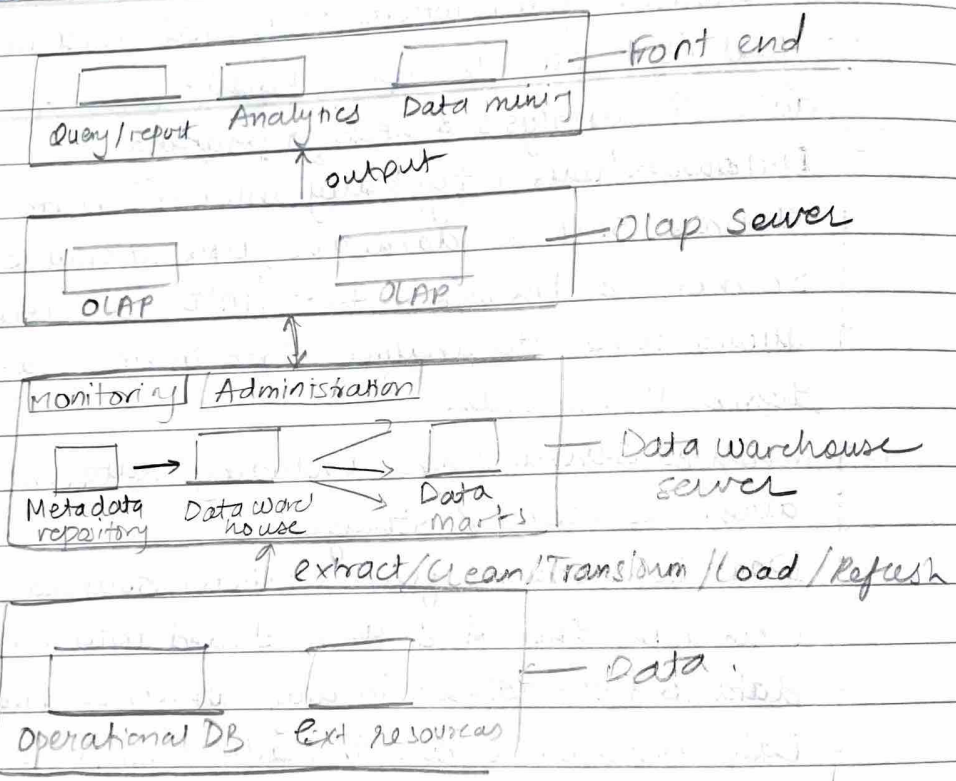
Data Warehousing.

- refers to collecting, organizing & storing data from various sources in a warehouse.
- warehouse - place where structured data is stored.
- goal is to provide comprehensive view of an organization's data for analysis & decision-making.
- Datawarehouses typically integrate data from a lot of resources such as databases, operational systems, external sources & transform them into consistent format.
- allows users to analyse data in the way it is useful to them & their needs.
- involves several stages including data extraction, transformation, loading & storage
- Data is extracted from various sources, transformed & into a common format & then loaded into the warehouse
- data is then stored in way which is easy for retrieval.
- Data warehouses are typically used for BI architecture.
- data stored in the warehouse can be analysed using different techniques such as data mining, machine learning etc
- enable org. to gain insights on data & make informed decisions.
- critical component of BI to manage & analyze huge amount of data.
- Databases & warehouses are related but not same.
- Database stores & records/ & access info. from single source
- non-volatile in nature.

* - Architecture.

- data storage framework's design of an organization.
- takes info. from raw datasets & stores it in structured format
- 3 ways of constructions.

1) Single-tier - create compact dataset & minimize amt. of data
2) Two-tier - server is used as data mart
3) multi-tier - creates more structured flow of data.



* bottom tier
- database of the warehouse
- responsible for loading cleaning sed & transformed data.
- database server

* middle tier
- application layer
- arranges data to make it suitable for analysis.

- done by OLAP server, implemented using ROLAP / MOLAP model

* Top tier
  - front end.
  - this is where user accesses & interacts with data.
  - done via queries, data vizualization & analytic tools.

Difference between BI & Data Warehouse

	Business Intelligence	Data Warehouse
1)	set of ~~tutes~~ tools to analyze data & discover, extract insights from it to make informed business decisions.	system for storage of data from various sources in an orderly / structured manner.
2)	Decision Support system	data storage system
3)	Serves at front-end	back-end
4)	aim is to ~~make~~ help users make informed business decisions.	aim is to provide BI users a comprehensive view of organization data.
5)	comprises of business reports, charts etc.	comprises of data held in "fact tables" & "dimensions".
6)	does not have much use without data warehouses as large amt. of data is needed for analyses.	BI is one of the use cases of warehouses.

	BI	Data Warehouse
7)	handled by executives & analysts	handled by data engineers who report to executives / analysts
8)	deals with OLAP, data visualisation, data mining etc.	deals with gathering, preprocessing, cleaning & transformation of data.
9)	Eg - SAP	Eg - BigQuery, Snowflake etc

* OLAP -

- Online Analytical Processing.
- enables users to analyse large & complex datasets in real-time.
- allows interactive exploration of data in multiple perspectives.
- designed to support complex queries & advanced ~~org~~ analytics
- provides user way to uncover trends & patterns in the data.
- works by organizing data into multidimensional structures called cubes.
  - These cubes can be sliced & diced to reveal different perspectives of data
- data in cubes is combined to provide summaries.
- provide insight for better ~~desi~~ decision making.
- optimized for fast query processing.

adv. i) - The speed of data processing is very high
ii) Combined & Detailed Data
iii) The data is represented in ~~da~~ multidimensional form.
iv) Uses familiar Business Expression.
v) Flat learning curve.

OLAP Operations

Roll up (summarize) | Drill down (splitting) | Slice (1D) | Dice (2 or more D) | Pivot (rotate)

Dis· i) The cost is very high
ii) OLAP is relational.
iii) Some system lack computational power which inhibits flexibility of OLAP model tool.

* OLAP Cube.

- Core concept of OLAP.
- data structure optimized for quick data analysis.
- consists of numeric facts called measures
- they are categorized by dimensions
- also called hypercube.
- usually spreadsheets are used to store data, which is ideal for 2D data
- OLAP contains multidimensional data from different unrelated sources.
- cube can store & analyze it in a logical & orderly manner
- Data warehouse extracts data from multiple resources & formats. (text, excel etc)
- extracted data is cleaned & transformed.
- loaded into an OLAP server where info. is pre-calculated in advance for further analysis.

Analytical Operations of OLAP.

1) Roll-up.
- also known as drill-up
- involves summarizing data along one/more dimensions to provide higher-level view of data
- "consolidation" or "aggregation".
- allows users to drill up from lower level of detail to higher level.

- done in 2 ways:
i) Reducing dimensions
ii) Climbing up concept heirarchy.

2) Drill-down.

- data is fragmented into smaller parts.
- opposite of roll-up.
- allows user to analyse data at lower granularity
- Eg. You have sales data aggregated by product, region, & month. After using drill down, we can expand data to view sales data by views, region, product & day.
- useful for identifying root cause of issues.
- enables users to analyse data in more detail.
- done in 2 ways
i) Increase dimensionality
ii) Moving down the concept heirarchy.

3) Slice.

- one-dimension is selected & new sub-cube is created.
- allows user to view a particular subset/portion of data that meets their requirements.
- Eg. You have sales data which is organized by region, product & month. By slice operation, you can filter data to view the sales for a particular region say Northeast America for a particular product, say laptop.
- usefulfor focusing on specific subsets of data relevant to user's analysis.
- makes it easier to identify trends & patterns in the data.
- helps to gain betta understanding of data → informed decisions.

4) Dice
- similar to slice
- & instead of 1, 2 or more dimensions are selected for the creation of new subcube.
- allows to view specific portion of data that meets the requirement based on multiple dimensions.
- useful for analysing complex data sets.
- helps user to identify trends, patterns.

5) Pivot.
- involves rotating the data to view it from different perspectives
- By pivoting data, we can swap rows & columns of data, perform summarisation & aggregation on the data.
- Eg.

	PC	Book	Shoes	Clothes
NJ				
LA				
Perth				
Sydney	605	825	14	400

Pivot

	NJ	LA	Perth	Sydney
PC				605
Book				825
Shoe				14
Clothes				400

- useful for changing perspective of data.
- helps user to gain a better perspective of data & make informed decisions

OLAP Architectures.

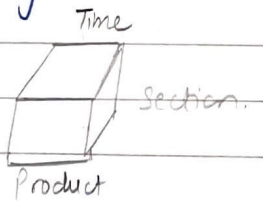
MOLAP ROLAP HOLAP.

1) MOLAP.

- stands for Multidimensional OLAP.
- data is stored in a multidimensional cube.
- storage is in proprietary form & not in relational database
- data is pre-aggregated & stored in the multidimensional cube for further analysis
- ideal for analyzing huge amounts of data.

Adv. i) fast query response time
ii) flexible data analysis.
iii) Optimal for slicing & dicing.
iv) can perform complex calc.
v) high scalability.

Dis. i) limited storage capacity
ii) need for pre-aggregation → time consuming.



OLAP cube with Time, Product, Section dimensions.

ROLAP.

- stands for Relational OLAP.
- in this, data is stored in relational database & accessed thru queries.

- maintains data in normalized form, which allows efficient storage
Adv. i) - can handle a large amount of data
ii) - high scalability
iii) flexible
iv) supports ad-hoc queries.
Dis. i) difficult to perform complex calculations in SQL.
ii) performance can be slow.

RDBMS

ID	Category	City	Unit Price	City
P101	Nuts	4	10.50	NY
P102	Bolts	5	35.50	LA
P103	Screws	7	12	NY.

Data stored in Relational database

HOLAP.

- stands for Hybrid OLAP.
- combine the advantages of MOLAP & ROLAP.
- combination of ROLAP & MOLAP.
- & multidimensional cube in MOLAP gives ~~high~~ fast query response & efficient data analysis
- relational database allows storage of more data without pre-aggregation.
- allows HOLAP to handle large volumes of data.
- provides users with more comprehensive view of the data.
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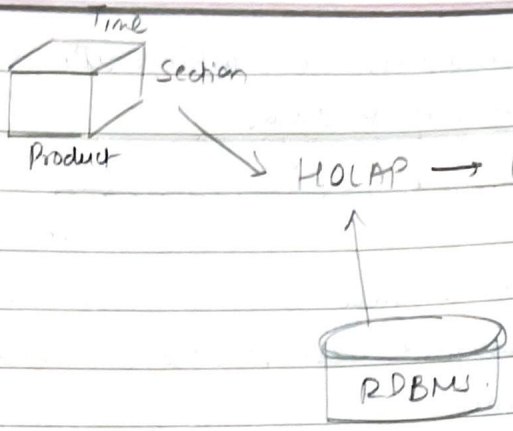
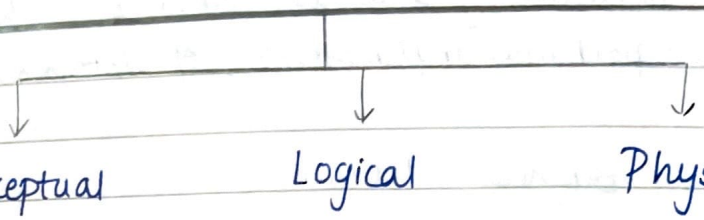


- detailed data stored in RDBMS
- highly summarized data → multidimensional cube.

* ROLAP VS MOLAP.

	ROLAP	MOLAP
1)	stands for Relational On Line Analytical Processing.	stands for Multidimensional On Line Analytical Processing
2)	used for large ~~tar~~ data volumes.	used for limited data volumes.
3)	ROLAP access is slow.	access of MOLAP is fast.
4)	Data is stored in relational database	Data is stored in multi-dimensional
5)	data is fetched from data warehouse	data is fetched from MDDBs database
6)	SQL queries are used	Sparse matrix is used.
7)	Static multi-dimensional view of data is created.	Dynamic multi-dimensional view of data is created.

Data Models.



1) Conceptual Model.

- view of data reqd. to help business processes.
- keeps track of business events & performance measures
- defines what system contains.
- focuses on finding data used in business rather than processing flow.
- main purpose is to organize, define business rules & concepts.

2) Logical Model

In L.M.
- the map of rules & data structures includes data reqd. such as tables, columns etc.
- created by data architects & business analysts.
- always present in root package obj.
- helps model to form base for physical model.
- no secondary or primary key is defined.

3) Physical Data Model.

- implementation is described using specific database system.
- defines all components & services required to build a database
- created using the database language & queries.
- represents each table, col", constraints like primary key, foreign key.

- main work is to create a database.
- model is created by Database Admin & developers.
- describes particular implementation of data model.

Tools in Business Intelligence

- Business tools are open source tools/applications used to collect, process, analyze, sort & report large quantities of data from int. to ext systems, raw data → useful info.
- used to transform raw ~~ra~~data & draw insights from it
- prepare raw data for ~~transformation~~ analysis, facilitate generation of reports, visualizations & dashboards.
- Types → Dashboards, Visualizations, Reporting, Data Mining, ETL & OLAP.

1) Spreadsheets.
   - ~~one~~ data organized in tabular format & to be easily queried

2) Dashboards
   - real-time user interface
   - diplays data visualisation
   - reflects current state of data.

3) Data mining tools.
   - Data mining employs AI ~~whi~~ to reveal patterns in the data

4) Ad-hoc Analysis
   - analysis process designed to answer specific queries on the spot.

5) Mobile BI
   - software that optimizes desktop BI for mobile devices.

6) OLAP.
   - provide computing method enabling multi-dimensional queries.

7) Data visualisation software
   - facilitates detection of patterns & correlations by giving visual context.

9) OpenSource BI.
- BI soln which do not require purchasing software license

10) Collaborative BI.
- merging of BI software with collaboration tools to streamline sharing process.

* Role of DSS, EIS, MIS & DASHBOARD.

1) DSS (Decision support system)

- provide support for unstructured, semi-structured decisions.
- DSS problems are often characterized by incomplete or uncertain knowledge or use of qualitative data.
- often include modelling tools → various alternative scenarios modelled & compared.
- decisions supported by DSS → Investment decisions.

2) MIS (Management Information System)

- sophisticated reporting system.
- built on existing transaction processing system.
- used to support structured decision making.
- also support tactical level management.
- eg → deciding on a product pricing.

3) EIS (Executive Information system).

- supports range of decision making
- often + unstructured.
- decision making on executive level.
- decisions made can impact the whole organization.
- system: ability to extract summary of data + external data.
  (Internal system) (provides intelligence)

- provides user friendly interface to internal & external into other systems.

4) Dashboards.

- business intelligence tool
- allows users to track, analyse & report key performance indicators.
- they typically visualize data in the form of chart, graph & maps
- This helps stakeholders to understand, share & collab. on the information.
- best BI dashboards, make it easy to combine data from variety of sources.
- It helps organizations answer questions & uncover insights which help to make smarter decisions.
- It turns raw data from multiple sources into actionable insights.

* Need for BI.

1) Gain new customer insights.
- gives companies greater ability to observe & analyse the current customer buying trends.
- the insights gained from the BI model/tool is used to create products & product improvement.
- improves organization's sales.

2) Improved visibility.
- BI organizations have better control over their processes & operating procedure due to improved visibility by BI system.

3) ~~prep~~ helps you to identify areas of improvement & allow you to be prepared not reactive.

~~4)~~

4) Actionable Information
- BI tools provide insights & trends in the data.
- allows you to understand implications of various processes & changes which leads to making informed decisions.

5) Efficiency Improvement
- help to improve organizational efficiency which increases productivity which can increase revenue.

6) Real Time Data.
- provides user with access to ~~real-time~~ data in real time.
- done through spreadsheets, visual dashboards & scheduled emails.
- large amount of data can be assimilated, interpreted & distributed quickly & accurately.

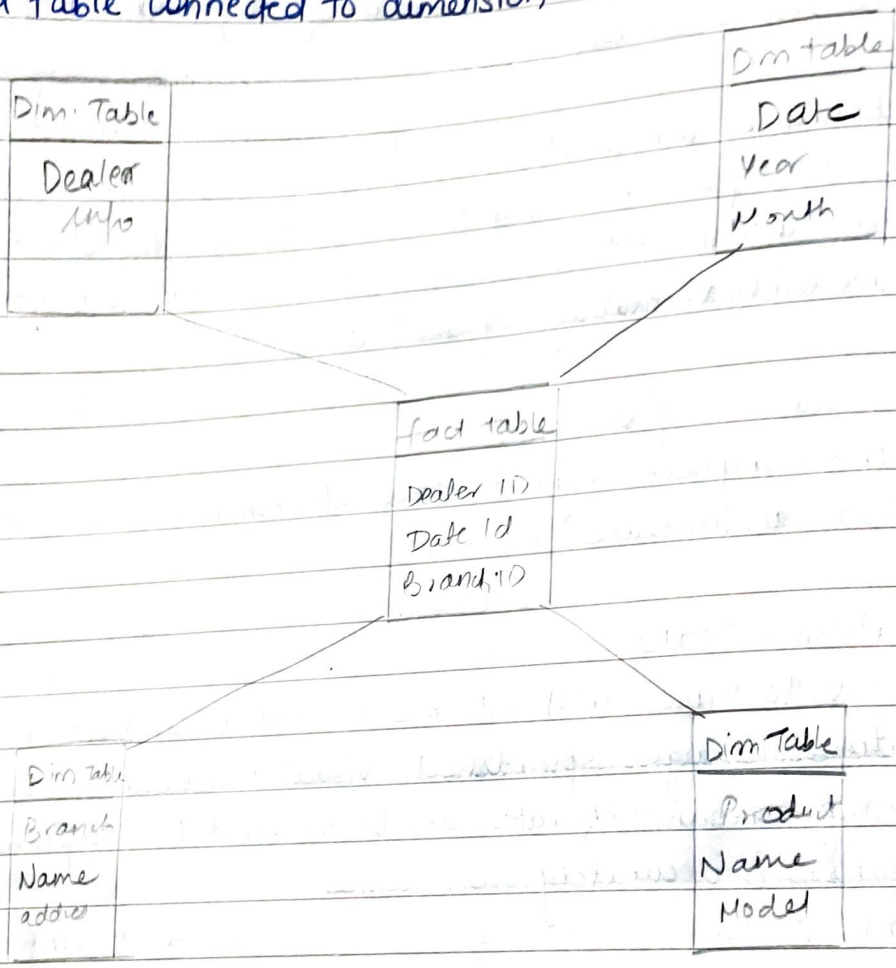
7) Competative Advantage
- help to gain insight into what your competition is doing, allowing org. to make educated decisions.

Defining Schemas

1) Star Schema.

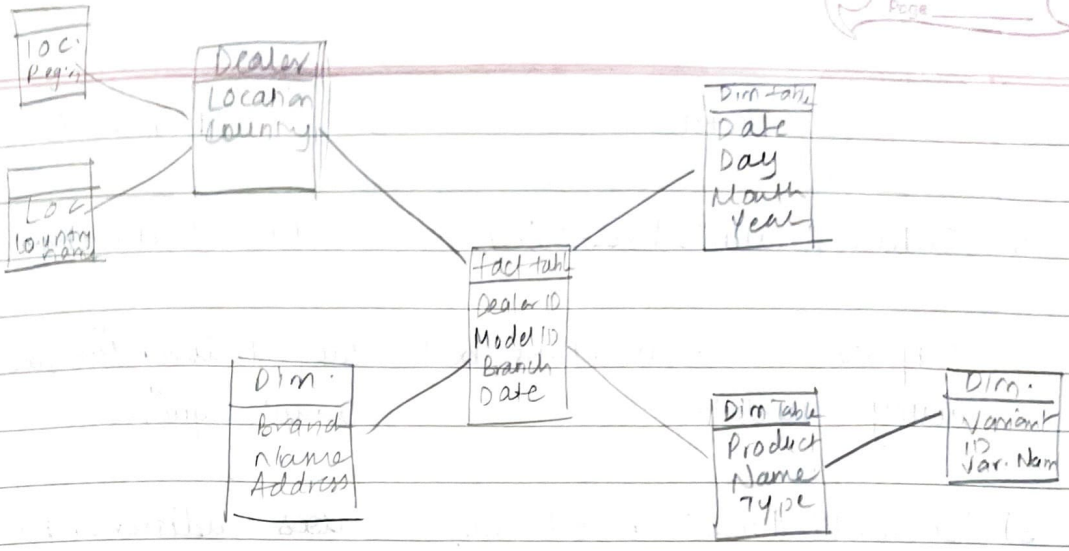
- type of database schema used in data warehousing.
- organizes data in a central fact table & a set of dimension tables.
- schema named after diagrammatic rep, which resembles a star.
- fact table → quant. info such as sale/revenue.
  dimension table → descriptive information which provides context to metrics such as data, product.

- fact table connected to dimension table via foreign keys.



2) Snowflake schema.

- logical arrangement of tables in a multidimensional db.
- such that ER diagram represents a snowflake.
- extension of star schema
- adds dimensions to Star Schema.
- dimension tables are normalized which split data into additional tables.
- More complex & difficult to understand.
- More flexible in data querying.



* Fact Constellation.

- similar to star schema but involves multiple fact tables sharing the same dimensions tables.
- also known as Galaxy Schema.
- logical structure of data warehouses & data marts.
- consist of multiple fact tables containing metrics which share one or more dimension tables.
- Eg. a fact table for ~~sho~~ sales, inventory, etc can be sharing a common dimension table for products.
- provides more flexibility for querying data.
- helps to increase / improve accuracy by reducing inconsistencies in data.
- multiple fact tables sharing one dimension table makes it complex.

Fact Table 1	Dimension Table	Fact Table 2
Business Results	Product	Business Forcast.
Product →	Prod no.	← Product
Quarter	Prod name	future, qtr
Reg.	Prod descr	Reg.
Revenue	Prod style	Proj. revenue

	OLAP	OLTP
1)	Online Analytic Processing	Online Transaction Processing
2)	supports short transactions, both query & updates	supports long transactions, complex queries.
3)	has multi-dimensional schema / uses cube to store data	uses traditional DBMS to store data.
4)	Tables in db are not normalised	Tables in db are normalised.
5)	used by ~~frontline workers~~ data scientists, business analysts.	used by frontline workers cashiers, bank tellers etc
6)	contains historical data.	contains current data.
7)	data comes from OLTP dbs.	original source of data.
8)	do not perform read/write operations	perform read-write operations
9)	Used for Decision Support System.	Used in day-to day operations
10)	processing speed is slow	processing speed is fast.
11)	queries are complex	queries are simple.
12)	DB Size : 100 MB to GB.	DB Size : 100 GB to TB.