



Course Name

BUSINESS ANALYTICS

Course Code

BAD714B

Course Coordinator

Contact Hours

40

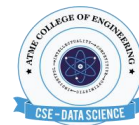
Mrs. MADHU NAGARAJ
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CIE Marks

50

SEE Marks

50



Course Learning Objectives

CLO 1. Understand the nature of data, statistical Modelling and visualization.

CLO 2. Learn concepts of Business analytics and Data Warehousing.

CLO 3. Gain knowledge on Data mining process and SNA, text & Web analytics.



Course Outcomes

- CO1. Explain the role of business analytics in a dynamic business environment.**
- CO2. Demonstrate modern tools for Statistical Modelling and Visualization.**
- CO3. Illustrate analytics for Business Analytics and Data Warehousing.**
- CO4. Implement algorithms for data mining techniques and processes.**
- CO5. Develop scripts for Text & Web mining and social network analysis.**



Text Book

**Ramesh Sharda, Dursun Delen and Efraim Turban,
“Business Intelligence, Analytics, Data Science and AI –
A Managerial Perspective”, 5th edition, Global Edition,
Pearson Education Limited, 2024.**

Reference Books

1. Steve Williams, Business Intelligence Strategy and Big Data Analytics - A General Management Perspective, Morgan Kaufmann (Elsevier), 2016. 2. Vincent Charles, Pratibha Garg, Neha Gupta and Mohini Agarwal, Data Analytics and Business Intelligence - Computational Frameworks, Practices, and Applications, CRC Press, 2023. 3. Ira J. Haimowitz, DATA ANALYTICS FOR BUSINESS - Lessons for Sales, Marketing, and Strategy, Routledge (Taylor & Francis), 2023.



Question Paper Pattern

The question paper will have ten questions.

Each full Question consisting of 20 marks.

There will be 2 full questions (with a maximum of four sub questions) from each module.

Each full question will have sub questions covering all the topics under a module.

The students will have to answer 5 full questions, selecting one full question from each module.



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INTRODUCTION

Module 1- Chapt 1

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Difference between Analysis & Analytics



Data Analysis : It is the technique of observing, transforming, cleaning, and modeling raw facts and figures with the purpose of developing beneficial information and acquiring profitable conclusions.

Data Analytics is the process of collecting, organizing and studying data to find useful information understand what's happening and make better decisions. In simple words it helps people and businesses learn from data like what worked in the past, what is happening now and what might happen in the future.

Data analysis is just one part of data analytics it focuses on finding meaning in data. On the other hand data analytics includes more than just analysis.



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Where have you encountered analytics in daily life?



- Online Shopping (e.g., Amazon, Flipkart)
- Social Media (e.g., Instagram, YouTube, Twitter)
- Food Delivery Apps (e.g., Swiggy, Zomato)
- Banking & Finance
- Healthcare
- Navigation & Travel (e.g., Google Maps, Uber)
- Education
- Workplaces & Productivity

Changing Business Environments

- Business environments are rapidly evolving due to technology, globalization, and competition.
- Organizations must adapt to changes quickly to remain competitive.
- Traditional decision-making is no longer sufficient for dynamic markets.

Need for Decision Support and Analytics

- Real-time data and advanced analytics are essential.
- Decision-makers require timely, data-driven insights.
- Enhanced systems are needed to support complex decisions.

Changing Business Environments and Evolving Needs for Decision Support and Analytics

Decision making is one of the most important activities in organizations of all kind. Unfortunately, it is not simple to make decisions.

De Smet et al. (2017) of McKinsey & Company management consultants classify organizational decision into the following four groups:

- Big-bet, high-risk decisions.
- Cross-cutting decisions, which are repetitive but high risk that require group work
- Ad hoc decisions that arise episodically.
- Delegated decisions to individuals or small groups.

Modern business is full of uncertainties and rapid changes



Decision-Making Process

managers considered decision making purely an art—a talent acquired over a long period through experience.

Managers usually make decisions by following a four-step process (we learn more about these in the next section):

1. Define the problem (i.e., a decision situation that may deal with some difficulty or with an opportunity).
2. Construct a model that describes the real-world problem.
3. Identify possible solutions to the modeled problem and evaluate the solutions.
4. Compare, choose, and recommend a potential solution to the problem.

The Influence of the External and Internal Environments on the Process



External Environment	Description	Examples	Impact on Decision-Making
Economic	Overall health of the economy influencing business activity	Inflation, interest rates, GDP growth, unemployment	Affects investment timing, pricing, budgeting, and expansion plans
Political & Legal	Government policies, laws, and political stability	Tax policies, trade regulations, labor laws, environmental laws	Shapes compliance requirements, market entry strategies, and operational risk
Socio-Cultural	Demographics, cultural values, and social trends	Aging population, sustainability awareness, lifestyle changes	Influences product design, marketing strategies, and HR policies
Technological	Rate of innovation and adoption of new technology	AI, automation, cybersecurity, digital platforms	Drives digital transformation, process improvement, and competitive advantage
Competitive	Rivalry within the market and industry dynamics	Price wars, new entrants, mergers & acquisitions	Forces differentiation, pricing strategies, and faster innovation
Global / International	Factors from the global market impacting operations	Exchange rates, trade agreements, global crises	Affects supply chains, market expansion, and risk management

Data and Its Analysis in Decision Making

- Computer applications have evolved from simple transaction processing and monitoring to supporting problem analysis and solution development.
- Modern management relies heavily on analytics and business intelligence (BI) tools.
- Key tools include:
 - Data warehousing for centralized data storage and management.
 - Data mining for discovering patterns and insights.
 - Online Analytical Processing (OLAP) dashboards for interactive data exploration.
 - Cloud-based decision support systems for scalability and accessibility.

These technologies form the foundation for effective, data-driven decision-making in today's organizations.

Technologies for Data Analysis and Decision Support

Besides the obvious growth in hardware, software, and network capacities, some developments have clearly contributed to facilitating growth of decision support and analytics in a number of ways, including the following:

1. Group Communication & Collaboration

- Remote teams increasingly make decisions together.
- Tools like video conferencing and smartphones ease communication.
- Cost-effective compared to assembling all members physically.
- Crucial in supply chains for real-time demand sharing and rapid response.

2. Improved Data Management

- Decisions often require complex data across locations.
- Supports multiple formats (text, audio, video) and languages.
- Modern systems ensure fast, secure, and transparent data transmission.

3. Managing Big Data

- Organizations manage vast data through data warehouses.
- Big Data allows diverse, real-time insights into performance.
- Special methods, including parallel computing and Hadoop/Spark, are available to organize, search, and mine the data.

4. Analytical Support

- Enhances decision-making with better forecasting and risk analysis.
- Enables quick simulations and evaluation of multiple scenarios.
- Expert insights can be gathered remotely or derived from systems.
- With such tools, decision makers can perform complex simulations

5. Overcoming Cognitive Limits

- Human brains have limited capacity to process complex data.
- Systems support by storing, retrieving, and processing vast information.
- Helps reduce errors and expands decision-making capabilities

6. Knowledge Management

- Firms gather structured/unstructured data from various operations.
- Knowledge Management Systems (KMS) support decision-making.
- Tools like IBM Watson and text analytics extract value from data.
- combining AI with big data analytics, move from reactive decision-making to proactive

7. Anywhere, Anytime Access

- Wireless technologies enable real-time access and decisions on the go.
- Managers and consumers expect fast processing and response.
- Mobile tools, analytics, and social platforms has enabled a different level of information systems (IS) to support managers.

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List of some capabilities of information technologies that can facilitate managerial decision making.

Capability	Managerial Benefit
Data Collection & Storage	Centralized, accurate records for easy access and analysis.
Data Processing & Analysis	Quick identification of trends, patterns, and anomalies.
Visualization & Reporting	Simplifies complex data for faster, clearer decisions.
Predictive & Prescriptive Analytics	Anticipates outcomes and recommends optimal actions.
Collaboration & Communication Tools	Enhances teamwork and coordination across locations.
Scenario Simulation & What-If Analysis	Reduces risk by testing strategies before implementation.
Real-Time Monitoring & Alerts	Enables immediate action on urgent issues.
Integration of Multiple Data Sources	Provides a complete, holistic view for strategic planning.



DECISION-MAKING PROCESSES AND COMPUTERIZED DECISION SUPPORT FRAMEWORK

- It is a process of choosing among two or more alternative courses of action for the purpose of attaining one or more goals.
- advisable to follow a systematic decision-making process.
- **Simon (1977)** said that Decision Making involves three major phases:
intelligence, design, and choice
- later added a fourth phase: **implementation**.
- **Monitoring** can be considered a fifth phase—a form of feedback.
- However, we view monitoring as the intelligence phase
- Simon's model is the most concise and yet complete characterization of decision making



1. The Intelligence Phase: Problem (or Opportunity) Identification
 - identifying the real problem (or opportunity)
 - Problem Classification,
 - Problem Decomposition
 - Problem Ownership
 - Application 1.1 case study - Making elevators go faster
2. The Design Phase - developing and analyzing possible courses of action (via modeling)
3. The Choice Phase – making the decision
4. The Implementation Phase – turning the decision into action

1. The Intelligence Phase:

- The intelligence phase begins with the identification of organizational goals and objectives related to an issue of concern.
- Problems occur because of dissatisfaction,
- In this first phase, a decision maker attempts to determine whether a problem exists,
- sometimes difficult to distinguish between the symptoms and the real problem.
- The existence of a problem can be determined by monitoring and analyzing the organization's productivity level

Identifying the real problem (or opportunity)

- Data are not available. As a result, the model is made with and relies on potentially
- inaccurate estimates.

Identifying the real problem (or opportunity)

- Obtaining data may be expensive.
- Data may not be accurate or precise enough.
- Data estimation is often subjective.
- Data may be insecure.
- Important data that influence the results may be qualitative (soft).
- There may be too many data (i.e., information overload).
- Outcomes (or results) may occur over an extended period.

When the preliminary investigation is completed, it is possible to determine whether a problem really exists.

To illustrate why it is important to identify the problem correctly, we provide a classical example- **Application Case 1.1: Making Elevators Go Faster!**

Problem Classification- the conceptualization of a problem in an attempt to place it in a definable category, possibly leading to a standard solution approach. Classifies problems according to the degree of structuredness

Problem Decomposition- Many complex problems can be divided into subproblems. Solving the simpler subproblems may help in solving a complex problem.

Problem Ownership- In the intelligence phase, it is important to establish problem ownership. A problem exists in an organization only if someone or some group takes the responsibility for attacking it and if the organization has the ability to solve it

The Design Phase

The design phase involves finding or developing and analyzing possible courses of action.

These include understanding the problem and testing solutions for feasibility.

A model is a simplified representation of reality used to analyze problems instead of experimenting with the real system.

Modeling involves conceptualizing the problem, identifying variables, and defining relationships (mathematical, quantitative, or qualitative).

Simplifications and assumptions are often made (e.g., assuming linearity) to make the model workable.

Trade-off:

Simple models → cheaper, faster, easier, require less data, but may be less accurate.

Complex models → more accurate, but costly, harder to manage, and data-intensive.

The goal is to find a balance between simplicity and realism to ensure useful and practical decision support.

In short: Models help analyze problems by abstracting reality, balancing accuracy with efficiency.

The Choice Phase

The choice phase is where the actual decision is made and commitment to a specific course of action occurs.

The boundary between design and choice is often blurred, since decision makers may move back and forth (e.g., generating new alternatives while evaluating existing ones).

It involves:

Searching, evaluating, and recommending a solution.

A solution = specific values of decision variables in a chosen alternative.

Evaluation of alternatives considers multiple goals, balancing them as needed.

Sensitivity analysis → tests robustness (small input changes → small output changes).

What-if analysis → examines effects of major changes in parameters.

Goal seeking → finds decision variable values required to achieve a desired outcome.



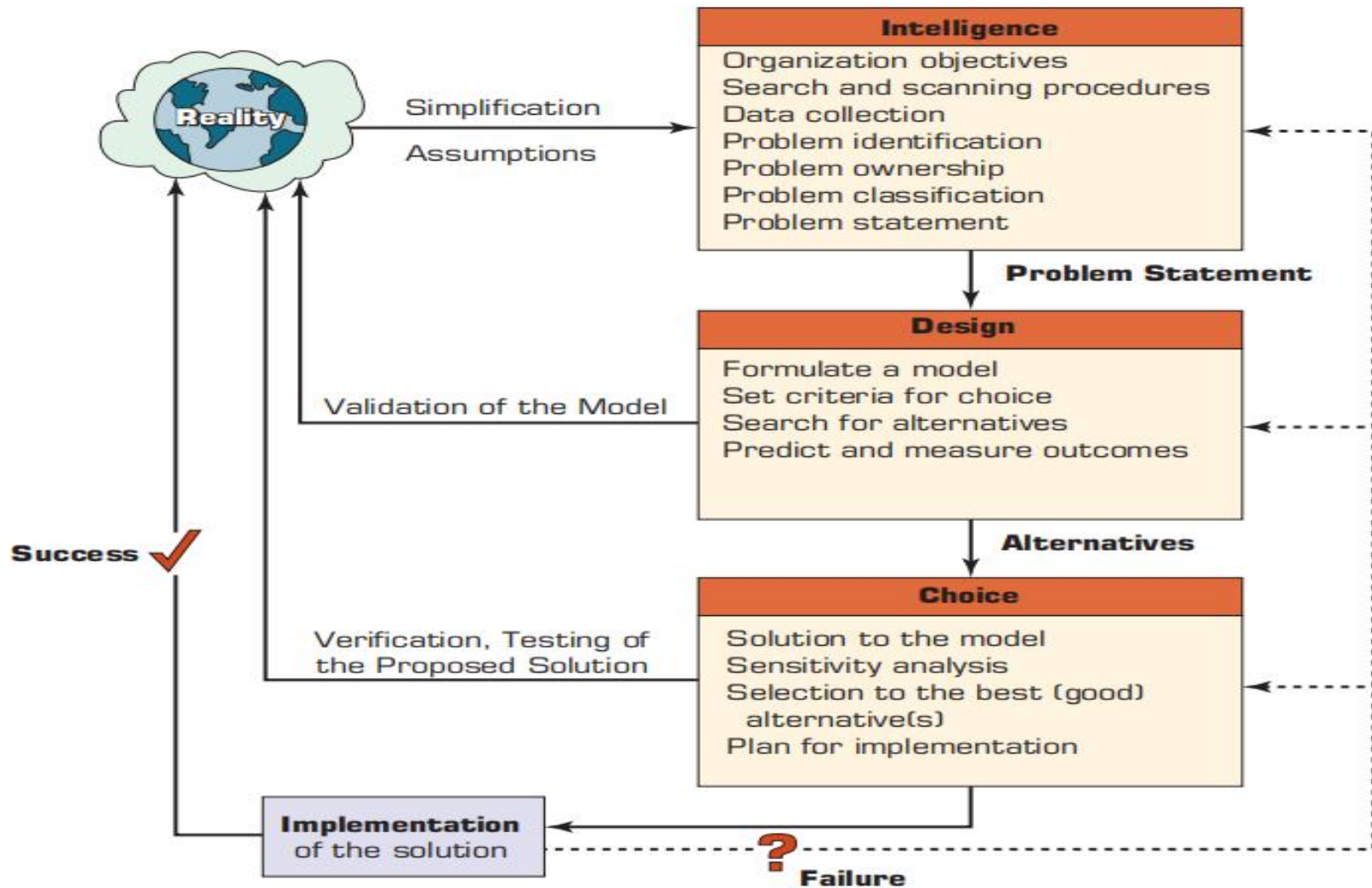
Implementation Phase

implementation is a long, involved process with vague boundaries. \

Simplistically, the implementation phase involves putting a recommended solution to work, not necessarily implementing a computer system.

Also includes thorough understanding of project management.

Implementation must also involve collecting and analyzing data to learn from the previous decisions and improve the next decision.



An Early Decision Support Framework



Type of Decision	Type of Control		
	Operational Control	Managerial Control	Strategic Planning
Structured	Accounts receivable Accounts payable Order entry 1	Budget analysis Short-term forecasting Personnel reports Make-or-buy 2	Financial management Investment portfolio Warehouse location Distribution systems 3
Semistructured	Production scheduling Inventory control 4	Credit evaluation Budget preparation Plant layout Project scheduling Reward system design Inventory categorization 5	Building a new plant Mergers & acquisitions New product planning Compensation planning Quality assurance HR policies Inventory planning 6
Unstructured	Buying software Approving loans Operating a help desk Selecting a cover for a magazine 7	Negotiating Recruiting an executive Buying hardware Lobbying 8	R & D planning New tech. development Social responsibility planning 9

Types of Decisions and Levels of Control

- Decisions differ based on their structure (how well-defined they are).
- They also vary by level of control:
 - Operational Control (day-to-day)
 - Managerial Control (tactical/medium-term)
 - Strategic Planning (long-term)

Structured Decisions: Definition: Well-defined, routine, repetitive, often programmable.

Operational Control:

- Accounts receivable
- Accounts payable
- Order entry



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Managerial Control:

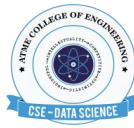
- Budget analysis
- Short-term forecasting
- Personnel reports
- Make-or-buy decisions

Strategic Planning:

- Financial management
- Investment portfolio
- Warehouse location
- Distribution systems



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Semistructured Decisions

Definition: Partly programmable, partly requiring human judgment.

Operational Control:

Production scheduling

Inventory control

Managerial Control:

Credit evaluation

Budget preparation

Plant layout

Project scheduling

Reward system design

Inventory categorization



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Strategic Planning:

Building a new plant

Merger & acquisitions

New product planning

Compensation planning

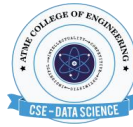
Quality assurance

HR policies

Inventory planning



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Unstructured Decisions

Definition: Novel, complex, rely heavily on human intuition and judgment.

Operational Control:

Buying software

Approving loans

Operating a help desk

Selecting a magazine cover

Managerial Control:

Negotiating

Recruiting an executive

Buying hardware

Lobbying



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Strategic Planning:

R&D planning

New technology development

Social responsibility planning

Conclusion

Structured decisions → routine & automated

Semistructured decisions → mix of automation + judgment

Unstructured decisions → rely on experience & intuition

Operational → short-term, day-to-day

Managerial → medium-term, tactical

Strategic → long-term, organizational impact

The Concept of DSS

What is a DSS?

- A Decision Support System helps managers and decision-makers solve semi-structured and unstructured problems.
- It integrates data, models, and user-friendly tools to support effective decision-making.

Properties of DSS

1. Supports semi-structured & unstructured problems

Handles messy, novel situations where not all rules are known (e.g., market entry, crisis response) using models, data, and human judgment.

2. Supports managers at all levels

Useful from operational (day-to-day) to managerial (tactical) to strategic (long-term) decisions—e.g., from shift scheduling to capacity planning to mergers.

3. Supports individuals and groups

- Works for a single analyst or a team.
- Group features may include shared workspaces, voting/ranking, chat, and meeting support (Group DSS).

4. Supports interdependent/sequential decisions

- Links decisions that affect each other over time (multi-stage planning).
- Changing one choice updates downstream implications/scenarios.

5. Covers intelligence, design, choice, implementation

Intelligence: identify/define the problem

Design: build alternatives/models

Choice: evaluate & pick

Implementation: track execution and outcomes



6.Supports varied decision processes & styles

Accommodates analytical, intuitive, collaborative, or data-driven styles—via dashboards, heuristics, optimization, what-if, and scenario tools.

7. Adaptable & flexible

Easily reconfigurable—new data sources, models, KPIs, and business rules can be added without rebuilding the whole system.

8. Interactive & easy to use

User-friendly UI with drill-downs, sliders, scenario toggles, and natural-language queries to explore “what happens if...?” quickly.



9. Improves effectiveness & efficiency

Better decisions (effectiveness) made faster with fewer resources (efficiency) by automating analysis and exposing better insights.

10. Keeps humans in control

Provides recommendations, not mandates. Users can override, add constraints, and see explanations/audit trails for transparency.

11. End-user developability

Low-code/no-code builders, templates, and wizards let analysts customize models, reports, and workflows without deep IT help



12. Provides models & analysis

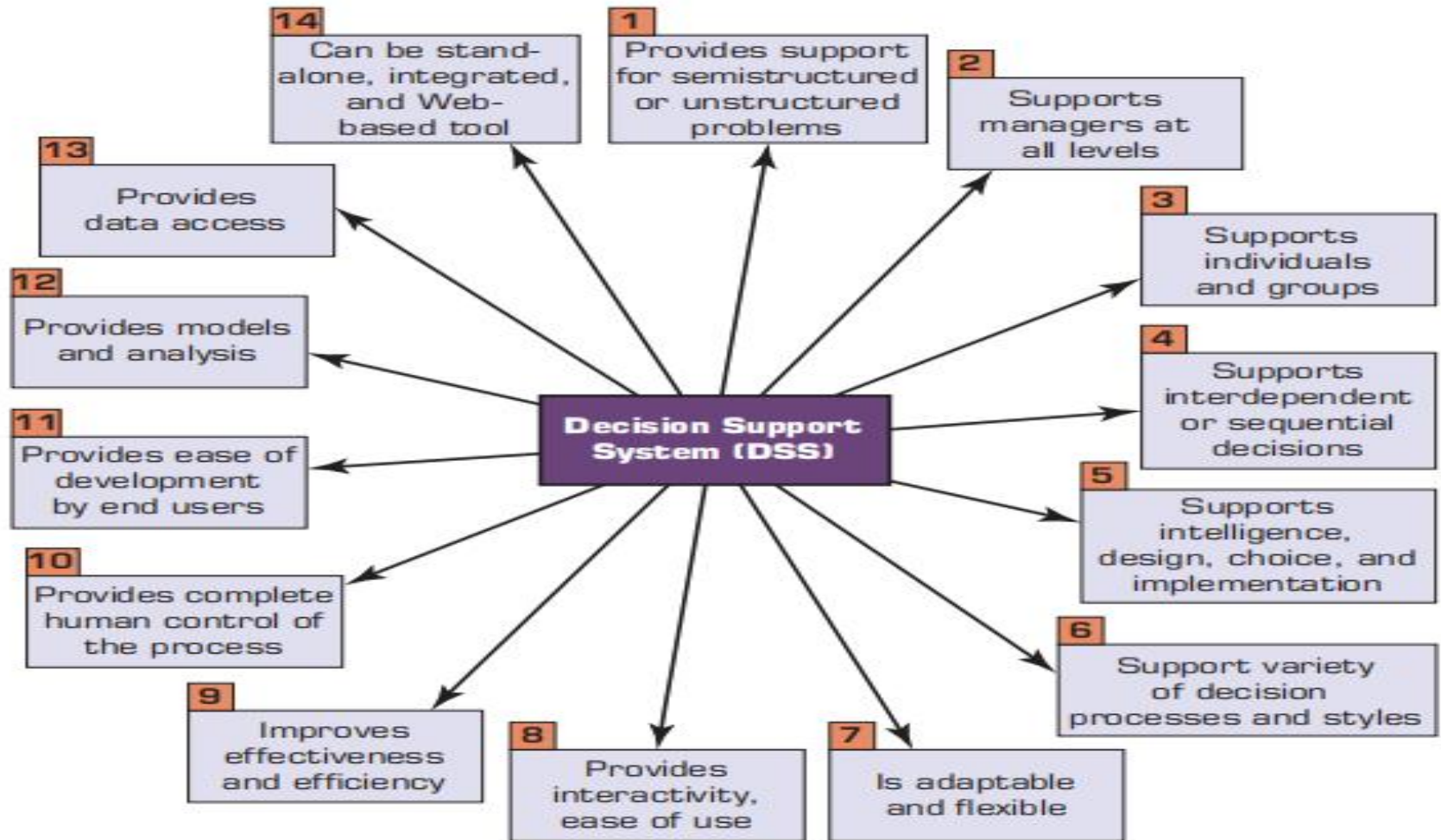
Includes descriptive (reports), predictive (forecasting, ML), and prescriptive (optimization, simulation) analytics to test alternatives.

13. Provides data access

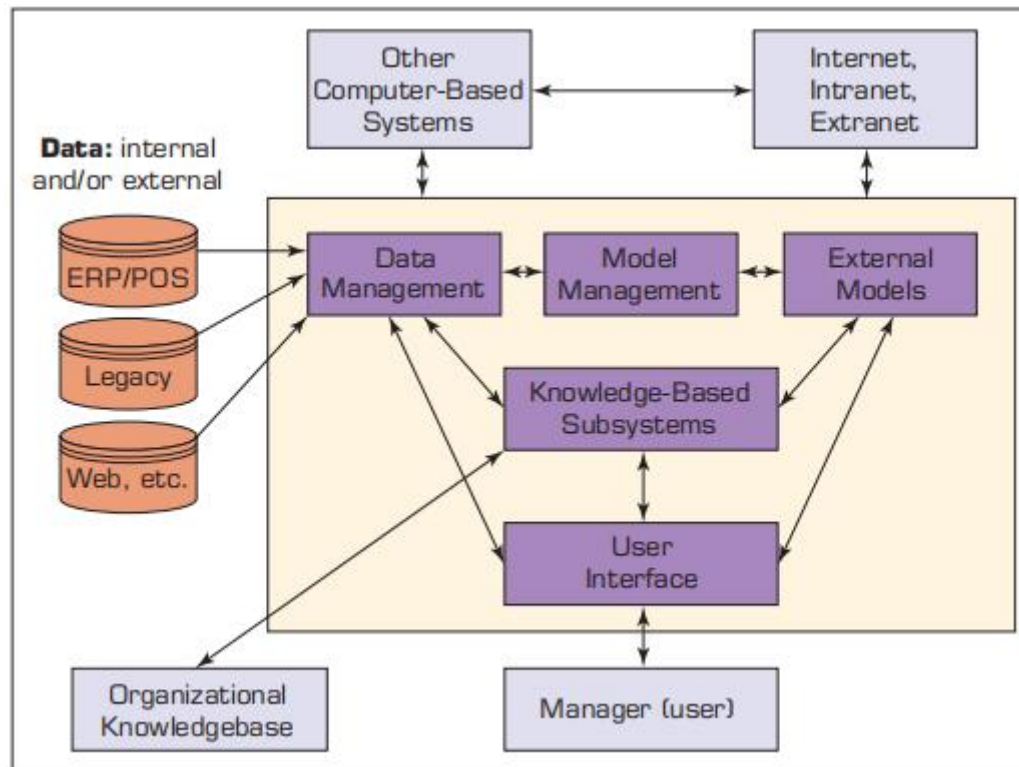
Connects to internal systems (ERP/CRM), data warehouses, and external feeds/APIs; supports ETL, real-time refresh, and data governance.

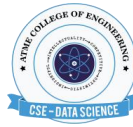
14. Flexible deployment (stand-alone, integrated, web-based)

Runs as a desktop app, embedded in enterprise platforms, or as web/cloud SaaS—scalable, secure, and accessible anywhere.



Components of a Decision Support System





A decision support system (DSS) comprises four key components:

- Data Management Subsystem:
- Model Management Subsystem
- User interface
- Knowledge-Based Management Subsystem

These components work together to help users analyze information, model potential outcomes, and ultimately make informed decisions.

1. Data Management Subsystem:

- This component stores and manages the data used by the DSS.
- Can include internal data from an organization, data generated by applications, and external data from sources like the internet.
- The database provides the raw material for analysis and decision-making.
- The data are stored or accessed via a database Web server.
- The data management subsystem is composed of the following elements:
 - DSS database
 - Database management system
 - Data directory
 - Query facility

2. The Model Management Subsystem:

- The model base contains various analytical models, algorithms, and mathematical tools that manipulate the data within the database.
- These models help in analyzing data, simulating scenarios, and predicting outcomes.
- Common types of models include statistical models, sensitivity analysis models, optimization models, and forecasting models.
- The model management subsystem of a DSS is composed of the following elements:
 - Model base
 - Modeling language
 - Model directory
 - Model execution, integration, and command processor
- **Application Case 1.2** SNAP DSS Helps OneNet Make Telecommunications Rate Decisions

3. User Interface:

- This is the component that allows users to interact with the DSS.
- Provides a way for users to input data, access information from the database, run models, and view the results.
- A good user interface should be intuitive and easy to use, making it simple for users to navigate the system and understand the information presented.

4. Knowledge Base:

- This component stores the relevant knowledge, rules, and principles related to the decision-making domain.
- The knowledge base helps the DSS to support decision-making by providing insights, suggesting potential solutions, and guiding users through the decision-making process.



Evolution of Computerized Decision Support to Analytics/Data Science

1970s – Decision Support Systems

-Decision Support Systems – AI/Expert Systems – Routine reporting

1980s – Enterprise/Executive IS-Enterprise Resource Planning (ERP)

– On-Demand Static Reporting – Relational DBMS

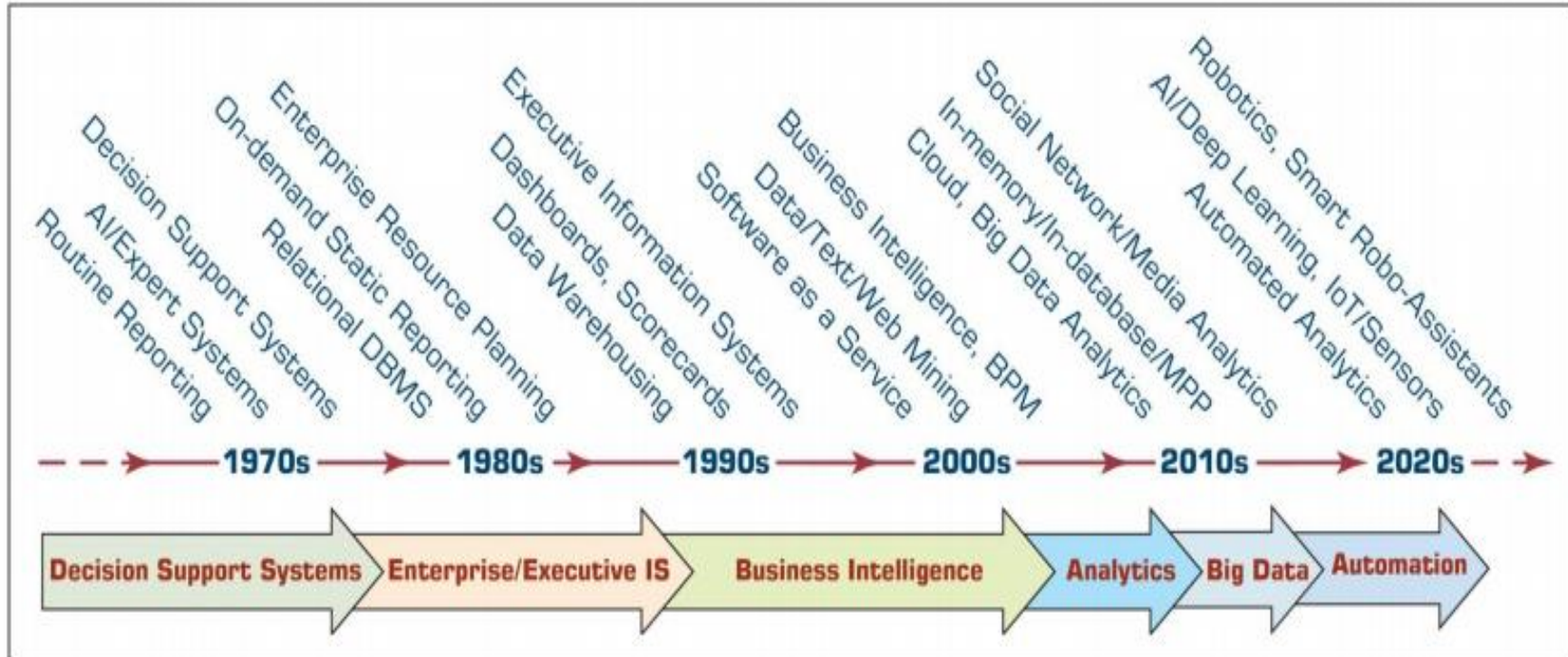
1990s – Business Intelligence

-Executive Information Systems – Dashboards & Scorecards – Data Warehousing

2000s – 2010s – Analytics & Big Data

-2000s - Business Intelligence – Data/Text Mining – Cloud Computing, SaaS

-2010s - Social Network/Media Analytics – In-Memory, IN-Database – Big Data Analytics



A Framework for Business Intelligence (BI)

- BI is an evolution of decision support concepts over time
 - **Then:** Executive Information System
 - **Now:** Everybody's Information System (BI)
- BI systems are enhanced with additional visualizations, alerts, and performance measurement capabilities
- The term BI emerged from industry.

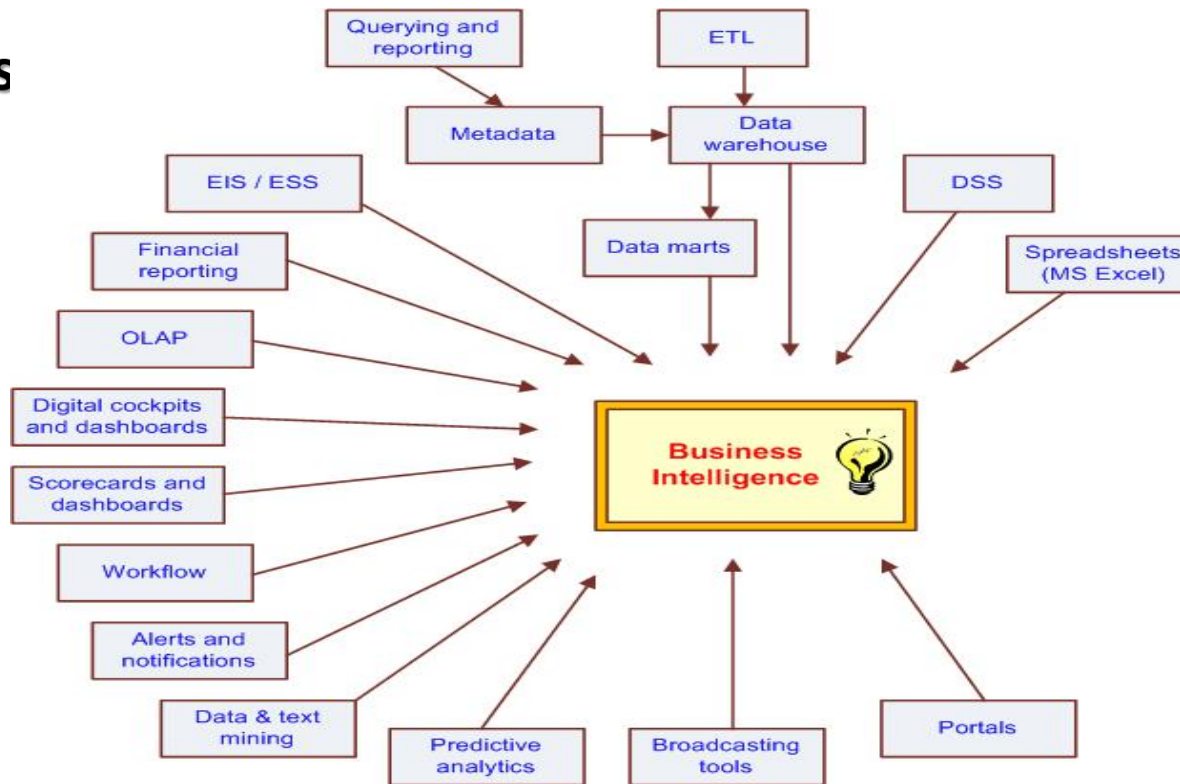
Definition of BI

- Business Intelligence (BI) is a broad concept that brings together system architectures, software tools, databases, analytical methods, applications, and processes to support better decision-making.
- BI is a content-free expression, so it means different things to different people
- BI's major objective is to enable easy access to data (and models) to provide **business managers** with the ability to conduct analysis
- BI helps *transform* data, to information (and knowledge), to **decisions**, and finally to **action**

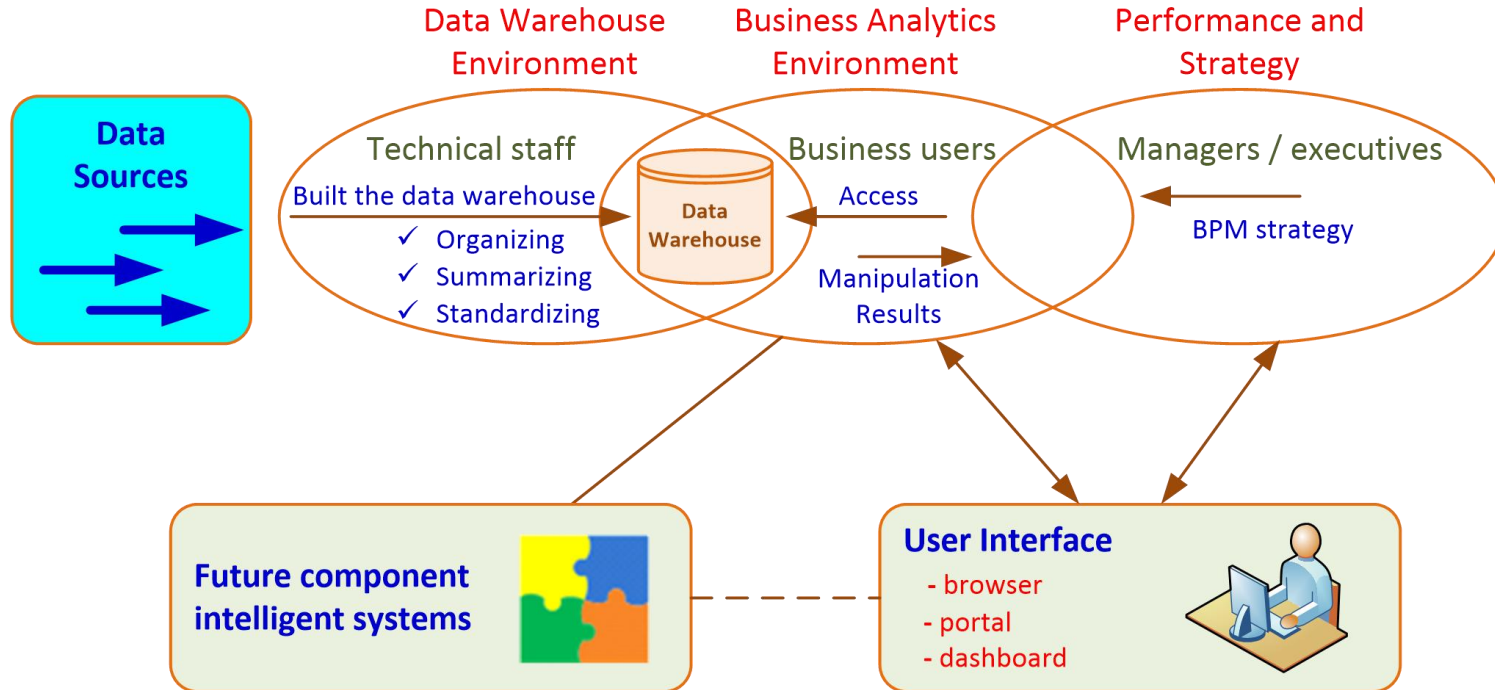
A Brief History of BI

- The term BI was coined by the Gartner Group in the mid-1990s
- However, the concept is much older
 - 1970s - MIS reporting - static/periodic reports
 - 1980s - Executive Information Systems (EIS)
 - 1990s - OLAP, dynamic, multidimensional, ad-hoc reporting -> coining of the term “BI”
 - 2010s - Data/Text/Web Mining; Web-based Portals, Dashboards, Big Data, Social Media, and Visual Analytics
 - 2020s - yet to be seen

The Evolution of BI Capabilities



A High-Level Architecture of BI



The Architecture of BI

- A BI system has four major components
 - A **data warehouse**, with its source data
 - **Business analytics**, a collection of tools for manipulating, mining, and analyzing the data in the data warehouse
 - **Business performance management (BPM)** for monitoring and analyzing performance
 - A **user interface** (e.g., dashboard)

Components in a BI Architecture

- The **data warehouse** is the cornerstone of any medium-to-large BI system.
 - Originally, the data warehouse included only historical data that was organized and summarized, so end users could easily view or manipulate it.
 - Today, some data warehouses include access to current data as well, so they can provide real-time decision support
- **Business analytics** are the tools that help the user transform data into knowledge (e.g., queries, data/text mining tools, etc.)

- **Business Performance Management** (BPM), which is also referred to as corporate performance management (CPM), is an emerging portfolio of applications within the BI framework that provides enterprises tools they need to better manage their operations
- **User Interface** (i.e., dashboards) provide a comprehensive graphical/pictorial view of corporate performance measures, trends, and exceptions.

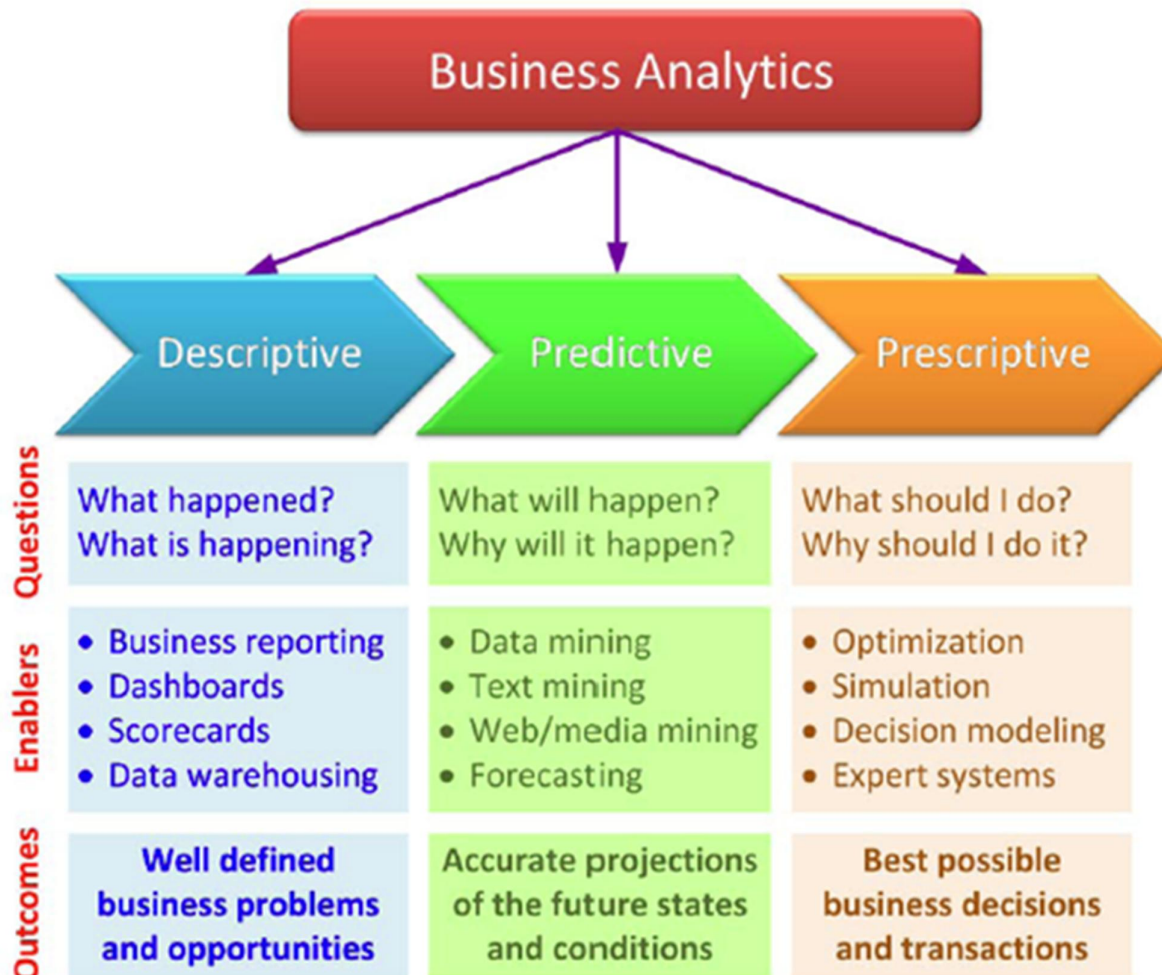
Analytics Overview

- The word analytics has largely replaced the previous individual components of computerized decision support technologies that have been available under various labels in the past.
- One can view **analytics** as the process of developing actionable decisions or recommendations for actions based on insights generated from historical data.
- For example, SAS Institute Inc. proposed **eight levels** of analytics that begin with standardized reports from a computer system. These reports essentially provide a sense of what is happening with an organization. Additional technologies have enabled us to create more customized reports that can be generated on an ad hoc basis.



Analytics Overview

- This idea of looking at all the data to understand what is happening, what will happen, and how to make the best of it has also been encapsulated by INFORMS in proposing **three levels of analytics**
- These three levels are identified (informatics.org/Community/Analytics) as descriptive, predictive, and prescriptive. Figure 1.11 presents a graphical view of these three



Descriptive Analytics

- Descriptive (or reporting) analytics refers to knowing what is happening in the **organization and understanding** some underlying trends and causes of such occurrences
- Usually, the development of this data infrastructure is part of DWs. From this data infrastructure we can develop appropriate **reports, queries, alerts**, and trends using various reporting tools and techniques.
- A significant technology that has become a key player in this area is **visualization**. Using the latest visualization tools in the marketplace, we can now develop powerful insights in the operations of our organization

Predictive Analytics

- Predictive analytics aims to determine what is **likely to happen in the future**. This analysis is based on statistical techniques as well as other more recently developed techniques that fall under the general category of **data mining**
- A number of techniques are used in developing predictive analytical applications, including various classification algorithms
- we can use classification techniques such as **logistic regression, decision tree models, and neural networks** to predict how well a motion picture will do at the box office. We can also use **clustering algorithms** for segmenting customers into different clusters to be able to target specific promotions to them

Prescriptive Analytics

- The third category of analytics is termed **prescriptive analytics**. The goal of prescriptive analytics is to recognize what is going on as well as the likely forecast and make decisions to achieve the best performance possible
- The goal here is to provide a **decision or a recommendation** for a specific action. These recommendations can be in the form of a specific yes/no decision for a problem, a specific amount (say, price for a specific item or airfare to charge), or a complete set of production plans.
- Thus, these types of analytics can also be termed **decision or normative analytics**



- Descriptive = Looks backward → tells you what happened.
- Predictive = Looks forward → tells you what is likely to happen.
- Prescriptive = Advises action → tells you what you should do.



Analytics Applied to Different Domains

1. Business & Marketing Analytics

Use: Understanding customer behavior, sales forecasting, campaign performance.

Example: Amazon uses analytics to recommend products based on your browsing and purchase history

2. Healthcare Analytics

Use: Predicting disease outbreaks, personalized treatments, improving patient care.

Example: Hospitals use predictive analytics to identify patients at risk of readmission after discharge

3. Finance & Banking Analytics

Use: Fraud detection, credit risk scoring, investment strategies.

Example: Banks use real-time analytics to flag unusual credit card transactions.

4. Retail & E-commerce Analytics

Use: Inventory management, pricing optimization, customer segmentation.

Example: Walmart applies analytics to manage stock levels and avoid shortages.

5. Education Analytics

Use: Tracking student performance, personalized learning paths, dropout prediction.

Example: Universities analyze student attendance and test data to identify those needing extra support.

6. Manufacturing & Supply Chain Analytics

Use: Reducing production downtime, demand forecasting, supply optimization.

Example: Toyota applies predictive analytics to schedule machine maintenance before breakdowns.



7. Sports Analytics

Use: Player performance analysis, injury prevention, game strategy.

Example: Cricket teams use analytics to study batting patterns of opponents and adjust bowling strategies.

8. Government & Public Policy Analytics

Use: Urban planning, traffic management, tax fraud detection.

Example: Cities use traffic analytics to reduce congestion and plan new roads.

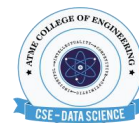
9. Telecommunications Analytics

Use: Customer churn prediction, network optimization, pricing models.

Example: Telecom providers analyze call data to predict which customers may switch to competitors.



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Analytics or Data Science?

INTRODUCTION TO ARTIFICIAL INTELLIGENCE

What is AI?

- Artificial Intelligence (AI) is the ability of a computer or machine to think, learn, and make decisions like humans.
- Instead of just following fixed instructions, AI can analyze data, recognize patterns, and adapt.

Key Characteristics of AI

Learning – Learns from data and experience.

Reasoning – Makes decisions based on logic and knowledge.

Problem-Solving – Finds solutions to complex issues.

Perception – Understands inputs like images, speech, and text.

Automation – Performs tasks with little or no human help.

Examples of AI in Daily Life

- Healthcare: AI diagnoses diseases from X-rays faster than doctors.
- Banking: Fraud detection by analyzing unusual transaction patterns.
- E-commerce: Amazon recommends products based on your browsing.
- Education: AI tutors (like ChatGPT) help students learn anytime.
- Transportation: Self-driving cars use AI to detect traffic signals and pedestrians.

- Benefits of AI
 - AI has the ability to complete certain tasks much faster
 - The consistency of the work
 - AI machines do not make arbitrary mistakes
 - AI systems allow for continuous improvement projects
 - AI can be used for predictive analysis via its capability of pattern recognition
 - AI can manage delays and blockages in business processes
 - AI machines do not stop to rest or sleep
 - Many more...

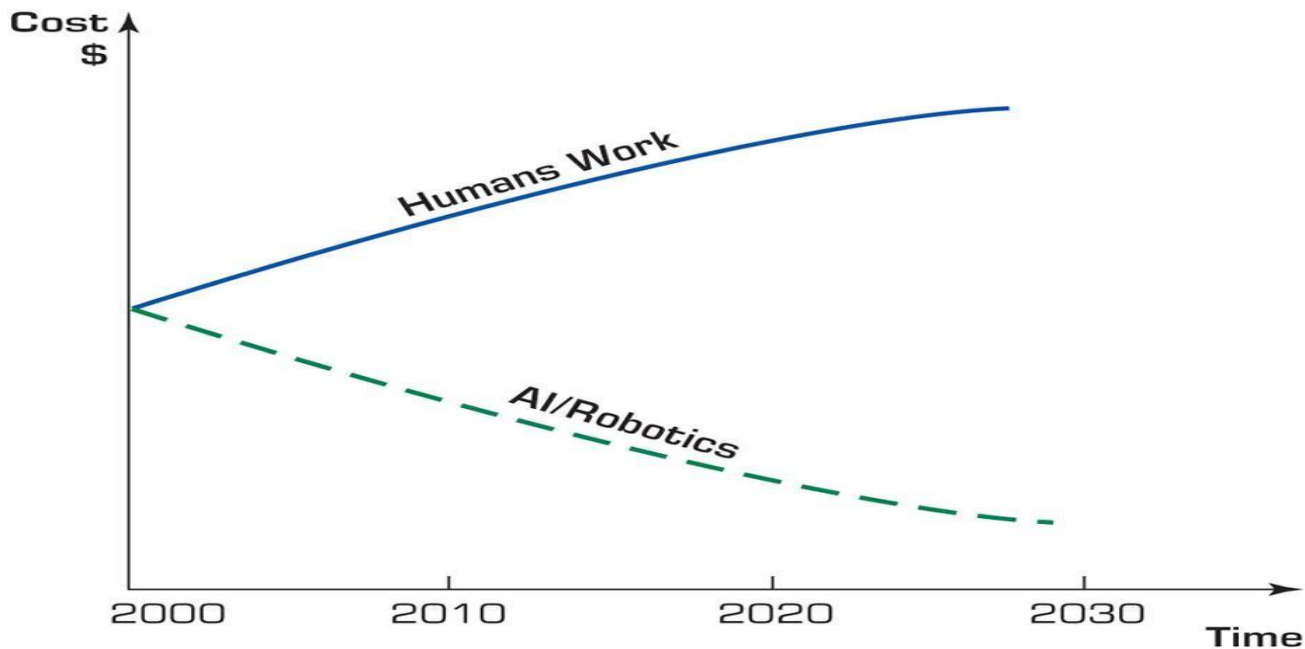


Figure 2:Cost of Human Work versus the Cost of AI Work.

- Examples of AI Benefits
 - ISDA uses AI to eliminate tedious activities
 - AI revolutionizing business recruitment
 - AI is redefining management
 - Help blind people experience the world around them
 - Identify overlooked borrowers
 - Predict customer expectation
 - Startup AI companies are emerging in large numbers
 - customer experience and enjoyment.

Some limitations of AI Machines

- Lack human touch and feel
 - Lack attention to non-task surroundings
 - Can lead people to rely on AI machines too much
 - Can be programmed to create destruction
 - Can cause many people to lose their jobs
 - Can start to think by themselves, causing significant damage
 - Hypothetically ... no evidence of that!
 - These limitations are diminishing over time

- What AI can and cannot do?

AI Can Do	AI Cannot Do
Process huge data sets instantly	Think like a human across all tasks
Recognize patterns in images, speech, and text	Truly understand meaning or context
Automate repetitive, rule-based tasks	Show emotions or empathy
Support decision-making with predictions	Exercise wisdom, morality, or ethics
Generate text, images, and music	Be truly creative or imaginative
Provide personalization & recommendations	Learn independently like humans

- Three Types of AI decisions

Flavor	AI Role	Human Role	Example
Assisted Intelligence	AI provides insights, suggestions	Human makes the final decision	GPS navigation
Autonomous Intelligence	AI makes and executes decisions	Human has little or no role	Self-driving car
Augmented Intelligence	AI + Human collaborate	Both share decision-making	Doctor + AI diagnosis support

- What is intelligence?
 - Intelligence is the ability to learn, understand, and apply knowledge to solve problems, adapt to new situations, and make decisions.
- Types of intelligence:
 - Linguistic and verbal, logical, spatial, body/movement, musical, interpersonal, intrapersonal, naturalist
- Intelligence is not a simple concept!
- Content of intelligence
 - Reasoning, learning, logic, problem-solving, perception, and linguistic ability

HUMAN AND COMPUTER INTELLIGENCE

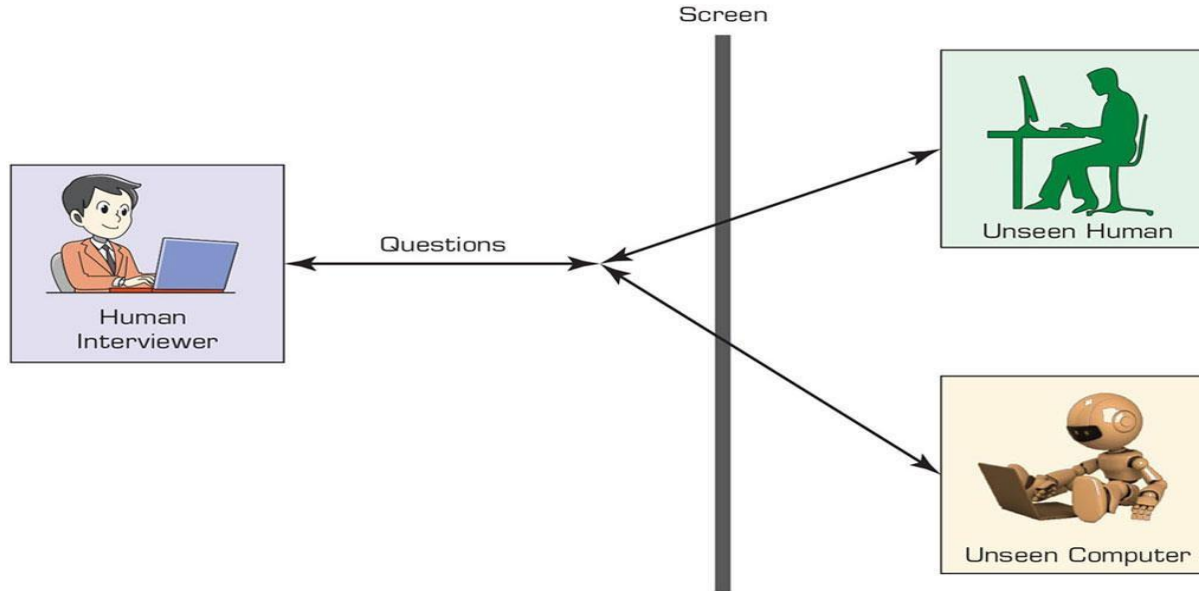
- Capabilities of intelligence
 - Learning or understanding from experience
 - Making sense out of ambiguous, incomplete, or even contradictory messages and information
 - Responding quickly and successfully to a new situation (i.e., using the most correct responses)
 - Understanding and inferring in a rational way, solving problems, and directing conduct effectively
 - Applying knowledge to manipulate environments
 - Recognizing and judging the relative importance of different elements in a situation

- How intelligent is AI?
- Comparing human intelligence with AI

Table 1 Artificial Intelligence versus Human Intelligence.

Area	AI	Human
Execution	Very fast	Can be slow
Emotions	Not yet	Can be positive or negative
Computation speed	Very fast	Slow, may have trouble
Imagination	Only what is programmed for	Can expand existing knowledge
Answers to questions	What is in the program	Can be innovative
Flexibility	Rigid	Large, flexible

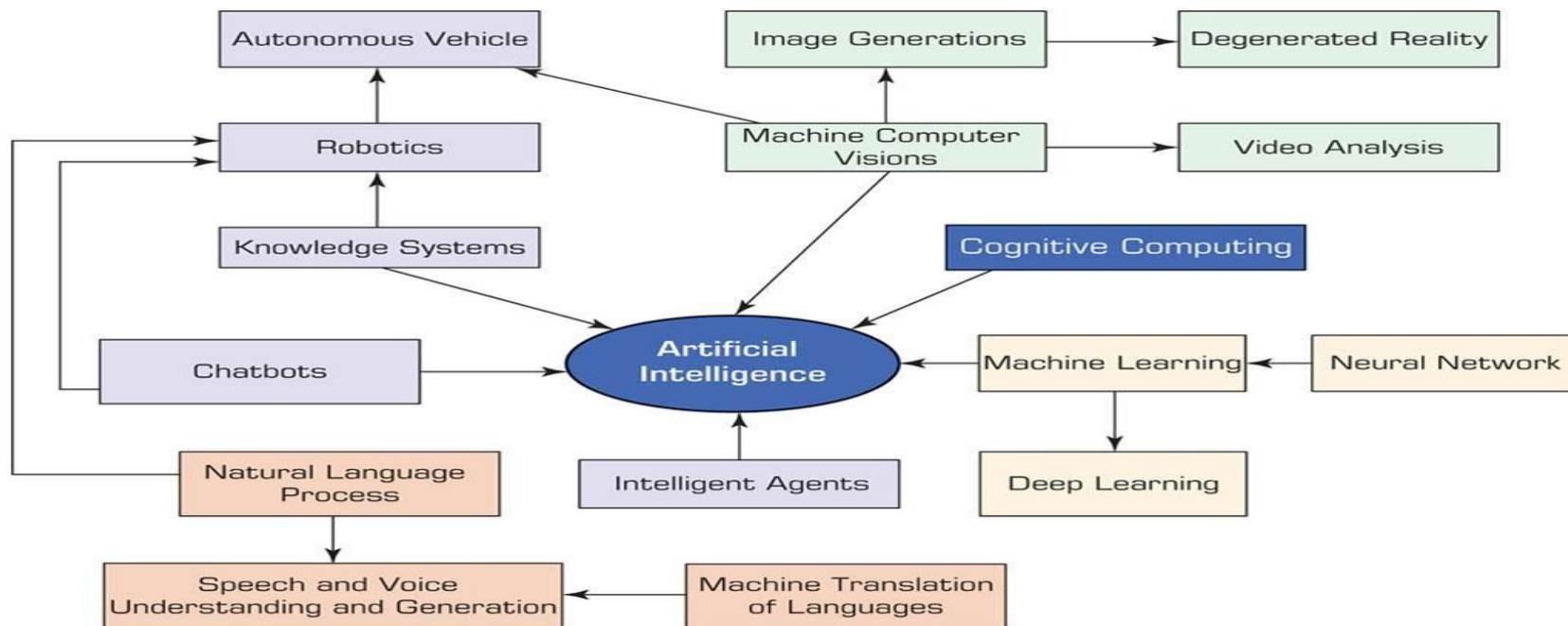
- Measuring AI: The Turing Test



MAJOR AI TECHNOLOGIES & DRIVERS

- Intelligent agents
 - Intelligent? Autonomous? Mobile? ...
- Machine learning
 - “Human learning embedded into machines”
- Deep learning
 - A part of machine learning
- Computer vision (machine vision)
- Video analytics

MAJOR AITECHNOLOGIES



Robotic systems

- Industrial robots [for manufacturing]
- Service robots
- Example: Walmart is using robots to properly stock shelves
- Use of robots (or bots) in eComemrce
- Many are being used at [Amazon.com](https://www.amazon.com)
- Online shopping robots (shopbots)
- SoftBank — a cellphone store in Tokyo entirely staffed by robots

- **Natural language processing**
 - Natural language understanding
 - Natural language generation
 - Speech (voice) understanding
 - An interesting application cs.cmu.edu/~listen
 - Machine translation of human languages
 - Babel fish (babelfish.com)
 - Google translator (translate.google.com)
 - Example: Sogou's travel translator

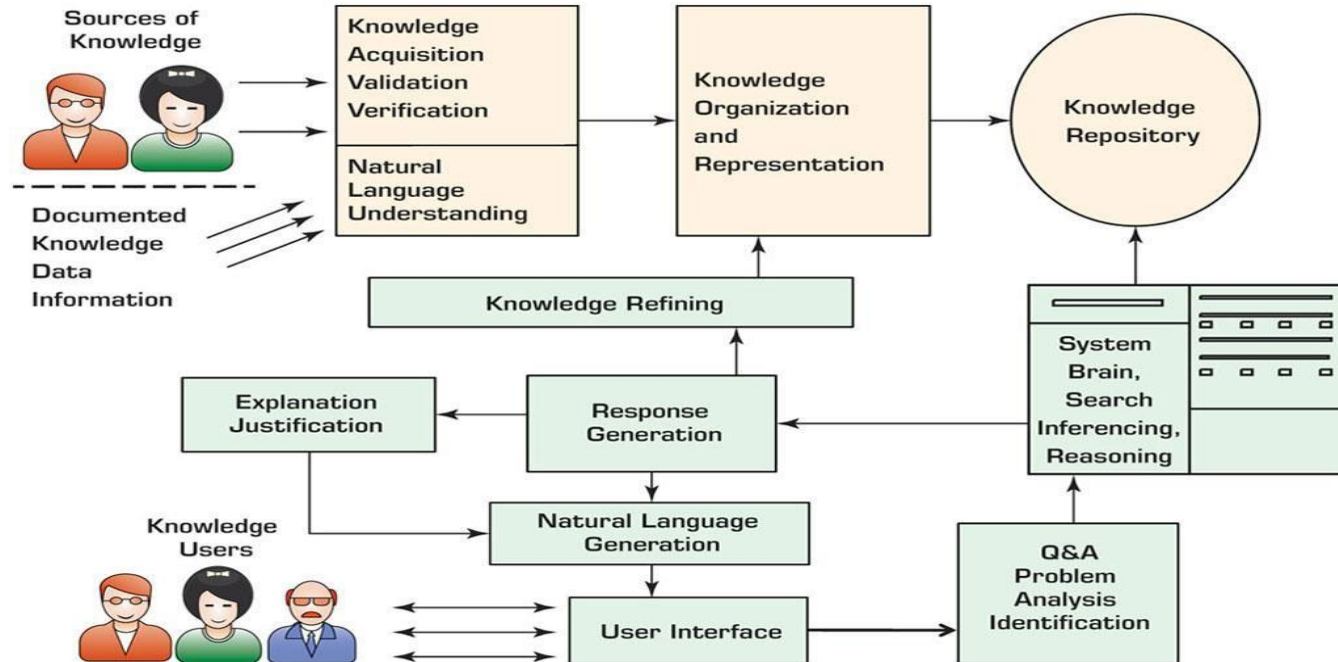
KNOWLEDGE AND EXPERT SYSTEMS

Knowledge sourced intelligent systems

- Knowledge acquisition
- Identifying experts
 - Knowledge representation
 - Reasoning from knowledge
- Chatbots
- Emerging AI technologies
 - Effective computing
 - Biometric analysis

- Cognitive computing
 - Knowledge derived from cognitive science
 - Self learning algorithms
 - IBM Watson
- Augmented reality
 - **Augmentation**: integration of digital information within the user environment in real time
 - Real + virtual combined
 - Virtual reality

AUTOMATED DECISION MAKING PROCESS



- Gather knowledge
- Organize and store it
- Analyze problems using reasoning
- Generate solutions
- Refine and justify
- Present to users in natural language.

Example 1: Medical Diagnosis System

Imagine an AI system helping doctors diagnose diseases.

Example 2: Amazon Alexa (Voice Assistant)

When you ask Alexa a question, e.g., “What’s the weather today?”

AI SUPPORT FOR DECISION MAKING

- Jeff Bezos, the CEO of [Amazon.com](https://www.amazon.com), said in May 2017 that AI is in a golden age ...
- AI can ...
 - Solve complex problems that people have not been able to solve.
 - Make much faster decisions.
 - Find relevant information, even in large data sources, very fast.
 - Make complex calculations rapidly.
 - Conduct complex comparisons and evaluations in real time.
 - Watch “AI Will Be Making Decisions for You” at <https://www.youtube.com/watch?v=Dr9jeRy9whQ>

USING AI IN DECISION MAKING

- Issues & factors:
 - The nature of the decision [routine vs non-routine]
 - The method of support /technologies used
 - Expert systems, recommender systems
 - Deep learning, pattern recognition, biometrics recognition
 - Cos-benefit and risk analysis
 - Using business rules
 - AI algorithms
 - Speed

AI SUPPORT FOR DECISION-MAKING PROCESS

- As it relates to Simon's decision making process
- AI support in problem identification
- AI support in generating or finding alternative solutions
- AI support in selecting a solution
- AI support in implementing the solution
- AI can (and should) play a role in each and every step in the decision making process



AI Across Simon's Process

Problem Identification (Intelligence): AI detects problems early through data analysis.

Generating Alternatives (Design): AI creates multiple innovative solutions using modeling and simulations.

Selecting a Solution (Choice): AI evaluates options and recommends the best decision.

Implementing (Implementation): AI automates execution and monitors performance.

Thus, AI is not just a support tool but a partner in decision-making — making the process faster, more accurate, and data-driven.

INTELLIGENT & AUTOMATED DECISION SUPPORT

Automated decision making (since 1970s)

- Common examples:
 - Small loan approvals
 - Initial screening of job applicants
 - Simple restocking
 - Prices of products and services (when and how to change them)
 - Product recommendation (eg, at [Amazon.com](https://www.amazon.com))
- **Example:** Supporting Nurses Diagnosis Decisions
 - An experiment conducted in a Taiwanese hospital (in 2015)
 - 87% agreement between AI and human experts

AI APPLICATIONS IN ACCOUNTING

- AI in big accounting firms
- AI in small accounting firms
 - Solve complex billing problems (especially in healthcare)
 - Claim processing and reimbursement
 - Real estate contracts, risk analysis ...
 - AI provides cheaper and better data-driven support
 - Generates needed insights from data analysis
 - Frees time of accountants for more complex tasks
 - Machine learning is often used for prediction
- AI will improve and automate accounting tasks but at the same time will take away some accounting jobs.

AI APPLICATIONS IN FINANCIAL SERVICES

- Diverse use of AI, in banking and insurance.
- Examples of AI use in general financial services:
 - Extreme personalization (eg, chatbots, personal assistants, etc.)
 - Shifting customer behavior both online and in branches
 - Facilitating trust in digital identity, revolutionizing payments
 - Sharing economic activities (eg, person-to-person loans)
 - Offering financial services 24/7 and globally
- Banking can also use AI for ...
 - Face recognition (safer online banking), help customer with smart investment decisions, prevent money laundering...
- Insurance – mostly in issuing policies and handling claims

AI APPLICATIONS IN FINANCIAL SERVICES

- Application of AI uses in Banking
 - Employee surveillance (AI machines, eg, IBM Watson).
 - Tax preparation/filing (H&R block uses IBM Watson).
 - Automated customer service; answering customer inquiries in real-time.
 - See Rainbird Co. at rainbird.ai as a company that provides such services (using IBM Watson).
 - Automated online support for paying bills and account inquiries using Amazon Alexa (e.g., Capital One).
 - Fraud detection and anti-money-laundering activities; also improving customer experience (Bank Danamon).
 - Virtual banking assistant, Olivia at HSBC, learn from experience and helps customer better.

AI IN HUMAN RESOURCE MANAGEMENT

- Recruitment – talent acquisition
 - See Application Case 2.6 for an example
- Training – AI facilitates training
- Performance assessment (evaluation)
- Retention –eliminating attrition
 - Predicting attrition way ahead of time to eliminate loss of talent
- Using chatbots for supporting HRM
 - See olivia.paradox.ai.

AI IN HUMAN RESOURCE MANAGEMENT

- Introducing AI to HRM operations:
 1. Experiment with a variety of chatbots
 2. Develop a team approach involving other functional areas
 3. Properly plan a technology roadmap for both the short and long term, including shared vision with other functional areas
 4. Identify new job roles and modifications in existing job roles in the transformed environment
 5. Train and educate the HRM team to understand AI and gain expertise in it.

AI IN MARKETING, ADVERTISING, & CRM

- One of the richest area for AI applications:
 1. Product and personal recommendations
 2. Smart search engines
 3. Fraud and data breaches detection
 4. Social semantics
 5. Web site design
 6. Producer pricing
 7. Predictive customer service
 8. ... many more in the book ...

AI IN MARKETING, ADVERTISING, & CRM

- Improving customer experience and CRM
 1. Use NLP for generating user documentation. This capability also improves the customer-machine dialogue.
 2. Use visual categorization to organize images (for example, see IBM's Visual Recognition and Clarifai)
 3. Provide personalized and segmented services by analyzing customer data. This includes
- AI in CRM Example: Salesforce's AI Einstein

AI IN PRODUCTION-OPERATION MANAGEMENT

- AI in manufacturing
 - Automation for compliance and cost reduction
 - React quicker and more effectively (agility)
- Implementation model
 - Streamlining processes, smart outsourcing, work automation, improving customer experience
- Intelligent factories
- Logistic and transportation
 - Example: DHL supply-chain

Drivers of Artificial Intelligence (AI)

AI didn't just grow by itself — certain factors (drivers) have accelerated its development and adoption.

1. Interest in Smart Machines and Artificial Brains

Humans have long been fascinated with creating machines that think and act like humans. This curiosity and research have pushed AI forward, from chess-playing computers to chatbots and autonomous cars.

2. Low Cost of AI Applications

As AI technologies become cheaper, more businesses (startups to large corporations) can afford to use them.

Example: Cloud-based AI solutions allow even small firms to use AI without investing in expensive hardware.

3. Desire of Large Tech Companies

Tech giants (Google, Microsoft, Amazon, Apple, Meta, IBM, etc.) are investing heavily in AI. Their investments in cloud AI services, assistants like Siri/Alexa, self-driving research are pushing the whole field forward.

4. Pressure on Management to Increase Productivity

Organizations need to reduce costs and improve efficiency.

AI provides automation (chatbots, predictive maintenance, process optimization), which directly helps boost productivity.

5. Availability of Quality Data

AI learns from data — and today, we generate data from social media, IoT devices, healthcare systems, e-commerce, etc.

The rise of “Big Data” fuels AI models, making them smarter and more accurate.

6. Increased Functionality and Reduced Cost of Computers

Computing power is much stronger and cheaper than before.

High-performance GPUs and TPUs allow training of deep learning models that were impossible 15 years ago.

7. Development of New Information Technologies (especially Cloud Computing)

Cloud platforms (AWS, Azure, Google Cloud) provide scalable, on-demand AI tools.

Businesses don't need to build their own infrastructure — they can just “rent AI power” from the cloud.