UNIT - I

An Overview of Business Intelligence, Analytics, and Decision Support: Analytics to Manage a Vaccine Supply Chain Effectively and Safely, Changing Business Environments and Computerized Decision Support, Information Systems Support for Decision Making, The Concept of Decision Support Systems (DSS), Business Analytics Overview

1) Analytics to Manage a Vaccine Supply Chain Effectively and Safely

Introduction

- Analytics is the process of using data to find useful information, understand trends, and make better decisions.
- Analytics can be categorized into:
- Descriptive Analytics: Focuses on understanding and interpreting historical data and trends to provide insights into past performance.
- Predictive Analytics: Uses statistical models and machine learning to forecast future outcomes based on historical data. (Predictive analytics forecasts future events.)
- Prescriptive Analytics: Suggests specific actions or decisions to achieve targeted outcomes by analyzing past data and predicting the effects of different strategies.

Analytics to Manage a Vaccine Supply Chain Effectively and Safely

- A Cold chain in healthcare is defined as a temperature-controlled supply chain involving a system of transporting and storing vaccines and pharmaceutical drugs.
- A Cold chain consists of three major components—

● Transport and storage equipment

● Trained personnel

● Efficient management procedures

- The majority of the vaccines in the cold chain are typically maintained at a temperature of 35–46 degrees Fahrenheit [2–8 degrees Centigrade].
- Maintaining cold chain integrity is extremely important for healthcare product manufacturers.

- Any extreme temperatures of heat or cold will reduce vaccine potency.
- Effectively maintaining the temperatures of storage units throughout the healthcare supply chain in real-time—i.e., beginning from the gathering of the resources, manufacturing, distribution, and dispensing of the products—is the most effective solution desired in the cold chain.
- Also, the location-tagged real-time environmental data about the storage units helps in monitoring the cold chain for spoiled products.
- A study conducted by the Centers for Disease Control and Prevention (CDC) looked at the handling of cold chain vaccines by 45 healthcare providers around the United States and reported that three-quarters of the providers experienced serious cold chain violations.
- Magpie Sensing Employs Analytics to Manage a Vaccine Supply Chain Effectively and Safely.
- Magpie Sensing, a start-up under Ebers Smith and Douglas Associated LLC, offers cold chain monitoring and analysis technologies for the healthcare industry.
- It provides shippable, wireless temperature and humidity monitors for real-time, location-based tracking of cold chain products during shipment.
- Magpie Sensing uses advanced analytics algorithms to process data from these monitors, enhancing cold chain efficiency and predicting potential storage issues before they arise.
- Magpie sensing applies all three types of analytical techniques-descriptive, predictive, and prescriptive analytics-to turn the raw data returned from the monitoring devices into actionable recommendations and warnings.

A. Descriptive Analytics:

- This data is visualized on a web dashboard, providing a clear picture of the cold storage environment.
- The properties of the cold storage system, which include the set point of the storage system's thermostat, the typical range of temperature values in the storage system, and the duty cycle of the system's compressor, are monitored and reported in real time.
- This information helps trained personnel to ensure that the storage unit is properly configured to store a particular product.
- All the temperature information is displayed on a Web dashboard that shows a graph of the temperature inside the specific storage unit.

Descriptive Analytics:

B. PREDICTIVE ANALYTICS

- Predictive Algorithms: Magpie's system determines the storage unit's thermostat set point and alerts users if it's incorrectly configured for various types of the stored products.
- Temperature Alerts: The system sends alerts about potential temperature violations, predicting risks like drops below freezing due to compressor cycles.
- Human Error Detection: By analyzing temperature trends, the system identifies possible errors such as doors left open , alerting users before temperature limits are breached. by

analyzing the temperature trend and alerting users via Web interface, text message, or audible alert before the temperature bounds are actually violated.

- Failure Detection: The system detects compressor or power failures and estimates the time before unsafe temperatures are reached, helping users prepare backup solutions like dry ice.

C. PRESCRIPTIVE ANALYTICS

- Magpie Sensing's analytics systems can provide prescriptive recommendations for improving the cold storage processes and business decision making.
- Prescriptive analytics help users dial in the optimal temperature, balancing freezing and spoilage risks, and providing time to prevent spoilage.
- Prescriptive analytics also gather useful meta-information on cold storage units, including the times of day that are busiest and periods where the system's doors are opened, which can be used to provide additional design plans and institutional policies that ensure that the system is being properly maintained and not overused.
- Prescriptive analytics can be used to guide equipment purchase decisions by constantly analyzing the performance of current storage units.

Summary: Analytics to Manage a Vaccine Supply Chain Effectively and Safely

- Magpie Sensing is a technology that uses data from cold storage monitoring devices to provide actionable insights and recommendations.
- Magpie sensing applies all three types of analytical techniques-descriptive, predictive, and prescriptive analytics-to turn the raw data returned from the monitoring devices into actionable recommendations and warnings.
- Data Collection: It collects real-time data on temperature, humidity, and compressor activity.
- Descriptive Analytics: This data is visualized on a web dashboard, providing a clear picture of the cold storage environment.
- Predictive Analytics: By analyzing data patterns, Magpie can predict potential issues like temperature violations, equipment failures, and human errors. It provides alerts to prevent problems before they occur.
- Prescriptive Analytics: Magpie offers recommendations to optimize cold storage operations, including setting optimal temperatures, identifying peak usage times, and suggesting equipment upgrades.

2) CHANGING BUSINESS ENVIRONMENTS AND COMPUTERIZED DECISION SUPPORT

- Previous topic illustrated how a company can employ technologies to make sense of data and make better decisions.
- Companies are moving aggressively to computerized support of their operations.
- To understand why companies are embracing computerized support, including business intelligence, Ramesh Sharda ,Dursun Delen And Efraim Turban developed a model called the *Business Pressures-Responses -Support Model.*
- **The Business Pressures–Responses–Support Model :**

The Business Pressures–Responses–Support Model, as its name

indicates, has three components:

1. **Business pressures** that result from today's business climate,

2. **Responses** (actions taken) by companies to counter the pressures (or to take advantage of the opportunities available in the environment)

3. **Computerized support** that facilitates the monitoring of the environment and enhances the response actions taken by organizations.(Support to better facilitate the process)

Fig : Business pressures -Responses -support model

A.The Business Environment:

- Today's business environment is increasingly complex, creating both opportunities and challenges.
- Globalization, for example, allows companies to find suppliers and customers worldwide, which means you can buy cheaper materials and sell more of your products and services. However, it also brings stronger competition.
- Business environment factors can be divided into four major categories: markets, consumer demands, technology, and societal. These categories are summarized in Table 1.1.

In addition, organizations and departments within organizations face decreased budgets and amplified pressures from top managers to increase performance and profit. Companies face rising pressures to perform better with fewer resources

FACTOR	DESCRIPTION
Markets	Strong competition
	Expanding global markets
	Blooming electronic markets on the Internet
	Innovative marketing methods
	Need for real-time, on-demand transactions
Consumer demand	Desire for customization
	Desire for quality, diversity of products, and speed of delivery
	Customers getting powerful and less loyal
Technology	More innovations, new products, and new services
	Increasing information overload
	Social networking, Web 2.0 and beyond
Societal	Growing government regulations and deregulation
	Prime concerns of homeland security and terrorist attacks
	Increasing social responsibility of companies

B. ORGANIZATIONAL RESPONSES:

- **Responses** (actions taken) by companies to counter the pressures (or to take advantage of the opportunities available in the environment)

- Be Reactive, Anticipative, Adaptive, And Proactive
- Private and public organizations are aware of today’s business environment and pressures , take different actions to counter pressure.
- Vodafone New Zealand, for instance, used BI to improve communication, retain customers, and increase revenue
- Managers may take other actions, including the following:
  - Employ strategic planning.
  - Improve partnership relationships.
  - Respond quickly to competitors' actions
  - Participate in business alliances.
  - Use new and innovative business models.

C. Decisions and Support represents the actual decision-making process, enabled by business intelligence and Integrated Computerized Decision Support tools.

- These tools provide the necessary data and analysis to make decisions.
- This component represents the decision-making process and the tools and resources that can support it. It includes:
- **Analyses:** Examining data and information to identify trends, patterns, and insights(**Analyzing** data)
- **Predictions:** Forecasting future outcomes based on available data.(Making **predictions**)
- **Decisions:** Making informed choices about the best course of action(Offering **support** (advice))
- Business Intelligence provides the data and analysis needed for decision-making.
- Integrated Computerized Decision Support provides the technology to support the decision-making process.

Definitions

- **Information Systems Support** involves using technology to enhance decision-making.
- **Business Intelligence (BI):** Analyzes data to create reports, dashboards, and visualizations, helping users understand past and present data.
- **Business Intelligence (BI)** focuses on analyzing historical and current data through reports, dashboards, and visualizations to provide insights into past and present performance, while **Decision Support Systems (DSS)** uses interactive tools and models for prescriptive and predictive analysis to assist in evaluating options and making decisions in complex or uncertain situations.
- BI is centered around reporting and visualizing data to understand past and current states, while DSS provides tools and models to guide decisions and predict future outcomes.

3) Information Systems Support for Decision Making

- **Computers** have moved from basic tasks like payroll to complex management decisions.
- **Computer applications** have moved from transaction processing and monitoring activities to problem analysis and solution applications, and much of the activity is done with Web-based technologies, in many cases accessed through mobile devices.
- Analytics and BI tools such as data warehousing, data mining, dashboards, and the use of the Web for decision support are the cornerstones of today's modern management.
- Besides growth in hardware, software, and networks capacities, several developments have significantly enhanced decision support and analytics, including the following:
    - Group communication and collaboration.
    - Improved data management
    - Managing giant data warehouses and Big Data.
    - Analytical support
    - Overcoming cognitive limits in processing and storing information
    - Knowledge management
    - Anywhere, any time support.

1. Group communication and collaboration.

- Teams often work together remotely using web tools and smartphones.

- This is especially useful for supply chain partners who need to share information.
- Bringing everyone together in one place is expensive, so technology helps teams collaborate from different locations.

2. Improved data management

- Many decisions involve complex computations.
- Data for these can be stored in different databases anywhere in the organization and even possibly at Web sites outside the organization.
- The data may include text,sound, graphics, and video, and they can be in different languages.
- It may be necessary to transmit data quickly from distant locations.

3. Managing giant data warehouses and Big Data.

- *Large data warehouses, like* the ones operated by Walmart, contain terabytes and even petabytes of data.
- Special methods, including parallel computing, are available to organize, search, and mine the data.
- The costs related to data warehousing are getting lower.

4. Analytical support.

- *With more data and analysis technologies, more alternatives* can be evaluated, forecasts can be improved and the views of experts (some of whom may be in remote locations) can be collected quickly and at a reduced cost.
- Expertise can even be derived directly from analytical systems.
- With such tools, decision makers can perform complex simulations, check many possible scenarios, and assess diverse impacts quickly and economically.

5. Overcoming cognitive limits in processing and storing information.

- The human mind has only a limited ability to process and store information.
- People sometimes find it difficult to recall and use information in an error-free fashion due to their cognitive limits.
- The term *cognitive limits indicates that an individual's* problem-solving capability is limited when a wide range of diverse information and knowledge is required.

- Computerized systems enable people to overcome their cognitive limits by quickly accessing and processing vast amounts of stored information

6. Knowledge management.

- **Knowledge management** (**KM**) is the process of organizing, creating, using, and sharing collective knowledge within an organization
- Organizations have gathered vast stores of information about their own operations, customers, internal procedures, employee interactions, and so forth through the **unstructured and structured communications** taking place among the various stakeholders.
- Knowledge management systems have become sources **of formal and informal support for** decision making to managers, although sometimes they may not even be called KMS.

7. Anywhere, any time support.

- Using wireless technology, managers can access information anytime and from any place, analyze and interpret it, and communicate with those involved.
- This perhaps is the biggest change that has occurred in the last few years.
- The speed at which information needs to be processed and converted into decisions has truly changed expectations for both consumers and businesses.

4) THE CONCEPT OF DECISION SUPPORT SYSTEMS (DSS)

- **Definition 1:** In the early 1970s, Scott-Morton defined decision support systems (DSS) as "interactive computer-based systems, which help decision makers utilize *data and models to solve unstructured problems*" *(Gorry and* Scott-Morton, 1971).
- **Definition 2**: The following is another classic DSS definition, provided by Keen and Scott-Morton 0978):

"Decision support systems couple the intellectual resources of individuals with the capabilities of the computer to improve the quality of decisions. It is a computer-based support system for management decision makers who deal with semistructured problems."

Components of DSS:

● DSS Database

● DSS Software System

● DSS User Interface

Types of DSS:

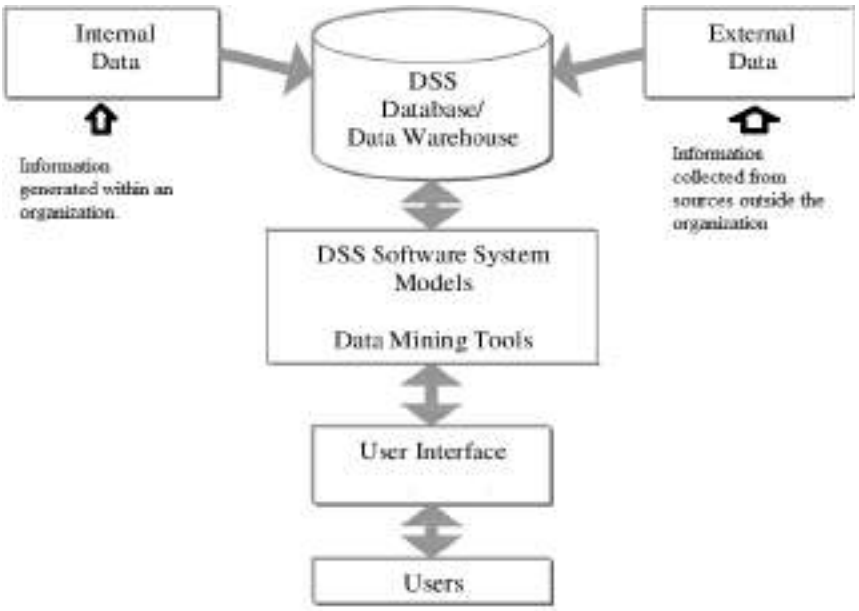
● Data driven DSS

● Model driven DSS

● Knowledge driven DSS

● Document driven DSS

● Communication driven DSS



- **Components of DSS:**
- **DSS Database**: Stores and manages comprehensive data sets essential for analysis and decision-making. **Salesforce** fits this component by storing customer and sales data for effective analysis.
- **Software System**: Includes models to simulate systems and predict outcomes. **IBM SPSS** fits this component by offering statistical modeling and predictive analytics.
- **User Interface**: Facilitates interaction with the system through various interface types. **Tableau** supports this component by providing interactive dashboards and visualizations, although it primarily focuses on data visualization.
- **Types of DSS:**
- **Data Driven DSS**: Focuses on analyzing and interpreting large amounts of data to support decision-making. Examples include systems that provide detailed reports and dashboards based on data queries.
- **Model Driven DSS**: Uses mathematical, statistical, or simulation models to analyze complex scenarios and predict outcomes. These systems help in decision-making by simulating various options.
- **Knowledge Driven DSS**: Relies on a knowledge base to provide recommendations based on expert knowledge and rules. These systems help with decisions by applying predefined knowledge and expertise.
- **Document Driven DSS**: Manages and retrieves documents to support decision-making. These systems help users access and utilize documents and reports relevant to their decisions.

- **Communication Driven DSS**: Focuses on facilitating communication and collaboration among users to support decision-making. These systems enhance group decision-making through shared communication platforms.

DSS as an Umbrella Term:

- The term **Decision Support System (DSS)** acts as an umbrella to cover various types of computerized systems that help with decision-making in organizations.
- **Knowledge Management System**: Under this umbrella, a company might have a system that helps everyone solve problems by providing useful information and guidelines.
- **Specialized Support Systems**: Another organization might use different DSS systems for specific areas like marketing, finance, and accounting, each designed to help with decisions in those particular fields.
- **Supply Chain Management (SCM) System**: This is a type of DSS that helps with managing production processes by optimizing the supply chain.
- **Rule-Based Systems**: These systems help with tasks like diagnosing product issues or providing help desk support by following a set of rules.

5) Evolution of DSS into Business Intelligence and The Architecture of Bl

Evolution of DSS into Business Intelligence

- Initially, DSS tools helped managers with supportive analysis, using staff to run analyses. As PC technology improved, managers became more tech-savvy and realized that technology could speed up and enhance decision-making.
- New tools like OLAP, data warehousing, data mining, and intelligent systems, delivered through the web, provided better access and capabilities for decision-making. By the mid-1990s, these tools were known as Business Intelligence (BI) and business analytics.

Business intelligence (BI)

- Business intelligence (BI) is a set of technological processes for collecting, managing and analyzing organizational data to yield insights that inform business strategies and operations.
- BI provides interactive, real-time access to data, allows for data manipulation, and supports analysis.
- Process: BI transforms data into information, then into decisions, and finally into actions

The Architecture of Bl

- A BI system has four major components:

- *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*
- U*ser interface (e.g., a dashboard).*

DEFINITIONS:

- **Analytics** is the science of analyzing raw data to make conclusions about that information. Analytics is the broadest term that encompasses both Decision Support Systems (DSS) and Business Intelligence (BI).
- **DSS (Decision Support Systems)**: Specialized tools within business analytics designed to assist in specific decision-making tasks.(EX:AnyLogic)
- **BI (Business Intelligence)**: Evolved from DSS to include a wider range of activities such as data warehousing, data mining, and reporting, and is a key component of business analytics.(Power BI)
- **Business Analytics**: Business analytics specifically uses statistical methods and technologies to analyze historical data for insights and improved decision-making.
- **Analytics** refers to the broad practice of examining and interpreting raw data to uncover patterns, trends, and insights across any domain, not limited to business. It is used in a variety of fields, such as healthcare, sports, finance, marketing, engineering, and more.
- The main goal of **business analytics** is to provide businesses with actionable insights for improving efficiency, identifying market opportunities, forecasting trends, and supporting strategic decision-making.

Business Analytics Overview

The Institute for Operations Research and Management Science (INFORMS) has created a major initiative to organize and promote analytics.

According to INFORMS, analytics represents the combination of computer technology, management science techniques, and statistics to solve real problems.

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 represented by INFORMS in proposing three levels of analytics.

These three levels are identified as descriptive, predictive, and prescriptive.

Figure 1 presents two graphical views of these three levels of analytics.

One view suggests that these three are somewhat independent steps (of a ladder) and one type of analytics application leads to another.

The interconnected circles view suggests that there is actually some overlap across these three types of analytics.

In either case, the interconnected nature of different types of analytics applications is evident.

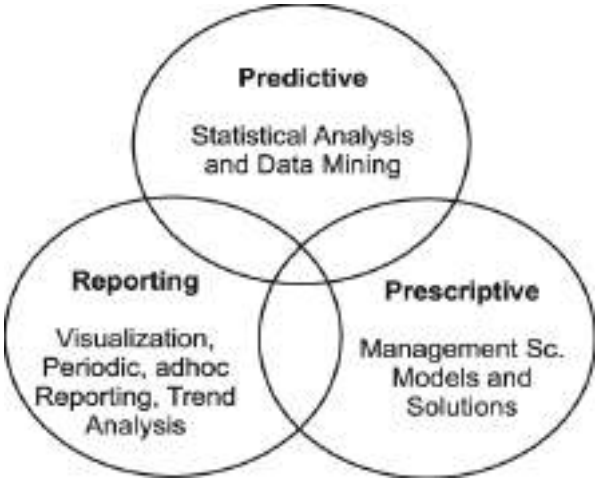
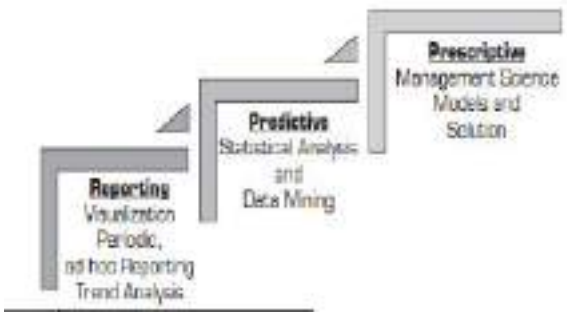


FIGURE 1



1.Descriptive Analytics

Descriptive Analytics: Focuses on understanding and interpreting historical data and trends to provide insights into past performance.

Descriptive or reporting analytics refers to knowing what is happening in the organization and understanding some underlying trends and causes of such occurrences.

This involves, first of all, consolidation of data sources and availability of all relevant data in a form that enables appropriate reporting and analysis. Usually development of this data infrastructure is part of data warehouses.

From this data infrastructure we can develop appropriate reports, queries,alerts, and trends using various reporting tools and techniques.

Visualization tools like Tableau are key in descriptive analytics, providing insights into organizational operations such as patient flow, resource allocation, and disease tracking. Healthcare case studies and interactive dashboards are available on Tableau's site.

2.Predictive analytics

Predictive analytics is the process of using historical data to predict future outcomes. It's about answering the question, "What is likely to happen?“

Predictive Analytics: Uses statistical models and machine learning to forecast future outcomes based on historical data. (Predictive analytics forecasts future events.)

Future-oriented: Unlike descriptive analytics which focuses on the past, predictive analytics looks ahead.

Statistical foundation: It's rooted in statistical methods, providing a rigorous approach to analysis

Data mining integration: It incorporates advanced data mining techniques to extract valuable insights from large datasets.

Real-world Applications

Customer churn prediction: Analyzes past customer behavior to predict which customers are likely to leave.

Customer segmentation: Uses data patterns to group customers and forecast their future preferences for targeted campaigns.

Product recommendations: Predicts which products customers are likely to buy based on previous purchases.

Fraud detection: Identifies patterns in transaction data to predict and flag potential fraudulent activities.

Risk assessment: Evaluates past data to estimate future risks in industries like finance and insurance.

Key Techniques

Classification: Categorizing data into predefined groups. For instance, predicting if a customer will churn or not (yes/no).

Decision Trees: Creating a tree-like model of decisions and their possible consequences.

Neural Networks: Mimicking the human brain to identify patterns.

Clustering: Grouping similar data points together. For example, segmenting customers based on purchasing behavior.

Association Mining: Discovering relationships between items. For instance, finding that customers who buy bread also tend to buy butter.

3.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 forms 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.

The decisions may be presented to a decision maker in a report or may directly be used in an automated decision rules system (e.g., in airline pricing systems). Prescriptive analytics helps airlines determine dynamic pricing by analyzing factors like demand, booking patterns, and competitor prices.

Prescriptive analytics helps ride-sharing companies like Ola and Uber set optimal and dynamic pricing based on real-time data and demand patterns.

Healthcare Treatment Plans: Prescriptive analytics can suggest personalized treatment plans for patients by analyzing medical history, treatment effectiveness, and patient outcomes.

Tools used to support prescriptive analytics are

Optimization: Google OR-Tools is widely used tools for solving complex optimization problems, including logistics and scheduling.

Simulation: SIMUL8 is popular for modeling various scenarios and assessing their effects on business processes.

Decision Modeling: Lucidchart is effective tools for creating decision trees and frameworks to help analyze and visualize decision-making processes.

Expert Systems: IBM Watson provide expert system capabilities for applications like medical diagnostics and customer support, leveraging advanced AI and machine learning technologies.