Business Intelligence

Week 9

Data Visualization and Reporting

- Introduction
- Visualization principles
- Dashboards
- Storytelling with data
- Reporting tools

Tilahun Melak(PhD)

May, 2026

Objectives

At the end of this lecture students will be able to :

- Develop an understanding of the role of data visualization in organizational decision-making.
- Apply visualization principles to design clear, accurate, and effective business reports and dashboards.
- Analyze and evaluate dashboards, scorecards, and Key Performance Indicators (KPIs) for performance monitoring.
- Utilize storytelling techniques to communicate analytical insights and support strategic business decisions.

Introduction

- When we want to convey some information to others, there are several ways to do so.
- The process of conveying the information with the help of plots and graphics is called **Data Visualization**.
- The plots and graphics take numerical data as input and display output in the form of charts, figures and tables.
- It helps to analyze and visualize the data clearly and make concrete decisions. It makes complex data more accessible and understandable.
- The goal of data visualization is to communicate information in a clear and efficient manner.

Colin Ware. (2019). Information visualization: Perception for design (4th ed.). Morgan Kaufmann.

Data Visualization in Business Intelligence

- Data visualization refers to the graphical representation of data and information using visual elements such as charts, graphs, maps, and dashboards to facilitate understanding, analysis, and decision-making.
- Objectives of Data Visualization
  - Transform complex datasets into understandable visual forms
  - Identify trends, correlations, and patterns
  - Support strategic and operational decision-making
  - Enhance communication of analytical findings
  - Improve user interaction with business data

Edward R. Tufte. (2001). The visual display of quantitative information (2nd ed.). Graphics Press.

Data Visualization in Business Intelligence…

- **Characteristics of Effective Visualization**
  - **Clarity:** Information should be easy to interpret
  - **Accuracy:** Visuals must represent data truthfully
  - **Simplicity:** Avoid unnecessary decorations and clutter
  - **Consistency:** Use standardized colors, scales, and formats
- **Common Visualization Techniques**
  - **Bar Charts:** Compare categorical data
  - **Line Charts:** Show trends over time
  - **Pie Charts:** Display proportions and percentages
  - **Scatter Plots:** Identify relationships between variables
  - **Heat Maps:** Visualize density and intensity patterns
  - **Geographical Maps:** Represent location-based insights

Edward R. Tufte. (2001). The visual display of quantitative information (2nd ed.). Graphics Press.

Data Visualization in Business Intelligence…

- **Role in Business Intelligence**
  - Facilitates real-time monitoring of organizational performance
  - Supports Key Performance Indicator (KPI) analysis
  - Enhances executive dashboards and reports
  - Assists in predictive and prescriptive analytics
  - Enables faster and evidence-based decisions
- **Advantages**
  - Faster comprehension of large datasets
  - Improved analytical efficiency
  - Better communication among stakeholders
  - Identification of hidden trends and anomalies

Edward R. Tufte. (2001). The visual display of quantitative information (2nd ed.). Graphics Press.

Data Visualization in Business Intelligence…

- **Challenges**
  - Information overload
  - Misleading visual representations
  - Poor chart selection
  - Data quality and inconsistency issues
- **Example Applications**
  - Sales trend analysis
  - Customer behavior analysis
  - Financial performance monitoring
  - Supply chain optimization
  - Healthcare analytics

Edward R. Tufte. (2001). The visual display of quantitative information (2nd ed.). Graphics Press.

Principles of Effective Data Visualization

- Visualization principles are fundamental guidelines used to design clear, accurate, and meaningful graphical representations of data.
- In Business Intelligence (BI), effective visualization improves analytical understanding, supports decision-making, and enhances communication of insights.

Edward R. Tufte. (2001). The visual display of quantitative information (2nd ed.). Graphics Press.

Principles of Effective Data Visualization

- Core Principles of Data Visualization

1. Clarity

- Clarity refers to the ability of a visualization to communicate information in a simple, understandable, and unambiguous manner.
- **Key Features**
- Use simple and readable chart designs
- Avoid unnecessary decorative elements ("chart junk")
- Maintain proper labeling and legends
- Highlight important information clearly
- **Importance**
- Reduces user confusion
- Enhances readability and interpretation
- Improves communication of analytical findings
- **Example**
- A simple line graph showing monthly sales trends is easier to interpret than a heavily decorated 3D chart.

Edward R. Tufte. (2001). The visual display of quantitative information (2nd ed.). Graphics Press.

Principles of Effective Data Visualization…

- Core Principles of Data Visualization

2. Accuracy

- Accuracy ensures that visualizations represent data truthfully without distortion or misleading interpretation.
- **Guidelines**
- Use correct scales and axis intervals
- Avoid truncated axes that exaggerate trends
- Maintain proportional representation of data
- Ensure data integrity and consistency
- **Importance**
- Supports reliable decision-making
- Prevents misinterpretation of business performance
- Maintains credibility of BI reports
- **Example**
- Bar charts should start from zero to avoid overstating differences between values.

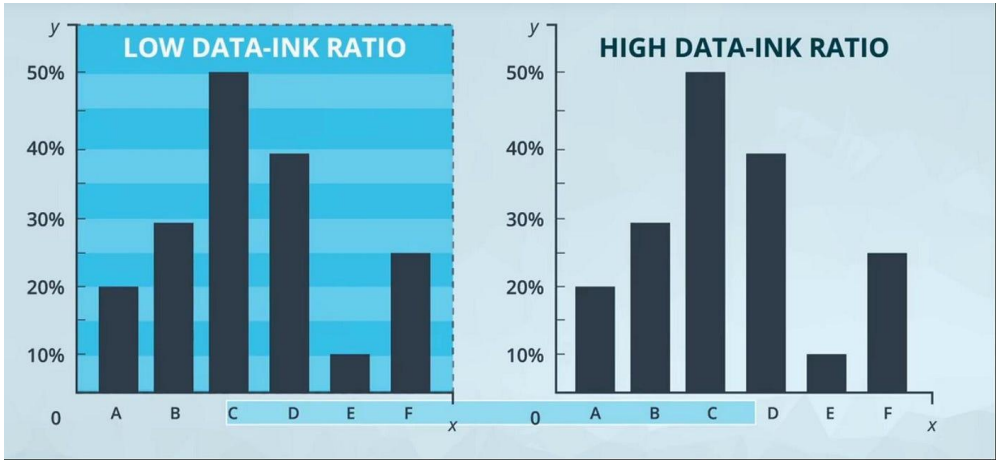
Edward R. Tufte. (2001). The visual display of quantitative information (2nd ed.). Graphics Press.

Principles of Effective Data Visualization…

- Core Principles of Data Visualization

3. Efficiency

- Efficiency refers to presenting maximum information with minimal visual complexity.
- **Key Concepts**
- Maximize the **data-to-ink ratio**
- Remove redundant gridlines and unnecessary effects
- Use concise labels and annotations
- Optimize screen space usage in dashboards
- **Benefits**
- Faster data interpretation
- Reduced cognitive load
- Improved analytical productivity



Edward R. Tufte. (2001). The visual display of quantitative information (2nd ed.). Graphics Press.

Principles of Effective Data Visualization…

- Core Principles of Data Visualization

4. Consistency

- Consistency involves maintaining uniform visual styles and standards across reports and dashboards.
- **Areas of Consistency**
- Color schemes
- Font styles and sizes
- Axis formatting
- Chart layouts and symbols
- **Importance**
- Improves user familiarity and navigation
- Enhances professionalism of reports
- Facilitates comparison across datasets

Edward R. Tufte. (2001). The visual display of quantitative information (2nd ed.). Graphics Press.

Principles of Effective Data Visualization…

- Core Principles of Data Visualization

5. Simplicity

- Avoid excessive colors, animations, and 3D effects
- Focus only on relevant information
- Reduce distractions from the main analytical message

6. Relevance

- Ensure visuals align with business objectives
- Present information meaningful to the target audience
- Avoid irrelevant or redundant data

7. Interactivity

- Modern BI systems support:
- Filtering
- Drill-down analysis
- Zooming and dynamic exploration
- This improves user engagement and analytical flexibility.

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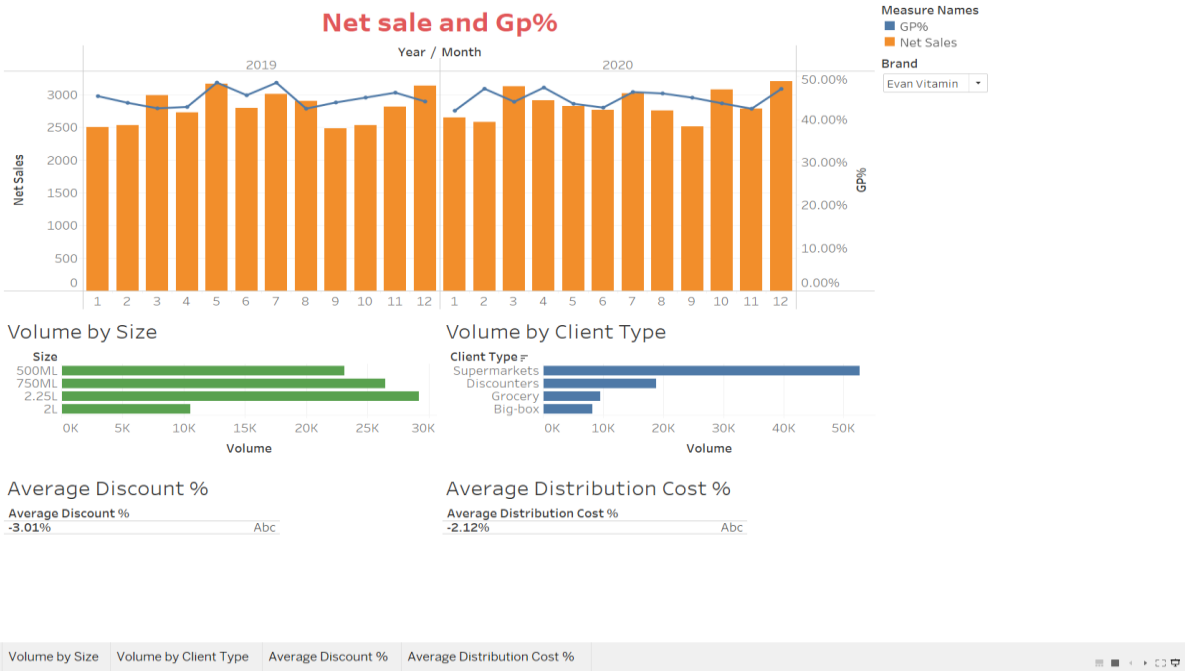
Dashboards in Business Intelligence

- A dashboard is an interactive visual interface that presents key business information, metrics, and performance indicators in a consolidated and easily understandable format to support monitoring, analysis, and decision-making.



Stephen Few. (2013). Information dashboard design: Displaying data for at-a-glance monitoring (2nd ed.). Analytics Press.

Dashboards in Business Intelligence…

- Purpose of Dashboards
  - Dashboards are designed to:
    - Monitor organizational performance in real time
    - Support strategic, tactical, and operational decisions
    - Summarize large volumes of data visually
    - Detect trends, anomalies, and business opportunities
    - Improve communication of key insights

Stephen Few. (2013). Information dashboard design: Displaying data for at-a-glance monitoring (2nd ed.). Analytics Press.

Dashboards in Business Intelligence…

- **Characteristics of Effective Dashboards**
  - **1. Real-Time Data Monitoring**
    - Displays continuously updated information
    - Supports rapid response to changing business conditions
    - Enables proactive decision-making
  - **Example:**
    - Real-time sales dashboards showing hourly revenue performance.

Stephen Few. (2013). Information dashboard design: Displaying data for at-a-glance monitoring (2nd ed.). Analytics Press.

Dashboards in Business Intelligence…

- **Characteristics of Effective Dashboards**
  - **2. Interactivity**
  - Modern dashboards allow users to:
    - Filter data dynamically
    - Drill down into detailed reports
    - Explore trends and patterns
    - Customize views based on needs

Stephen Few. (2013). Information dashboard design: Displaying data for at-a-glance monitoring (2nd ed.). Analytics Press.

Dashboards in Business Intelligence…

- **Characteristics of Effective Dashboards**
  - **3. Visual Representation**
  - Dashboards use:
    - Charts and graphs
    - Gauges and scorecards
    - Heat maps
    - KPI indicators
    - Geographic maps
  - Visual representations improve analytical comprehension.

Stephen Few. (2013). Information dashboard design: Displaying data for at-a-glance monitoring (2nd ed.). Analytics Press.

Dashboards in Business Intelligence…

- **Characteristics of Effective Dashboards**
  - **4. Consolidation of Information**
  - Dashboards integrate data from:
    - Data warehouses
    - Enterprise systems
    - Cloud platforms
    - Operational databases
  - This provides a unified business view.

Stephen Few. (2013). Information dashboard design: Displaying data for at-a-glance monitoring (2nd ed.). Analytics Press.

Dashboards in Business Intelligence…

- **Components of a Dashboard**
  - **Key Performance Indicators (KPIs)**
  - KPIs measure organizational performance against objectives.
  - **Examples:**
  - Revenue growth
  - Customer retention rate
  - Inventory turnover
  - Website traffic

Stephen Few. (2013). Information dashboard design: Displaying data for at-a-glance monitoring (2nd ed.). Analytics Press.

Dashboards in Business Intelligence…

- **Components of a Dashboard**
  - **Charts and Graphs**
  - Used to represent trends, comparisons, and distributions.
  - **Common Types:**
    - Bar charts
    - Line graphs
    - Pie charts
    - Scatter plots

Stephen Few. (2013). Information dashboard design: Displaying data for at-a-glance monitoring (2nd ed.). Analytics Press.

Dashboards in Business Intelligence…

- **Components of a Dashboard**
  - **Filters and Controls**
  - Enable users to:
    - Select time periods
    - Focus on departments or regions
    - Customize analytical views
  - **Alerts and Notifications**
    - Dashboards may generate warnings when:
    - Performance falls below thresholds
    - Unusual patterns occur
    - Risks are detected

Stephen Few. (2013). Information dashboard design: Displaying data for at-a-glance monitoring (2nd ed.). Analytics Press.

Dashboards in Business Intelligence…

- **Types of Dashboards**

  1. Operational Dashboards

  Purpose:

  - Monitor daily business operations in real time.

  Features:

  - High-frequency updates
  - Detailed transactional data
  - Supports frontline managers

  Example:

  - Call center performance dashboard.

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Dashboards in Business Intelligence…

- **Types of Dashboards**

  2. Tactical Dashboards

  Purpose:

  - Support mid-level management and departmental analysis.

  Features:

  - Trend analysis
  - Comparative reporting
  - Performance monitoring

  Example:

  - Marketing campaign performance dashboard.

Stephen Few. (2013). Information dashboard design: Displaying data for at-a-glance monitoring (2nd ed.). Analytics Press.

Dashboards in Business Intelligence…

- **Types of Dashboards**

  3. Strategic Dashboards

  Purpose:

  - Support executive-level strategic planning.

  Features:

  - Long-term KPIs
  - High-level summaries
  - Forecasting insights

  Example:

  - Executive financial performance dashboard.

Stephen Few. (2013). Information dashboard design: Displaying data for at-a-glance monitoring (2nd ed.). Analytics Press.

Dashboards in Business Intelligence…

- **Benefits of Dashboards**
  - Faster access to information
  - Improved decision-making
  - Enhanced organizational transparency
  - Better performance monitoring
  - Increased operational efficiency
  - Supports data-driven culture
- **Challenges in Dashboard Design**
  - Information overload
  - Poor visualization choices
  - Inconsistent data sources
  - Lack of user customization
  - Slow system performance

Stephen Few. (2013). Information dashboard design: Displaying data for at-a-glance monitoring (2nd ed.). Analytics Press.

Dashboards in Business Intelligence…

- **Dashboard Tools in Business Intelligence**
  - Common dashboard platforms include:
    - Microsoft Power BI
    - Tableau
    - Qlik Sense
    - SAP BusinessObjects
- **Applications of Dashboards**
  - Dashboards are widely used in:
    - Finance and banking
    - Healthcare management
    - Supply chain monitoring
    - Sales and marketing analytics
    - Education systems
    - Manufacturing industries

Stephen Few. (2013). Information dashboard design: Displaying data for at-a-glance monitoring (2nd ed.). Analytics Press.

Storytelling with Data in Business Intelligence

- Storytelling with data is the process of combining data, visualizations, and narrative techniques to communicate insights clearly, effectively, and persuasively for informed decision-making.
- It transforms raw analytical findings into meaningful business stories that stakeholders can easily understand and act upon.
- Organizations generate massive amounts of data; however, data alone does not guarantee understanding. Storytelling helps:
  - Convert analytical outputs into actionable insights
  - Improve communication between technical and non-technical audiences
  - Support strategic decision-making
  - Increase stakeholder engagement and understanding
  - Make complex information memorable and impactful

Cole Nussbaumer Knaflic. (2015). Storytelling with data: A data visualization guide for business professionals. Wiley.

Storytelling with Data in Business Intelligence…

- **Core Components of Data Storytelling**
  - **1. Data**
  - Data serves as the factual foundation of the story.
  - **Requirements**
  - Accurate and reliable
  - Relevant to business objectives
  - Timely and consistent
  - Properly analyzed and interpreted
  - **Examples**
  - Sales figures
  - Customer behavior metrics
  - Financial performance indicators

Cole Nussbaumer Knaflic. (2015). Storytelling with data: A data visualization guide for business professionals. Wiley.

Storytelling with Data in Business Intelligence…

- **Core Components of Data Storytelling**
  - **2. Visualizations**
  - Visual representations help audiences quickly understand patterns, trends, and relationships.
  - **Common Visualization Tools**
  - Bar charts
  - Line graphs
  - Scatter plots
  - Heat maps
  - Dashboards and infographics
  - **Purpose**
  - Simplify complex datasets
  - Highlight key insights
  - Improve audience comprehension

Cole Nussbaumer Knaflic. (2015). Storytelling with data: A data visualization guide for business professionals. Wiley.

Storytelling with Data in Business Intelligence…

- **Core Components of Data Storytelling**
  - **3. Narrative (Story)**
  - The narrative provides context and explains:
  - What happened
  - Why it happened
  - Why it matters
  - What actions should be taken
  - **Characteristics of Effective Narratives**
  - Clear and concise
  - Audience-focused
  - Logical flow of ideas
  - Insight-driven

Cole Nussbaumer Knaflic. (2015). Storytelling with data: A data visualization guide for business professionals. Wiley.

Storytelling with Data in Business Intelligence…

- **Process of Storytelling with Data**
  - **Step 1: Understand the Audience**
  - Different stakeholders require different levels of detail.
  - **Examples:**
  - Executives prefer strategic summaries
  - Analysts require detailed technical insights
  - Customers may require simplified visual explanations
  - **Step 2: Define the Objective**
  - Clearly identify:
  - The business problem
  - The key message
  - Desired outcomes or decisions

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Storytelling with Data in Business Intelligence…

- **Process of Storytelling with Data**
  - **Step 3: Build the Narrative**
  - Structure the story logically:
  - **Beginning**
  - Introduce the problem or context.
  - **Middle**
  - Present evidence, patterns, and insights.
  - **End**
  - Provide conclusions and recommendations.

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Storytelling with Data in Business Intelligence…

- **Techniques Used in Data Storytelling**

1. Highlighting Key Insights

- Use:
- Colors
- Annotations
- Callouts
- Labels
- to direct audience attention.

2. Showing Trends and Comparisons

- Demonstrate:
- Performance changes over time
- Comparisons between categories
- Variations across regions or departments

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Storytelling with Data in Business Intelligence…

- **Techniques Used in Data Storytelling**

3. Simplification

- Remove unnecessary details
- Focus on essential insights
- Avoid information overload

4. Emotional Engagement

- Stories become more persuasive when linked to:
- Human impact
- Business value
- Organizational goals

Cole Nussbaumer Knaflic. (2015). Storytelling with data: A data visualization guide for business professionals. Wiley.

Storytelling with Data in Business Intelligence…

- **Role in Business Intelligence**
  - Storytelling enhances BI by:
    - Improving interpretation of dashboards and reports
    - Supporting executive decision-making
    - Making analytics accessible to non-technical users
    - Increasing adoption of BI systems within organizations
- **Applications of Data Storytelling**
  - Financial reporting
  - Marketing analytics
  - Healthcare performance analysis
  - Supply chain optimization
  - Customer behavior analysis
  - Risk and fraud detection

Cole Nussbaumer Knaflic. (2015). Storytelling with data: A data visualization guide for business professionals. Wiley.

Storytelling with Data in Business Intelligence…

- **Benefits of Storytelling with Data**
  - Better communication of insights
  - Faster understanding of analytical results
  - Improved strategic planning
  - Increased stakeholder engagement
  - Enhanced data-driven culture
- **Challenges of Data Storytelling**
  - Poor visualization design
  - Misinterpretation of data
  - Biased narratives
  - Overcomplicated presentations
  - Lack of audience alignment

Cole Nussbaumer Knaflic. (2015). Storytelling with data: A data visualization guide for business professionals. Wiley.

Reporting Tools in Business Intelligence…

- Reporting tools are software applications used to collect, organize, analyze, and present business data in the form of reports, dashboards, and visual summaries to support decision-making.
- **Common Reporting Tools**
  - Microsoft Power BI
    Used for interactive dashboards, data visualization, and real-time reporting.
  - Tableau
    Provides advanced visualization and business analytics capabilities.
  - Microsoft Excel
    Widely used for data analysis, charts, pivot tables, and reporting.
  - Qlik Sense
    Supports self-service analytics and interactive reporting.

Ramesh Sharda, Dursun Delen, & Efraim Turban. (2018). Business intelligence, analytics, and data science: A managerial perspective (4th ed.). Pearson.

Summary

- Business Intelligence (BI) transforms raw data into meaningful insights using visualization, dashboards, storytelling, and reporting tools.
- Data visualization principles such as clarity, accuracy, consistency, and simplicity improve understanding and support effective decision-making.
- Dashboards and scorecards monitor organizational performance through interactive displays and Key Performance Indicators (KPIs).
- Storytelling with data combines visuals and narrative techniques to communicate analytical insights clearly to stakeholders.
- Reporting tools such as Microsoft Power BI, Tableau, and Microsoft Excel help organizations generate reports, monitor trends, and support data-driven decisions.

Reference

- Colin Ware. (2019). *Information visualization: Perception for design* (4th ed.). Morgan Kaufmann.
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- Ramesh Sharda, Dursun Delen, & Efraim Turban. (2018). *Business intelligence, analytics, and data science: A managerial perspective* (4th ed.). Pearson.