MBUS673 - Business Intelligence

Contents and coverage:
• Managerial approach
  ➢ Concepts, models etc.
• Hands-on realization
  ➢ Software tools
    ✔ Data Mining
      – Rapid Minder (free download) one user only with full features
    ✔ Business Performance Management
      – AHP (Analytical Hierarchy Process) web version

Chapter 1
An Overview of Business Intelligence, Analytics, and Decision Support

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Event Driven Alert - A Scenario

• Three transactions were posted in a credit account while the account holder was traveling in summer 2010:
  ➢ Ranch 99 San Jose, California $102.33 Aug. 1, 2010
  ➢ Exxon Austin, Texas $99.12 August 3, 2010
  ➢ Exxon Houston, Texas $120.44 August 5, 2010
• What action will you (the credit company) take and why?
• How the scenario can be detected?

What is “Business Intelligence”?

• “Business intelligence is the process of making better decisions in an environment that provides data and reporting that is timely, reliable, consistent and understandable in a useful format or presentation”.

Questions Posed in a BI seminar

• “I am not sure what BI really is these days, but our execs tell me we need it.”
  ➢ the question really is …
• “Why is BI suddenly such a hot topic with our senior management team? We are already using several end-user tools and yet they want more!”

More Questions

• Why BI is on the agendas of the majority of CIOs
  ➢ because CIOs have become extremely aware of BI’s importance in providing a competitive differentiator at all levels of the business.
• What is the primary goal of BI at the enterprise level?
  ➢ is to deliver critical business information and analysis from all data sources in context and in a timely manner.
**Goal of Business and Its Supporting Decision Making Processes**

- **MIS/IT** → **Information** → **Decision Making** → **Problem Solving** → **Revenue/Profit**

**DECISION MAKING**

- **Reasons for the growth of decision-making information systems**
  - People need to analyze large amounts of information
  - People must make decisions quickly
  - People must apply sophisticated analysis techniques, such as modeling and forecasting, to make good decisions
  - People must protect the corporate asset of organizational information

**DECISION MAKING**

- **Model** – a simplified representation or abstraction of reality
- **IT systems** in an enterprise

**DBQ: Explain the difference between transactional information and analytical information. Be sure to provide an example of each**

- **Transactional information** encompasses all of the information contained within a single business process or unit of work, and its primary purpose is to support the performing of *daily operational tasks*.
  - Examples of transactional information include withdrawing cash from an ATM or making an airline reservation.

- **Analytical information** encompasses all organizational information, and its primary purpose is to support the performing of *managerial analysis tasks*.
  - Examples of analytical information include trends, sales, and product statistics.

**Major Roles of Information Systems**

- **Support of Strategic Advantage (BI/BA/EIS)**
- **Support of Managerial Decision Making (DSS)**
- **Support of Business Operations (TPS)**

**Decisions in the Business**

- **Decision Characteristics**
  - Unstructured
  - Semi-structured
  - Structured

- **Operational Management**
  - Planning and Control of Day to Day Operations by Supervisory Management

- **Tactical Management**
  - Planning and Control of Organizational Subunits by Middle Management

- **Strategic Management**
  - Planning and Control of Overall Organizational Direction by Top Management

**Which type of decision(s) is the target of BI?**
Learning Objectives

- Understand today's turbulent business environment and describe how organizations survive and even excel in such an environment (solving problems and exploiting opportunities)
- Understand the need for computerized support of managerial decision making
- Describe the business intelligence (BI) methodology and concepts
- Understand the various types of analytics

Opening Vignette…

Magpie Sensing Employs Analytics to Manage a Vaccine Supply Chain Effectively and Safely

- Company background
- Problem
- Proposed solution and results
- Answer & discuss the case questions

Questions for the Opening Vignette

1. What information is provided by the descriptive analytics employed at Magpie Sensing?
2. What type of support is provided by the predictive analytics employed at Magpie Sensing?
3. How does prescriptive analytics help in business decision making?
4. In what ways can actionable information be reported in real time to concerned users of the system?
5. In what other situations might real-time monitoring applications be needed?

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1. What information is provided by the descriptive analytics employed at Magpie Sensing?

- The descriptive analytics monitor and report the properties of the cold storage system, including the set point of each thermostat, the typical range of temperatures in the system, and the duty cycle of each compressor. These values tell trained personnel whether each storage unit is properly configured for storing particular products.

2. What type of support is provided by the predictive analytics employed at Magpie Sensing?

- The predictive analytics use the descriptive data to alert users when a unit is not configured properly for storing the products. It also sends an alert when average temperature and compressor cycle runs signal that a temperature may go out of range (for example, after a power failure) or that there may have been a human error, such as failure to shut a door.
- These analytics tell users about a problem that may occur, giving them time to prevent the problem.

3. How does prescriptive analytics help in business decision making?

- Prescriptive analytics guides decision makers to the alternative with the greatest benefits. In Magpie’s cold chain system, prescriptive analytics uses data about storage unit performance to help buyers select the best storage units. And based on data about storage system efficiency and product sensitivity, prescriptive analytics guides decisions about where to distribute particular products in the supply chain.

4. What are possible ways to report actionable information in real time to the concerned users of the system?

- The system uses shippable wireless monitors. These continuously measure temperature, humidity, and location and transmit the data to the computer that analyzes the data.

5. What other situations might need real-time monitoring applications?

- Answers will vary, but students should consider other systems where current performance provides information about changes or decisions that would improve future performance.
- Examples include monitoring inventory levels at a manufacturing company to determine when to replenish stocks, monitoring sales in a store to identify when and how to adjust the mix of products, and monitoring patient status in a hospital to identify situations where different treatment is required or devices are malfunctioning.

1.2 Changing Business Environment & Computerized Decision Support Model

- Companies are moving aggressively to computerized support of their operations — Business Intelligence
- Business Pressures—Responses—Support Model
  - **Business pressures** result of today’s competitive business climate
  - **Responses** to counter the pressures
  - **Support** to better facilitate the process for making (or improving) better decisions

Fig. 1.1: Business Pressures — Responses — Support Model

![Diagram showing Business Pressures, Responses, and Support](image-url)
The Business Environment

• The environment in which organizations operate today is becoming more and more complex, creating:
  ➢ opportunities, and
  ➢ problems.
  ➢ Example: globalization.

• Business environment factors:
  ➢ markets, consumer demands, technology, and societal.

Organizational Responses

• Be Reactive, Anticipative, Adaptive, and Proactive
  • Managers may take actions, such as
    ➢ Employ strategic planning.
    ➢ Use new and innovative business models.
    ➢ Restructure business processes.
    ➢ Participate in business alliances.
    ➢ Improve corporate information systems.
    ➢ … more [in the book]

Closing the Strategy Gap

• One of the major objectives of computerized decision support is to facilitate closing the gap between the current performance of an organization and its desired performance, as expressed in its mission, objectives, and goals, and the strategy to achieve them.

1.2 A Framework for Business Intelligence (BI)

1.3 A Framework for Business Intelligence (BI)

• BI is an evolution of decision support concepts over time.
  ➢ Meaning of EIS/DSS…
    ✓ Then: Executive Information System
    ✓ Now: Everybody’s Information System (BI)

• BI systems are enhanced with additional visualizations, alerts, and performance measurement capabilities.

• BI’s major objective is to enable easy (interactive) 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.
**Business Intelligence (BI) — cont.**

- BI is an *umbrella* term that combines architectures, tools, *databases*, analytical tools, applications, and methodologies.
- The first is the *business aspect* of BI:
  - the need to get the most value out of information.
  - this need hasn’t really changed in over fifty years (although the increasing complexity of the world economy means it’s ever harder to deliver).
- The second is the *IT aspect* of BI:
  - what technology is used to help provide the business need. This obviously does change over time — sometimes radically.
- In summary, 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

*Video: History of Business Intelligence (10m 36s)*

**The Process of BI**

**Definition of BI:**

- BI can be considered as an *integrated* solution suite, where its power and functionality may be utilized by anyone who touches data within a particular context.
- In general, BI is the application of end-user query, reporting, dashboards, and other non-programming technologies to provide information that is not available to the business using traditional programming methods and services.

*(The New Era of Enterprise BI, Mike Bierie, 2001)*

**Fig. 1.2: The Evolution of BI Capabilities**

- **Metadata:**
  - data about data — data dictionary of a database
- **ETL:**
  - Extraction, transformation and load (raw data) – taking data from a transactions-processing system, cleaning it up, and moving to a data warehouse.
- **Data Warehouse:**
  - Mostly historical data for analysis of corporate performance, can contain current data for online transaction processing - e.g. Teradata warehouse system
- **Data Marts:**
  - Smaller (particular subject or department) and more focused than a data warehouse - marketing data mart as a subset of a corporate data warehouse
- **DSS:**
  - Decision Support System - System to help managers in decision making, e.g., for mortgage loan decisions, project selections, etc.

**The Architecture of BI**

- A BI system has four major components:
  - 1. a **data warehouse**, with its source data
  - 2. **business analytics**, (or analytical environment) a collection of tools for manipulating, mining, and analyzing the data in the data warehouse;
  - 3. **business performance management** (BPM) for monitoring and analyzing performance
  - 4. 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 (for details see Chapter 2).

Data Marts and the Data Warehouse

ETL: Extract, Transform and Load
(We will experience it using Rapid-Miner.)

Legacy systems feed data to the warehouse.

The warehouse feeds specialized information to departments (data marts).

Independent data mart data warehousing architecture

Data marts: Mini-warehouses, limited in scope

Separate ETL for each independent data mart
Data access complexity due to multiple data marts

Dependent data mart with operational data store: a three-level architecture

ODS provides option for obtaining current data

Single ETL for enterprise data warehouse (EDW)

Simple data access
Dependent data marts loaded from EDW
Components in a BI Architecture

- Business Analytics are the tools that help users transform data into knowledge (e.g., queries, data/text mining tools, etc.).

Business Analytics – another perspective

- Business Analytics (BA) is an umbrella term including data warehousing, business intelligence, enterprise information management, enterprise performance management, analytic applications, and governance, risk, and compliance.
- Business Intelligence (BI) is a set of technologies and processes used to describe business performance.
- Companies find success through better use of analytics.
- Many companies offer similar products and user comparable technologies.
- Business processes are among the last remaining points of differentiation.
- Focus on fact-based management to drive decision making.

What’s The Difference? Business Analytics vs Business Intelligence

- Business Analytics (BA) is a close cousin of Business Intelligence (BI). Both are meant to help companies make better decisions by analyzing business data. The difference is in their methods, and in the general direction of their analysis.
- Business Intelligence, the most common form, concentrates on data from the present and the immediate past, and drawing conclusions from that.
- Business Analytics makes more of an effort to predict the future using more complex tools relying heavily on anything from statistics to neural nets.

Business Intelligence vs. Business Analytics

- Business Intelligence
  ➢ traditionally focuses on using a consistent set of metrics to both measure past performance and guide business planning.
- Business Analytics
  ➢ focuses on developing new insights and understanding of business performance

What’s the difference between Business Analytics and Business Intelligence? The correct answer is: everybody has an opinion, but nobody knows, and you shouldn’t care
While the terms business intelligence and business analytics are often used interchangeably, there are some key differences:

<table>
<thead>
<tr>
<th>BI</th>
<th>Business Intelligence</th>
<th>Business Analytics</th>
</tr>
</thead>
<tbody>
<tr>
<td>Answers the questions:</td>
<td><strong>What</strong> happened?</td>
<td><strong>Why</strong> did it happen?</td>
</tr>
<tr>
<td></td>
<td><strong>When</strong>?</td>
<td><strong>Will it happen again?</strong></td>
</tr>
<tr>
<td></td>
<td><strong>Who</strong>?</td>
<td><strong>What will happen if we change it?</strong></td>
</tr>
<tr>
<td></td>
<td><strong>How many</strong>?</td>
<td><strong>What else does the data tell us that never thought to ask?</strong></td>
</tr>
<tr>
<td>Includes:</td>
<td>Reporting (KPIs, metrics)</td>
<td>Statistical/Quantitative Analysis</td>
</tr>
<tr>
<td></td>
<td>Automated Monitoring/Alerting (thresholds)</td>
<td>Data Mining</td>
</tr>
<tr>
<td></td>
<td>Dashboards</td>
<td>Predictive Modeling</td>
</tr>
<tr>
<td></td>
<td>Scorecards</td>
<td>Multivariate Testing</td>
</tr>
<tr>
<td></td>
<td>OLAP (Cubes, Slice &amp; Dice, Drilling)</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Data Mining</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Ad hoc query</td>
<td></td>
</tr>
</tbody>
</table>

**Business Analytics (cont.)**
- Davenport and Harris suggest that companies who are successful competing with business analytics have these five capabilities:
  - Hard to duplicate
  - Uniqueness
  - Adaptability
  - Better than competition
  - Renewability

- Characteristics of strategic resources are:
  - valuable,
  - rare,
  - non-imitable,
  - non-transferable,
  - non-substitutable,
  - combinable, and
  - exploitable

**KM Project vs. IT Project**
- According to Davenport and Prusak point out in their “33 1/3% rule,”
  - if more than one-third of the time and money spent on a project is spent on technology, the project becomes an IT project rather than a KM project.

**The Benefits of BI**
- The ability to provide accurate information when needed, including a real-time view of the corporate performance and its parts
  - Faster, more accurate reporting (81%)
  - Improved decision making (78%)
  - Improved customer service (56%)
  - Increased revenue (49%)

- See Table 1.2 for a list of BI analytics applications, the business questions they answer and the business value they bring.

**1.4 Intelligence Creation and Use**
- A Cyclical Process of Intelligence Creation And Use
  - Data warehouse and BI initiatives typically follow a process similar to that used in military intelligence initiatives depicted in this figure.
  - Pre-condition: a data warehouse must be in place.

**Table 1.2 Business Value of BI Analytical Applications**

<table>
<thead>
<tr>
<th>Analytic Application</th>
<th>Business Question</th>
<th>Business Value</th>
</tr>
</thead>
<tbody>
<tr>
<td>Customer segmentation</td>
<td>What market segments do my customers fall into, and what are their characteristics?</td>
<td>Personalize customer relationships for higher satisfaction and retention.</td>
</tr>
<tr>
<td>Propensity to buy</td>
<td>Which customers are more likely to respond to my promotions?</td>
<td>Target customers based on their need to increase their loyalty to your product line. Also, increase campaign profitability by focusing on the most likely to buy.</td>
</tr>
<tr>
<td>Customer profitability</td>
<td>What is the lifetime profitability of my customer?</td>
<td>Make individual business interaction decisions based on the overall profitability of customers.</td>
</tr>
<tr>
<td>Fraud protection</td>
<td>How can I tell which transactions are likely fraudulent?</td>
<td>Quickly determine fraud and take immediate action to minimize cost.</td>
</tr>
<tr>
<td>Customer attrition</td>
<td>Which customer is at risk of leaving?</td>
<td>Prevent loss of high-value customers and let go of lower-value customers.</td>
</tr>
<tr>
<td>Channel optimization</td>
<td>What is the best channel to reach my customer in each segment?</td>
<td>Interact with customers based on their preference and your need to manage cost.</td>
</tr>
</tbody>
</table>

Intelligence Creation and Use

• Steps Involved
  - Data warehouse deployment (pre-condition)
  - Creation of intelligence
    - Identification and prioritization of BI projects
      - By using ROI and TCO (total cost ownership-benefit analysis)
      - This process is also called BI governance
  - BI Governance
    - Who should do the prioritization?
      - Partnership between functional area heads and/or product/service area leaders (middles)
      - Partnership between customers and providers

BI Governance Issues/Tasks

1. Create categories of projects (investment, business opportunity, strategic, mandatory, etc.)
2. Define criteria for project selection
3. Determine and set a framework for managing project risk
4. Manage and leverage project interdependencies
5. Continuously monitor and adjust the composition of the portfolio

Intelligence and Espionage

• Stealing corporate secrets, CIA, …
  - Intelligence vs. Espionage

• Intelligence
  - The way that modern companies ethically and legally organize themselves to glean as much as they can from their customers, their business environment, their stakeholders, their business processes, their competitors, and other such sources of potentially valuable information

• Problem — too much data, very little value
  - Use of data/text/Web mining (see Chapters 4, 5)

1.5 Transaction Processing vs. Analytic Processing (OLTP vs. OLAP)

• Transaction processing systems are constantly involved in handling updates (add/edit/delete) to what we might call operational databases.
  - ATM withdrawal transaction, sales order entry via an ecommerce site – updates DBs
  - Online transaction processing (OLTP) handles routine on-going business
  - ERP, SCM, CRM systems generate and store data in OLTP systems
  - The main goal is to have high efficiency

Transaction Processing vs. Analytic Processing (OLTP vs. OLAP)

• Online analytic processing (OLAP) systems are involved in extracting information from data stored by OLTP systems
  - Routine sales reports by product, by region, by sales person, etc.
  - Often built on top of a data warehouse where the data is not transactional
  - Main goal is effectiveness (and then, efficiency) – provide correct information in a timely manner
  - More on OLAP will be covered in Chapter 2

More on OLTP vs. OLAP

• The figure depicts a relational database environment with two tables.
  - The first table contains information about pet owners; the second, information about pets. The tables are related by the single column they have in common: Owner_ID.
  - By relating tables to one another, we can reduce redundancy of data and improve database performance.
  - The process of breaking tables apart and thereby reducing data redundancy is called normalization

Fig. Extra-2: A simple database with a relation between two tables. For those have database background.
Most relational databases which are designed to handle a high number of reads and writes (updates and retrievals of information) are referred to as **OLTP** (OnLine Transaction Processing) systems.

OLTP systems are very efficient for high volume activities such as cashing, where many items are being recorded via bar code scanners in a very short period of time.

However, using OLTP databases for analysis is generally not very efficient, because in order to retrieve data from multiple tables at the same time, a query containing **joins** must be used.

**Denormalization** typically takes place at the time data are copied out of the transactional system. It is important to keep in mind that if a copy of the data is made in the data warehouse, the data may become out-of-synch. This happens when a copy is made in the data warehouse and then later, a change to the original record is made in the source database.

Data mining activities performed on out-of-synch records may be useless, or worse, misleading.

An alternative archiving method would be to move the data out of the transactional system. This ensures that data won’t get out-of-synch, however, it also makes the data unavailable should a user of the transactional system need to view or update it.

To be successful, BI must be aligned with the company’s business strategy (think about **IS/IT Triangle Strategy Model**).

- BI cannot/should not be a technical exercise for the information systems department
- BI changes the way a company conducts business by
  - improving business processes, and
  - transforming decision making to a more data/fact/information driven activity
- BI should help execute the business strategy and not be an impediment for it!
**Issues for Successful BI**

- Developing vs. Acquiring BI systems
- Justifying via cost-benefit analysis
  - It is easier to quantify costs
  - Harder to quantify benefits
- Security and Protection of Privacy
- Integration of Systems and Applications

**Real-Time, On-Demand BI Is Attainable**

- The demand for “real-time” BI is growing!
- Is “real-time” BI attainable? *(Continental Airlines case to be discussed in chapter 2)*
- Technology is getting there…
  - Automated, faster data collection (RFID, sensors, …)
  - Database and other software technologies (agent, SOA, …) technology is advancing
  - Telecommunication infrastructure is improving
  - Computational power is increasing while the cost for these technologies is decreasing
- Trend -> Business Activity Management (BAM)

**BI Implementation Considerations**

- Developing or acquiring BI systems
  - BI shell?
  - In-house versus outside consultants
- Justification and cost-benefit analysis
- Security and protection of privacy
- Integration of systems and applications

**1.7 Analytics Overview**

- Analytics?
  - Something new or just a new name for …
  - “The process of developing actionable decisions or recommendations for actions based upon insights generated from historical data.”
- A Simple Taxonomy of Analytics
  - **Descriptive/Reporting Analytics**
    - Knowing what is happening in the organization and understanding some underlying trends and causes of such occurrences.
  - **Predictive Analytics**
    - Aims to determine what is likely to happen in the future.
  - **Prescriptive Analytics**
    - The goal is to recognize what is going on as well as the likely forecast and make decisions to achieve the best performance possible.
- Analytics or Data Science?
  - Business-oriented vs. Science/technical-oriented

**Fig. 1.5: Three Types of Analytics**

<table>
<thead>
<tr>
<th>Descriptive/Reporting Analytics</th>
<th>Predictive Analytics</th>
<th>Prescriptive Analytics</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>What happened?</strong></td>
<td><strong>What will happen?</strong></td>
<td><strong>What should I do?</strong></td>
</tr>
<tr>
<td>Business reporting</td>
<td>Data mining</td>
<td>Optimization</td>
</tr>
<tr>
<td>Dashboards</td>
<td>Test mining</td>
<td>Simulation</td>
</tr>
<tr>
<td>Scorecards</td>
<td>Web/media mining</td>
<td>Decision modeling</td>
</tr>
<tr>
<td>Data warehousing</td>
<td>Forecasting</td>
<td>Expert systems</td>
</tr>
</tbody>
</table>

**Outcomes**

- Well defined business problems and opportunities
- Accurate projections of the future states and conditions
- Best possible business decisions and transactions
Introduction to Big Data Analytics

- Big Data?
  - Not just big!
  - Volume
  - Variety
  - Velocity
  - structured, unstructured, or in a stream
- Two aspects for studying “Big Data”
  - storing and processing /analyzing “Big Data”
- Push computation to the data instead of pushing data to a computing mode.
- More on big data and related analytics tools and techniques are covered in Chapter 6.

End-of-Chapter Application Case

Nationwide Insurance Used BI to Enhance Customer Service

Questions for Discussion

1. Why did Nationwide need an enterprise-wide data warehouse?
2. How did integrated data drive the business value?
3. What forms of analytics are employed at Nationwide?
4. With integrated data available in an enterprise data warehouse, what other applications could Nationwide potentially develop?

1. Why did Nationwide need an enterprise-wide data warehouse?

- With more than 100 business units offering a variety of products, Nationwide experienced duplication of effort in gathering data, analyzing it, and generating reports. Data-processing environments were widely dissimilar, and there was extreme data redundancy, resulting in higher expenses.
- Mergers and acquisitions only added to the difficulty and cost. A single, authoritative data warehouse would apply best practices and provide clean, consistent, and complete data.

2. How did integrated data drive the business value?

- Integrated data about customers improved marketing campaigns and better targeted communications, which improved customer satisfaction and retention, as well as contributing to a gain in sales.
- Integrated financial data made financial reporting faster and more efficient and added tools for better risk assessment and decision support.
- Integrated data following mergers fostered smoother integration of businesses. Integrated data for reporting gave agents easy access to reports within seconds rather than days, significantly improving productivity.

3. What forms of analytics are employed at Nationwide?

- It uses the three basic types of business analytics.
- The company’s data warehouse supports descriptive analytics for all functions. For example, the data describes customer behavior, financial performance, and policy information.
- It uses predictive analytics in the Customer Knowledge Store to identify the kinds of customer interaction that are important for customers at different points in their lives.

3. (cont.)

- At the level of prescriptive analytics, the Financial Performance Management system applies financial data to a decision support system.
- You may identify additional examples of these three categories. Optionally, you may also refer to analytics applied to different domains, such as marketing analytics, financial analytics, and even insurance analytics.
• With integrated data available in an enterprise data warehouse, what other applications could Nationwide potentially develop?

• The case described customer relationships and financial reporting.

• Other areas of decision making for an insurance business would include the development and pricing of products, regulatory compliance, hiring, risk management, and the location of facilities.

Plan of the Book

• Introduction
  ➢ Chapter 1

• Data Foundations
  ➢ Chapter 2

• BI & Analytics
  ➢ Chapters 3-6

• Emerging Trends
  ➢ Chapter 7