LECTURER: Nghia Duong-Trung
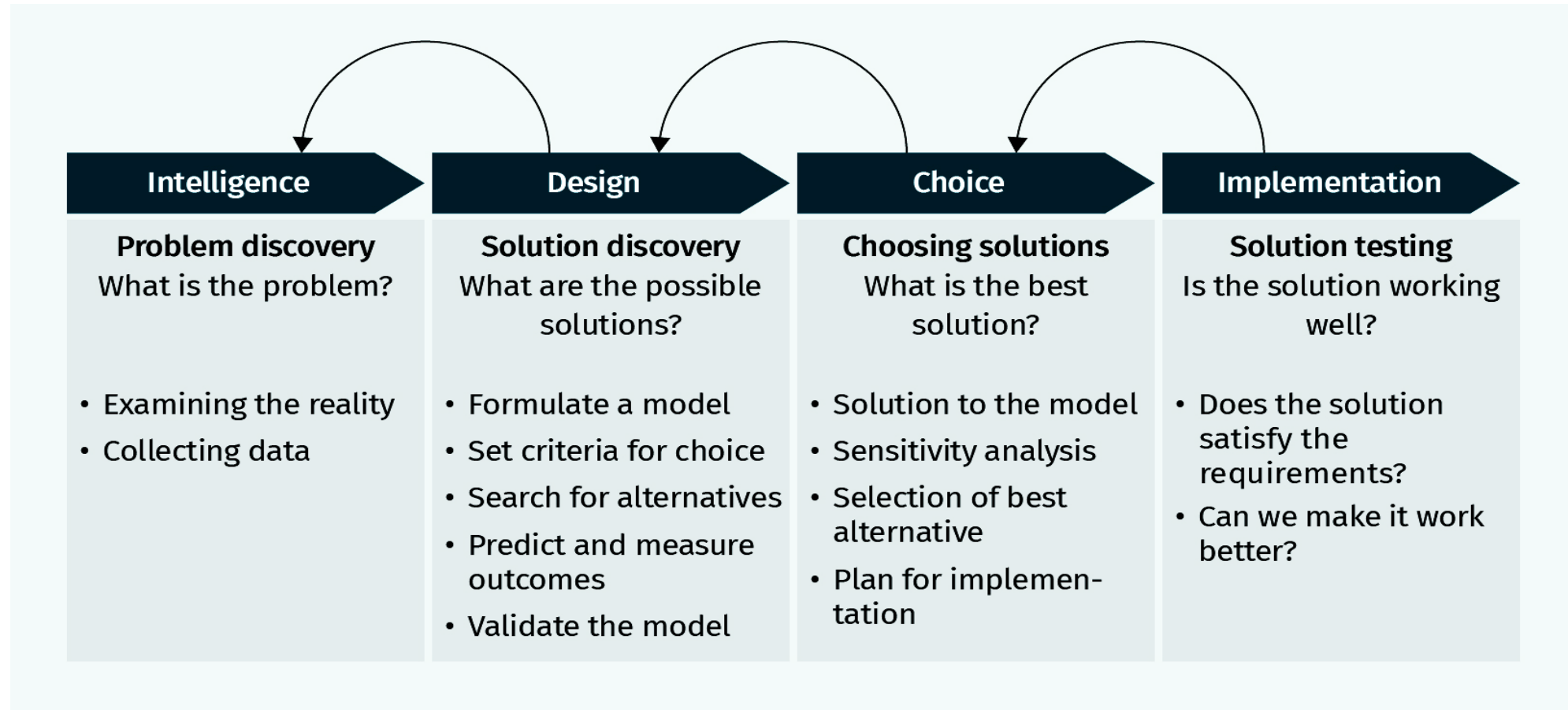
DATA UTILIZATION

DECISION SUPPORT

On completion of this unit, you will have learned …

- … the general process of decision making.

- … types of decision-making problems according to level of control and type of decision.

- … determinant, invariant, and alternatives.

- … techniques and methods used to model a decision-making problem.

- … the difference between correlation and causality.

- … the concepts and applications of data dashboards.

- … the structure and components of data warehouses and data cubes, as well as the operations defined on data cubes.

- … the ETL process for extracting and integrating data from different sources into a data warehouse.

1. What are the four phases of a decision making process?
2. Name some well-known methods of building decision models.
3. Describe the difference between correlation and causation.

A model decision-making process includes four phases:

Intelligence	Design	Choice	Implementation
Problem discovery What is the problem?	**Solution discovery** What are the possible solutions?	**Choosing solutions** What is the best solution?	**Solution testing** Is the solution working well?
• Examining the reality • Collecting data	• Formulate a model • Set criteria for choice • Search for alternatives • Predict and measure outcomes • Validate the model	• Solution to the model • Sensitivity analysis • Selection of best alternative • Plan for implementation	• Does the solution satisfy the requirements? • Can we make it work better?

Source of the graphic: Simon, 1977

Decision-making problems may be represented in two dimensions according to:

– **type of decision-making:** structured, semi-structured, or unstructured

– **type of control:** operational, managerial, or related to strategic planning

Structured decision making is **an approach for careful and organized analysis of natural resource management decisions**. Based in decision theory and risk analysis, SDM encompasses a simple set of concepts and helpful steps, rather than a rigidly-prescribed approach for problem solving.

A semi-structured decision is **one in which most of the factors needed for making the decision are known but human experience and other outside factors may still impact the decision**. A good example of a semi-structured decision is the hiring process.

Unstructured decision making is **a dynamic process where an individual must create an alternative because one is not available or provided**. In this type of a decision, an individual may not have formed preferences or may not know the path to arrive at a solution.
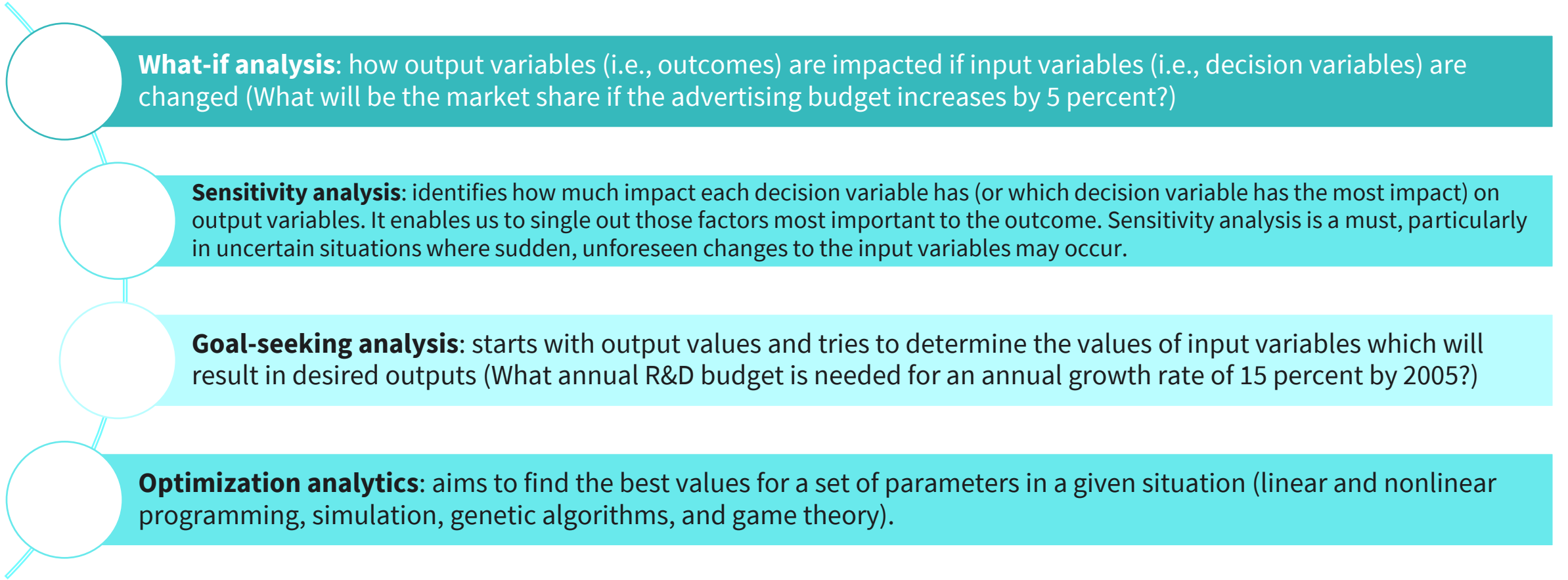
DECISION-MAKING FRAMEWORK

Types of decision-making	Type of control			
	Operational control	Managerial control	Strategic planning	Technology support needed
Structures	Accounts receivable, accounts payable, and order entry	Budget analysis, short-term forecasting, personnel reports, and make-or-buy	Financial management (investment), warehouse location, and distribution systems	Management information systems, management science models, and transaction processing
Semi-structured	Production scheduling, inventory control	Credit evaluation, budget preparation, plant layout, project scheduling, reward system design, and inventory categorization	Building a new plant, mergers and acquisitions, new product planning, compensation planning, quality assurance planning, HR policies, and inventory planning	Decision support system (DSS), knowledge management system (KMS), group support system (GSS), customer relationship management (CRM), supply chain management (SCM)
Unstructured	Selecting a cover for a magazine, buying software, approving loans, and help desk	Negotiating, recruiting and executive, buying hardware, and lobbying	R&D planning, new technology development, and social responsibility planning	GSS, KMS, expert system (ES), neural networks
Technology support needed	Management information systems, management science	Management science, executive information system (EIS), SCM, CRM, GSS, DSS, ES	GSS, CRM, EIS, ES, neural networks, KMS	

Several parameters and variables may influence the outcome of a decision-making process like:

– **Invariants:** Those parameters in a problem that are unchangeable and treated as constraints in the decision-making process. In other words, we must find solutions that stay within these constraints.

– **Determinants:** Input variables in the decision-making process that have a direct impact on the final result (changeable variables).

Decision support system analysis models may be categorized into the following groups:

What-if analysis: how output variables (i.e., outcomes) are impacted if input variables (i.e., decision variables) are changed (What will be the market share if the advertising budget increases by 5 percent?)

Sensitivity analysis: identifies how much impact each decision variable has (or which decision variable has the most impact) on output variables. It enables us to single out those factors most important to the outcome. Sensitivity analysis is a must, particularly in uncertain situations where sudden, unforeseen changes to the input variables may occur.

Goal-seeking analysis: starts with output values and tries to determine the values of input variables which will result in desired outputs (What annual R&D budget is needed for an annual growth rate of 15 percent by 2005?)

Optimization analytics: aims to find the best values for a set of parameters in a given situation (linear and nonlinear programming, simulation, genetic algorithms, and game theory).

Source of the text: O'Brien & Marakas, 2011

LINEAR PROGRAMMING, SIMULATION & ANALYTIC HIERARCHY PROCESS

Other Famous Decision Support System Analysis Techniques

Linear Programming

Solves linear optimization problems and consists of an objective function (which we want to optimize), a set of input variables (which we want to find values for that will optimize the objective function), and a set of constraints to be satisfied by the input variables.

Simulation

For solving complex decision-making problems.
Simulation enables us to evaluate the response of a system to different input variables so we gain a better understanding of the behavior of the system in various circumstances.

Analytic Hierarchy Process

For group decision-making processes. AHP breaks down complex problems into simple sub-problems that are easier to solve. The goal is first transformed and broken down into several different criteria. Each criterion is then evaluated on its alternative solutions and makes the decision-making process much easier.

Distinguishing between the notions of correlation and causality is important in modelling and strategic decision-making. Misunderstanding these concepts can lead to erroneous conclusions and incorrect decisions.

Correlation	Causality
Correlation is a statistical term and measures the interdependence between two random variables. If **changes in one variable are matched by changes in another variable, we say the two variables are correlated**. correlation analysis tries to determine whether there is a linear or non-linear relationship between variables. The Pearson correlation coefficient is one of the most frequently used methods to identify a linear relationship between two variables.	Causality lies at a deeper level and is not easily detected. In a causal relationship, **a change in one variable causes the other variable to change (or makes it happen)**. For example, as the weather gets warmer, ice cream sales and the sale of sunglasses will both rise. When modelling or interpreting data, it is crucial to distinguish between the notions of correlation and causation in order to find the true nature of relationships between variables.

Causation means one thing causes another—in other words, action A *causes* outcome B. On the other hand, **correlation is simply a relationship where action A *relates to* action B**—but one event doesn't necessarily cause the other event to happen.
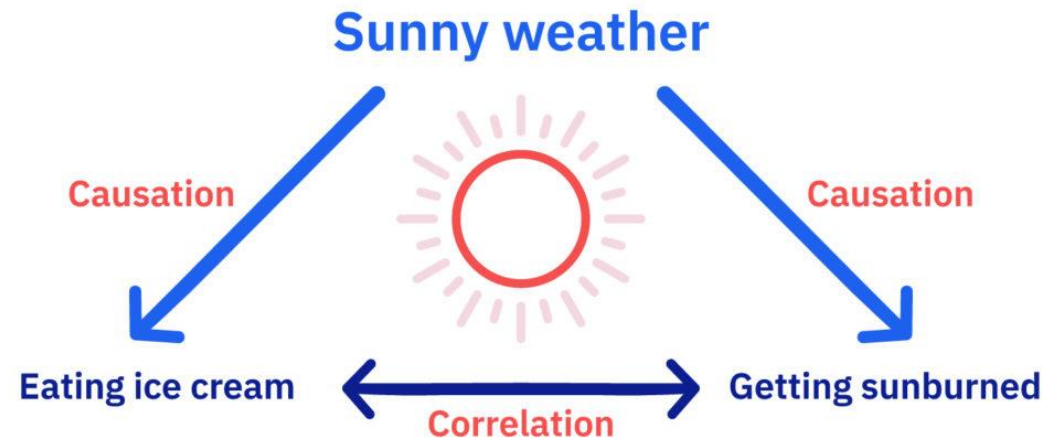
DATA DASHBOARD AND DATA WAREHOUSE

— A data dashboard is a visual tool which can provide managers and business decision-makers with detailed reports on key performance indicators with a brief information panel.

— Data dashboards are often used in conjunction with a data warehouse. A data warehouse is an integrated repository of data which is used both as a mechanism for data integration and a supportive data repository for data dashboards.

Source of the graphic: Course Book DLMBBD01, p. 183
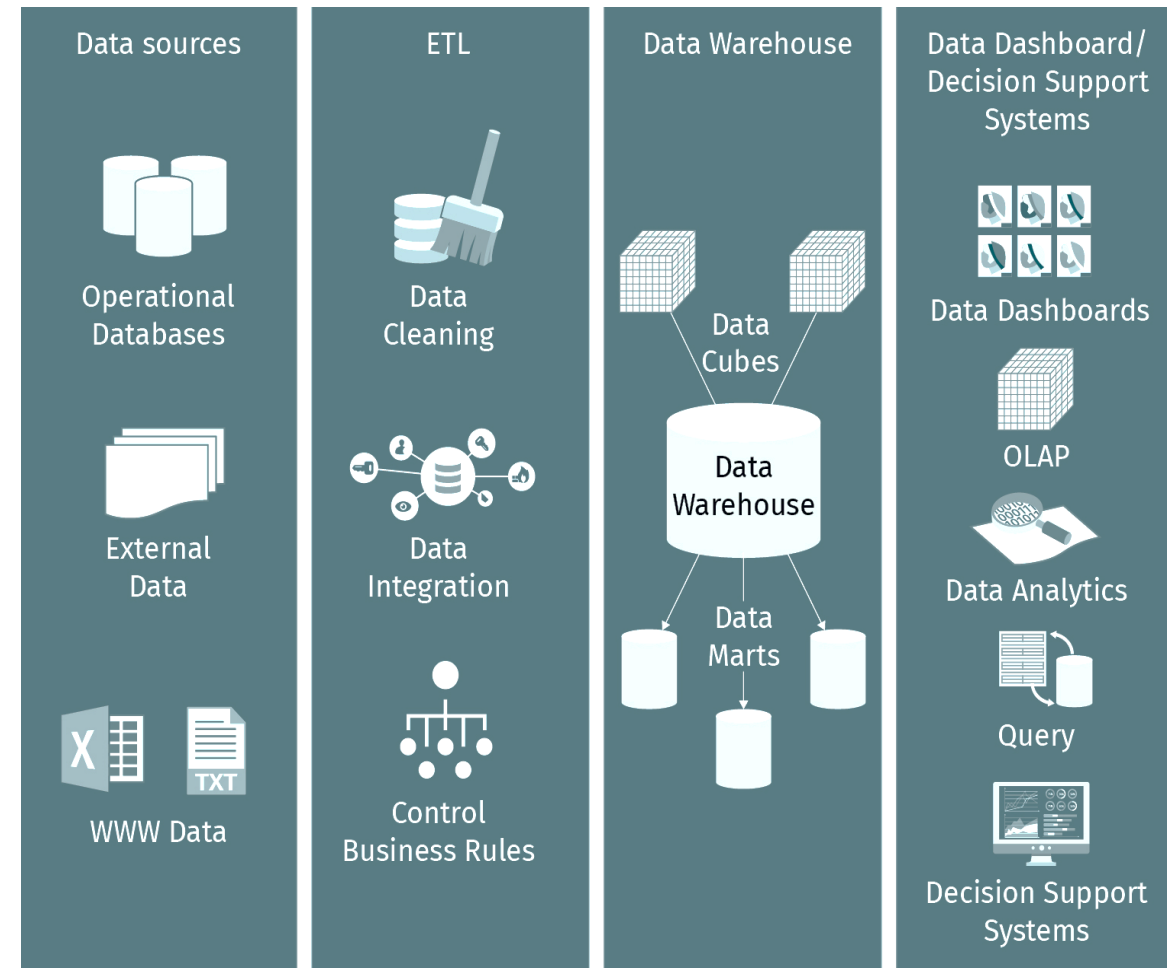
DATA DASHBOARD AND DATA WAREHOUSE – SAMPLE DATA DASHBOARD PAGE

https://www.datacamp.com/blog/power-bi-vs-tableau-which-one-should-you-choose

– The first step of the data dashboard is to gather data from different internal and external sources (e.g., (ERP) systems, Excel files, (CRM) systems, (SCM) systems) and then extract and transform the data into a unified format before loading it onto the central repository. These three database functions are called ETL.

– Tools for ETL: Microsoft SQL Server, Oracle, Microsoft Integration Service, Oracle BI suite, and Spoon (Kettle)

ETL

Extract Data

Transform Data

Load Data

DATA CUBE

A data cube is a multidimensional representation of data where each dimension corresponds to a query field, such as product, store, or year.

Operations on a data cube:

- drill-down: moving from summarized data to detailed data

- roll-up: summarizing the data along a dimension

- pivot: rotate a cube and analyze its various facets

- slice/dice: selecting a value of one dimension and then cutting the cube along that entry

Source of the graphic: Han et al., 2011.

TOOLS

Pentaho
A complete suite for data analytics and visualization which supports ETL and big data analytics.

Tools for Data Visualization and Dashboard Systems

Tableau
Suite of business analytics tools that help organizations manage and share their data and is completely integrated with Microsoft systems.

Microsoft Power BI
Provides facilities to query relational databases, OLAP, Spreadsheets and Cloud, and data visualization through various data graphs.

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DATA SECURITY AND DATA PROTECTION

On completion of this unit, you will have learned …

- … what kind of security issues threaten our data.

- … what the main data security issues are.

- … how data processing and the individual privacy are regulated in countries in the European Union.

1. What are two required measures for protecting personal data?
2. List three measures to protect the confidentiality of data.
3. Mention two cases where data collection and processing are not included in the GPDR.

SECURING DATA STORAGE METHODS

Accountability service
Considering logging all data access activities and traces events in the case of security violations.

Confidentiality service
Restricting access rights to data and information about data, such as time, frequency, and transmission methods to trusted users (password, encryption).

Integrity service
Unauthorized access to data is not limited to reading secured and sensitive data; the alteration of data can be just as harmful. Data from authenticated senders might be altered and convey unintended information.

Data Availability service
Providing reliable and effortless access to data and guarantees continuous availability of the data access service, even in the presence of hardware failure.

- **GDPR: General Data Protection Regulation** (2016), is the regulation enforcing the protection of the privacy of individuals and their rights to grant or revoke access to their private data, the processing of that data, and the sharing of that data with third parties.

- The regulation considers all kinds of data processing where the data is either about an EU citizen or the processing is carried out by an organization within the EU.

- GDPR guarantees that the owner of the data will be informed of the type and extent of data collected about them and will be able to prevent the data from being processed if it is in violation of their privacy.

- Based on GDPR Personal data can be processed in cases where data owners have declared their consent or the processing is considered a legal obligation of the data controller.

On completion of this unit, you will have learned …

— … what kind of security issues threaten our data.

— … what the main data security issues are.

— … how data processing and the individual privacy are regulated in countries in the European Union.

TRANSFER TASK

As mentioned, analytic hierarchy process (AHP) is a useful technique in decision-making, particularly when it concerns group decision-making. AHP breaks down complex problems into simple sub-problems that are easier to solve.

Define a situation that needs a group decision making process, use hierarchy of criteria and explain how this method can help you to make a better decision in that complex situation.

TRANSFER TASK

https://en.wikipedia.org/wiki/Analytic_hierarchy_process_%E2%80%93_car_example
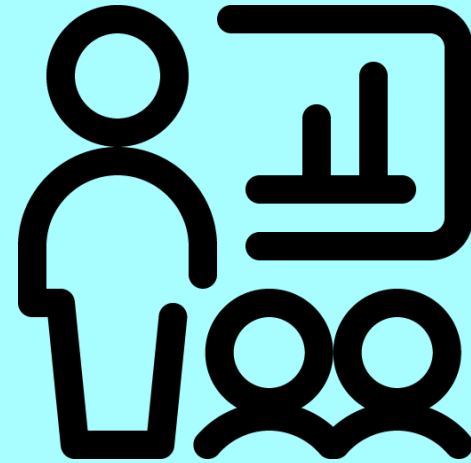
https://bpmsg.com/ahp-introduction/

https://bpmsg.com/ahp/ahp-examples.php

https://www.spicelogic.com/docs/ahpsoftware

Please present your results.

The results will be discussed in plenary.

1. Data collected for national security purposes…
   a) … is covered by the GDPR.
   b) … is not part of the GDPR.
   c) … is not considered personal data.
   d) … automatically available to all EU institutions.

2. The GDPR is monitored and enforced by…

    a) … national supervisory agencies in each EU country.

    b) … a central EU agency.

    c) … a task-force within the companies.

    d) … independent advisors and experts.

3. Encryption and passwords are used to…
   a) … strengthen the data privacy efforts.
   b) … strengthen both data security and data privacy efforts.
   c) … strengthen the data security efforts.
   d) … protect users from accidental exposure of sensitive data.

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