Chapter 6: Business intelligence

- Business intelligence may be defined as a set of mathematical models and analysis methodologies that exploit the available data to generate information and knowledge useful for complex decision-making processes

Effective decisions

- The application of rigorous analytical methods allows decision makers to rely on information and knowledge which are more dependable.
- As a result, they are able to make better decisions and devise action plans that allow their objectives to be reached in a more effective way.
- Indeed, turning to formal analytical methods forces decision makers to explicitly describe both the criteria for evaluating alternative choices and the mechanisms regulating the problem under investigation.
- Furthermore, the ensuing in-depth examination and thought lead to a deeper awareness and comprehension of the underlying logic of the decision-making process.

Timely decisions

- Enterprises operate in economic environments characterized by growing levels of competition and high dynamism.
- As a consequence, the ability to rapidly react to the actions of competitors and to new market conditions is a critical factor in the success or even the survival of a company

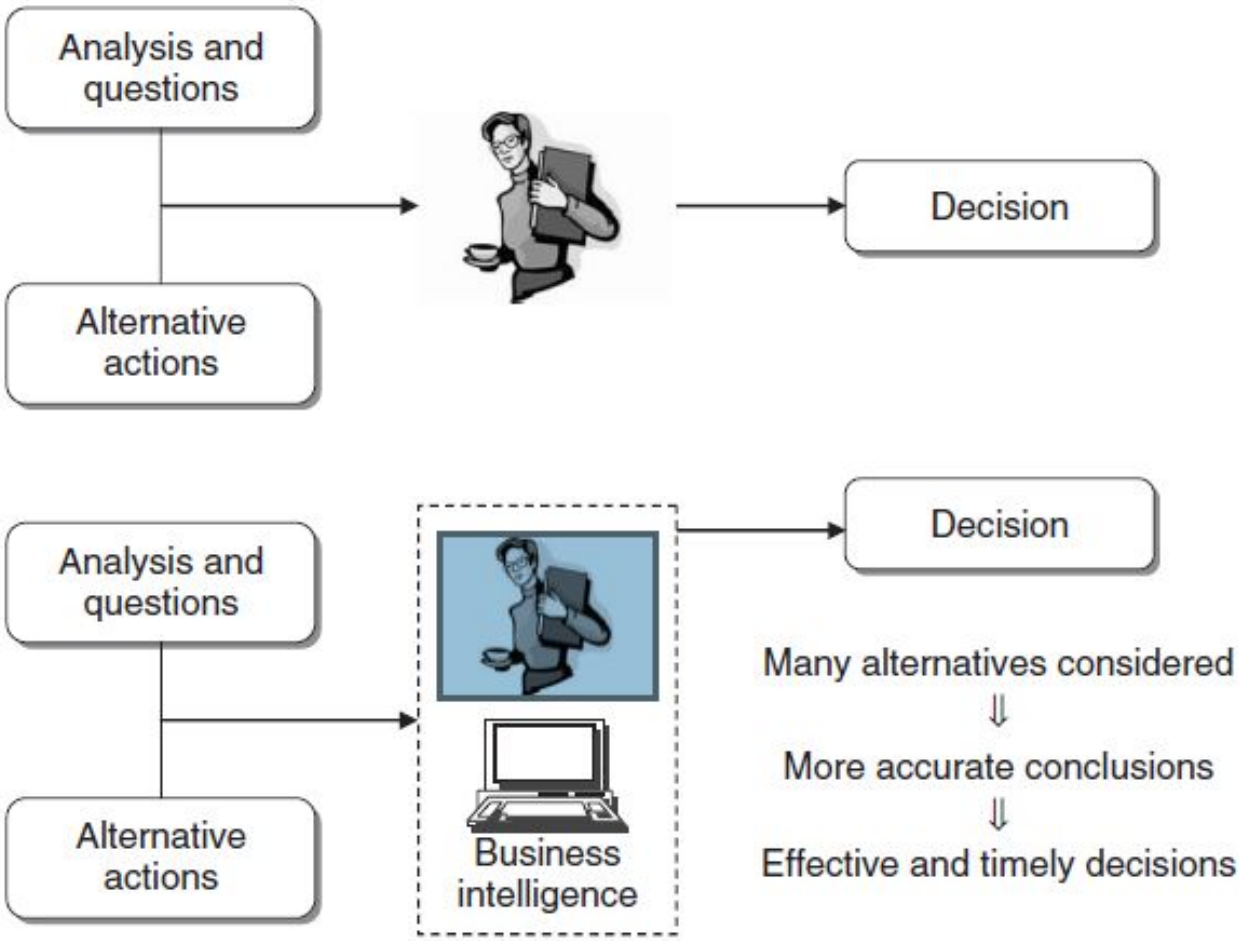


Figure 1.1 Benefits of a business intelligence system

Data:

- data represent a structured codification of single primary entities,
- as well as of transactions involving two or more primary entities
- For example, for a retailer data refer to primary entities such as customers, points of sale and items,

Information:

- Information is the outcome of extraction and processing activities carried out on data
- For example, to the sales manager of a retail company, the proportion of sales receipts in the amount of over ¤100 per week represent meaningful pieces of information that can be extracted from raw stored data.

Knowledge:

- Information is transformed into knowledge when it is used to make decisions and develop the corresponding actions
- For a retail company, a sales analysis may detect that a group of customers, living in an area where a competitor has recently opened a new point of sale, have reduced their usual amount of business.
- The knowledge extracted in this way will eventually lead to actions aimed at solving the problem detected, for example by introducing a new free home delivery service for the customers residing in that specific area.

The role of mathematical models

- A business intelligence system provides decision makers with information and knowledge extracted from data, through the application of mathematical models and algorithms.
- In some instances, this activity may reduce to calculations of totals and percentages, graphically represented by simple histograms, whereas more elaborate analyses require the development of advanced optimization and learning models.

Business intelligence architectures

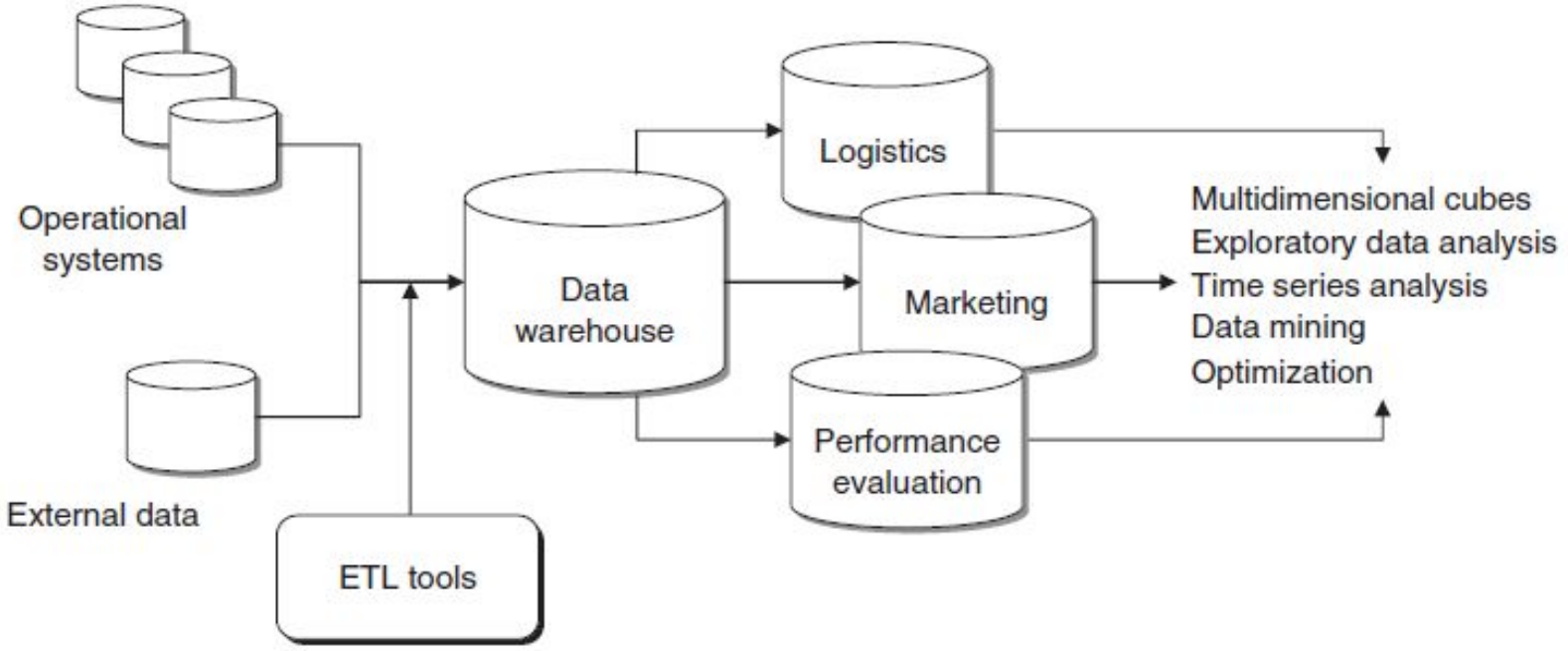


Figure 1.2 A typical business intelligence architecture

Business intelligence architectures contd..

- The architecture of a business intelligence system includes three major components

- **Data sources:** In a first stage, it is necessary to gather and integrate the data stored in the various primary and secondary sources, which are heterogeneous in origin and type.

- **Data warehouses and data marts:** Using extraction and transformation tools known as extract, transform, load (ETL), the data originating from the different sources are stored in databases intended to support business intelligence analyses. These databases are usually referred to as *data warehouses and data marts*

- **Business intelligence methodologies:** Data are finally extracted and used to feed mathematical models and analysis methodologies intended to support decision makers.

The pyramid in Figure 1.3 shows the building blocks of a business intelligence system. So far, we have seen the components of the first two levels when discussing Figure 1.2. We now turn to the description of the upper tiers.

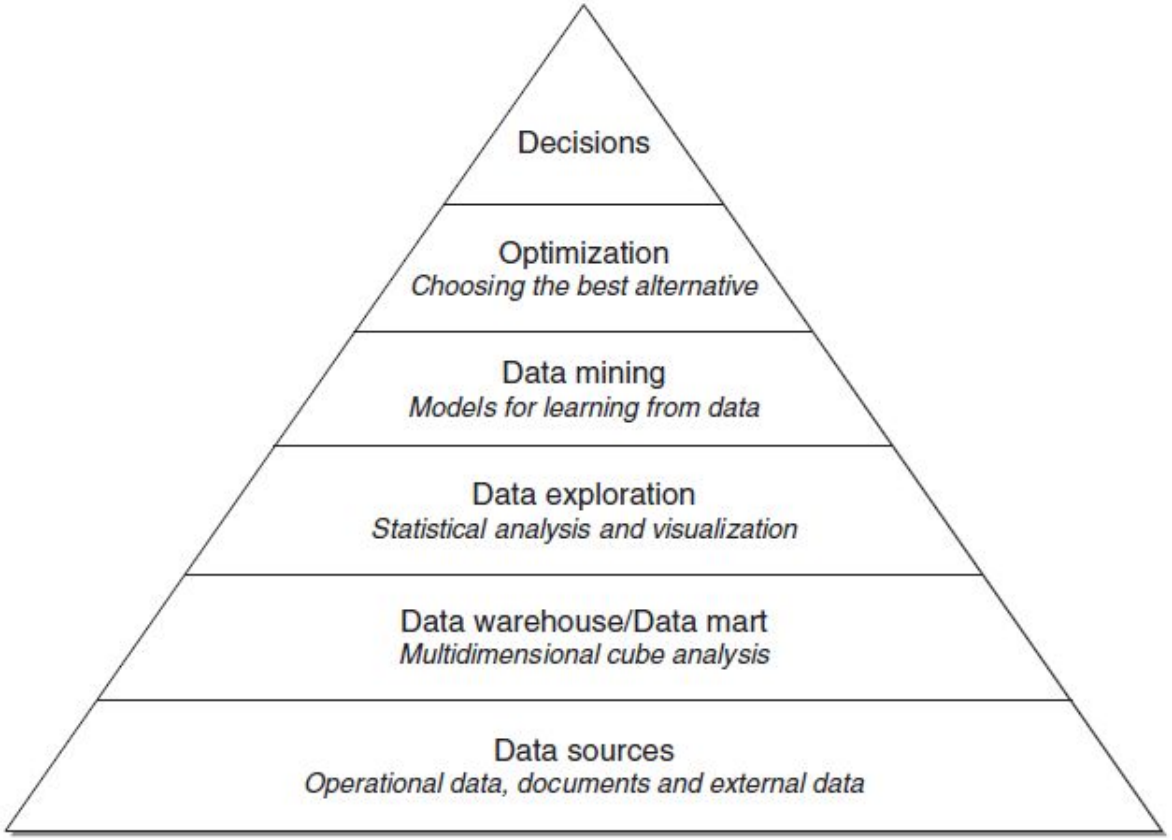


Figure 1.3 The main components of a business intelligence system

- **Data exploration:** At the third level of the pyramid we find the tools for performing a passive business intelligence analysis, which *consist of query and* reporting systems, as well as statistical methods
- **Data mining:** The fourth level includes *active business intelligence methodologies,* whose purpose is the extraction of information and knowledge from data.
- **Optimization.** By moving up one level in the pyramid we find optimization models that allow us to determine the best solution out of a set of alternative actions
- **Decisions.** Finally, the top of the pyramid corresponds to the choice and the actual adoption of a specific decision, and in some way represents the natural conclusion of the decision-making process.

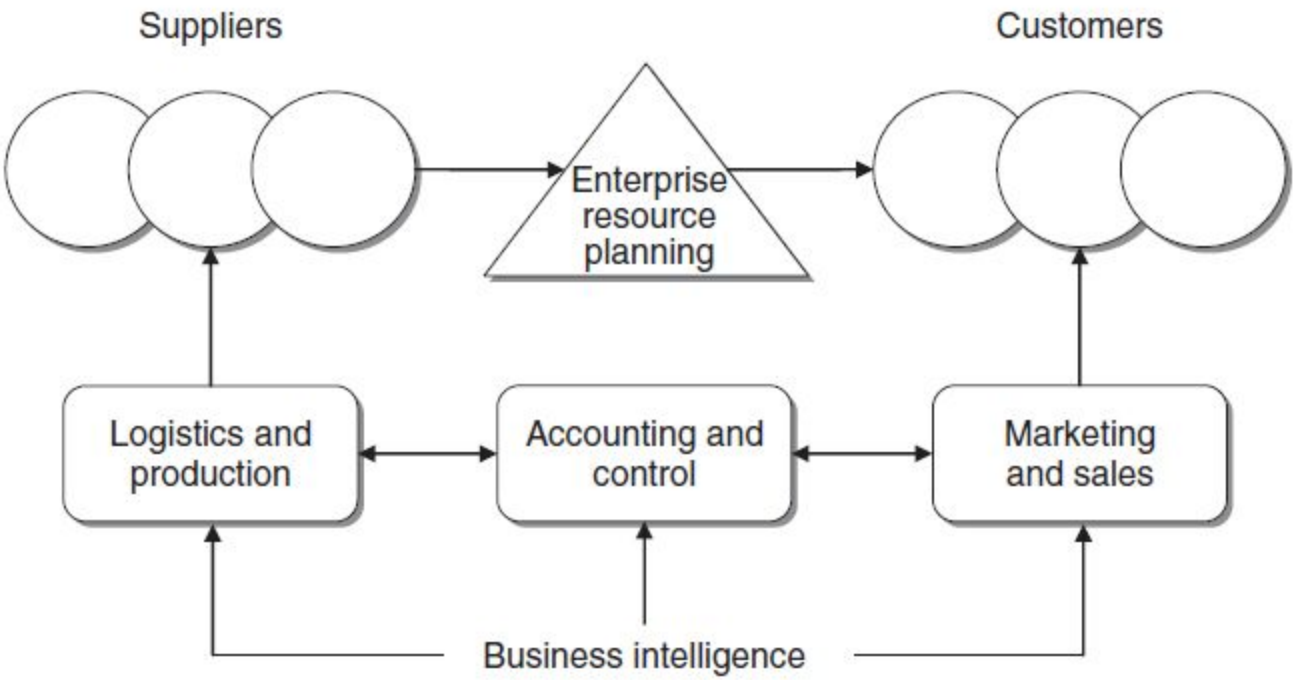


Figure 1.4 Departments of an enterprise concerned with business intelligence systems

if we restrict our attention to enterprises, business intelligence methodologies can be found mainly within three departments of a company marketing and sales; logistics and production; accounting and control.

Cycle of a business intelligence analysis

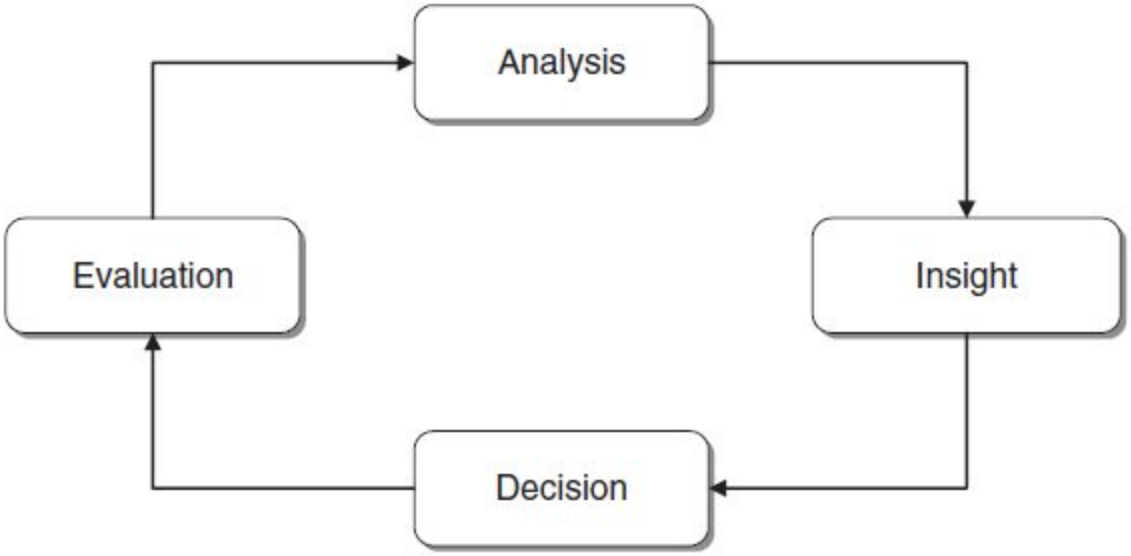


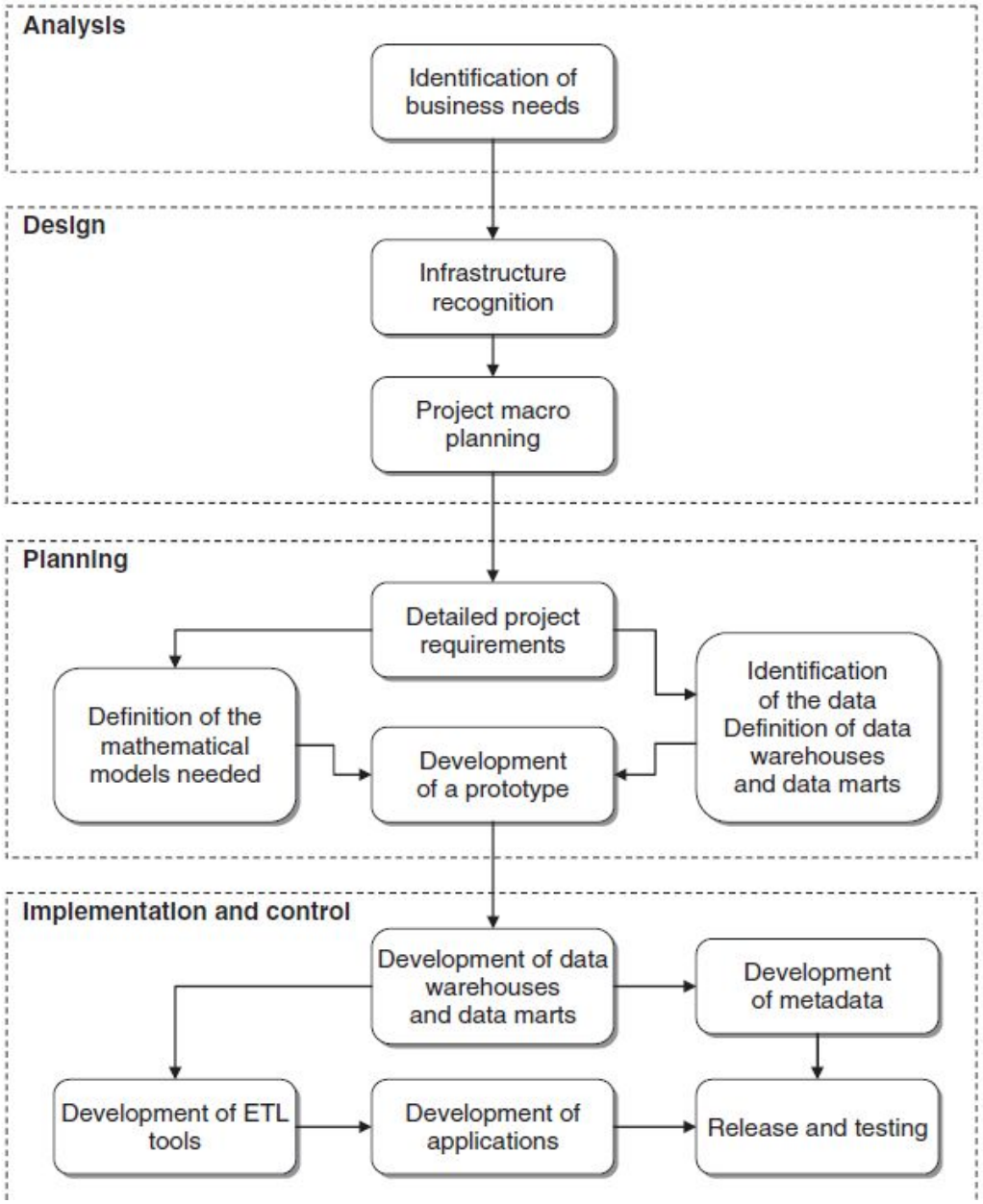
Figure 1.5 Cycle of a business intelligence analysis

Cycle of a business intelligence analysis contd..

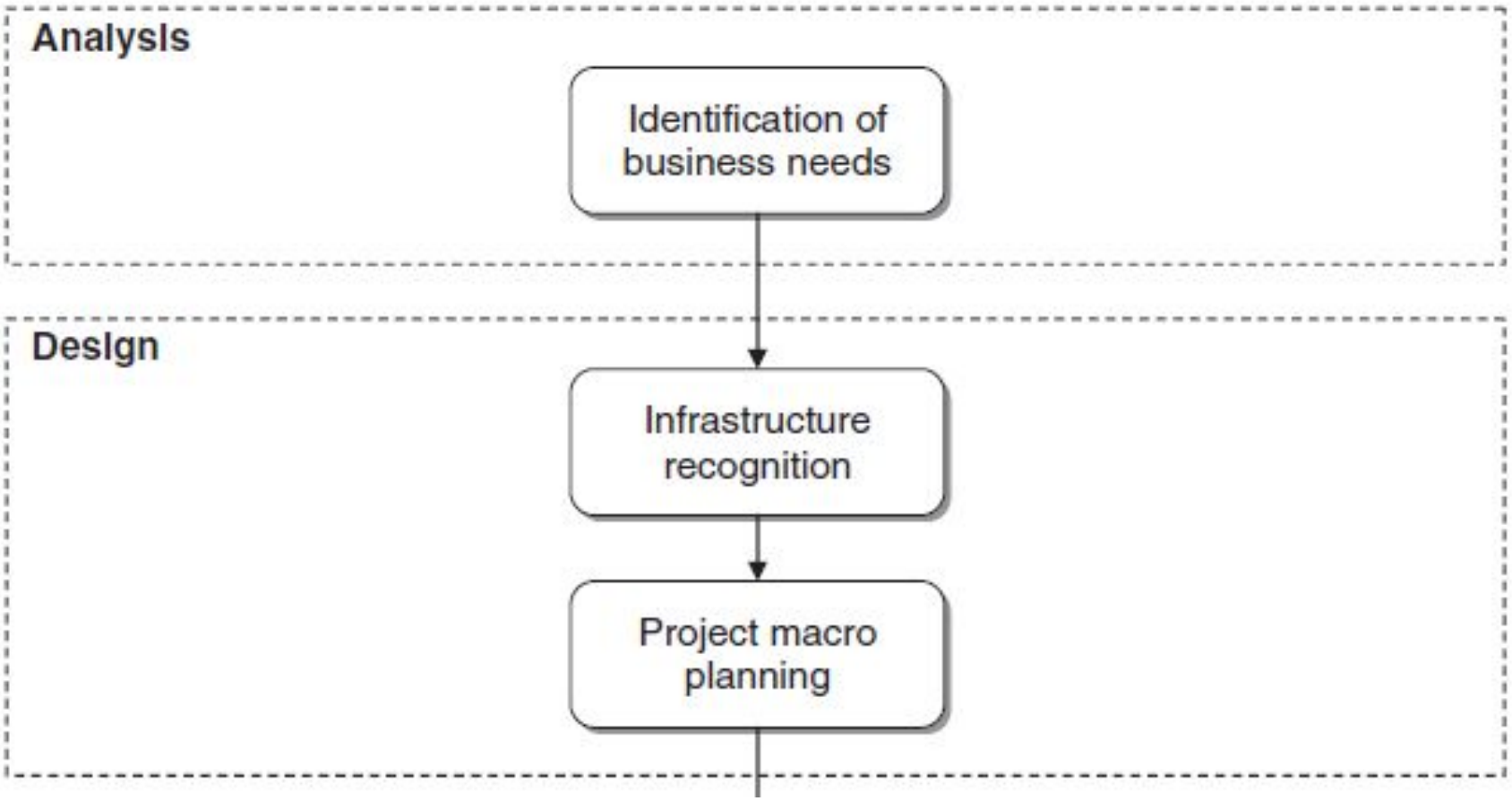
- **Analysis:** During the analysis phase, it is necessary to recognize and accurately spell out the problem at hand.
- **Insight:** The information obtained through the analysis phase is then transformed into knowledge during the insight phase For instance, if the analysis carried out in the first phase shows that a large number of customers are discontinuing an insurance policy upon yearly expiration, in the second phase it will be necessary to identify the profile and characteristics shared by such customers.
- **Decision:** During the third phase, knowledge obtained as a result of the insight phase is converted into decisions and subsequently into actions
- **Evaluation. Finally, the fourth phase of the business intelligence cycle involves** performance measurement and evaluation

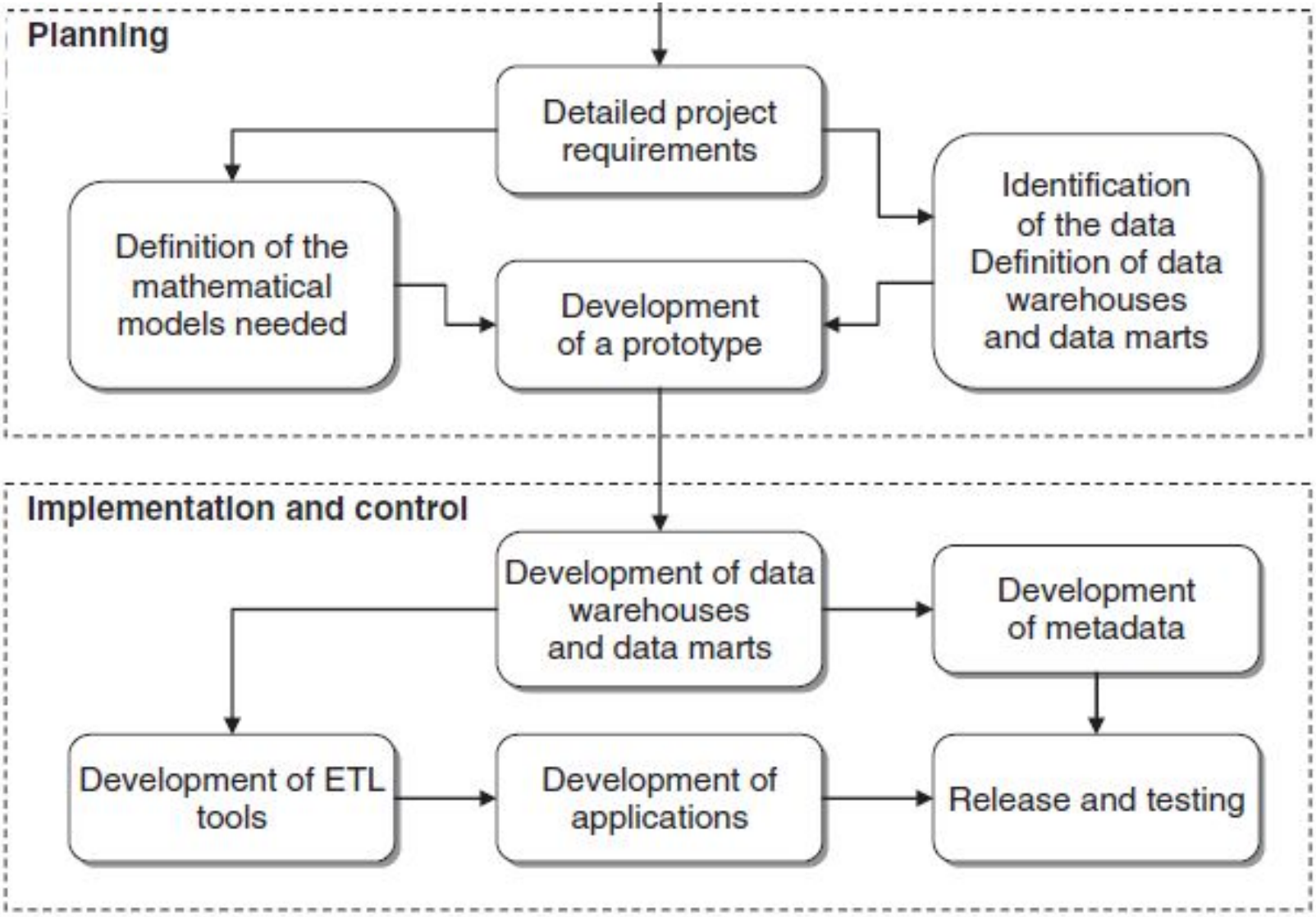
Enabling factors in business intelligence projects

- Some factors are more critical than others to the success of a business intelligence project: --*technologies, analytics and human resources.*



Phases in the development of a business intelligence system


Analysis
Identification of business needs
Design
Infrastructure recognition
Project macro planning


Planning
Detailed project requirements
Definition of the mathematical models needed
Development of a prototype
Identification of the data Definition of data warehouses and data marts
Implementation and control
Development of data warehouses and data marts
Development of metadata
Development of ETL tools
Development of applications
Release and testing

Analysis:

- **During the first phase, the needs of the organization relative to the** development of a business intelligence system should be carefully identified.
- This preliminary phase is generally conducted through a series of interviews of knowledge workers performing different roles and activities within the organization.
- It is necessary to clearly describe the general objectives and priorities of the project, as well as to set out the costs and benefits deriving from the development of the business intelligence system.

Design:

- **The second phase includes two sub-phases and is aimed at deriving** a provisional plan of the overall architecture, taking into account any development in the near future and the evolution of the system in the mid term
- First, it is necessary to make an assessment of the existing information infrastructures.
- Moreover, the main decision-making processes that are to be supported by the business intelligence system should be examined, in order to adequately determine the information requirements.
- Later on, using classical project management methodologies, the project plan will be laid down, identifying development phases, priorities, expected execution times and costs, together with the required roles and resources.

Planning:

- The planning stage includes a sub-phase where the functions of the business intelligence system are defined and described in greater detail

Implementation and control:

- **The last phase consists of five main sub-phases .**First, the data warehouse and each specific data mart are developed.

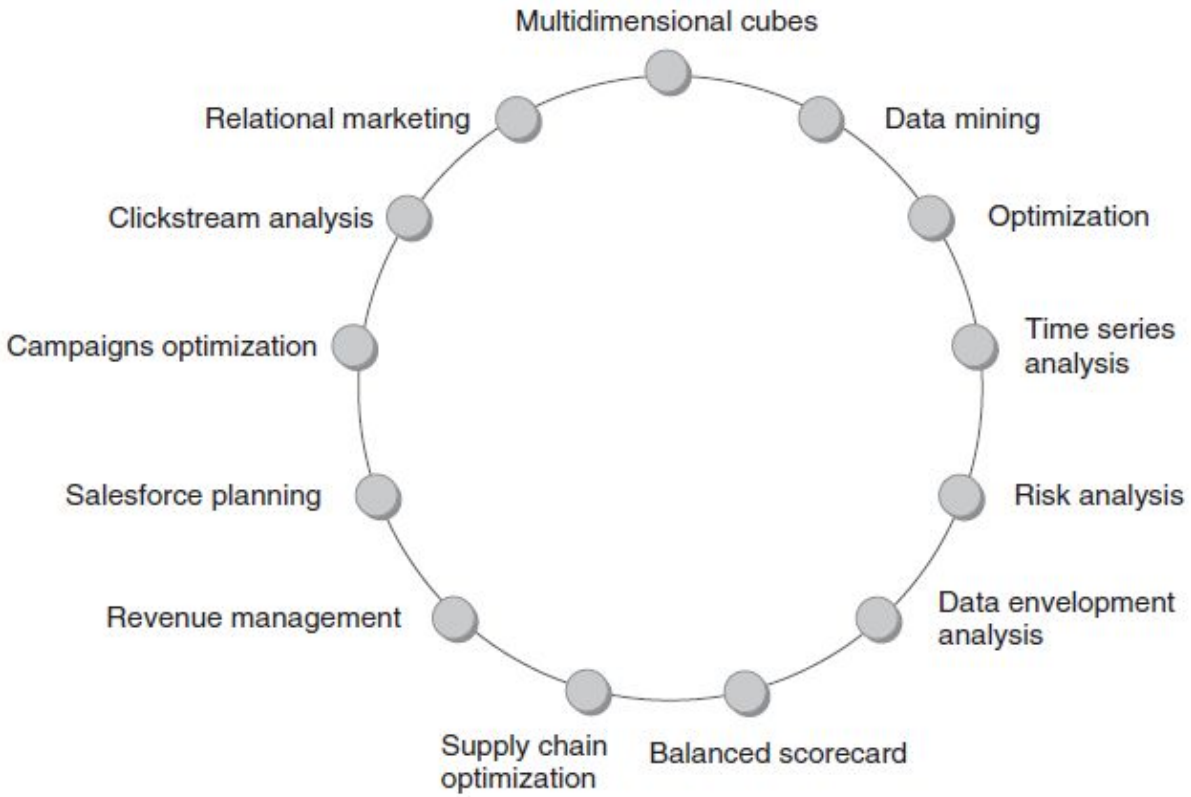


Figure 1.7 Portfolio of available methodologies in a business intelligence system

Decision support system (DSS)

- A decision support system (DSS) is an interactive computer-based application that combines data and mathematical models to help decision makers solve complex problems faced in managing the public and private enterprises and organizations

- The analysis tools provided by a business intelligence architecture can be regarded as DSSs capable of transforming data into information and knowledge helpful to decision makers.

The decision-making process

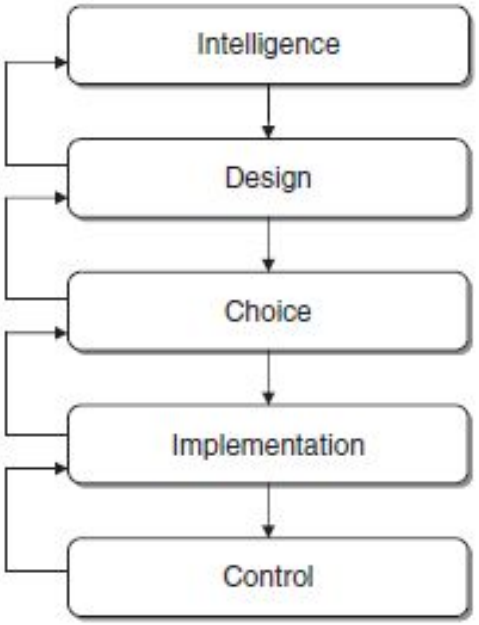


Figure 2.5 Phases of the decision-making process

Phases in Decision making process

- **Intelligence.**
  - In the intelligence phase the task of the decision maker is to identify and define the problem that emerges in the system under study
- **Design.**
  - In the design phase actions aimed at solving the identified problem should be developed and planned
- **Choice.**
  - Once the alternative actions have been identified, it is necessary to evaluate them on the basis of the performance criteria (mathematical model/decision tree)

Phases in Decision making process contd..

- **Implementation.**
  - When the best alternative has been selected by the decision maker, it is transformed into actions by means of an implementation plan. This involves assigning responsibilities and roles to all those involved into the action plan.
- **Control.**
  - Once the action has been implemented, it is finally necessary to verify and check that the original expectations have been satisfied and the effects of the action match the original intentions.

Types of decisions

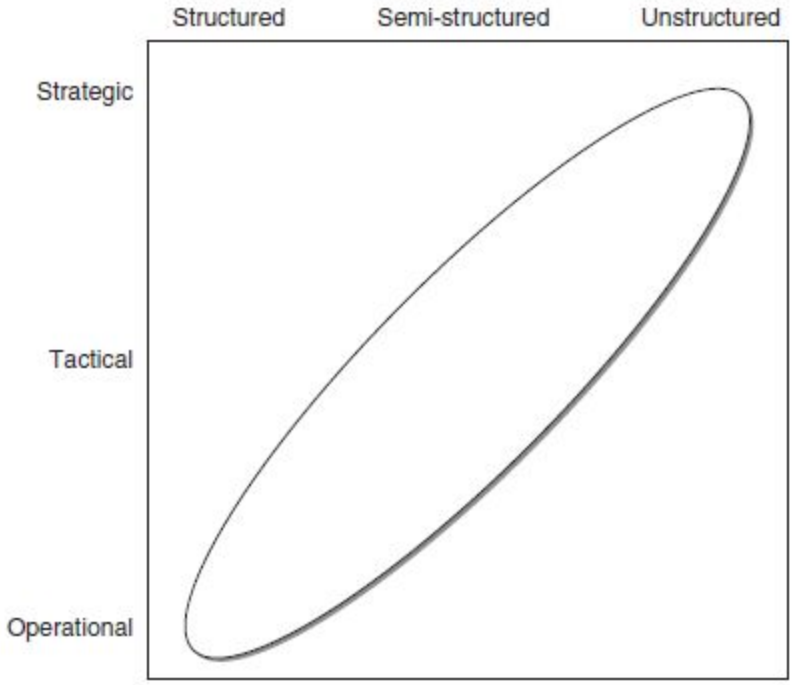


Figure 2.6 A taxonomy of decisions

decisions can be classified as *structured, unstructured* or *semi-structured.*

- **Structured decisions.**
  - A decision is structured if it is based on a well-defined and recurring decision-making procedure.
  - We have a structured decision if input flows, output flows and the transformations performed by the system can be clearly described in the three phases of intelligence, design and choice.
- **Unstructured decisions.**
  - A decision is said to be unstructured if the three phases of intelligence, design and choice are also unstructured.
  - This means that for each phase there is at least one element in the system (input flows, output flows and the transformation processes) that cannot be described in detail and reduced to a predefined sequence of steps.
- **Semi-structured decisions.**
  - A decision is semi-structured when some phases are structured and others are not.

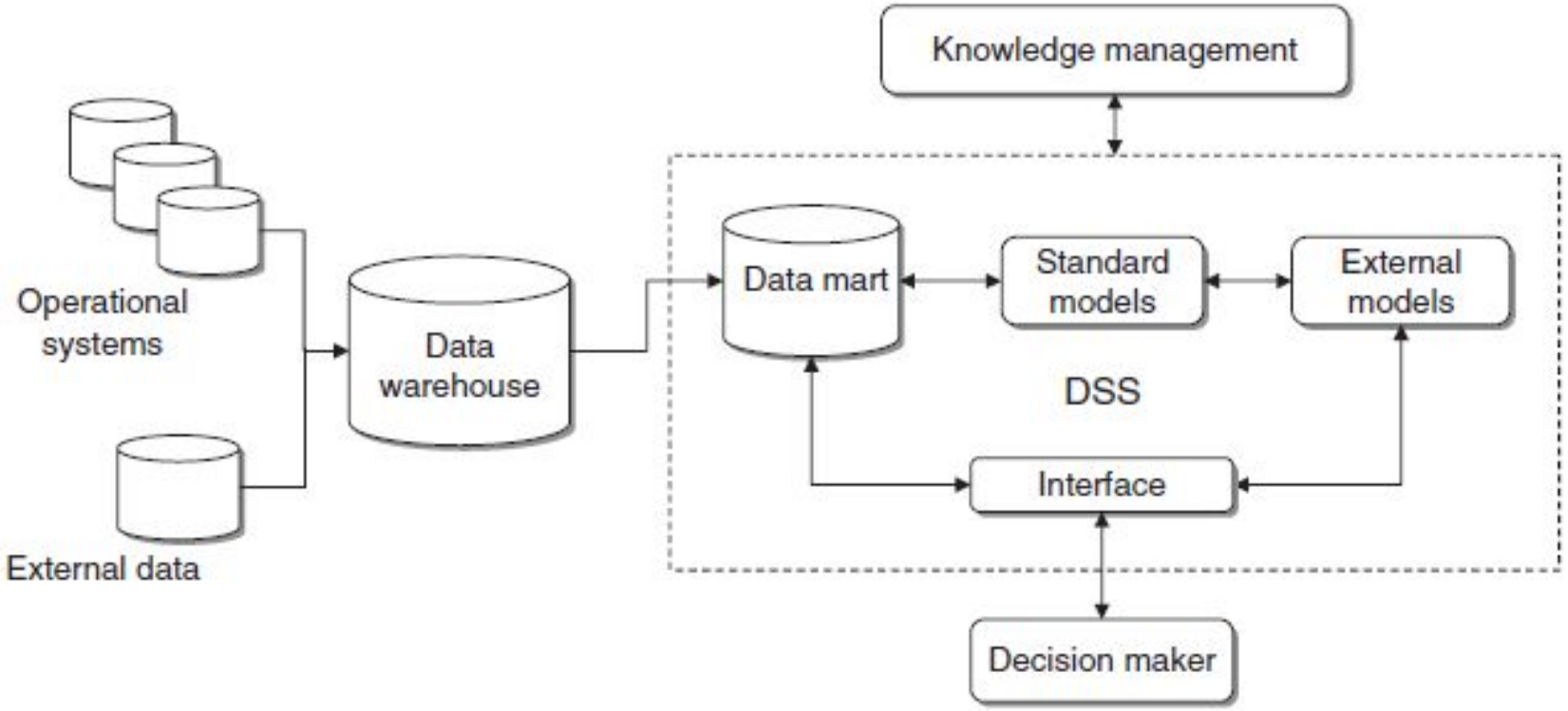


Figure 2.9 Extended structure of a decision support system

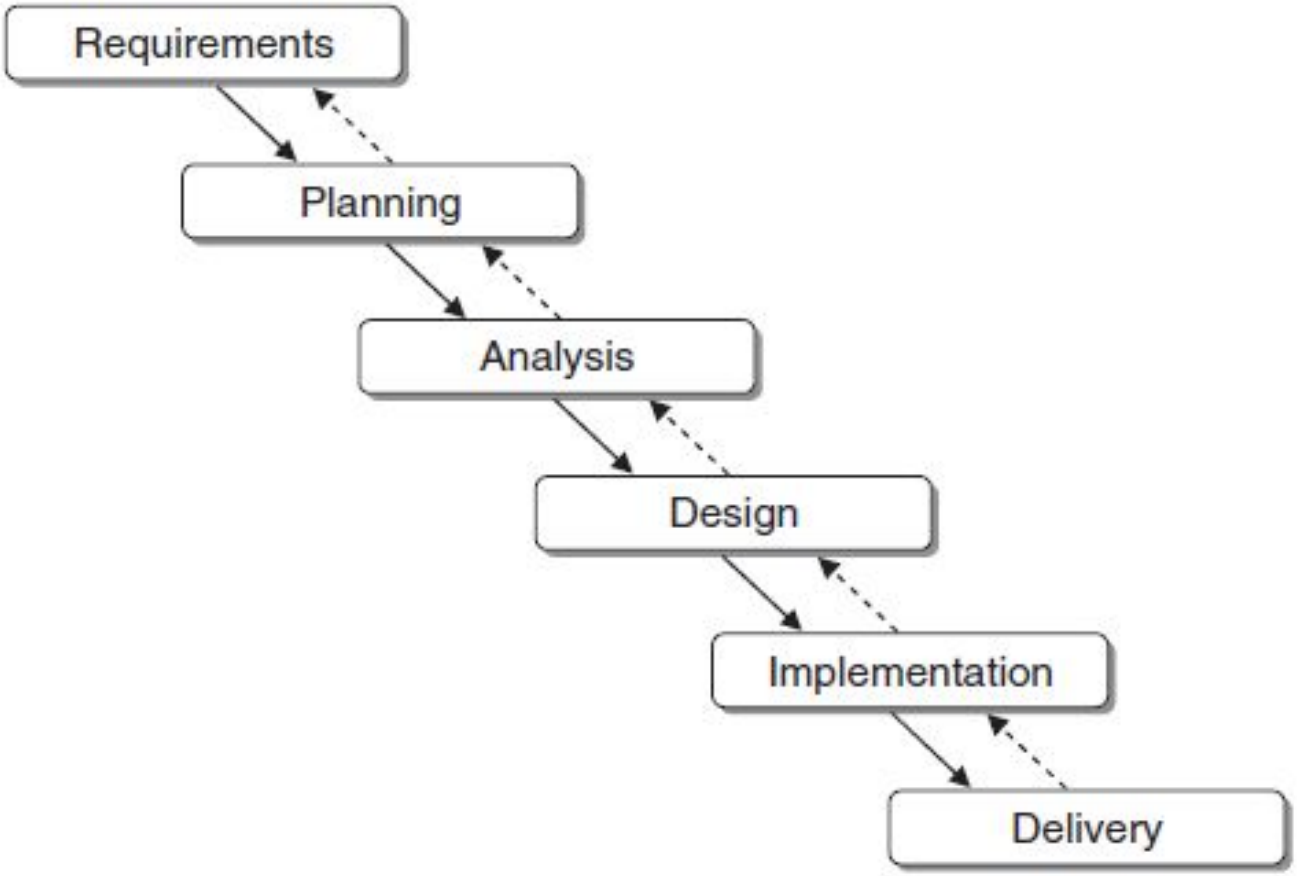


Figure 2.10 Phases in the development of a decision support system