Computerized Decision Support

Objectives:

- understanding
  - the foundation of decision making;
  - Simon's 4 phases of decision making:
    - intelligence, design, choice, implementation;
  - the concept of rationality and its impact on decision making;
  - the foundations, definitions and capabilities of DSS;
- describe
  - DSS components and technology levels;
  - the various types of DSS and explain their use;
- explain the importance of
  - databases and database management;
  - models and model management.

Decision making (~problem solving)

Definition: ”**Decision making** is a process of choosing among two or more alternative courses of action for the propose of attaining a goal or a goals.”

Example: Planning involves a series of decisions:
What should be done? When? Where? Why? How? By whom ?

Definition: ”**Decision style** is the manner in which decision makers think and react to problems.” People make decisions in different ways (perceive, responses, beliefs, *f(*individual, situation)).

Decision-making styles may be:

- heuristic or analytic,
- autocratic or democratic, and
- consultative style.

The computerized system should fit the decision style – should be flexible and adaptable to different users and should help decision makers use and develop their own styles, skills and knowledge. Different decision styles require different decision support.

Decision Makers

Individual decision makers need access to data and to the experts who can provide advice, and groups need collaboration tools.

Decisions are made by:

- **individuals** – at lower level or small organizations – may be conflicting objectives even for a sole decision maker (decisions may be fully automated – after a human decision maker);
- **groups** – at medium or large organizations – consensus can be a difficult problem (the process of decision making by a group can be very complicated), because groups can be from different departments or organizations and people may have personality types, different cognitive or decision styles. Computerized support can greatly enhance group decision making. Computer support can be provided at a broad level, enabling members of whole departments (even entire organizations) to collaborate online.

Enterprise Information System: Group Support System, Enterprise Resource Management, Enterprise Resource Planning , Supply Chain Management, Knowledge Management System, Customer Relationship Management Systems.

Models

Definition: A **model** is a simplified (reality is too complex to describe exactly and much of complexity is irrelevant in solving the problem) representation or abstraction of reality.

Models can represent systems or problems with various degrees of abstraction.

Classification of models ← degree of abstraction:

- ***iconic*** – *scale model* – a different scale from the original:
  - 2-D → ex. photographs,
  - 3-D → ex. 3D objects (solids).
- ***analog*** – symbolic representation of reality – charts, diagrams
  - organization chart → structure, relationships, …
  - maps → different colors represent dif. types of objects.
  - animations, …

… *Models (classification)*

- ***mental*** – descriptive representation of decision-making situations that people form in their heads and think about, consider the utility and risk involved – are used when there are mostly qualitative factors in the decision-making problem. Cognitive maps can be used to explicate a mental model of an individual or to develop a group consensus.
- ***mathematical*** (quantitative) – more abstract models are described mathematically and most DSS analyses are performed numerically with mathematical or other quantitative models, because the complexity of relationships cannot be represented by icons or analogically.

The Facilities of Models

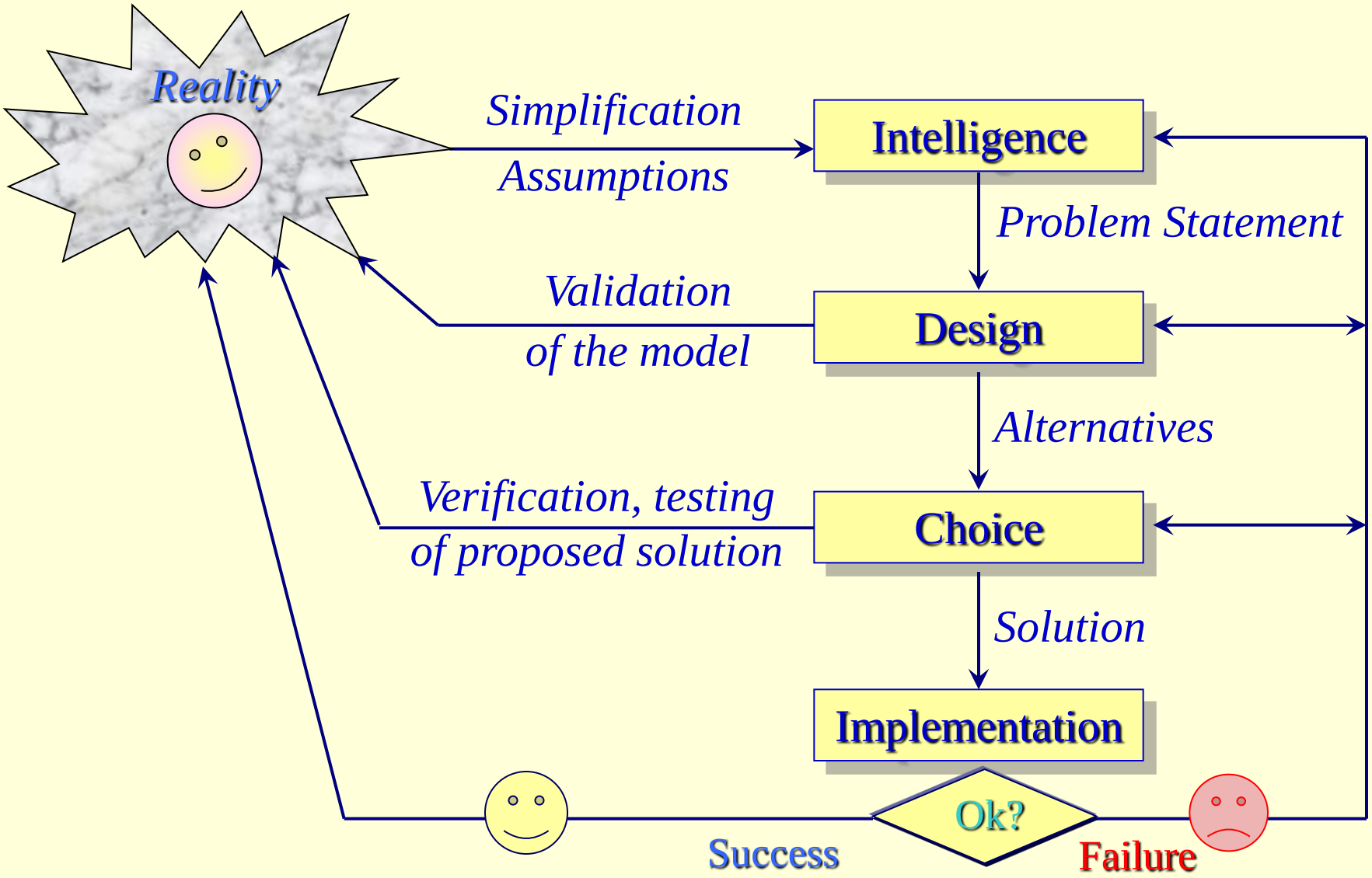
- ***Model manipulation*** (changing decision variables or the environment) is much easier than manipulating a real system. Experimentation is easier and does not interfere with the daily operation of the organization.
- ***Models enable the compression of time*** → years of operations can be simulated in minutes or seconds.
- ***The cost of modeling analysis*** → much lower than the cost of a similar experiment on a real system.
- ***The cost of making mistakes*** → during the experiment is much lower when models are used than with real system. (!)
- ***We can estimate the risks*** → resulting from specific actions.
- ***Mathematical models enable the analysis of a very large number of possible solutions .***
- ***Models enhance and reinforce learning and training.***

Phases of the Decision-Making Process

There are five major phases *(Simon three-1977 plus two ... later)* **:**

1. ***Intelligence*** **–** decision maker examines reality and identifies the problem; problem ownership is established as well.
2. ***Design*** **–** the model (that represents the system) is constructed making assumptions that simplify reality and writing down the relationships (among variables). The model is validated and criteria are determined (choice of evaluation); identifies alternative solutions.
3. ***Choice*** **–** includes selection of a proposed solution (is tested for viability) to the model. If solution is reasonable we may pass to the next phase else we must return to an earlier phase.
4. ***Implementation*** **–** successful result in solving the real problem.
5. ***Monitoring*** **–** *intelligence applied to the implementation* – a form of feed back.

The Decision Making/Modeling Process



… Activities of phases

Intelligence
Organization objectives
Search and scanning procedures
Data collection
Problem identification
Problem ownership
Problem classification
Problem statement

Design
Formulate a model
Set criteria for choice
Search for alternatives
Predict and measure outcomes

Choice
Solution to the model
Sensitivity analysis
Selection the best alternative
Plan for implementation

*The **Intelligence** Phase of Decision-Making*

The intelligence phase involves scanning the environment – identifying problem situations (opportunities), monitoring the results of implementation.

1. ***Problem – opportunity –*** identification of organizational goals and objectives: a decision making attempts to determine whether a problem exists, identify its symptom, determine its magnitude and explicitly define it. What is described as a problem may be only a symptom of a problem (real world problems are complicated by many interrelated factors and is difficult to distinguish between the symptoms and the real problem). The measurement of productivity and the construction of a model are based on real data. The collection of data and the estimation of future data is a difficult step in the analysis.

Data may have some inconvenient like:

- data are not available,
- obtaining data may be expensive,
- data estimation may be subjective,
- data may be insecure,
- important data that influence the results may be qualitative,
- there may be too many data – information overload,
- results may occur over an extended period,
- the future data will be similar to historical data.

After the preliminary investigation is possible to determine whether a problem really exists, where is located, how important it is, whether an information system is reporting a problem or only the symptoms of a problem.

Problem decomposition

The complex problems can be divided into sub-problems. Solving the simpler sub-problems may help in solving the initial one. Poorly structured problems may have highly structured sub-problems.
Decomposition facilitates communication among decision makers.
Decomposition is one of the most important aspects of the Analytical Hierarchy Process – AHP – which helps decision makers incorporate both qualitative and quantitative factors into the decision-making models.

Problem ownership

In the intelligence phase it is important to establish problem ownership. A problem exists in an organization only if someone or some group takes on the responsibility of attacking it and if the organization has the ability to solve it.
Problem ownership ::= the assignment of authority to solve the problem.

*The **Design** Phase of Decision-Making*

The design phase involves finding or developing and analyzing possible courses of action: understanding the problem and testing solution for feasibility. A model of the decision-making problem is constructed, tested and validated.

Modeling involves conceptualizing a problem and abstracting it to quantitative and qualitative form – for a mathematical model the variables are identified, their mutual relationship are established. Simplifications are made whenever necessary through assumptions.

A simpler model leads to lower development costs, easier manipulation and a faster solution but is less representative of the real problem and can produce inaccurate results.

The process modeling is **art** (creativity are required when determining what simplifying assumptions can work and how to integrate models to obtain valid solutions) and **science** (there are many standard model classes available and an analyst can say which one is applicable).

Selection of a principle of choice

A **principle of choice** is a criterion that describes the acceptability of a solution approach. In a model is a result variable. Involves how a person establishes decision making objectives and incorporates them into the model. We must recognize the difference between a criterion and a constraint.

Normative models

Normative models ::= models in which the chosen alternative is demonstrably the best of all possible alternatives. The decision maker should examine all the alternatives and prove that the selected one is the best (this process is optimization). Optimization can be obtained in one of three ways:

1. Get the highest level of goal attainment from a given set of resources.
2. Find the alternative with the highest ratio of goal attainment to cost or maximize productivity.
3. Find the alternative with the lowest cost that will meet an acceptable level of goals.

Descriptive models

Descriptive models describe things as they are or as they are believed to be. These models are typically mathematically based. These models are useful for investigating the consequences of various alternative courses of action under different configurations of input and processes. **Simulation** (the imitation of reality- an artificial reality is created) is a descriptive modeling method. **Virtual reality** is a form of *simulation* because the environment is simulated.

Classes of descriptive models: Complex inventory decision, Environmental-impact analysis, Financial planning, Information flow, Markov analysis (predictions), Scenario analysis, Simulation (alternative types), Technological forecasting, Waiting-line (queuing) management.

There are also **nonmathematical descriptive models** for decision making: *The cognitive map* (Eden, Ackermann, Jenkins, 2002) help the decision maker focus on what is relevant and what is not (*Decision Explorer*), *Narrative* (story that helps a decision maker uncover the important aspects of the situation and leads to a better understanding and framing.

*The **Choice** Phase of Decision-Making*

In the ***choice phase*** the actual decision and the commitment to follow a certain course of action is made.

The ***choice phase*** includes the search for, evaluation of, and recommendation of an appropriate solution to a model. A *solution* to a model is a specific set of values for the decision variables in a selected alternative. A solution to the model yields a recommended solution to the problem The problem is solved if the recommended solution is successfully implemented.

Solving a decision-making model involves searching for an appropriate course of action. Search approaches include *analytical techniques*, *algorithms*, *heuristics*, and *blind searches*.

Sensitivity analysis is used to determine the robustness of any given alternative: slight changes in the parameters lead to slight changes in the alternative chosen. *What-is analysis* is used to explore major changes in the parameters. *Goal seeking* helps a manager determine values of the decision variables to meet a specific objective.

*The **Implementation** Phase of Decision-Making*

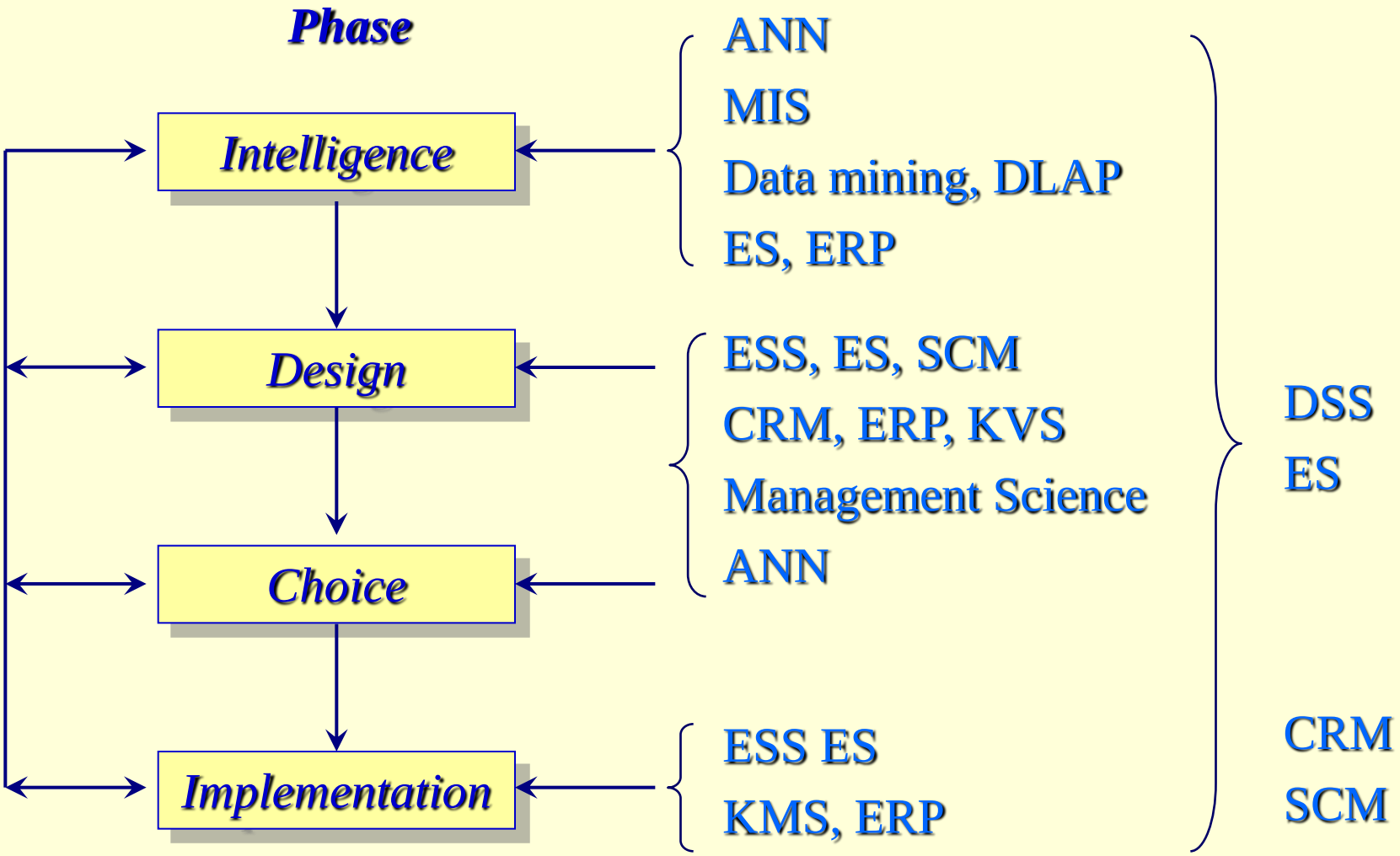
The ***implementation*** of a proposed solution to a problem is the initiation of a new order of things or the introduction of change.
The ***implementation phase*** involves putting a recommended solution to work, not necessarily implementing a computer system.

*The **Intelligence** Phase of Decision-Making*

The primary requirement of decision support for the intelligence phase is the ability to scan internal and external information sources for opportunities and problems and to interpret what the scanning discovers.

How Decisions are supported ? ...

*Support for the **Intelligence** Phase*

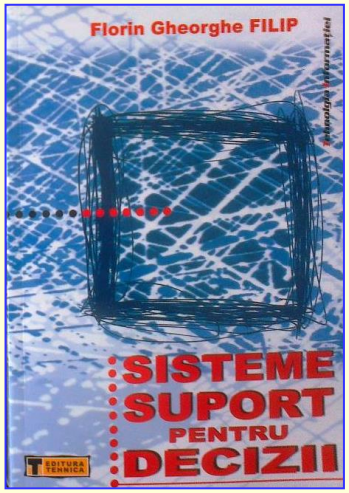


Possible **titles** (ideas, papers → projects) for ***Seminar:***

1. Decisions and Decision-Makers
2. Decision Activities
3. Methods and Techniques
4. Human Judgment-Based Methods and Techniques
5. Data and Document Analysis – Based Concepts Methods and Techniques
6. Modeling and Simulation to Support Decision-Making
7. Methods for Multiobjective Decisions
8. Multiattribute Decision Analysis
9. Artificial Intelligence and Decision Support

Filip F.G. (2005), *Decizie asistata de calculator: decizii , decidenti, metode de baza si instrumente informatice asociate*, (Editia doua completata si revizuita a lucrarii din 2002), Ed. TEHNICA, Bucuresti, ISBN 973-31-2254-8, XXVIII + 376 pag. (http://www.academiaromana.ro/carti2005/c0414_ffilip.htm)

1. Decisions Support System: A general View
2. Utilisation of DSS
3. Construction of DSS
4. Technology of DSS
5. Particular DSS subclasses



Filip, F.G. (2007). *Sisteme suport pentru decizii*. (Editia II revazuta si adaugita a lucrarii din 2004), Ed. TEHNICA, Bucuresti (ISBN978-973-31-2308-8), XI + XIX + 372 pag. (http://www.acad.ro/carti2007/carte07_02FF.htm).

Telecardiology	*Medical Imagistic Dss*
Agent based DSS	*Simulations in Dss*
Agents DSS	*Visualization of simulation in Dss*
Procesul ierarhiei analitice	*Image Processing in Dss*
Web-based DSS	*Evacuare in Cladire*
DSS in System Enginering	*Agents DSS*
Dss economy?	*AHP implementation-choose song*
Visualization	*Web-based DSS*
Decision making in incident	*DSS in System Enginering*
Asset and lybilities management	*Budget salaries based on economy*
Expert systems	*Expert system in tourism*
Group decision making systems	*DSS ORM Project*
ORMs and decision support systems	*Marine Weather DSS*
Weather Decision Systems	*DSS generator application*
Building a DSS	*Car adviser*
DSS in SEO	*Project Management DSS*
DSS for Project Management	*Project DSS Army*
DSS for Army	*Optimizarea cantitatii de hrana*
Dss in Farm Managemnt	*A computer graphics-based DSS*
Analiza Multicriteriala a Deciziilor	*Combining DSS and image processing*

- *Support for the Intelligence Phase*
- *Support for the Design Phase*
- *Support for the Choise Phase*
- *Support for the Decision Making*
- *Software Support for Simulation*
  - *Simulation Software Tools*

End of … 2.

DSS for

- Career Decisions
- Education Decisions
- Pesonal Financial Decisions
- Infomation Technology Decisions
- Investment Decisions
- Legal Decisions
- Purchasing Decisions
- Real Estate Decisions
- Relocation Decisions
- Retirement Decisions
- Shipping Decisions
- Travel and Entertainment Decisions
- Vehicle Decisions
- Geographic/Spatial

http://www.uky.edu/BusinessEconomics/dssakba/instmat.htm