BERITA ACARA PENGAJARAN
SEMESTER GANJIL 2020/2021
PROGRAM STUDI TEKNIK INDUSTRI

NAMA DOSEN : NATAYA CHAROONSRI RIZANI, ST, MT
MATA KULIAH : PEMODELAN SISTEM
SKS/SEMESTER : 3
HARI/JAM : KAMIS/ 19.00-20.40
KELAS/RUANG : K/ ONLINE

NO	TANGGAL	MATERI PENGAJARAN	JML MHS	TANDA TANGAN
1	17/9/20	PENGANTAR MODEL, SISTEM, SIMULASI	4	
2	24/9/20	PENGANTAR MODEL, SISTEM, SIMULASI (2)	4	
3	1/10/20	SISTEM DINAMIS	4	
4	8/10/20	SISTEM DINAMIS (2)	4	
5	15/10/20	DASAR SIMULASI	4	
6	22/10/20	DASAR SIMULASI (2)	4	
7	5/11/20	UTS	4	
8	19/11/20	DATA GATHERING	4	
9	26/11/20	DATA COLLECTION	4	
10	3/12/20	MODEL BUILDING	4	
11	10/12/20	VERIFICATION AND VALIDATION	4	
12	17/12/20	PRO MODEL FOR SIMULATION	4	
13	7/1/20	SIMULATION OUTPUT ANALYSIS	4	
14	14/1/21	COMPARING SYSTEM	4	
15	14/1/21	SIMULATION USING PROMODEL	4	
16	21/1/21	UAS	4	

Mengetahui
Kepala Program Studi Teknik Industri

Ir. Iriandi Ilyas, MT

Dosen Yang Bersangkutan

Nataya Charoonsri Rizani, ST, MT

DAFTAR NILAI

SEMESTER GANJIL REGULER TAHUN 2020/2021

Program Studi : Teknik Industri S1
Matakuliah : Pemodelan Sistem
Kelas / Peserta : K
Perkuliahan : Kampus ISTN Bumi Srengseng P2K - Kelas
Dosen : Nataya Charoonsri Rizani, ST. MT.

No	NIM	N A M A	ABSEN	TUGAS	UTS	UAS	MODEL	PRESENTASI	NA	HURUF
			5%	20%	35%	40%	0%	0%		
1	19234703	**Fernando Haidar Ariyantho**	100	100	73	80	0	0	82.55	**A**
2	19234704	**Riska Nastasha Constantine**	100	100	73	80	0	0	82.55	**A**
3	19234705	**Mohammad Zakie Farid**	100	100	73	65	0	0	76.55	**A-**
4	19234706	**Robith Ardianto**	100	100	73	75	0	0	80.55	**A**

Rekapitulasi Nilai							
A	3	B+	0	C+	0	D+	0
A-	1	B	0	C	0	D	0
		B-	0	C-	0	E	0

Jakarta,1 March 2021

Dosen Pengajar

Nataya Charoonsri Rizani, ST. MT.

Security ID 75d590174471870cb33bc3061e223d05

MODELING AND SIMULATION SYSTEM

Session 1 & 2
Introduction to System, Model and Simulation

Learning Objectives

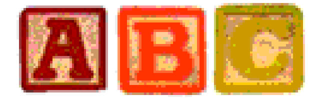
At the end of this session, the students are expected to :

1. Understand the concept of system, model and simulation
2. Give the examples of basic model

What are we will discuss about ?

- System Definition
- Ways to Study a System
- Classify of Models
- Characteristics of a Good Model
- Introduction to Simulation

So…What is a system?

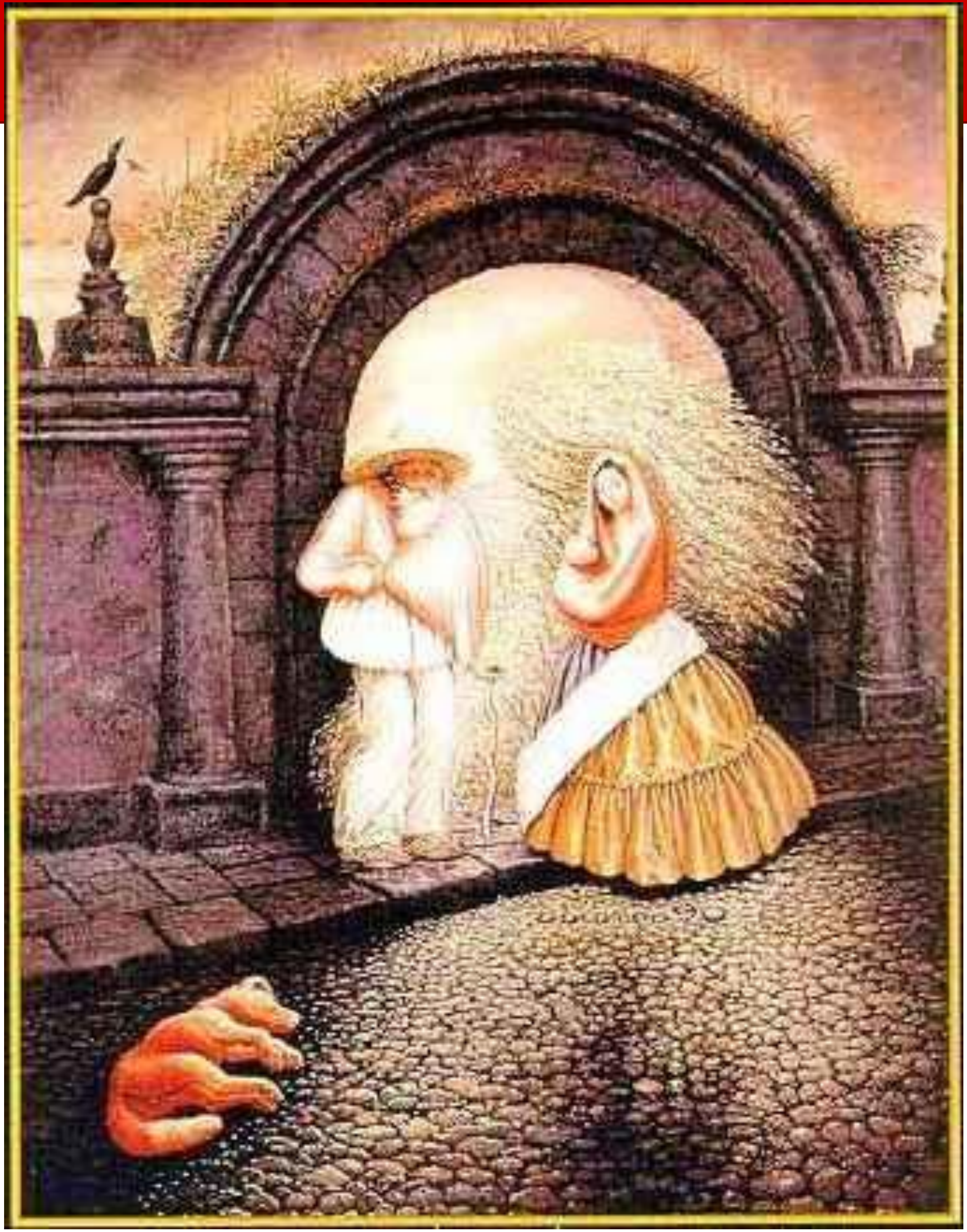


1……………………………………………

2……………………………………………

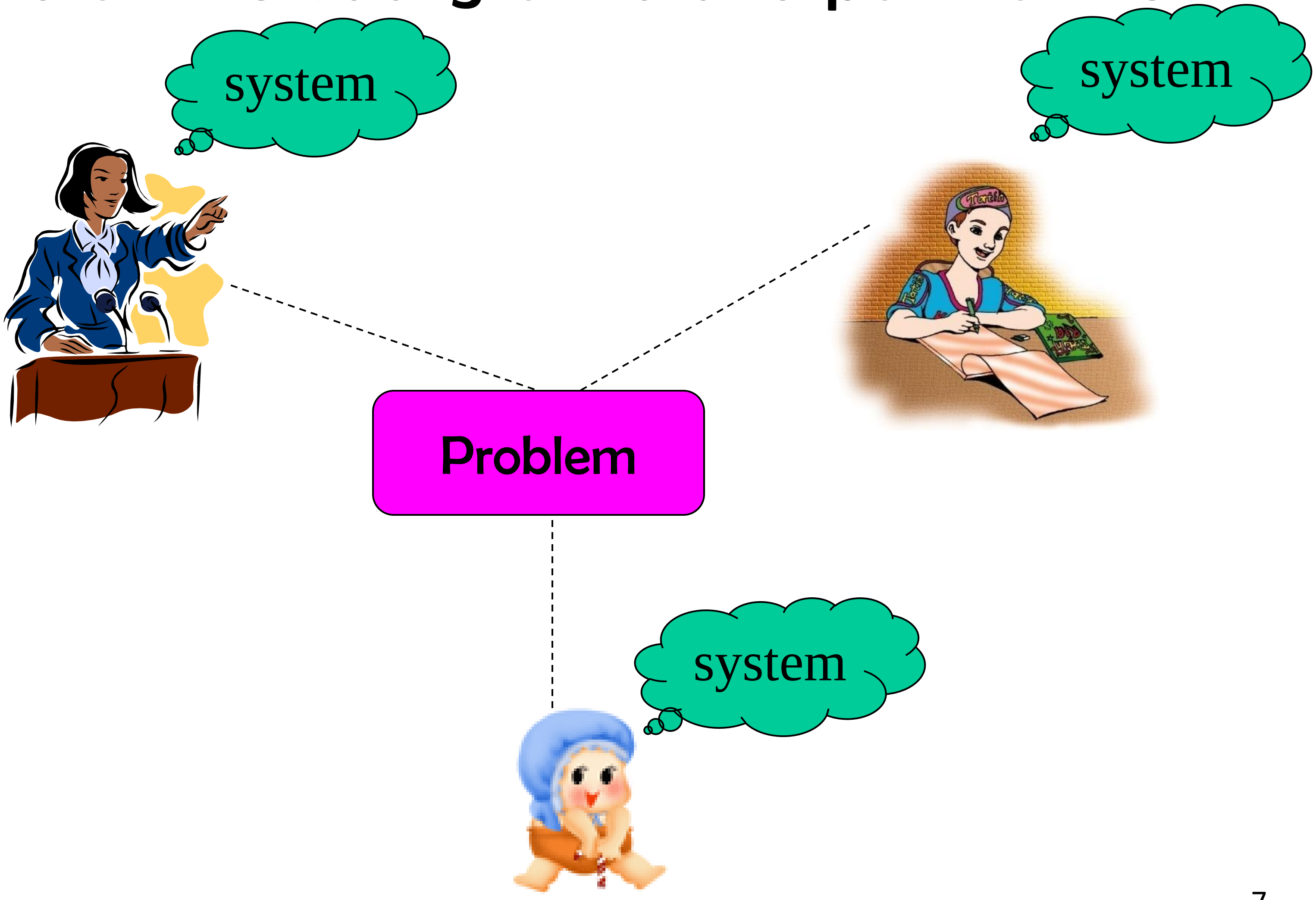
3……………………………………………

4……………………………………………



Why we get different definition?

Depend on the background and point of view



System Definition

System is defined as

a collection of elements that function together to achieve a desired goal

And the KEY POINTS are.........

- ☞ A system consists of multiple elements
- ☞ These elements are interrelated and work in cooperation
- ☞ A system exists for the purpose of achieving specific objectives.

Examples of Systems

- Traffic systems
- Political systems
- Economic systems
- Mo
  syst
- Ser

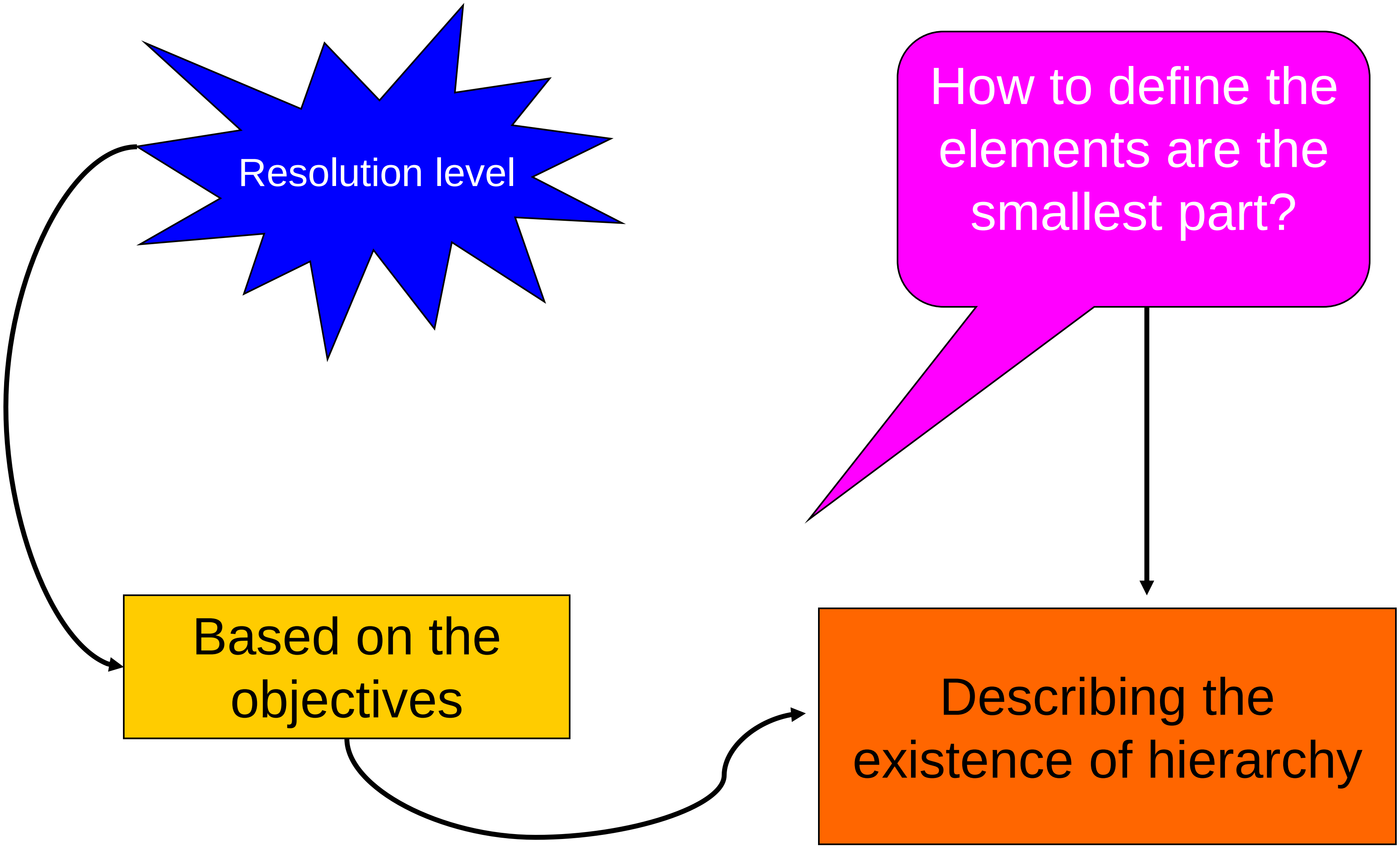


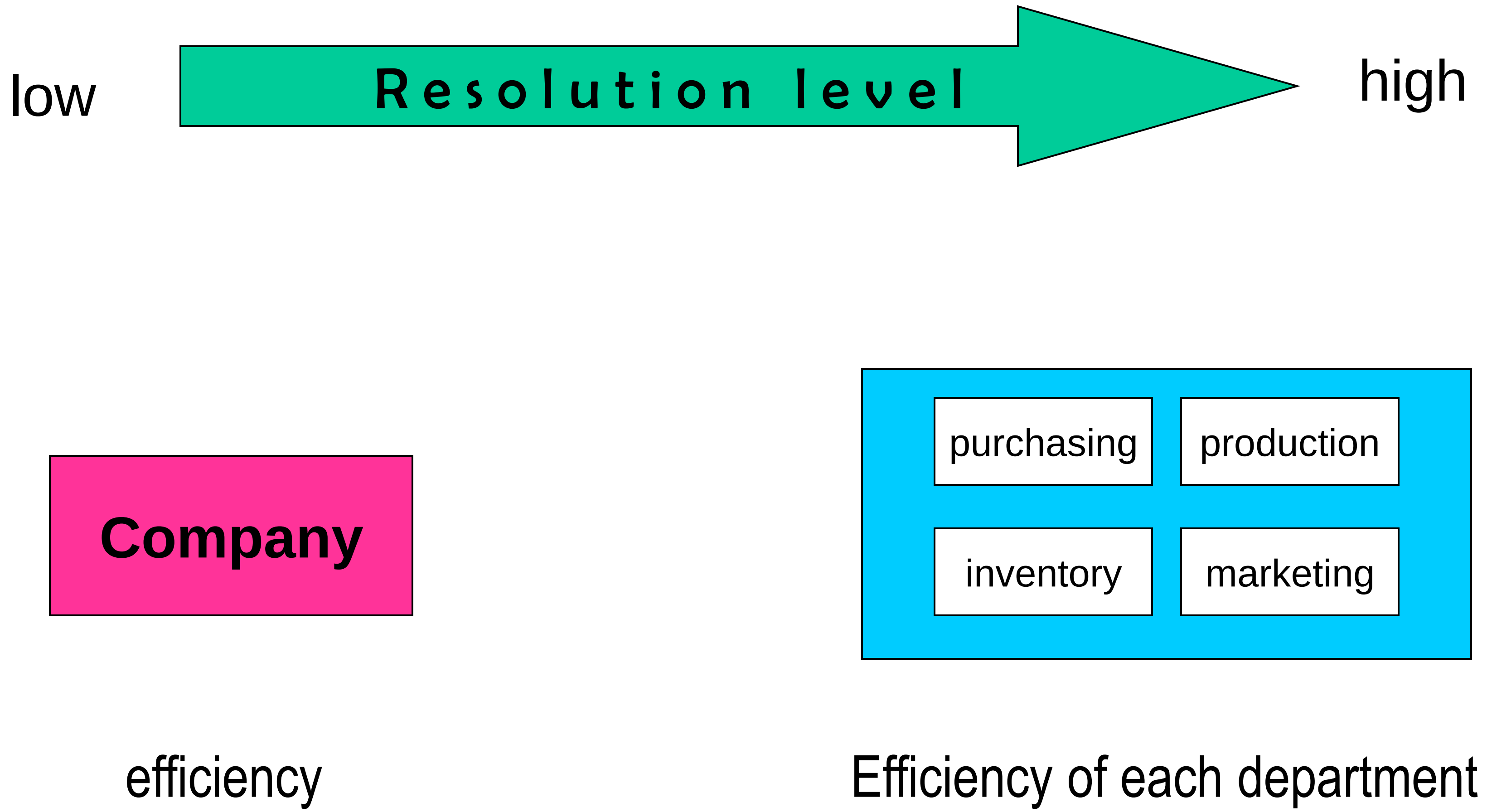



Definition of element system

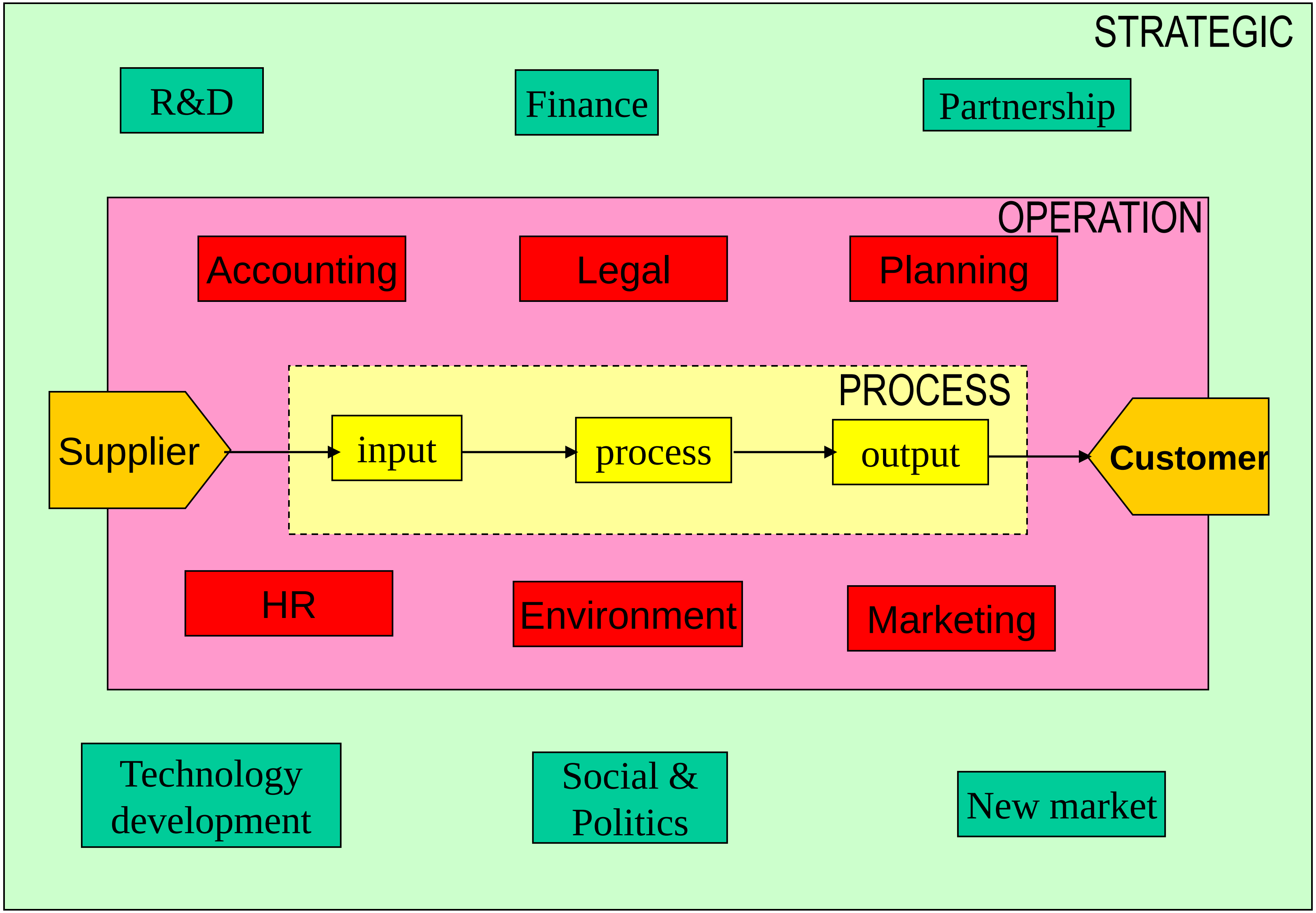
- The smallest part that can be identified
- Can not be divided
- The smallest part that will be observed
- The interracting elements known as sub system

The concept of system hierarchy




low
Resolution level
high
Company
purchasing
production
inventory
marketing
efficiency
Efficiency of each department

Hierarchy of manufacturing system



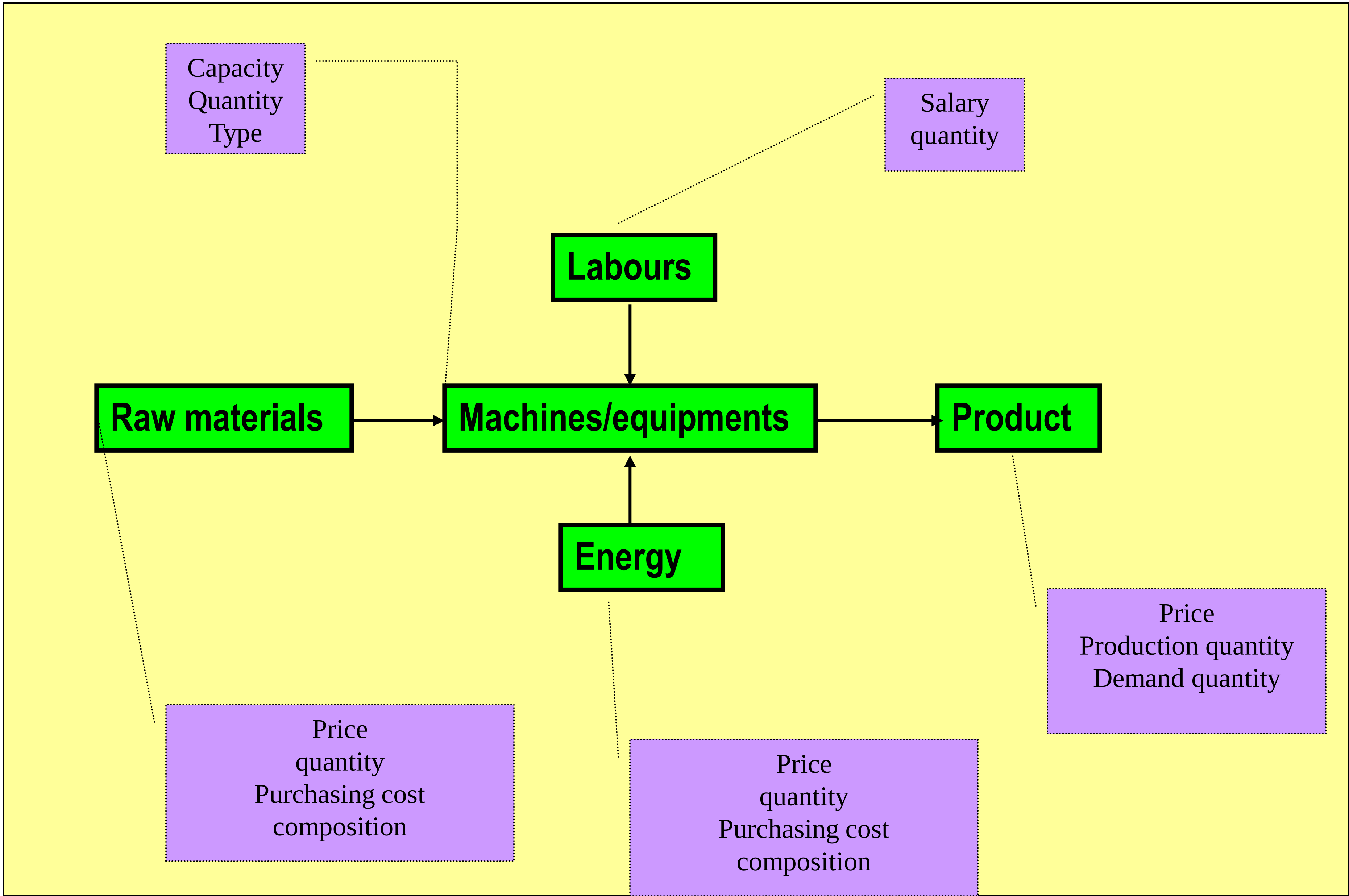
Attribute

My name is Samantha
I am one year old
I am still a baby
I am genius

So attributes are :

1. Informations of the element
2. Possible to be observed, measured and counted
3. In math terminology can be defined as variable or parameter

Attribute of elements

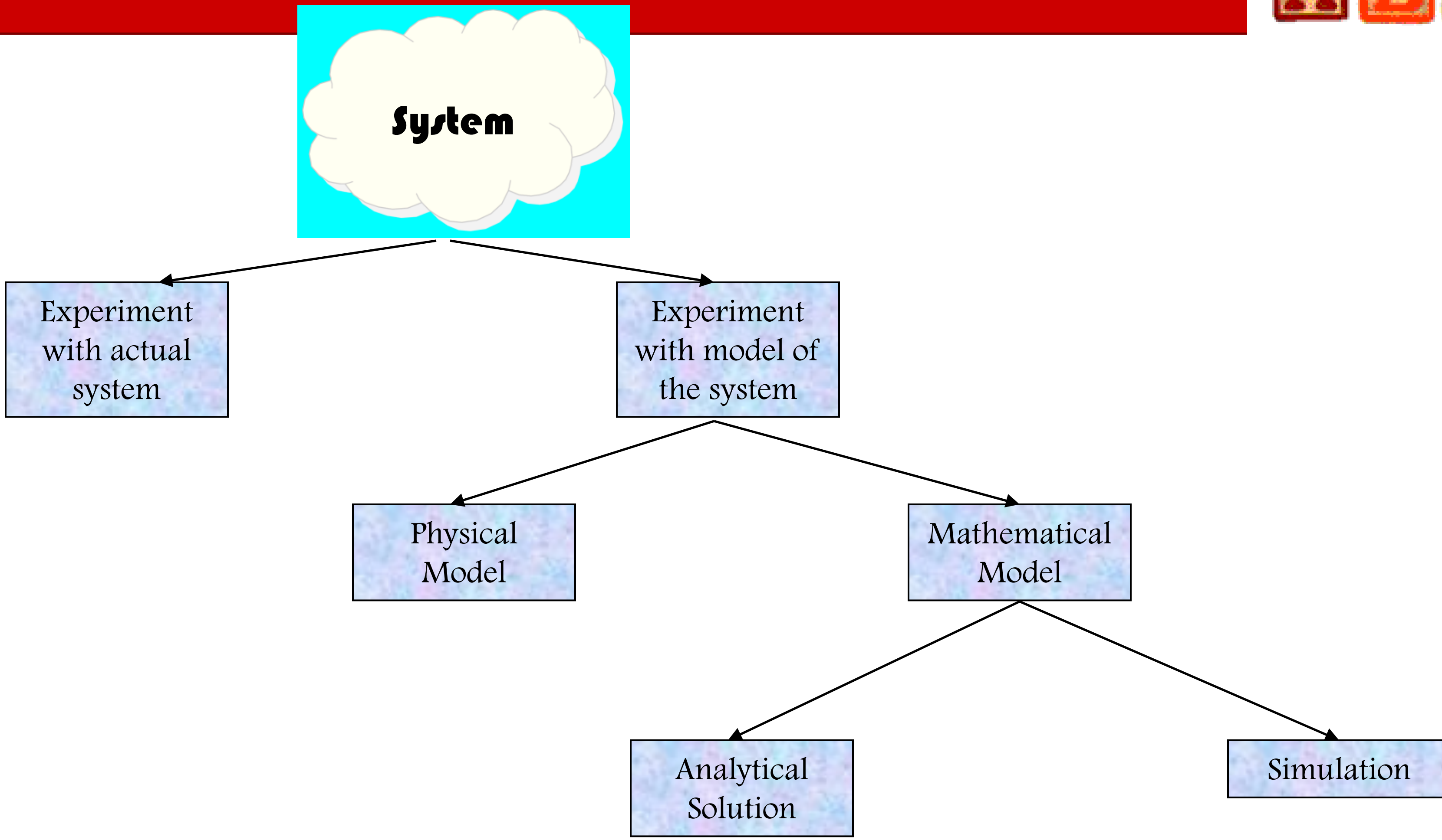


State of a System

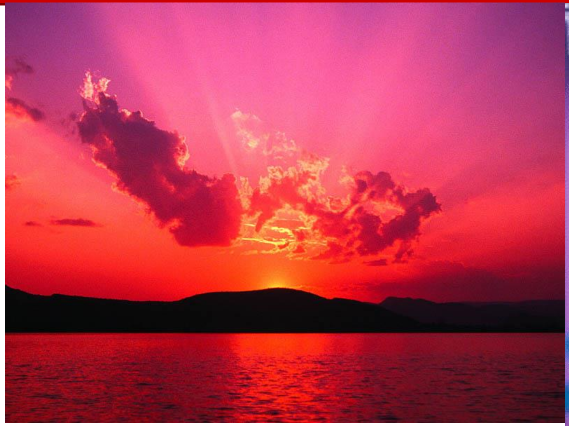
- ✓ *state* of a system : the collection of variables necessary to describe a system at a particular time, relative to the objectives of a study.
- ✓ Example : In study of the front office activities on the bank
  - – Possible state variables are
    - ❑ the number of busy tellers
    - ❑ the number of queuing customers in the bank
    - ❑ the time of arrival of each customer in the bank
    - ❑ etc

Our focus on *manufacturing and service systems* that process materials, information and people.

How to learn the system?



Model????



DEFINITION OF MODEL

- Representative of the actual system
- Describing the most important and useful part of the system
- Adequately

Model Classification (1)

Type of classification	Type of model
Function	Descriptive Predictive Normative
Structure	Iconic Analog symbolic
Time reference	Static Dynamic
Certainty level/randomness	Deterministic Probabilistic/Stochastic
Generalization level	General Spesific
Interaction with the environment	Open close
Quantification level	Qualitative Quantitative
Dimension	2 dimension 3 dimension

Function

- Descriptive : imitation from actual system
  - Ex : plant lay-out, structure of organization
- Predictive : estimation of value or event
  - Ex : estimation of BEP
- Normative : providing the best solution of the problem
  - Ex : Critical path Method

Structure

- Iconic : similar but different size
  - Ex : miniature of airplane
- Analog : make analogy from other system
  - Ex : studying traffic system from electricity system
- Symbolic : mathematical model

Time Reference

- ✓ A *static* model is representation of a system at a particular time, or one that may be used to represent a system in which time simply plays no role.
  - ✓ Example: Monte Carlo Model.
- ✓ A *dynamic* model represents a system as it evolves overtime.
  - ✓ Example: Conveyor system in a factory.

Randomness

- No content of any probabilistic (i.e., random) components, it is called *DETERMINISTIC*.
  - Example: a complicated (and analytical intractable) system of differential equations describing a chemical reaction
- Having at least some random input components, and these give rise to *STOCHASTIC* models
  - Examples: Most queuing and inventory system are modeled stochastically
  - Notes: Stochastic models produce output that it self random, and must therefore be treated as only an estimate of the true characteristics of the model; this is one of the main disadvantages of simulation

Continuous vs. Discrete Models

- A *discrete model* represents of a system for which the state variables change instantaneously at separated points in time

- Example : A bank is a discrete system, since state variables –e.g., the number of customers in the bank- change only when a customer arrives or when a customer finishes being served and departs.

video

What are the state variables?

1……………………………

2……………………………

3……………………………

- A *continuous model* represents of a system for which the state variables change continuously with respect to time.

- Example: An airplane moving through the air is an example of a continuous system, since state variables such as position and velocity can change continuously with respect to time

And the good model characteristics are

- Having the high generalization
- Transparant mechanism
- Developed potentially
- Responsiveness to asumption changing

Modelling Criterion

- ✓ Representing the actual system
- ✓ The Simplification from system complexity

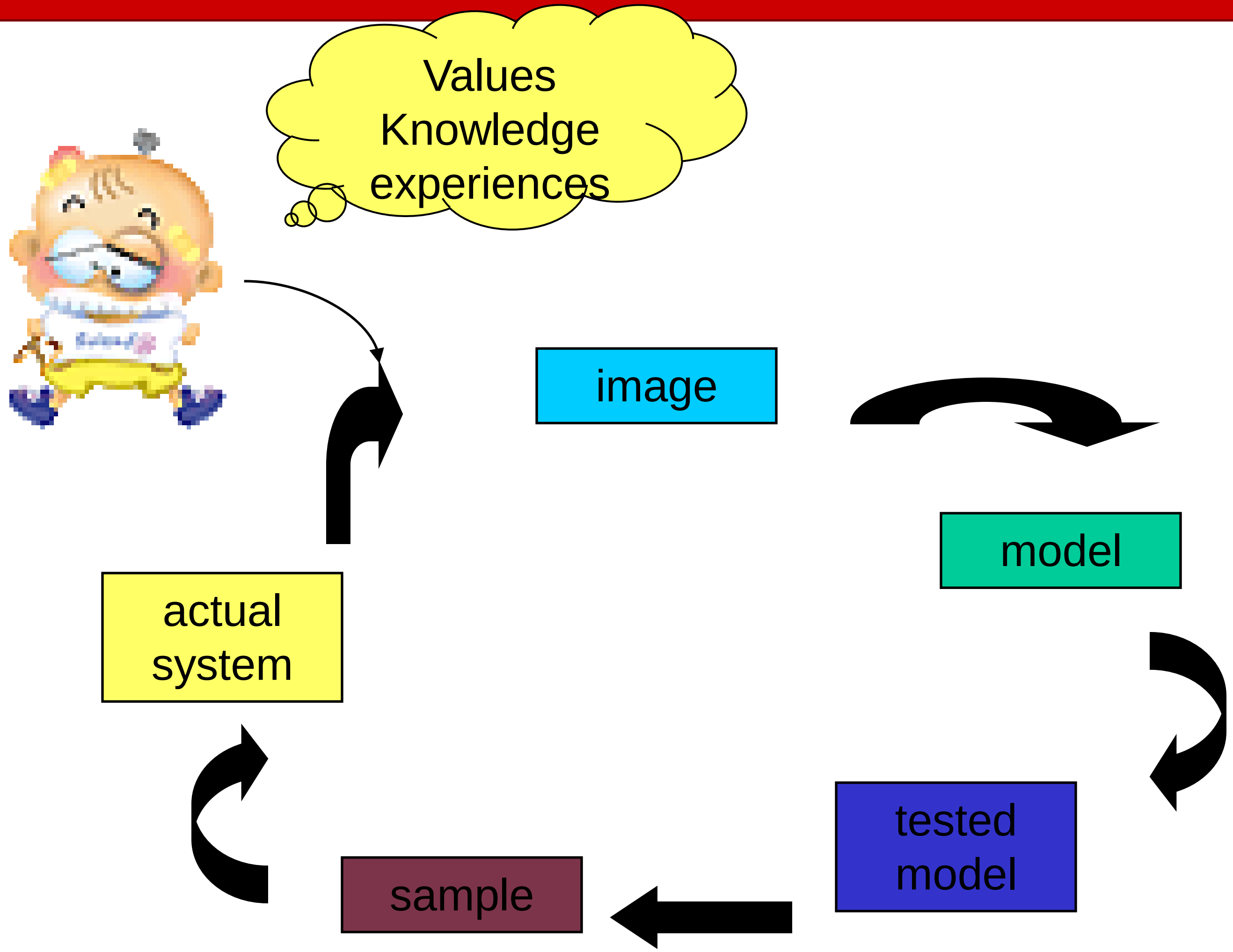
Problems Complexity

- Developing, Changing
  - Information technology
  - Environment
  - Culture
- Unstructured
- Conflict of interest
- Multidiscipline
- Different point of view

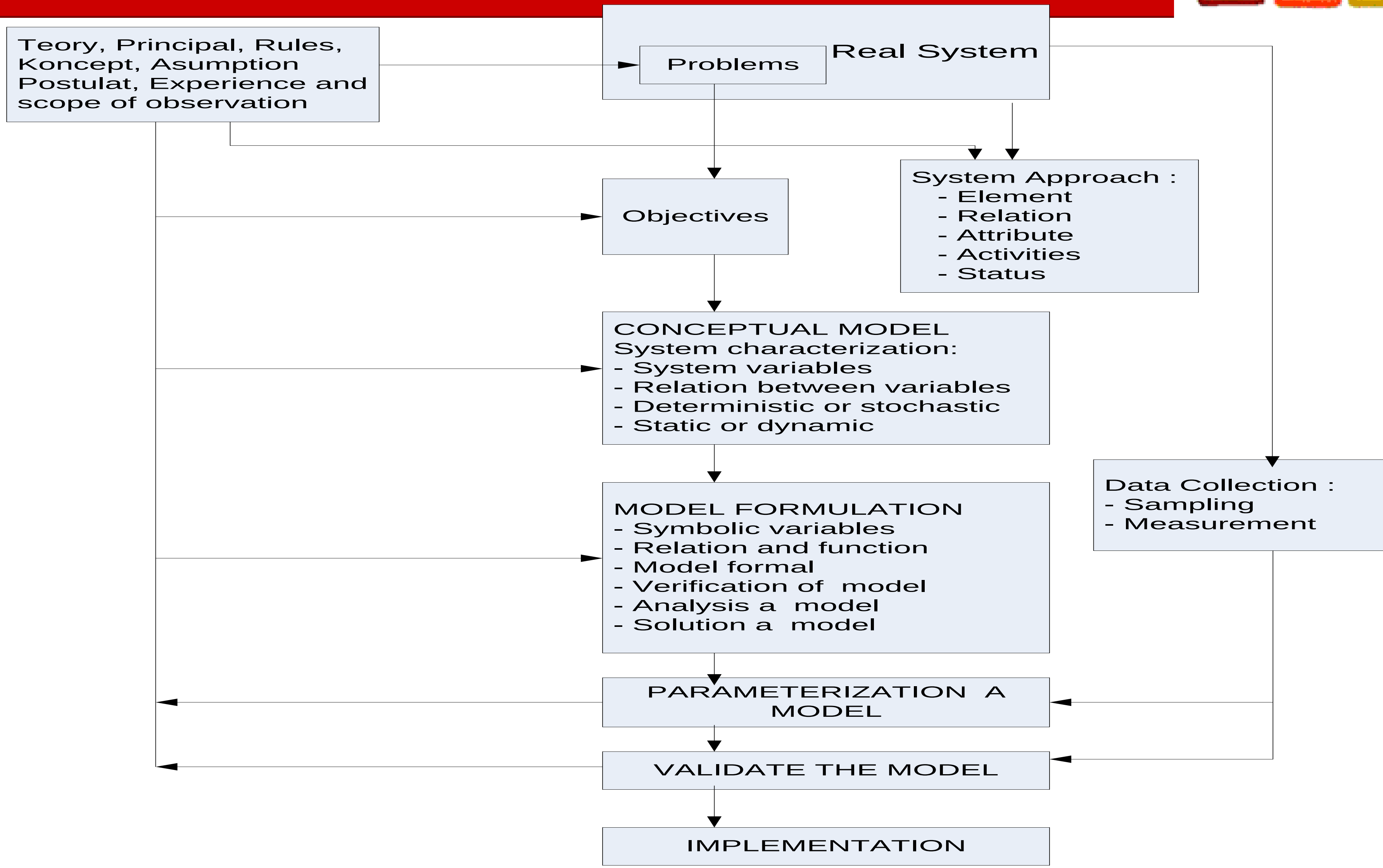
Model Developing Principles

- *Elaboration*
  Start from simple thing
- *Sinektik*
  Analogically developed
- *Iteratif*

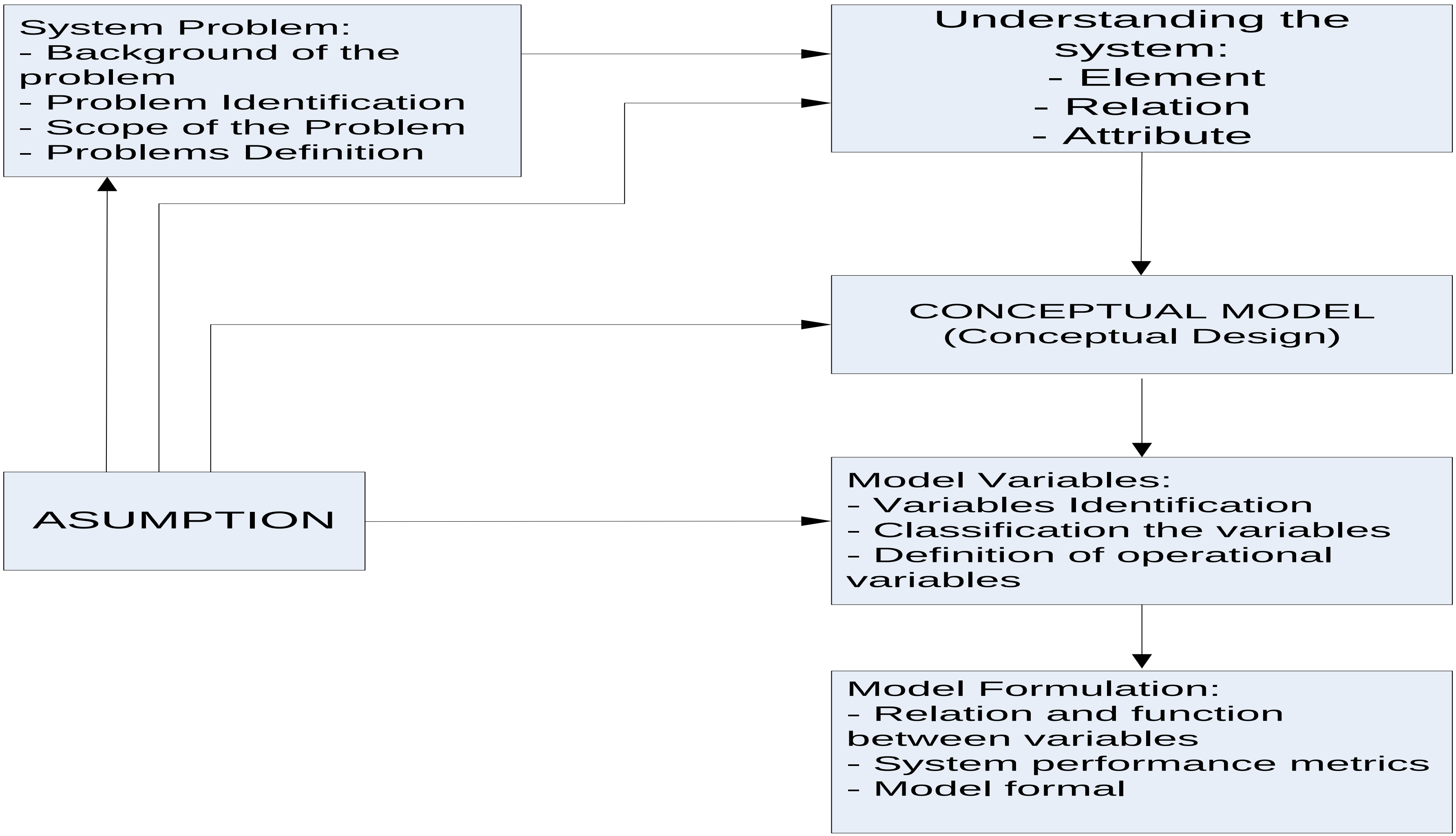
Modelling Scheme



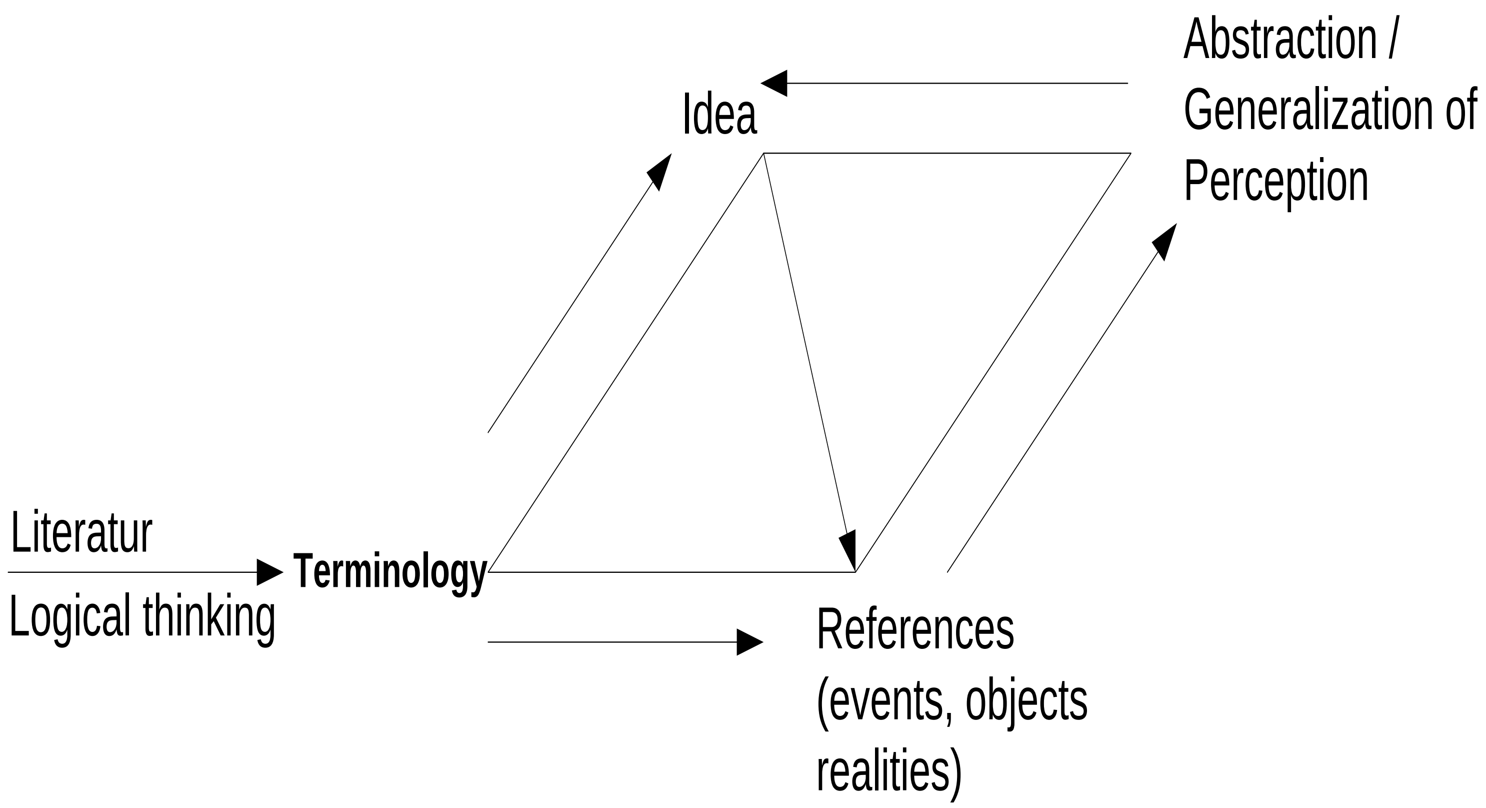
Steps of Developing a Model



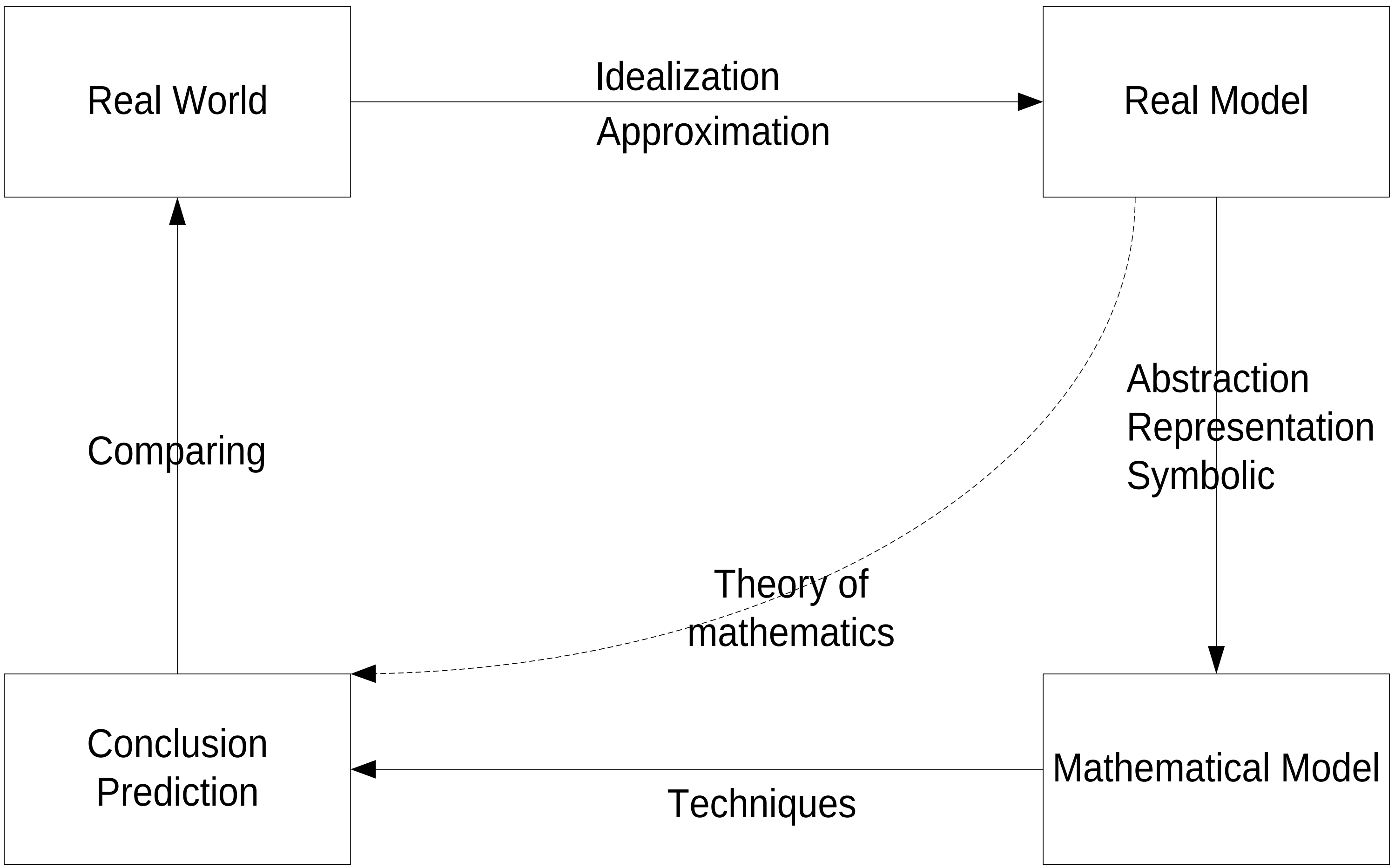
Steps in Model Formulation



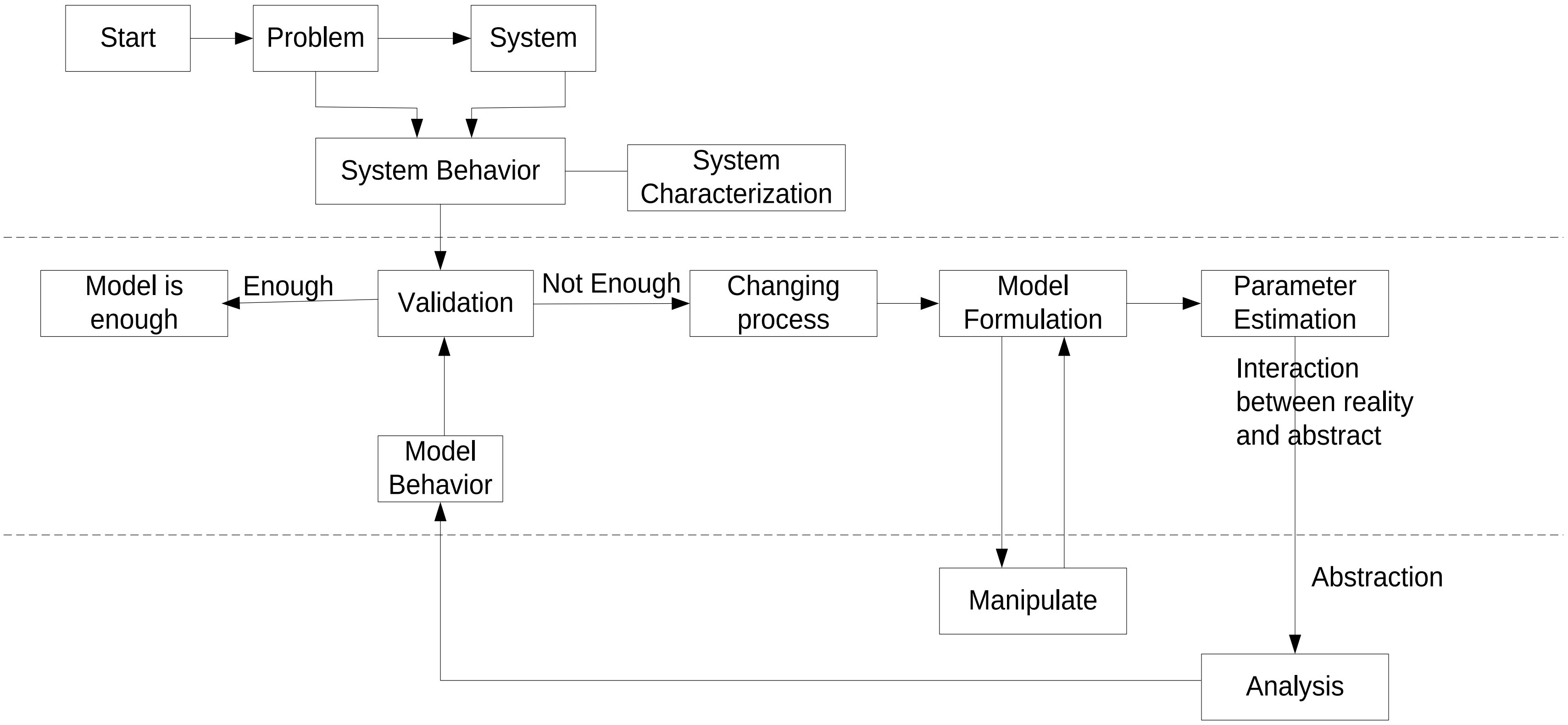
Conceptualization Process



Construction a Mathematical Model



Mathematical Modeling Process



Model Parameterization

- *Model* or *formula* consists of three components
  - constant
  - variable and
  - parameter
- *Parameter* is a constant that can change from region (condition) to another region (other condition).

Methods for Model Parameterization

1. Objective Methods

   a. Statistics, using point estimation or interval estimation.

   b. Standard, using standard such as ISO, DIN, SII, etc.

2. Subjective Methods

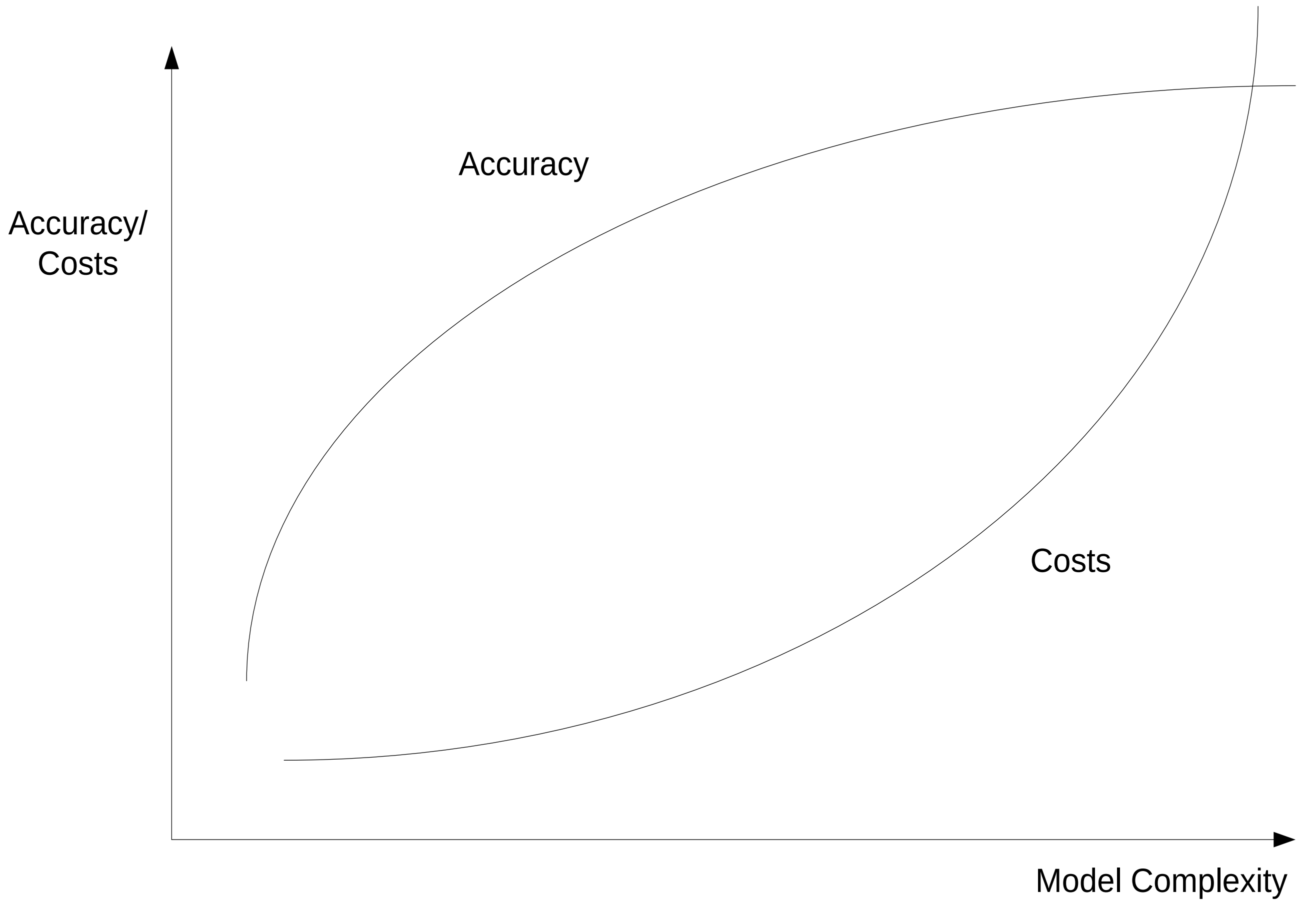
   Expertise opinion, observer or decision maker.

   Examples: Delphi, AHP, etc.

3. Combination Method

   Combination between objective and subjective methods.

Model Complexity, Model Accuracy and Model Costs



So….Model Complexity depends on…

- Accuracy of the model
- Costs to model a system
- The number of information collected to solve the problem.
- Availability data to test and prove the model.

video

We should learn from actual system or model of the system?????

Why?????

Dangerous

time consuming

expensive

disruptive

When is the experiment with actual system conducted?

If it is possible (and cost-effective)

- to alter the system physically
- let it operate under the new conditions, it is probably desirable to do so

there is no question about whether what we study is valid

For Nuclear system??

It is usually necessary to build a *model* as a representation of the system and study it as a surrogate for the actual

- What are the differences between physical and mathematical model?
- Give the example!!!!

Mathematical model..........

- represents a system in terms of logical
- quantitative relationships
- then manipulated and changed to see how the model reacts
- and thus how the system would react-if the mathematical model is a valid one

Analytical Solution vs. Simulation.

Model simple enough ⇨ work with its relationships and quantities to get an exact ⇨ analytical solution

Numerically exercising the model for the inputs in question to see how they affect the output measures of performance ⇨simulation

Classify Simulation Models

- The influence of time will divide simulation to....

  Static vs. Dynamic Simulation Models

- A *static* model is representation of a system at a particular time,

  ......or one that may be used to represent a system in which time simply plays no role. Example: Monte Carlo Model

- A *dynamic* simulation model represents a system as it evolves overtime, such as conveyor system in a factory.

The randomness will divide simulation to….

Deterministic vs. Stochastic Simulation Model.

- no contain any probabilistic (i.e., random) components,

  it is called *deterministic.*

  Give example!!!!!!
- having at least some random input components,

  ….. and these give rise to *stochastic* simulation models.

  Examples: Most queuing and inventory system are modeled stochastically.

At last…….

- *Continuous vs. Discrete Simulation Models.*

  ????????????

  We define *discrete* and *continuous* simulation models analogously to the way discrete and continuous systems were defined

What is Simulation?

- Simulation is a way "to reproduce the conditions of a situation, as by means of a model, for study or testing or training, etc." (Oxford American Dictionary, 1980); reproduce the *operational behavior* of dynamic systems.
- Simulation is the *modeling of a process* or system in such a way that the model mimics the response of the actual system to events that take place over time (Schriber, 1987).
- Simulation is the imitation of a dynamic system using a computer model in order to *evaluate and improve* system performance.

The Other thing about simulation….

- Simulation is used to
  - *Visualize*
  - *Analyze*
  - *Improve*

  the performance of manufacturing and service systems.
- Focus primarily on discrete-event simulation

Still The Other thing about simulation….

- Simulation is much more meaningful when we understand what it is actually doing
- Understanding how simulation works help us to know whether we are applying it correctly and what the output results mean

Simulation software

- Provides a realistic, graphical animation of the system being modeled
- User can do "what if" analysis
- Some of them provide optimization capability

- Commercial simulation software that has modeling constructs specifically designed for capturing the dynamic behavior of systems
- www.promodel.com

Why Simulate?

- Simulation provides a way to validate whether or not the best decisions are being made.
- Simulation avoids the expensive, time-consuming, and disruptive nature of traditional trial-and-error techniques.
- Simulation provides a method of analysis that is not only formal and predictive, but is capable of accurately predicting the performance of even the most complex systems.
- Simulation provides precisely that kind of foresight.
- By simulating alternative production schedules, operating policies, staffing levels, job priorities, decision rules, a manager can more accurately predict outcomes and therefore make more informed and effective management decisions.
- Risk free.

Why Simulate? (cont.)

- Promotes a try-it-and-see it attitude
- Encourages thinking 'outside the box"
- Takes the emotion out of the decision-making process by providing objective evidence
- Forces decisions on critical details

Characteristics of Simulation

- Captures system interdependencies
- Accounts for variability in the system
- Is versatile enough to model any system
- Shows behavior over time.

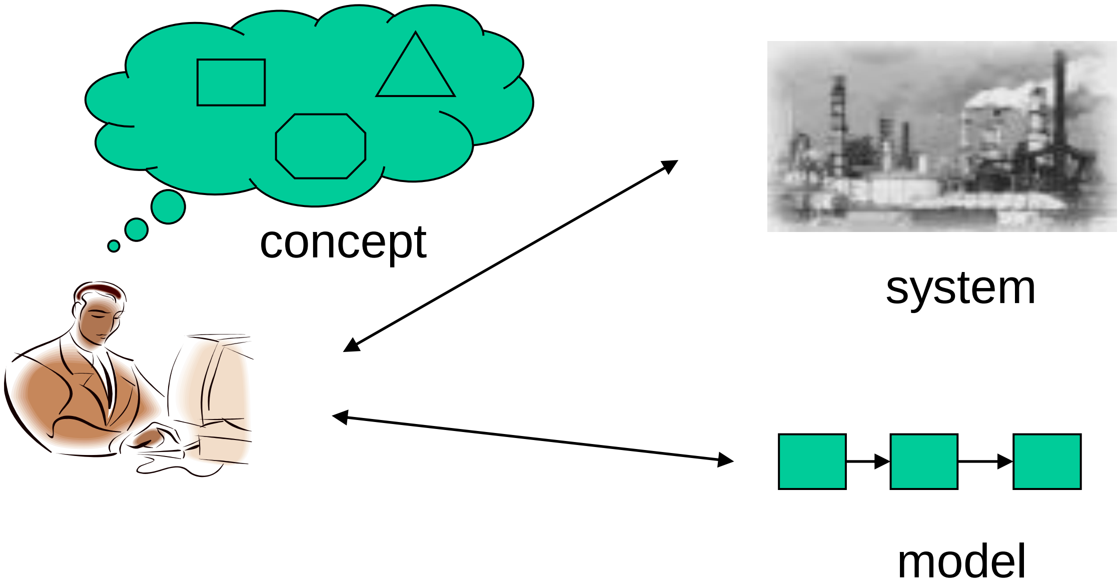
Characteristics of Simulation (cont.)

- Is less costly, time consuming and disruptive than experimenting on the actual system.
- Provides information on multiple performance measures.
- Provides results that are easy to understand and communicate.
- Runs in compressed, real, or even delayed time.
- Forces attention to detail in a design.

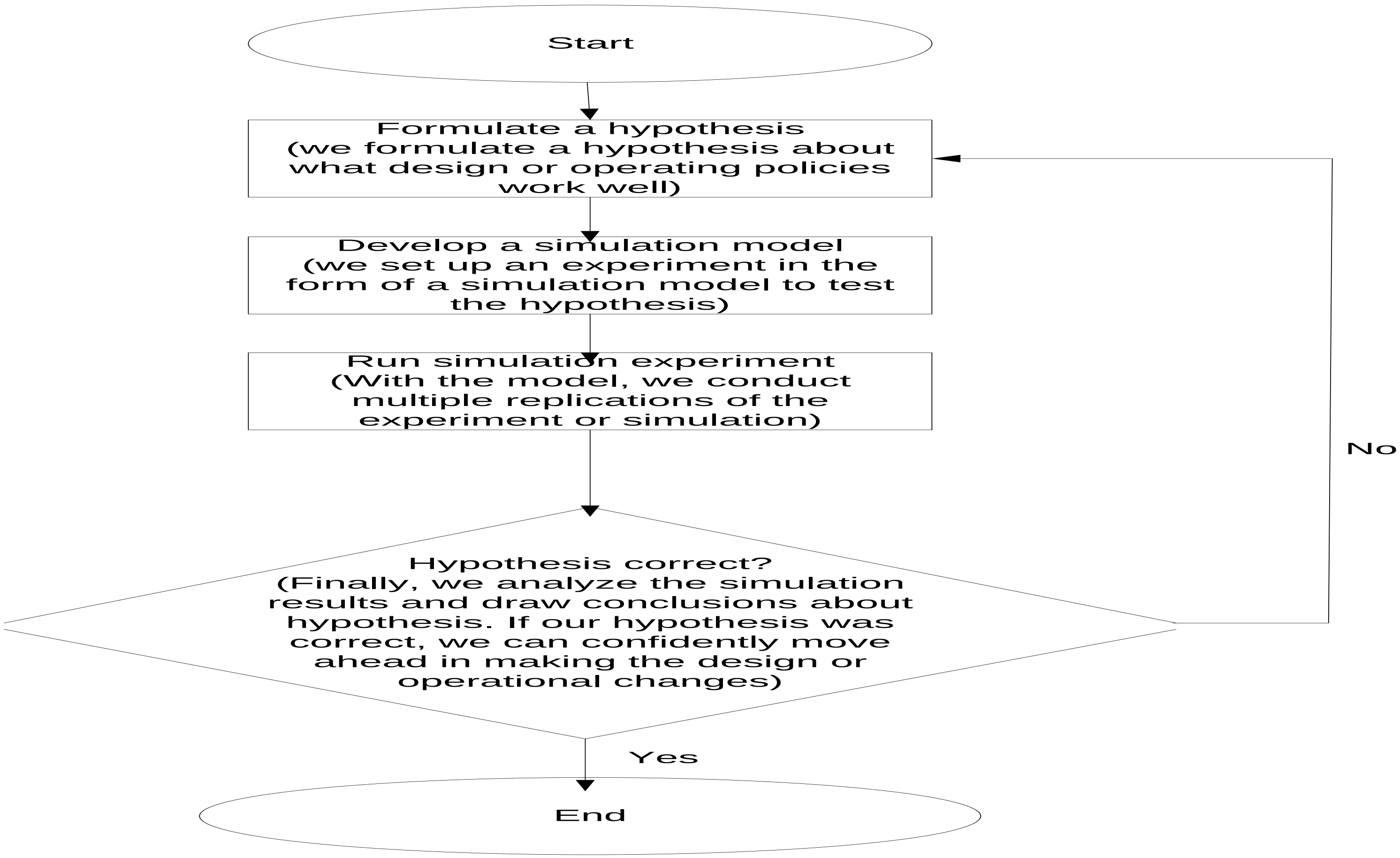
Doing Simulation

- Doing simulation is the process of designing a model of a real system and conducting experiments with this model
- Performed as part of larger process of system design or process improvement
- An experimentation tool in which a computer model of a new or existing system is created

Doing Simulation (cont.)



DOING SIMULATION (CONT.)



The process of simulation experimentation

Doing Simulation (cont.)

- It obvious that simulation is **NOT a solution tool** but rather an *evaluation tool.*
- Simulation should be viewed as an *extension of the mind* that enables one to understand the complex dynamics system; **, NOT a substitute for thinking.**
- **Describes how a defined system will behave, NOT prescribe how it should be designed.**

Use of Simulation

- Began in the 1960s using FROTRAN language.
- In the last couple of decades, simulation gained popularity as a decision-making tool in manufacturing and service industries.
- Simulation has become a standard practice when a new facility is being planned or a process change is being evaluated.

Application of Simulation

- Work-flow planning
- Capacity planning
- Cycle time reduction
- Staff and resource planning
- Quality improvement
- Cost reduction
- Inventory reduction
- Productivity improvement
- Layout analysis
- Line balancing
- Production scheduling, etc.

Use of Simulation (cont.)

The surge in popularity of computer simulation can be attributed to the following:

- Increased awareness and understanding of simulation technology.
- Increased availability, capability, and ease of use of simulation software.
- Increased computer memory and processing speeds, especially of PCs.
- Declining computer hardware and software costs.

Use of Simulation (cont.)

The primary use of Simulation is decision support in the area of manufacturing, which includes warehousing and distribution systems

To make system design and operational decisions

Use of Simulation (cont.)

Other uses:

- Communication and visualization
- Computer-based training

Why is it so popular?

- Increased awareness and understanding of simulation technology
- Increased availability, capability and ease of use of simulation software
- Increased computer memory and processing speeds, especially of PCs
- Declining computer hardware and software cost

When Simulation is Appropriate??

Simulation has certain limitations

NOT all system problems that COULD be solved with the aid of simulation SHOULD be solved using simulation

Simulation may be overkill

When Simulation is Appropriate (cont.)

- Decisions should be of an operational (logical or quantitative) nature.
- Process should be well defined and repetitive.
- Activities and events should be interdependent and variable.
- The cost impact of the decision should be greater than the cost of doing the simulation.
- The cost to experiment on the actual system should be greater than the cost of simulation.

An operational (logical or quantitative) decision is being made

- Limitation on the quantitative or logical issues
- NOT for qualitative or sociological issues:
  - How to improve reliability
  - How to improve personal performance

The process being analyzed is well defined and repetitive

Simulation is USELESS when:

- It is applied on a process that does NOT follow a logical sequence and adhere to define rules
- It is NOT possible to make reasonable assumptions of how a system operates
- It is applied on one-time projects or processes that are never repeated the same way

Activities and events are interdependent and variable

- Simulation is USELESS when it is applied on a system which has activities that never interfere with each other (or deterministic)
- The number of interdependent and random activities makes a system difficult to analyze, NOT the number of activities.

The cost impact of the decision is greater than the cost of doing the simulation

- Simulation is USELESS when the impact of the decision itself is so insignificant
- i.e.: whether a worker should repair rejects as they occur or wait until 4 or 5 accumulate

The cost to experiment on the actual system is greater than the cost of simulation

- In some situations, it may be quicker and more economical to experiment on the real system
- Simulation is USELESS when it is applied on a problem that can be solved through direct experimentation quickly, inexpensively and with minimal impact to the current situation
- i.e. whether to seal envelopes before or after they are addressed

80 – 20 Rule

- Simulation follows the 80-20 rules
- 80 percent of the benefit can be obtained from knowing only 20 percent of the science involved

Qualifications for Doing Simulation

Knowledge and Skill required :

- Project management
- Communication
- Systems engineering
- Statistical analysis and design experiments
- Modeling principles and concepts
- Basic programming and computer skills
- Training on one or more simulation products
- Familiarly with the system being investigated.

Economic Justification of Simulation

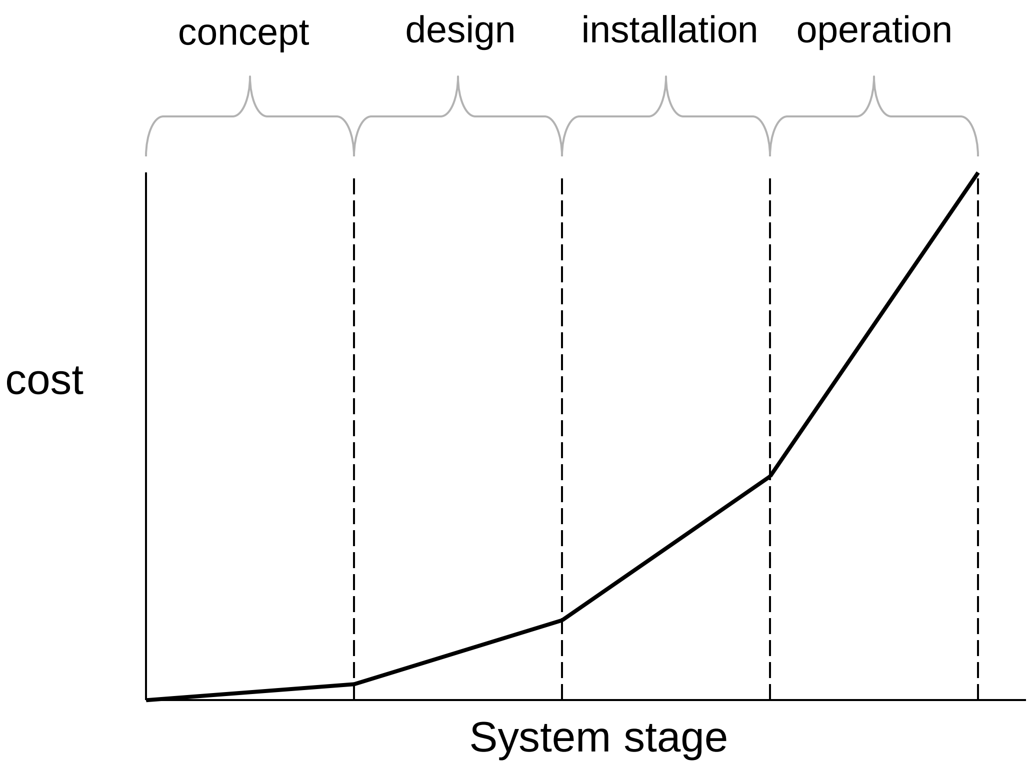
- If cost exceeds the expected benefit → simulation should NOT be used
- Simulation products: USD 1,000 – USD 20,000
- Initial investment of simulation software tool may be between USD 10,000 and USD 30,000 (including training and start-up)
- Recovered after the first 1-2 projects
- Ongoing expense for individual projects: 1-3%
- <5% of the overall system design time

Economic Justification (cont.)

NOT knowing in advance how much savings will be realized until it is actually used

ROI or payback analysis

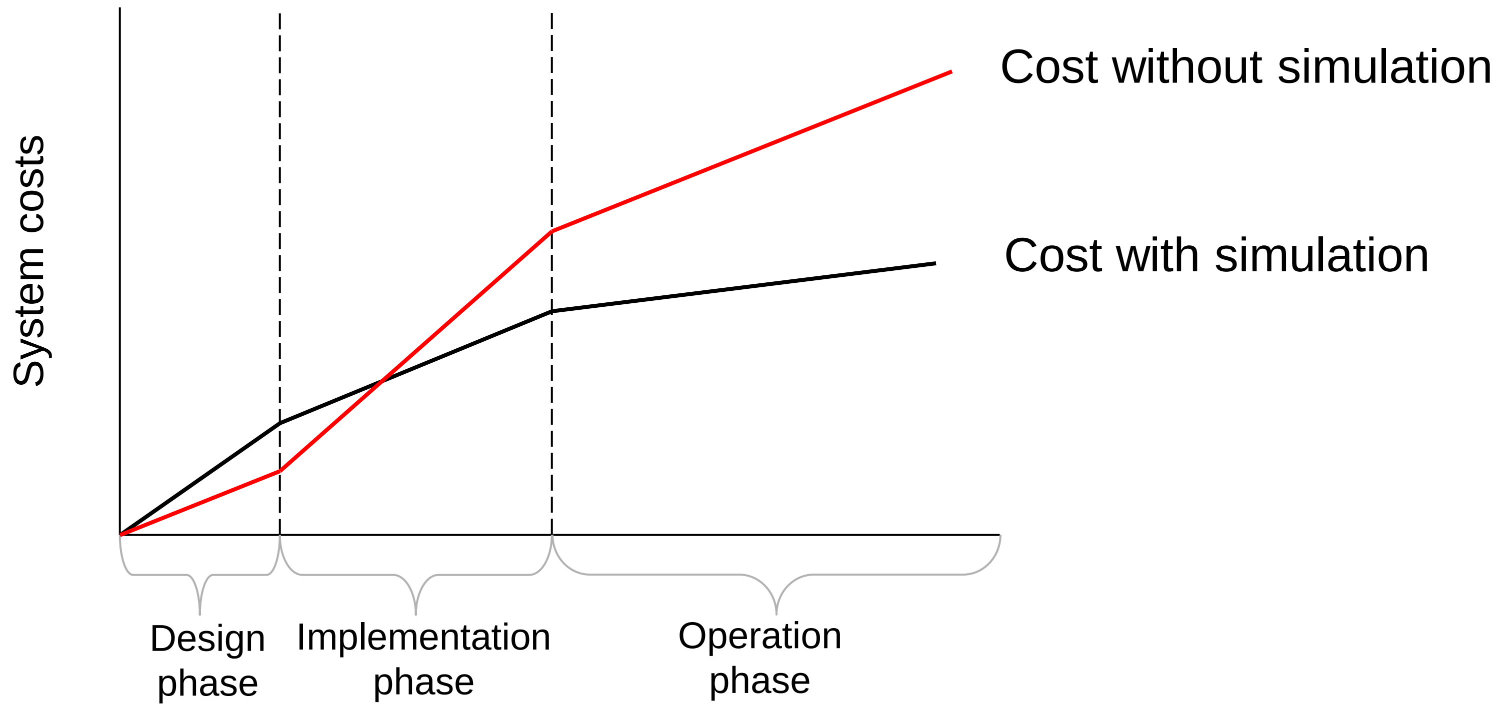
Rule of Tens



Rule of tens:
The cost to correct a problem increases by a factor of 10 for every design stage through which it passes without being detected

Cost of making changes at subsequent stages of system development

Cost without vs. with Simulation



Summary

- Simulation is a powerful technology to improve system performance by providing a way to make better design and management decisions
- Simulation is an invaluable decision-making tool
- Simulation stimulates creative thinking and results in good design decision