

**Pathways to Higher Education**  
**Faculty of Engineering -CAPSCU**  
**Cairo University**



# Analytical Thinking

By:

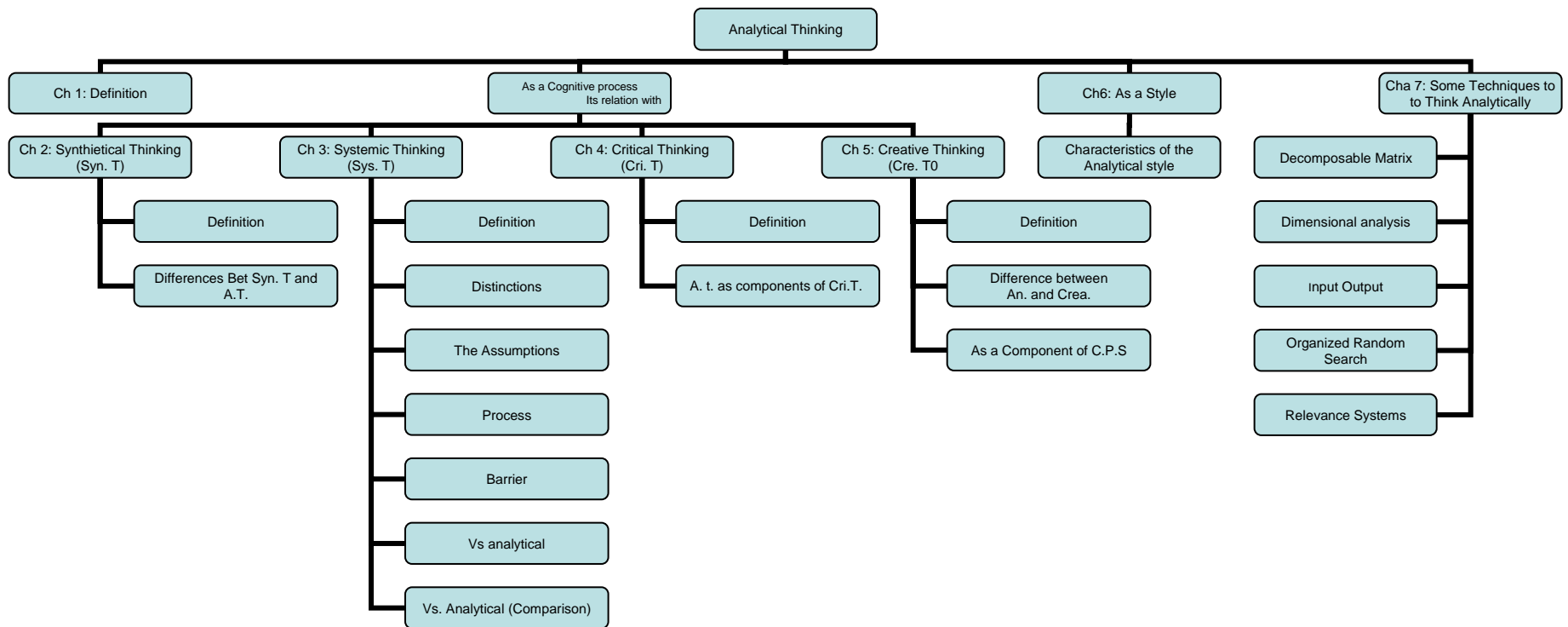
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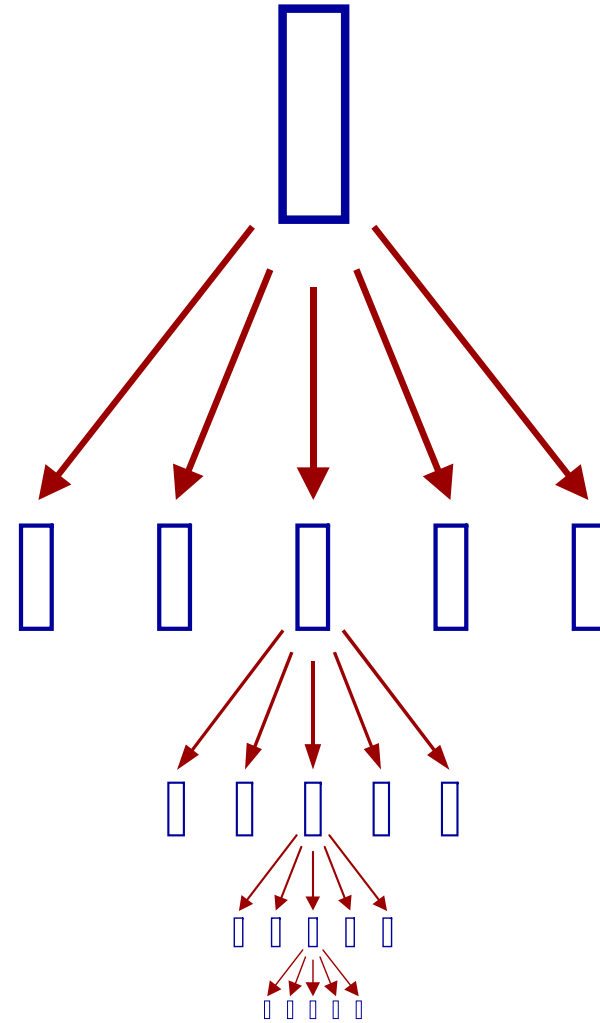
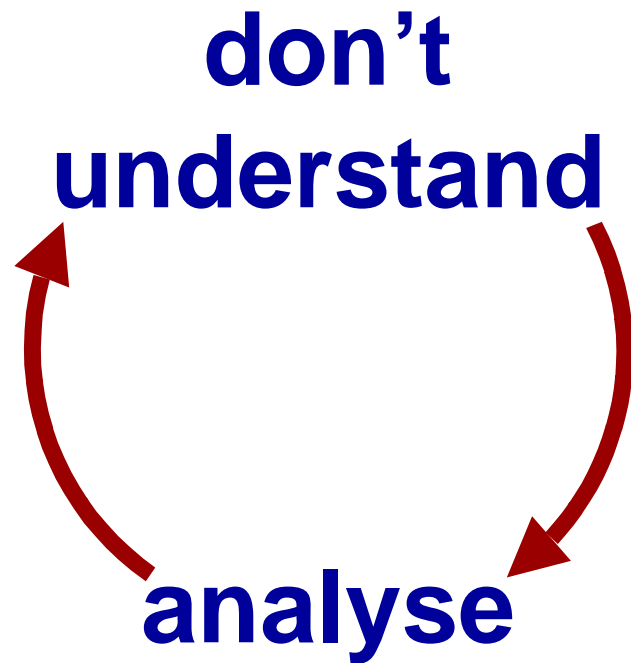
# Definition of Analytical Thinking

**Analytical thinking is** The ability to scrutinize and break down facts and thoughts into their strengths and weaknesses.

# The main components of the course



# Analysis paralysis



# Importance to Use Synthetical Thinking with Analytical Thinking

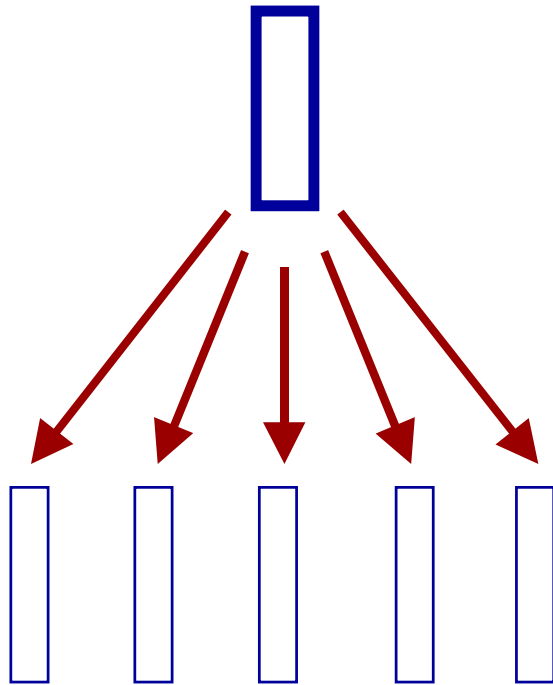
**When we break things** down into smaller and smaller components, we tend to lose sight of the interactions between them.

**Analysis makes the interactions less visible**, so insight diminishes, so we analyze things further - and things go from bad to worse.

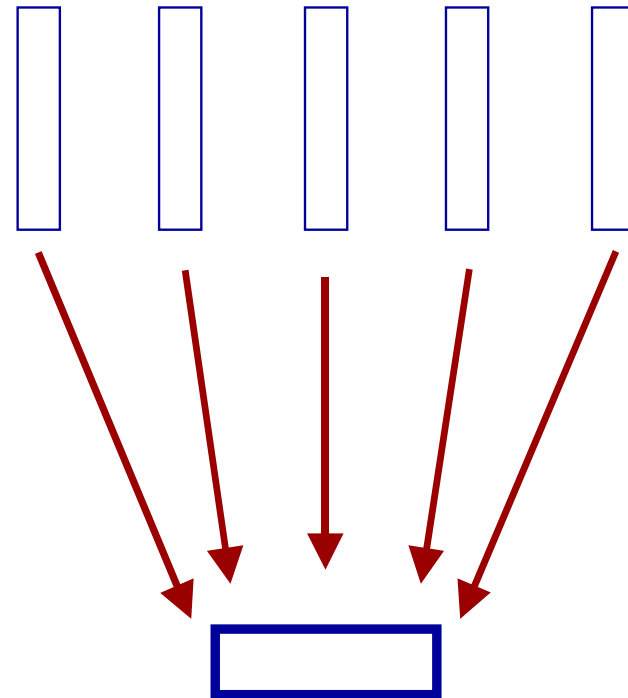
**In sum we need both analysis and synthesis** .Each is of only limited value without the other - in a systemic world .  
Systemic thinking is nothing more than a combination of analytical thinking and synthetical thinking.

# Analysis and synthesis

**Analysis**



**Synthesis**



# Definition of Systemic Thinking and Its Importance

- **Systemic thinking** is a simple thinking technique for gaining systemic insights into complex situations and problems .
- Systemic thinking is nothing more than a combination of analytical thinking and synthetical thinking.



# Difference between Analytical Thinking and Synthetical Thinking

- Analytical thinking **enables us to understand the parts of the situation.** Synthetical thinking enables us to understand how they work together.
- Analytical thinking **breaks things down into their component parts;** synthetical thinking finds the patterns across those component parts.

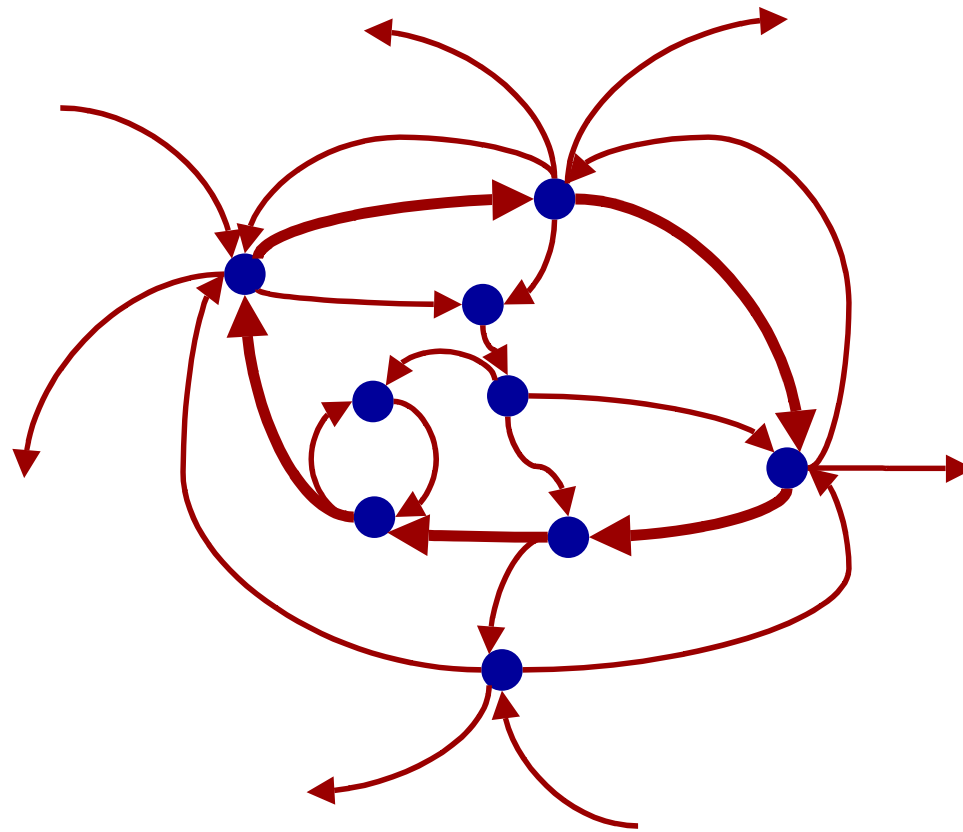
- Analysis is about **identifying differences** **synthesis** is about finding similarities.
- Analytical thinking **is the easy bit**. We've been taught to do it from birth. Synthetical thinking is harder because we haven't been taught to do it deliberately.

- **Synthetical thinking is a lot harder than analytical thinking because the interactions are harder to deal with and it is dynamic rather than static.**
- **Synthetical thinking is deliberately finding repeating patterns (or common themes) across a system or situation.** analytical thinking doesn't do so directly.

# Distinctions of Systemic Thinking

<b>Systematic Thinking</b>	<b>Systems Thinking</b>	<b>Systemic Thinking</b>
Thinking methodically.	Thinking about how things interact with one another.	A simple technique for finding system-wide focus.

# Fundamental Assumption of Systemic Thinking



**Everything is systemic**

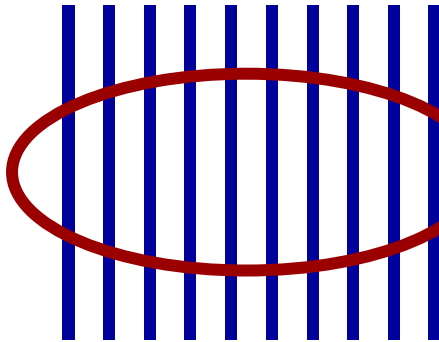
# Fundamental Assumption of Systemic Thinking

- **The fundamental assumption, on which the systemic thinking concept is based, is that everything is systemic.**

# Systemic thinking process

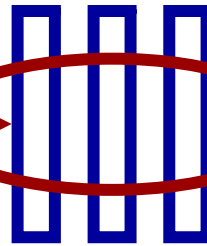
1

List the  
systemic  
elements



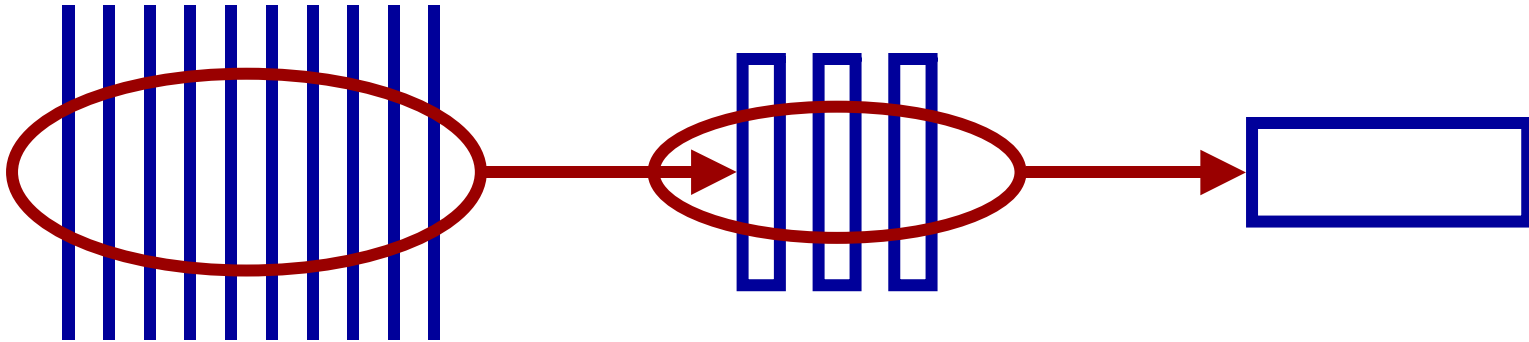
2

Group into  
**sub**  
themes



3

Find the  
common  
theme



# Systemic thinking process

- **Step one** is to list as many system elements (of the type you're interested) in as you can think of. (e.g. problems, solutions, ideas, opportunities, desired outcomes, needs etc)
- **Step two** is to group similar elements together and describe what each group has in common.
- **Step three** is to find the common theme across (running through) the group descriptions.



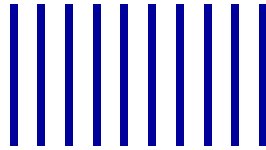
# **Barrier to Systematic thinking**

- **First trick is the grouping of things together in stages is the first trick.**
- **Second trick is to realize that the message from your brain saying "there is no theme.**
- **A third is to develop a library of systemic solutions.**

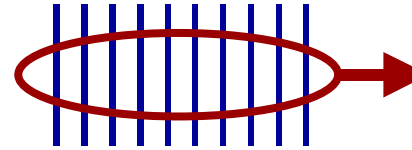
# Comparison of Systemic and Analytical Thinking

## systemic thinking

elements



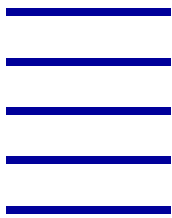
List as many as possible



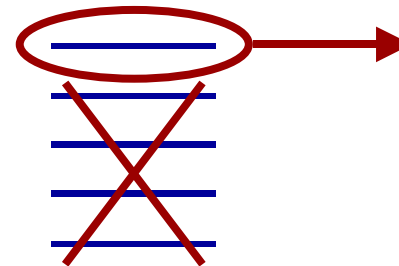
Find the theme

## analytical thinking

elements



List a handful



Select one

- **Systemic thinking** *lists as many elements as possible* (to ensure that the theme is as representative as possible), while **analytical thinking** *lists only a handful of elements (to make the workload manageable)*.
- **Systemic thinking** *finds and focuses on the theme across the elements*, while **analytical thinking** *selects and focuses on the most attractive or promising element*.

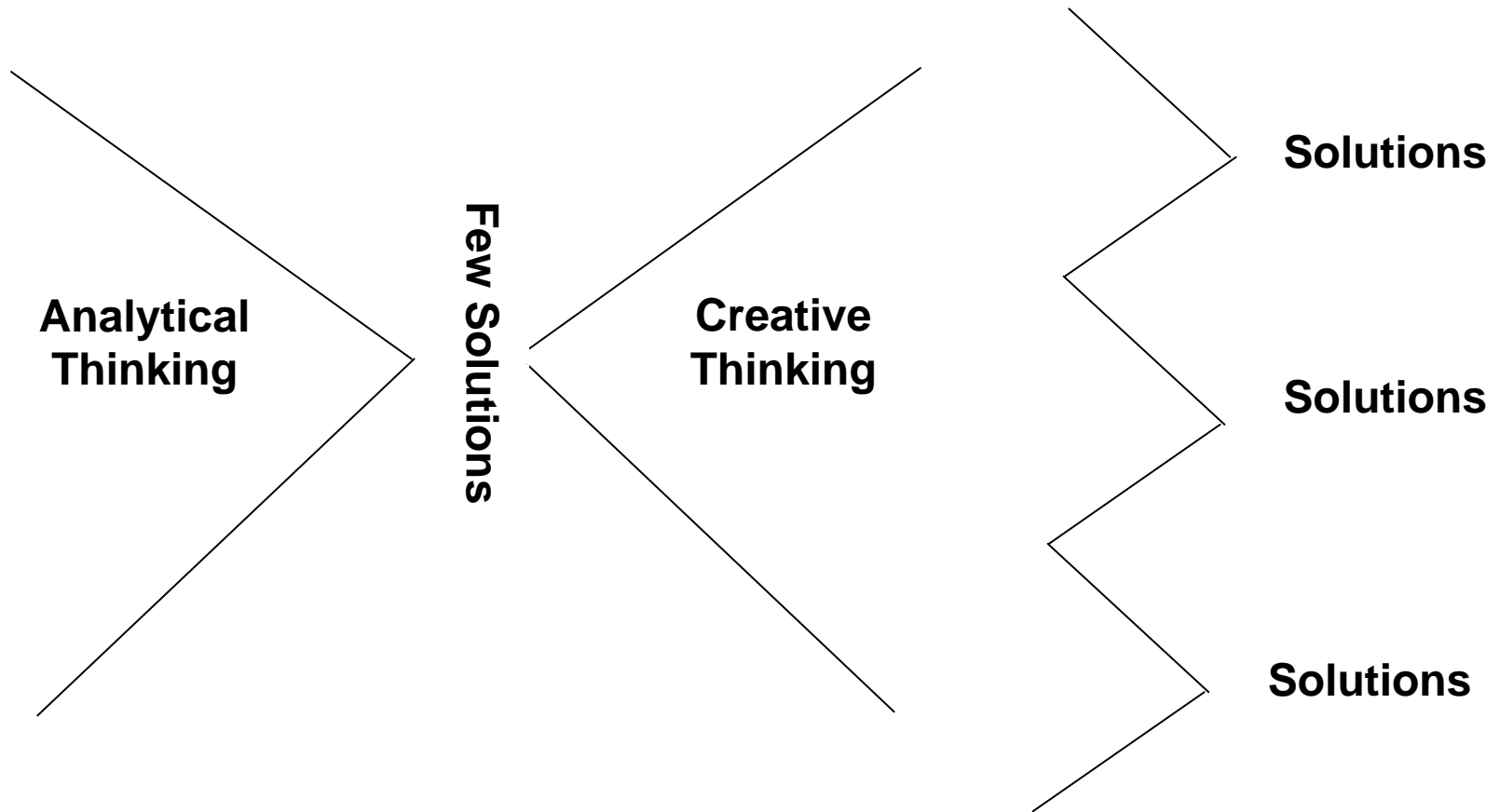
# Definition of Critical Thinking

The critical thinking *is the ability to analyze facts, generate and organize ideas, defend opinions, make comparisons, draw inferences, evaluate arguments and solve problems* (**Chance, 1986, p. 6**);

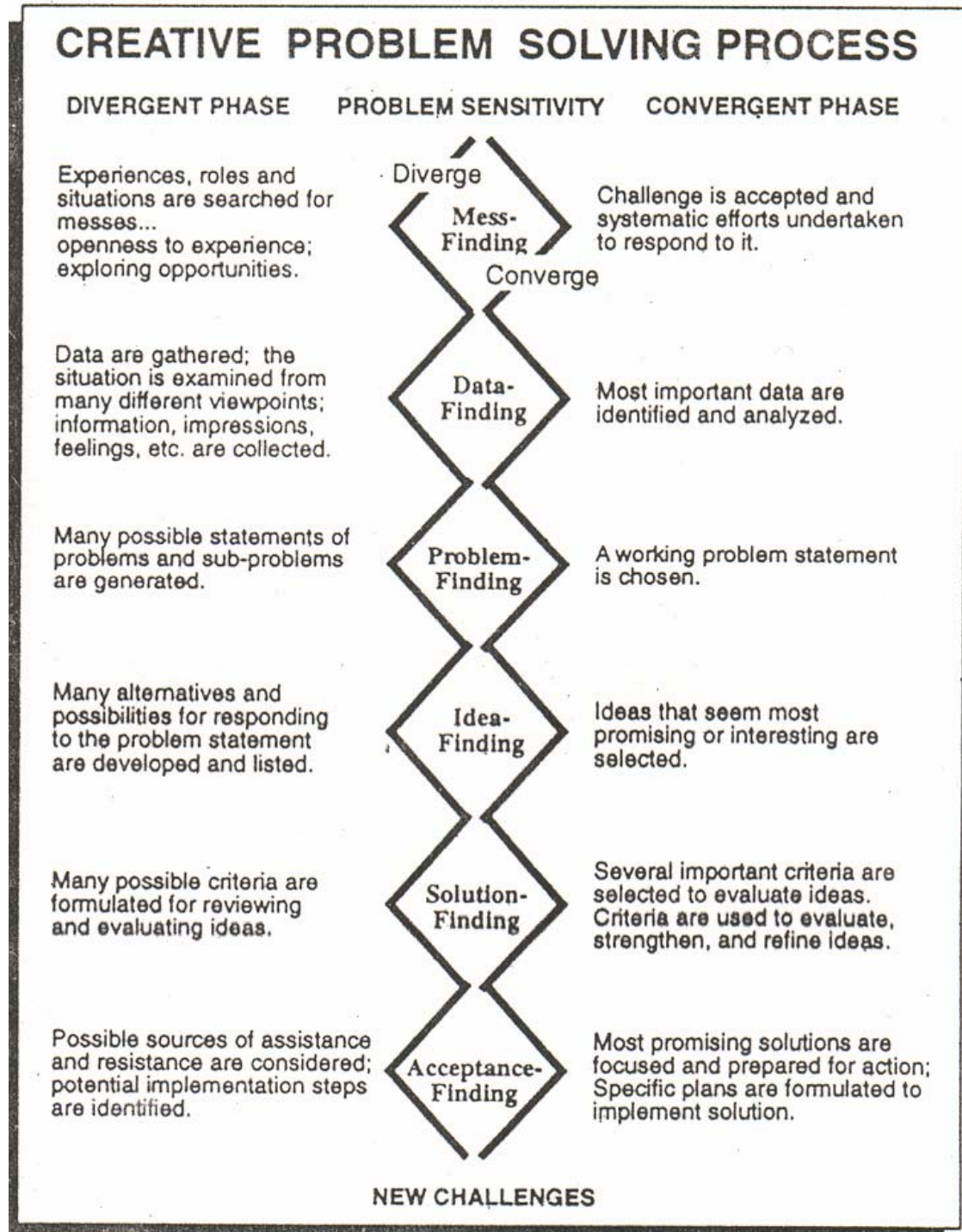
# Two sorts of thinking

<b>Convergent</b>	<b>Divergent</b>
<ul style="list-style-type: none"><li>•Logic</li><li>•Unique (or few)</li><li>•Answers</li><li>•Convergent</li><li>•Vertical</li></ul>	<ul style="list-style-type: none"><li>•Imagination</li><li>•Many possible</li><li>•Answers or ideas</li><li>•Divergent</li><li>•Lateral</li></ul>

# Two sorts of thinking



# Six-Stage Model of CPS



# Analytical Thinking as a Style

Analytical Style include the following:

- Deliberate, controlled, logical
- Independent of others and non-aggressive
- One who weighs all alternatives, remaining steadfast in purpose
- Unemotional, business-like and persistent
- Disciplined, lets others take the social initiative



# Analytical persons

- **Approach problems based on facts and logic rather than emotions**
- **Tend to do well** when the nature of the task is problem-solving,
- **Tend to take a problem-solving approach to most situations.**

# Analytical persons

- **Oriented more toward ideas** and data than toward relationships or feelings, they tend to prefer study and contemplation to immediate action.
- **Like things to be rational and well organized.**
- **Want to collect many facts** and opinions before making a decision

# Analytical persons

- people with an analytical style are bothered by these situations in their interactions with others when:
  - they don't know all the answers
  - they have to interrupt others
  - they must deal with overly aggressive or critical people
  - people invade their private space or get too close when speaking

# Analytical persons

- people with an analytical style are bothered by these situations in their interactions with others when:
  - people do not have all of the facts or will not listen to reason
  - someone's behavior is loud and obnoxious
  - people are unfocused or don't pay attention
  - people pass themselves off as something they are not

# How to Improve Your Interaction with Analytics?

- ✓ Slow the tempo and use more even-tempered presentations
- ✓ Provide all the necessary information
- ✓ Follow through on your commitments to them
- ✓ Provide rational reasoning, not emotional arguments
- ✓ Make sure they understand the ``rules``
- ✓ Be direct and straightforward
- ✓ Listen fully to what they have to say

# Characteristics of Critical Thinker

- **Asks significant and pertinent questions and states problems with specificity.** Arrives at solutions through hypothesis, inquiry, analysis, and interpretation.
- **Assesses statements, insights, and arguments** according to the knowledge and skills provided by formal and informal logic.

# Characteristics of Critical Thinker

- **Formulates propositions or judgment** in terms of clearly defined sets of criteria.
- **Strives to acquire knowledge of the various disciplines**, knowing that such knowledge is a necessary, though not sufficient, and condition for critical thinking.

# Characteristics of Critical Thinker

- **Understands the different modes of thought appropriate to the various disciplines.** Can apply these modes of thought to other disciplines and life.
- **Is aware of the context or setting in which judgments are made,** and of the practical consequences and values involved.



# Characteristics of Critical Thinker

- **Thinks about the world through theories**, assessing these theories and their contexts to determine the validity of their claims.
- **Seeks and expects to find different meanings** simultaneously present in a work or event.
- **Is aware of the limitations of knowledge** and exhibits epistemological humility.

# Characteristics of Critical Thinker

- **Recognizes and accepts contradiction and ambiguity**, understanding that they are an integral part of thought and creativity.
- **Constructs and interprets reality** with a holistic and dialectical perspective. Sees the interconnectedness within a system and between systems.
- **Tolerates ambiguity**, yet can assume a committed position.

# Characteristics of Critical Thinker

# Characteristics of Critical Style

<b>Adaptor</b>	<b>Innovator</b>
<ul style="list-style-type: none"><li>• Does things better</li><li>• Seen as disciplined</li><li>• Accept problem definition</li><li>• Makes "goals" of "Means"</li><li>• Precise, reliable, dependable</li></ul>	<ul style="list-style-type: none"><li>• Does things differently</li><li>• Seen as undisciplined</li><li>• Challenges problem definitions</li><li>• Questions or disregards "Means"</li><li>• Unique, visionary, ingenious</li></ul>

# **Analytical Techniques**

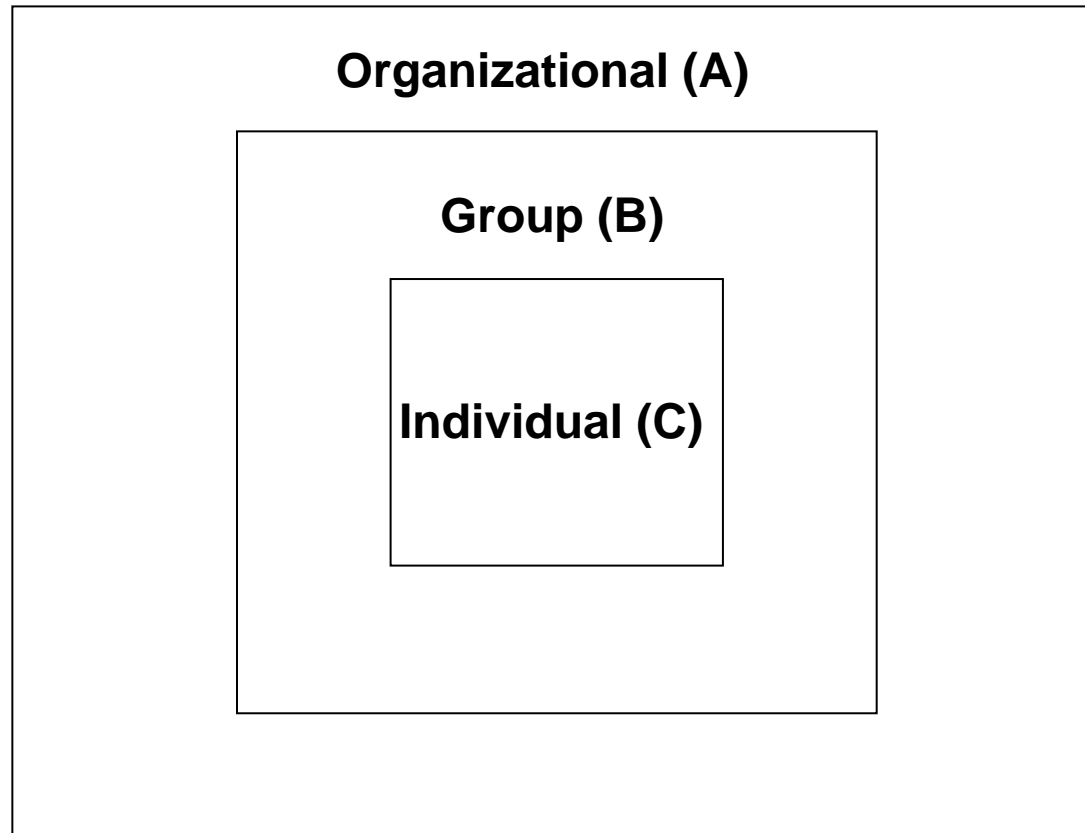
- 1. Decomposable matrices technique**
- 2. Dimensional analysis technique**
- 3. Input-Output technique**
- 4. Organized random search technique**
- 5. Relevance systems.**

# 1. Decomposable matrices technique

The following steps are used for this process:

- **Determine** if the problem is analyzable subsystems.
- **List the major** subsystems and the components of each.
- **Construct a matrix** of the subsystems and their components.
- **Using a 1 to 5 point scale**, weight the degree of relationship for each of the interactions between and within the subsystems.
- **Select the highest-weighted** interactions for further analysis or generation of ideas.

# 1. Decomposable matrices technique



**Major Organizational Subsystems**

# 1. Decomposable matrices technique

	Organizational			Group			Individual		
	1A	2A	3A	1B	2B	3B	1C	2C	3C
System Design 1A		ο	ϣ	ϒ	ε	ι	ι	ι	ι
Organizational Goals 2A			ε	ϣ	ϒ	ι	ι	ι	ι
Power 3A				ϣ	ϒ	ϣ	ι	ι	ι
Leadership 1B					ε	ο	ϣ	ϒ	ε
Communication 2B						ε	ϣ	ϒ	ε
Cohesiveness 3B							ε	ι	ε
Needs 1C								ο	ο
Values 2C									ο
Expectations 3C									

## Decomposable Matrix of Organizational Subsystems and Components



## **2. Dimensional Analysis technique**

**The dimensional analysis technique examines five elements of a problem:**

- Substantive dimension.**
- Spatial dimension.**
- Temporal dimension.**
- Quantitative dimension.**
- Qualitative dimension.**

## 2. Dimensional Analysis technique

Dimensional analysis could be used as follows:

1. **State** the problem.
2. **Briefly** write down separate descriptions of the problem in terms of What? Where? When? How much? How serious?

## 2. Dimensional Analysis technique

3. Using these descriptions, **answer** the questions listed for each of the dimensions (Table 1).
4. **Evaluate** the answers to these questions by considering the implications of each for solving the problem.
5. **Select** those areas most applicable to the problem for further analysis.

# 2. Dimensional Analysis technique

<b>Substantive</b>	<b>Spatial</b>	<b>Temporal</b>	<b>Quantitative</b>	<b>Qualitative</b>
Commission or .1 ?Omission	Local or .1 Distant	standing -Long .1 ?or Recent	Singular or .1 ?Multiple	Philosophical .1 or Surface
Attitude or .2 ?Deed	Particular .2 )s(Location Within a Location	Present or .2 ?Impending	Many or Few .2 ?People	Survival or .2 ?Enrichment
Ends or .3 ?Means	Isolated or .3 ?Widespread	Constant or .3 ?Flow-and-Ebb	General or .3 ?Specific	Primary or .3 ?Secondary
Active or .4 Passive			Simple or .4 ?Complex	What Values .4 are Being ?Violated
Visible or .5 Invisible			Affluence or .5 ?Scarcity	To What .5 Degree are the Values Being ?Violated
				Proper or .6 Improper Values