Challenges for Science and Humanities

# Tower of Babel: Some Remarks on Vulnerability of Scientific and Technological Communication in Interdisciplinary Projects

Torre di Babele: Vulnerabilità della Comunicazione Scientifica e Tecnologica nei Progetti Interdisciplinari

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## Vulnerability of Scientific and Technological Communication ...

1. **Vulnerability and Crisis**
2. Causes of Sc.& Technol. Projects Vulnerability
3. Example: “information” concept
4. Conclusions

*“No problem can be solved from the same level of consciousness that created it”*

[ Albert Einstein]

*"Not exists any concept without an intelligent entity "*

[Adam M. Gadomski]

## Main Concepts Definitions: Crisis,Vulnerability

**Vulnerability:** **Lack of immunity** or insufficient résistance on **unexpected** but **possible** **events.** [Gadomski]

*Crisis creates a system with **unknown functionality*** [Addis,1990] **and behavior.**

**Crisis is when the model applied for the management is not more adequate to the real organization structures and processes.**

**Vulnerability is a readiness to a crisis state.**

[A.M.Gadomski]

**We distinguish two basic types of vulnerability:**

**A.** Vulnerability on **external events:** dangerous situations, attacks, intrusions
- human-based threats, natural threats, technological, market threats.

**B.** Vulnerability on **internal events:** **internal comprehension crisis**, org.pathologies, (as improper reorganization), soc-cognitive factors

**V. of Interdisciplinary Project Consortium (is B type):**
**comprehension and soc-cognitive crisis.**

**Remark.**
**Efficacy** of the organization is considered its top-attribute in a goal-oriented approach.

## Symptoms of the Vulnerability

**Vulnerability of Scientific and Technological Communication** is well visible in large interdisciplinary projects which involve different research organizations and sc. competences.

**Our interest is focused on**: **Communication on the Cognitive Level**

**V. Symptoms:**

- Lack or weak reciprocal comprehension between specialists from different research domains.
- Production of not congruent and not complementary models
- Difficulties with cooperation and common tasks

**In the case of software systems development**:

- Autonomous development of functional components from theory to implementation.
- Difficulty with standardization and common glossaries.

**Causes**

## Causes of the Communication Vulnerability

**Causes**

1. Terminology
2. Theoretical bases
3. Objectives/goals
4. Psychological cognitive factors

They all are usually connected.

**Communication vulnerability only is in the context of cooperation.**

Cooperation
History



## Causes of the Communication Vulnerability

**Three research generations in the human culture** [Gadomski, SCEF-2003 ] **.**

**First Generation** - *specialization approach*; **incremental grown** of subject oriented sciences and technologies.

Well isolated activity and self-limited by: their language (conceptualization systems), observation/measurement tools and engineering approaches.

- **No communication and homogeneous cooperation.**

**Second Generation** - *interdisciplinary approach*; **autonomous cooperation** between different branches of research motivated by common economical interests and request of one product.

Common: Functional interfaces or independently developed project of the whole product.

- **Forced communication, top-down governed . Heterogeneous cooperation.**

**Third Generation** - *over-disciplinary approach*;**, new common perspectives**, shared top conceptualization and ontology (redefinition of basic terms from a higher more abstract/universal perspective).

- **Bottom-up consensus building based on top-down rules.**
- **Homogenization of heterogeneous problems. - Human problem-solver centered.**

Key example: **Information** concept

# Terminology example: **Information** concept

**Basic question:** The same concept or the same term?

We may consider **information** as a basic link between traditional physics paradigms and the cognitive and systemic sciences.

In other words, for the physicists community, **information is a fundamental conceptual bridge between physics and physicist**.

- Different meanings in physics, biology, informatics, cognitive science.

**Norbert Wiener:**

*Information cannot be of a physical nature: Information is information, neither matter nor energy. No materialism that fails to take account of this can survive the present day.*

The successive work of **Claude Shannon** (1948), about ***'A Mathematical Theory of Communication'***, was influenced by the previous approach of N. Wiener.

Shannon

# Information as a quantity

**Shannon** preferred to correlate the loss of the quantity of **information** in the signal transmission, proposing an equivalence **to the grow of Entropy** in a closed thermodynamic system: :

· Ordered energy in a closed system dynamics go versus disorganized energy (heat)

· High-quantity of transmitted signals in a closed channel go versus low-grade of information.

In this way " information conceptualization " according to Shannon, is not related to the effective nature of the physical informational data, thus because information refers to one particular aspect of symbols.

The Shannon's Theory of Information,found application not only in computer science, and in communication engineering, but also was applied in biological information systems including nucleic acid and protein coding, and hormonal and metabolic signalling, and also was extended in several applications in linguistics, phonetics and cryptography.

**The numerical value of information become exactly the same,** whether these messages are determined by random sequences or by means grammatically ordered sentences with a **meaningful value of concrete understanding of information.**

As a matter of facts a source of symbols (Bits or Letters) is not a source of physical information. In fact it will be essential to keep in mind very clearly that the meaning of the messages goes beyond the scope of "information theory" that is only useful when the information signals comes from a source and transmitter to a receiver.

## Information as an active factor

**Understanding Life Sciences**

Information is a necessary conditions for Life but if we think again to follow the Shannon's approach to the theory of information certainly it will be not possible to reply to the question: **Is information a physical or mental property**? So that nowadays for advancing in science remains to reply also to the following questions:

**What means information communication in genetics?**

**What is the meaning and origin of Information in modern biology?**

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**DNA and Information problem.**

Quantum Mechanics

## Negative Information

http://physicsweb.org/articles/world/11/3/9

### Negative Information in Quantum Mechanics

The nature of information in Quantum Mechanics (Q.M.) is founded on the entanglement of the existence of a quantum **non-separated matter - energy interaction** in the dual form of waves and particles. The wave equation represents all the possible "*chaotic virtual trajectories" of phantom* particles , therefore cannot be possible to know directly nothing about the information of the Wave-function.

So that, although is **anti-intuitive** to accept an information less than zero, in Q.M. a "***Negative Information***", can be carried by the wave-function collapse, generating a quantum jump.

**It seems to be a paradox that in Q.M , it is true that is impossible to obtain positive information.**

It seems that "**negative information**" is really only what each of us can physically extract from the environmental observation also in the normal living system of sensory perceptions.

The mental construction of the real environment have to be perceived through senses, by means of some vibration-energy, on the basis of an effective subject-object entanglement functioning in a real brain.

**- Here, we may notice that information need a physical carrier.**

## Socio-Cognitive Engineering: information from the computational cognitive & systemic perspective

**Information is a complex dynamic property of mass and energy.**

**Information** is always a concept from the **ontology of a modeler**, problem solver, or decision-maker.

In this view, information are data describing a property of an object or entity of interest. **Only when contextualized**, it means, **when data represent a property of a human or computer domain** it may **become information** ( see TOGA Meta-theory, 1993). For example, 630483404, a string of digits or a number, is data. When I think of this in the context of my office, I then have information: 630483404 is a phone number of my lab.

**- every piece of information has a subjective true or false value for its receiver/owner.**



## Socio-Cognitive Engineering perspective

**Information is a relative concept; that is, what is a piece of information for one person might only be a no meaning signal for another.**

-This information, in frame of the **IPK** (Information, Preferences, Knowledge) framework can be used by **knowledge** ( denoted as Ќ operator) which is such ability of matter which may to transform information in another information or in action or in knowledge:

$$I_b = Ќ_I\, I_{a,\ ,}$$

$$A_a = Ќ_A\, I_a \quad \text{or}$$

$$Ќ_I = Ќ_K\, I_a\,.$$

$A_a$ - an action

I - information, $Ќ_K$ – meta-knowledge operator

## Cognitive & systemic perspective

### First Conclusion

**Here, two different concepts are called information.**

**The same term - different meaning in different theories.**

**Remark:**

**Definition of abstract object is based on the consensus.**

**For ex. *1 meter* does not exist physically.**



## Computational cognitive & systemic perspectives

MRUS Methodology (from the TOGA Meta-theory)

Example: Observation of one mountain

Here, for definitions of concepts and specification of problems **different formal mental observational attributes are employed**

Spatial **metaphoric properties** of the **TOGA Cognitive Perspective** ( point of view) :

- **distance,**
- **angle,**
- **observ. tool.**

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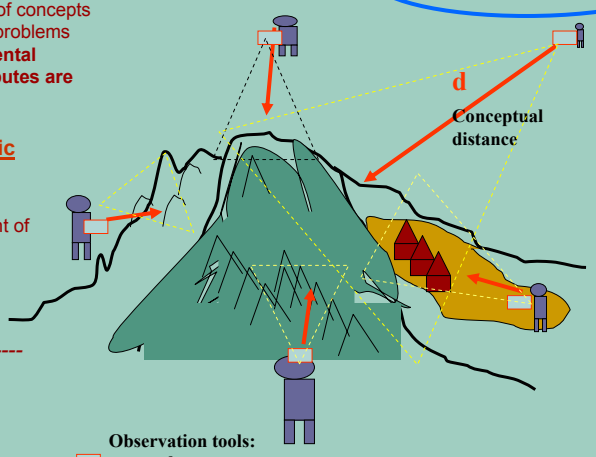
Product:
**Cognitive image of the problem**



# Information: P. Manzelli Physical Perspective

**An integration hypothesis**

Taking into consideration information as a parameter of the general description of the energy-matter transformation (inclusive of brain interactive function), the global differential, (d), of the different aspects of energy, obtained from the sum of the Vibration-Energy, (E), and the codified-energy like Matter (M), and also the Information energy (I) we can easily known the component of total energy, inclusive of the fraction dissipated into the information process of each interaction between transmitters and receptors , must be equal to zero.

Because the variation (d) of any constant (K) is equal to zero
we may write : **<E total = (E) + (M) + (I) = K> ;**
i.e. at any time < *d[ (E) + (M) + (I) ] = 0* >
Hence

**+d(I) = - d(E) - d(M)**

This result is named **"PRINCIPLE OF FERTILE EVOLUTION" (PFE)**

"PFE" is important because it permits to anticipate the guidelines of the **knowledge driven society** and it can be useful for focusing a better understanding of emerging areas of science & society in a knowledge driven society.

(. P. Manzelli, SCIENCE AND CREATIVITY,2005)



# Final Conclusions

**In general, *information* is an abstract object.**

**Remark:**

- Definition of abstract object is based on human consensus.
- The Physics is also based on human consensus.

**Therefore we need a conscious consensus on:**

1. Terminology (glossaries, ontology – goal-oriented)
2. One common theoretical conceptualization base/platform
3. Explicit and declared research objectives
4. Individual researchers emotional motivations congruent with 3. (Psychological cognitive factors).

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