Internet of Everything - 2nd Cybernetics approach

1

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Meetup based on the paper presented at CSIE2015

This presentation is based on the paper we presented the 28th of June in Bangkok at International Conference on Computer Science and Information Engineering (CSIE2015).

Next paper

A paper with mathematical details accepted at:

MISSOURI S&T | MISSOURI UNIVERSITY OF SCIENCE AND TECHNOLOGY

COMPLEX Adaptive Systems

Engineering Cyber Physical Systems: Machine Learning, Data Analytics and Smart Systems Architecting

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IoT

IOT is a communication network connecting things which have naming, sensing and processing abilities.

IoE

Internet of Everything (IoE) is an integrated network of organizational and physical agents. Software agents are able to cooperate with each other while maintaining their autonomy in view of the results shared or common goals.

IoE + IoT

The existence of the Internet of Everything (**IoE**) is the essential prerequisite for the creation of virtual communities and ecosystems of companies, communities and smart objects (**IoT**).
IoE is built on the connections among people, processes, data and things (IoT).

| People	Process	Data	Things
Connecting people in more relevant, valuable ways	Delivering the right information to the right person (or machine) at the right time	Leveraging data into more useful information for decision making	Physical devices and objects connected to the Internet and each other for intelligent decision making

Cybernetics approach

In this meetup we will analyze the requirements to establish an **Internet of Everything** that filters, selects and distinguishes relevant information to a specific agent. To transform information into processes and products is necessary to gain from the sharing and use of knowledge.
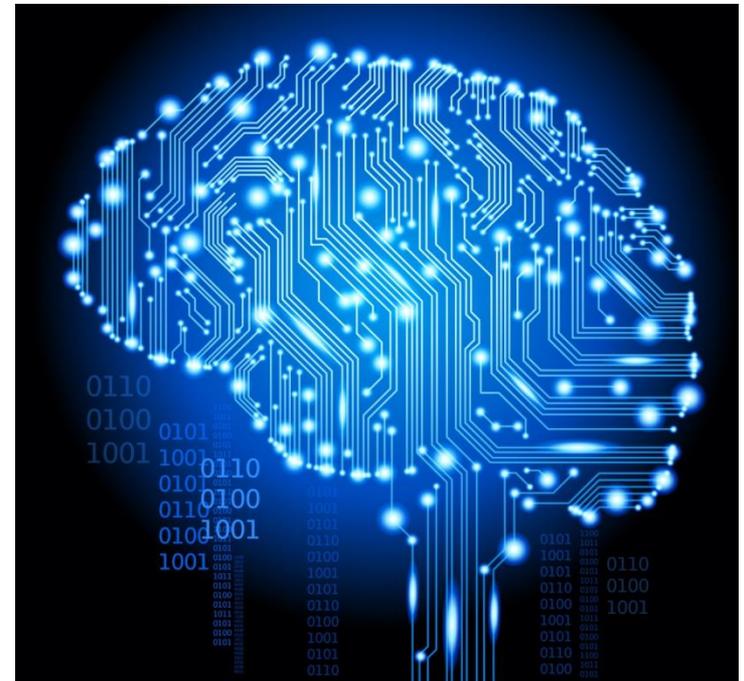
Organization, Order and Chaos

8

Complexity increase

Our society is characterized by a dramatic complexity increase characterized by a cluster of events, actions, interactions, feedbacks, determinations and uncertainty that make up our world.

This situation is a consequence of the increasingly **changes of the people's needs**, the technologies evolution and the increase of new competitors on the market.

Survival

The situation is similar for individual citizens in the various work and social environments which are struggling to grasp the opportunities that their capabilities deserve.

To survive in such a context it is necessary to:
a) Filter, select and distinguish relevant information to a specific agent to avoid loss of information;
b) Rapidly transform this information into processes / products to seize the opportunities presented in an increasingly volatile environment.

IoE for survival

IoE is an organizational system for the simultaneous management of **social needs** for both firms, communities and smart objects:
a) An high capacity for accumulation of knowledge (selective order);
b) A large capacity for rapid exploitation of the same.

The IoE is a **global entity** organized at a high level of self-regulation of interrelationships between agents able to cooperate with each other.

Acquiring knowledge in different ecosystems

Vertical Integrated Companies

- remarkable capacity for accumulation of knowledge
- limited ability to use it effectively
- rigidity of the organizational forms

Online communities

- huge amount of knowledge
- rapid transformation of knowledge into products and services available
- prevalence of informal communications

Individuals and firms

- more difficult to acquire and enhance skills independently
- it's hard to respond effectively to the growth of complexity

The objective of maximizing the efficiency and effectiveness in the process of accumulation of knowledge generated within a single company or a single individual organizational structure is hardly compatible with the flexibility and speed of response to environmental stress.

Meet the challenge

- Expand the **knowledge base** available through a large number of interactions with other entities that can participate in the process of production and accumulation of the same;
- The use of the knowledge gained from the peripheral system of belonging to exploit locally and quickly the different business opportunities or life that arise.

The direction to take is the establishment of **network systems** in which the focus moves from the simple transaction exchange of goods and services governed by the price mechanism to a broader and more complex information exchange driven by a strong spirit of partnership and finalized on the growth of shared knowledge base.

The solution

The solution lies in network systems whose relationships are even more complex and advanced than those currently used, such solution is based on a particular organizational model: ***the Internet of Everything.***

The Requirements of the Internet of Everything

15

Network system of the IoE

The Internet is a global entity of Everything organized by interrelationships between operating units , smart objects and individuals at high level of self-regulation and able to cooperate with each other while maintaining their autonomy in view of the shared results or purpose common.

In this sense, the **Internet of Everything** can be thought of in terms of organizational capacity potential that favors rapid aggregation of businesses and people aimed at the exploitation of opportunities.

The organization

The <u>individual parts</u>, although <u>moving in total autonomy</u>, <u>are held together by a</u> **system** <u>of simultaneous infrastructure that allows them to act as one entity</u>. All the participants in the Internet of Everything are an entity held together by a complex set of <u>ties based on specific contexts that governs the relations between the parties in a spirit of global partnership.</u>
In this system, the purpose is the sharing of knowledge, expertise and <u>capacity for self-organization to guide and model the perception of external stimuli, and their spread rapidly through the system, quickly directing context based actions</u>.
The way of performing processes is therefore characterized by a continuous and articulated mutual interaction between companies and the surrounding environment of human and non-human (smart things) communities.

IoE as a living organism

As a living organism the Internet of Everything is <u>an aggregation of elementary processes in a structured hierarchy of integrated autonomous subsystems.</u> <u>Each subsystem pursues its own independent objective but is able to align with all other in pursuing a common goal</u>.

The Internet of Everything is an <u>alliance</u> or an ecosystem to deal with specific problems within a particular business system and ensures maximum operating time with the support of an upper base of systemically knowledge.

Internet of Everything foundation

- Internet of Everything has as foundation two principles :
- the multiple contextual membership
- the subsidiarity.

Contextual multiple membership

Contextual multiple membership

Multiple simultaneous memberships is first principle: each agent belongs to a local context as a social group and at the same time to a more complex system as a federation of groups and organization systems.

Topological awareness in the relationship between agent and context based organizations is able to orient significantly the behavior of an agent within the organization. The priorities and decisions, attitudes and behaviors of an agent are constrained by the system of local relationships with other agents or groups.

If any agent or group membership takes **multiple contexts** the acceptance of restrictions becomes more natural condition that they are useful to the overall aims of the system itself.
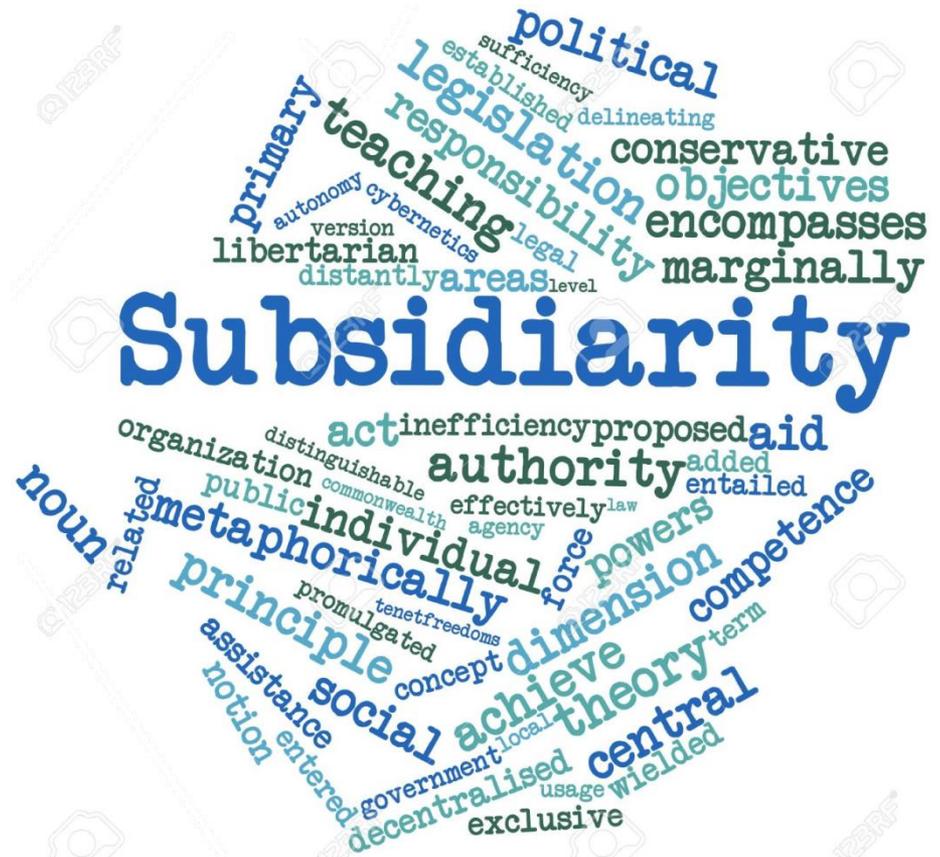
Subsidiarity

The second fundamental principle is the **subsidiarity**: the parties delegate to the logical center some powers and functions and the logical center are at the service of the parties.

To **centralize** certain activities means to put in place economies of scale unattainable by single agent.

Shared values in a system

The existence of a system of shared values prevents the possibility that the process of individual choice is influenced by assumptions about the behavior of other agents of the system which, in turn, lead us to make a decision in the opposite direction to interest.

In an Internet of Everything there is no single center logical decision, but rather a plurality of potential decision-making centers.
Each logical center potential is able to assume **leadership** at any time according to different stresses that generate contextual changes in the scenario in which operates.

System of shared values

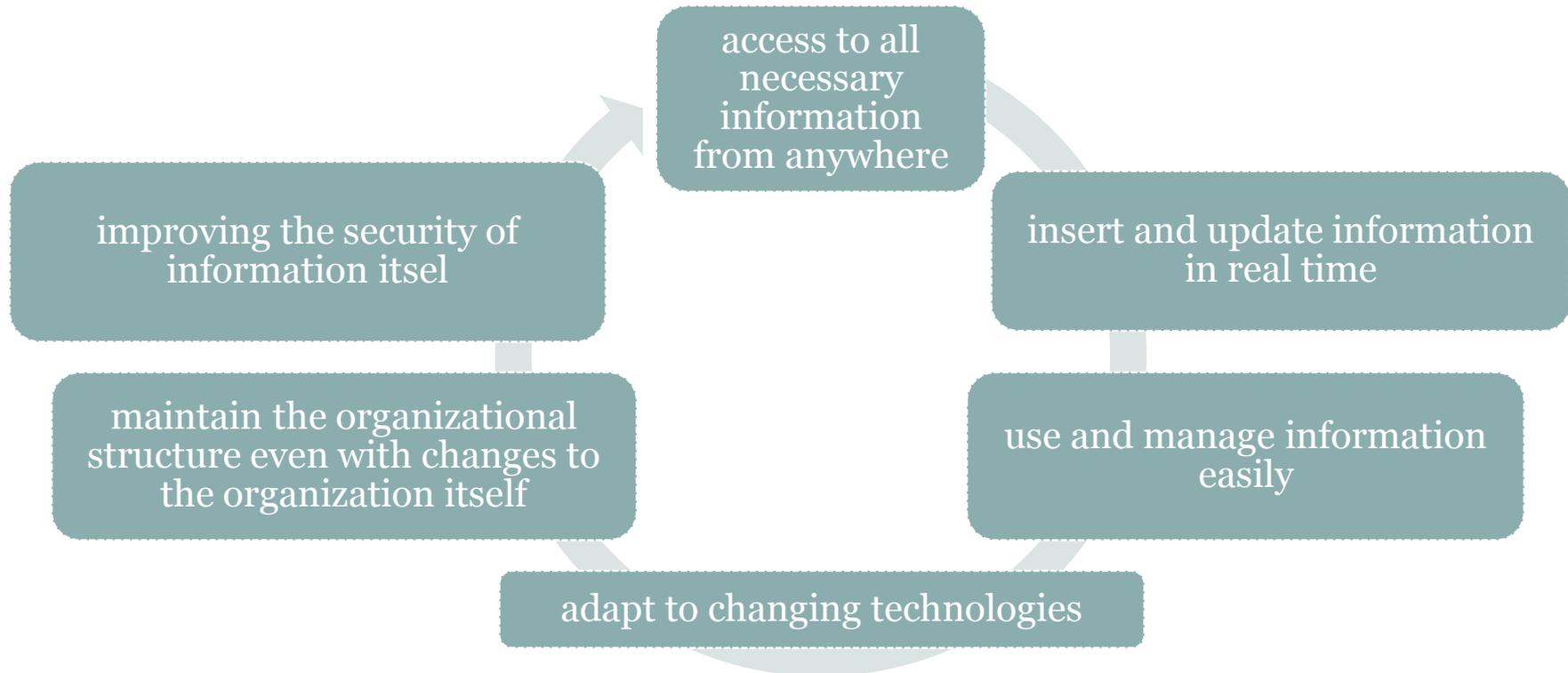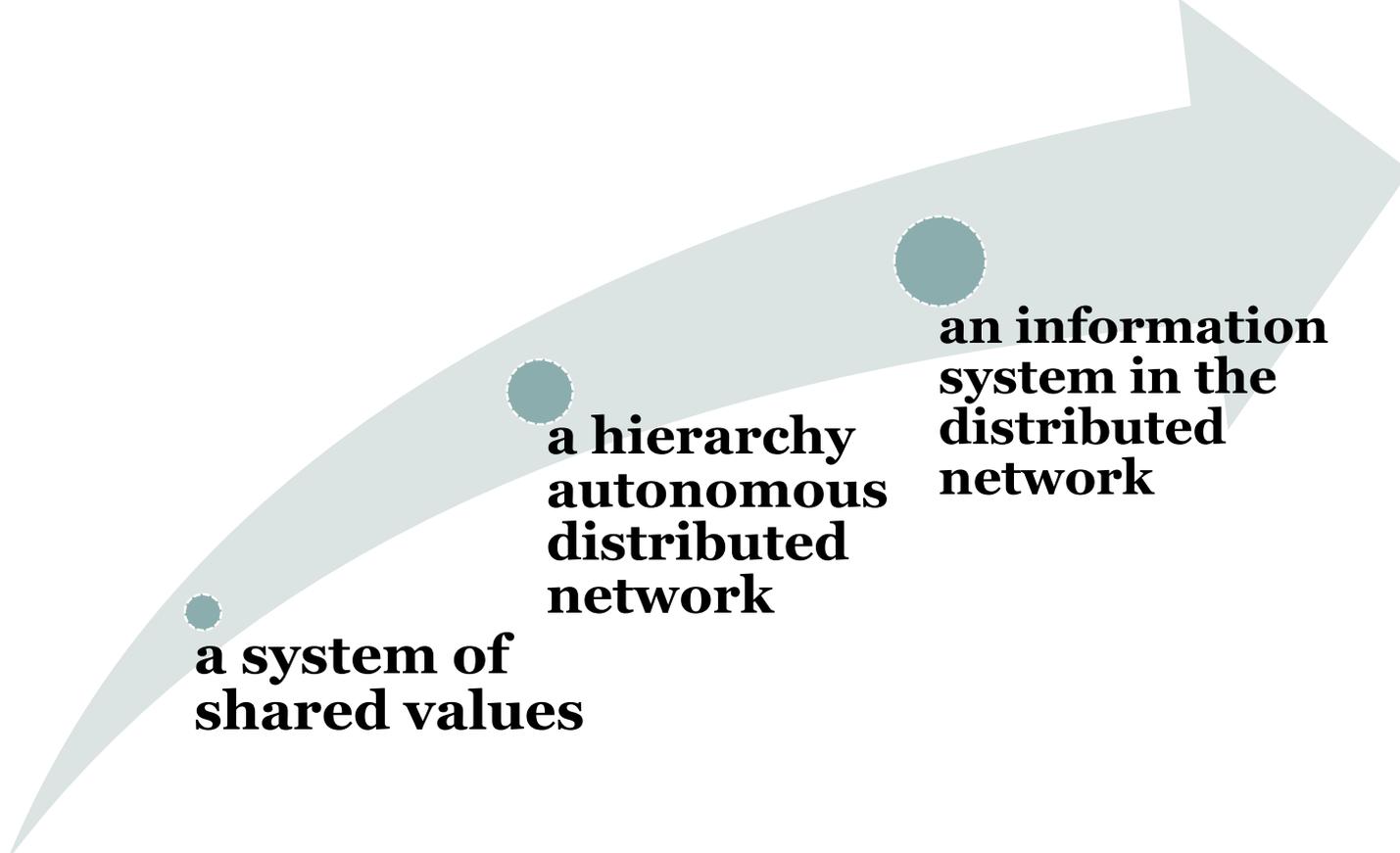| **The system of shared values is the glue of a fundamental IoE as it allows to:**	harmonize the dynamic behaviors of the different agents
	encourage the development of <u>topological awareness of global visions</u>
	support the maintenance of the dynamic equilibrium between the parties

Information transparency

It is necessary that information is distributed and available in every part. Information transparency is not only a baseline abstract but becomes an organizational fact.

access to all necessary information from anywhere

insert and update information in real time

use and manage information easily

adapt to changing technologies

maintain the organizational structure even with changes to the organization itself

improving the security of information itsel

Internet of Everything is characterized by

an information system in the distributed network

a hierarchy autonomous distributed network

a system of shared values

IoE fundamental charecteristics

IoE

Speed of Response

IoE has to respond quickly to signs of change, more or less weak, from different sources and turn them into business or personal opportunities. For each agent (system unit) is an "antenna" system and communicates "real-time" with the whole system which it belongs.

Adaptability

Opening to the outside and circulation of information within the system remain constantly active. All business units are encouraged to take advantage of every form of intelligence. The more a system is far from static equilibrium much more possibilities of self-organization and evolution exist.

Survival and Evolution

IoE has chance of survival and evolution far superior to any other. In the presence of any disturbing signal, the system is able to decompose and recompose the various subsystems, in real time, replacing the parts no longer fully functional without being destroyed.

Stability

IoE maintains its dynamic equilibrium continually balancing the action of opposing tendencies but complementary. Only in this context can arise those particular organizational forms highly reactive to environmental stress, guided directly by the market and focused only on the creation of value for the customer that we have identified as "virtual companies".

Summary

The Internet of Everything has to be **context centered** and has to respond **quickly to signs of internal and external changes.**

Changes are facilitated by a **diffuse subsidiarity** that becomes the requirement of **adaptability** with extensive self-organization and evolution.

A system with this characteristics has the main goal to **survive and evolve** decomposing and recomposing the various **subsystems**, tending in **real time** to stability.

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