ENTROPY AND EMERGENCE IN ORGANIZATIONS UNDER A TURBULENT ENVIRONMENT

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ABSTRACT

System science, studies important systems processes, among of them are elements in the life cycle of organizational systems: entropy and emergence.

Entropy, a thermodynamics concept, has become a part of the systems language. It indicates the degree of system disorganization. Entropy can be conceptualized as the progressive loss of the relationships that integrate a system. Collapse is violent and sudden, disgregation of systems structures and processes that occur under turbulent conditions.

This process can be modeled with the life cycle metaphor of organizations, which include four stages: birth (design), growth (improvement), maturation (maintenance), and death (obsolescence). The gradual stages of improvement and maintenance occur under stable conditions and the sudden stages of design and obsolescence, occur under turbulent environmental conditions. When organizations systems operate near state of equilibrium stability prevails through an homeostatic process of change. Organizations under turbulent conditions suffer an entropic process, loose their heterogeneity and suffer collapse of their structures and processes. When organizational systems are far from an equilibrium state, they can collapse, or new complex systems may develop with emergent properties.

In a strategic planning process, the conditions a system collapse can be visualized to design preventive measures. This paper includes a comparative systemic analysis of the conditions of risk and vulnerability in Japan and Mexico.

Keywords: entropic, homeostatic, and morphogenetic equilibrium, collapse, emergence, cycle of life.

INTRODUCTION

Many types of organizational suffer a process of entropy of collapse, and at the same type new systems appear with emergent properties. When we describe this process of change with the Life-Cycle Metaphor, we can identify process of growth and decay, slow and violent stages of evolution. The most complex and dynamic systems are human organizations, or open socio technical systems. In their life cycle they emerge and eventually collapse. When a human organization collapses, new organizations resurge under a different form or architecture. Pierre Teilhard de Chardin described this dynamic of change as a complexification and conscientization process. Figure 1 represents this process of change.

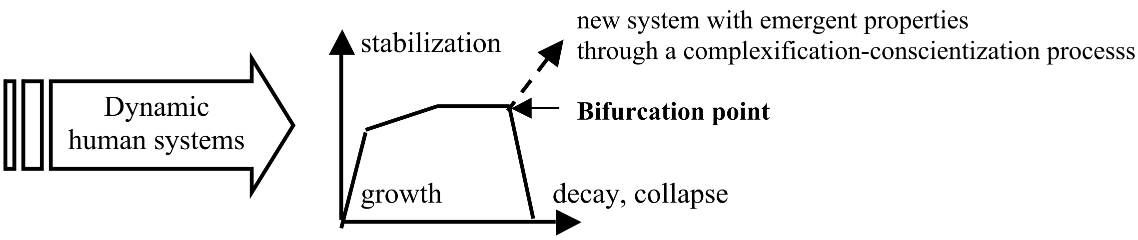


Figure 1 Process of change.

Entropy

Inside of the General Systems Theory there are several important properties of the systems, one of them is the entropy. The entropy as a concept of thermodynamic has become part of the systems language, indicating the degree of disorder of a system.

The entropy is a concept of the thermodynamic which is a branch of the physics that studies the phenomenons in those that heat intervenes. The word entropy was used by Clausius in 1850 to qualify the degree of disorder of a system (Atkin,1992).

When speaking of entropy next to it , concepts like disorder , order, number of states, irreversibility, spontaneity, information, negentropy, among others, appear.

In scientific terms, the disorder comes given by the number of states in those that a system can be present. A system will be more disordered than other when the number of different states in which we can find the first one, is bigger than those of the second. In the irreversible processes the entropy of the system increases and vice versa, if a system experiences an entropy increase after a process, this one is irreversible.

Observing the atmosphere that surrounds us, the spontaneity implies irreversibility. That is to say that if a process happens spontaneously, without energy contribution, it doesn't tend to return to the initial situation, the process is irreversible. The process is logical, since if it happens spontaneously it is because it goes to a more probable situation. The irreversible processes imply an increase of the entropy of the system. Then, if spontaneity implies irreversibility, and this one means an entropy increase: the spontaneous processes bear an entropy increase.

As for the negentropy, the best way to understand the concept is opposing it to the entropy concept, considering it as equivalent to the antientropy that is to say order.

If the balance state is that state of a system in which the entropy is maximum, but it is equally (as it points out the statistical mechanics) the most probable state, then any unlikely state can be considered as a neguentropic state.

For the physical systems it has been possible to establish procedures to measure the entropy. In the thermodynamic systems, due to the contributions of Sadi Carnot, Prigogine, Boltzmann, Freyman and many other, the entropy is measured as the relationship of the quantity of transferred heat and the absolute temperature (Joules / ^{o}Kelvin). In the mixture of gases, for simple analogy, it is considered the same relationship to measure the entropy and it is only added a constant to adjust the physical units (Zemansky,1990).

The physical entropy in its simpler form is mathematically defined as:

$$S = \int dE / T$$

Where:

S = Entropy
E = Energy used inside the system
T = Temperature with which it is exchanged of phase

We have also turned to the field of the probabilities, considering that there is always a probability for a system to be found in one of its possible states, therefore the entropy in a certain state is the summary of all the previous states probabilities (Atkin,1992,12). Mathematically defined in the following way:

$S = - Ks * p_i * \ln p_i$
Where:

S = Entropy
pi = Probability of micro-state occurrence i
Ks = Constant of the system

The entropy is also manifested in the information systems deteriorating or modifying the content of the computer message. It is said this way that the information system passes from a state of enough information to a state of scarce information (sufficiency to inadequacy).

In the theory of the communication or of the information, the entropy is a number that measures the uncertainty of a message. The entropy is null when the certainty is absolute. This knowledge is useful in the economy (Tejeida, 2005).

When we add information to a physical object we are ordering the elements in a certain way they compose the system of that object. If we are carving a sílex stone to transform it into an arrow tip, we are selecting (by means of the elimination of the lascas) the parts of the stone that maintain a certain order; what characterizes an arrow tip, its symmetry, triangle form and sharp border, is in fact the order of its components(Martínez, 2004). That order is, precisely, the technological information. Any aleatory change that takes place in the form of the arrow will have an effect of increase of its entropy, that is to say, the loss of order and of the information that contains.

For the analysis of the information the formula is defined as:

$I = -K_i * p_i * \log_2 p_i$
Where:

I = Information
p_i = Probability of occurrence of the i-ésima possibility
K_i = Constant of the system

Economists like Theil and Georgescu-Roegen have discussed the concept. Henry Theil in his book Economics and information Theory he uses the concept of entropy in a way in which he finds a varied number of applications (Theil, 1976).

The eminent economist Nicholas Georgescu-Roegen in his book titled The Entropy Law and the Economics Process stands out the importance of the entropy law and makes reference to the idea that a good administrator cannot be left without a clear knowledge of this law (Georgescu, 1971).

The biological and economic systems are not isolated systems. Both receive the heat of the sun. Therefore, while they receive more energy than the one that they emit, the economic and biological systems will be able to reduce their entropy. In flat words, that is to say, inexact but comprehensible in an intuitive way, while there is a sun that heats the biomass it will be able to increase and the national gross world product will be able to grow.

The fundamental concept of the entropy involves a process of change, of energy in the physical systems when passing from a state of more energy concentration to another state of smaller concentration (inequality to equality), of order in the non physical systems when passing from a state of more structural order to another state of smaller order (organization to disorganization).

In its more elementary form, the entropy law expresses that all entity either object, entity, thing, body, system, organization, society, etc., starting from its same birth, goes through different states in each one of which gives away part of the energy that gives coherence, vitality, order, etc. to it, until arriving to a final state, in which this energy disappears totally and consequently the entity stops working as such (Badillo & Orduñez, 2002).

The entropy process can be considered as the progressive loss of the relationships that form a system, that can be the relationships inside an organization.

Every system suffers of matter exchange, energy and information with its environment, all the time, this exchange results in the entropy process that affects the system. Therefore, the organization can be considered as a living system capable to react with the environment that surrounds it, to be able to maintain the function that achieves the purpose of its creation in viable balance.

From the first moment of its existence, the organization is exposed to the entropy, which takes it to the process of a gradual and growing deterioration. Obviously, if watched over, the entropy can end up being controlled inside certain limits, and modify the organization's cycle of life.

Although it is certain that the organization can take resources of its environment to avoid the deterioration, it cannot make it by itself, this process has to be rather initiate and driven by the very own human elements of the organization or by external agents.

When the direction of an organization is closed (without contemplating the environment), the phenomenon of entropy deteriorates it until extinguishment.

Emergence

Emergence is...

1. That parts of a system do together that they would not do by themselves: collective behavior.
2. What a system does by virtue of its relationship to its environment that it would not do by itself: e.g. its function.}
3. The act or process of becoming an emergent system (Francois, 1997).

According to 1. emergence refers to understanding how collective properties arise from the properties of parts. More generally, it refers to how behavior at a larger scale of the system arises from the detailed structure, behavior and relationships on a finer scale. In the extreme, it is about how macroscopic behavior arises from microscopic behavior.

According to this view, when we think about emergence we are, in our mind's eye, moving between different vantage points. We see the trees and the forest at the same time. We see the way the trees and the forest are related to each other. To see in both these views we have to be able to see details, but also ignore details. The trick is to know which of the many details we see in the trees are important to know when we see the forest.

In conventional views the observer considers either the trees or the forest. Those who consider the trees consider the details to be essential and do not see the patterns that arise when considering trees in the context of the forest. Those who consider the forest do not see the details. When one can shift back and forth between seeing the trees and the forest one also sees which aspects of the trees are relevant to the description of the forest. Understanding this relationship in general is the study of emergence.

Acording to 2. emergence refers to all the properties that we assign to a system that are really properties of the relationship between a system and its environment.

A useful example is a key. A key has a particular structure. Describing its structure is not enough to tell somone that it can open a door. We have to know both the structure of the key, and of the lock. Without describing the structure of either, however, we can tell someone that it can unlock the door.

One of the problems in thinking about the concepts of complex systems is that we often assign properties to a system that are actually properties of a relationship between the system and its environment. Why do we do this? Because it makes thinking about what is going on simpler. Why can we do this? Because when the environment does not change, then we only need to describe the system and not the environment in order to give the relationship. Thus, the relationship is often implicit in what we think and what we say.

The second aspect of emergence 2. is related to the first aspect 1. because the system can be viewed along with parts of its environment as together forming a larger system. The collective behaviors due to the relationships of the larger system's parts reflect the relationships of the original system and its environment.

The role of relationship:

> Both 1. and 2. have to do with relationships, the relationships of the parts, or the relationship of the system to its environment. When parts of a system are related to each other we talk about them as a network, when a system is related to parts of a larger system we talk about its ecosystem.

The role of pattern:

> When there are relationships that exist between parts of a system we talk about the existence of patterns of behavior.

The idea of emergence is often contrasted with a reductionist perspective. The reductionist perspective thinks about parts in isolation. It is the often vilified "anti-complex systems" view of the world. However, even the idea of a system is based upon a partial reductionism. To understand this, one should carefully understand the notion of approximation or "partial-truth" which is essential for the study of complex systems.

CONTEXT OF COLAPSING UNDER A TURBULENT ENVIROMENT

The theme for the 51th annual meeting of the ISSS is "Integrated Systems Sciences, Systems Thinking, Modeling and Practice" is a systemic approach that links the virtual models of systems with the practice in the real world.

The contemporary condition of the social and natural environment is extremely turbulent. There are frequent wars, a polarized economic system that can provoke grave social disturbances, illegal traffic of drugs, guns, people, organs, and wastes, in addition to world wide health problems such as AIDS, the depletion of natural resources such as oil, pollution, migration, natural disasters, etc. Under this chaotic situation, the life cycle of natural and social systems can be very brief. The premature collapse of biological and cultural systems can be very dangerous, and we have every indication that the natural and cultural systems are unsustainable under the present circumstances.

Under this chaotic context, the following questions surge:

Is the most probable scenario, one with the multiplication of many types of natural, and cultural systems collapses?

Can we design and implement systemic measures to prevent the collapse of the most important natural and cultural systems?

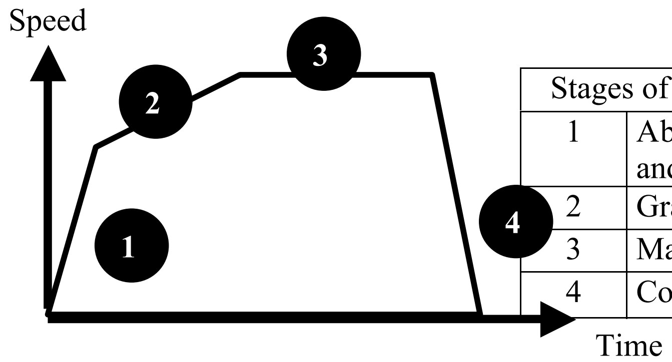
If the organized groups of society can not prevent the collapse of natural, and social systems, what can they do to address its main consequences, and its aftermath?

How a creative radical and robust transformation process, a structural change of social systems under the perspective of collapse can be designed?

Combining the two concept described before Entropy and Emergence, the process of collapse can be described as a stage of change in the Life Cycle process.

The Life Cycle Metaphor

Every type of system is dynamic, non living, living and conscious systems are in a perpetual process of change at some stages toward a higher and in another stages toward a lower level of order, of complexity, it is a complexification process. The process of change can be described with the Cycle of Life Metaphor stages of transformation. In the first stage of a particular type of system creation, the process of change is violent, in its second stage the transformation is a gradual evolutionary process, in the third stage the system achieves temporal stability, and in the last stage of its cycle, the system collapses (Figure 1). It is a simplified linear model of the Life Cycle Metapho



Stages of the Life Cycle Metaphor	
1	Abrupt process of change, and emergence
2	Gradual evolutionary growth
3	Maduration and stability
4	Collapse and entropy

Figure 2. Life Cycle Metaphor

In the Life Cycle Metaphor, the first and fourth stages are violent while the second and third stages of change are gradual and stable. The first and second stages are life process of growth, while the fourth stage is a process of collapse, of death. The Life Cycle of natural and cultural systems are a part of the evolutionary process. In the XIX century Darwin developed the theory of the evolution of bilogic systems. In the XX century Pierre Teilhard de Chardin (1967) incorporated the concepts of complexification and conscientization in the theory of evolution.

Evolution and the complexification-conscientization process:

Galileo transformed our sense of space. In both cases the boundaries of the universe were extended to infinity. As astronomy has exploded the geocentric universe in which earth sits in its fixed place at the center of all things, with the heavens above and hell below, so geology and biology have pushed the horizons of time backwards into the remote past and forwards into the far distant future. Also, as life came to be seen as evolving across the millennia in a gradual succession of living forms, suddenly a notion of progress was born.

Teilhard went on to argue that there have been three major phases in the evolutionary process:.

- The first significant phase started when life was born from the development of the biosphere.
- The second began at the end of the Tertiary period, when humans emerged along with self-reflective thinking.
- And once thinking humans began communicating around the world, along came the third phase. This was Teilhard's "thinking layer" of the biosphere, called the noosphere (from the Greek noo, for mind). Though small and scattered at first, the noosphere has continued to grow over time, particularly during the age of electronics. Teilhard described the noosphere on Earth as a crystallization: "A glow rippled outward from the first spark of conscious reflection. The point of ignition grows larger. "till finally the whole planet is covered with incandescence."

For Pierre Teilhard de Chardin:

- Evolution as the "general condition to which all other theories, all hypotheses, all systems must bow and which they must satisfy henceforward if they are to be thinkable.
- Nature is moving, erratically and haltingly perhaps, but nonetheless moving, towards higher and higher forms of consciousness.
- An increase in consciousness was accompanied by an increase in the overall complexity of the organism. Teilhard called this the "law of complexity consciousness," which stated that increasing complexity is accompanied by increased consciousness. "The living world is constituted by consciousness clothed in flesh and bone." He argued that the primary vehicle for increasing complexity consciousness among living organisms was the nervous system. The informational wiring of a being, he argued - whether of neurons or electronics - gives birth to consciousness. As the diversification of nervous connections increases, evolution is led toward greater consciousness.

As a Abraham (1994) points out, Teilhard's complexity-consciousness law is the same as what we now think of as the neural net. "We now know from neural-net technology that when there are more connections between points in a system, and there is greater strength between these connections, there will be sudden leaps in intelligence, where intelligence is defined as success rate in performing a task." If one accepts this power of connections, then the planetary neural-network of the Internet is fertile soil for the emergence of a global intelligence.

His picture of the noosphere as a thinking membrane covering the planet was almost biological - it was a globe clothing itself with a brain. Teilhard wrote that the noosphere "results from the combined action of two curvatures - the roundness of the earth and the cosmic convergence of the mind."

Evolution includes slow evolutionary process of change and revolutionary violent transformations.
The birth and death of individual systems, their initial and final states are only

temporal stages of the existence of species. Their collapse and transformation process are linked. Each cycle of life is followed by new cycles of life,. at the end of each life cycle there is death and after the death of individual elements new living beings are born, after the disapearence of social and cultural systems, other organizations emerge.

The Life Cycle of each type of system is a temporal view of its individual long term behaviour. Living species and cultural systems suffer an evolutive process through many cycles of adaptation and change. Living systems are adaptive, and cultural systems are creative teleological systems. While the evolution of natural adaptive systems is slow, the transformation process of creative cultural systems is violent (Figures 2 and 3). Through and autopoietic process living systems maintain the identity in a turbulent environment, living beings die, species survive. The cultural systems change their identity through their process of transformation, thorough a complexification and conscientization process, they obtain emergent properties at each stage of development.

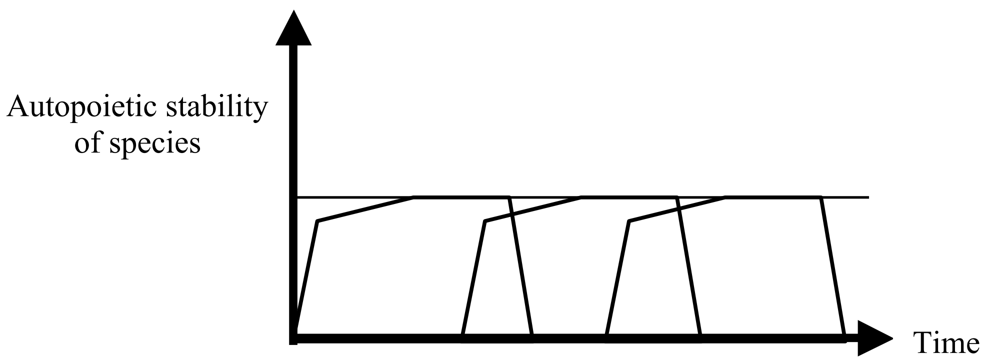


Figure 3. Life Cycles of living species

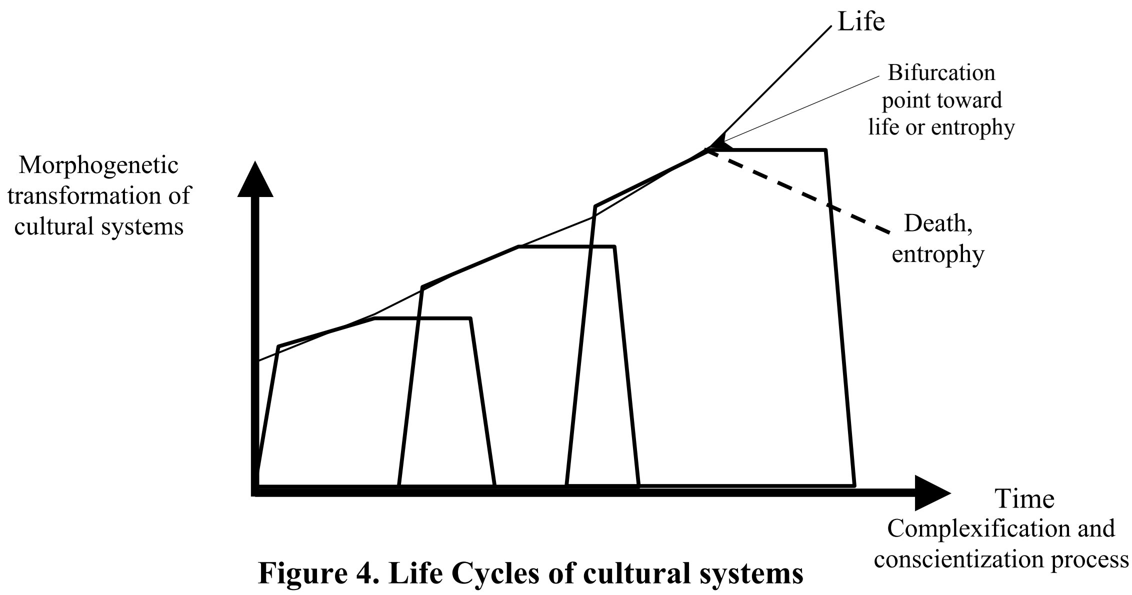


Figure 4. Life Cycles of cultural systems

The complexification and conscientization evolutionary transformation from non living, to living, and conscious systems, from simple to complex and conscious processes is represented on Figure 4. At each evolutionary jump, emergent properties appear. Living systems not only have physical properties but also organic processes. Conscious systems have organic processes, and also teleological capabilities. A force at work across the whole face of this planet as life evolved from the most simple and original forms to the most complex.

The social context in the systemic study of disasters

For the study of disaster the following premises can be defined:

1. Natural disasters interrupt a certain process of development.
2. Natural disasters should be studied as part of social and economical processes
3. A distinction can be made between the internal attitudes of the population groups directly affected by the phenomena, and the external response of local and federal authorities
4. The effects of the natural disasters ad additional hardships to the social and economic daily disasters of the local population.

From those experiences, it can be understood that the natural disaster play the role of an additional detonators of the social, economical, and political crisis. The causes are multiple and the socio-economic and environmental situation of a particular place that has been affected should be analyzed from a systemic approach.

Natural disasters are only a manifestation of nature they can provoke a social disaster when there are conditions of vulnerability. There are two main types of impact: natural, and socio-economic.

In the systemic study of disasters as open and dynamic large scale complex processes of transformation it is difficult to design models of socio-cultural, aspects of change and their links. There are different investigation approaches toward for the understanding of the social context. The scientific approach is a continuous one to learn from the social practice, the knowledge we obtain is a reflex of the projection of the real world, it is a dynamic process for a deeper and complex knowledge.

There are different investigation approaches toward for the understanding of the social context. The scientific approach is a continuous one to learn from the social practice, the knowledge we obtain is a reflex of the projection of the real world, it is a dynamic process for a deeper knowledge of the catastrophic phenomena of the natural world.

We should not forget, that the study of a particular phenomenon in but an element of a whole, it is true that it is important to know about the manifestations of a natural catastrophe, its main effects are social. There is a relationship between the parts and the whole. The destructive effects of a catastrophe can not be explained by its elements but by the whole. The whole includes social, economic, political, educative, physical, and technical dimensions. The social and political actors may understand part of the wholesome effects of the natural disasters.

Each type of disaster should be analyzed in its own particular context as a dynamic phenomenon. For that reason it is useful to develop a systemic tool under a cultural perspective to understand better the causes and effects of each type of natural disasters under its own social and historical perspective.

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Law of requisite variety

Only variety (of regulator subsystem) can overcome variety generated by the system (adapted from Beer, 1977).

The application of this law could help us to detect and mitigate the impact of disaster. A collapse happen when:

a) The information coming from de systems in risks of collapse is not a terminate to mach de capability to understand it by the subsystem accountable to regulate and to take preventive action.

b) The capability of the subsystem accountable for regulate and take preventive actions is not enough amplified to mach the variety of the systems in risks of collapse.

c) Acombination of a) and b)

Comparative systemic analysis of risk and vulnerability of Japan and Mexico under turbulent conditions

The evaluation of conditions of risk and vulnerability are very important for prospective studies of the conditions of systems collapse. The economy and welfare of the people in nations such as Mexico and Japan can be affected by turbulent conditions such as different types of catastrophes. A comparative study of the conditions of collapse in different types of systems can be useful for the design of large scale preventive strategies.

Japan has a higher potential risk of collapse than Mexico under the effect of natural catastrophes such as hurricanes, monzons and earthquakes, and Mexico has a higher risk of social and political disruptions than Japan. The nuclear energy system in Japan has a huge potential risk. Both countries have very dangerous nuclear powers as neighbors. (Adendum 1)

Japan´s economy is more vulnerable than Mexico´s economy, when catastrophes occur, but at the same time it has important economic resources, and a well organized society for an effective response to the effects of catastrophic events, Mexico is more vulnerable than Japan to the social effects of catastrophes.

CONCLUSIONS

A systemic study of systems entropic collapse and its aftermath, is very important for the prevention of disasters, and for the radical redesign of new socio technical systems. Violent change caused by a combination of internal and external forces can drastically reduce the life cycle of organizational systems. Some times preventive measures can be designed with sufficient time, in other occasions the external forces are so sudden that little can be done to prevent the collapse of the organizational system. We need to be aware, because in every critical situation there are also opportunities for a creative radical change.
The study of Ashby Law of Requisit Variety will help to understand vulnerability of disasters.

ADDENDUM 1

Comparative systemic risk analysis between Mexico and Japan (Peon, 2007)				
RISK FACTORS	**CAUSES OF COLAPSE**	**JAPAN**	**MEXICO**	**COMPARATIVE ANALYSIS**
Natural	Sysms	Japan is located in a zone with a high risk of earthquakes	The Pacific coast in Mexico is a high risk of earthquakes	Japan is in greater danger, because of the small size of its territory and its a high risk of earthquakes
	Hidrological phenomenons (hurricanes, monzons, tsunamis, draughts)	Japan has been affected by monzons, and other hidrological phenomenons in the past. Huge cities such as Tokyo-Yokohama are in the coast, they have a very high risk.	The Pacific and Gulf Coasts of Mexico have received the impact of huge hurricanes, they are a high risk space. In the coastal and mountain areas destructive landslides, and inundations have occurred.	Mexico has been affected more often than Japan by hidrological catastrophic events. Japan with its huge coastal cities has a very large risk.
	The depletion of natural resources	Japan is a country that is highly dependent in external natural resources	Mexican is highly dependent in its main economic resource, oil.	Even with its strong economy Japan has a high risk for its dependency in external resources

Human	Industrial accidents	Japan industry, one of the largest in the world has excellent security systems with a low risk.	The security systems in Mexican industries is poor and their risk is high.	The paradox is that Japan has a larger and at the same time lower risk than Mexico, the large size of its industry is risky and the excellent security systems lower their risks.
	Air, water, and soil pollution	The normative and control systems of pollution in Japan are well designed, with effective processes of control.	Mexico has a high level of air, water and soil pollution, the system of control is not effective.	The paradox is that Japan has a larger and at the same time lower risk than Mexico, the large size of its industry is risky and the excellent security systems lower their risks
	Accidents in energetic systems	Tens of old nuclear plants in Japan have a high potential risk. Old systems can fail, there is also the risk of terrorists acts. So far few accidents have happened, but the danger could be higher in the future.	They are very frequent in the oil industry.	Japan a small country with so many old nuclear energy plants has a potential risk, that could be very high
	Social and politic conflicts.	With its economic equality and social order, Japan is a country with a very low social and political risk	The risk of social conflict in Mexico is growing. The economic polarization, and socio political conflicts in Mexico are an area of great concern	The socio political risk of is much higher in Mexico than in Japan
	Economic collapse	Japan a rich country with great economic dependency in external resources such as oil can be risky	The end of the oil reserves in Mexico is a grave danger for its economic development.	The economy of both countries are dependent on a non renewable energetic resource that is at the end of its life cycle
	Health crisis	One of the main health problems of Japan is the old age of a large proportion of its population	The health system of Mexico has important limitations	Health problems are much larger in Mexico than in Japan
Geopolitic	Dangeous neighbors (with their nuclear systems of war)	The most dangerous neighbor of Japan is China	The most dangerous neighbor of Mexico is United States	Japan and Mexico live near most dangerous nuclear powers
In syntesis Japan has a higher potential risk than Mexico for the effect of natural phenomena such as hurricanes, monzons and earthquakes, and Mexico has a higher risk of social and political disruptions than Japan. The nuclear energy system in Japan has a huge potential risk. Both countries have very dangerous nuclear powers as neighbors.				

Systemic comparative analysis of socio-economic vulnerability in Japan and México (Peon, 2007)				
VULNERABILITY FACTORS	**CAUSES OF VULNERABILITY**	**JAPAN**	**MEXICO**	**COMPARATIVE ANALYSIS**
Infraestructure	Communication systems	The important communication infrastructure of Japan, is vulnerable to the effects of natural catastrophes (monzons, earthquakes, and tsunamis).Movil phone network, could be mitigated impact..	The communication infrastructure of Mexico, is vulnerable to the effects of natural catastrophes in the coasts and in the central area of the country	Japan with its expensive communication infrastructure, can suffer high economic costs when natural catastrophes occur. At the same time with its large economy and well organized social processes, it can deal efficiently with the effects of catastrophic events

	Energy systems	Old nuclear energy facilities could be very vulnerable to accidents, caused by natural catastrophes, to industrial accidents and to international terrorism.	The main energy system in Mexico is the oil industry. It is a fragile system with the depletion of oil reserves	Japan is very vulnerability because of its dependency on old nuclear energy facilities, and its lack of natural resources
	Health systems	It is a high quality health system that has to deal with the age growth of its population	Has a weak health system, specially in extensive rural areas	Mexican health system is more vulnerable than Japan health system.
	Housing systems	It is vulnerable to fire, because of its extensive use of wood and paper in its housing systems.	The use of recyclable materials and weak structures, in large zones where poor communities live in high risk areas, makes them very vulnerable	The risk of fire in Japan is much larger than in Mexico. The poor inhabitants of large zones in rural and urban communities in high risk areas in Mexico are very vulnerable to the effects of natural catastrophes.
Social 0rganization	Governmental organization	Highly organized governmental organization systems and low vunerability	Weakly organized governmental organization systems and high vunerability	With its highly organized governmental organizations, Japan can respond quickly and effectively to the effects of disasters
	Community organization	Highly organized communal organizations systems and low vunerability	Highly organized communal organization systems and high vunerability	With its highly organized communal organizations, Japan can respond quickly and effectively to the effects of disasters
	Training and conscientization programs for catastrophic situations	It has well organized training and conscientization programs for catastrophic situations	Its training and conscientization programs for catastrophic situations are very weak	A big challenge for Mexico, is to develop well organized and effective training and conscientization programs for an effective response to catastrophic situations
Japan has higher costs than Mexico when catastrophes occur, but at the same time with its large economy, and highly organized society has a great capacity for an effective response to the effects of catastrophic events, Mexico is more vulnerable than Japan to the effects of catastrophes.				

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