

A HOLISTIC DESIGN FOR THE SELF-CONSTRUCTION OF THE CORE OF A MODULAR SMALL HOUSE AND ITS SERVICES FOR DISASTER ZONES

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ABSTRACT

Haiti's catastrophic systemic collapse after the earthquake is a dramatic example of the connection between a natural phenomenon and the social and economic organization in an underdeveloped country. The earthquake had a much smaller magnitude than the subsequent seismic event in Chile, but the damages. In Haiti there was a widespread destruction of its infrastructure, the reconstruction had to begin from scrape. Today a large part of the refugees is living in temporal living lodgings there are not enough funds to restore the fragile housing infrastructure of the country. The poor regions of different countries have a very fragile infrastructure that can be severely affected by natural disasters. When a catastrophic event happens, a widespread destruction occurs. After the event, an international effort is made to reconstruct the houses, and services that were destroyed. The relief effort does not last for a long time, and after the initial effort the population is abandoned, they have to solve their problems with their own scarce resources.

At the Instituto Politecnico Nacional (IPN), a large and influential Mexican public university, a project is being developed for the construction of a strong modular transportable mini house (bathroom and kitchen, and its services) as a first step in the rebuilding effort in disaster zones. The first step in the reconstruction of the housing infrastructure and its water service (with the recycling of water) can be a strong central core of the medium and long term rebuilding of houses and their services. The construction process of this small central core of housing is the beginning of a participative self-sufficient effort by organized communities, a gradual or long term rebuilding process of their complete houses and services, with their own resources and knowledge.

INTRODUCTION

The modular core is the first part of a participative self-help autonomous construction process with local materials after training and workshops. Currently, we are already in the first step of this process (workshop and training) in Haiti, with NGO partners such as Caritas and Misereor. The critical situation that gave origin to the systemic research project is the potential for natural disasters in urban and rural areas inhabited by economically marginal groups. As part of an initial stage, the concern is for the systemic visualization of a disaster phenomenon, aiming to describe, understand, forecast and control it (Gelman and Serra, 1982). Thus, the principal objective is the identification and solution of any safety and safeguard problems within the human settlements and the environment. An estimation of the inherent risks to which the vulnerable communities are

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exposed is necessary, in order to design preventative measures to mitigate and provide resilience to the inhabitants of affected zones through self-reliance efforts.

By its inter and transdisciplinary character (Nicolescu, 2002, systemics are a form of knowledge that generate creative solutions when faced with complex problem situations which gravely affect marginal communities. In the design of solutions, a participative transdisciplinary research-action process or a second-level cybernetic process is used. There is a search for a synergic connection among theoretical experts and the communities involved in risk situations, in order to define and enact integral solutions that take into account technical, economic, socio-cultural and environmental dimensions.

This method was used to design an integral solution, which includes the structural safety of the basic progressive living module (bath and kitchen), the self-sufficient water service for basic needs (capture, optimal use, treatment and reuse), propitiating the generation of the initial phase of progressive dwelling through modular auto-construction systems by communities directly affected by the disasters. This also includes the group training process for self-sufficiency through self-reliance.

CONTEXT

The object of this work is to reframe the various problems in the area of natural disasters, specifically in regard to the consequences of seismic events and hurricanes in the areas of housing, communication, potable water and city sanitation, and in this manner, to outline mitigation measures and corrective actions to improve the resistance or resilience of any vulnerable groups suffering the majority of damage in their communities.

The potable water and sanitation systems are exposed to natural and anthropogenic phenomena on a regular basis. Earthquakes, hurricanes, floods, landslides, droughts and volcanic eruptions are part of the wide range of events that result in deaths, injuries, diseases, as well as having a great impact on national economies.

Clearly, water and sanitation systems are of vital importance to the health and development of populations, and it is of essential priority to provide these services in optimal conditions, since any deterioration of them may generate health issues for the majority of the population.

The primary interest in risk-prone areas is maintenance of qualitative and quantitative services in accord with needs, so that interruptions in potable water supply or in the collection, treatment and disposal of wastewater is as prompt as possible.

Given the markedly negative effects of various natural phenomena on the sanitation and water supply systems –effects like rupture of adduction and distribution pipelines, the elevated pollution of natural springs or the effect on treatment plants- all prevention and mitigation processes are indispensable.

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THEORETICAL FRAMEWORK: SYSTEMS THINKING

Despite the achievements of the unidisciplinary traditional approach in diverse areas of science and branches of engineering (Ackoff, 1973; Gelman, 1992), its use involves certain restrictions in the study of the diverse manifestations of the disaster phenomenon, since it does not take into account the multiple interrelations between either destructive phenomena and the components of the exposed systems, or between the consequences they provoke at a short and long term (Gelman, 1992).

Also, the strategy of deep specialization (Ackoff, 1979) —which habitually constitutes the strength of the unidisciplinary focus, allowing the study of specific problems, with feasible solutions within a restricted context of a scientific discipline or engineering branch— in the case of natural disasters has limited the obtained results, due to the omission of socioeconomic and political dimensions, decisive for the definition, study and control of such complex phenomena (Gelman, 1996). This has resulted in the production of partial solutions and insufficient, inefficient measures for the prevention and emergency response, thus highlighting the need for improved solutions.

Furthermore, as the analysis of the development of systems investigation and engineering shows, its interdisciplinary character was achieved through their joint creation outside of a single traditional discipline context, and thus without the obligation of remaining loyal to a particular area of expertise (Ackoff, 1976), which allowed the establishment of particular subjects of study and the creation of unique and specific methods of research.

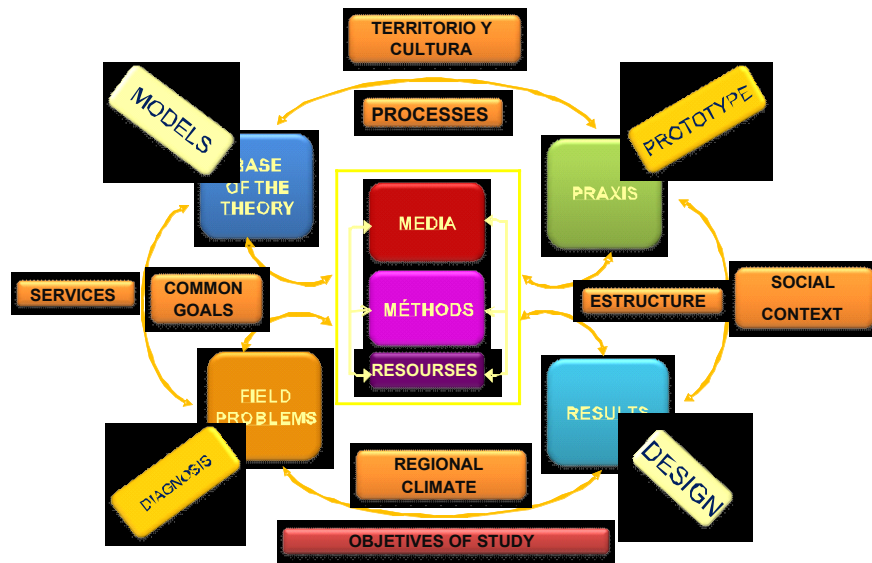


Figure 1. Functional structure of risks according to the participative action-research theory

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CYBERNETIC SYSTEMIC METHOD OF PARTICIPATIVE ACTION-RESEARCH

In this project, an open cybernetic process of applied participative research was adopted (Participative Action-Research, PAR) in order to incorporate not only the interdisciplinary knowledge of theoretical experts, but also the tacit knowledge and worldview of practical experts within the communities affected by the natural phenomena. The goal is to train these participants so that they become agents of their own development, using local resources and information. For this reason a transdisciplinary form of knowledge is handled, a form that integrates the distinct sources of learning necessary in a project of this nature.

For the sustainable development of a resilient or viable autonomous system, specially for the reconstruction stage, it is necessary to use participative planning and execution processes to strengthen community organization, strategic in all disaster situations. This is an organizational process that may be modeled according to S. Beer's Viable Systems Model (1982), under a neurocybernetic metaphor.

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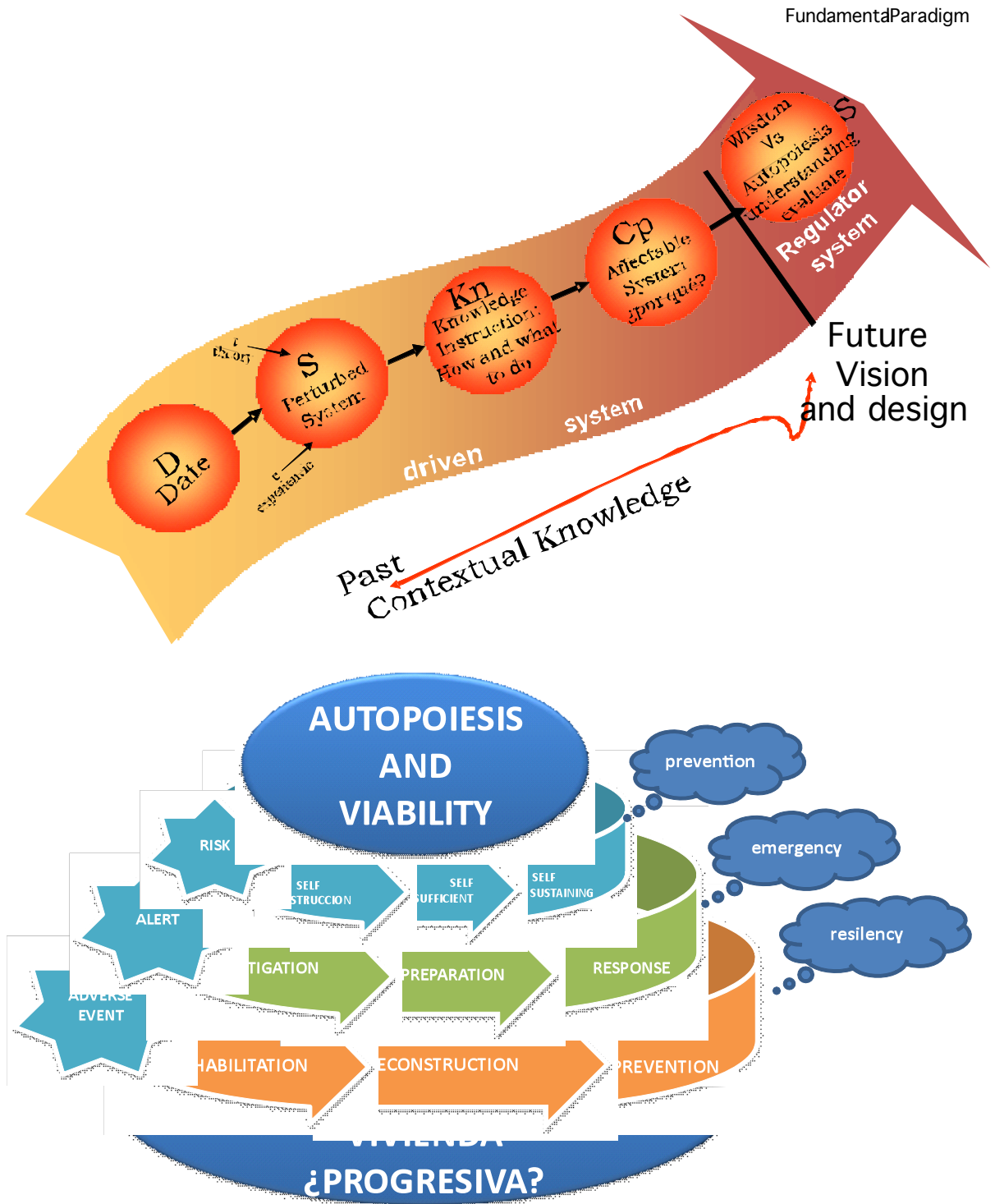


Figure 4. Goals of disaster control.

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Management plan for progressive housing:

Given all the circumstances stated above, we created an integral proposal that satisfies security needs, housing precariousness in the presence of disasters, water shortages, lack of economic and material resources. The idea is to create progressive, self-sustained, self-constructible and self-sufficient housing with the objective of generating a viable autopoietic management plan.

For the elaboration of a progressive housing management plan, a risk and vulnerability evaluation of the zone of interest is fundamental. One of the steps in the vulnerability analysis consists in identifying and evaluating the precariousness conditions that arise at different stages of a disaster and which befall the area occupied by the rural or urban community. A study of historical records in the region is needed, as well as reports of damages incurred at every stage (Figure 5).

- Prevention
- Mitigation
- Reconstruction

Once the disaster has occurred, response activities such as rehabilitation and reconstruction are initiated. These activities must be self-promoted for the processes of:

- Auto-construction,
- Self-sustainability and
- Self-sufficiency

The above-mentioned actions are of vital importance for the sustainability of community systems, which need to learn to be resilient under disastrous conditions. On the other hand, during reconstruction efforts, it is fundamental for the city or population to assume the responsibility of including prevention and mitigation measures in the construction work. Urban planning strategies must be implemented in order to avoid previous weaknesses in the older urban planning systems.

Structural, operational and administrative damages of the housing system will be assessed through the vulnerability analysis of the region under seismic threat. Results will illuminate any threats to the global system as well as any factors that may only endanger certain components of the system.

This analysis, will provide any relevant information needed to generate concrete actions through endowment programs and acquisition of adequate land which will allow for the reduction of negative effects in human settlements. This is the starting point for effectively reducing the impact of disasters through prevention, mitigation and response programs, as well as for the creation of emergency plans.

The methodology employed for the vulnerability assessment is based on the utilization of up to date reliable information. The preparation of blueprints, operative methods and data on all components of the systems constitutes one of the first steps. Details relating to each of the potential threats to the region must be taken into consideration as the future scope of the Project.

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- To incorporate the information onto risks and vulnerabilities maps clearly of all regions potentially affected.
- Strategies for determining priorities in the development of future studies, as well as strategies for community training in self-management processes.
- Integral viability analysis of the progressive housing system
- Cybernetic method of planning, evaluation and continuous improvement of actions
- Policies for the development of disaster scenarios
- Support in the creation of civilian protection programs
- Elaboration of means and processes of support, such as operation centers, support systems for planning and decision-making, databases and communication systems
- Security organization and planning for the welfare of human settlements, productive areas, strategic services, high risk installations and public works within different confines
- Identification and search of solutions to problems of security generated after disasters.

A correct application of the self-sustainable progressive housing systems a measure of prevention and mitigation requires absolute political and community decisiveness that provides support within the confines of planning-action to respond in emergency situations.

CONCLUSIONS

At present, incidence of the various risks is not predictable, in spite of the quantity of information on the causes of natural disasters that geologists and meteorologists have amassed. Nevertheless, vulnerability conditions linked to economic marginality and to poor planning of human settlements may be known by means of vulnerability blueprints of risk zones. Even if this does not help in the prediction of the actual date of occurrence of a disaster, it does aid in prevention and reconstruction planning much like the self-sustainable progressive housing system provides, which lessens the human and material losses and eases reconstruction efforts.

In Latin American cities, investment in the prevention of disasters such as earthquakes and hurricanes is minimal or in some cases non-existent. The consequences of natural catastrophes on the environment and on living organisms are therefore devastating. It has been demonstrated that it is less costly to invest in prevention than in reaction after this sort of events occur. Safe and self-sustained progressive housing is an important preventive and restoration measure for marginal communities suffering the consequences of a catastrophic event.

As much as we recognize the impossibility of having systems that offer a 100% safety guarantee before these sort of disasters, it is indispensable that a city or population be internally capable of solving the difficulties that arise before, during and after the impact of an earthquake or any other natural or man-made disaster.

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