Sustainable city and risk management

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ABSTRACT: Cities are increasingly becoming the engines of national economic growth and magnets for new residents flooding in from rural areas. Decision makers at all levels are faced with the task resolving urban problems from transportation to waste management, from urban drinking water supply to the preservation of urban green space. Urban changes after a destructive eventuality are rapid, random and unpredictable. The result of such eventualities is immediate transformation of areas of the city, an abandonment of existing development procedures, causing dramatic urban mutations and unpredictable reactions by residents. Built environment management in cases of natural disaster is one of the issues subsumed within the field of urban planning. Risk management analysis proceeds to a thorough classification of the city's vulnerability factors, while assessing the data from the vulnerability analysis according to various criteria. It also needs to consider new factors that have rarely been taken into consideration in the past, such as social, economic and functional vulnerability of the city.

INTRODUCTION

A city is only considered sustainable when it follows a development path where current progress does not take place at the expense of future generations (i.e. bad planning, debt, environmental degradation, etc) and there is an equilibrium between different issues. In other words, the goal is an across-the-board development, instead of handling issues one by one.

The significance of each of these issues differs in importance from city to city depending on the given city's background. For example, in India the most important urban issue is the migration of people to the cities, while in Europe transportation is important or in North America urban sprawl is the most pressing issue. The term sustainable development goes beyond the boundaries of science, and business development and trade to include human development, values and differences between cultures. In fact, many organisations refer to sustainable human development as opposed to sustainable development in order to emphasise issues such as the importance of gender equality, participation in decision-making processes, and access to education and health.

Cities have become the focal points of these components as major consumers and distributors of goods and services. However, many cities tend to be large consumers of goods and services, while draining resources out of the external regions that they depend on. As a result of the increasing consumption of resources and the growing dependency on trade, the ecological impact of cities extends beyond their geographic locations. It has been recognised that the concept of sustainable development is an evolving, debatable term. This section provides an overview of how sustainable (urban) development was defined by the Brundtland Commission and how it is defined by different organisations in different geographical regions.

The most widely known definition of sustainable development comes from the Brundtland Commission, which defined sustainable development as *development that meets the needs of the present without compromising the ability of future generations to meet their own needs* [1]. During the preparatory meetings for the URBAN21 Conference (Berlin, July 2000), the following definition was developed to define sustainable urban development:

> *Improving the quality of life in a city, including ecological, cultural, political, institutional, social and economic components without leaving a burden on the future generations. A burden which is the result of a reduced natural capital and an excessive local debt. Our aim is that the flow principle, that is based on an equilibrium of material and energy and also financial input/output, plays a crucial role in all future decisions upon the development of urban areas.*

However, there are many other definitions, such as:

Sustainable community development is the ability to make development choices which respect the relationship between the three E's - *economy, ecology, and equity* [2]: a) Economy - *Economic activity should serve the common good, be self-renewing, and build local assets and self-reliance,* b) Ecology - *Human are part of nature, nature has limits, and communities are responsible for protecting and building natural assets,* c) Equity - *The opportunity for full participation in all activities, benefits, and decision-making of a society.*

A sustainable community is one in which improvement in the quality of human life is achieved in harmony with improving and maintaining the health of ecological systems; and where a healthy economy's industrial base supports the quality of both human and ecological systems [3].

A sustainable community uses its resources to meet current needs while ensuring that adequate resources are available for future generations. It seeks improved public health and a better quality of life for all its residents by limiting waste, preventing pollution, maximizing conservation and promoting efficiency, and developing local resources to revitalize the local economy.

Sustainable communities are defined as towns and cities that have taken steps to remain healthy over the long term. Sustainable communities have a strong sense of place. They have a vision that is embraced and actively promoted by all of the key sectors of society, including businesses, disadvantaged groups, environmentalists, civic associations, government agencies, and religious organizations. They are places that build on their assets and dare to be innovative. These communities value healthy ecosystems, use resources efficiently, and actively seek to retain and enhance a locally based economy. There is a pervasive volunteer spirit that is rewarded by concrete results. Partnerships between and among government, the business sector, and non profit organizations are common. Public debate in these communities is engaging, inclusive, and constructive. Unlike traditional community development approaches, sustainability strategies emphasize: the whole community (instead of just disadvantaged neighbourhoods); ecosystem protection; meaningful and broad-based citizen participation; and economic self-reliance [4].

A community that believes today's growth must not be achieved at tomorrow's expense [5] ...the deliberate effort to ensure that community development not only enhances the local economy, but also the local environment and quality of life [6].

ANALYSIS OF THE VULNERABLE COMPONENTS OF THE CITY

Experience shows that even in the present age of high technology and progress, the city is particularly vulnerable to natural disaster phenomena which, apart from the immediate damage they cause, often result in the dissolution of all development, creating irreversible situations, even leading to complete decay. An examination of the vulnerability of the city is part of a general risk management plan, a specialised planning approach to urban space. It is obvious that measures for the prevention of, and the protection from, natural phenomena must be included in the overall process of urban planning. Vulnerability analysis, therefore, relies on an evaluation of human and material losses, if possible on economic terms, with a view of making a quantitative assessment of damage and an appreciation of the risk. This approach to vulnerability, which is based on the dire consequences of the event, is complemented with a qualitative approach related to the causes of the disaster. According to this view, vulnerability corresponds to the tendency that a given community has to suffer damages due to some natural phenomenon [7].

Vulnerability, then, depends on a host of parameters, urban planning, socio-economic, political, demographic, psychological, historical, technical, functional, etc. When compared with other types of natural disaster, the consequences of an earthquake are usually completely unpredictable, dramatic and random. In addition, the earthquake can affect a much wider area and the urban components that will receive the consequences will be great in number. Therefore, it is unrealistic to claim that one can analyse every component's vulnerability in detail. For this reason, one can often resort to a selection of vulnerable components, those which damage or complete destruction will cause the most severe dysfunction for the city. In this sense, the vulnerable elements of space are:

- The population in the broad sense, that is, the permanent inhabitants, as well as the temporary population (visitors for business purposes, tourists, etc);
- Certain buildings and city infrastructure (such as public buildings, services, etc) that receive a large number of visitors on a regular basis;
- Buildings of strategic significance characterised by their usefulness at times of crisis, such as hospitals, communication centres, transportation networks, networks of general infrastructure, decision quarters (Ministries, City Hall, etc), production centres, etc;
- Monuments and buildings that belong to the local cultural and historical heritage, including buildings of architectural significance;
- Components that are particularly susceptible to risk, such as particular plants, nuclear station, toxic material storehouses, etc.

Anticipating the possibility of a natural disaster, that is, a *crisis situation*, must have been preceded by an identification of all vulnerable elements of the city above, everything that could impede its normal functioning. Apart from the above analysis of natural vulnerability, that is, the vulnerability that concerns the built space, an investigation of the vulnerability of the city must also include an analysis of additional vulnerability factors. In particular, it is essential that one conducts a study of population distribution of its socio-economic characteristics, of urban indices of the city, of its functions, of productive and economic activity, of its infrastructures, as well as the city's relation to the surrounding area.

SEISMIC RISK MANAGEMENT

Risk management analysis proceeds to a thorough classification of the city's vulnerability factors. While assessing the data of the vulnerability analysis according to various criteria, it must then investigate new factors that had not usually been taken into consideration in the past, such as the social, economic and functional vulnerability of the city. In other words, it defines the direction that the planning of a shielding system for the city must take in cases of natural disaster.

The goal of seismic risk analysis is to process various crisis scenarios in order to predict the consequences of a possible earthquake and try to curtail them. Different seismic scenarios can be invented in connection with the consequences they might have. According to these, the consequences can be direct or indirect. The limitation of risk to the direct consequences relies on improvements in the construction quality of the buildings and on modifications of anti-seismic regulations. Current trends in seismic vulnerability analysis have opened up new research directions such as financial vulnerability and planning against it by the agents affected. The analysis of the direct consequences of seismic risk and the prevention measures against them might be considered inadequate, depending on the complexity of the matter. The complexity of urban space and its components gives rise to the need to investigate a series of indirect consequences. Damage, for instance, at points providing access to the city are expected to create problems to the entire urban system, as well as to the local economic functioning of the city. Network vulnerability, transportation systems, administrative buildings, and the remaining central functions, etc, will have similar consequences for the city.

In the face of a catastrophic phenomenon, the city is simultaneously a built space, a space for the concentration of population, administrative space, a space with its own identity and its own characteristics. The concept of the identity of space emerges from its image, its symbols, its practices and the effect all these have on its inhabitants and the external population. The identity depends on the very location of the city within the immediate and broader environment, and the relation the city develops with it.

On the one hand, an examination of the vulnerability of the city involves the very components of urban space that face the natural disaster and, on the other hand, their conduct at the various *phases* of the phenomenon [8].

The duration of the disruption of city life due to a catastrophic phenomenon will depend on its intensity. The catastrophic consequences on the components of urban space are located in different time periods, beginning at the moment the event takes place, and lasting until the moment the system affected regains its stability. In each of these periods, the city has to respond to specific questions regarding its shielding and the prevention measures planned by the agents responsible.

In a general framework of planning objects and goals that also concerns urban planning, three different phases can be distinguished [9]:

1. *The phase of the normal development of the city - phase external to the crisis*. This phase that constitutes a *reference point,* for the planning refers to the city's normal course of living before the earthquake. The analysis of the functions of the system during this phase is essential so that all its vulnerable components can be identified, and its developmental tendencies and so that the possible conditions of the crisis can be understood. The aim is to bring all developmental processes of the city - urban planning, economic, social, cultural - within a framework of preventive planning and negotiation concerning seismic risk, which will provide all that is required for the protection and shielding of the city.
2. *The crisis phase*. The catastrophic phenomenon itself determines the onset of this phase, while its duration is dependent on the intensity of the earthquake, the extent of its disastrous consequences and the vulnerability of city components. It usually lasts a few days up until some weeks. This is a critical period in which specialised functions and civil protection responsibilities must be activated. The primary course of action is to provide first aid and medical attention to earthquake victims, as well as to respond to the vital needs of all those affected. Furthermore, a series of additional actions are found to be equally important during a crisis. In brief, these are the following:

    - providing the population with direct access to safe areas and setting up areas of short-term accommodation (creation of shelters, medical stations, etc) away from locations that can be considered high risk;
    - restoring the city networks (water supply, power supply, telecommunications, transportation, etc);

- facilitating the provision of external aid, so that certain primary functions of the city can be preserved and all actions can be co-ordinated.

3. *The rehabilitation phase* can also be termed the return to autonomy phase. Efforts, in this phase, are directed towards the planning of necessary courses of action for the city to regain a minimum number of primary functions. The recommencement of the city's activities will depend on how long its basic functions will be delayed before returning to normal (power supply networks, transportation networks, etc). All these are directly connected with the extent to which the city has been prepared during the phase of normal development with risk management planning and the shielding of the city [10].

The return to autonomy phase, therefore, may last a few months or perhaps even years. It all depends on the city's infrastructure before the catastrophic event, the extent to which it seems prepared to withstand it, and its reaction to it.

PROPOSALS

The conclusions to be drawn from risk management research and the assessment of the vulnerable elements of the city in the event of an earthquake lead to the formation of a general framework of directions for the revision of the city's urban plan. The framework should be focused on the relationship between the necessary interventions and effectiveness to ensure the safety of the community and of the environment (including monuments) in a way that is economically feasible. In other words, it does not relate to the concept of sustainable development at the primary design stage or subsequent interventions, but with interventions in a dangerously shaped urban environment, making use of all the institutional potentials and at the same time introducing new principles for the designing of new or existing areas in view of new conditions. A general framework of policy directions is:

- A revision of the Master Plan with a redefinition of the built-up exponents aiming at adjusting densities, that is, their decrease where possible and organisation and redefinition of uses in the city centre, that is, their adaptation to rates of risk and safety;
- Taking specific measures for the protection of the city's monuments and other notable buildings;
- Planning an extensive network of free spaces properly integrated in the urban environment;
- Integration of free spaces in the development of a uniform network of private and state owned free spaces;
- Traffic adjustments aimed at facilitating the immediate evacuation of the city in the event of an earthquake;
- Control studies of the already constructed pedestrian zones according to safety regulations to allow the passage of emergency vehicles (fire brigade and ambulances) in the event of an earthquake;
- Designation of specific routes leading to free spaces.

Along with the specific targets listed above, more general policy proposals would be included in the programme, such as: the reinforcement of state organisations and services; the existence of essential infrastructure in the city so that its normal operation (economic, social, etc) is not disrupted in the event of an earthquake; the quality control of constructions and precautionary anti-seismic control; the upgrading and institutionalisation of state emergency services that are available in the event of an earthquake, based on city planning parameters and micro-zone study; co-operation between the programme's research bodies and the relevant organisations of the city.

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