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Interface between public and private treatment of «public goods» and the like

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Interface between public/private treatment of "public goods" and the like

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Abstract

The paper focuses on two main sectors where the public/private interface is particularly relevant in determining risk conditions and the capacity to respond to disasters. Such interface reflects the nature of objects or services to be produced, which are public goods or hold a collective relevance. Secondly, the sectors will be analyzed across the disaster cycle.

The first sector is the construction industry of residential buildings, which is primarily private, but needs to confront with legislation and regulations regarding both the areas to be developed, transformed or preserved and the codes that must be complied with. The construction sector has significant impact in the generation of exposure and vulnerability; but it may also contribute to trigger some hazards, in both the pre-impact and the recovery/reconstruction phases.

The second sector that will be tackled refers to lifelines: the privatization trends of the last decades impacted in uneven and spot-like fashion different segments of the production and provision of energy, water, gas, communication. The coexistence of lifelines with differential technological upgrading and maintenance quality, that are strongly interconnected during emergencies, has been already investigated. Better tools for assessing and managing residual functionality have still to be fully developed.

1. Introduction

The present paper focuses on the examination of two sectors where public/private interface is implied by the same nature of the objects to be produced or services to be guaranteed, which are themselves public goods or provide commodities that if not public hold a relevant collective meaning.

The first sector is housing. Apart from a small public component, housing is primarily private, but needs to confront with legislation and regulations regarding both the lands where development can take place or where transformation should occur and the codes and performance standards that buildings should comply with.

The second sector is lifelines: the production and provision of energy, water, wastewater treatment, gas, and communication has been run for long as a sort of natural monopoly, either managed directly by public bodies or strongly regulated and supervised by the latter.

The interface between public and private bodies in those two sectors shapes risk conditions and response capacities to natural hazards and their potential consequences on existing assets. The need to investigate more in depth the type of relationships that exist between private and public bodies stems from some considerations that are shortly listed below.

First, risk governance means production of safety, protection of the community by prevention interventions and management of the immediate consequences of natural disasters (civil protection), and re-establishment and recovery after their impact. Such functions must be performed at the same time (non-rivalry), without excluding anyone, no matter what gender or social conditions (non-excludability) (Stavins, 2000). The production of safety from natural hazards can be legitimately regarded as a public good (Reddy, 2000). Such an hypothesis implies at least a partial market failure in the production of safety. The socio-economic system alone cannot guarantee the protection from natural hazards to the whole community and exposed elements at the needed conditions: some form of public intervention is therefore always needed.

Second, following an economic perspective, the damage provoked by a natural extreme means a loss of developmental resources for a territorial system as a whole (Pesaro, 2007). In fact, damage impact can affect territories for long periods, contributing to slow down development. Avoiding large regional or national loss requires the intervention of an authority to mitigate the damage and its secondary consequences in the short period after the impact, and the establishment of goals and tools to enhance prevention ex- ante to mitigate risk in the long run. In the medium and long period perspective, investments in prevention are preferable to damage recovery, especially in presence of not renewable resource; public finance is suffering and expenditure to cope with damage has been increasing steadily in the last few decades.

Third, benefits are achievable by establishing more stable and long period forms of interaction, negotiation and cooperation between public and private actors. Even though failure of pure market mechanisms in safety provision have to be expected and are in fact observed, the public performance appears reinforced and more effective and efficient in a mix of state and market, able to activate a variety of territorial subjects, resources, and capabilities. Moreover, solutions based on mixes of traditional and more flexible, innovative tools, chosen by a variety of actors, may be

strategically implemented to manage risks in different contexts, maximizing expected results by adapting solutions to local contexts.

In our rationale, public-private cooperation based tools are mainly addressed as an important contribution to the ex-ante reduction of damages and to the increase of systemic safety (Pesaro 2007) more than a possible source of funding to face emergencies. They are able to both promote proactive behaviours and increase the number and quality of interventions to reduce vulnerability and exposure by private households and economic subjects.

A stable and strategically organized public-private partnership produces effectiveness and efficiency in action as territorial resources are better used by competent and skilled subjects and economy/market dynamics are mobilized. If public and private forces learn to work together, the direct and organized involvement of private subjects in disaster management could positively influence:

- ordinary working practices and land use models in a more resilient perspective;
- investments in prevention interventions;
- financial reserves to be used in case of disaster for emergency and recovery;
- tools and practices for enhancing preparedness to disaster management, therefore improving territorial systems capability to face disasters and enhance resilience.

2. Residential system and critical infrastructures interacting with natural extremes: need for a multidimensional and systemic analysis

The type of damages that housing and critical infrastructures sectors can suffer and in part produce is still a research topic. Traditional classifications of damages and losses in fact often fail to grasp the highly dynamic and interdependent nature of failures, due to different levels of vulnerability and copying capacities in exposed systems.

Residential houses are hit by the majority of disasters: earthquakes, landslides, floods, hurricanes have the potential to destroy or severely damage the home of people. Residential houses are one system that is particularly prone to direct physical damage provoked by most “natural” hazards.

Critical infrastructures in their turn are more prone to suffer what can be labeled as systemic damage, usually termed as indirect or secondary damage (Van der Veen et al., 2003; Margottini et al., 2011). Clearly individual components of lifelines can be physically affected, yet, several case studies show that the largest and most significant failures are due to loss of functionality (Menoni, 2001). With a relatively small percentage of physical direct damage, critical infrastructures may experience city or region wide failures, as a consequence of ripple and cascading effects, due to their complex systemic nature (Nojima, 1998). Therefore, critical infrastructures require a different kind of control and regulation that fully reflects the highly dynamic and interdependent nature of failures, at varying levels of vulnerability and copying capacity.

2.1. A prevalent systemic component in an unevenly interconnected world

Linked to the discourse on the type of enchained direct and indirect damages is the systemic dimension characterizing the two sectors.

In the residential housing sector, one cannot limit the analysis to the construction industry, but has to consider also the institutional and legislative framework in which developers act, and the features of the housing market, including the propensity of individuals to move often, or, on the contrary, stay all their life in the same city or region.

In the case of critical infrastructures, the complexity is at its top, as each lifeline is composed in its own by several systems, components, parts, which are physically distributed but also constituted by node like elements. Each lifeline is in its turn depending to different degrees on the others; finally, physical, functional and organizational aspects are tightly connected to each other, as several levels of mutual influences exist between norms, modes of conduct, physical features and shape of networks.

2.2. Multiple stakeholders

Multiple systems are managed by a variety of different stakeholders, both private and public. The arrangements that have been set in the last decades to accommodate the requirements and the interests of those stakeholders are continuously changing. A really stable configuration has not been achieved yet. The presence of multiple stakeholders cannot be neglected as for its implications in the case of a disaster. Actually there is a growing recognition that the traditional approach according to which state agencies prepare for dealing with the aftermath of a disaster, set the rules for preventing its potential consequences in the pre-impact phase and provide the means for recovery is no longer viable. In each of the two sectors, such traditional mode of operations has shown severe limitations. The emergence of a new strategy, seeking less to be prepared for well identified threats and more to augment the capacity to face a variety of stresses, partially foreseeable partially new, can be seen in many countries, that have developed new agencies, new organizations to build what is generally labeled as a more "resilient" society (for example UK Resilience, Medd and Marvin, 2005; or the development of a national disaster resilience strategy in Australia, see Apec, 2010).

2.3. Multiple spatial and temporal scales

Multiple spatial and temporal scales must be considered in a comprehensive analysis of both the residential and the critical infrastructures sectors.

As for the former, laws and codes to protect buildings from some hazards are set at a national level, sometimes agreed upon at an international level, as for the Eurocode in the European Union. Urban planning is certainly a local activity, nevertheless its boundaries and a number of constraints are set in regional or national laws.

As for infrastructures, criticalities emerge often only at larger scales (regional, national), and in order to tackle them a continuous check across spatial scales must be performed. In the case of information this is even more evident: thanks to the internet, a local information has the potential to become global in a very short time. Actually the new means make much more difficult to discern between what has to be considered a local information, and what should be considered as a strategic information to coordinate among different localities, at regional, national or even inter-national scales.

In disasters, not only spatial, but also temporal scales matter. The capacity to enforce mitigation measures before any event strikes influences significantly both response and recovery; the type of instruments, organizations, tools and resources that can be used in the aftermath determine to a large extent the type of reconstruction that will be achieved, which in its turn constitutes a new pre-event phase. In each sector, decisions and arrangements that are made before a disaster are crucial, yet in the aftermath, new, unexpected solutions may emerge that are not totally (or even not at all) determined by what has been prepared before. Such solutions may persist and constitute a new basis for preparedness as well as be forgotten and abandoned after a certain time has passed since the disaster impact.

2.4. A complex knowledge is required to address the systemic components at multiple levels

The existence and relevance of multiple systems, acting and defined at multiple spatial and temporal scales, entails the recourse to complex knowledge, provided by various experts, whose contributions cannot be simply summed up but require to be organized and structured in innovative frameworks.

Public-private cooperation influences the capability and efficiency of information and knowledge production on vulnerability, exposure, and risk. Given that a territorial system should produce the information and other means needed to successfully balance between the demand for safety and the economic resources needed for prevention and preparedness, information and knowledge sharing is essential for reducing overall losses in pre and post crises.

This logically relates to the capability of the system to assign adequate value to knowledge building to be regarded as a concrete contribution to damage mitigation. The funding of hazard management does not imply the provision of financial resources only but also of needed services. Public-private partnerships could therefore be also recognized in stable information exchange activities able:

- to produce more realistic images of the economic and social elements and values exposed to natural hazards,
- to work on vulnerability and exposure decrease,
- to contribute in reducing the costs of information and knowledge building, sharing and maintenance.

The focus on knowledge systems is relatively new among organizations and agencies in charge of disaster risk reduction. An example that can be brought refers to the Indian case. A knowledge management system has been developed by the Indian Government (Ministry of Home Affairs) in the form of a web platform networking between private and public institutions and organizations sharing responsibilities in disaster risk management and reduction (see:

http://nidm.gov.in/default.asp). Quoting Mohanty et al (2006), Seneviratne et al. (2010, p. 4) held that: «knowledge on disaster management strategies appears fragmented, emphasizing a perceived gap in information coordination and sharing. Accordingly, the knowledge and experiences of disaster practitioners are remaining in individual or institutional domain. The lack of effective information and knowledge sharing, and knowledge creation on disaster management strategies can thereby be identified as one of major reasons behind the unsatisfactory performance levels of current disaster management practices».

Un-controlled development in the hazard prone area in Istanbul and the economic cost of retrofitting low quality housing stock

Turkish national policies regarding economic development in the 50s affected significantly the physical, social and economic structure of Istanbul. In 1945 the city's population was 1 078 000, due to its dominant economic role in the 50s this number reached 1 533 000, corresponding to an increase of 42%. Today the population of the city is above 12 million people (SIS, 2008). In the 50s the central government abandoned the idea of developing regional development policies and focused on the economic improvement of Istanbul and its region (Tekeli, 1994). As a result, the city itself and the Marmara Region developed rapidly and attracted population from the entire country.

Regarding to the situation before the 1999 Marmara Earthquake, the first plan of Istanbul had been prepared by Henry Prost between 1936 and 1950 (Angel, 1993). By this plan, a part of the existing housing stock was demolished to open new roads, and industrial facilities were located in the centre of the city. Existing residents of Istanbul moved to the peripheries, as the housing stock in the city centre deteriorated. Central and local governments were unable to fulfil the residential needs of large number of low income immigrants, therefore immigrated population either moved in the emptied, deprived old urban fabric that is located in the hearth of the city, or built their own houses illegally in the peripheries which are mostly situated on areas exposed to floods or to amplification of seismic waves. The squatter housing law in 1966 and the squatter amnesty law in 1976 legalised most of those areas. Furthermore, in 1997, 2 years before the 1999 Marmara Earthquake, Istanbul had indicated as the first priority earthquake zoning. Buildings that were built before 1998 have not been built according to the anti-seismic building code. It was required to retrofit buildings built before 1998, on the basis of a risk prioritization strategy (Erdik, 2003).

Current practices of urban redevelopment imply a heavy economic load both on government and households. For this reason a public-private initiative has been set to mitigate the existing earthquake risk. The TCIP (Turkish Catastrophe Insurance Pool) started to function in 2000 with the support of the World Bank to provide earthquake insurance coverage at affordable rates for all registered urban dwellings. The program is aimed at limiting the government's financial exposure to natural disasters, build long-term catastrophe reserves to finance future earthquake losses, and encourage risk reduction and mitigation practices in residential construction (World Bank, 2006). However the main problems are the high cost of retrofitting and the need to keep the buildings empty for several months during the retrofitting process. Moreover, according to Erdik, "*direct use of TCIP in earthquake risk mitigation, such as the funding of retrofit applications, does not seem to be realistic*", as the rates of the insurances are very low and market forces require high insurance premiums to be effective (Erdik, 2003, p.86). Erdik holds that TCIP has not sufficient funding to cover claims in case of a big event, and at the current financial level it is not convenient to use the insurance pool to fund retrofitting (Erdik, 2003, p.86).

Box 1. Housing and land use changes in Istanbul

3. Public-private interface in the residential sector

3.1. Building codes

For the residential housing sector, the public/private interface with relevance to disaster risk management can be split in two components. The first relates to building codes to make houses resist better to the stress provoked by extreme natural events. It must be said that as it stands for the current state of art, such codes exist only for certain hazards (typically earthquakes or strong winds brought by hurricanes or typhoons) and not for others. This lack of instruments to guide builders can be seen as a gap in scientific advancement and in technical capabilities. In fact, from a theoretical perspective, several countermeasures can be taken to reduce the vulnerability of buildings to a variety of other threats (like different types of landslides, avalanches, storms, cyclones, and even some types of hazards related to volcanic eruptions). Yet experience gained in past events and observations on the ground have not been translated neither in vulnerability indicators nor in prescriptive norms for new constructions. Some projects (see for example Ensure[1]) have tried to systematize the knowledge that already exists to define physical vulnerability of structures and urban fabric to a variety of stresses.

A second limitation of building codes refers to their temporal validity, as they are binding only for new houses built after their inclusion in a law, while the sometimes large built stock that pre-exists remains largely unregulated. In some cases there are guidelines to retrofit traditional/old buildings, but retrofitting is rarely compulsory. Such problem does not affect only old constructions, but sometimes also relatively new as the same discipline of building codes is evolving. New norms are introduced in building codes and areas where such norms were not prescribed now become regulated.

A third limitation depends on lack of compliance with building codes in cases where they should have been enforced. Thiruppugazh (2007/2008) suggests that this was the case for the large number of collapses in the Gujarat earthquake in 2001, in a country where seismic building codes were not only existent but also conforming to the highest standards available in the world. The problem of compliance though is not limited to the Indian case, as earthquakes in Turkey (1999, see also the box on the Istanbul case) and Algeria (Boumedere, 2001) testifies, nor is limited to developing countries, as cases in Italy (L'Aquila, 2009) or the more controversial case of New Zealand (Christchurch, 2010) earthquakes show.

Problems of norms enforcement, or compliance with criteria for constructing hazard resistant buildings are very relevant today; and even more so as the same norms and the criteria according to which hazardous zones are classified, is in continuous evolution. An example can be brought from the recent Italian earthquake which affected three Italian regions and with particular evidence Emilia Romagna in May 2012. Issues of liability have been risen regarding industrial constructions that were mostly damaged and caused the majority of victims. Constructors hold that new antiseismic codes were introduced in the area only in 2003. Judges intend to mount trials for failures and collapses, while builders complain about the overloading of factories and stock centres

[1] See www.ensureproject.eu

far beyond the weight carrying capacity for which they had been designed. In a nutshell, it is a typical example in which traditional regulatory regime fails in providing the wished result, that is the safety of citizens and buildings resistance.

Planned development in the floodplain in London

By the late 1970s, in all cities throughout Britain large empty or semi-empty lands were the results of disused industrial or warehouse buildings waiting for redevelopment (Hall, 1988, p.351). The effect of the national policy to reuse such areas can be clearly seen in the London Docklands. One characteristic of the Dockland, which also makes it different from other redevelopment areas, is its location in the Thames floodplain. Therefore, as a first step construction of the Thames Barrier started in 1974 (EA) as a key structural measure to reduce flood risk. It was opened in 1982 (EA). The cost of the Thames Barrier was provided through the central government funding (75%), the rest provided by Local Government (EA, 2012).

Figures 1 and 2: Changing urban environment in London Canary Wharf, Docklands

Docklands' regeneration shows how private stakeholders intensely operated throughout the London during the 1980s. This domination had been fostered by the deregulation of British financial services in 1986 and was coupled to an unexpected recovery of population growth in central London (Champion, 1987; cited in Parker, 1999, p.199). Afterwards, the Docklands model was extended to the rest of the Thames Gateway to satisfy London's continued growth with the support of the Greater London Council.

When the construction of the Thames barrier began in 1974, climate change and sea level rise were not considered, and this could affect its life and shorten it (Parker, 1995). Thus, the Thames Estuary 2100 project has established to consider the ever changing situations and provide solutions for the next 30, 50 and 80 years.

Although flood hazard probability is changing due to climate change and sea level rise, the main reason of increasing flood risk in London is the *post-defence development* (Parker 1995, p.341) and consequent increase of ownership of goods and property in the floodplain (Parker et al. 1987; Green and Penning-Rowsell, 1989, cited in Parker 1995, p.42). By the regeneration project the pre-existing urban fabric was replaced by *high quality prestige type developments* (Parker et al. 1995, p.13) and infrastructures (Figures 1 and 2). The post-defence development after the construction of the Thames Barrier in the 80s in the floodplain, led to increase both the value of the area and the economic cost of a potential disaster accordingly. In case of a disaster, not only expected direct damages but also indirect damages are going to increase, as a consequence of the growing number of businesses, infrastructure and traffic in the area (Parker, 1995, p.342).

Box 2. New planned development in London

Bosher et al (2007) suggest that the current state of affairs will not improve unless a more spread culture of safety will not become the target of builders and builders associations. Those authors refer mainly to the case of the UK (see also the box on the London case), but it is clear that those problems are not confined to any particular country.

3.2. Land tenure arrangements

The second component that must be dealt with regarding residential housing refers to the land use regulatory regime. There exist a large variety of regulatory approaches and a synthesis is not easy to draw. Table 1 may help understand some of the crucial factors that need to be considered. As for land tenure system (the second column) the most relevant distinction is between private ownership of land, often set as a constitutional right, to totally public land. Of course intermediate situations exist. A distinction which is important as for its potential consequence on disaster risk reduction policies relates to the level of fragmentation of properties. In fact in case of highly fragmented properties it may be difficult to implement risk reduction measures, as for example in the case of retrofitting of already urbanized areas, before or after a disaster. The reconstruction process after the Umbria Marche, Italy 1997 earthquake is emblematic in this regard: significant difficulties were encountered in developing plans for entire urban fabrics or blocks in historic centres that were affected. Several owners were trying to make administrations approve their own individual project, related to one small parcel and even to one individual dwelling within a damaged structure.

The land is public in socialist countries and in some developing countries (for example in Africa). The potential power of public authorities to decide and intervene for the sake of safety and sustainability is often diminished by practical and political constraints. In fact administrative deficiencies (some of which are the indirect/implicit result of bad political will) produce a distortion in land availability, increasing the prices of homes and pushing many to build illegally. Territorial administrations and urban planning agencies hold the crucial responsibility to correctly manage and control land uses be it in a regime of private or public property. No arrangement can be considered as optimal independently from any further consideration of how states actually work and are able to provide planning and administration as strategic services in the community interest.

Different styles of urban and spatial planning frameworks can be found. In the table, four “families” representatives of different settings that can be found in Europe are shown. Such styles of planning are in evolution and it is not easy to keep pace with the highly dynamic transformations that have characterized the sector in the last decades. This may be also the reason why few studies and analyses exist in this field.

Non European developed countries conform to one or another European style, yet coupling elements that descend from the colonial history; many developing countries have only recently adopted one administrative framework, drawn from European or North American model, sometimes with little attention to pre-existing arrangements and especially to the enforceability of norms and regulations that are simply taken from another juridical tradition and make sense only within a certain cultural context.

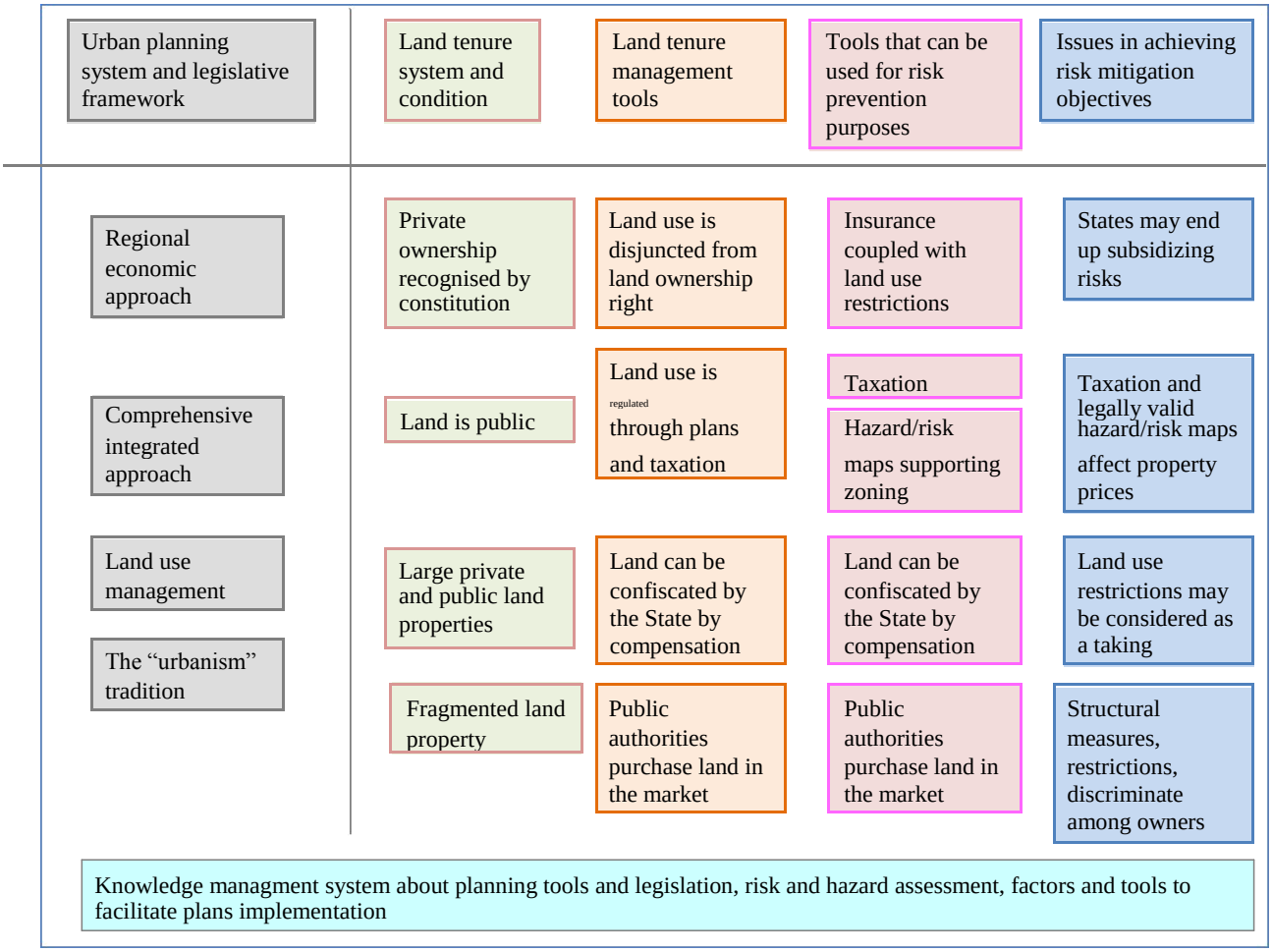

Table 1. Land tenure arrangements and their relationship with risk mitigation

In general it can be said that also in countries where private land ownership is established by law, some limitation to its use must be guaranteed in the more general interest. Social concerns of access to services and shelter, environmental compatibility, reasonable practices of waste treatment and water provision require some intervention to guarantee that land development and use does not conflict with fundamental human, social and environmental needs. Different tools have been developed to manage land tenure as well:

- Land use is disjointed from land ownership right. This in theory functions very well, but in practice this arrangement requires a very strong public authority that has the legal and political strength (and will) to prescribe given land uses in contrast with owners' wish for example to urbanise and build. In terms of risk mitigation the difficulties in actually achieving prevention through land use limitations are reflected by the large number of court trials that exist in countries that have experienced such arrangement. In fact it creates a disparity among owners that is difficult to justify on the basis of risk assessments, that are in their turn affected by uncertainties, evolving as new knowledge and information become available. There have been examples of legally binding hazard maps that had to be retired after strong political opposition by land owners even in developed countries (see May et al., 1996).
- Land use is regulated through plans and taxation; in this case the plan embeds the authority's decision regarding a given area. For example, public administrations can create infrastructures and services so as to attract private investments in safer zones (see Bolton et al., 1986) and/or create

incentives by reducing taxation in safer areas while augmenting them in hazardous ones. This type of regulatory system requires a very strong government, and an efficient public administration able to control and maintain vigilance over time. The French system based on risk prevention plans (PPPR) that prescribe measures as well as issue recommendations to urban planning may be considered as probably the best available. Yet it has been shown that it has its own limitations, particularly when communities challenge public authorities to develop hazardous zones, when the latter are seen as an important economic resource. On the other hand, risk prevention plans are costly to develop and therefore the full coverage of an entire country may be difficult to achieve (see Sanson, 2001). Furthermore, risk prevention plans also prescribe structural measures aimed at defending already urbanized areas. In this case (see Pigeon, 2012), public administrations may even encourage risky behaviors by building structural defenses that may call for further development and provide a false sense of security to citizens. This argument has been brought also by De Marchi and Scolobig (2009) in a recent survey conducted in a Northern Italian region.

- Finally, there exist tools for acquiring land for public purposes. In this regard two main possibilities exist: the state may confiscate by compensating owners for depriving them of their properties or may act as an actor (even though a privileged one) like others and acquire land in the market. Both solutions are restricted in case of large state dept and consequent unavailability of funds for either compensate or buy. The second solution may be favoured as the state intervention is felt as less coercive and authoritarian than the first. Example of such acquisition policies for the purposes of risk mitigation have been attempted in South Eastern Wales in Australia, where the State has progressively bought private properties in hazardous coastal areas with the aim of pulling them out from the market and impede future urban development (see May et al, 1996).

As shown in the fourth column of table 1., direct intervention of public bodies in land acquisition may be used as a tool for achieving prevention complementary to other aims such as creating new infrastructures, green areas, public services. Another important tool that can be coupled to land management is insurance, when restrictive conditions to developing hazardous zones are set as a precondition to insurability, as is the case for the US Federal national flood insurance program (Nfip). The latter provides a rather tightly coupled mix of voluntary adhesion to the program (insurance is not compulsory) with the prescription that public bodies (such as counties, municipalities) be insured for their citizens to get access to insurance. In exchange of entering the insurance provision, public organizations must accept safety standards in the flooding zones as assessed by studies engaged by Fema and detailed to guarantee a one by one parcel identification. In fact the system is risk based: lowering the risk will be rewarded with reduced insurance rates. This system is certainly interesting and was welcome as highly promising when it was introduced in 1968 (Burby, 1998). Nevertheless some negative points emerged after the 1993 dramatic Mississippi floods that triggered a reexamination of the Nfip. The most relevant critique that has been raised relates to the fact that by promoting insurance, the Federal State ended up subsidizing the risk taken by private owners. In fact until detailed studies were ready (which require long time) a rather low premium was set (encouraging risky behaviours); furthermore, the State was also directly supporting private citizens who could not afford the full amount of insurance (Burby and French, 2001).

The last column in table 1. summarizes some problems that may arise in achieving risk prevention through a variety of tools. For example, taxation can be an important leverage for encouraging or

discouraging risk prevention measures. Apart from the most obvious direct differential taxation on zones at higher (or lower) risk, one may consider also policies encouraging retrofitting. As two opposite examples, the reconstruction after the Umbria Marche, Italy after the 1997 earthquake and after the Kobe, Japan earthquake in 1995 can be brought. As for the first, it was introduced in the 1997 fiscal law that any refurbishment of houses involving also seismic retrofitting would receive a strong discount on taxation for the new works; in Japan, instead, buildings renovation and retrofitting particularly in rental apartments was hampered by the fact that to any increase in quality an increase in taxation would have corresponded.

Legally binding hazard and risk maps may affect land prices, creating a disadvantage for citizens that already owned a parcel in the newly identified hazardous area. To an extreme, such maps may become the object of political conflict. In the already quoted Australian case, such maps were retired as promised during the pre-election period by the candidate who got the largest number of votes. As maps, also structural measures defending one zone but not another, restrictions that are imposed on some properties but not on others may create unequal treatment among owners; in particular land use restrictions may be considered as a taking that should be compensated.

An interesting observation has been proposed by Platt (2008) quoting the words of a planner, who uses to ask "*When has a building code requirement ever been challenged as a 'taking'?*". In other words, whilst prescriptions on the way buildings have to be constructed in hazardous zones is somehow accepted at least in principle, limitations on the possibility to develop hazardous areas is considered as a significant impairment in economical development chances of a municipality or region. Different reasons may be considered. On the one hand the fact that decisions regarding land uses are seen as less technical than rules for buildings and therefore more open to public debate; on the other whilst codes can be considered as rather deterministic (even though, more or less explicitly they assume inevitably an "acceptable" risk threshold), for planning purposes hazards are defined probabilistically. And probabilities are often misunderstood or wrongly both communicated by "experts" and interpreted by decision makers. Last but not least because responsibilities are easier to identify in case of building failures than in case of wrong land zoning, or at least this has been the case until present days.

Interests in case of zoning land uses are multiple at various scales, ranging from local to very global and to a certain extent this is true also for residential housing. Differences have been clearly recognized between small private owners of their own dwelling to land developers with no localized vested interest but the wish to make a profit by transforming rural areas into profitable apartments and villas.

Table 1. should be red vertically rather than horizontally, even though loose links exist between boxes along the same line. In fact further research efforts would be needed to fully develop the table and identify the most relevant horizontal links. It can be certainly said that different mixes of arrangements exist, meaning that similar planning approaches may be found in countries that recognize or do not private land property rights; a variety of management tools can be used in combination by administrations to achieve a variety of goals including risk prevention. At the left side of the framework, one should consider the state administrative organisation, that may be highly centralized versus decentralized, federal, regionalized, granting or not large autonomy to the local level. Different kinds of such arrangements certainly influence the strength that different urban and

spatial plans may have. In any case, the financial condition of the state in general and its strength with respect to private stakeholders significantly shape the power relations with respect to land tenure management. What can be said in the times of financial crisis is that "the traditional planning tools, generally top-down oriented and needing huge public efforts in terms of organisation and financial resources, are no longer effective"; "currently, public/private agreements, on a consensual basis, are increasingly used because of the difficulties- both practical and political – in making the public interest authoritatively prevail over the private rights" (Marcińczak and Zanon, 2011).

A side effect of non properly or badly managed land tenure and urbanization in general is illegal housing. The latter is a cumbersome problem particularly in rapidly growing urban and metropolitan areas, which cannot be neglected because of its potential consequences for vulnerability to natural extremes. Traditional forms of regulation of land use have failed to keep pace with change in both developed and developing countries. In many developing countries a framework had to be introduced, many times without considering pre existing informal local arrangements and thus superimposing a legislation that may be considered good in abstract but that will never work in practice. Correctly therefore UN-Habitat (1996) has introduced a sort of classification of illegal forms of land use, distinguishing between illegal in the sense of "not complying with rules that are in any case impossible to follow given the situation or given the bureaucratic arrangements" and illegal in the sense of squatters, occupying marginal lands and deprived of basic services. This classification of illegal situations has important implications as far as physical vulnerability of both the resulting buildings and urban fabric are concerned. Meaning that in order to assess if an illegal quarter is physically and systemically vulnerable a careful analysis must be carried out, in order to appreciate the specific features and characteristics that make it more or less vulnerable.

3.3. Knowledge management as a key component in a private/public partnership involving the residential sector

In the lower part of table 1., knowledge management systems are relevant to all the columns related to land tenure and risk mitigation tools aimed at mitigating risk for households. As for land tenure, it has been discussed (among the others Lyons and Schilderman, 2010) how the lack of cadastral updated systems, the incapacity to track relevant changes in land ownership and use limit the capacity of public bodies to provide reasonable access to land to various social groups and to design services and quality in urban spaces. This lack of information and knowledge sharing capacity is not just technical, but political and reflects the lack of will to contrast powerful stakeholders who hold large vested economic interests in land and land use. Indirectly, not grasping in time the tendency of residential markets in developing certain areas may turn into larger exposure and vulnerability in hazardous zones.

A highly computerized, modern and up to date cadastre is essential for guaranteeing the effectiveness of any strategy based on taxation or regulation. Lacking, obsolete or not updated cadastral information has been identified as a crucial obstacle to reconstruction particularly after destructive events such as earthquakes that may erase the properties subdivision evidences.

The same value of the information attached to individual buildings or to urban areas is different as far as risks are concerned. In the case of buildings, the fact for example that they have been constructed or retrofitted to resist a given hazard augments its market value (May et al., 1996); on the contrary the existence of hazard maps showing that a given parcel is subject to a hazard has been considered detrimental to its market value. Despite of the fact that the relationship between information on hazards and consequences on land and buildings values is not linear nor has been demonstrated once for all in a satisfactory way (see for example Montz, 1992), the integration of hazard maps into the land use planning system has proved to be extremely difficult in most countries where such integration is required by law.

As in the construction sector in land development and redevelopment projects too, norms are not fully or satisfactorily complied with if the motivation of such norms, their implications on exposure and vulnerability are not understood by planners. Without a deeper understanding of the nature of the different hazards that may threaten a given area, planners and land owners will continue to see constraints and limitations as a taking, instead of pieces of information that can be used to achieve a more robust and resilient settlement.

4. Relevance of the public/private systemic interface in the critical infrastructures sector

The interface between the public and private sectors in the case of critical infrastructures is characterized by a smaller variability in institutional arrangements compared to the housing and land use sector. Because of their intrinsic nature, of their extension over large territories, the difficulties in managing them, critical infrastructures have been run and considered for long as a sort of natural monopolies. Some infrastructures in particular, like for example water and sewerage systems are often managed by public bodies.

The production of vital public network services like energy, water and ICT is differently organized across the world in mixes of private and public ownership, management and service provision utilities. This means that decision making processes relating to localization, dimensioning and design of networks are in turn linked to a private rationality facing public interest. Where the private components tend to be prominent (privatization of services), the capability to regulate and control vital services production by public bodies becomes crucial (see, among others, Jamison et al., 2005). An enormous literature has been produced in the last twenty years on this matter but only recently some attention has been focused on the issue of disaster management (see Paton and Johnston, 2006). In lifelines and public /universal services management, natural disasters are treated as a case in which private subjects must promptly intervene in order to reduce disruptions as much as possible. Public subjects are those who set the conditions according to which private companies are obliged to produce essential services to communities affected by a disaster, as in principal-agent models. On the other hand, those private subjects normally compete on a market and a cost increase could result in a more fragile position in time. Consequently private costs arising from a natural disaster are generally directly covered by public bodies (public expenditure) or, more often, are shared with all other users of services not affected by the disasters. This by a tariff-setting system in which private actors include a mechanism (portions of tariff) to pay back the costs of unexpected external events such as natural disasters.

In this apparently stable state of affairs, though, one has to consider the potentially disruptive effect of the privatization trend which has occurred at different degrees and speed in many countries in the last decade. This process may have side effects detrimental to safety and security as shown by Perrow (2007). He suggests that the need to make a profit has introduced a number of weaknesses in the power system, pushing service providers to run grids at the limit of their capabilities, letting little room for redundancy and built in safety in case the system is overloaded.

Furthermore, in disaster situations, problems arise not only in individual critical infrastructures but also as a consequence of multiple failures (even though not necessarily large) that occur at the same time in different systems that are interconnected to each other. For example, the Kobe case has shown how difficulties and the long time needed to recover some utilities, such as water, were due to organizational and systemic rather than physical, technical problems. Traffic congestion or difficulties in accommodating large numbers of technicians needed for repairs were among such organizational vulnerabilities hampering fast lifelines restoration(see Menoni, 2001).

It has to be also reminded that some infrastructures have undergone tremendous technological advancement while other have remained basically stuck to technologies and materials dating back to the Fifties or the Sixties. The coexistence of lifelines with differential upgrading and maintenance quality that are strongly interconnected becomes a source of disruption and malfunctioning during emergencies.

The case of critical infrastructures is emblematic for what has been defined as "systemic vulnerability". Van der Veen and Logtmeijer (2005) suggest that three elements concur to shape systemic vulnerability: interconnectedness, lack of redundancy, and limited transferability. The Tohoku Japan earthquake 2011 is an appalling example of all of the three. As for redundancy, the existence of two separated networks in Japan, the North- Western section at 60Hz and the South-Eastern section at 50Hz had significantly limited the possibility to redistribute power from the South to the North; the interconnectedness of different infrastructures and particularly the dependence of most of them on power implied country wide failures of communication and water systems (for pumping). Transferability of parts of the hit systems, both physically and functionally is limited by Japan being an island, habitable mainly along the costs, and only to a very limited extent in the inaccessible volcanic inland.

In lifelines and utilities infrastructure local characteristics and conditions deeply influence the services design and functioning. Local technical expertise is therefore required to inform decision making from the beginning, which typically exists within the private sector (da Silva 2007). The disaster management subjects will therefore need direct support from private utility managers: a stable partnership with the local private subjects, in such a case, could not only reduce information costs but also enhance effectiveness of intervention in crises and post crises phases. The failure to efficiently and effectively develop arrangements between the private and the public sectors have been witnessed with particular evidence in the handling of the Fukushima na-tech. But also in many other severe disasters, the obligation of each lifeline service to keep a minimal level of provision can be significantly hampered by lifelines interconnections and by the emergency context. Unexpected crises may occur and in such cases the recourse to the obligations written in the contacts between the public authority and the private company running the service is of little use.

Attempts made by public authorities to discharge their responsibility to the private manager do not generally succeed (see again the Fukushima case), whilst full cooperation between public agencies and private organizations to meet the many challenges of a crisis may produce positive crisis outcomes. As an example, the successful handling of the widespread long lasting disruption of the Quebec power grid as a consequence of the severe icestorm that hit the country in 1998 can be mentioned (see Lagadec, 2001).

Due to the crucial importance of lifelines and public services facilities, public bodies' contribution in safety and pre-disaster preparedness investments is necessary. Public bodies may therefore invest resources on reducing vulnerability of key components of infrastructure, particularly those with post disaster significance. At the same time they should be able to influence, when not oblige, critical operational facilities which need to remain functional in the aftermath of a disaster to be located in low risk areas and designed to prevent damage. A certain level of flexibility must be designed in the contract agreements between public agents and private organizations running critical infrastructures to allow adaptation to specific local conditions.

4.1. Knowledge systems to manage the complexity of critical infrastructures

Among the different types of investment to make critical infrastructure more robust and resilient to external stressors, investment in knowledge and information sharing seem essential, yet underdeveloped. At first the need for such an investment has to be recognized: the Italian initiative linking the Central Bank of Italy and critical facilities providers to guarantee the continuity of the financial market (Codise, acronym standing for Continuità di servizio della piazza finanziaria italiana) is a relevant example in this regard. Interestingly enough, the Codise experience has been brought into a report prepared by the World Bank and presented at the recent G20 (World Bank, 2012) forum that examines the costs related to disastrous events and the need to keep them under control, particularly in times of economic crisis. Studies on dependability (see Kyriakopoulos and Wilikens, 2001) have shown since the Nineties the relevance of inter and intra-connections among lifelines and provided a first attempt to model them in a more satisfactory way. In fact, not only an information system is necessary to provide timely and updated information on the conditions of different segments, critical nodes, and plants, but also a deeper understanding of lifelines functioning when a certain level of physical failure occurs but not to the point the entire system is paralyzed. Modelling interaction is one part of the story, the other being the existence of forums as the one suggested by Codise for mutual coordination and cooperation. Shared agreements and protocols cannot be subscribed during the crisis, or, better, the negotiation and technicalities that are required imply large delays and malfunction. Such delays may disrupt significantly the response capacity of entire urban and regional systems even in cases where the physical damage to technical systems is not so severe to impede a reasonable level of performance.

In this regard, shared knowledge development means not just storing somewhere relevant information about assets, materials, devices and personnel for repairs (which still is insufficient in most contexts), but also scenario building. The effort of collectively think about what interactions may arise among systems and how an individual failure may transform into a more generalized problem is part of what is considered here as knowledge building. Public authorities can go beyond

imposition of service guarantees to actually support the interaction and links among companies managing different sectors of critical infrastructures that do not meet or share information on a regular basis. In times of emergency, in fact, it is too late to achieve the best out of improvised interaction. ICT can certainly play a relevant role in enhancing and facilitating not only relevant information retrieval, but also in guiding the involved stakeholders into scenarios modeling and comparison (Comfort, 1994; Plebani and Pernici, 2009).

5. A glance at the future: working with a framework to address vulnerability and resilience in disaster risk scenarios

At first some reflections should be devoted to the relationship between vulnerability, resilience and resources. An interesting link has been proposed by Smit and Petley (2009) between vulnerability and resources, in a figure in which the authors suggest that resources are such within the boundaries of our control capacities, outside of which they become a threat. One may take as an example water: it is certainly a key resource, one which is considered above all as a common, to remain publicly owned and strongly publicly regulated. Yet, depending on our exposure and vulnerabilities, an excess of water constitutes a threat in the form of floods, while too little water constitutes a threat in terms of drought. How the boundaries are defined actually depends on the levels of vulnerability of a given community/society. The concept provided by Smit and Petley can be extended in a more general way to the overall relationship between the three terms. In some cases it has been hold that the existence of critical infrastructures constitutes per se an element of vulnerability. Such statement should be challenged, by considering that an area deprived of resources is certainly more vulnerable to any threat including natural extremes. The mere existence of a resource cannot be considered a vulnerability; on the contrary, what makes it more or less vulnerable is its intrinsic fragility/weaknesses with respect to the threats.

A significant link exists also between resources and resilience: in the aftermath of a disaster a community may or may not find additional, unexpected, innovative, creative resources to adapt and manage the new situation and condition produced by the crisis. Such resources, that are not only "physical" but clearly also systemic, organizational, related to the social and the human capital are a key to identify the conditions and the possibilities of a resilient response (Norris, 2008).

From the considerations above, what emerges is a way of considering the relationship between resilience and vulnerability as only partially overlapping and largely independent (Galderisi and Ferrara, 2011). To be clearer, reference can be made to figure 3.

In the figure the interactions between hazards, vulnerability and resilience across the time before an extreme event strikes, its impact, the emergency phase, recovery, and reconstruction are shown. Despite of the cautions that must be taken in considering such phases as a sort of automatic framing of a calamity (see Neal, 1997) which is clearly not the case, they can be considered as a general reference to identify key concepts and categories which emerge across the impact of an event. Basically, before the event, the mitigation capacity is concerned with a. assessing the potential threats and weaknesses of the system, stretching up to the potential response scenario, given the conditions that can be evidenced at the moment of the assessment; b. taking measures so as to reduce fragilities and enhance the response capacity. To a certain extent whatever in the figure

stands “after” the impact has to be considered in the pre-even phase, with a long view on how systems can be made more robust to natural hazards in the reconstruction.

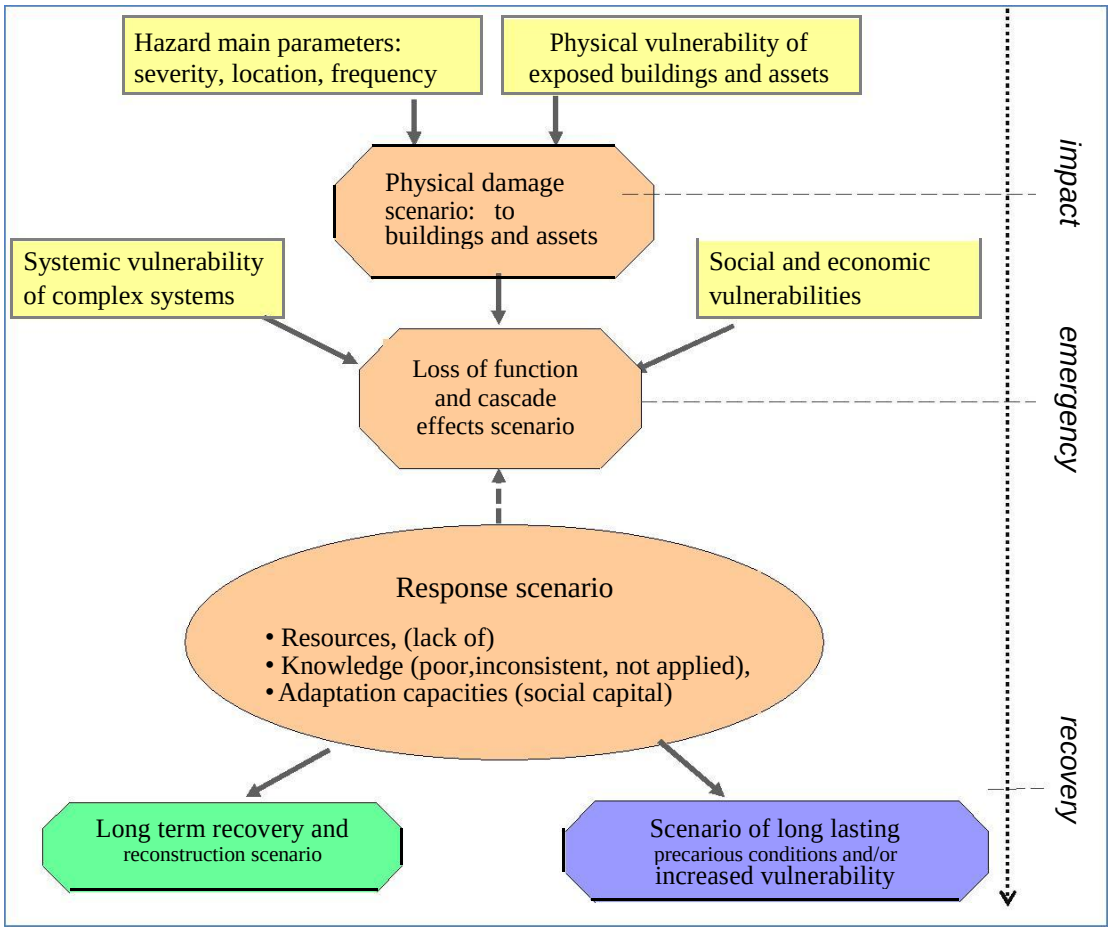

Figure 3. Framework representing resilience and vulnerability across the disaster management phases

At the impact, the physical damage scenario becomes more evident, and within this scenario, damage to residential buildings and critical infrastructures emerge as a significant portion, even though reliable numbers and even statistics are not so easily available (Comerio, 1998; World Bank, 2012). Moving into the emergency phase, the more complete scenario, comprising also cascading and enchained effects due to systemic vulnerability, is the one to be coped with by responders. In some cases, this scenario can be significantly more challenging and disruptive than the reported physical damage would suggest.

The lower part of the diagram represents the main factors comprising the response scenario, where the social and economic systems put in place countermeasures to manage the crisis. Institutional arrangements, social and human capital, financial capital are key aspects to assess whether or not and how well the scenario response will be able to contrast effectively the direct and indirect damage scenario (the “loss of functions and cascade effects scenario”).

The diagram clearly is a rough simplification of reality, one that though permits to highlight the mutual relationships of vulnerability and resilience. In fact, the "loss of functions and cascade effects scenario" depends on both systemic vulnerability and response capacity: the worst cascading failures can be avoided by a correct and timely response even though systemic vulnerability is high. In this part of the framework, systemic vulnerabilities and resilience are considered as strongly interacting. If under the term "systemic vulnerability" one considers also the organizational arrangements that permit a more or less successful management of key assets for facing the crisis, as would be suggested by Van der Veen and Logtmeijer's definition, resilience is in fact its opposite.

As the time from the event passes, other resources may emerge, perhaps not prepared in advance, sometimes unexpected, in the form of external help, or of other institutional or organizational creative responses. In this case it can be held that resilience is independent from vulnerabilities. This idea reflects the empirical observation of communities that are extremely vulnerable to disasters but in the meantime able to respond in a resilient way, transforming the damages and severe disruption into an opportunity for a better reconstruction. In this sense resilience is considered as a concept that does not coincide with the one used in physics: it does not refer to the "bouncing back", but to the possibility of a more sustainable recovery and reconstruction that has the potential to overcome pre-event vulnerabilities and environmentally unsustainable practices.

5.1. Final considerations on the building of resilience in the three sectors of residential housing, critical infrastructures, and information provision

Should this interpretation of the relationship between vulnerability and resilience, rather controversial as demonstrated by Cutter et al. (2008), be accepted, some key points should be drawn. The first one, and perhaps most important for the implications to the public/private interface, is that while vulnerabilities can be reduced through regulations and norms, resilience requires a different approach, more oriented towards the creation of cooperation and voluntary agreements.

As for the two sectors that have been considered in this paper, the following can be derived from the statement above. The residential building sectors can be (and in fact is) regulated through codes that dictate how design and construction should take into consideration additional stresses provoked by natural hazards. In this regard, developing regulations in a "all hazards" approach would represent a major improvement with respect to the current situation. Yet, as already discussed, forms of public/private cooperation, involving builders associations, enlarging community awareness mechanisms are very important to enhance resilience, by creating a condition in which land use limitations and buildings regulations will not be felt only as an "external" obligation but as part of a spread understanding of the nature of hazards and the threat they pose to the built environment.

In the case of critical infrastructures, current arrangements are already designed to create public authorities with the power to prescribe conditions of service even in crisis situations to managing companies. Nevertheless, it is also widely recognized that only by mean of control mechanisms it is virtually impossible to guarantee even the basic level of service essential to carry out emergency interventions. Other, more flexible forms of coordination and cooperation under the umbrella of

mixed private/public bodies, are necessary as well. The case of Codise in Italy, of the American Lifelines Alliance (see: ALA, 2006) in the US can be quoted as significant examples. Such forms of cooperation cannot eliminate the possibility of critical infrastructures collapse, but create the conditions for a faster response, sharing the responsibilities, thus creating resilience.

Why should private companies cooperate with public bodies in the information and knowledge production? Among others, nowadays Social Corporate Responsibility can play a relevant role. The motivation for private sector companies to assist in natural disasters are broad (Johnson, Connolly and Carter, 2010). Apart from an action intended to protect their assets, employees and stakeholders, and to give relief to their customers and target communities, private companies often recognize that they have a moral responsibility to be good 'corporate citizens'. Such activities therefore become the contents of Corporate Social Responsibility investments (in many cases in a marketing approach).

Investing in knowledge creation, sharing and maintenance has been recognized as crucial for modern economies and business organisations (Simon, 1999). Among the fields where enhanced knowledge is required, risk assessment and management practices has proved to be increasingly relevant in the last disasters that have hit also important economic sectors. On purpose knowledge of risks and not of hazards is considered here, as stakeholders should pay increasing attention to the interaction between "natural" stressors and human and territorial systems.

New powerful platforms exist today to assist in sharing and developing such knowledge across sectors and stakeholders. Until now the power of modern tools, such as interactive web services have been considered mainly in the crisis phase, highlighting the possibility for remote actors to intervene with relevant information and results of sophisticated computations. However, as suggested by Nolon (2006), ICT advanced tools could be used also for raising awareness about existing threats and risks among a variety of stakeholders. Why not thinking that the potentialities of the new technologies and the rapidly dramatically increased capacities of representing territories in the digital earth (Craglia et al., 2008) could be used to guide communities into a more advanced consideration of the relationship between natural hazards and land uses? Physical damage and even more "complete" scenarios (Goodchild, 2011) might be visualized in the next future. The digital earth may provide the support to assess how different options regarding zoning, location of critical infrastructures and strategic facilities, density of houses may change expected scenarios.

As an example, the case of the Chile earthquake in February 2010 as reported in the World Bank's quoted document (2012) can be considered. Apart from the significant involvement of private actors in crises and post crises, during the first year of the reconstruction process, several public and private entities developed 25 studies of master plans for the main urban areas along the southern coast that were affected by the tsunami, with the objective of integrating and coordinating not only the reconstruction projects but also the risk reduction strategy with a long-term holistic vision.

The final goal should be to stabilize the partnership in the medium-long term. A stable and strategic public-private partnership implies the development of tools and intervention means capable of making cooperation a structural element of the system of hazard management and resilience enhancement. Spot voluntary interventions should of course continue to be welcomed but a real strategy should provide for voluntary schemes or other models to formalize cooperation and

partnership in the long period. The idea is of course not to reduce variety but to try to organize it in more recognizable frameworks (like in environmental protection systems).

Like in the environmental protection field, stable cooperation between private and public subjects can result strategic not to lose too much resources (related to time and economic and human costs of interruptions) where command and control regulation alone fails. As Auerswald et. al (2006) say

"*the challenge for public policy is to find a way for the government to provide incentives to the private sector to invest adequately in security (including both technical designs and management practices*)".

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