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Preface
"Natural hazard resilient cities"

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1 Is the resilience concept a solution for sustainable natural hazard management in an urban environment?

Even though a large number of hazard management techniques are not really innovations, the current period is characterized by a certain number of phenomena that may lead to calling the traditional model seriously into question. Must hazard management remain essentially based on restrictions as to the use of land, and must hazard management logics remain dependent on risk assessment? Have the powerful "engineering" factors underlying development of structural measures on the virtually unique basis of risk assessment been progressively diminished?

Whereas the notion of resilience is developing rapidly both in current developments and in the scientific world, research scientists[1] are observing a lack of any methodology and research on characterizing urban resilience. Scientific studies on implementing urban resilience are few and far between, and this special number endeavours to fill the gap by being devoted to principally presenting the methodology of study.

In this introductory article, we would like to resituate contributions in their historical and ideological context and draw conclusions – the main concepts that seem to be appearing in resilience in action.

[1]This observation was clearly explained by the researchers present at the initial sessions associating natural hazard and resilient cities at the annual congresses of the European Geosciences Union in 2010 (NH9.13: Natural Hazard Resilient Cities) and 2011 (NH9.11: Natural hazard resilient cities: methods and tools to qualify and quantify)

2 Resilience – a totally different concept?

Resilience is not a new concept; the term "resilience" was used in physics in the 1960s. In the field of ecology, the main question to which an answer needed to be given in the 1970s and 1980s was how to define the sustainability or the persistence of a complex ecosystem. It was in this context that Holling introduced the concept of "resilient systems" in 1973 (Holling, 1973). A system is resilient "if it survives shocks and disturbances from the internal and/or external environment" (Vickers, 1995), quoted in Paquet (1999). In 1973, Holling defined resilience as "the magnitude of disturbance that can be absorbed before an ecosystem changes its structure." The time needed for returning to an acceptable state of operation is also associated with resilience (Dauphiné and Provitolo, 2003). In the field of economics, Paquet speaks of "the intrinsic capacity of companies, organisations and communities to return to a state of equilibrium" (Paquet, 1999): resilience appears to be the key to sustainability. In the field of social sciences, researchers make a distinction between *passive resilience* and *proactive resilience*.

It is sometimes difficult for certain nations to integrate this resilience concept. The term's ambiguity provides a reason for a large number of debates and reveals all the difficulties in its implementation. In France, it was not until 2000 that C. Aschan-Leygonie offered an excellent synthesis on the resilience of space systems. The objective of her work was to "explore the possibility of adapting the concept of resilience, as it is conceived in ecology, to geography and more particularly to the dynamics of a space system" (Aschan-Leygonie, 2000). The concept of resilience is analysed on the basis of an exclusively anglophone bibliography (Aschan-Leygonie, 2000). Since the beginning of the 21st century, syntheses have appeared that try to define the term "resilience" in an

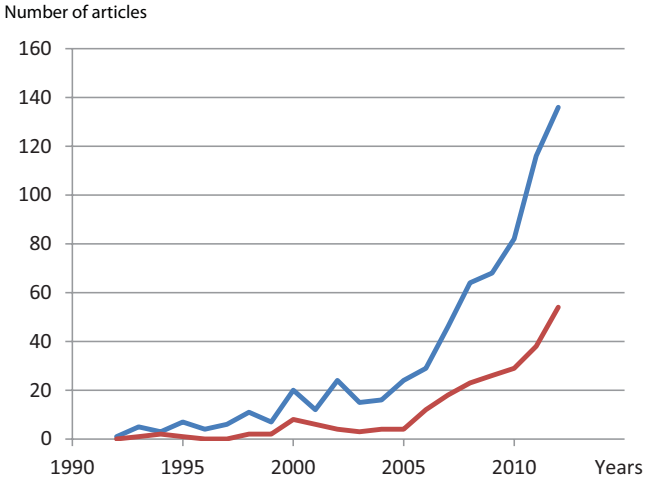

Fig. 1. Data from the Web of Science.

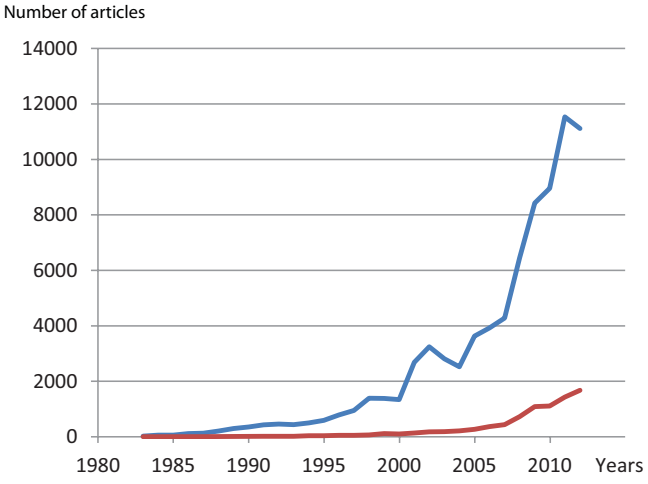

Fig. 2. Data from the Factiva database.

urban development context and to identify a number of innovative examples (Djament-Tran and Reghezza, 2012; Serre et al., 2013; Richard et al., 2007; Zevenbergen et al., 2011; Vale and Campanella, 2005). Resilience is a promising solution to the recurrent difficulties encountered in managing hazards in urban environments, but the conditions for its use and its relevance in an operational context must be questioned (Reghezza et al., 2012).

3 From the concept to the way the term is diffused in fields of research and the press

Various authors observe that, at present, the term’s use is increasing rapidly in geography and planning (Serre, 2011; Reghezza et al., 2012), and sometimes it is even qualified as a *buzzword* (Comfort et al., 2010). In just a few years, the resilience concept has become the central concept in hazard management, especially in anglophone countries (Vale and Campanella, 2005). The evolution of this notion can be analysed by means of databases referencing scientific publications or the press. We have selected two of them:

- Web of Science – a scientific database that gives access to references for articles appearing in over 10 000 multidisciplinary reviews (science and technology, social and economic sciences, human sciences, arts, etc.) and 120 000 conference proceedings.
- Factiva – a database concerning international news giving access to complete texts from most of the non-specialized press such as *Mediapart*, *Libération*, *Le Figaro*, *Les Echos*, *The New York Times*, *El País*, etc, and the economic press from over 150 countries.

The queries entered into this database were limited to the fields of geography and regional planning. In view of the enormous amount of data on queries combining a selection of terms from fields covering planning, geography and urban development with resilience, a sampling operation was carried out. For the analysis of the use of the term outside research, the same queries were entered into the Web of Science and Factiva database. Figures 1 and 2 show the occurrence of the word “resilience” in two different manners. The figures identify on one hand, in red, the number of articles (after sampling) that integrate the terms of planning, geography or urban development (or land use planning, town planning, urban planning, urban design, spatial planning, geography, geology, geomorphology, territorial development or urban development – as well as their translations into French); on the other hand, in blue, the number of articles matching the same criteria, after adding the terms “territory” and “city” to the list (or land use planning, town planning, urban planning, urban design, spatial planning, geography, geology, geomorphology, city, territory, territorial development or urban development –as well as their translations into French). Analysis performed on the Web of Science (Fig. 1) gives a view of the way these notions are used in fields of research. It appears that curves have become steeper since about 2005. The term resilience has increased its penetration for 2005. For example, the book Resilience Thinking: sustaining ecosystems and people in a changing world (Walker and Salt, 2006) was a big success; it suggested that the concept of resilience became a norm, and this book is recognized as a starting point of such occurrence of the word “resilience”. Results from the Factiva database (Fig. 2) show that use of the term resilience is also recent.

How can the growing use of the notion of resilience be interpreted in increasingly complex and vulnerable technological societies as observed by Boin et al. (2010)? If the emergence of the term of resilience is recent, this evolution may be justified on several counts: transformation of

the meaning of the term resilience over the last few years, the increasing complexity of urban systems, the evolution of practices in planning or even the more operational impact of the concept of resilience compared with that of vulnerability (Barroca et al., 2013).

4 Implementing resilience – lessons to be drawn from this Special Issue

This Special Issue "Natural-hazard-resilient cities" contains eight articles. Amongst these articles, one of them is a short communication (Toubin et al., 2012). The teams that have contributed to this number come from different types of laboratories. The following are to be found amongst the different disciplines represented:

- civil engineering,
- town planning and spatial development,
- geosciences,
- geography, and
- geo-information sciences.

Several types of hazards have been tackled in this special number. First and foremost, we name that hazards that are sensitive to questions linked to climate change (e.g. heat waves) (Tromeur et al., 2012). However, above all, it is the predominance of flood hazards that is discussed in six articles (Mebarki et al., 2012; Gersonius et al., 2012; Toubin et al., 2012; Beraud et al., 2012; Lhomme et al., 2013; Eleutério et al., 2013). Lastly a multi-hazard approach has been developed in the article by Djalante (2012).

However, even though the flood hazard may appear to be predominant, it must be remembered that the concept of resilience is at the heart of all these research subjects and that the hazard, no matter whether it is flooding or anything else, constitutes nothing more than a study case or a possible illustration of the resilience concept and its territorial application. On account of its size, its topicality and its social and economic cost, flood hazard has been named as the critical issue at stake in most of the territories studied in this special number. This approach via flooding could have been replaced by other types of hazard, or even by multi-hazard approaches (Gersonius et al., 2012; Toubin et al., 2012; Béraud et al., 2012; Lhomme et al., 2013; Euletério et al., 2013).

Looking at the different contributions presented in this special number, the type of hazard does not seem to be a determining factor for characterizing urban territories' resilience. It appears that resilience is essentially based on finding appropriate scales and data with systematic approaches made by interdisciplinary teams. As a result, resilience is to be found at the intersection point between the different disciplines as presented in the diagram below.

5 A new approach or composite risk management?

From a scientific point of view, contributions reveal that resilience in a strictly monodisciplinary approach (as in a solely engineering approach) does not appear to be appropriate for studies on urban environments (Serre, 2011). With transdisciplinarity, global diagnoses that are integrated into urban issues can be made, dependency factors can be identified (Toubin et al., 2012) and the most appropriate means of action can be found. Letting engineering implement urban resilience and critical infrastructure resilience all by itself,amounts to taking the risk of reproducing past errors. Fukushima is still there to remind us that the engineers thought they were capable of protecting themselves from natural hazards by building accurately sized protective dikes and anti-earthquake measures[2].

In order to analyse the resilience of urban systems, approaches must be transdisciplinary – especially for enabling the following:

- New tools to be mobilized: resilience studies go beyond the normal methodological framework used by contributing teams coming from different types of laboratories. As a result, functional analyses and graph theories are some of the tools used for works connecting resilience, towns and their operation.
- These tools and methods to be developed and adapted to urban systems: mobilizing methodological tools, which are not normally used by these research scientists, reveals the need to adopt new approaches, to upset old habits and to invent new ones.
- Validations to be made: to become operational, the approaches presented in this number need to be adjusted, developed further and tested.

The articles brought together in this number offer innovative methodologies, but when taken globally, they suggest that the development of resilience does not call traditional hazard management completely into question. Protection does not disappear, and it would appear that the tendency is towards implementing various combinations to compensate for weaknesses. Furthermore, the forms of organisation, operation and control are not fundamentally called into question, as is also the case for participants' involvement. The need for a new approach in hazard management is not accepted at present. As far as resilience is concerned with its adaptation, resistance and avoidance aspects, it must necessarily be conceived in a transdisciplinary approach.

Therefore, it appears appropriate to continue exploring risk management by decompartmentalizing monodisciplinary approaches so that resilience can achieve its "full

[2]Built to provide protection against a wave 5 m high and to resist an earthquake of level 8 on the Richter scale. In March 2011, the level 9 earthquake and the tsunami wave 15 m high (locally 30 m) directly hit the nuclear reactor located 50 m a.s.l.

potential”. Moreover, in the near future, the Vertig*O* and *Sapiens* reviews will be publishing special numbers also contributing to making research advances in the topic of “natural-hazard-resilient cities”.

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