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Multiple interpretations of resilience in disaster risk management

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Abstract

Resilience is a key term in disaster risk management (DRM). However, resilience is interpreted in a variety of ways that can seem inconsistent and there is significant academic debate over definition of the term. This paper summarises the problems of resilience definitions, highlighting the key aspects where there are differences in interpretation. In light of these differences, a conceptual framework for examining multiple interpretations of resilience in DRM is presented. The paper suggests that a strict consensus on the definition of resilience is not practical or perhaps not even possible. Adopting the concept of resilience in a range of contexts inherently requires some flexibility in meaning. The proposed framework encourages an acceptance that there are multiple, valid interpretations of resilience. It is designed to promote cross-disciplinary understanding of resilience in DRM.

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Keywords: Resilience; disaster risk management; conceptual understanding

1. Introduction

In the past decade, resilience has emerged as a guiding principle for urban development and disaster risk management (DRM). However, the interpretation of resilience as a guiding concept is context dependent and open to interpretation. In engineering, there is a tendency to view resilience as a property of materials and infrastructure. This is typically associated with physical intervention, or *structural* measures, for disaster risk reduction (see United

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Nations International Strategy for Disaster Reduction (UNISDR) (2009) for full terminology). However, policy frameworks, organisational and community capacity (or *non-structural* measures) are also key components of resilience in DRM. There is not always consensus or clarity over the needs for both *structural* and *non-structural* measures.[†]

The aim of this paper is to address the problem of the multidisciplinary interpretations of resilience in DRM. It attempts to address the lack of methods for making sense of how different interpretations relate to each other. In Section 2, this paper summarises issues of definition in four key categories: precision, circularity, context, and incomplete knowledge. These categories are borrowed from a framework developed in another field. Section 3 then presents a conceptual framework that helps to manage some of the fundamental problems of definition. It classifies the key components that shape the application of resilience in DRM and the contextual factors that may influence the nature of the application. The idea for this framework is derived from a study in linguistics. Example case studies demonstrate how the framework can be applied. This is followed by a discussion (Section 4) of the potential usefulness of the proposed framework and how it may be further developed and refined. Concluding remarks reflect on the benefits of the proposed framework.

2. Definition of resilience

2.1. Problems of definition

Resilience has both literal and figurative definitions. Literal applications are associated with the action of rebounding or the physical property of elasticity. Resilience in disaster risk management is a figurative application, referring to: "*The quality or fact of being able to recover quickly or easily from, or resist being affected by, a misfortune, shock, illness, etc.; robustness; adaptability*" (OED online, 2014). However, problems arise when this strict terminology is interpreted in different contexts, even across disciplines within the field of DRM.

Lucini (2014) highlights different types of resilience: ecological, environmental, institutional, infrastructural, organisational, economic, social, community, familial, and individual – all of which are relevant to DRM. This paper focuses on the built environment, the organisations that manage it and the communities it supports. Familial and individual resilience is more sociological and psychological phenomenon, which is a step removed from this discussion.

The debate over the diverse applications of resilience suggests a need to understand the underlying theory and interpretation of the term. To provide an overview of definitional problems, this study adopts a classification structure developed for analysing terms in physics. Through content analysis of the *Feynman Lectures,*[‡] Wong, Chu and Yap (2014) developed four key classifications of problems of definition: precision, circularity, context and incomplete knowledge. These are described in Table 1 below. Wong, Chu and Yap suggest these classifications not only help to analyse definitions of concepts, but they may provide a new perspective on the problems of definition and act as a basis on which to discuss them.

Recent reviews of the concept of resilience already provide a good in-depth discussion of the multidisciplinary history of the term and reasons for debate over definition. These reviews highlight a range of different issues and it can become difficult to consider how they may be addressed in a meaningful way. These issues are categorised in Table 2, according to the problems of definition outlined in Table 1. This helps to summarise the issues, provide a basis on which to discuss the underlying problems of definition and to consider ways to move forward.

[†] Note, DRM is defined as: "*The systematic process of using administrative directives, organizations, and operational skills and capacities to implement strategies, policies and improved coping capacities in order to lessen the adverse impacts of hazards and the possibility of disaster*" (UNISDR, 2009, p.10).

[‡] A famous lecture series delivered to undergraduates by physicist Richard Feynman in the 1960s. The lectures are now in a textbook, which has recently been made freely available online. Feynman's analysis of concepts focused on definitions (Wong, Chu and Yap, 2014).

Table 1. Problems of definition, adapted from Wong , Chu and Yap (2014).

Problem of definition	Description
Precision	The definition is imprecise due to an ill-defined or undefined feature. The feature may be an object, theory, equation, or condition.
Circularity	The term being defined appears in the term that defines it (self-referencing) or a there is a problem of logic where one term is defined by another and vice versa (circular reasoning).
Context	Words can have different meanings depending on circumstances in which they are applied. This can lead to multiple definitions depending on the application or discipline.
Completeness of knowledge	The definition is unclear due to incomplete theory or knowledge.

Table 2. Problems of definition as applied to the concept resilience in DRM.

Problem of definition	Evidence of the problem discussed existing reviews of the concept of resilience
Precision	• There is lack of consensus on defining features. For example, resilience may be defined as a process or an outcome (emphasis has been moving towards a process definition) (Manyena, 2006).
	• Resilience has been described as an outcome, a state, a property, a process, or some combination of these terms (Reghezza-Zitt *et al.*, 2012).
	• Resilience may be defined as a system attribute or an umbrella concept that encompasses other attributes. The umbrella concept is not defined in a way that supports planning or management (Klein, Nichols and Thomalla 2003).
	• It is uncertain whether resilience applies to individuals, communities, physical infrastructure or the structure of institutions (McEntire *et al.*, 2002; Manyena, 2006) (this is also an issue of context).
Circularity	• Resilience can be seen as a factor of, or the inverse of vulnerability (Klein, Nichols and Thomalla, 2003; Manyena, 2006; Reghezza-Zitt *et al.*, 2012).
Context	• There is a range in scale of application: individuals, communities, cities and nations can have resilience (McEntire *et al.*, 2002; Manyena, 2006).
	• Resilience on one scale does not imply resilience on a different scale (Reghezza-Zitt *et al.*, 2012).
	• Institutional and organisational dimensions of resilience will be influenced by cultural, political and social systems (Garschagen, 2011).
	• Cultural and psychological attitudes are a frequent focus of discussion. Some definitions link resilience to urban planning, building location and construction (McEntire *et al.*, 2002).
	• Urban resilience has four perspectives: ecological, hazards and disaster risk reduction, urban and regional economies, governance and institutions – each focusing on different components of the urban environment (Leichenko, 2011).
	• A crisis (or disaster) can increase uncertainty and impacts on the timing and the normal "rhythm" of decisions. It can be difficult to decipher between adaptation, resilience and inertia (Reghezza-Zitt *et al.*, 2012).
Completeness of knowledge	• Resilience has "gained currency" without a philosophical basis and clarity of application. A variety of authors have put forward different bases or principles of resilience (Manyena, 2006).
	• Throughout history, resilience has been used in a range of ways, from describing material property through to being a concept for a body of thought (Alexander, 2013).
	• Resilience as applied to social systems is inherently different to ecological systems - humans have the capacity to anticipate and act proactively (Handmer and Dovers, 1992).
	• Some interpret resilience as the ability of a system to maintain or return to a stable state (i.e. ability to absorb change). Others allow for the possibility of transition between multiple states (Reghezza-Zitt *et al.*, 2012).

The problems identified in Table 2 can be summarised into common themes:

- **Precision**: The fundamental form or mode of resilience may be framed as an outcome, process or physical property. It may relate to physical features, political strategies or less tangible concepts such as community capacity. The concept may then be applied to a range of objects – from individuals through to organisations and infrastructure systems. This lack of precision links to problems of completeness of knowledge.
- **Circularity:** There can be an element of circular reasoning where resilience can be seen as a factor of, or the inverse of vulnerability.
- **Context**: The definition of resilience is influenced by the scale and location of application, cultural context and timing in relation to crises.
- **Completeness of knowledge**: Interpretation of resilience in a range of disciplines has led to competing views and uncertainty around how 'resilience' should be described and measured.

2.2. Addressing the problems

Given these definition problems, resilience may be viewed as "too vague a concept" to meaningfully contribute to disaster risk reduction (Manyena, 2006). Yet continuing use of the term, despite ongoing issues outlined above, suggests otherwise. The most relevant and unifying definition of resilience in the field of disaster risk reduction is that of the UNISDR, where resilience is defined as: *"The ability of a system, community or society exposed to hazards to resist, absorb, accommodate to and recover from the effects of a hazard in a timely and efficient manner, including through the preservation and restoration of its essential basic structures and functions"* (UNISDR, 2009, p. 24). The inclusion of supporting functions in community and society here clearly moves resilience beyond scientific analysis of systems and brings to attention the role of governance, institutions and the ability to gather knowledge and learn (Olsson *et al.*, 2006; Davoudi, 2012).

This supports the notion that rather than seeking precision and completeness of knowledge through a unifying theory, the diversity of the concept of resilience is something to be embraced. This is recently discussed by Fekete, Hufschmidt and Kruse (2014) and reflected in definitions that capture alternative versions of resilience, such as Holling's (1996) *engineering* and *ecological* resilience. Embracing diversity first means accepting the different interpretations, then integrating them as part of an overall approach to DRM. Past paradigms of DRM relied on physical resistance to hazards. There is now more emphasis on strengthening community capability in other ways (Spurway, 2011) – that is, the *non-structural* approaches to reduce risks. Yet, developing resilience of physical infrastructure systems is vital to the recovery of urban environments after disaster (Chang *et al.*, 2014). The reality is that both *structural* and *non-structural* approaches have value; the challenge is in finding the correct balance.

In summary, our proposed solution to some of the fundamental problems of definition requires an acceptance that there are multiple, valid interpretations of resilience in DRM. There are limitations to this in that resilience must in essence relate to the basic lexical definition. For DRM, the UNISDR definition is a good starting point. It can be considered the core concept of the conceptual framework presented below. The framework incorporates the idea of diversity through categorising multiple interpretations of resilience as part of a broader concept. The framework also addresses issues of context by highlighting the factors that shape the setting in which 'resilience' is used.

Note that circularity presents a specific issue with regards to the relationship between the terms resilience and vulnerability, which is the subject of academic debate. We suggest that greater clarity over the application of resilience itself would help to address this issue. We will not be addressing this further in this paper.

3. Conceptual framework

3.1. Developing the concept

The idea for this framework derives from linguistics research by E .R. H. Waage (2012) that investigated the meaning of the Icelandic concept of landscape: *landslag*. Like resilience, *landslag* has a long history of use and it has been subject to change in meaning. As part of the research, Waage carried out a detailed analysis of the term

land in a group of medieval Icelandic texts. The findings of this analysis summarise the different conceptions of *land* in a framework of concentric circles. *Land* is the core term and the outer circles separate land into three categories then three sub-categories. Compound words (containing the word *land*) found in the text are then linked with the relevant sub-category, as presented in Figure 1a. Each layer of the hierarchy refines the definition towards alternative interpretations in compound words. In an attempt to set out how resilience may be better understood in the context of DRM, we have built on the idea of such a framework, as shown in Figure 1b. The adapted framework has an extra layer of categories, but does not go as far as identifying specific words or related terms (although this is a possible addition that could be explored). The hierarchy is also applied in a slightly different way. Two main categories (*application* and *context*) are divided into secondary categories, each of which forms a key element of any interpretation of resilience in DRM. It is at the tertiary category level where interpretations will differ.

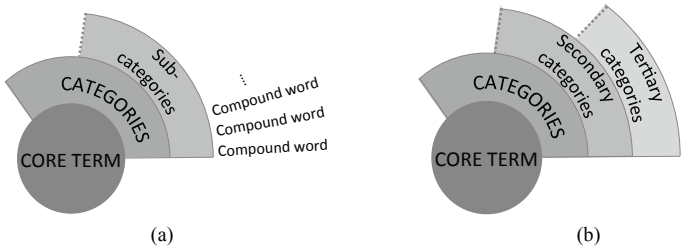


Fig. 1. (a) Outline of conceptual framework used in Waage (2012) (b) Adapted framework used in this paper.

Following this framework structure, Figure 2 presents a categorisation of resilience. The categories were established through an iterative literature review covering a range of texts focused on resilience in DRM. Key themes of the reviewed papers include: philosophical, etymological and conceptual reviews of resilience; infrastructure resilience assessment; community resilience assessment; planning case studies; and, reconstruction case studies. The draft framework was tested through a more detailed content analysis of selected case studies reported in literature, the results of which are presented later in this section.

The framework is shaped around two aspects of *application* and three *context* factors. The *application* aspects relate directly to how resilience may be applied, these are assigned the terms *perspective* and *object*. *Perspective* relates to the emphasis given to *structural*, *organisational/institutional* or *sociopolitical* realms. *Object* describes the object or mode of resilience under question – whether it is seen as an element of *governance* (which tends to be associated with a decision *process*), a *system property* or a *physical property*. The *context* factors may influence what modes of resilience are emphasised. The *chronological* factor highlights the division between a *pre* or *post disaster* context. The *societal* factor refers to the level of development of the location, represented by a separation between *developed* and *developing* countries. The scale indicates a focus on *local/community* or *city/regional* conditions. The *context* factors are somewhat external to the definition of resilience itself. While a truly holistic approach would embrace all of the tertiary categories of *application* the *context* factors may vary according to the situation. Note that any one application of resilience will embody at least one tertiary category within each secondary category, as demonstrated in the examples that follow.

3.2. Applying the concept – literature case studies

Literature-based case studies were used to test the validity of the framework and usefulness of its application. The process involved a manual content analysis of the text, searching for explicit and implicit references to the key aspects of application and context of resilience outlined in the conceptual framework. Table 3 provides a brief summary of a sample of cases. Figure 3 summarises the cases in terms of the conceptual framework, highlighting the differences in interpretation of resilience. While this is a limited sample of the literature, the examples help to demonstrate the diverse way in which resilience is interpreted in DRM. The remainder of this section briefly explores differences in application of resilience in these cases.

Fig. 2. Conceptual framework of resilience in DRM

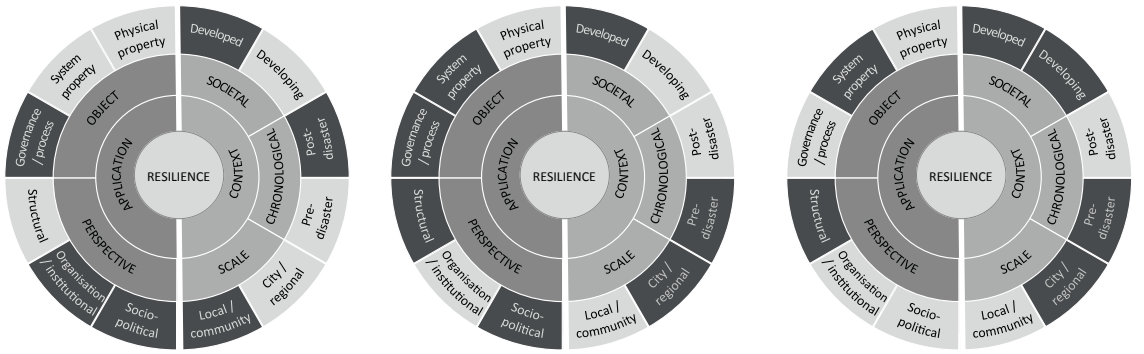
Table 3. Case studies used to test applicability of the conceptual model

Document	Summary	Definition of resilience
"Resilience: a capacity and a myth: findings from an in-depth case study in disaster management" (Kuhlicke, 2010)	Focuses on capacities of people coordinating disaster response. It presents the 'myth of resilience' concept and how the 'myth' can serve to create a worldview that justifies certain decisions. It discusses use of the term 'resilience' in hazard and disaster research, then frames the 'myth' as a way of sense-making in a post-disaster environment. This is applied to a flood response case study in Germany.	"The 'myth of resilience' is defined here as a way of retrospectively making sense of radically surprising discovery of something entirely unknown (nescience) by explicitly referring to the capacity to deal with rapid and radical change as well as having the capacity to survive and even benefit from this change." (p. 65)
"Infrastructure resilience to disasters" (Chang *et al.*, 2014)	Develops a framework for characterising the infrastructure vulnerability of a community and its resilience to disaster. The process relies on eliciting expert knowledge. It applies the methodology to a case study in Vancouver, Canada, addressing both earthquake and flood scenarios.	The paper presents Bruneau *et al.*'s (2003) 'loss triangle' concept to describe resilience within infrastructure systems. It then says that: "To foster infrastructure resilience, research is needed that links urban physical systems with human communities, that supports the information and communication needs of infrastructure organizations, and that directly addresses infrastructure decision making at the urban and regional scales." (p. 419)
"Incorporating resilience into sustainability indicators: an example for the urban water sector" (Milman and Short, 2008)	Develops an indicator framework for resilience for supporting both an understanding of the state of the system and providing a warning of potential problems. A "Water Provision Resilience indicator" set is developed and tested on two case studies. The process relies on eliciting expert knowledge of the networks. This framework is applied to both developed and developing country case studies.	Resilience is "the ability of a system to maintain (or improve) upon its current state over time." (p. 758)

Kuhlicke's definition of resilience (see Table 3) is a significant stretch of the lexical definition of resilience, even in its metaphorical sense. This provides an interesting example of the breadth of application of resilience in DRM. The case study presented by Kuhlicke is focused on employee sense-making at a local municipality and the impact their decisions had on institutional arrangements in a post-disaster context. The aim of the paper is to highlight

"diverging interests and social and political conflicts" (Kuhlicke, 2010, p.62), signifying a strong socio-political framing. Kuhlicke suggests a negative side to resilience, where it may be used to promote hidden agendas.

The remaining two examples are primarily focused on the resilience of infrastructure systems. They have a common feature in that they both gather information through seeking expert judgment. Chang *et al.*'s (2014) approach is based on facilitating multidisciplinary discussion across different stakeholders to share knowledge and create a more informed understanding of infrastructure interdependencies. Despite a focus on infrastructure, Chang *et al.*'s overall framing of resilience clearly acknowledges both structural and non-structural elements. Milman and Short (2008) have a slightly different approach. Their use of expert judgment is to inform the development of a Water Provision Resilience indicator. While this indicator is ultimately for the use of water providers to identify where they might prioritise investment, Milman and Short focus on resilience of the system rather than its governance.



(a) Kuhlicke, 2010 (b) Chang *et al.*, 2014 (c) Milman and Short, 2008

Fig. 3. Conceptual analysis of the application of resilience in various case studies. Applicable tertiary categories are shaded dark grey.

4. Discussion

This paper is not a study of linguistics or a philosophical examination of resilience. However, the analysis provided here offers a useful reflection on the definition and practical applications of resilience. The heuristic nature of the conceptual framework has its benefits and limitations. At the very least, the framework helps to facilitate an awareness of differences in using resilience as a concept to guide practical decisions. For example, the visual representation of the framework (as per Figure 3) helps demonstrate that there are fundamental differences in the application of resilience in the case study examples. It is hoped that the framework helps to create insight and understanding of the differences and similarities between interpretations of resilience, thus helping to facilitate cross-disciplinary discussion.

The case studies indicate that the application of resilience tends not to comprehensively cover all three areas perspectives identified in the framework. This reflects how each interpretation tends to expose some sort of disciplinary bias that inherently influences perspective. This is likely to be a factor as to why there are differences between academic or theoretical conceptions of resilience and application of the concept in practice.

The framework is inevitably influenced to some extent by judgments made throughout its development, particularly through deciding which categories deserve emphasis. A potential limitation of the framework is that it does not capture the methodology adopted in the case studies. For example, system property resilience can be examined through a variety of different approaches such as eliciting expert judgment (as discussed in the case studies) or by probabilistic system modeling (as in Ouyang, Dueñas-Osorio and Min, 2012). The question remains as to whether an extra layer for any of the categories adds requisite detail, or if it would serve to over-complicate the concept. Future development of the framework will consider how constraints in implementation, such as available finances, could be included.

5. Conclusion

The conceptual framework proposed here provides a way of making sense of the use of resilience in a range of applications. The example case studies demonstrate how the framework can help to quickly establish differences and similarities across different applications of resilience in DRM. The framework provides a way to move beyond some of the problems of definition of resilience in DRM and could help to facilitate cross-disciplinary discussion. Through creating clarity around how different perspectives could contribute to the broader concept of resilience in DRM, the framework may help shape preliminary discussions in the future development of resilience assessments.

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