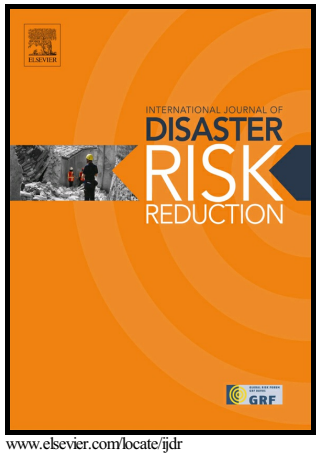

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CRITICAL REVIEW OF EXISTING BUILT ENVIRONMENT RESILIENCE FRAMEWORKS: DIRECTIONS FOR FUTURE RESEARCH

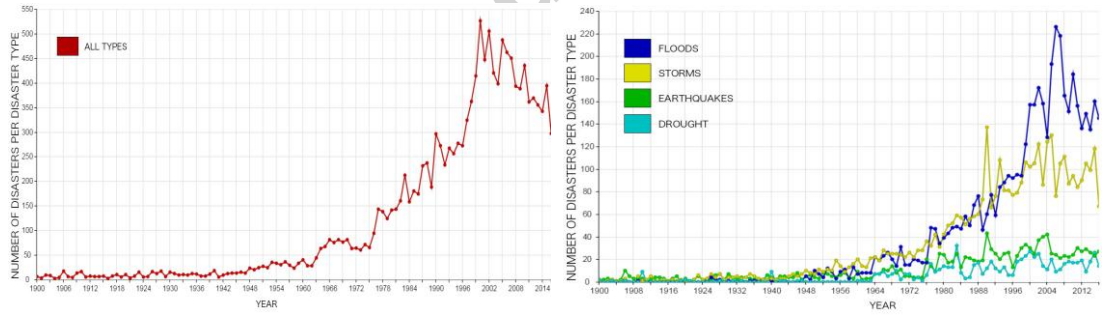
Giulia Cerè[1] • **Yacine Rezgui**[1] • **Wanqing Zhao**[1]

Abstract Resilience, in general, is widely considered as a system's capacity to proactively adapt to external disturbances and recover from them. However, the existing resilience framework research is still quite fragmented and the links behind various studies are not straightforwardly accessible. The paper provides a critical state-of-the-art review of both quantitative and qualitative considerations of resilience, approached from a built environment engineering perspective, with a focus on geo-environmental hazards. A research gap is identified and translated into a holistic and systemic approach to conceptualise resilience, factoring in related concepts such as vulnerability, adaptive capacity and recoverability. A generic built environment resilience framework is proposed informed by a critical and comprehensive review of the related literature. The paper concludes with insights into four key strategic areas requiring further research, namely: (a) risk based cost optimal resilient design and standards of buildings and infrastructures, (b) model based evaluation and optimisation of buildings and infrastructures, (c) integrated risk modelling, inference and forecasting, and (d) heterogeneous disaster data acquisition, integration, security and management.

Keywords Resilience · Geo-environmental Hazard · Built Environment · Vulnerability

1 Introduction

Recent disasters worldwide highlight the vulnerability of our built environment and stress the often dramatic consequences of disasters, as illustrated in Fig. 1. This is directly linked to [often] unplanned urban development and ecosystems [1]. Disasters lead to a wide range of consequences, including human and financial losses [2]. Fig. 2a-2c illustrate the trend (dotted line) in terms of damaged buildings of different typologies (i.e., housing, education and healthcare facilities) between 1990 and 2013 in relation to extensive natural disasters. Although the real distribution of the dataset (solid line) varies over time, the trend appears to be clearly positive for all the three typologies of buildings, highlighting a positive tendency in the increasing amount of structures significantly affected by geo-environmental hazards.



(a) (b)

Fig. 1 Disaster trends from 1900 to 2015. All types of disasters (a); Specific hazard categories (b) [http://www.emdat.be]

A noteworthy example of the devastating consequences of earthquakes can be found in the Wenchuan territory following the 2008 earthquake, exacerbated by major landslides. Damages affected both buildings and

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