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ScienceDirect

Procedia Engineering 212 (2018) 286–293

**Procedia
Engineering**

www.elsevier.com/locate/procedia

7th International Conference on Building Resilience; Using scientific knowledge to inform policy and practice in disaster risk reduction, ICBR2017, 27 – 29 November 2017, Bangkok, Thailand

Investigating the resilience of civil infrastructure firms in New Zealand

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Abstract

The civil infrastructure sector plays a significant role in the community, particularly contributing to the overall economy and the improved resilience of society. Despite this, the resilience of the sector on its own has not been fully investigated. Building on previous studies, this research aims to develop a resilience framework for New Zealand civil infrastructure firms. From case studies of sampled civil contractors, it was found that strong leadership and management, well-trained staff, strong supply chain relationships and alliances, and the ability to foresee and cope with unexpected changes in the market were considered as the top indicators that constitute their resilience. External factors such as streamlined procurement systems, integrated crisis management systems, standardised procedures for legislation compliance, guidelines for resilient industry practices, improved training systems, and assurance of the work pipeline play a role in affecting their level of business resilience. The findings contribute to the literature concerning organisational resilience, and are intended to encourage the development of resilience strategies and policies for the New Zealand construction sector and generate lessons for other countries.

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Peer-review under responsibility of the scientific committee of the 7th International Conference on Building Resilience.

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Keywords: disaster; resilience; civil infrastructure; construction; New Zealand

1. Introduction

The construction sector is a significant component of an economy, contributing between 4 to 10% of the gross domestic product or GDP [1]. As of 2015, the sector contributes to 8% of New Zealand's GDP and 10% of its national employment [2]. Responsible for providing society with housing, buildings, and infrastructure, the sector plays an essential role in communities' quality of life, in achieving government policies, and in driving economic growth [3, 4].

Recent studies highlight the role of the construction sector in improving society's resilience [4-7]. As society becomes increasingly dependent on critical infrastructures such as power, water, telecommunications, and transportation, there is a growing need for these infrastructures to be resilient [8, 9]. If critical infrastructures are continuously able to maintain a certain level of service after a disruptive event and recover quickly, crises can be prevented, resulting in a more resilient society [8, 10]. However, resilient infrastructures are not only defined by robust physical assets; to ensure that these infrastructures are continuously available to communities whether during crises or business as usual, organisations which build, operate and manage these infrastructures must also be resilient [8, 9]. Without reliable contractors to carry out civil infrastructure projects, communities and governments could be crippled.

Despite the critical role of the civil infrastructure sector, its resilience has not yet been fully investigated. To do so, a tool to measure their resilience must be developed [1, 7]. This study aims to determine what indicators can be used to measure the resilience of the civil infrastructure sector. The authors first make a comprehensive review of organisational resilience frameworks from past studies, with a focus on the construction sector. By doing case studies of large civil contractors, existing generic organisational resilience indicators are modified to develop a resilience framework for civil contractors. Using this framework, the resilience levels of civil contractors are benchmarked and compared to each other. Finally, the significance of the study in terms of practical use, policy, and educational value is highlighted, and suggestions for future studies are made.

2. Literature review

2.1. Defining 'resilience'

The concept of resilience is an emerging paradigm and a growing research topic in the recent years, acquiring a variety of definitions across disciplines [11-13]. One of the early definitions of resilience was presented in the context of ecology, when Holling [14] defined resilience as the capacity of systems to absorb change and persist despite disturbances. Gunderson et al. [15] further built on Holling's [14] definition and identified two kinds of resilience: engineering and ecological. Whereas engineering resilience is the ability of a system maintain functionality during a disturbance and subsequently return to its stable state, ecological resilience recognises the presence of multiple stable states, and is defined as the capacity of a system to absorb disturbances before restructuring to a new stable state [15].

In the context of psychology, the resilience of an individual is defined by Masten et al. [16] as the capacity to adapt despite adversity or threatening circumstances. On the other hand, infrastructure resilience is the ability to anticipate a disruptive event, to provide a certain level of service after a disruptive event, and to recover quickly, to prevent a crisis from escalating. [10, 17, 18].

Nowadays, the concept of resilience is also widely associated with disaster risk reduction [5]. According to the United Nations International Strategy for Disaster Reduction [19], the resilience of a community depends on its ability to resist, absorb, accommodate and recover from the impacts of a hazard. To be resilient, countries, communities and households must be able to either maintain their living standards despite shocks and stresses, or adapt to the changes caused by such events without compromising their long-term prospects for development [12, 20].

Though there appears to be a lack of consensus on the definition of resilience, several commonalities on the concept of resilience can be observed. These are:

- the ability to anticipate and prevent potentially disruptive events;
- the ability to maintain a certain level of functionality during disruptive events;
- the ability to recover quickly from the negative impacts of disruptive events and
- the ability to adapt to the changes brought about by disruptive events

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