The impact of contextual factors on the predicted bulk water pipe repair times in Wellington City

A thesis presented in partial fulfilment of the requirements for the degree of Master In Emergency Management

At Massey University, Wellington

New Zealand

Andrew Keith Sherson

2017

[This page has been intentionally left blank]

Abstract

Lifelines, like the water supply, are essential for the survival of people, communities, and businesses. In the event of a significant natural disaster, like an earthquake, it can be expected that these regional lifelines will be severely damaged. Wellington, the capital of New Zealand, contains many lifelines that are highly vulnerable to failure. The water supply is especially susceptible, as it crosses the Wellington Fault multiple times and carries water through landslide prone corridors. Because of the risk, and potential impact on people, several predictive models have been created to calculate the likely downtimes so individuals and organisations can prepare for the loss. Many of these predictive models are comprehensive in what they calculate. However, they require improvement as they do not include local and contextual factors or the influence of other lifelines. For example, they do not include the impact of staff logistics, assume access to required equipment is a given, and ignore interdependencies between lifelines, such as the loss of access to repair sites because of damage to the transportation network.

This research aims to improve these current models by investigating the magnitude of these site-specific and interdependency factors. Following a sequential mixed methods approach and using a pragmatic viewpoint, experts directly involved in the repair and maintenance of lifelines were selected for interviews. In total 20 professionals were contacted using a snowball and convenience sampling technique. Out of these 20, five were available for in-depth semi-structured phone interviews. From these interviews, anything stated to affect the repair times was highlighted, the most prominent of which were incorporated into current predictive models and their influence on repair times calculated. In total 12 different issues were discussed, 4 of which were examined further. These factors were: staff logistical problems; the slope of the land affecting damage inspection processes; the impact of uncommon pipe diameters on the repair process; and access problems. Once identified, these factors were incorporated into current predictive models, and the impact on repair times calculated. By including these contextual influences, it was found that they increased repair times by between 3 and 13 days depending on the water source and 31 and 111 days when incorporating the influence of landslides. Thus, proving contextual influences have a significant impact on repair times. Overall this study 1) revealed the importance of including contextual factors into predictive calculations and 2) created more accurate downtime predictions for the water supply in Wellington City, allowing for people, organisations, and planners to better prepare for the potential risk.

Acknowledgements

Writing this thesis has been great a challenge and learning experience, where I have grown and developed in many different facets. Throughout the research process, there have been key people that have made the project possible, have kept me going, and have given me great feedback, all of whom I would like to express gratitude to.

Firstly, I would like to thank my thesis supervisors, Dr Raj Prasanna and Dr SR Uma who were incredibly patient, repeatedly gave me great advice, made sure that the project was on schedule, and coached me throughout the research.

Secondly, I want to thank all the experts involved in the research project, who took time out of their busy schedules for the interviews, sharing their knowledge, and helping the project come to fruition.

Thirdly I would like to thank all my friends in Wellington who have been active in their support, giving great advice, and just spending time with me away from the thesis. I want to thank my flatmates Phil Mtambo and Lucas Sklenars specifically for their patience and for all the fun adventures. In addition, I want to offer my gratitude to all my fellow Life group members who rooted for me through the process, especially Liam Koedyk who had been through the thesis process before and gave me great words of wisdom.

Fourthly I would like to thank my family for all the support from afar, listening to all my queries, and answering all of my crazy questions about life.

Fifthly I want to express gratitude to all those who read through the thesis and helped me improve my grammar.

Finally, I would like to thank my wonderful fiancée Eleanor who continually offered love, and without whom, I probably wouldn't have been able to finish the project.

Table of Contents

List of Figures

List of Tables