Loss estimation methods utilised by stakeholders involved on residential post-canterbury earthquake reconstruction

Daniel Burrell[1], Linda Kestle [2]

Abstract

The importance of natural disaster economic loss estimations is paramount, in terms of assisting policy makers in mitigation decisions, risk assessments and tracking losses as they occur. Historically the New Zealand construction industry and associated affiliate stakeholders has not employed a systematic method to estimate, or record the losses that have occurred as a result of natural disasters. Therefore records are lacking. The Canterbury earthquake of February 22nd 2011 in particular, was the most significant natural disaster in New Zealand's history, with economic loss occurring at all levels of the New Zealand economy. There have been numerous complexities around how to measure this loss, and what should be included or excluded in the estimates. Government's direct intervention in respect of residents' red zoned properties has added a further complication when trying to establish realistic loss estimation methods and data storage. Loss estimations have historically relied heavily on insurance data collected after large scale events. This exploratory research aimed to investigate the loss estimation methods / evaluative processes utilised by stakeholders involved in the post-disaster residential sector of Christchurch, and compare the findings to the reviewed literature. Semi-structured interviews were conducted with six selected participants from five insurance and project management companies in Christchurch. The findings suggested that there is a lack of regulation, no systematic framework, nor any consistency of process within the New Zealand construction industry, or their associated stakeholders.

Keywords: loss estimation, canterbury earthquake, residential sector

1. Introduction

This research topic resulted from sighting a number of publications following the 4th September 2010 earthquake in Christchurch, such as the $2 billion initial estimate (EQC 2011), and then subsequently after the 22nd February 2011 earthquake, reports of $10 billion, which was later increased to $20 billion (TVNZ, February 28, 2011). From the media

[1] Department Construction; Unitec Institute of Technology, PB 92025 Auckland 1142, New Zealand; Email. burreldani@gmail.com

[2] Assoc Professor; Department Construction; Unitec Institute of Technology, PB 920125 Auckland 1142, New Zealand; Email. lkestle@unitec.ac.nz

reports it was unclear as to what the estimates included, excluded, or how the figures were even derived. The main source of data for economic loss estimates has been insurance information according to Walton (2004), and following the Canterbury Earthquake(s) there have been 302,000 claims lodged with the Earthquake Commission EQC as at April 2011(Mathewson 2011). A complicating factor due to EQC involvement was that there are now multiple claims on individual properties, due to each major earthquake (Sept2010,Feb22,June13 2011) being treated as separate event, from an insurance perspective. Residential housing represents a substantial percentage of loss as a result of the Canterbury Earthquakes. The concept of economic loss estimation is broad and dependent on many factors such as time, geographic context, and the needs of the end user (Cochrane, 2004). For the purpose of this research the scope was limited to the residential sector only, due to insurance data being a main source of direct economic loss information. Research literature on the topic of loss estimation frameworks following natural disasters suggested that no consistent framework or relevant inclusions *et al*. were used in New Zealand. This, despite the issue being raised over 25 years ago by Ericksen (1985) and although this reference was in respect of flood losses, the principle remains relevant to any and all natural disasters. The research involved stakeholders engaged in Christchurch residential reconstruction work, where a sample of employees representing Insurance Companies and Project Management Companies were selected using a purposive non-random sampling technique. For the purposes of clarification, the following key terms are noted and explained in brief.

Direct Loss: "Direct losses as those that result from the physical destruction or damage to buildings, infrastructure, vehicles and crops" (Committee on Assessing the Costs of Natural Disasters 1999 p35).

Indirect Loss: "Indirect loss is any loss other than direct loss [which occurs as a result of a natural disaster]" (Cochrane 2004 p291).

Intangible Loss: "Intangible losses are those with no market value" (Bureau of Transport Economics 2001 p61).

Natural Disaster : "A natural disaster occurs when a natural hazard event causes damage to property or harms people" (Bureau of Transport Economics 2001 p5).

2. Literature Review

The selected literature on the topic of loss estimation included available and relevant New Zealand literature, most however were overseas publications.

2.1 Loss Estimation overview

From the literature reviewed there is no consistent approach to economic loss estimation in New Zealand, Australia or the US. This statement was supported by the findings from Walton (2004), The Bureau of Transport Economics (2001) and the Committee on Assessing the Cost of Natural Disasters (1999). The challenge is in defining a consistent dataset for estimating disaster losses and identifying which data should be included in the estimates (Committee on Earthquake Engineering 1990). The literature had consistent themes but varied on how losses were calculated and what information was included and excluded. “Some measure only direct losses whereas others purport to include indirect losses”(Committee on Assessing the Costs of Natural Disasters: 1999 p8). Economic loss estimates are important in making informed mitigation decisions, for example, “it would be difficult to gauge the cost-effectiveness of public policy decisions such as relocating residents out of earthquake-prone areas without loss information” Despite this “little is known about the economic costs of natural disasters” (Bureau of Transport Economics 2001 p3). Even though there was no agreed framework within the reviewed literature, losses were generally broken up into two broad categories being ‘direct loss’ and ‘indirect loss’, and then further broken into measurement subcategories of ‘intangible’ (non-market values) and ‘tangible’(market values). These same classifications were proposed by Handmer (1985), Smith *et al.*(1995) and supported by Walton (2004). There were, however, existing frameworks from overseas sources, namely the *Economic Costs of Natural Disasters in Australia,* and *the Impacts of Natural Disasters: A Framework for Loss Estimation.* This software based Loss framework followed a similar classification system of breaking the losses into two categories, direct loss and indirect loss. Natural disaster loss estimation software developed over the past two decades has provided an integrated framework and incorporated geographic information systems (GIS) to display spatially referenced data such as population, building types and infrastructure (Strasser *et al.* 2008 p1). The development of *HAZUS* (Hazards United States), provided an integrated framework for loss estimation. This framework used mathematical formulae and information on building stock, economic data and GIS to display shaking from an earthquake (Committee on Assessing the Costs of Natural Disasters 1999). The outputs of the model included direct and indirect economic losses displayed as dollar losses, and although the model was originally developed for earthquake assessment it has been expanded to include flood loss and storm loss. Examples of earthquake software have included HAZUS, KOERI-loss (Kandilli Observatory and Earthquake Research Institute), SELENA (Seismic Loss Estimation using a logic tree approach), and a relatively new ‘Riskscape’ programme which is a New Zealand application developed by the National Institute of Water and Atmospheric Research (NIWA) and Geological and Nuclear Science (GNS) to predict losses and early assessment of natural disasters (King & Bell, 2006). In New Zealand much is known about earthquakes due to past research by GNS and the Geonet system. Riskscape uses information from systems such as Geonet and formulates the impacts that may result from natural disasters much like HAZUS. Development of the Riskscape programme began in 2004 and currently this New Zealand application is limited in scope as it only has a direct loss output. Asset inventories are used as base data to the estimates; this includes bridges, buildings and pipeworks (Riskscape, 2010). Riskscape has two levels for estimation and uses synthetic data. Level 1 determines damage through the modified Mercalli (MM) intensity scale based on past earthquake data, to assess how buildings react based on the type of building and distance from the centre of the earthquake The output is based on algorithms which model how assets perform in a natural disaster. There has been ongoing research in this field in New Zealand by Dowrick & Rhoades (2005, 2010) and a specific model is under development for the Canterbury region (Stirling *et al.*2008). Level 2 has more engineering input with the analysis of specific design spectra within a specific building class (King & Bell, 2006). Riskscape has “the potential to become a nationally applied hazard and impact assessment tool enabling a standardised approach across the country" (Riskscape 2011).

2.2 Direct Loss Estimation and Measurement

There are different ways in which direct loss can be calculated, either based on imperial data (collected data), or synthetic data (based on likely impacts). Imperial data collection of direct losses can be divided into two groups, 'Primary data' collection which is most often surveys of businesses and households and the other is 'Secondary data', such as tabulated insurance claims, small business loans and various other sources (Brookshire *et al.* 1997) "There is little debate over the classification of direct economic loss which is the easiest to classify, they are losses that result from the physical destruction or damage to buildings, infrastructure, vehicles and crops" (Bureau of Transport Economics 2001 p15). The Edgecumbe Earthquake publication by Butcher *et al*. (1998), highlighted one of the potential problems with the data utilised, as a significant amount of money was involved in restoring chimneys, when in fact this may not have been earthquake related damage, and more likely general wear and tear; This would overstate the loss.

2.3 Indirect Economic Loss and Measurement

Indirect Economic Losses which are caused by natural disasters are losses resulting from the consequences of physical destruction. These have not been measured, studied, or modelled to the same extent as direct losses, despite the fact that indirect economic loss can have more of an impact than the direct economic loss in large events (Committee on Assessing the Costs of Natural Disasters 1999). New Zealand could incur significant indirect losses due to an open economy that is vulnerable to 'capital flight', with speculative investors withdrawing their investments from the New Zealand Economy (Cochrane1995 p68).

2.4 Intangible (non-market)losses

The importance of intangible loss is generally accepted, however they are often not measured, and are therefore discounted in the evaluation of natural disasters (Bureau of Transport Economics 2001 p88). Cochrane (2004 p291) supported this statement, stating that "Non-market losses are never estimated. Disaster losses are almost exclusively limited to impacts measured by market values".

2.5 Timing and Measurement of Losses

There are a number of issues associated with measuring economic losses. Issues such as the use of replacement value vs. depreciated value (Ashley 2007 p197) also ignoring post-disaster liabilities, ignoring non-market losses, double counting, differentiation between gross and net values and confusing data as to whether post disaster economic trends are a product of the event or another unrelated factor (Cochrane 2004 p290). Often the effects are measured over a shorter period to reflect the full range of outcomes from the event "indirect flood loss estimation due to business interruption cannot be estimated over a single point in time but has to be regressed over the full recovery period" according to Ashley *et al*. 2007 pp197-198). This was further reiterated by the Committee on Assessing the Costs of Natural Disasters 1999 p18), when stating that, “Timing of the estimate also has an impact on the estimate. Measuring the losses of natural disasters takes time. In the case of earthquakes, the extent of the damage to houses or businesses have suffered may take weeks to establish. Initial loss estimates may understate actual losses, potentially by wide margins”

2.5.1 Ignoring Post Disaster Liabilities

Loss accounting often fails to account for the region’s liabilities or borrowings, and the cost of indebtedness could be missed if measured over a too short a period, as long-term these liabilities could have impacts on the region and economic growth (Cochrane 2004 p291).

2.5.2 Double Counting

Double counting is a common problem in loss estimation. Cochrane (2004 p290-291) suggested that double counting is endemic and that it is very easy to make the mistake of double counting disaster losses. “It is commonly asserted that total damage is the sum of direct damage (damage to building and contents) and lost value-added. Double counting exists here because value-added includes the services of capital, whereas direct damage should reflect the cost of replacing the depreciated portion of such capital.

2.6 Summary

The reviewed research was focused mainly on direct loss estimation, and the areas of most contention were those around the classification and measurement of indirect and intangible losses. Indirect loss data has proven difficult to collect, which has led to attempts to model the indirect losses using synthetic data. Intangible losses are rarely measured and are therefore excluded from most loss estimates. This is attributed to there being no market or agreed way of measuring them, such as health effects or loss of heritage buildings.The focus recently, has been around integrated frameworks with the development of software such as HAZUS and Riskscape a New Zealand application. This is still in development and does not have the capability to provide an indirect economic loss output. The development of a framework has been hindered due to the complexities and the debate over exactly what information should be included or excluded in a framework. Three measurements that can alter the result significantly are the timeframe in which the loss is measured; the unique nature of the event; and the geographic context of the loss estimate. Further to this there are measurement limitations which need to be addressed such as double counting, identifying the impacts on loss estimation by the uninsured, and replacement versus depreciated values. New Zealand has not measured the economic losses that result from natural disasters consistently in the past. Instead, the focus has been on understanding the event, and this is shown by the extensive works conducted by Dowrick & Rhoades (2005, 2010). The type of economic modelling used is dependent on the end user for example, insurance companies are only interested in insured loss, and not in the losses incurred by the ‘uninsured’.

3. Methodology

Following the 2010 and 2011 earthquakes in Christchurch, loss estimation occurred across several sectors, both locally within Canterbury and nationally on a scale never before witnessed in New Zealand. Although extensive research has been conducted in the field of loss estimation, there was only a limited amount of published knowledge related to the research question being explored, and little or no information about the specific loss estimation methods actually used in New Zealand. The scope of this particular research was deliberately restricted to residential housing and the insurance sector due to the level of remaining uncertainties in other post-disaster claim sectors. The research was exploratory, confirmatory and applied, exploring the methods stakeholders employed to estimate economic losses following natural disasters. The methodology was confirmatory in accord with the findings of Walton (2004) and the Bureau of Transport Economics (2001) which stated “there is no consistent approach to loss estimation and storage of that information.” The participant sample was non-random and purposive, as the participants were deliberately selected for their known attributes. Knowledge of the topic was seen as a key factor to the success of the qualitative data collected. The six selected participants from the five project management and insurance companies sampled, were in managerial roles, had an overview of the respective company’s processes and were involved in the loss estimation of residential housing following the Christchurch earthquakes. All were interviewed to compare and contrast the findings with the reviewed literature. Face-to-face semi-structured interviews were undertaken, and given the potential sensitivity of the information, the structure of the interviews focussed on methods and processes rather than on actual, and therefore commercially sensitive, statistics. The data collected data were then analysed and organised into categories. The findings were compared and contrasted across the various stakeholder participants’ responses, and with the findings from the reviewed literature.

4. Results/Findings

4.1 Initial Estimation Method

Of the five companies sampled, only the two Insurance Companies (A & B) and two Project Management companies (D&E), used a form of initial estimation to establish an indicative cost of the loss incurred on a residential property. Company A used their own historic insurance information using ‘a basic average of historical data over a period of time’ to establish a likely cost based on the insured’ s description of the damage. Company C then set the estimation level which was based on factors such as the post-disaster property zoning (red, green, orange, blue-green). Similarly Company B used a computer based programme where the cost was calculated using their own empirical insurance data. Company D & E’s estimation methods used primary data collected from on-site inspections combined with secondary cost data from various market sources, and established an initial estimate of the loss. This was later used to evaluate residential repair options. This method was more intense than the method employed by the insurance companies as it was based on surveys from the actual damage and current market rates rather than historic data and costs. The insurance and project management companies considered that historic data bore little or no relevance to the (unique) earthquake events of 2010 and 2011. In effect then the five companies sampled all used different methods to conduct loss estimates. This was in line with the main findings of the literature where there was an inconsistency in industry around loss estimation methods, due in the main to a lack of an agreed and common framework. Both Company A and B stated that the initial estimate was not particularly accurate when compared with the actual cost, and that “the initial estimate was essentially never right and often inaccurate”. An important distinction was that the scope of estimations conducted by the Insurance Companies was based on a per claim basis rather than on the overall loss. An overall loss estimation would occur later in the process, however this was not discussed in-depth in the interviews due to commercial sensitivity and because it tended to relate more to Insurance Company’s risk assessment rather than to loss estimation. Of note though is that all five companies utilized the actual, and therefore the replacement value of repairs, when finalizing their initial estimate assessment for every claim received, rather than the depreciated value .

4.2 Natural Disaster Loss Estimation and BAU

The selected six participants generally agreed that their methods for loss estimation following the Christchurch Earthquakes were essentially the same as BAU (business as usual) work as the end goal(s) remained the same . The notable differences though, was the necessary involvement of outside parties to assist in the process, and the fact that the companies’ loss estimation method(s) had to be simplified in order to respond to the scale of the damage being experienced, and the massive increase in the number and nature of claims received. From the findings it was difficult to compare the earthquake events with the companies BAU work. Despite the two Insurance Companies using the existing estimation method, all included some form of new process to deal with the earthquake events. However, one of the significant changes to BAU estimations by the Insurance Companies was to include a Project Manager on staff. The reason being that the insurers had never had to allow for earthquakes in Christchurch before, and therefore had no relevant /documented processes nor project management skills in-house. In the past, they (the insurers) had managed the process ‘from go to whoa’. The Project Managers’ most significant changes involved the incorporation of increased and specialised Information Technology (IT) Systems being introduced to manage the claims process, and the development of a new overall claims management process.

4.3 Consistency within the Industry

All participants believed there was a definite lack of consistency within the process of claims assessments and that the different parties were handling the earthquake related claims completely differently from each other. This was due in the main to the competitive market in which the insurance companies work, and the policy response of the insurer’s, where some are focused on the bottom line while others are customer focused. Insurers do not share information about their estimation methods, as that forms an essential part of their competitive edge in the market. This was not highlighted as an issue within the literature, but would be a prohibitive factor to introducing a loss estimation framework into New Zealand, which has one of the least regulated insurance markets in the world” (Insurance Council of New Zealand, 2008). This market is largely self-governed, and there is no framework for compulsory reporting which would be a major factor in having a consistent method of estimation. To implement a standard method when there is a lack of control or a governing body that can implement a scheme, would be difficult. Furthermore, the current situation is complicated by the uniqueness of the (earthquakes) event, where entire pockets of land have been retired from use (meaning that they are unbuildable now). Insurance policies have never been written to take this into account before now. In addition, the New Zealand government has taken on some of the private insurer's risk where the property(s) were/are in the Red Zone, and offering packages to those red zone residents. The literature suggested the potential use of software in economic loss estimation such as HAZUS or Riskscape, but none of the companies interviewed have utilised software from New Zealand or overseas for loss estimation, as yet. This it seems was due to the perceived 'lack of need or benefit of new technology' in the residential insurance sector, as the companies have their own processes in place, and were confident regarding 'estimate accuracy'. The participants considered the current and new software on offer as more suited to risk assessment and hazard response rather than loss estimation on this (Christchurch earthquakes) scale.

4.4 Lessons Learned

A number of lessons have been learned by the Insurance companies and the Project Management companies as a resultant of the Christchurch Earthquake evens t(s). Three participants (from Company B,C &D) noted that the information technology and processes utilised have had to be changed to assist in processing the large numbers and scope of claims. Company B had to adjust cost estimates for repair of foundations to allow for a range of differing repair strategies, and associated (labour) rate ranges. Company D&E has had to upskill their contractors' abilities to prepare detailed post-natural disaster quotes, and what to include or exclude from those estimates. They also noted the need to find ways to ensure better consistency in pricing and communications in-house and with clients.

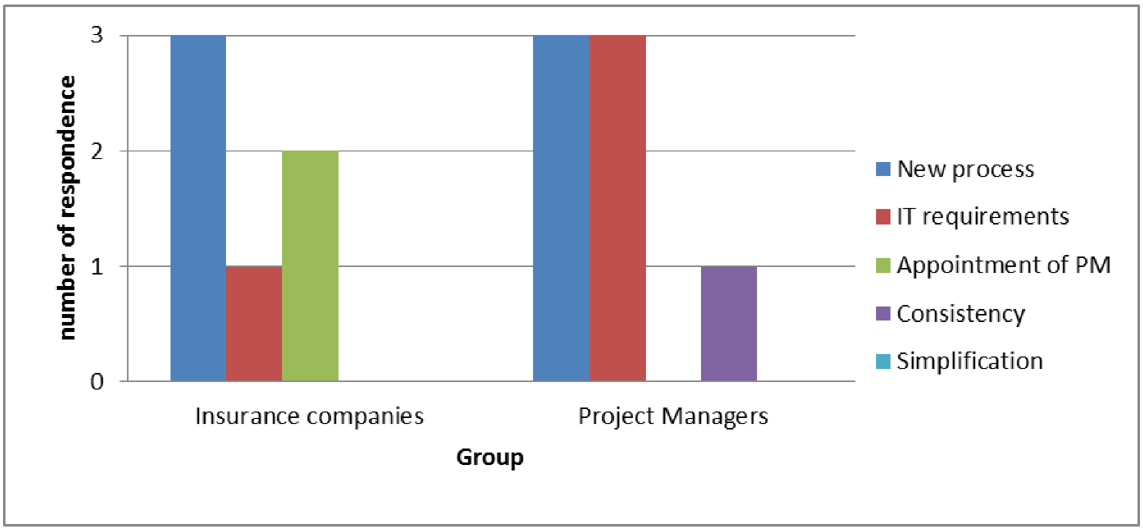

Figure 2: Number and Type of Response for Lessons Learned

4.5 Administration Costs

No literature was found in relation to how administration costs should be allowed for in an estimate or how it should be recorded. In the Christchurch earthquake event, a large amount of coordination and additional personnel was needed, adding to the administration cost, and this was shown by EQC paying out $138,000,000 in wage till September 2011 (Bennett 2011). This was an indirect cost which was a direct result of the event. The five companies sampled, identified significant administration costs relating to the Canterbury Earthquake, none had factored this cost on a claim by claim basis, instead it was treated separately.

5. Conclusion

The literature review established the current state of loss estimation and the limitations and problems associated with establishing a framework. The research findings identified that there was no consistent method of estimation loss, and this also agreed with the literature findings, as did the reasoning regarding why this occurred. To establish a consistent method between companies within the residential sector would be difficult, due to the competitive and sensitive nature of the private insurance market. In addition, the lack of regulation within the insurance industry does not aid the establishment of a consistent process. There would be value in having a consistent framework for natural disaster loss estimation in New Zealand to assist policy makers in the future, and aid in mitigation decisions by having comprehensive loss data stored and used in a consistent manner. Comparisons could then be made without fear of bias within the data. However, such a framework would be difficult to implement due to the issues identified and discussed as the research progressed. There is a possibility that in the future, and as the process evolves, uniformity may occur.

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