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IMPACTS OF THE PROPERTY MARKET ON SEISMIC RETROFIT DECISIONS

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ABSTRACT

Recent damaging earthquakes have shown that strengthening of buildings susceptible to seismic risks is one of the key issues in hazard and disaster management field. Using the property market to create value for seismic safety has been suggested in literature as a motivator to improve the implementation of adequate seismic mitigation measures. The purpose of research in this paper is to investigate how property investment can be used to create value for earthquake risks, in order to encourage seismic retrofit implementation of EPBs. A case study methodology was used to understand the impacts of the property market stakeholders' practices on seismic retrofit decisions. Findings provide important new insights on how property market-based incentives and investment practices can be used to promote the adoption of adequate risk mitigation measures. The findings suggest the need for stakeholders involved in property investment and retrofit decisions to work together to foster seismic rehabilitation of EPBs. Market-based incentives such as mandatory disclosure of seismic risks and insurance premium discounts for retrofitted EPBs can offer compelling reasons for the different property market stakeholders and the public at large to retain, care, invest, and act responsibly to rehabilitate EPBs.

Key Words: Earthquake Prone Buildings (EPBs), Seismic retrofit decisions

1. INTRODUCTION

The increasing impacts of earthquake disasters such as those that have occurred in Sumatra, Indonesia (2005), Sichuan, China (2008), Italy (2009), Haiti, Chile (2010), and Japan (2011) provide a painful reminder regarding the vulnerable nature of the global community to seismic disasters. At a local level the earthquake 'swarm' of 2010 and 2011 in Christchurch have resulted in the widespread devastation of the Central Business District (CBD) and left thousands homeless in suburban areas.

Developments in improved seismic structural design solutions over the last three decades have been available to ensure that property owners can implement appropriate earthquake risk mitigation measures in the form of seismic retrofitting. The legislative framework has also been in place in New Zealand to encourage and if necessary enforce this seismic retrofitting. Evidence from past studies on hazard mitigation suggest that seismic retrofitting of earthquake prone buildings (EPBs) reduce loss of life and property, disaster relief costs, business interruption, and social and environmental losses from an earthquake disaster (Nuti and Vanzi 2003, Rose *et al.* 2007).

However, despite these benefits and the growth of the technical knowledge base on earthquake risk mitigation, property owners are often unwilling to retrofit their EPBs (Hopkins 2005). It has been estimated that approximately 3867 Unreinforced Masonry (URM) buildings in New Zealand urgently require seismic retrofitting in order to reduce the impacts of earthquake disasters. The cost of this retrofitting has been estimated to cost approximately $2 billion (Ingham and Griffith, 2011). Unfortunately no official statistics are collated that measures the amount of money being spent on seismic retroffiting. The cost of such work is included within the general category of "alterations" in terms of data collected by the New Zealand Department of Statistics.

The unwillingness of owners of EPBs to retrofit their EPBs has been a critical issue in earthquake pre-disaster planning and management. Many factors such as cost, risk perception and efficacy of mitigation measures interact to influence seismic retrofit decisions (Egbelakin and Wilkinson 2010, Lindell and Prater 2000a). Studies in the social, economic and decision sciences have sought to address this dilemma from different

perspectives. Many socio-psychologists have focused on the impact of risk perception on mitigation decisions, concluding that how people perceive and personalise earthquake risk significantly influence the type of protective decision and behaviour adopted (Lepesteur et al. 2008, Lindell and Prater 2000b, Lindell and Prater 2002, Mulilis and Duval 1995, Tierney et al. 2001, Weinstein et al. 1998). Sociologists studied the social aspects of earthquake risk mitigation. These researchers found that quality of risk information provided to owners, communication style, and characteristics of the agencies responsible for conveying this information affect building owners' willingness to adopt protective measures (Mileti and Fitzpatrick 1993, Mulilis and Lippa 1990, Pidgeon et al. 2003, Tierney et al. 2001).

Economists have focussed on the financial viability of valuation decisions and policies regarding hazardous situations, providing a rationale on the overall economic benefits of implementing various mitigation measures (Bernknopf *et al.* 1990, Cohen and Noll 1981, Schulze *et al.* 1987). Various studies on earthquake risk and property market prices found correlations between risks information and communication style, property values, location, government initiated policies and programs, house prices, investment decisions and owners' attitudes towards implementing mitigation measures (Beck *et al.* 2002, Onder *et al.* 2004, Palm 1985, Palm 1987, Willis and Asgary 1997).

Despite the increasing number of studies, there is comparatively little research on how practices among the stakeholders in the property market impede building owner's mitigation decisions. A stakeholder's approach was adopted in this study to examine property market practices acting as impediments to seismic retrofit decisions and to investigate incentives that may be used to drive investments in EPBs retrofits. This research focussed on pre-1976 buildings used for commercial purposes in New Zealand. Older commercial buildings are often earthquake prone due to inadequate seismic strength, age and deterioration of construction materials. For instance, Wellington (New Zealand's capital city) has about 52% of its building stock classified as potential EPBs, deduced by raw property counts (Stevens and Wheeler 2008). The research findings in this paper provide background information useful to policy development aimed at increasing the likelihood of building owners undertaking mitigation actions to reduce earthquake hazard vulnerability in New Zealand.

2. BACKGROUND

2.1 Seismic Retrofit Implementation in New Zealand

New Zealand is a seismically active country with an approximate of thirty earthquakes having magnitude greater than 6.0 in the last fifteen years (GNS Science 2010). The recent New Zealand's earthquake in September 2010 had a magnitude of 7.1 and a financial implication around NZ$ 4 billion (Daniell 2010). Since this initial earthquake a swarm of aftershocks and another earthquake in February 2011 has increased estimates of earthquake damage to over $20 billion. The economic implication of earthquake disasters suggests the need to develop other measures of reducing earthquake impacts. Seismic retrofitting of existing EPBs is one of the means of reducing losses in an earthquake event.

Early buildings in New Zealand were characterised by the use of timber which was both plentiful and cheap. Problems with fire however encouraged the use of unreinforced masonry in towns and cities with little thought given to the perils of earthquakes prior to the Napier earthquake of 1931. This resulted in the introduction of the first earthquake design standards in 1935. Significant design changes were also introduced in 1965 and 1976 with additional refinements in 1984, 1992 and 2005. These design changes recognised the growing body of knowledge about earthquakes and changes in construction methods. The issue of designing buildings to survive earthquakes is not unique to New Zealand but one shared with many other countries including those located on the "pacific rim of fire" such as Japan and the west coast of the USA.

Although the issue of designing new buildings to survive earthquakes has been addressed by improved design standards, the issue of dealing with old buildings that were not designed to withstand earthquakes has long been a problem for Territorial Authorities (TAs) in New Zealand. Under Section 301 of the Municipal Corporations Act 1968 and then Section 624 of the Local Government Act 1974 TAs were given wide ranging powers that enabled them to have the buildings made safe. These powers were continued in section 66 of the Building Act 1991 and remain in section 124 of the Building Act 2004.

However, the extent to which these powers have been used has varied widely between different local authorities. A few TAs such as Wellington have used their powers in an active way by the serving of notices on owners requiring them to take action to make their buildings 'safe'. In order to do this the owners must either,

strengthen, demolish or effectively 'mothball' their buildings. Most TAs in New Zealand tended to take a passive approach to using their powers and did not serve many section 66 notices on buildings. A 1997 survey of TAs by the Building Industry Authority (BIA) showed that only 5 out of the 64 responding Councils had actually issued notices under section 66 of the Building Act (New Zealand Society for Earthquake Engineering, 1998).

In response to concerns raised by the earthquake risk buildings study group of the New Zealand Society of Earthquake Engineers (NZSEE), the Building Industry Authority began preliminary public consultation (BIA, 1997) on Section 66 of the Building Act in 1997. Consultation included a number of public forums in the major cities after which the BIA produced a discussion paper in February 1998 called "Keeping Buildings Safe and Sanitary". This paper contained a number of suggested changes to the Building Act in relation to earthquake prone buildings. The process was then effectively put on hold however, as it became apparent that the entire Building Act needed to be revised and not just Section 66. This review process was lengthy but it eventually culminated in the passing of a new Building Act which came into force on the 30 November 2004.

Of significance to owners and developers of old buildings were those changes relating to "earthquake prone" buildings which incorporated many of the changes that were proposed back in 1998. One of the major changes that occurred was in relation to the definition of what constituted an 'earthquake-prone" building. The definition as set out in Section 122 of the Building Act 2004 contains a number of significant changes to the comparable definition contained in the 1991 Act. The definition of an earthquake prone building under the 1991 Act only applied to unreinforced masonry buildings. The definition of an earthquake prone building was altered in the 2004 Act to catch other buildings such as non masonry or concrete buildings.

The old definition was based on compliance with the 1965 Chapter 8 Building Code to a level of 50% of this code. This equates to structural strengths of approximately 10% of the current building code.

The current definition of an earthquake-prone building now explicitly takes into account ground conditions as well as the structure of the building itself. It is also linked to a further definition (of what constitutes a moderate earthquake) which is contained in the regulations. As a result the current trigger level or minimum standard under the 2004 Act is a level equivalent to one third that of a new building.

This means that far more buildings are now subject to Section 122 of the current Building Act than were previously caught by Section 66 of the old Act. The new 'trigger' level had the effect of reclassifying some buildings that previously were not considered to be earthquake risks to become classified as earthquake prone. This process may well continue as a result of the Christchurch earthquakes. The Department of Building and Housing has already increased the seismic hazard factor for Christchurch by 35% and other changes may result from the Royal Commission of Inquiry currently being conducted into the Christchurch earthquakes.

Having identified a building as either insanitary, dangerous or earthquake prone the TA has wide ranging powers under Section 124, to take action. These powers conferred on TAs under Section 124 in relation to earthquake prone buildings are nothing new and are similar to the powers under the 1991 Act and before that to those under Section 624 of the Local Government Act. As discussed earlier what is new is the 'threshold' level in the regulations.

However, another significant change in the Act was the requirement for TAs to prepare and adopt a policy that explicitly addressed the problem of earthquake prone buildings (and unsafe and unsanitary buildings). Under previous legislation the response of TAs to this problem had generally been limited, with Wellington City being one notable exception. The 1991 Act left it up to the individual TAs to decide to what extent they proactively enforced Section 66. Most chose not to enforce Section 66 but the new requirements imposed by Sections 131 and 132 makes this option less politically tenable, particularly since the Christchurch earthquakes have raised public awareness about seismic risks.

In response to section 131 each TA had to develop a suitable policy by 31 May 2006. Note that under section 131 the TLA is only required to adopt a policy and there are still no legislative directives as to the form that this policy must take. It would therefore be possible that a TA could adopt a policy that did nothing in terms of regulating earthquake prone buildings. Clearly though the policy is expected to achieve the purpose of the Act – in particular the "health and safety provisions" embodied in Section 3 which sets out the purpose of the Act. There also appears to be a degree of review by the chief executive of the Building Department and it is clearly the intention of the Building Act to encourage TAs to take a more proactive role in addressing the problem. The Department of Building and Housing developed a "Policy Template" and some "Policy Guidelines" (DBH, 2005) as an aid to TLAs.

The role of the Policy Guidelines document was described as follows:

The document is intended to act as a resource from which TAs can draw in developing their individual policies. It is not prescriptive. It is expected that TAs, in consultation with their communities, will develop policies that strike a balance between the need to address earthquake risk and other priorities, taking account of the social and economic implications of implementing the policy.

The policy guide sets out in the Appendices the two main approaches that can be used by Councils which are characterised as either "active" or "passive". These are described in the guidance notes as follows:

Approaches to policy implementation

Before a TA submits its draft EPB policy for community consultation, it should consider the way in which it wishes to implement its policy. The Department considers that there are two principle approaches that TAs could adopt.

An active approach

Under an active approach, a TA would carry out an initial evaluation of buildings in its district to identify those likely to be at high risk. In the light of this, the TA should establish priorities for further, more detailed evaluations, set timetables for action and set guidelines of required performance levels for upgrading.

A TA would then advise building owners that their buildings are likely to be earthquake-prone and, if appropriate, seek from them a detailed assessment of the building. The policy should address which party will bear the cost of the assessment.

Adoption of this approach will provide a TA with the best possible risk reduction programme as it is able to set and control the level of any work required to mitigate risk.

A passive approach

If a TA were to adopt a more reactive approach, the IEP and detailed assessment and any improvement of structural performance would be triggered by an application under the Building Act for building alteration, change of use, extension of life or subdivision.

With this arrangement, on receipt of an application relating to a building that the desktop research indicated could be earthquake-prone, a TA would undertake an IEP on the building. If this process indicated that the building was likely to be earthquake-prone, the TA would seek a detailed assessment of the building's structural performance before issuing a building consent. If the detailed assessment indicated that a building was earthquake-prone, a TA would issue a notice to reduce or remove the danger to the level set out in its EPB policy. This work could be undertaken as part of the building work for which an owner seeks consent. However, once an application activates the EPB policy, a TA should require any necessary upgrading to be undertaken even if a building owner decides not to undertake the building work set out in the application.

This second approach has the significant disadvantage that it relies on a somewhat haphazard order of remediation based essentially on an owner's intention for a building. This could leave some significant high-risk buildings untouched for a long period of time. On the other hand, the cost of administering such a programme would be significantly less than for an active programme.

Despite saying that the guidelines are not prescriptive the purpose of the legislation is to 'spur' TA's into being more proactive regarding earthquake strengthening and there is a clear bias in the guidelines towards the implementation of an 'active approach'. The results of this encouragement can be seen in a summary of the various policies that was compiled by the Department of Building and Housing relating to the various 1st generation earthquake-prone building policies from all 73 TAs. This survey showed that approximately 45% had adopted an active policy, 32% had adopted a passive policy and the remaining 23% had policies that are both active and passive (DBH, 2008).

Typically the process of developing an earthquake prone buildings policy has been a daunting one in that it has required the structural assessment of a large number of buildings with resultant demands on budgets and staff. In addition it also leads to confrontation with some property owners. Most Councils have taken a staged approach in terms of the identification process and put in place deadlines for action that reflect a prioritization of seismic strengthening. An example of a typical response by a TA is shown in Table 1. This is an extract from the policy introduced by the Nelson City Council in 2006 and illustrates how they have set a range of deadlines for action

and also staged the identification process. Note that under this policy if an owner applies for consent to carry out significant alterations then this will also trigger the need to carry out seismic strengthening where the building is deemed to be earthquake prone.

Table 1.

Building Category	Date of Identification and Subsequent Action
Importance Level 4 Buildings with special post-disaster functions as defined in AS/NZS 1170.0:2002	December 2008 (15 Years)
Importance Level 3 Buildings that contain people in crowds or contents of high value to the community as defined in AS/NZS 1170.0:2002	December 2009 (20 years)
Heritage Classification A and B Buildings with a Heritage Classification of A or B under the Council's register	December 2010 (25 years)
Importance Level of less than 3 Buildings with an importance level of less than 3 as defined in AS/NZS 1170.0:2002	December 2011 (30 years)

Many TA's are currently undertaking a review of their Earthquake Prone Building Policies in order to comply with the requirements of section 132 to review their policies at not less than 5 year intervals. Many of these 2nd generation policies are currently going out for consultation. No comprehensive survey has been undertaken as to how these differ from the 1st generation policies but there is clearly pressure on TA's to make them 'tougher'. This is being achieved by such things as making the policies more active, reducing the timelines for owners to take action and increasing the level of strengthening that needs to be achieved.

There is considerable divergence of legal opinion over the level of strengthening that can legally be enforced by TAs in relation to their Earthquake Prone Building Policies. Legal advice commissioned by Local Government New Zealand was of the opinion that owners could only be forced to upgrade their buildings to a level that equalled or exceed one third of new building code. A contrasting legal opinion was obtained by Gisborne City Council after their earthquake in 2007. This advice was of the opinion that they could enforce higher levels and as a result they introduced a policy that requires buildings to be strengthened to two-thirds of current code. Some other TA's are following their lead particularly in relation to 2nd generation policies. The cost implications for owners of the change in upgrade requirements can be significant as shown by a survey carried out by John Hare of Holmes Consulting in 2010 on a sample of 25 Christchurch heritage buildings in the CBD (Hare, 2010). The average cost of the seismic retrofit increased from $369,000 to $923,000 when the 'target' was raised from 33.33% to 66.66% of current code.

The Act also stipulates that an existing building requiring a change of use must comply with the building code regarding seismic strength in the same manner as a new building (Section 115). The Act also stipulates that a building requiring alterations must also comply with the operative Earthquake Prone Building Policy administered by a local council.

The earthquakes in Christchurch has created political pressure to increase the use regulations to force owners to carry out seismic retrofits. The research in this paper examines reasons why voluntary seismic upgrading has been limited due to the actions of the different property market stakeholders along with their influence on earthquake risk mitigation.

1.2 Stakeholders involved in Property Market Investment and Seismic Risk Mitigation Decisions

Seismic retrofit decisions emphasised the reduction of the built environment's earthquake vulnerability (EERI 1998), while property investment decisions are based on ensuring that an investor achieves a satisfactory return on his investments in the market place in form of an income flow or capital gain or a combination of both (Adair *et al.* 1994). Arguably, various stakeholders' including property owners, investors, developers, occupiers, valuers, insurance and financial institutions, governmental agencies and hazard-related professionals contribute to property investment and earthquake risk mitigation decisions (Lindell *et al.* 1997, Luke *et al.* 2010, Su 2010). These stakeholders operate at different levels in the public and private sectors, having varying impacts on building owner's risk mitigation decisions (Lindell *et al.* 1997).

The prevalence of similar stakeholders in property investment and seismic risk mitigation decisions suggests similarities and overlaps in both decision-making processes, such as making investment and retrofit decisions simultaneously at the time of purchase or construction. Other similarities include the impacts of real estate market conditions and level of uncertainty and risks associated with both decisions (Asgary and Willis 1997).

A major difference between the two decisions is the period of transaction involved. Lindell *et al.* (1997) explained that the decision to adopt risk mitigation measures may cover the property's entire life span, while property investment decisions usually depend on the motive of acquisition either on long or short-term investment basis. Lindell and his colleagues asserts that the motive of property acquisition affects the decision whether to retrofit or not, emphasising that investors/developers with short term motive of acquisition are more interested in the income from the property or land value on which the building sits, and will generally not consider seismic rehabilitation of a potential EPB. The similarities and overlaps between these two decisions can be employed to foster improved seismic retrofit implementation because both decisions can be taken concurrently to reduce expenditure on future losses (Lindell *et al.* 1997).

However, Bradley *et al.* (2008) explained that retrofit and investment decisions of existing buildings are usually considered individually, such that strengthening cost are not usually factored into property prices and investment decisions. Langston *et al.* (2008) highlight the need for a transformation in the traditional decision-making processes of property stakeholders towards more sustainable practices, strategies and outcomes.

Clearly the property owner amongst the various stakeholders is the most important because he/she is the main seismic risk bearer who ultimately makes decisions and takes actions that may affect a building's earthquake risk vulnerability and mitigation. For instance, an owner or investor make choices whether or not to purchase or invest in properties located in low or high hazard-prone regions, and if pre-disaster mitigation activities that will reduce the risks posed by such hazard will be adopted. It should be noted that the owner who acquires the building for their own use or as a passive investment will differ from a property developer who acquires the property with a view to short term ownership. The real estate developer in order to maximise profits makes the initial allocation of resources to develop in a location that is susceptible to earthquake hazard, but does not necessarily invest in any mitigation measures to reduce losses from potential seismic event in the long term unless there is market demand for such mitigation.

It is also clear is that there are a number of other stakeholders either influencing or affected by the owners seismic retrofit decision. The occupier of the building (if different to the owner) is interested in the use value and especially in matters affecting business productivity and operating costs such as appearance, comfort, safety and energy efficiency. The need for employers to provide a safe working environment for their employees under the Health and Safety in Employment Act may well drive potential occupiers away from EQP buildings. Most building occupiers are generally unaware of the property's seismic risks, unless issues regarding the building safety are raised (Butcher and Cooper 2004).

The valuers' knowledge regarding the building's seismic risks can affect the market valuation analysis of the building. This knowledge may be used by potential purchasers and lenders carrying out a due diligence process. Valuation advice may also be sought in the preparation of feasibility studies looking at development and retrofit options for buildings.

Design professionals such as architects and engineers have an important role to play in the decision making process of the owner as they provide advice on the need for seismic retrofitting. They also advise on the alternative retrofit methods and appropriate strength levels along with cost estimates.

The insurance and financial institutions work together to ensure the sustainability of business transactions in the property market. Financial institutions have a significant stake in a catastrophic event, especially to the degree

that substantial portion of their financial assets are at risk from a single earthquake disaster (Lindell *et al.* 1997). Losses from natural disasters can have a severe impact on an insurer's financial situation. An insurer may limit coverage in any given area or charges higher premiums in order to keep the likelihood of insolvency at an acceptable level (Lindell *et al.* 1997).

Government agencies such as the local councils and territorial authorities are important because they are the level of government directly affected by a disaster and most capable of affecting property and business owners' decisions to adopt mitigation measures through policies and regulation (Lindell *et al.* 1997). The powers conferred on TAs as discussed in the previous section potentially allow seismic retrofits to be made compulsory rather than left as a voluntary decision to be made by the owner.

With multiple stakeholders involved in the decision making process it is necessary to examine methods and strategies that will enhance seismic retrofit decisions from the context of the various property market stakeholders' practices.

3. RESEARCH METHOD

The objective of the research in this paper was to investigate the impact of the property market stakeholders' practices on retrofit decisions, and to recommended market-based incentives that will increase the likelihood of building owners to voluntarily adopt earthquake risk mitigation measures. A multiple case study research approach was adopted and interviews chosen as the method of data collection. Cases and participants were selected through a "snowball" or reputational sampling technique. The research is qualitative and exploratory in nature and participants were selected based on referrals and their knowledge and involvement in the area of seismic retrofitting. Thirty-five interviews were conducted in four geographic regions chosen using a risk-based selection method, utilising criteria such as seismicity, hazard factor and percentage of retrofitted and non-retrofitted EPBs. The four cities of Wellington, Auckland, Christchurch and Gisborne selected for the study showed diversity in seismicity, mitigation efforts, past earthquake events, economic resources and population (Statistics New Zealand 2010). The interviews were conducted in 2008 and 2009. This was before the Christchurch earthquakes but after the Gisborne earthquake of 2007.

The stakeholders selected for the research were a mix of building owners, property valuers, engineers, architects, and managers of insurance, financial and governmental organisations that have been involved in seismic rehabilitation of EPBs. Building owners include both persons that have and have not retrofitted their EPBs, while other participants had at least a minimum of two years recent involvement in EPBs retrofit projects. Personal face-to-face interview techniques were used because it allowed an in-depth understanding of the research topic and the use of intensive probing questions to gain more insight into the research problem. A semi-structured questionnaire was adopted as the data collection instrument because it allows for structure, spontaneous discussion, and follow-up questions on the research topic. In examining the impact of the market stakeholders' practices on building owners' retrofit decisions, the main questions explored were as follows:

- Can you describe how activities in the property market influence a building owner's seismic retrofit decision?
- What roles do the stakeholders involved in investment and seismic retrofit decisions play in earthquake risk mitigation?
- What are the market-based incentives that can enhance retrofit decisions and how can these incentives effectively promote seismic rehabilitation of EPBs?

In order to analyse the data collected, the recorded interviews were transcribed. The transcripts provided a complete record of the interviews that facilitated the content analysis of the discussions. All interview transcriptions were analysed thematically for qualitative content, using NVIVO software. The main objective of the analysis was to identify themes and trends or patterns that appeared in the interviews. The analysis allowed theoretical explanations of themes and patterns, similarities, differences and outliers in the identification of the stakeholders' practices that affect owners risk mitigation decisions.

Of those interviewed, 16 (46%) of the participants were building owners, 5 (14%) were design professionals, 3 (9%) were insurance providers, 6 (17%) were in government and 5 (14%) were valuers. At the time of the interviews, 42% of the participants had personally experienced an earthquake.

4. IMPACTS OF THE PROPERTY INVESTMENT MARKET ON SEISMIC RETROFIT DECISIONS

The property investment landscape as a whole has gained considerable attention in moderating the market value of a building but little emphasis has been placed on understanding its full impact on seismic retrofit decisions. The stakeholders involved in property investment and seismic retrofit decision-making processes were examined in this study to understand how practices in the investment market affects building owners' risk mitigation decisions. The complexity of seismic retrofit decision arises from the wide range of stakeholder involved, who differ in their knowledge, resources, and perception of earthquake risks

The interplay between the different stakeholders is important as together they fashion property investment and retrofit decisions. It can be argued that earthquake risk mitigation plans failing to recognise these interrelationships between these stakeholders may be deficient, leading to suboptimal outcomes. The impacts of the property market on seismic risk mitigation decisions are discussed from the perspective of the various stakeholders.

4.1 The Role of the Valuer

A pertinent issue involves property valuations of retrofitted and non-retrofitted EPBs. The assessment of a property's market value affects investment and seismic risk mitigation decisions. The interviews revealed that earthquake risk receives a marginal consideration in the current investment practices and property valuation in New Zealand. Given that earthquake risk appears to have potential significant effect on the overall income return from a property and hence on the building's market value (Onder *et al.* 2004, Willis and Asgary 1997), yet seismic risk is poorly accounted for in property valuation and investment decisions.

The exclusion of earthquake risk assessment from property valuation was attributed to the New Zealand property valuation policy not directly addressing issues relating to seismic risks. The onus is left to the valuers' discretion. Valuers usually include a disclaimer on any related seismic risks in their valuation report, to reduce the scope and rights that may be exercised should a case of litigation ensue.

A property valuer said that,

"We do not have access to many buildings seismic risk properties making our job as valuers difficult. The lack of this information has contributed the lack of awareness regarding earthquake risk in the market. A generally acceptable risk in the market will increase the demand to include the risk in valuation analysis because owners, investors and insurers will ask for it".

This lack of information sometimes mislead the market stakeholders regarding issues surrounding the property vulnerability to seismic risks has significant influence on owners' mitigation decisions. Non-availability of this information results in insufficient weighting accorded to strengthening cost of EPBs in investment and purchase decisions leading to over or underestimation of risk mitigation cost in investment decisions (Beron *et al.* 1997, Nahkies 2009). Buyers are likely to pay high prices to purchase older buildings because their due diligence fails to account for earthquake strengthening requirements adequately. These buildings subsequently become economically unfeasible to strengthen. Moreover, non-availability of individual buildings' seismic properties can render the market for retrofitted and non-retrofitted EPBs inefficient because the assessment of insurance risk premiums and property valuation will be erroneous.

Excluding earthquake risk assessment in property valuation affects the potential property value and hence, building owners' mitigation decisions. The property valuers interviewed argued that from experience the property values of two similar buildings in terms of rental space and location are likely to generate the same income, despite one of the property being vulnerable to seismic risks because occupiers are likely to pay the same rents. Increasing the property market value of a retrofitted EPB therefore correlates to occupiers' willingness to pay for improved safety.

The valuer interviews revealed that another way to recapture the added value expended on seismic retrofitting of EPBs is through reduced capitalisation rates. Some of the valuers argued that the market reacts to uncertainty by increasing the investment risk premium. If the market comprises a mix of both strengthened and un-strengthened buildings then it is possible to analyse the variation in capitalisation rates attributable to seismic retrofitting. Apart from the use of sales analysis no alternative methods of risk adjustments to the capitalisation rates were

put forward by the valuers interviewed. Theoretically, if investors and owners can accurately assess the cost of the retrofit required and subsequently factor this into investment decisions, then risk premiums relating to seismic retrofit will reduce. This could optimally reduce the capitalisation rates of retrofitted buildings due to lower investment risk. Nahkies (2009) suggests that another way to capture the added economic value to retrofitted buildings is for the property to achieve lower operating costs to the users. This can be in term of improving the building's sustainability, or obtaining higher occupancy rates by overcoming market concerns regarding health and safety issues. In addition, insights from the interviews suggested that an informed market could possibly force down the property value of non-retrofitted EPBs. For instance, if most occupiers are well informed about earthquake risks and its benefits, they may be willing to pay appropriate rents for retrofitted buildings

One of the valuers interviewed said,

> *"Most times when making real-estate investment decisions, we assume that risks from rare disaster events such as earthquake are negligible compared to other market risks relating to the building net operating income and taxation".*

This suggests that seismic risks are not generally considered in financial analysis of most investment opportunities. Even in cases where earthquake risk is included in investment decisions, there is currently no consensus on how to embed seismic retrofit cost analysis effectively in property valuation assessment. In current real estate market practice, earthquake risk analysis in investment decisions is limited to the evaluation of probable maximum loss (PML) with no commonly accepted quantitative definition of earthquake PML (Zadeh 2000). Most working definitions involve some level of loss associated with large, infrequent seismic disasters (Rubin 1991). Although, some financial institutions often use PML to decide whether to underwrite a mortgage, it provides very little information about the degree to which earthquake risk contributes to the overall market risk. PML represents a scenario loss analysis that is not appropriate to estimate the value of a property value accurately (Beck *et al.* 2002).

4.2 The Role of the Building Owners

Of the building owners interviewed 94% explained that seismic retrofit cost can be enormous, and such expenditure does not increase the property's market value. Thus, it becomes a challenge for owners to recapture the added value expended on seismic retrofitting. This adversely affects seismic risk mitigation decisions. Most property owners prefer to transfer the risk by either selling the property or purchasing insurance rather than adopting risk mitigation measures.

In compliance to section 112 of the Building Act seismic rehabilitation of EPBs often triggers other building code requirements in terms of means of escape from fire and access and facilities for disabled people. Cost implications due to these triggers can discourage building owners from implementing voluntary seismic mitigation (Egbelakin and Wilkinson 2008, Nakhies 2009).

Territorial Authorities have been encouraged to take an "active" approach in their Earthquake Prone Policies. This requires the TA to undertake an Initial Evaluation Procedure (IEP) to identify EPBs within their jurisdictions. Steven and Wheeler (2008) reported that in the IEP carried out by a high seismic risk city (Wellington), 65% of the identified potential EPBs owners did not respond to the notices issued to them, while 43% of EPBs owners who responded requested time extensions ranging from 15 years to 25 years to seismically retrofit their EPBs. This low response from EPBs owners indicates that they are reluctant to make appropriate decisions to adopt risk mitigation measures.

However, Steven and Wheeler (2008) noted that prompt responses were received from owners whose properties were on sale in the market. This perhaps suggests that awareness of seismic risks in the property market potentially affect business transactions such as the sale value and net income from potential EPBs.

The interviews revealed that trust in earthquake hazard management professionals such as engineers have significant influence on owners' mitigation decisions. Evidence from this study indicate that trust and belief are highly inter-related; owners' trust in professionals such as engineers influence their belief in the effectiveness of the recommended retrofit solutions. One of the building owners declared that:

"I don't believe any of the solutions recommended to me by these engineers. You see that building over there, when I wanted to rehabilitate it, one engineer recommended 33%, while another 67%NBS. Do you think they know what they are doing? I have decided not to do anything about it for now, since the last Gisborne earthquake, where my friend's retrofitted building was damaged"

A number of the owners consulted (56%) neither believe in the effectiveness of the engineer's design solutions nor think that the engineer is capable of providing functional retrofit designs. Participants' belief in the efficacy of seismic retrofit design solutions differs among the cases. Insights from the interviews suggested that the differences in the responses to questions regarding trust and belief in seismic retrofit techniques and professionals across the cases relate to damages to new buildings by the recent earthquake event. Damages to new buildings with supposed high seismic strength affect people's perception of the design engineers and the efficacy of the structural solutions recommended. The study further discovered that disparities among consulting engineers in New Zealand contributed to the lack of trust in seismic retrofit professionals. Engineers do not have a consensus on the appropriate seismic performance standard that should be adopted, when recommending solutions for retrofitting. Most owners become confused when two engineers recommend strengthening levels that differ widely, which is interpreted as incompetence. These findings on lack of trust and belief in retrofit techniques and professionals suggest the need for engineers to have a consensus on an acceptable range for structural performance standards for retrofitting EPBs. This consensus will help to reduce the disparities observed by property owners.

4.3 The Role of the Design Consultants

The engineering profession has had considerable input into policy development in relation to seismic retrofit implementation. Engineering research has concentrated more on developing various seismic design solutions, with little attention to promoting the adoption and implementation of these solutions by building owners (Tierney 2008). A fundamental issue of concern in the engineering environment relates to the slow uptake of design solutions by property owners.

Additionally, lack of information regarding individual buildings' seismic properties is another concern of engineers and architects. Professionals in the earthquake engineering industry are aware of the substantial information and knowledge regarding the likelihood of an earthquake event and its potential impacts on the built environment through research and overseas experience. Much of this information is relevant to enhance building owners' mitigation decisions and other stakeholders' practises in the property market (Butcher and Cooper 2004). The interviews revealed a consensus across all the participants in the four regions that lack of information regarding individual buildings' seismic properties affects owner's retrofit decision.

Lack of information regarding individual buildings' seismic properties was attributed to territorial councils' poor coordination of building hazard information. Lack of a unified earthquake safety assessment information system that includes the seismic characteristics of all buildings within a particular hazard-pone area contributes to the poor coordination of this information.

Of those interviewed 89% suggested that a unified safety assessment information system would help other relevant professional groups and property market stakeholders to access any buildings' seismic risk data. This data will help them become aware of commonly encountered issues and imperatives regarding earthquake risks. The availability of this information system to the market will likely influence the price setting and valuation process of individual property transactions, thus informed investment decisions can be made. The obligations assigned to territorial local authorities under the Building Act (2004) and Civil Defense Emergency Management Act (CDEM) (2002) to assemble relevant information needed to address natural disasters such as earthquakes may improve and accelerate the information availability process. Engineers and other professionals involved in the assessment of seismic properties of EPBs can also contribute to the development of the unified earthquake safety assessment information system by providing the councils with updated version of the building's seismic risk data they have worked on. The availability of this information will improve the assessment of property valuation and investment opportunities (Beron *et al.* 1997, Palm 1982). For instance, such information can help potential owners to make appropriate decision whether to continue with the purchase of the building prone to earthquake risks, while including retrofit cost in the investment decision.

4.4 The Role of the Regulators

The regulatory environment has significant impacts on the property industry and building owners' decision to mitigate seismic risks. The stakeholders operating within this environment include City/Territorial local councils, the Department of Building and Housing (DBH) and industry group organisations such as New Zealand Society for Earthquake Engineer (NZSEE). These stakeholders are responsible for formulating, implementing and offering recommendations regarding the regulatory frameworks guiding seismic risk mitigation. Building Codes, and Earthquake Prone Building Policies should affect the value and market perception of buildings and be a significant driver of enhanced seismic retrofit and investment decisions.

However, surprisingly 79% of the participants were unaware of the obligations imposed by changes in the Building Act regarding EPBs. The interviews revealed that most of the stakeholders in the market have little or no knowledge about seismic retrofit standards, legal obligations and potential liabilities relating to seismic risks, suggesting that non-mandatory disclosure of buildings' seismic risks in earthquake prone building policies contributes to this lack of awareness. Evidence from this research suggest that lack of seismic risk awareness among the stakeholders in the market was encouraged by property vendors and real estate agents disregarding issues relating to seismic risks so that the property sale or rent period is not reduced. Lack of awareness of the building codes and legislation undermines the adoption of risk mitigation measures by owners of EPBs. One of the participants said that,

"It is difficult for all market stakeholders to know the issues around seismic risks unless the law mandates that it must be disclosed. Most owners and real estate agents will prefer to be salient on such issues because it will affect their business transactions"

Of the participants interviewed 63% believed that mandatory disclosure of a property's seismic risk at the point of sale or lease and exhibiting placards on building to warn people about the property's seismic risk would increase the market awareness on seismic risk issues and perhaps force down the value of non-retrofitted EPBs. However, 77% of the building owners and developers claimed that mandatory disclosure of risk would slow down the time taken to complete the property sale or rental transaction. They added that mandatory disclosure of risk of EPBs will increase the economic burden on building owners without allowing a gradual cost adjustment. Thus, a further examination on how mandatory seismic risk disclosure affects earthquake hazard mitigation is essential.

Presently, there is no incentive for seismic risk disclosure at the point of sale or lease of a building in the New Zealand market. Mandatory disclosure of seismic risks in earthquake policy provides information that is more accurate to the buyer, insurer and lending institution. All parties involved would understand the risk in the building before completing a business transaction. Kunreuther (2001) argued that the adoption of a seal of approval from financial institutions on buildings that meet or exceed the code standard would promote hazard mitigation measures. In addition, Cohen and Noll (1981) provided an economic justification why risk disclosure should be mandatory. The researchers explained that a building that fails in the event of an earthquake might create externalities in the form of economic dislocations and other social costs that are beyond the owners' economic losses. This could be in the form of social cost to the government or additional cost to other property owners not affected by the disaster. All financial institutions and insurers who are responsible for these other properties at risk would favour building codes to protect their investments. This will in no doubt help to promote mitigation measures as property traders are aware that the value of the property would be reduced if the building seismic risks were high, while the insurer would be able to estimate the building risks through a risk-based premium adequately.

4.5 The Role of the Insurance Industry

Earthquake insurance premiums were identified in this study as part of the factors that affect building owners' mitigation decisions. Insurance is a vital consideration in managing earthquake risks and has significant implication for seismic mitigation and investment decisions (Spence and Coburn 2006). Managers of insurance companies generally have a greater knowledge regarding seismic risks than most owners and investors (Nahkies 2009). Earthquake insurance policies in New Zealand generally cover a portion of shake damage to a structure from a seismic event. Building owners may also need to spend money for rehabilitation in an earthquake event for damages not covered under the policy. Across all cases studied, the participants indicated that the cost of earthquake insurance is relatively high in New Zealand. One of the building owners explained that,

"It was difficult for me to get insurance for this building and I have to pay a huge amount of money for insurance premiums." The guy from the insurance company told me even if I retrofit my building to higher performance level, the insurance premium is not likely to change".

However, one of the building owners claimed that although the premiums are high, they are able to negotiate lower deductibles and less expensive premiums through a portfolio approach which is a predominant practice among medium to large scale owners. A large proportion of the participants (86%) mentioned that owners of EPBs often find it difficult to obtain insurance and in most cases pay very high premiums. No specific figures were given by the participants as to the cost of insurance but as a guide insurance costs for a typical office building is given in Rawlinsons Construction Handbook (Rawlinsons, 2011) as $3.28 per square metre which equates to 8% of the total operating expenses for the building. This is for a new building and it is expected that the premiums for an old building would be considerably higher. Since the Christchurch earthquakes the media have reported on a number of premium increases ranging from 150% up to 400%.

Coburn (2008) explained that lower deductibles offered as incentive to building owners by insurers target only professional and corporate buyers of insurance policy rather than mass markets or medium size businesses where mitigation incentives would be valuable. High earthquake insurance premium increases the operating expenses of older buildings compared with newer properties making them less competitive in the market thus, becoming an impediment to the owners' seismic 'retrofit decisions. The participants from the insurance industry occupying senior management positions responded that the high premiums relates to the risks associated with earthquake uncertainty because the market respond to such risk by increasing property capitalisation rate. Enormous insurance premiums increase the operating expenses on these buildings making seismic retrofitting uneconomical. Anecdotal evidence suggest that there has been a gradual decline of investors/buyers interest in older buildings, unless the buildings have redevelopment potentials such as demolition and rebuilding, in which case seismic retrofit implementation becomes a non issue

Evidence from the findings showed that the cost of insurance premiums does not reflect seismic mitigation actions implemented in an EPB. Of concern was that 28% of the owners interviewed complained they were unable to purchase insurance after retrofitting their EPBs to structural performance standard greater than 67%NBS. Though EERI (1998) suggested that insurance premiums should reflect risk and take into account mitigation actions on the building provided the insurance losses on the structure is reduced by implementing such action. This is yet the case in New Zealand. Participants from the insurance industry claimed that accessing individual seismic mitigation actions on EPBs is difficult and costly. Moreover, the lack of a reliable database hampers the assessment of the mitigation actions undertaken (Spence and Coburn 2006). A large proportion of the interviewees (92%) suggested that buildings retrofitted well beyond minimum requirement should be eligible for premium discounts indicating that reduction in insurance premium is a key component of any hazard mitigation program aimed towards improving seismic retrofit decisions and implementation of EPBs. However, insurers are unwilling to offer a discount because a reduction in insurance premiums is likely to attract more owners of EPBs which increases insurance companies' risk exposure in the event of an earthquake (Bradley *et al*. 2008). This study finding showed that reducing insurance premiums for undertaking seismic hazard mitigation would encourage owners to make decisions regarding adopting risk reduction measures. Moreover, insurance premiums that reflect the building seismic risk will provide earthquake hazard signals to individual owners.

4.6 The Role of the Banking Industry

High interest rates on loans and were identified in this study as one of the factors that affect building owners' mitigation decisions. Financial institutions influence the moderation of business transactions such as investment decisions in the property market (Su 2010). However, financial institutions in New Zealand play a minimal role in promoting seismic retrofit decision or implementation. Banks usually consider issues such as loan-value-ratios, credit issues and debt service coverage (ratios of fund available to make loan repayments) on the property before giving out loans to property owners to rehabilitate their EPBs. The study showed that banks are often less eager to lend to owners of older buildings unless the owners have built up enough equity to support the loan. Hence, most small-scale owners of EPBs often find it difficult to secure loans to retrofit their EPBs. One of the owners explained that financial institutions usually request a full replacement earthquake insurance cover before approving the desired mortgage to purchase a potential EPB, most insurers are unwilling to insure such buildings. Therefore, potential owners are discouraged from the purchase and retrofit of an EPB. Erdik and Durukal (2008) suggest that financial organisations should participate in comprehensive urban regeneration projects aimed at reducing earthquake vulnerability within the built environment by providing long term low

interest loans to building owners to implement risk reduction measures. Lenders and insurers to date have contributed to a situation in which earthquake risks is not managed equitably in the market place (Earthquake Engineering Research Institute (EERI) 2000). The government now bears a significant portion of the risk by paying for response-rescue activities, clean up and recovery costs in an earthquake event.

5. SUMMARY AND CONCLUSIONS

The objectives of this study were to (1) examine the impacts of the property market stakeholders' practices on seismic retrofit decisions and (2) examine the market-based incentives that could be used to enhance retrofit decisions.

Significant impacts of the property investment market on seismic retrofit decisions identified in this study include the assessment of property valuations, high earthquake insurance premiums, lack of trust in earthquake risk management professional4s and lack of a unified earthquake risk assessment information of individual buildings.

Market-based incentives can take many forms such as recognition of seismic risks by the New Zealand property valuation policy, including earthquake risk assessment in the property valuation process, provision of a unified earthquake safety assessment information system and mandatory disclosure of buildings' seismic risks in the property market. They can offer reasons for the different stakeholders and the public at large to retain, care, invest, and act responsibly to rehabilitate EPBs. If adequate strategies considering some of these factors could be developed or nurtured, the market place might end up taking care of many EPBs within the communities.

Society in general will greatly benefit from a retrofit awareness campaign aimed at reducing the physical, social, and consequential societal losses that will eventually be covered by the public. It is important to note that these above named factors concern various stakeholders involved in seismic retrofit decision. Any policy implementation needs to consider how the insurance companies, banks, building owners, tenants, professionals in building and real estate communities can work together to foster seismic rehabilitation of vulnerable buildings.

A balanced awareness program regarding seismic risk and retrofit benefits tailored to meet the demands of all stakeholders in the property market is also necessary. This program will help owners, and occupiers to make sound investment decisions as well as improve the practices of other professionals in the market dealing with earthquake risks. The recognition of seismic risks by the New Zealand property valuation policy and incorporating earthquake risk assessment in property valuation reports will be an added advantage to promote seismic retrofit decisions and implementation.

The findings of this study suggest that insurance and financial institutions should assume greater responsibilities in raising earthquake risk awareness in the property market and encouraging owners to adopt seismic retrofit implementation.

Using the real estate market to reduce seismic risks has been suggested in literature as a motivator to improve seismic retrofit implementation of EPBs (Hopkins 2005). One of such ways is to ensure the viability of retrofitted EPBs in the market because the inherent value of commercial real estate comes from the net operating income stream that the market generates (Beron *et al.* 1997). However, the income from a property and its value can be uncertain because of changes in real estate market risks, including economic downturn and legislative reforms such as the changes in the New Zealand Building Act (Adam 2004).

Ultimately, the impact of tenants requirements for safe buildings is likely to be one of the biggest drivers of change in the commercial real estate market in New Zealand for older buildings. The Christchurch earthquakes have raised awareness of seismic risk to unprecedented levels in New Zealand and anecdotal evidence is growing that shows clearly that tenants are avoiding buildings that do not meet current building code standards. This may make some older buildings effectively obsolete for their current use unless the owners are willing to invest in seismic retrofits.

Clearly creating value for seismic safety in the property market is a strong motivator for improving the seismic performance of EPBs. The impacts of the Christchurch earthquakes are already impacting on the property markets outside Christchurch and will ultimately lead to strong market driven demand for seismic retrofitting. It may also lead to widespread demolition of old buildings which raises some serious issues in relation to heritage buildings.

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