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Impacts of the Property Investment Market on Seismic Retrofit Decisions

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ABSTRACT: Implementing seismic risk mitigation is a major challenge in many earthquake prone regions. The objective of this research is to investigate how property investment market practices can be used to enhance building owners' decisions to improve seismic performance of earthquake prone buildings (EPBs). A case study method adopted, revealed the impacts of the property market stakeholders' practices on seismic retrofit decisions. The findings from this research provide significant new insights on how property market-based incentives such as such as mandatory disclosure of seismic risks in all transactions in the property market, effective awareness seismic risk program and a unified earthquake safety assessment information system, can be used to enhance EPBs owners seismic retrofit decisions. These market-based incentives offer compelling reasons for the different property market stakeholders and the public at large to retain, care, invest, and act responsibly to rehabilitate EPBs. The findings suggest need for stakeholders involved in property investment and retrofit decisions to work together to foster seismic rehabilitation of EPBs.

Kew Words: Building owners, Earthquake Prone Buildings (EPBs), Seismic retrofit implementation, Property market, Investments and Retrofit Decisions

1 INTRODUCTION

Promoting and enhancing building owners' earthquake risk preparedness decisions is essential to reduce losses such as loss of life, damage to property and infrastructure, as well as economic and social disruption in an earthquake in a seismic disaster. Given the infrequent nature and severity of earthquakes, seismic retrofitting of earthquake EPBs is essential to sustain community resilience. Many communities within active seismic zones have placed much emphasis on understanding the scientific nature of earthquakes, developing technical solutions and devising legislative means to ensure that EPBs are seismically retrofitted to reduce earthquake losses, but these efforts have not always resulted in satisfactory success (Tierney, Lindell and Perry 2001). Seismic rehabilitation of EPBs lags behind advances in scientific and engineering understanding because little attention has been focussed on how to motivate building owners' decisions to adopt seismic adjustments (Hopkins *et al.* 2006). Property owners were found unwilling to retrofit their EPBs (Hopkins 2005). This unwillingness has been a critical issue in earthquake pre-disaster planning and management, and has been related to many factors such as retrofit cost, risk perception and efficacy of mitigation measures interact to influence mitigation decisions (Egbelakin and Wilkinson 2010). For the purpose of this study, seismic risk mitigation decisions refer to the choices made by property owners to adopt pre-disaster seismic adjustments (Bostrom, Turaga and Ponomariov 2006, Mcguire 2008, Egbelakin and

Wilkinson 2010). Pre-disaster seismic adjustments include either actions or behaviours undertaken by people to reduce immediate risk of damage and loss during earthquake events; or preparation for post-impact conditions that might adversely affect survival probabilities (Tierney, Lindell and Perry 2001, Spittal *et al.* 2008, Solberg *et al.* 2010). Examples of pre-disaster seismic adjustments include structural and non-structural mechanisms to rehabilitate existing buildings that are otherwise vulnerable to earthquake hazard policy, purchase of earthquake insurance and securing house contents.

Studies in the social, economic and decision sciences have sought to address this dilemma from different perspectives. Many psychologists have focused on the impact of risk perception on mitigation decisions, concluded that how people perceive and personalise earthquake risks significantly influence the type of protective decision and behaviour adopted (Lepesteur *et al.* 2008, Lindell and Prater 2000, 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, and submitted that the 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 valuations decisions and policies regarding hazardous situations, and accordingly provided a rationale for the overall economic benefit of implementing mitigation measures (Bernknopf *et al.* 1990, Cohen and Noll 1981, Schulze *et al.* 1987). Various studies on earthquake risks and property market prices found correlations between risk information and communication style, property values, location, government initiated policies and programs, investment decisions and owners' attitudes towards adopting seismic adjustments (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 decision to adopt seismic adjustments. A stakeholder's approach was adopted in this study to; (i) examine how property market practices act as impediments to seismic retrofit decisions, and (ii) investigate incentives that may be used to drive investments in EPBs retrofits projects. 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, derived by raw property counts (Stevens and Wheeler 2008). Findings from this research sought to devise strategies that will increase the likelihood of building owners undertaking mitigation actions to reduce earthquake hazard vulnerability in New Zealand. For the purpose of this study, seismic risk mitigation decisions refer to the choice made by property owners to adopt pre-disaster seismic adjustments (Bostrom *et al.* 2006, Egbelakin and Wilkinson 2010, McGuire 2008). While pre-disaster seismic adjustments include actions or behaviours undertaken by people to reduce immediate risk of damage and loss during an earthquake event or to prepare for post-impact conditions that might adversely affect survival probabilities (Lindell and Perry 2004, Solberg *et al.* 2010, Spittal *et al.* 2008, Tierney *et al.* 2001). Examples of pre-disaster seismic adjustments include structural and non-structural mechanisms to rehabilitate existing earthquake prone buildings (EPBs) and purchase of earthquake insurance policy.

2 BACKGROUND

2.1 *Seismic Retrofit implementation in New Zealand*

New Zealand is a located in a highly susceptible earthquake region. The recent New Zealand's earthquake of magnitude 6.3 in April 2011 with severe fatalities and an estimated financial loss of NZ$10.5 billion (Vervaeck and Daniell 2011) suggests the need to develop momentous measures of reducing earthquake disaster impacts. These earthquake events demonstrated the economic implication of the Act's minimum seismic performance requirement and non-retrofitting of EPBs. Adopting high seismic performance standard in policies regarding low probability disasters such as earthquake is usually difficult to enact because decision-makers perception of risks differ. Moreover, the cost implications of adopting high seismic performance level discourage building owners to voluntarily

adopt seismic adjustments (Nakhies 2009, Egbelakin and Wilkinson 2010).

The New Zealand Building Act (2004) was devised to reduce the level of earthquake risk to the public over time, targeting the most vulnerable buildings. The enactment of the Act has several implications that affect seismic retrofit implementation. The Act allows the Territorial Authorities (TAs) to choose either a passive or an active mitigation approach to implement the policy. The active approach involve a rigorous identification and detailed assessment of EPBs and retrofitting the identified EPBs within 3-10 years, while in the passive approach, seismic strengthening is triggered only by the application for a building alteration, change of use and life extension. A total of 45% of the TAs adopt a passive approach, 32% chose an active approach while 23% chose the passive-active approach (DHB, 2005). One outcome of such a model, evident from the TAs mitigation approach is that some districts and communities have good programs in place to mitigate earthquake hazards, while other communities would have done little or lack adequate resources to implement mitigation measures. The TAs were advised in the Act 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 market could potentially affect property business transactions regarding sales value and net income streams of potential EPBs. 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 that retrofitted EPBs are viable 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, property values or income streams 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). The research in this paper examined different property market stakeholders' practices and their influence on seismic retrofit implementation.

2.2 *Stakeholders involved in Property Market Investment and Seismic Risk Mitigation Decisions*

Seismic retrofit decisions involve reducing 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, capital gain or a combination of both (Adair *et al.* 1994). Arguably, various stakeholders' including property owners, investors, developers, occupiers, valuers, insures, lenders government officers and hazard-related professionals contribute to property investment decisions (Lindell *et al.* 1997, Luke *et al.* 2010, Su 2010). These stakeholders operate at different levels within the public and private sectors, and have varying impacts on building owner's risk mitigation decisions (Lindell *et al.* 1997). The different characteristics of these stakeholders are discussed below.

Among the various stakeholders, the property owner is the main seismic risk bearer who makes decision and undertakes 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. The owner also makes decisions whether pre-disaster mitigation activities will be adopted to reduce the risks posed by such hazard. Most building occupiers are generally unaware of the property's seismic risks, unless when issues regarding the building safety are raised (Butcher and Cooper 2004). They are more interested in the use value, and especially in matters affecting business productivity and operating costs such as appearance, comfort, and energy efficiency. The real estate developer may maximise profits by making initial allocation of resources to increase economic activity in a location that is susceptible to earthquake hazard, but may not invest in any long-term seismic adjustments. Government agencies such as the local councils and TAs 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 seismic adjustments through policies and regulation (Lindell *et al.* 1997). In addition, the insurance and financial institutions work together to ensure the sustainability of business transactions in the property market. The valuers' knowledge regarding the building's seismic risks can affect the property's market valuation analysis. Losses from natural disasters can have severe impacts on an insurer's financial situation, resulting in higher premiums or limiting coverage in an hazardous area in order to keep the likelihood of insolvency at an acceptable level (Lindell *et al.* 1997). 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). The prevalence of similar stakeholders in property investment and seismic risk mitigation decisions suggest similarities and overlaps in both decision-making processes, such as making investment and retrofit decisions simultaneously at the time of purchase or rehabilitation. Other similarities include the impacts of real estate market conditions and the level of 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 seismic adjustments may cover the property's entire life span, while property investment decisions usually depend on the motive of acquisition (long or short-term investment basis). Lindell and his colleagues asserts that the motive of property acquisition affects the adoption of seismic adjustments , emphasising that investors/developers with short term motive of acquisition are more interested in the income from the property or land value, 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. 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. Therefore, it is necessary to examine methods and strategies that will enhance seismic retrofit decisions from the context of the property market stakeholders' practices, and to recommended market-based incentives that will increase the likelihood of building owners to voluntarily adopt seismic adjustments.

3 RESEARCH METHOD

3.1 *The Study*

The objective of this study is to investigate the impact of the property market stakeholders' practices on retrofit decisions. A multiple case study research approach was adopted and interviews chosen as the method of data collection. Cases and participants were selected through a purposeful sampling procedure based on the research objectives, which are limited to the study populations. 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 (See Table 1). Four of the fifteen cities in New Zealand selected for the study showed diversity in seismicity, mitigation efforts, past earthquake events, economic resources and population (Statistics New Zealand 2010). The stakeholders selected for the research include building owners, property valuers, engineers and architects, 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 have at least a minimum of two years recent involvement in EPBs retrofit projects. Personal face-to-face interview technique was used because it allows 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:

- What roles do the stakeholders involved in investment and seismic retrofit decisions play in earthquake risk mitigation?

- Can you describe how activities in the property market influence a building owner's seismic retrofit decision?
- 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 facilitating the content analysis of the discussions. All interview transcriptions were analysed thematically for qualitative content, using NVIVO software. The analysis allowed theoretical explanations of themes and patterns, similarities, differences and outliers in the examination of the impact of the stakeholders' practices on owners' decisions o adopt seismic adjustments.

Table 1. Summary of Cases

Cases	Hazard factor (Z)	Level of earthquake risks	Last Significant earthquake	Retrofit standard adopted	Mitigation Approach
Case 1	0.13	Low	Oct. 2010	33% NBS	Passive
Case 2	0.22	Medium	April 2011	33% NBS	Passive
Case 3	0.36	High	Dec. 2007	67% NBS	Active
Case 4	0.4	V. High	Aug. 1942	33% NBS	Active

Earthquake hazard factor (Z) is the equivalent to the acceleration coefficient with annual probability of exceedance in 1/500) for different locations in New Zealand (Standards New Zealand 2004). Earthquake hazard factor and seismicity are used to establish the probability and severity of a seismic event, which varies between provinces.

3.2 *Participant Characteristics*

Participants' characteristics are summarised in Table 2. A majority of participants are in the senior management category. 45% of the participants are building owners, while 55% are other stakeholders' involved in seismic retrofit decisions. Three types of owners were identified: private (53.3%), public (26.7%) and non-profits (20%). 42% of the participants have personally experienced an earthquake. The average working experience of the participants in seismic retrofit building projects is 5.5 years, with a minimum and maximum of 3 years and 8 years respectively. The average of 5.5 years experience indicates that most respondents have reasonable work experience in seismic retrofitting of EPBs.

Table 2. Profile of Participants

Characteristic	Category	No	Percentage %	Characteristic	Category	No	Percentage %
Participants	Building owners	15	45.5	Years of Experience with EPBs	≤ 5 Years	3	9.1
	Professionals	6	18.2		6 - 10 Years	7	21.2
	Insurance providers	3	9.1		11 - 15 Years	6	18.2
	Governmental Organisations	5	15.2		16 - 20 Years	8	24.2
	Property Valuers	4	12.1		21 - 25 Years	4	12.1

Characteristic	Category	No	Percentage %	Characteristic	Category	No	Percentage %
Type of Ownership	Private Owners	8	53.3		> 25 Years	5	15.2
	Public Owners	4	26.7	Location	Wellington	8	24.2
	Nonprofits	3	20.0		Gisborne	10	30.3
Designation	Upper management	23	69.7		Christchurch	7	21.2
	Middle management	7	21.2		Auckland	8	24.2
	Professionals	3	9.1	Personal experience of earthquake	Yes	14	42.4

4 IMPACTS OF THE PROPERTY INVESTMENT MARKET ON SEISMIC RETROFIT DECISIONS

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 influence of the stakeholders operating in different environments on building owners mitigation decisions is illustrated in Figure 1.

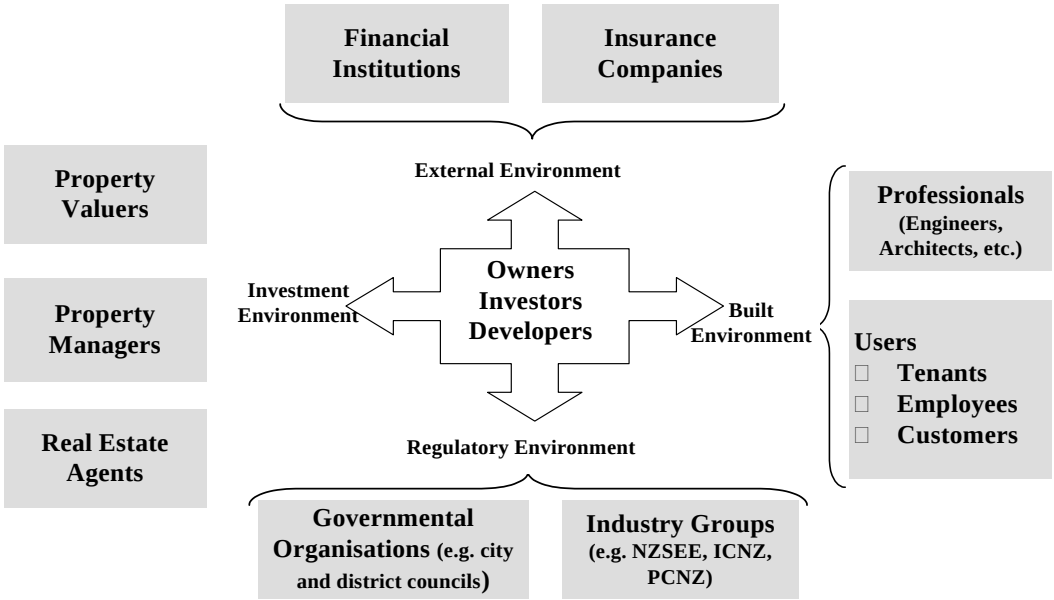

Figure 1. Seismic retrofit implementation and investment decisions

The stakeholders' different operating environments amidst the property market include the built, investment, regulatory and external environments as illustrated above. The interplay between these environments provides an important role that fashions property investment and retrofit decisions. It can be argued that earthquake risk mitigation plans failing to recognise these interrelationships between these environments and their respective stakeholders may be deficient, leading to suboptimal outcomes. The impacts of the property market on seismic risk mitigation decisions are discussed from the operational perspective of the stakeholders' environment.

4.1 *Investment Environment*

The investment environment of comprised of property managers, valuers and real estate agents as illustrated in Figure 1. A pertinent issue considered in this environment involve the assessments of property values of retrofitted and non-retrofitted EPBs. Each of these stakeholders contributes to the assessment of a property's market value, which consequently 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.

68% of the property valuers interviewed explained that seismic risks are not generally not considered in property valuation reports, unless specifically requested by clients. One of the stakeholders 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 the financial analysis of most investment opportunities because earthquake risks are not significantly considered in property valuation assessment. Potential investors are not well informed regarding the financial impacts of seismic risks on property value. As a result, there is insufficient weighting given to potential earthquake strengthening costs in investment and purchase decisions. Buyers therefore pay too much for their old buildings because their due diligence fails to adequately account for earthquake strengthening requirements. Thus, rendering retrofitted of such EPBs less viable in the market. Anecdotal evidence suggest that this situation is encouraged by vendors and real estate agents 'playing down' the situation and the confusion or market disinformation regarding the degree to which existing buildings may have been strengthened. The reason for this is due to ignorance in the market about current strengthening levels. Most buildings that have been 'strengthened' in the past have been strengthened to comparatively low levels when compared with the current code. Many tenants or owners have purchased or leased buildings in the belief that they have been "strengthened" or even "fully strengthened to 100% of Code" without fully understanding what this means. They are unaware that the code being referred to is the 1965 Code and that as a result the degree of strengthening is substantially less than that of a comparable new building. There is the possibility that if property valuation directly assesses the economic implication of seismic risks in property valuation, investors could adequately estimate the cost to retrofit such an EPB and factors it in investment decisions.

Excluding earthquake risk assessment from property valuation practice was attributed to the Australia and New Zealand Valuation and Property Standards 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. 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. 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).

92% of the building owners interviewed explained that seismic retrofit cost can be enormous, and such expenditure cannot be easily recaptured in terms of increase property's market value or income streams. Hence, building owners are not motivated to adopt seismic adjustments in their EPB because of the lack of perceived financial benefits from retrofitting either at the time of sale or during a lease. Increasing the property market value or income streams from a retrofitted EPB therefore correlates to investor's or occupiers' willingness to pay for improved safety, which is only possible if the occupier is well informed about the benefits of implementing seismic risk mitigation. 48% of the valuers with over 20 years of industry experience explained that another way to recapture the added value expended on seismic retrofitting of EPBs is through reduced capitalisation rates. They argued that market reacts to uncertainty by increasing the investment risk premium. If investors and owners can accurately assess the cost of 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. Nakhies (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 heath 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.

4.2 *Built Environment*

The built environment has been of much focus and discussion in relation to seismic retrofit implementation. The built environment has concentrated more on developing various seismic design solutions, emphasising little attention to the adoption and implementation of these solutions by building owners (Tierney 2008). A fundamental issue of concern in the built environment relates to the adoption of design solutions by property owners. The interviews revealed that trust in 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 damage"*

58% of the owners consulted 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. In case one, 52% of the participants indicated that they do not in believe the seismic retrofit techniques available in New Zealand. This lack of belief in retrofit techniques relates to the absence of any significant earthquake in the region, as the solutions adopted have not been tested. While case three has the highest percentage of participants (67%) with no belief in engineering techniques. 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. Also, engineers and delegated territorial councils officers should pay more attention to seismic designs recommended and approved to reduce the impact of earthquake disasters on new buildings to improve people's trust in their recommendations.

Additionally, lack of information regarding individual buildings' seismic properties is another concern in the built environment. Professionals in the earthquake engineering industry such as engineers 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). Questions considering this lack of information generated a response rate of 87% among the participants in case 3. 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. A property valuer said that,

> *"We don 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, Nakhies 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. 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.

89% of the participants 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.

4.3 *Regulatory Environment*

Regulatory environment has key impacts on the property industry and building owners' decision to mitigate seismic risks. The stakeholders operating within this environment include City/Territorial local councils, 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, earthquake policies, valuation and property standards and other related regulations that may affect reconstruction and sale transactions of buildings are significant drivers of enhanced seismic retrofit and investment decisions.

Across cases, 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 policy 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"*

63% of the participants interviewed 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 would cause inflation in the market because immediate strengthening 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.

4.4 *External environment*

The stakeholders in the external environment include financial institutions and insurance companies. High deductibles in earthquake insurance premiums and loan interest rates 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).. Across all cases studied, participants indicated that the cost of earthquake insurance and the policy deductibles 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 and deductible is not likely to change".*

86% of the participants mentioned that owners of EPBs often find it difficult to obtain insurance and in most cases are subjected to higher deductibles. However, 22% of the building owners in case 4 claimed that although the premiums are high, they are able to negotiate lower deductibles through a portfolio approach which is a predominant practice among medium to large-scale owners. Coburn (2008) explained that lower deductibles offered as incentive to building owners by insurers target the corporate buyers of insurance policy rather than mass markets comprising of small and medium size owners and businesses where mitigation incentives would be valuable. Insights from the interviews suggest that planes in the seismically active zones usually carry higher deductibles. Hence, the higher the deductible the lower will be the liability of the insurance company and lower premium. The qualitative analysis revealed that earthquake insurance is viewed by many homeowners as too costly but because of the high deductibles, and often reduces their willingness to adopt it.

Furthermore, evidence from the findings showed that the cost of insurance premiums does not reflect seismic mitigation actions implemented in a retrofitted EPB. 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. 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, because each building is different requiring separate assessments. Moreover, the lack of a reliable database hampers the assessment of the mitigation actions undertaken (Spence and Coburn 2006). 92% of the interviewees 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. This study finding showed that insurance premiums that reflect the building seismic risk would provide earthquake hazard signals to individual owners.

Financial institutions influence the moderation of business transactions such as investment decisions in the property market (Su 2010). 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. Therefore, 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 as part of the collateral before approving the desired loan to strengthen an 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 seismic adjustments. 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), ensuing the government to bears a significant portion of the risk by paying for response-rescue activities, clean up and recovery costs in an earthquake event. 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.

5 DISCUSSION

The research findings revealed in this study provide an empirical support for creating value for seismic safety in the property market. Creating value for earthquake risks in the property market significantly influence the adoption of seismic adjustments, through mandatory disclosure of earthquake risks in all property market transactions and comprisal in Australia and New Zealand Valuation and Property Standards. Mandatory disclosure of seismic risks will allow accurate information to be communicated buyer, insurer and lenders leading to an informed market. Anecdotal evidence tends to support the view that market awareness regarding the potential liabilities and legal obligations relating to earthquake prone buildings in New Zealand is limited. Therefore, the premise behind much of the following discussion is that the property market is far from efficient and that obligations imposed by the changes in legislation have generally not been anticipated by the market and factored into investment decisions. Insights from the interviews suggested that a market that is adequately informed about earthquake risks and seismic retrofit benefits would possibly force down the property value of non-retrofitted EPBs. For stance, informed occupiers or investor may be willing to pay appropriate rents or price for a retrofitted EPB, thus increasing the property value of the building. Mandatory disclosure of seismic risks will significantly enhance owner's benefits from retrofitting such as through increase property value and lower insurance premiums. Mandatory comprisal of seismic risks in Australia and New Zealand Valuation and Property Standard will enhance decisions to retrofit EPBs, as valuers will be obligated to disclosure and estimate the value of a building's earthquake risk to market stakeholders. Property owners will recognise that their property value could be reduced if their seismic risk becomes public information thus promoting the adoption seismic adjustments. Subsequently investors, owners and insurers can accurately assess the cost of retrofit required, and factors it into property prices and investment decisions. The insurer will adequately estimate the building risk through a risk-based premium, reducing the capitalisation rates of retrofitted buildings due to lower investment risk.

To explore the use of mandatory disclosure of earthquake risks in property transactions and comprisal in Australia and New Zealand Valuation and Property Standard, a balanced awareness program regarding seismic risk and retrofit benefits tailored to meet the demands of all stakeholders in the property market is necessary. This program will help owners, investors, insurers, lenders and occupiers to make sound investment decisions and improve the practices of other professionals in the market dealing with earthquake risks. In addition, appropriate risk definition and effective communication plans are important vehicles to ensure that the market stakeholders and implementers understand the need and benefits of adopting seismic adjustments, so that increasing seismic risk's awareness can have meaningful impacts. An effective risk communication program is an essential component of any community's efforts to reduce its hazard vulnerability. Bourque *et al.* (2010) suggested that in order to generate an effective response from risk communication, the distribution of earthquake preparedness information should include a mix of passive and proactive approaches that utilises both traditional and emerging information technologies. Increasing seismic risks awareness in the property market by using adequate risk definitions and communication principles has an advantage of simultaneously improving people's perception regarding earthquake probability and severity (Tierney *et al.* 2001), and emphasising the need for a unified earthquake safety assessment information system.

Insights from the interviews suggested that trust could improve the effectiveness of interpersonal relationships that exist among the stakeholders when dealing with high-uncertainty risks such as earthquakes. Owners' lack of trust in the seismic retrofit professionals relate to their previous experience of dealing with them, leading some owners to discredit their advice on seismic adjustments. The study found that the disparities in advice from structural engineers contribute to the lack of trust in information about seismic techniques and professionals. Consulting engineers need to reach a consensus on

the acceptable level for seismic retrofit necessary to eliminate the danger associated with EPBs and to avoid building owners' confusion and mistrust. One recommendation to increase trust between professionals and owners of EPBs relates to the advice that building owners received regarding possible outcomes of the retrofit solutions selected in the event of an earthquake. This advice might help to reinstate their recommendation in the event of an earthquake, which is evident from the findings reported in Case 3. Professionals and regulatory authorities should pay more attention to the structural designs they recommend and approve. Stakeholders involved in seismic retrofit decision-making process are therefore encouraged to develop a better understanding of the seismic risks and the implications of their corresponding retrofit decisions.

Findings from this study have several practical implications for policies that aim to increase building owners' adoption of seismic adjustments. An appraisal of the policy implementation approach adopted by some the TAs is necessary. TAs within medium to high risk zones should adopt an active implementation approach, coupled with proactive public awareness programs and community engagement in order to improve the TAs' commitment level and to achieve consistent earthquake mitigation strategies across the regions. This reappraisal should incorporate the suggestions from Comerio (2004) and Bourque et al. (2010) regarding performance-based policies, community participation and awareness programs. In addition, the provision of financial incentives (such as loan interest loans and tax deductibles) specifically designed for EPBs should be introduced in the TAs policy-implementation program, which can be partly funded by central government for jurisdictions that lack necessary financial resources. The introduction of incentives will reduce the economic burden on building owners, thereby allowing owners to retrofit their EPBs. However, further research is necessary to develop effective incentives and reward strategies that would enhance seismic retrofit decisions. Further research is also necessary to examine the possibility of using law to make the owners of unretrofitted EPBs liable for damages caused by their building to adjoining properties in an event of an earthquake. This may provide an opportunity to use the law to indirectly mandate adequate seismic retrofitting of EPBs to 67% of the New Building standard.

6 **CONCLUSION**

Creating value for seismic safety in the property market is a strong motivator for improving the seismic performance of EPBs. The objective of this study is to examine the impacts of the property market stakeholders' practices on seismic retrofit decisions and investigate market-based incentives that can 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 deductibles, lack of trust in risk management professionals and a unified risk assessment information of individual buildings. Market-based incentives such as recognition of seismic risks by the Australia/New Zealand Property Valuation Standards, including earthquake risk assessment in property valuation process, and mandatory disclosure of buildings' seismic risks in the property market transactions. If adequate strategies considering these factors could be developed or nurtured, the market place might end up taking care of many EPBs within the communities. The macro scale 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 and implementation suggesting how the insurance companies, financial institutions, building owners, tenants, professionals in building and real estate communities can work together to foster seismic rehabilitation of vulnerable buildings.

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