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Impeding factors causing long-term delays in the recovery of Christchurch CBD

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ABSTRACT

Twelve years on from the first earthquake on 4th September 2010 and its damaging aftershock on 22nd February 2011, the recovery of Christchurch CBD, New Zealand, has not been completed. To better understand the impeding factors that caused the long-term delays in the recovery of CBD, a field-based study in October 2022 was undertaken. By conducting semi-structured interviews with twelve individuals who were or are still heavily involved in the recovery of Christchurch City, this research revealed five impeding factors that are still influencing decisions around buildings damaged in the earthquakes that have not been repaired or demolished.. These impeding factors included 1) conditions of neighbouring/adjacent structures and facilities, 2) complexity in decision-making on buildings involving many stakeholders, 3) lack of specialised building materials and human resources, 4) duration and frequency of aftershock series, and 5) insurance coverage and mechanisms. As the long-term delay of earthquake recovery imposes significant socio-economic effects and uncertainties for local communities, the findings from this research are hoped to provide insights in terms of the most appropriate recovery strategies to assist with the rapid decision-making of buildings from a multi-stakeholder perspective.

Keywords: Post-earthquake recovery, Built environment, Downtime, Field study, Canterbury earthquakes sequence, Christchurch

INTRODUCTION

The 2010-2011 Canterbury earthquake sequence extensively impacted the built environment of Christchurch City, New Zealand [1]. More than 60% of buildings with three or more stories in the central business district (CBD) of Christchurch were demolished, resulting in losses exceeding $NZD 40 billion [2]. The September 2010 earthquake caused an estimated repair and rebuilding cost of approximately $NZD 5 billion, while the cost of repairing damage caused by the aftershock sequence was much higher [3].

Over the past decade since the earthquakes, the recovery of infrastructure and commercial buildings in Christchurch CBD has shown significant progress. The Stronger Christchurch Infrastructure Rebuild Team (SCIRT) was established in 2011 to restore publicly-owned horizontal infrastructure in the city [4]. In the five and a half years of its program, SCIRT made solid progress in repairing pipes and roads, with 87% of its infrastructure repairs completed by April 2016 [5]. However, while SCIRT made solid progress in repairing damaged infrastructure, its mandate ended by the end of 2016 [4], leaving remaining works in the CBD that still need to be completed. In addition to the recovery of infrastructure, remarkable progress has been made in the reconstruction of commercial buildings in Christchurch CBD, with the building stock reaching 85% of the 2010 level as of 2020 [6]. Nonetheless, the recovery of commercial buildings remains incomplete, with some areas still having vacant sites and damaged buildings even twelve years after the earthquakes (Figure 1a and 1b) [7]. Furthermore, many landmarks and heritage buildings, such as the Christchurch Cathedral, McLean's Mansion, and Former Canterbury Provincial Government Buildings, are still undergoing restoration or awaiting a decision on whether to repair or demolish them. In summary, despite significant progress made over the past decade, the recovery of the Christchurch CBD remains incomplete.

(a) *(b)*

Figure 1. Aerial view of the recovery progress of Christchurch CBD: (a) Victoria Square and the Avon River Precinct (Source: Chrtistchurch City Council, 2018 [8]), (b) The city centre (Source: Chrtistchurch City Council, 2018 [8]).

The speed and effectiveness of post-earthquake recovery efforts can have significant impacts on the well-being and livelihoods of affected communities, as seen in the differing experiences of Japan and Chile. The delayed recovery can have long-lasting negative consequences, as seen in the aftermath of the Great East Japan Earthquake in 2011. Despite setting a 10-year recovery timeline, the Japanese government faced deliberation concerns that slowed the recovery process [9]. The reconstruction of residential buildings was particularly slow due to a lack of repair materials [10], causing significant social challenges such as displacement of residents, business closures, and disruptions to daily life [11]. In contrast, Chile managed the post-earthquake recovery process more effectively following the 2010 magnitude 8.8 earthquake due to the balanced approach adopted by the government that combined speed and deliberation [9]. By the end of 2011, 222,000 home-rebuilding projects were subsidised by the Government of Chile [12,13], and 74% of these projects were completed within 17 months after the earthquake [14]. The rapid recovery in Chile can be attributed to factors such as robust building codes, comprehensive enforcement of the building codes, and good local coordination [9]. Compared with experience in Japan and Chile, the recovery process of Christchurch CBD is still ongoing twelve years after the earthquakes, and the causes of the long-term delays in the recovery remain unclear.

Given this background, it is essential to investigate the impeding factors still causing long-term delays in the recovery of Christchurch CBD. This field-based study aims to investigate these impeding factors by conducting semi-structured interviews with twelve individuals who were or are still heavily involved in the recovery process. The interviews were conducted during a field trip to Christchurch CBD in October 2022. The insights gained from this study are expected to guide the appropriate governance mechanisms for efficient post-earthquake decision-making from a multi-stakeholder perspective.

LITERATURE REVIEW

The devastating earthquakes of the past two decades have drawn global attention to the post-earthquake recovery of the built environment. Researchers, governmental agencies, and industrial practitioners have made substantial efforts to develop methods for downtime assessment and estimation [15-17]. Post-earthquake recovery assessment frameworks, such as the Federal Emergency Management Agency (FEMA) P-58 methodology and the REDi™ downtime assessment framework, have started incorporating methods for downtime calculations [18,19]. However, it is important to note that the post-earthquake recovery timeframe is not solely determined by the time it takes to complete necessary repairs. Several impeding factors can also cause additional delays to the recovery process [19].

Numerous studies have investigated the impeding factors that cause delays in the post-earthquake recovery of the built environment. Table 1 summarises the key impeding factors derived from the previous literature. Comerio first suggested in 2006 that the recovery time of buildings depends on many "irrational" factors outside the control of engineers, contractors, and building owners, such as financing, relocation of operations, and human resources [20]. In 2013, Almufti and Willford incorporated some impeding factors into the REDi™ downtime assessment framework, including post-earthquake inspections, financial resources for repair works, engineering mobilisation, obtaining permits for repair works, contractor mobilisation, and procuring components with long-lead time [19]. Mayes et al. (2013) further identified resolving insurance claims as an impeding factor in downtime estimation [21]. Mieler et al. (2018) assessed and quantified the impact of aftershocks on post-earthquake downtime [22]. Meanwhile, Chang-Richards et al. (2018) accounted for potential financing delays during post-earthquake recovery that may arise in settling insurance claims [23]. More recently, Cook et al. (2022) incorporated two additional impeding factors into their framework for post-earthquake downtime assessment, namely clean-up and temporary repair and local stabilisation [24].

Although various impeding factors have been previously identified, many have not been adequately incorporated into current post-earthquake recovery frameworks. For example, the participation of stakeholders has been recognised as a crucial impeding factor affecting the recovery process, but it still needs to be adequately incorporated into current frameworks [25]. Additionally, while the interdependencies between buildings and lifeline infrastructures have been shown to have a notable influence on the recovery time of the built environment, it requires further study to be fully incorporated into the existing frameworks [26,27]. Therefore, further research is necessary to fully integrate the identified impeding factors into current frameworks to improve the evaluation of post-earthquake downtime. Furthermore, as different impeding factors can affect post-earthquake recovery depending on the local contexts in various countries or regions [28], it is essential to conduct a deeper investigation of the specific context of Christchurch CBD to identify emerging impeding factors that have caused the long-term delay of its recovery.

Table 1. Impeding factors identified from the literature review.

Impeding factors	Sources
Engineering mobilisation	[15,19,21]
Contractor mobilisation	[15,19,21]
Permitting	[19,29]
Long-lead time components	[19,23,30]
Post-earthquake inspection	[17,19]
Financing	[19,20]
Relocation of operations	[20]
Availability of human resources	[20]
Economic and regulatory uncertainty	[20]
Clean-up and temporary repair	[24]
Local stabilisation	[24]
Duration and frequency of aftershock series	[22,31]
Settlement of insurance claims	[21,23]
Participation of stakeholders	[25]
Interdependency between building and/or lifeline infrastructures	[26,27]

METHODOLOGY

Christchurch CBD

Christchurch is the largest city in the South Island of New Zealand, with a population of approximately 370,000 residents prior to the earthquake sequence. The central area of Christchurch City is Cathedral Square, surrounding the now-earthquake-damaged landmark, the Christchurch Cathedral. The area around this square and within the Four Avenues of Christchurch, namely Bealey Avenue, Fitzgerald Avenue, Moorhouse Avenue, and Deans Avenue, is considered to be the CBD of the city (as shown in Figure 2) [32]. Christchurch CBD is a longstanding commercial hub, which at the time of the earthquakes, had a daily working population of 51,000 people and over 6,000 businesses, attracting more than 1.8 million visitors annually. The CBD was also home to existing residential communities, with approximately 7,000 residents and 3,500 households before the earthquakes [33]. The Canterbury earthquake cause severque damage in the CBD, particularly older buildings that lacked reinforcement and were constructed before strict earthquake codes were introduced [34]. By February 2015, there had been 1,240 demolitions within the bounds of the four avenues [35].

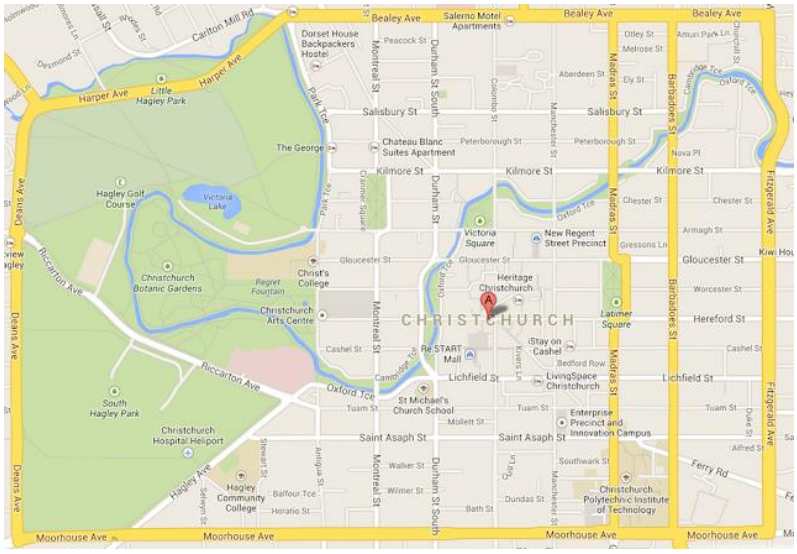

Figure 2. Map of Christchurch CBD within Bealey Avenue, Fitzgerald Avenue, Moorhouse Avenue and Deans Avenue (Source: New Zealand Blog, 2013 [36]).

Following the February 2011 earthquake, the Canterbury Earthquake Recovery Authority (CERA) was established on 29th March 2011 by the Prime Minister of New Zealand and Christchurch Mayor to oversee the earthquake recovery, working in cooperation with the government, local councils, and residents [37]. The Christchurch Central Development Unit (CCDU) was later created in April 2012 as a unit within CERA, primarily focusing on rebuilding the Christchurch CBD [38]. A significant challenge identified by CCDU during its establishment was the need to generate demand for commercial, residential, and retail space while planning for coordinated redevelopment in line with the vision outlined in the Central City Plan [39]. As the long-term recovery process progressed, several additional issues emerged, such as the presence of partially demolished and neglected buildings, vacant sites, derelict buildings, and governance issues related to early recovery policies [40].

Methods

This study utilised a field-based research approach to investigate the impeding factors causing long-term delays in the post-earthquake recovery of Christchurch CBD. The approach involved conducting face-to-face interviews with people who were or are still heavily involved in the recovery process and field-based observations to gather data on the recovery status of damaged buildings.

Semi-structured interviews were conducted with twelve individuals, including local governmental agencies, central governmental agencies, contractors, engineering consultancies, material suppliers, and researchers. The interviews were conducted in the interviewees' preferred locations, and each interview lasted approximately 45 minutes to an hour. The role of each interviewee in the recovery process and the corresponding codes used to ensure anonymity are summarised in Table 2.

Table 2. Profile of the Interviewees

Role/Type of organisation	Interviewee Code
Central government agency	CG1-CG5
Local government agency	LG1
Contractor	C1
Engineering consultancy	E1
Material supplier	S1
Researcher	R1-R3

In addition to the interviews, field-based observations were conducted to gather data on the current status of damaged buildings in the earthquake. The observations were carried out in different areas of Christchurch CBD, and photos were taken to document the conditions of the buildings. The photos were used to complement the data obtained from the interviews and visually represent the recovery progress.

The data collected from the field-based research was analysed using a thematic analysis approach. This method enabled the identification of expected and unexpected themes and patterns in the data, resulting in a thorough understanding of the research problem. The interview data were transcribed, coded, and organised into themes using the NVivo 12 software [41]. The identified themes were then interpreted and analysed to develop a comprehensive understanding of the impeding factors

impacting post-earthquake downtime in Christchurch CBD [42]. The researchers employed the constant comparative method to compare data within and across interviews to identify similarities and differences in the impeding factors reported by the interviewees [43].

RESULTS

Thematic analysis of the interview data and field-based observations identified the top five factors causing long-term delays in the post-earthquake recovery of Christchurch CBD. These impeding factors include: 1) conditions of neighbouring/adjacent structures and facilities, 2) complexity in decision-making on buildings involving many stakeholders, 3) lack of specialised building materials and human resources, 4) duration and frequency of aftershock series, and 5) insurance coverage and mechanisms.

Conditions of neighbouring/adjacent structures and facilities

The recovery of damaged structures after an earthquake can be impeded by the condition and recovery status of adjacent structures. One interviewee (CG1) highlighted Cathedral Square as an example of how its recovery status negatively affected the recovery of neighbouring buildings. The Christchurch Cathedral sustained severe damage during the Canterbury earthquakes sequence, particularly in the February 2011 earthquake when the tower and spire collapsed [44]. The repair of the Christchurch Cathedral has been significantly delayed due to various legal challenges and disagreements over whether to demolish and rebuild or restore the original structure. Despite restoration initiatives being expected in late 2016, progress towards the restoration was not made until August 2018, with the signing of a joint venture agreement that established the Christchurch Cathedral Reinstatement Limited to reinstate the Cathedral [45]. Even though the reinstatement resource consent was granted in December 2020 [44], the repair works on stabilising and strengthening the main building structure of the Cathedral only began in October 2022 [46]. The delayed recovery of the Christchurch Cathedral profoundly impacted the recovery of neighbouring buildings, which have not undergone significant development due to the dysfunction surrounding the building. As the interviewee (CG1) highlighted:

> *The Christchurch Cathedral has had a massive impact on neighbouring windows, not really developed due to the dysfunction surrounding the building, as no one is willing to invest in an area that faces a construction site*.

In contrast, the same interviewee cited the new Regent Street as a positive development that could create a lively street and positively impact the recovery of neighbouring buildings such as the Cathedral Junction complex and the Pacific Tower. The photographs taken during the field-based observation of Cathedral Square and the new Regent Street are presented in Figure 3 (a) and (b), respectively.

(a) *(b)*

Figure 3. Photos from field-based observations: (a) Cathedral Square (taken by Shen Zhan in October 2022), (b) the new Regent Street (Source: Naylor Love, 2013 [47]).

Moreover, one interviewee (R1) emphasised the importance of considering potential hazards from adjacent buildings during recovery. For instance, as shown in Figure 4 (a) and (b), parts of the external wall of the damaged Harey Chambers Building (located at the corner of Cambridge Terrace and Worcester Street) are leaning against the newly rebuilt 141 Cambridge Terrace/Lane Neave building. The interviewee (R1) has pointed out that the heavily damaged Harey Chambers Building has significantly influenced the decision-making process of the adjacent buildings due to the potential risks of further physical damage.

(a) *(b)*

Figure 4. Photos of the damaged Harey Chambers Building (courtesy of Beth Mayer, taken in October 2022): (a) a part of the external wall leaning against the adjacent building, (b) a closer look at the shed component.

Moreover, aside from neighbouring damaged buildings, damaged roads have further impeded the post-earthquake recovery process of surrounding structures. One interviewee (E1) indicated that one of the most significant challenges was accessing sites after the earthquake due to significant road damage. The interviewee (E1) stated:

> *One of the biggest challenges was accessing places after the earthquake due to significant roading damage. The building itself had no major issues, but the road to get there was very questionable.*

The interviewee highlighted how damaged roads had impacted site accessibility, which impeded the inspection of damaged structures.

Complexity in decision-making on buildings involving many stakeholders

The decision-making process in the post-earthquake recovery process can be complex and time-consuming, especially regarding the building owners' role. They have a critical responsibility in determining the fate of their buildings, including whether they should be inspected, repaired, or demolished. As noted by one interviewee (E1), some owners, particularly those who own properties as investments outside the affected area, may choose to sell their properties instead of undertaking repairs themselves. As stated by the interviewee (E1):

> *Before the earthquakes, a lot of buildings around the CBD had cheap rent and were unoccupied. Most investors were based outside of the city, either in Wellington, Auckland, or overseas. After the earthquakes, they were happy to take their insurance payouts and leave without reinvesting in the city.*

This has prolonged the recovery period of numerous buildings and exacerbated debates around decision-making, such as whether to repair or demolish and whether to keep or sell. Furthermore, the interviewee highlighted that some owners might sell their houses after claiming a payout from the EQC without completing the necessary repairs.

Moreover, the post-earthquake recovery process is influenced by various stakeholders, such as tenants, government agencies, design professionals, and local communities, apart from building owners. As one interviewee (R1) highlighted:

> *Larger tenants, such as government agencies, hold more sway in determining the condition of their buildings and influencing what developers are building and designing compared to smaller tenants.*

Furthermore, including diverse opinions from different stakeholders in decision-making is challenging, as highlighted by one interviewee (CG1):

> *A lot of community opinions of what they want their CBD to look like were included, thus creating diversity. However, this was also difficult, as people tend to forget that other people have opinions and need to be accounted for.*

Lack of specialised building materials and human resources

The availability of specialised building materials and human resources is critical to the post-earthquake recovery process for damaged buildings and infrastructure. As noted by certain interviewees, supply chain disruptions and sourcing difficulties can lead to delays in the recovery process. For instance, one interviewee (CG4) pointed out that:

> *Material supply is an issue; some materials and components need to be imported from overseas, and quarries and local resources may be used up quickly.*

As observed during the field-based study, seismic base isolators were sued in many buildings for protection against future seismic events, as shown in Figure 5 (a) and (b). Yet, these isolators rely heavily on overseas imports from the United States.

(a) *(b)*

Figure 5. Photos of seismic base isolators (taken by Shen Zhan in October 2022): (a) seismic base isolators on foundations, (b) Label of a seismic base isolator.

Conversely, other interviewees argued that the availability of repair materials did not significantly impact the recovery process (C1 and S1). For instance, one interviewee (S1) highlighted that.

> *Materials like concrete were unlikely to be in short supply as there were lots of companies and quarries around the country.*

These divergent viewpoints may be attributed to various factors, including the nature of the reconstruction project and the specialised building materials needed. Therefore, further research is necessary to comprehensively understand the impact of specialised building materials available on the post-earthquake recovery process.

Furthermore, restoring earthquake-affected buildings requires significant human resources, including engineers, contractors, and management professionals. Interviewees highlighted a shortage of experienced engineers for post-earthquake inspections as a potential factor that could delay recovery. As one interviewee (E1) noted:

> *Engineers had no experience with inspecting earthquake-impacted buildings before the 2010 earthquake. They (engineers) had no experience with the tagging system before, and there was a very steep learning curve for everyone.*

Duration and frequency of aftershock series

The September 2010 earthquake in Christchurch generated a significant series of its own aftershocks, including the February 2011 earthquake, which caused more damage than the September 2010 earthquake [48]. Continuous aftershocks with body-wave magnitudes of 5.0 and above occurred until early 2012, causing several disturbances to the recovery process of damaged structures [49]. One such event was a 5.3-magnitude aftershock on 16th April 2011, which caused further damage and power cuts, as well as several large rocks falling [50,51]. Another series of strong shocks occurred on 23rd December 2011, featuring a 5.8 at 1:58 pm and a 6.0 at 3:18 pm [52,53]. These earthquakes disrupted power and water supplies, caused three unoccupied buildings to collapse, and led to liquefaction in eastern suburbs [54]. The ongoing aftershocks posed risks of further damage and even collapses, which resulted in potentially unsafe workplaces for repair workers. As shown in Figure 6 (a) and (b), the Durham Street Methodist Church was highlighted by one interviewee (E1) as an example of such risks:

> *The Durham Street Methodist Church was badly damaged in the September earthquake and 26th December aftershock, and the organ required retrieval. The engineer told the workers that they could spend up to 10 minutes at a time in the building before having to evacuate. The workers just happened to be inside during the February aftershock, killing three of them.*

(a) *(b)*

Figure 6. Photos of the Durham Street Methodist Church: (a) under reconstruction in November 2010 (Source: Robertson, 2010 [55]), (b) collapsed in the February 2011 earthquake (Source: Aldersgate Centre, 2011 [56]).

The ongoing aftershocks have also impacted the decision-making of many stakeholders. For example, as highlighted by one interviewee, insurance companies were particular about what aftershocks caused what damage and how will aftershocks impact work being done on buildings. Consideration of disturbance of recovery and further potential damage caused by further aftershocks were included in the decision-making process of resolving insurance claims.

Insurance coverage and mechanisms

Interviewees have widely noted the role of insurance coverage and mechanisms in post-earthquake recovery. The lack of insurance coverage can significantly delay the recovery process and increase the financial burden on the government. Some interviewees (GC3 and E1) reported that the Christchurch City Council was underinsured before the 2010-2011 Canterbury earthquake sequence, which delayed the recovery process. Moreover, insurance coverage for housing is also a crucial factor in post-earthquake recovery. As noted by one interviewee (E1):

> *The EQC covered housing damage up to the first $100,000 plus GST, but only for houses that already had private insurance.*

In addition, the process of insurance settlement has been slowed down by a large number of claims and variations in contracts. Many buildings remain damaged and left unattended till now due to delays in the insurance settlement. For example, as observed during this study, the 85 Worcester Street building (Figure 7) adjacent to Cathedral Square remained unattended due to insurance decisions.

Figure 7. Photo of the 85 Worcester Street building as unattended due to insurance decisions (Source: Google Maps Street View, 2023 [57]).

DISCUSSIONS

While some of the impeding factors identified in this study have been previously acknowledged in existing research (summarised in Table 3), this study provides new insights into the challenges encountered during the recovery of Christchurch CBD. Previous studies have discussed stakeholder participation during post-earthquake recovery [25], but this research delves deeper into the role of different stakeholders, such as building owners and larger tenants, in the decision-making process. Building owners are responsible for determining the fate of their buildings, but their decisions can sometimes prolong the recovery process, intensifying debates around decision-making. Similarly, larger tenants have a more significant influence on the condition of their buildings and can shape the designs and choices of developers, leading to tensions and debates around decision-making.

Table 3. Impeding factors revealed in the current study align with the literature review

Impeding factors revealed in the present study align with the literature review.	Literature previously acknowledged the impeding factor.
Complexity in decision-making on buildings involving many stakeholders	[25]
Lack of specialised building materials and human resources	[20]
Duration and frequency of aftershock series	[22,31]
Insurance coverage and mechanisms	[21,23]

The availability of building materials and human resources have previously been identified in the literature as factors that impact the time needed for resource mobilisation and recovery decision-making [20]. However, this study has revealed divergent opinions on the impact of building materials available on the recovery of Christchurch CBD, attributed to the nature of the reconstruction project and the specialised building materials needed.

The impacts of aftershocks on the post-earthquake recovery process have already been identified and quantified in downtime estimation [22,31]. Correspondingly, Christchurch CBD experienced continuous aftershocks for over a year after the September 2010 earthquake, resulting in significant additional losses and delays in the recovery process. This study highlights the importance of considering the disturbance in repair works and potentially further damage caused by aftershocks.

Previous literature has highlighted the potential financing delays that may occur in the process of settling insurance claims [21,23]. As found in this study, insurance coverage and mechanisms have notably impacted the recovery of Christchurch CBD, as both the government and local housing were significantly underinsured, causing delays in mobilising financial resources for repair works. Moreover, although EQC was responsible for managing the insurance settlement for housing, the large number of claims and variations in contracts severely overloaded its capacity, adding to the delays in the recovery process.

The findings of this study have important implications for future post-earthquake recovery efforts. Firstly, the role of insurance coverage and mechanisms needs to be carefully considered, as underinsurance can significantly delay the recovery process. Building owners and other stakeholders need to be educated on the importance of adequate insurance coverage, and measures should be put in place to streamline the insurance settlement process. Secondly, the recovery status of adjacent buildings and facilities also needs to be taken into account, as the condition of neighbouring structures can significantly influence the decision-making process of building owners and delay recovery efforts. Collaborative efforts between stakeholders are essential in facilitating recovery, and governmental agencies need to work closely with the community to ensure a coordinated approach to recovery efforts. Lastly, this study highlights the need for a more nuanced understanding of the decision-making process of different stakeholders. By addressing these aspects, post-earthquake decision-making can be made more efficient and effective, leading to a more rapid recovery of the earthquake-affected area.

CONCLUSIONS

After twelve years since the 2010-2011 Canterbury earthquake sequence, the recovery of Christchurch CBD is still ongoing. This study aims to understand the impeding factors that caused delays in the Christchurch CBD recovery. By conducting a field-based study in October 2022 and interviewing twelve individuals who were or are still heavily involved in the recovery efforts, the study identified the top five factors that are causing delays in the long-term recovery of the city. These impeding factors include 1) conditions of neighbouring/adjacent structures and facilities, 2) complexity in decision-making on buildings involving many stakeholders, 3) lack of specialised building materials and human resources, 4) duration and frequency of aftershock series, and 5) insurance coverage and mechanisms.

This study provides important insights into the impeding factors that have caused delays in the recovery of Christchurch CBD, including newly revealed factors that were previously unknown. This study highlights the importance of considering the role of different stakeholders in decision-making and the need for a more nuanced understanding of their decision-making process. To ensure rapid and effective recovery, collaborative efforts among stakeholders and a coordinated approach are essential. Additionally, the condition of neighbouring structures needs to be considered to facilitate recovery efforts.

The impeding factors revealed in this study can assist policymakers and industry practitioners in developing more efficient and practical approaches for post-earthquake recovery decision-making processes. By offering a multi-stakeholder perspective on decision-making processes, this study can facilitate more rapid decision-making for buildings, ultimately leading to a faster recovery process for Christchurch CBD.

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