

CASE STUDY

Open Access



Comparative analysis of construction businesses in New Zealand: Global Financial Crisis, earthquakes, and COVID-19

Faezeh Mirhosseini^{1*}, Mostafa Babaeian Jelodar¹ and Suzanne Wilkinson²

Abstract

Construction businesses are increasingly exposed to diverse and recurring crises, yet their resilience across different disruption types remains underexplored. Most existing research focuses on single events, overlooking the compounded effects of crises such as economic downturns, natural disasters, and pandemics. This study addresses that gap by analyzing how New Zealand construction businesses responded to three major disruptions: the 2008 global financial crisis, the Christchurch and Kaikoura earthquakes, and the COVID-19 pandemic. These cases were selected because they represent the most transformative economic, natural, and health-related shocks in recent New Zealand history, enabling a rare longitudinal and cross-crisis perspective. Using a qualitative, exploratory multi-case study approach, the research draws on 16 semi-structured interviews with industry professionals and a systematic literature review. To enhance validity, interview data were triangulated with secondary sources such as industry reports and government documents. Thematic analysis, supported by NVivo and guided by Resilience Engineering, Institutional Learning, and Systems Thinking, ensured robust and triangulated findings. Three consistent vulnerability areas emerged across all crises: contractual rigidity, supply chain fragility, and workforce constraints. These issues were intensified during COVID-19 due to extended uncertainty, regulatory shifts, and global logistics challenges. While some businesses innovated at the firm level, responses remained largely reactive, exposing sector-wide gaps in learning and foresight. The study offers a cross-crisis resilience framework linking business vulnerabilities to theoretical constructs and recommends adaptive contracts, diversified supply strategies, and institutional learning mechanisms to strengthen future preparedness in the construction sector. This framework advances both theoretical understanding and practical guidance for policymakers and industry leaders.

Keywords COVID-19, Global financial crisis, Earthquake, Construction businesses, New Zealand

*Correspondence:

Faezeh Mirhosseini

F.Mirhosseini@massey.ac.nz

¹School of Built Environment, Massey University, Albany Campus, Auckland 0632, New Zealand

²Faculty of Design & Creative Technologies, Auckland University of Technology, Auckland 1010, New Zealand



© The Author(s) 2026. **Open Access** This article is licensed under a Creative Commons Attribution 4.0 International License, which permits use, sharing, adaptation, distribution and reproduction in any medium or format, as long as you give appropriate credit to the original author(s) and the source, provide a link to the Creative Commons licence, and indicate if changes were made. The images or other third party material in this article are included in the article's Creative Commons licence, unless indicated otherwise in a credit line to the material. If material is not included in the article's Creative Commons licence and your intended use is not permitted by statutory regulation or exceeds the permitted use, you will need to obtain permission directly from the copyright holder. To view a copy of this licence, visit <http://creativecommons.org/licenses/by/4.0/>.

Introduction

The construction sector is a cornerstone of New Zealand's economy, contributing over NZD 18.6 billion in 2022 and supporting approximately 80,600 businesses [1, 2]. Yet, its role as both an economic driver and a vulnerable industry makes it a critical lens through which to study the impacts of crises. In this paper, a crisis is defined as an unexpected, high-impact event that threatens the stability or functioning of an organization or system and demands urgent adaptive responses [3, 4]. Crises differ from routine disruptions in scale, uncertainty, and systemic consequences, often extending beyond organizational boundaries to affect entire industries and supply chains. In the construction context, crises such as financial shocks, natural disasters, and pandemics disrupt project continuity, resource flows, and institutional coordination, requiring strategic and adaptive management responses [5]. Drawing on [6] taxonomy distinguishing risk, crisis, and disaster, this study classifies earthquakes as disaster events that trigger organizational crises. While disasters represent large-scale external shocks with physical destruction, crises refer to the consequential breakdowns in decision-making, stability, and coordination that unfold within affected systems. Hence, the Christchurch (2011) and Kaikoura (2016) earthquakes are treated as natural disasters that induced prolonged crises for New Zealand's construction sector, disrupting operations, project continuity, and institutional governance.

The term disruption refers to a sudden event or condition that interrupts the normal functioning of a system, leading to temporary or prolonged deviations from expected performance [7]. Disruptions can have a range of causes including human-made external shocks, and natural shocks [8]. Each crisis imposes distinct pressures, but shared patterns of disruption are emerging, warranting a cross-crisis comparative approach. By conceptualizing these crises as distinct yet comparable forms of disruption, the paper examines how New Zealand's construction sector experienced and adapted to operational interruptions across physical, economic, and institutional dimensions.

Although the Global Financial Crisis, major earthquakes, and the COVID-19 pandemic differ markedly in scale, origin, and duration, their comparison provides valuable insight into how diverse forms of disruption test different dimensions of resilience within the same industry. The financial crisis primarily challenged investment flows and firm liquidity, earthquakes disrupted physical assets and infrastructure, and COVID-19 strained workforce mobility, supply continuity, and contractual stability [9–11]. Analyzing these distinct disruption pathways within a unified national context enables the identification of cross-cutting vulnerabilities and adaptive

capacities that transcend crisis type, thereby strengthening the comparative and theoretical contribution of this study.

The COVID-19 pandemic revealed systemic weaknesses in planning, contract management, and operational agility across New Zealand's construction sector, exacerbating preexisting vulnerabilities [12]. These included delayed projects, disrupted supply chains, workforce shortages, and financial uncertainty [13, 14].

Even before COVID-19, the industry grappled with chronic issues such as labor shortages, mental health challenges, limited diversity, and slow digital uptake [15, 16]. These structural stressors compounded the effects of external shocks. Similarly, the 2008 global financial crisis and the Christchurch and Kaikoura earthquakes triggered severe disruptions to business continuity, from credit access and reduced demand to infrastructure collapse and insurance disputes [17, 18]. Together, these crises represent the most transformative economic, natural, and health-related shocks of recent decades in New Zealand, providing a unique basis for cross-crisis comparison.

Despite recurring crises, little is known about how construction businesses adapt financially and operationally across disruption types, particularly in a small, open economy context like New Zealand. Existing studies tend to isolate individual events, often overlooking how resilience mechanisms evolve or fail under different systemic stressors [19, 20].

We investigate how New Zealand construction businesses adapt financially and operationally across distinct types of crises, and why certain resilience strategies succeed or fail. The objectives of this research are: (1) to examine the financial impacts of each crisis on construction businesses; (2) to identify coping mechanisms and adaptive strategies employed; and (3) to compare the lessons learned across crisis types to inform future resilience planning.

Accordingly, this study seeks to answer the following research question: How have New Zealand construction businesses experienced, absorbed, and adapted to different forms of crises; namely the Global Financial Crisis, major earthquakes, and the COVID-19 pandemic; and what lessons can be drawn to strengthen sectoral resilience? This study advances construction resilience scholarship by developing a cross-crisis framework that integrates empirical insights with systems-based theory. In doing so, it responds to calls for longitudinal and comparative crisis research that moves beyond single-event analysis. It also provides practical recommendations for contract reform, supply chain continuity, and workforce agility under stress.

Background

This section provides a comparative overview of three major crises affecting New Zealand's construction businesses: the global financial crisis (2008), the Christchurch Earthquake (2011), and the Kaikoura Earthquake (2016), followed by the COVID-19 pandemic. The study considers the Christchurch (2011) and Kaikoura (2016) earthquakes collectively as major earthquakes representing seismic crises in New Zealand. Although these events differed in geographic scope and intensity, both produced comparable forms of disruption to construction operations, infrastructure networks, and regulatory systems; therefore, they are analyzed together as a single crisis type. It sets the stage for analyzing their implications on construction business resilience and justifies their selection as the most transformative crises of the past two decades in New Zealand. Global Financial Crisis (2008): According to the WorldBank [21], in 2008/2009, the global economy faced its worst financial crisis since the 1930s. This contraction reflected the financial system's exposure to global capital volatility, impacting investment in construction and infrastructure. Notably, New Zealand was among the first countries to enter the global recession in early 2008, mainly due to internal imbalances such as a housing market downturn and high private debt [22]. The economic slowdown led to reduced consumer spending and a significant increase in unemployment rates, from 3% to 6.5% by the third quarter of 2009. Due to its robust financial system, New Zealand's recession was comparatively mild [22]. Although the country had a robust financial system, its reliance on foreign capital meant that credit tightening significantly impacted borrowing conditions, restricting access to finance and limiting investment opportunities [23]. For construction businesses, this translated into reduced demand, canceled projects, and constrained access to capital.

Christchurch Earthquake (2011) and Kaikoura Earthquake (2016): Three years after the global financial crisis, the Christchurch earthquake struck, causing widespread physical destruction and economic disruption. Construction businesses experienced a surge in reconstruction demand amid damaged infrastructure and the need to retrofit buildings to new compliance standards [24, 25]. This crisis paradoxically created a boom in construction activity, especially visible by 2013, but also placed immense pressure on business capacity, labor, and compliance adaptation.

Following the Kaikoura earthquake, the construction businesses in the Kaikoura District reported a 34% reduction in functionality in the first week. Functionality improved to a 5% reduction within three months, but the interim period brought significant logistical challenges [26]. Both earthquakes created cascading logistical disruptions, with infrastructure damage impeding material

flow and labor availability. They also underscored the uneven distribution of impacts, with small regional firms particularly vulnerable to infrastructure bottlenecks and workforce shortages.

The COVID-19 Pandemic (2019): The COVID-19 pandemic caused unprecedented challenges. Morris [27] performed a risk assessment specific to construction businesses, identifying six main challenges associated with COVID-19. These challenges include stopping current projects, canceling future projects, and causing problems in the supply chain, which result in production delays and logistical slowdowns. Other issues are contractual deficiencies, workforce shortages, and health and safety concerns. Lastly, financial troubles may arise due to a weak economy and limited access to funding.

The pandemic has had a significant adverse effect on construction businesses by creating financial difficulties [14]. The construction business significantly contributes to countries' economies by generating jobs and fostering wealth creation [28]. Conversely, as long as the pandemic crisis persists, construction businesses face financial struggles and ongoing uncertainty regarding business continuity and strategic planning horizons [29]. Introducing lockdowns, safety protocols, and a drop in consumer expenditure has reduced construction businesses' revenue [14].

Besides reducing the construction businesses' income, continuing work during COVID-19 increased operating expenses. Health protocols increased site costs and reduced productivity. Disruptions in the supply chain also amplified financial pressures triggering shortages, procurement delays, and material cost inflation that led to project cancellations [30]. Maintaining cash flow supports continuous operations and is necessary for long-term projects and managing uncertainties and risks. Disruptions in cash flow can lead to project delays, increased costs, and contract violations [31].

Efforts to implement safety measures to reduce the spread of COVID-19 have led to decreased production capacity due to limitations on the number of on-site workers, staggered work shifts, and minimizing social contact. These adaptive measures forced construction firms to operate under constrained labor regimes, increasing reliance on lean planning and task reprioritization [32].

While the pandemic primarily produced adverse outcomes, it encouraged businesses to explore innovative and digital solutions. Digital technology increased as the tendency to work remotely increased. Remote work adoption accelerated the integration of digital collaboration tools, virtual inspections, and online procurement systems. It also impacted design processes by adapting updated designs to meet the changing needs in a post-pandemic world [33].

In New Zealand, the COVID-19 pandemic revealed practical limitations in contractual obligations and risk-sharing mechanisms across the construction sector. Standard contracts such as NZS 3910 were not designed for prolonged, nationwide shutdowns, leading to disputes over extensions of time, cost entitlements, and interpretation of force majeure provisions. Recent analyses indicate that these gaps exposed the sector's vulnerability to systemic shocks and prompted discussion on reforming risk-allocation frameworks to enhance contractual resilience [34–36]. Resilience Engineering [37] frames adaptation as the ability to anticipate, absorb, and reconfigure amid stressors, concepts central to understanding firm-level responses across the crises. Organizational resilience is the capacity to absorb disturbance, reorganize, and continue functioning [38]. Recent systematic reviews have shown that resilience research in construction has shifted from viewing crises as isolated shocks to recognizing them as interconnected and dynamic disruptions that occur within volatile, uncertain, complex, and ambiguous (VUCA) environments. As Li et al. [39] note, this evolution highlights the need for a holistic framing of resilience that integrates structural, operational, and supply-chain dimensions. In disaster contexts, recovery is shaped not only by rebuilding infrastructure but also by how businesses adapt their operations, contracts, and staffing to survive and evolve [40, 41]. Construction firms that are agile, collaborative, and financially prepared tend to recover faster [42]. Applying this lens across multiple crises allows for identifying resilience mechanisms that are transferable rather than event-specific.

Complementing these resilience-oriented perspectives, Business Continuity Management (BCM) offers a structured managerial framework for sustaining essential functions during and after disruptions. Defined by ISO 22301 [43] as a holistic process for building organizational resilience, BCM focuses on preparedness, resource redundancy, communication, and recovery planning that collectively mitigate operational downtime. In the construction context, BCM practices such as contingency planning and staged recovery moderate the severity and duration of project and supply-chain interruptions. In this paper, BCM is incorporated as a conceptual lens that informs the interpretation of findings rather than a prescriptive analytical model [44].

Methodology

This study aims to investigate the impacts of three major disruptions affecting New Zealand construction businesses, including the COVID-19 pandemic, and to understand how businesses responded to these events. It employs a two-phase methodology comprising a systematic literature review and qualitative thematic analysis (including qualitative content analysis). This research

is grounded in a qualitative, interpretivist paradigm with a constructivist ontology, acknowledging that knowledge is co-produced through participants' experiences and the researcher's interpretation.

Different research methods need to be adopted according to the nature of the problem and how specific the problem is [45]. Given the fragmented nature of knowledge production, systematic literature reviews offer an effective tool for synthesizing prior research and advancing theoretical development [46, 47].

To conduct a systematic literature review, following specific standards and guidelines, such as PRISMA (Preferred Reporting Items for Systematic Reviews and Meta-Analyses), is essential. PRISMA provides a structured approach and a flow diagram to ensure transparency in the review process, thereby improving the quality and reproducibility of academic research [48]. Initially, the research subject was firmly established, setting the stage for the literature review [49]. The databases chosen for sourcing relevant articles were Scopus and Google Scholar. The criteria were narrowed down to include only journal articles written in English. A set of keywords was carefully selected based on the research objectives and refined using Boolean operators. The selected date span was from 2008 onward (the year of the global financial crisis), and the search was conducted within article titles, abstracts, and keywords. A subsequent step involved checking the references of selected articles to expand the final selection.

The initial search in Scopus with the keywords “construction business” and “global financial crisis” returned 152 articles. By screening titles, eighty-six articles were deemed irrelevant and removed, leaving sixty-six. Further refinement through abstract and full paper reviews reduced the selection to twenty-six articles. Then, a similar process was applied with the “Christchurch earthquake” and “Kaikoura earthquake.” Additional articles were sourced via targeted Google Scholar searches using phrase matching and citation tracking.

To ensure comprehensive coverage of the results, forward and backward citation tracking was conducted. Citation tracking helps uncover relevant articles that might be overlooked in bibliographic database searches, thereby strengthening the validity of the review process [50]. We screened 223 titles and abstracts, of which 215 were discarded due to irrelevance or overlap with prior results, culminating in a total of eight articles from Google Scholar for our study, increasing the number of articles to thirty-four. The PRISMA diagram (Fig. 1) is included below to illustrate the article selection process.

Following the literature review, qualitative content analysis was employed to deeply examine the data. Content analysis, as a qualitative research method, derives meaning from the textual data's content [51]. Systematic

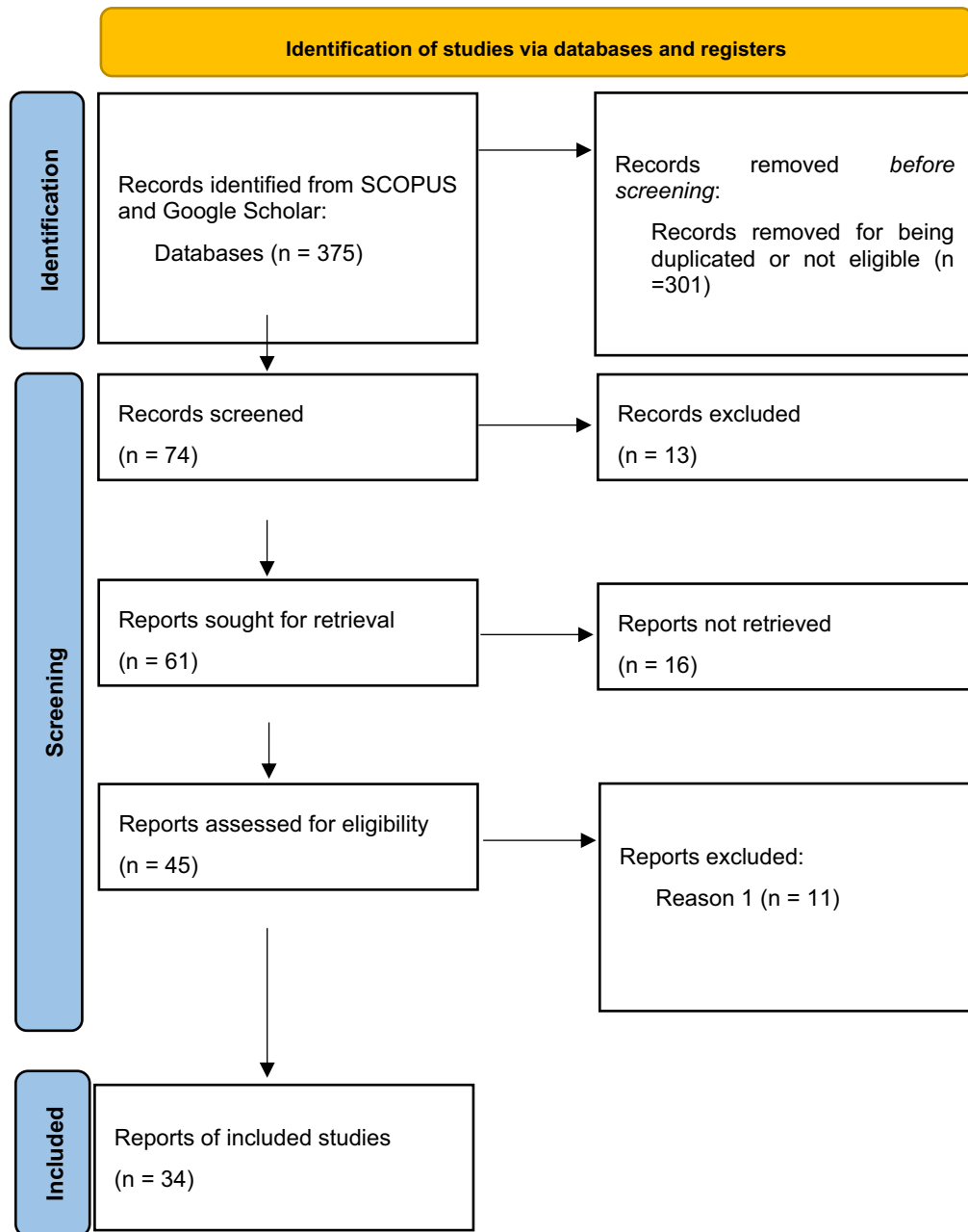


Figure 1: PRISMA 2020 flow diagram for new systematic reviews [48].

thematic analysis involves a structured approach that has six key steps: transcript creation and data familiarization; keyword identification; code selection; theme development; conceptualization through the interpretation of keywords, codes, and themes; and, finally, the development of a conceptual model. This step-by-step process provides a clear framework for handling qualitative data, ensuring methodological rigor and enriching the depth of the research findings [52]. The approach ensured a transparent and traceable pathway from raw data to conceptual understanding, as summarized in Table 1.

To enhance methodological clarity, illustrative excerpts were incorporated at each analytical stage to demonstrate how raw data progressed through the six steps of thematic analysis. For example, during data familiarization, statements such as “we couldn’t get materials for weeks because everything was stuck at the ports” and “financially, we were burning through cash just to keep the sites secure” were highlighted as significant. These were then converted into keywords in Step 2 (e.g., “import delays,” “supply bottlenecks,” “cash-flow pressure”) and subsequently coded in NVivo in Step 3 under initial codes

Table 1. Stepwise approach for systematic thematic analysis.

Step	Description	Illustrative Example from Data	Output
1. Transcript creation and data familiarisation	Audio/video recordings were transcribed and repeatedly read to gain a comprehensive understanding of participant experiences.	"We couldn't get materials for weeks because everything was stuck at the ports."	Clean, reviewed transcripts and initial impressions.
2. Keyword identification	Significant words and phrases reflecting key ideas or recurring issues were identified across transcripts.	From excerpt: keywords identified included "import delays," "supply bottlenecks," "project slowdowns," "cash-flow pressure."	Preliminary list of recurring keywords.
3. Code selection	Keywords and meaningful data segments were systematically coded using NVivo 12 to capture patterns and relationships.	Keywords above were coded under "global supply dependency," "operational disruption," "financial strain."	Set of organised initial codes.
4. Theme development	Related codes were grouped into broader categories to form potential themes representing core ideas.	Codes such as "import delays," "cost escalation," and "material shortages" were grouped into the category "Supply-related constraints," later developed into the theme Supply Chain Fragility.	Draft set of candidate themes.
5. Conceptualisation	Keywords, codes, and themes were interpreted collectively to reveal conceptual linkages and underlying meanings.	Linking "import delays" (supply chain) with "cash-flow pressure" (financial strain) highlighted systemic interdependencies, informing the conceptual grouping of Financial Challenges, Supply Chain Fragility, and Labour & Resource Constraints.	Thematic map and refined conceptual categories.
6. Conceptual model development	Final themes were synthesised into a conceptual model	Themes such as Financial Challenges, Contractual Rigidity, Labour and Resource Constraints, Supply Chain Fragility, and Strategic Responses and Adaptation were distilled into the final model.	Final conceptual framework grounded in data.

such as "global supply dependency," "operational disruption," and "financial strain." During theme development (Step 4), coded segments were compared to identify conceptual similarities and distinctions, and provisional themes were checked against the raw data to ensure representativeness. Step 5 involved conceptualization, where relationships between categories were examined—for instance, linking "supply delays" with "cash-flow stress" to understand cross-crisis interdependencies. Related codes were then merged into higher-order categories, which informed the development of the final themes in Step 6, such as Supply Chain fragility. Another audit-trail example further illustrates this progression from raw data to thematic interpretation. The statement "During COVID, half of our crew were isolating, so we had to slow the programme and reshuffle tasks constantly" was first highlighted during familiarization and then distilled into keywords such as "workforce isolation," "programme delays," and "task reallocation." These keywords informed initial NVivo codes including "absenteeism impacts," "productivity reduction," and "operational flexibility." As similar codes were compared and clustered, they formed the sub-theme "labour availability constraints," which ultimately contributed to the higher-order theme "Labour and Resource Constraints." This example similarly demonstrates how individual participant statements were systematically transformed into higher-level analytical insights.

To achieve our objectives, we employed semi-structured interviews with construction experts with at least five years of experience working in New Zealand, including during the pandemic. To account for limited direct recall of earlier events (the 2008 GFC and the

Christchurch/Kaikōura earthquakes) among some participants, interview prompts explicitly elicited organizational memory (e.g., inherited procedures, records, and policies), and evidence for those periods was triangulated with secondary sources. These interview results were then triangulated with the findings from the systematic literature review to enhance credibility and strengthen the validity of the research outcomes. The study's objectives guided the design of the semi-structured interviews. Semi-structured interviews enable researchers to explore a topic deeply while facilitating a conversational style that allows for the inclusion of clarifying questions [53]. Interview questions are typically a variation of the "why" question [54]

In qualitative studies, researchers usually work with smaller sample sizes to enable detailed, case-focused analysis, a fundamental characteristic of this research methodology [55]. Guidelines for determining sample sizes, particularly for purposive sampling, are based on the concept of "saturation," where no new information or themes emerge in the data. Data saturation occurs within the first twelve interviews, with basic elements for meta-themes emerging as early as six interviews [56]. "Saturation means that no additional data are being found whereby the sociologist can develop properties of the category. As he sees similar instances repeatedly, the researcher becomes empirically confident that a category is saturated" [57]. Galvin and Tywoniak [58] suggested that interviewing 12 to 15 participants is typically sufficient to reach data saturation. Data saturation was confirmed by interview 12, in line with established qualitative research guidelines [56, 59].

Interviewees were purposively chosen from different areas of the construction industry using the “snowball sampling method.” Snowball sampling is a non-probability sampling method in which current study participants refer future subjects from their network, such as colleagues, friends, or acquaintances. The researchers select available respondents who meet the study’s criteria and then ask for referrals to other individuals who fit the requirements. The sample size expands gradually as more referrals are added, resembling a snowball rolling and growing in size [60]. Initial respondents were from different-sized construction organizations and were found through professional networks, including LinkedIn. Sixteen construction experts were interviewed in 2022, each interview lasting 40 to 60 minutes.

The interviews were conducted via Microsoft Teams. The participants provided both written and oral consent before the interview. The discussions started with the respondents providing their background and work experience, then focusing on the pandemic’s impact on the construction industry and their coping mechanisms. Table 2 presents the interviewee profiles, including their professional roles and experience within New Zealand’s construction sector.

All interviews were audio-recorded, transcribed using transcription software, and manually verified before import to NVivo. NVivo 12.0 supported coding and data management. Data were iteratively grouped into codes, sub-themes, and themes to facilitate interpretation and the development of comprehensive findings [53]. The coding process demands careful attention from the researcher, which could lead to potential coding errors. To mitigate such inaccuracies, coding was performed twice independently by the researcher over a two-week interval and cross-checked to ensure consistency. NVivo

software assisted in reducing the likelihood of coding inconsistencies [61]. Each interview was read several times to extract the fundamental principles. The final codebook and audit trail were maintained to document coding decisions and ensure dependability. One of the emerging themes was the impacts of COVID-19 on construction businesses. The researcher combined related codes into higher-order categories and removed those that were infrequent or misaligned with the research scope, resulting in a set of higher-order themes used to structure the findings.

By integrating a systematic literature review with semi-structured interviews, the study’s methodology offers a robust framework for analyzing the effects of COVID-19, the global financial crisis, and earthquakes on construction businesses. The literature review establishes a theoretical and empirical foundation, while the semi-structured interviews offer expert-driven, context-specific insights. Together, they enable a comparative understanding of how New Zealand construction businesses have adapted and responded to various crises. These methods also informed the development of a cross-crisis resilience framework that links empirical themes with systems-based theory.

Findings

To enhance clarity and coherence, the findings are organized into five themes, each linked to the research questions. Themes 1–4 (Financial Challenges, Contractual Rigidity, Labour and Resource Constraints, and Supply Chain Fragility) collectively address Research Question 1 by demonstrating how construction businesses experienced and absorbed financial, contractual, workforce, and supply-chain pressures across the Global Financial Crisis, major earthquakes, and COVID-19. Theme 5 (Strategic Responses and Adaptation) primarily addresses Research Question 2 by identifying the adaptive strategies, innovations, and systemic gaps that reveal the lessons needed to strengthen sectoral resilience.

Theme 1: financial challenges

Across all three crises, the global financial crisis, earthquakes, and COVID-19 construction businesses in New Zealand experienced significant financial strain, though the nature and timing of these challenges varied. These financial stressors manifested through reduced revenue, disrupted cash flow, tightened credit access, and rising operating costs. Taken together, these pressures show that financial fragility is not an episodic problem but a structural vulnerability with direct consequences for continuity of operations, ability to retain staff, and ability to meet contractual obligations. In Business Continuity Management (BCM) terms, financial fragility directly threatened firms’ capacity to sustain essential functions

Table 2. The profile of interviewees.

Expert	Current role	Experience (years)
R1	Project manager	15
R2	Project manager	11
R3	Project manager	19
R4	Quantity surveyor	19
R5	Planner	17
R6	Quantity surveyor	11
R7	General manager	35
R8	Site engineer	7
R9	Operation manager	30
R10	Planner	12
R11	Operation manager	15
R12	Site engineer	6
R13	Quantity surveyor	7
R14	General manager	22
R15	General manager	32
R16	General manager	25

under disruption, especially cash flow – dependent activities such as wage payments, supplier commitments, and site security [43].

Global financial crisis

The global financial crisis created a liquidity squeeze, as banks reduced lending to the construction sector in favor of low-risk bonds, limiting working capital and halting planned projects [62]. Construction activity contracted sharply between 2008 and 2010, with demand-side shocks creating a lagged but lasting downturn in revenues [63]. This erosion of profitability forced firms to reduce overheads, delay hiring, or exit the market entirely. Small-to-medium enterprises were particularly vulnerable, lacking the institutional links to secure state-funded work, highlighting an unequal distribution of resilience buffers across firm sizes. At the organizational level, firms' survival depended on their liquidity discipline; at the sector level, the shock revealed how heavily the entire construction market relied on ongoing private investment flow [64].

From a theoretical lens, these effects reflect a breakdown in financial buffering capacity [37], limited institutional learning from past economic downturns [65] and illustrate weak BCM preparedness as firms generally did not maintain pre-defined continuity plans for situations where projects stall but fixed costs remain. In other words, financial continuity was treated as a project-by-project assumption rather than a managed strategic function.

Earthquakes (Christchurch and Kaikoura)

In Christchurch, the destruction of buildings and office space led to temporary closures, relocations, and significant productivity losses [66]. While the demand for reconstruction services surged, access to these projects was not evenly distributed. Many local firms lacked the scale or pre-approval to participate in major government rebuild contracts, resulting in missed revenue opportunities [67]. Financial resilience here depended less on liquidity and more on market access. That dynamic pushed vulnerability upward from the individual project level (paused or canceled projects) to the organizational level (ability to qualify for rebuild work), and then to the industry level (concentration of recovery funds among larger actors). The Kaikoura earthquake led to increased logistics and transportation costs, especially due to damage on State Highway 1 and rail networks, forcing businesses to reroute deliveries and absorb inflated freight expenses [26]. These stressors expose a disconnect between recovery financing and business accessibility, reinforcing the need for adaptive funding frameworks and inclusive procurement strategies [68].

COVID-19 pandemic

The financial shock of COVID-19 was immediate, widespread, and multi-dimensional. Businesses suffered simultaneous revenue loss and cost escalation. Lockdowns forced site closures, halting income while fixed costs, such as rent, wages, and security persisted (R1, R14). Interviewees reported delayed payments from clients and increasing uncertainty in cash flow management: "Cash flow was a huge stress. We had no idea how long we could hold out" (R1). "Shutting down with no income affects a lot of people subcontractors, families, the whole chain" (R3). Rising health compliance costs including PPE, sanitation, and physical distancing added new overhead burdens: "These unanticipated expenses further reduced already thin margins, disproportionately affecting smaller firms" (R8, R12). In parallel, tender prices became misaligned with real procurement costs due to post-award material inflation. "The tender pricing and procurement pricing were not the same" (R4), referring to pandemic-driven supply cost surges. Rising interest rates in 2021–2022 also dampened investor appetite: "The interest rates killed a few deals. Developers just pulled out" (R11). Here, continuity risk and financial risk moved the problem from isolated project underperformance to organization-wide solvency risk. Cascading client withdrawals and financing hesitation indicate that financial instability had industry level effects on the investment climate of the entire sector, not only on single firms.

These experiences align with Resilience Engineering's principle of insufficient redundancy, as most businesses lacked financial buffers. The pandemic also revealed a failure in institutional memory, repeating lessons unheeded from the global financial crisis such as the need for flexible cost provisions and cash flow protections. Financial stress consistently emerged as the most immediate and compounding vulnerability across all crises. Yet, despite repeated exposure, the construction sector's financial resilience remained underdeveloped, with limited institutional reform following each disruption. This persistence suggests that financial fragility is primarily an industry-level vulnerability that then cascades downward to compromise organizational stability and, ultimately, project delivery.

Theme 2: contractual rigidity

Contractual rigidity was a persistent vulnerability across all three crises, undermining the sector's adaptive capacity and generating financial and legal disputes. Fixed-scope contracts, ambiguous force majeure clauses, and limited flexibility to accommodate unexpected disruptions consistently exposed businesses to risk.

Global financial crisis

Contractors were pressured to deliver full contractual obligations despite shrinking budgets and tighter financial conditions [69]. The absence of adaptive pricing clauses or escalation mechanisms prevented equitable cost-sharing between clients and contractors, especially as input prices fluctuated or project schedules shifted [70]. This created an enforced transfer of crisis risk from clients to contractors, rather than a shared adjustment approach, meaning the contract functioned less as a coordination tool and more as a rigidity mechanism. Under Institutional Learning theory, the fact that these rigid arrangements persisted after the financial crisis shows that the sector did not treat risk allocation reform as a resilience priority.

Earthquakes (Christchurch and Kaikoura)

Many reinstatement policies were under-insured or ambiguously worded, leading to prolonged negotiations between insurers, property owners, and contractors [71]. Contractual ambiguity further slowed rebuilding efforts, compounding financial pressures on affected firms [72]. Additionally, rapid regulatory changes following the earthquakes required urgent design modifications, yet many contracts failed to specify how design compliance changes would be handled mid-project [24]. These gaps illustrate the incompatibility of rigid contract structures with the dynamic and uncertain conditions of disaster recovery, underscoring the importance of adaptive clauses for regulatory and design flexibility. At project level, this meant delayed scopes, stand-down time, and unrecoverable labor cost. At organizational level, it meant cash flow stress due to delayed approval and variation settlement. At sector level, it meant slower rebuild timelines, because disputes over scope interpretation and liability became a systemic bottleneck.

COVID-19 pandemic

COVID-19 exposed a severe deficiency in contractual preparedness for systemic, nonphysical disruptions. Unlike earthquakes, pandemic risks were largely unaddressed in standard construction contracts. Force majeure clauses often excluded pandemics or were vaguely worded, leading to disputes over time extensions, liquidated damages, and termination rights (R9, R14). Interviewees described widespread confusion: "The contract said nothing about this type of event; everyone had a different interpretation" (R2). "It was hard to tell who was responsible for delays: the client? the contractor? the government?" (R10). Clients sometimes insisted that construction shutdowns were government-imposed, not client-driven, and therefore outside contractual allowances for delay claims, further escalating disputes (R12). This contractual ambiguity translated into ambiguity in

continuity strategy, because firms could not confidently plan staged shutdown, phased restart, or workforce retention strategies without clarity on entitlement to time/cost relief.

The pandemic thus revealed contractual blind spots that failed to anticipate systemic health risks or government-mandated work stoppages. These weaknesses amplified legal uncertainty and strained relationships between clients, contractors, and subcontractors. Despite exposure to multiple crises, contract frameworks were repeatedly left unrevised, demonstrating a lack of institutional learning and reinforcing rigidity as a structural weakness. This repeated breakdown in contractual resilience positions risk allocation as a sector-level governance issue rather than an individual commercial preference, because these clauses determine who can survive a crisis.

Theme 3: labour and resource constraints

Across all crises, labor availability and resource access emerged as critical vulnerabilities that directly impacted project delivery, workforce continuity, and long-term sector resilience. Labor market rigidities and resource scarcities interacted with broader financial and operational pressures, compounding systemic fragility.

Global financial crisis

Mass layoffs depleted the construction workforce, with many skilled workers permanently exiting the sector [17]. Firms shifted toward short-term, flexible contracts, reducing permanent staffing levels to limit overhead risk, but at the cost of workforce continuity and skills retention [73]. This response protected short-term liquidity but damaged long-term adaptive capacity by weakening firms' ability to scale back up rapidly when demand returned. In continuity terms, organizations preserved financial survival at the expense of future capability continuity. The crisis also interrupted apprenticeship pipelines, constraining long-term skills replenishment. Disruptions to vocational training and certification programs weakened human capital development, with effects lasting well beyond the initial financial shock. The shock was not only project-level (cannot staff this job today) but organizational-level (the national talent pipeline was structurally narrowed), which reappeared as a constraint in later crises. From a theoretical lens, these workforce contractions reflect a reduction in organizational adaptive capacity [38] and erosion of human capital reserves critical for recovery [37, 74].

Earthquakes (Christchurch and Kaikoura)

Widespread displacement of residents and damage to housing and commercial facilities limited workforce mobility and availability [66]. The surge in reconstruction

demand triggered wage inflation, further stretching project budgets and timelines [75]. Kaikoura faced similar challenges, albeit on a smaller scale. The redirection of labor from other regions like Auckland disrupted both local projects and national resource allocation [76]. At the national level, no coordinated workforce strategy was developed to balance urgent reconstruction needs with regional stability, leaving the sector reliant on ad hoc reallocations [72].

COVID-19 pandemic

COVID-19 introduced both health-related and policy-induced workforce disruptions, compounding preexisting fragilities. Border closures cut off the supply of migrant labor a key source of skilled and semi-skilled workers for New Zealand's construction sector. Interviewees consistently highlighted severe shortages: "When the borders closed, we couldn't bring in the specialists we needed for key projects" (R7). "We were already short before COVID, this just pushed us over the edge" (R3). Health protocols transformed previously routine tasks into complex, time-intensive operations, reducing site efficiency by up to 30–40% in some cases (R8, R12). Labor absenteeism due to illness or caregiving responsibilities further compounded delays. Even workers who remained employed were often unavailable, forcing frequent rescheduling and reallocation of teams (R15). This shows a direct clash between keeping the project running day to day and keeping the workforce available and safe. Firms were forced to choose between compliance with health protocols and productivity targets, revealing that labor continuity under a public health crisis is a cross-pressure between safety governance and delivery governance.

These constraints reflect the vulnerability of lean labor models, where firms lacked workforce redundancy to absorb operational shocks. Labor fragility became a cascading vulnerability that amplified financial and scheduling risks across the supply chain [32, 37]. In resilience terms, workforce shortages functioned both as an immediate bottleneck and as a systemic weakness that undermined recovery trajectories. Across crises, the sector consistently lacked institutional mechanisms to retain, retrain, or scale its workforce dynamically, reflecting weak human capital resilience and adaptive capacity [38, 74]. This means labor fragility is not just an organizational issue; it is a sector-level strategic vulnerability that continuously reappears in different crisis types and directly limits the feasibility of BCM at project level.

Theme 4: supply chain fragility

Supply chain disruptions represented one of the most persistent and system-wide vulnerabilities across the examined crises, though the depth and complexity of these disruptions intensified over time. Construction

supply chains in New Zealand remain highly exposed due to geographic isolation, import dependency, and limited domestic manufacturing capacity. This creates a structurally tight coupling between global logistics performance and local project delivery, meaning that continuity of site operations is often dependent on global actors outside any single firm's control.

Global financial crisis

Falling construction activity led to reduced orders for materials, forcing suppliers to scale back operations or exit the market [77]. Many local suppliers faced financial strain from delayed payments, credit tightening, and declining order volumes, which destabilized supplier networks [63]. Contractors who had relied heavily on lean inventory systems were left vulnerable when financial institutions imposed tighter lending restrictions on supplier credit lines [78]. Though the global financial crisis did not involve physical disruptions, it exposed the sector's over-reliance on external financial stability to maintain procurement continuity, reflecting a failure to develop redundant supplier capacity, a core feature of supply chain resilience [37]. This illustrates how financial shocks alone can destabilize supply chains in the absence of built-in redundancy or diversification.

Earthquakes (Christchurch and Kaikoura)

In contrast to the global financial crisis, the earthquakes produced highly localized but severe physical disruptions to supply chains. Road closures, port damage, and utility failures directly impaired material delivery and distribution [79]. Following the Kaikoura earthquake, the main coastal highway (State Highway 1) and trunk rail lines were severely damaged, forcing firms to adopt longer, costlier transport routes (Market [26]). These disruptions triggered cascading delays. Any delay in critical material arrival, particularly heavy equipment and structural components forced rescheduling of labor, subcontractors, and site preparation activities, amplifying time and cost overruns [67]. The sudden surge in regional demand for reconstruction materials created temporary bidding wars, exacerbating procurement instability [66]. The earthquakes revealed high network centrality and limited redundancy within regional supply chains, consistent with Systems Thinking's concept of tight coupling and cascade vulnerability [80]. At the project level, sites went idle waiting for components; at the organizational level, cost to deliver escalated sharply; at the industry level, physical transport infrastructure itself became the bottleneck.

COVID-19 pandemic

COVID-19 introduced the most complex and globalized supply chain disruptions encountered by the construction

sector. Border closures, factory shutdowns, port congestion, and freight capacity shortages converged to create chronic procurement instability [30].

Interviewees described acute challenges: “Shipping costs went up 140%. The freight prices were unbelievable” (R10). “Copper prices jumped 12% almost overnight” (R2). Contractors struggled to maintain budget integrity when upstream pricing shifts outpaced project cash flow and tender allowances (R4, R9). Procurement bottlenecks were compounded by container shortages, port backlogs, and regulatory delays. Even when materials were ordered, it became increasingly uncertain when and if they would arrive on-site (R5, R12). The pandemic amplified the Bullwhip Effect [81], where minor upstream disruptions (e.g., Chinese factory closures) led to amplified downstream volatility in pricing, scheduling, and resource allocation. These experiences demonstrate the consequences of hyper-lean, globally integrated procurement models lacking geographical and supplier diversification, consistent with Resilience Engineering’s call for buffer capacity and redundancy in system design [37]. This exposed a fundamental limitation in BCM as most firms could not meaningfully plan around missing materials because alternative sources either did not exist domestically or were already captured by competitors.

Supply chain fragility repeatedly emerged as a vulnerability multiplier across crises. Despite prior exposures, the sector consistently failed to institutionalize supplier diversification, domestic manufacturing investment, or collaborative resource-sharing agreements that could buffer future shocks. This persistent failure underscores a breakdown in institutional learning and an overreliance on reactive procurement models [37, 65, 82]. Critically, supply chain fragility operates primarily at the industry/system level, but it directly determines project-level continuity. This positions supply chain resilience as a shared strategic function that exceeds the control of individual firms and therefore requires coordinated governance, not just individual contractor mitigation.

Theme 5: strategic responses and adaptation

While each crisis exposed vulnerabilities, they also prompted varying degrees of adaptive behavior by construction businesses. These firm-level strategies reflected both short-term survival mechanisms and isolated innovations but often failed to translate into sector-wide institutional learning. Many organizations improvised continuity strategies under stress, but these strategies were rarely formalized, standardized, or scaled beyond the originating firm. As a result, continuity capability stayed local and temporary rather than becoming embedded at industry level.

Global financial crisis

Many businesses downsized operations, deferred expansion plans, and pivoted toward smaller, short-term projects to preserve liquidity [73]. Firms with diversified private and public sector portfolios navigated the downturn more effectively, leveraging repeat business and long-term partnerships [63]. Large contractors with stronger political and institutional ties secured public work, while SMEs struggled to compete [23]. Analysis showed clear size-based differences in financial resilience and only large firms had fully recovered their liquidity structure measures to pre-2010 levels by 2022 [83]. Adaptations largely reflected reactive resilience rather than systemic transformation, demonstrating limited institutional learning or structural change in business continuity planning [65]. These adaptations were therefore protective at the organizational level but did not address the systemic asymmetry in bargaining power and market access between large firms and SMEs. In other words, resilience capacity was unevenly distributed across stakeholders.

Earthquakes (Christchurch and Kaikoura)

Businesses expanded partnerships, shared resources, and engaged in collaborative joint ventures to access rebuild projects [24]. Firms adopted Building Information Modelling (BIM), streamlined procurement systems, and invested in logistical coordination to handle complex rebuild schedules [68]. These collaborative sourcing models helped stabilize procurement and improve delivery certainty during reconstruction peaks [75]. While these adaptations demonstrated situational flexibility, much of the innovation remained firm-specific and lacked sector-wide institutional codification or policy integration to ensure future scalability [72]. This highlights a stakeholder coordination issue: actors that could coordinate such as large contractors, and government, did so to secure continuity for high-priority rebuild work, but there was no equivalent mechanism to extend those collaborative protections to smaller firms or lower-priority projects. As a consequence, resilience gains remained spatially and institutionally selective.

COVID-19 pandemic

COVID-19 generated the most diverse set of strategic adaptations, forcing businesses to innovate across contractual, operational, and financial domains. Contractual Innovation: Firms increasingly adopted Early Contractor Involvement (ECI) to enable shared risk management and dynamic scheduling: “ECI allowed us to resolve issues early, without waiting for disputes” (R9). ECI facilitated proactive client-contractor collaboration during uncertain procurement and labor market conditions [84,85].

Financial Management: Larger firms diversified project portfolios, prioritized high-revenue jobs, and renegotiated client payment schedules to stabilize cash flow: “We focused on projects where margins could absorb the additional costs” (R7). Emergency credit lines and wage subsidy programs also buffered short-term liquidity [86]. **Digital Transformation:** Firms accelerated adoption of remote working platforms, digital design processes, and online procurement tracking systems. Virtual inspections, remote collaboration, and online approvals became operational norms during lockdowns [33]. **Local Supply Resilience:** Some businesses expanded local supplier relationships to reduce global dependency: “We tried to source as much as possible domestically to avoid shipping delays” (R5). These strategies directly align with BCM principles of continuity of core functions, communication, staged recovery planning, and local redundancy. However, interview data suggest these responses were improvised rather than the result of preexisting continuity plans. This implies that BCM in the New Zealand construction sector is emergent, tactical, and organization-specific rather than institutionalized across the sector. Despite these innovations, many adaptations remained ad hoc, firm-specific, and poorly institutionalized at sector or policy level, echoing earlier crises’ failures to embed learning systemically [65].

Across all crises, firms demonstrated localized learning and situational flexibility. However, sector-wide institutional learning remained weak, with minimal translation of firm-level innovations into standardized resilience frameworks or national policy integration. This shows that resilience is currently actor-dependent: businesses with internal strategic capacity, stronger bargaining position, or better stakeholder leverage were able to maintain a degree of continuity, while others were left exposed. Stakeholders’ terms all experienced the crisis differently and those structural asymmetries shaped who absorbed the majority of risk.

Table 3 presents an analytical synthesis of recurring vulnerabilities across the Global Financial Crisis, major earthquakes, and the COVID-19 pandemic. It condenses five systemic themes (financial fragility, contractual rigidity, labor shortages, supply-chain fragility, and adaptive responses) showing how each operates across project, organizational, and industry levels. The table integrates key theoretical perspectives, including Resilience Engineering, Business Continuity Management, Human Capital Theory, Adaptive Capacity, and Systems Thinking, to explain the persistence of these weaknesses. Overall, the analysis indicates that most failures originate at the industry or system level and cascade downward, while learning and reform remain limited. Although firms demonstrated short-term adaptability, resilience in New

Table 3 Analytical synthesis of cross-crisis vulnerabilities, theoretical interpretation, and levels of Impact in New Zealand’s construction sector.

Theme	Key Cross-Crisis Pattern	Dominant Level of Impact	Theoretical Interpretation	Evidence of Learning/Reform
Financial Fragility	Recurrent cash-flow crises: GFC (credit squeeze), Earthquakes (uneven access to rebuild funding), COVID-19 (revenue loss + rising compliance costs). SMEs most exposed.	Industry → Organisation → Project	Resilience Engineering – lack of redundancy and buffers [37]. BCM – absence of predefined continuity finance [43].	No sector-wide liquidity or contingency fund after any crisis; reliance on short-term government aid or overdrafts.
Contractual Rigidity	Fixed-price and inflexible risk-allocation structures persisted across crises; disputes delayed recovery.	Project ↔ Organisation (cascades to industry)	Institutional Learning – repeated failure to adapt contract standards [65]. Systems Thinking – rigid nodes blocking adaptation [80].	Minor uptake of ECI during COVID-19, but no formal reform of NZS 3910; lessons remain ad hoc.
Labour Fragility	Workforce volatility recurring: layoffs (GFC), displacement (Earthquakes), border closures + illness (COVID-19).	Industry → Organisation → Project	Human Capital Theory – erosion of skill investment [74]. Adaptive Capacity – weak re-deployment & retraining [38].	Still no national labour-surge or protected apprenticeship pipeline; workforce continuity unmanaged.
Supply-Chain Fragility	Increasing exposure: financial (GFC), physical (Earthquakes), global logistics (COVID-19). Price and schedule volatility amplified each time.	Industry-level	Systems Thinking & Bullwhip Effect – tight coupling and ripple amplification [81]. Resilience Engineering – missing redundancy.	No embedded diversification or shared stockpiles; dependence on imports persists.
Strategic Adaptation/Learning	Firms improvised locally, digital tools, ECI, joint ventures, but sector lacked mechanisms to codify lessons.	Organisation → Industry	Institutional Learning & BCM – absence of formal feedback loops and preparedness systems.	No central resilience platform or mandated post-crisis audits; learning remains experiential not institutional.

Zealand's construction sector remains largely reactive and under-institutionalized.

Discussion

This study provides a cross-crisis comparative analysis of how New Zealand construction businesses experienced and adapted to the Global Financial Crisis, the Christchurch and Kaikoura earthquakes, and the COVID-19 pandemic. While these crises varied in origin, timing, and nature, they repeatedly exposed deeply rooted systemic vulnerabilities within the sector. Earthquakes generated sharp but regionally concentrated disruptions affecting local labor pools, material availability, and project continuity in specific zones. In contrast, the GFC and COVID-19 imposed system-wide shocks that cascaded across the entire New Zealand construction sector. Recognizing these scale differences is essential for interpreting variations in adaptive capacity, resilience pathways, and the transferability of lessons learned across crises. The recurrence of financial fragility, contractual rigidity, labor instability, and supply chain disruptions reveals not isolated weaknesses, but embedded structural patterns that have persisted across multiple disruptions. Business Continuity Management (BCM) is defined as the holistic process by which organizations build resilience and ensure that critical functions continue during and after a disruption [43]. These findings contribute to resilience scholarship by demonstrating the persistent failure to convert crisis experience into systemic learning, institutional memory, and structural reform. The repetition of these failure points suggests that resilience in the sector remains predominantly reactive, concentrated at the firm level, rather than being systematically embedded across the industry through policy, governance, or sector-wide standards. BCM provides an interpretive bridge between project level impacts, organizational adaptive capacity, and industry resilience [87]. Within this framing, the New Zealand construction sector's vulnerabilities can be understood as repeated failures to operationalize BCM principles beyond the firm level.

Financial fragility: systematic failure of buffering capacity

Financial vulnerability emerged as the most immediate and consistent failure mode across all crises. The global financial crisis disrupted credit access, drying up liquidity and investment pipelines [23, 62]. SMEs struggled to survive, as many operated with limited liquidity buffers and minimal capacity to absorb prolonged revenue shocks [63]. In BCM terms, this demonstrates a breakdown of redundancy and preparedness, the absence of reserve capital and predefined financial contingency procedures for sustaining essential functions. The Reserve Bank's liquidity support buffered banks, but these measures

provided delayed and indirect relief for construction businesses [88].

After the Christchurch and Kaikoura earthquakes, businesses faced further financial strain from damaged physical assets, relocations, reduced commercial activity, and increased logistics costs [66]. Delayed insurance settlements and under-insured commercial properties prolonged these financial pressures [71]. However, no systemic financial stabilization mechanisms were introduced to insulate firms from the financial aftershocks of disaster recovery processes.

COVID-19 produced the sharpest and most widespread financial disruptions. Site closures eliminated income streams while fixed costs such as rent, wages, and site security continued (R1, R3, R14). Simultaneously, compliance costs from new safety protocols (R8, R12), tender-pricing mismatches due to volatile material costs (R4), and delayed client payments destabilized firm cash flows: "Cash flow was a huge stress; we had no idea how long we could hold out" (R1). From a Resilience Engineering perspective these recurring financial crises reflect a persistent absence of sector-wide buffering capacity. Across all events, businesses lacked both firm-level financial redundancy and sector-level safety nets capable of stabilizing liquidity across extended disruptions.

Despite repeated financial shocks, no institutionalized sector-wide mechanisms for liquidity support, SME stabilization, or public-private financial buffers were introduced to embed resilience beyond individual firm improvisation. This pattern shows that financial continuity risk operates at multiple levels: directly at the organizational level (cash flow and solvency), indirectly at the industry level (credit tightening and investment withdrawal), and structurally at the industry level (policy response and liquidity support). The disruption thus acted simultaneously as a direct shock to projects and an indirect destabilizer of institutional confidence.

Contractual rigidity: repeated failures in risk allocation

Contract rigidity was a recurring vulnerability that prevented contractual frameworks from adapting under crisis-induced uncertainty. During the global financial crisis, contractors were often required to deliver full project scope despite shrinking budgets, with no adjustment mechanisms to renegotiate terms under deteriorating market conditions [69]. Fixed-price contracts exposed firms to rising costs while owners transferred risks downstream [70]. From a BCM standpoint, inflexible contracts limited the ability to implement continuity actions such as suspending non-critical work or re-sequencing tasks without breaching obligations. This reveals that legal structures and BCM are interdependent: continuity cannot be executed when contractual design prohibits adaptation.

Following both earthquakes, insurance-related disputes dominated post-crisis negotiations, delaying rebuilds as ambiguities in reinstatement policies were contested [71]. Contractual terms did not accommodate the complexities of physical destruction, ongoing inspections, or scope variability that emerged during reconstruction [72]. COVID-19 fully exposed the sector's lack of contractual preparedness for nonphysical, systemic disruptions: "The contract said nothing about this type of event; everyone had a different interpretation" (R2). Force majeure clauses often excluded pandemics, leaving parties uncertain about entitlement to time extensions, liquidated damages, or cost relief (R10, R14). While some firms experimented with Early Contractor Involvement (ECI) to introduce flexibility into delivery systems [84] & R9, these were isolated innovations not embedded sector-wide.

From an Institutional Learning perspective [65], this represents repeated failure to institutionalize prior crisis experiences into adaptive contractual norms. Contract design remained rigid and reactive across all crises, continuously exposing businesses to unmanaged financial, operational, and legal risks. This pattern reflects brittle contractual systems that act as failure points rather than resilience enablers.

Labor fragility: long-term erosion of adaptive capacity

Labor constraints emerged across crises as both immediate bottlenecks and long-term systemic failures. The global financial crisis caused widespread workforce reductions, with skilled workers permanently exiting the sector as projects were suspended or canceled [17]. Apprenticeship pipelines were disrupted, weakening future skills replenishment [73]. From a BCM lens, labor resilience depends on continuity of critical functions such as staffing, training, and redeployment [89]. None of these were formally embedded within New Zealand's construction sector: workforce continuity was managed ad hoc at firm level, with no national surge capacity or cross-sector mobilization strategy.

The earthquakes created regionally concentrated demand surges that overwhelmed local labor capacity, forcing costly relocations of staff and inflating wages [66,76]. COVID-19 fully exposed the sector's reliance on migrant labor. "When borders closed, we couldn't bring in the specialists we needed for key projects" (R7). Social distancing protocols reduced on-site productivity by 30–40%, while absenteeism due to illness and caregiving obligations created frequent disruptions (R8, R15).

From an Adaptive Capacity and Human Capital Theory lens, these disruptions demonstrate the sector's fragile labor system architecture: highly lean, inflexible, and lacking redundancy. Despite repeated crises, no national workforce surge capacity, retraining platform,

or cross-sector labor mobilization framework was developed. This absence perpetuates structural labor fragility, undermining long-term resilience. At the project level, absenteeism and protocol delays directly reduced productivity; at the organizational level, firms struggled with retention and upskilling; and at the industry level, migration dependence created a structural vulnerability.

Supply chain fragility: bullwhip amplification and systems failure

Supply chains became progressively more fragile and globally exposed across successive crises. During the global financial crisis, supplier financial viability was threatened as demand reductions forced smaller suppliers out of business [78]. SMEs struggled to sustain operations amid delayed payments and restricted credit.

The earthquakes introduced severe physical disruptions to supply chain infrastructure. The Kaikoura earthquake severed primary transport routes, forcing businesses to adopt costly, inefficient alternative logistics solutions [26].

COVID-19 amplified these vulnerabilities globally. Port closures, container shortages, and manufacturing delays created significant material shortages, volatile prices, and severe scheduling uncertainty [30]. "Shipping costs went up 140%; copper prices jumped 12% almost overnight" (R10, R2). This aligns directly with the Bullwhip Effect, where minor upstream disturbances created extreme downstream volatility. From a Systems Thinking perspective [80], tight coupling across global procurement networks, absent buffering mechanisms, rendered the sector systemically brittle.

Despite multiple crises, no meaningful diversification of sourcing strategies, domestic manufacturing development, or procurement consortia emerged to reduce systemic exposure. This repetition highlights a failure of institutional memory, where known vulnerabilities are repeatedly left unaddressed. From a BCM perspective, the affected BCM factors were lack of alternative suppliers, absence of stockpiles, and limited coordination across tiers. These weaknesses meant that continuity was contingent on external recovery rather than internal adaptation.

At the project level, material shortages caused schedule overruns; at the organizational level, cash flow collapsed due to non-delivery; and at the industry level, national production bottlenecks hindered reconstruction and new development.

Adaptive responses: local improvisation without institutionalisation

While many firms displayed rapid flexibility through digital adoption, client renegotiation, supplier shifts, and early contractor involvement, these adaptations

remained isolated to individual businesses. No centralized mechanism existed to capture, share, or codify these crisis-driven practices into permanent sectoral standards or policy reform. From an Institutional Learning perspective, resilience was achieved at the firm level but failed to scale into sector-wide learning. BCM theory posits that continuity becomes resilient only when lessons are institutionalized into preparedness systems and recovery protocols [89]. The absence of such codification in New Zealand’s construction sector reflects a systemic learning deficit. At the project level, improvisation maintained short-term functionality but without documentation or replication. At the organizational level, learning remained experiential rather than procedural. At the industry level, absence of coordination mechanisms prevented systemic reform.

Table 4 synthesizes the recurrent vulnerabilities observed across the global financial crisis, Christchurch Earthquake, Kaikoura Earthquake, and COVID-19 Pandemic in New Zealand’s construction sector. It categorizes primary impacts, financial, labor, supply chain, operational, and contractual challenges across crises, and links each domain to its underlying systemic mechanism using Resilience Engineering, Systems Thinking, Adaptive Capacity, Institutional Learning, and Bullwhip Effect frameworks. The synthesis highlights consistent failures to translate crisis experience into institutionalized resilience measures, reflecting sector-wide learning deficits that have perpetuated fragility across multiple disruptions. This table also forms the foundation for the proposed cross-crisis resilience framework, which integrates

these insights into a conceptual model for systemic adaptation.

Figure 2 provides an overview of how the study moves from its evidence base to its final conceptual contribution. At the top, it shows the three major crises examined, the Global Financial Crisis, the Christchurch and Kaikōura earthquakes, and the COVID-19 pandemic which acted as major shocks to New Zealand’s construction sector and formed the starting point of the analysis. The next layer presents the qualitative approach used to study these events, combining a systematic review of existing research with semi-structured interviews. These materials were analyzed using NVivo and thematic synthesis, which helped identify five recurring vulnerabilities: financial fragility, rigid contractual arrangements, labor and resource pressures, supply-chain weaknesses, and the varying degrees of strategic adaptation shown by firms. Each of these themes was then examined through several theoretical lenses, Resilience Engineering, Systems Thinking, Business Continuity Management, Human Capital Theory, and Institutional Learning. This allowed the analysis to trace how the issues connect across project, organizational, and industry levels.

The Cross-Crisis Resilience Framework outlines five key pathways for strengthening resilience: improving financial stabilization, designing more adaptive contracts, expanding workforce surge capacity, diversifying supply chains, and embedding sector-wide learning mechanisms.

Table 4 Cross-crisis comparative analysis of systemic vulnerabilities and institutional learning failures in New Zealand’s construction sector.

Aspect	Global Financial Crisis	Christchurch Earthquake	Kaikoura Earthquake	COVID-19 Pandemic	Systemic Mechanism
Primary Impact	Funding constraints, reduced demand	Physical destruction of buildings & infrastructure	Damage to key transport infrastructure	Revenue loss, global supply chain failures, rising costs	Multi-crisis exposure across financial, physical, and systemic domains
Financial Challenges	Credit tightening, reduced revenue, halted private investment	High reconstruction costs; insurance delays strain liquidity	Increased logistics & repair costs	Immediate cash flow crises, fixed costs continue, compliance costs escalate	Absence of financial redundancy; lack of systemic liquidity buffers
Labour and Resource Issues	Workforce layoffs, exit of skilled labour; disrupted apprenticeship pipelines	Severe labour shortages, wage inflation, relocation pressures	Labour reallocation from unaffected regions	Migrant labour shortages, illness-related absenteeism, productivity losses from protocols	No national workforce surge capacity or training mobilisation
Supply Chain Disruptions	Supplier insolvencies from demand collapse	Infrastructure damage delays material delivery	Road & rail closures disrupt logistics	Global material shortages, shipping failures, extreme price volatility	Tight coupling, no redundancy; amplified Bullwhip Effect
Operational Challenges	Project suspensions, delayed timelines	Business relocations; multiple office moves; loss of site access	Disrupted logistics; higher freight times	Site closures; productivity loss from staggered shifts, PPE, safety measures	Lack of contingency planning; absence of systemic coordination
Contractual Issues	Fixed-price contracts inflexible to market shocks	Insurance disputes delay rebuilding	Limited contractual flexibility	Widespread force majeure gaps, contract ambiguity on pandemic scenarios	Repeated failure to reform risk allocation structures
Post-Crisis Learning	Minimal contract reform; weak financial reforms	No workforce mobilisation system; no supply diversification	No procurement alliances developed	Still no systemic resilience frameworks after COVID-19	Institutional learning failure across all crises

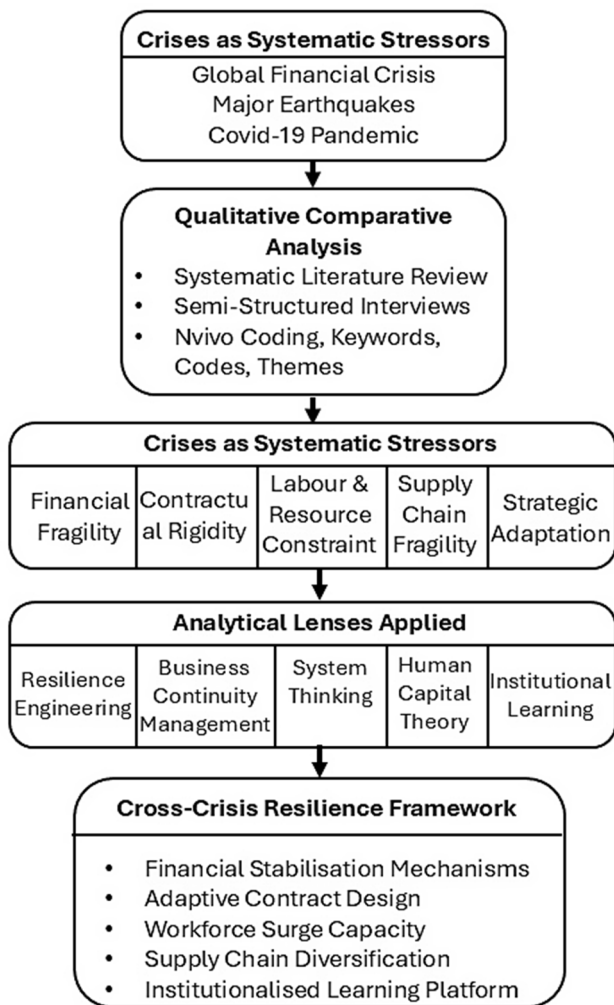


Fig. 2 Integrated cross-crisis resilience framework for New Zealand construction businesses.

Recommendations

Developing sector-wide financial stabilisation mechanisms

The recurring financial fragility observed across the global financial crisis, the Christchurch and Kaikoura earthquakes, and the COVID-19 pandemic highlights the absence of formal financial buffers within New Zealand’s construction sector. Firm-level liquidity management, heavily reliant on continuous project-based cash flow, has proven insufficient to absorb systemic shocks. To address this, the sector requires the establishment of a dedicated Construction Liquidity Stabilisation Fund through a public-private partnership model. This fund would serve as an immediate financial buffer during declared national or sectoral emergencies, offering rapid-access working capital particularly targeted at small and medium-sized enterprises, which consistently demonstrate heightened vulnerability due to their limited financial reserves. The activation of such funds should be linked to predefined

crisis indicators, allowing timely disbursement during major disruptions.

In addition, large contractors should be subjected to strengthened regulatory guidelines requiring the maintenance of contingency reserves proportionate to project size, scope, and contractual obligations, thereby enhancing firm-level financial resilience without destabilizing smaller sub-contractors. Alongside these measures, commercial lending institutions should be encouraged to develop crisis-contingent loan facilities, with automatic expansion of credit access triggered by government-declared disruptions. Collectively, these financial stabilization strategies would operationalize key principles of Resilience Engineering by introducing redundancy and liquidity reserves directly into the financial architecture of the sector.

Reforming contractual risk allocation and legal flexibility

The contractual structures underpinning construction projects in New Zealand have repeatedly demonstrated inflexibility when exposed to crisis conditions. Across all analyzed events, the sector’s dependence on rigid, fixed-price contracts exacerbated risk exposure, delayed conflict resolution, and undermined financial continuity. To address these shortcomings, it is recommended that New Zealand’s standard contract forms, including NZS 3910, be comprehensively reviewed and revised. These revisions should explicitly incorporate expanded force majeure provisions, recognizing not only traditional physical disruptions but also systemic events such as pandemics, public health emergencies, regulatory shut-downs, and global supply chain failures.

Furthermore, pricing adjustment clauses must become standard contractual instruments, allowing pre-defined cost recalibration in response to substantial market volatility in construction materials and logistics. This approach would protect both contractors and clients from unanticipated financial distress driven by globalized procurement failures, as witnessed most severely during COVID-19. Delay management protocols must also be updated to include flexible escalation frameworks for labor shortages, transport constraints, and regulatory delays emerging from future crises. Simultaneously, the widespread institutionalization of Early Contractor Involvement (ECI) is recommended, allowing clients and contractors to collaborate more flexibly on project design, scope, scheduling, and pricing from the early stages of project development.

To support these reforms, it is essential that small and medium-sized contractors receive enhanced contractual training and legal education, reducing their historical disadvantage in negotiating risk allocation terms with larger, better-resourced clients. This comprehensive contractual reform directly addresses the persistent failures

of institutional learning observed throughout the sector ensuring that lessons from past crises are embedded into future contract frameworks rather than repeatedly ignored.

Building national workforce surge capacity and long-term Labour resilience

Labor fragility, consistently exposed across each crisis, demands sector-wide reform to establish workforce surge capacity and reduce long-term skill shortages. New Zealand's construction sector requires the development of a national workforce mobilization framework capable of rapidly reallocating human resources during regional or national crises. Such a framework should include a national labor registry, mapping the location, skills, and availability of workers across both construction and related sectors, thereby enabling government and industry bodies to redeploy personnel efficiently during post-crisis reconstruction periods.

Concurrently, apprenticeship pipelines must be expanded and stabilized through sustained government investment. Importantly, apprenticeship enrollments should be strategically protected during both growth periods and economic downturns, preventing the recurring loss of skilled labor experienced following the global financial crisis. In addition, flexible rapid-retraining programmes should be developed, allowing displaced workers from other sectors to transition into construction roles during periods of heightened demand following disasters. By embedding these workforce reforms, the sector would enhance its adaptive capacity and strengthen its long-term resilience to repeated labor shortages. Such reforms align with Human Capital Theory by recognizing labor as a critical resilience asset that requires ongoing investment and protection.

Diversifying supply chains and embedding redundancy into procurement systems

The extreme supply chain volatility exposed across all crises underscores the sector's dangerous reliance on global procurement systems without sufficient redundancy. Recent modeling in construction supply chains shows that resilience emerges from a portfolio of tactics including multi-sourcing, inventory buffers, and flexible scheduling, that jointly dampen capacity and demand shocks [90]. To reduce this systemic exposure, a policy shift toward localized manufacturing capacity is critical. Firms need to move away from single, world-spanning supply chains toward regionalized or local-for-local networks. Critically, reliance on multiple suppliers is no longer optional; dual sourcing is becoming the minimum viable standard which often involves splitting production capacity across multiple factories within a country and

intentionally introducing additional buffer/flexibility into sourcing strategies [91].

Government-supported investment should be channeled into domestic production facilities for key construction materials, including timber components, steel fabrication, concrete products, and prefabrication systems. This would not only reduce procurement delays during border closures but also support regional economic development and workforce growth. In parallel, procurement governance frameworks must incentivize collaborative procurement alliances within the sector, encouraging shared resource agreements, supplier partnerships, and the pooling of logistics infrastructure, particularly during crisis periods. Sector-level stockpiling of essential materials may also be introduced, coordinated through industry bodies, to mitigate against future global supply shocks. Furthermore, the development of real-time supply chain monitoring platforms, supported by digital technologies such as blockchain and Artificial Intelligence (AI) advanced logistics tracking, would enable firms and regulators to identify emerging supply vulnerabilities and intervene proactively. This investment in digital technologies, can simultaneously foster innovation, strengthen stakeholder relationships, and lead to significant cost and operational benefits [92]. While innovation is essential, there is a risk that small and medium-sized companies struggle to acquire the necessary resources and capabilities for implementing these advanced technologies [93] which reflect the need to address tight coupling and interdependence failures articulated in Systems Thinking frameworks. They also operationalize Resilience Engineering principles by embedding redundancy, buffers, and early-warning systems into procurement design.

Institutionalizing sector-wide learning and crisis memory

Perhaps most critically, the sector requires an institutionalized learning architecture capable of capturing, evaluating, and disseminating lessons from each crisis. The organizational resilience in the construction sector is not a fixed attribute of firms but an emergent property arising from the interaction between individual, team, and organizational capacities. As Mitansha and Potangaroa [94] demonstrate, resilient organizations are underpinned by empowered individuals who can adapt, collaborate, and act autonomously during crises, yet these traits only translate into system-level resilience when supported by enabling conditions such as strong leadership, continuous learning, and a shared organizational vision. The failure to translate firm-level adaptations into systemic reforms has allowed vulnerabilities to persist across crises. It is therefore recommended that a dedicated Construction Resilience Learning Platform be established under joint industry-government leadership.

This body would systematically collect post-crisis data, evaluate both successful and failed adaptive practices, and integrate these lessons into ongoing policy and regulatory development.

Regular sector-wide resilience audits should be mandated, assessing contractual flexibility, financial preparedness, workforce readiness, and supply chain vulnerability against evolving crisis typologies. Moreover, national simulation exercises and scenario planning initiatives should be conducted periodically, allowing policymakers, contractors, suppliers, and labor representatives to jointly stress-test sector-wide crisis response capabilities. These measures directly address the failures of institutional learning transforming fragmented, ad hoc lessons into an enduring crisis memory that strengthens preparedness over time.

This study reveals that repeated crises have generated profound social and practical implications for New Zealand's construction sector, underscoring systemic vulnerabilities that extend beyond project-level disruption. Practically, the results demonstrate an urgent need for industry-wide reform to strengthen continuity in future crises. This includes mandating contract structures that distribute risk more equitably, fully institutionalizing Early Contractor Involvement (ECI) at the public procurement level, actively diversifying supply chains and promoting domestic manufacturing, and establishing a national workforce-surge capacity complemented by sector-wide financial stabilization mechanisms to prevent liquidity collapses during shocks. Socially, the findings highlight how recurrent financial strain, workforce instability, and supply-chain volatility disproportionately affect the most vulnerable cohorts: small businesses, migrant workers, apprentices, families dependent on construction income, and communities relying on timely housing and infrastructure delivery. Labor shortages, mental-health pressures, and the erosion of apprenticeship pipelines weaken the long-term human capital base, consequently reducing social resilience and deepening inequalities within the workforce. The study shows that without embedding institutional learning; through formal resilience platforms, sector audits, and crisis-memory systems; New Zealand will continue repeating predictable failures, resulting in preventable project delays, cost overruns, and community-level socioeconomic impacts.

Conclusion

This study has examined how New Zealand's construction sector experienced, absorbed, and responded to three major crises: the global Financial Crisis, the Christchurch and Kaikoura earthquakes, and the COVID-19 pandemic. While these crises were distinct in their nature, scope, and triggers, they consistently revealed recurrent systemic vulnerabilities that transcended event-specific circumstances. Financial fragility, contractual

rigidity, labor shortages, and supply chain disruptions were repeatedly observed, despite clear opportunities to institutionalize learning from earlier crises. The sector's resilience was repeatedly dependent on localized firm-level adaptations rather than systemic reforms, resulting in a fragmented capacity to absorb successive shocks. This pattern underscores the persistence of reactive resilience rather than the development of systemic resilience.

Drawing on Resilience Engineering, Systems Thinking, Institutional Learning, and Adaptive Capacity frameworks, this study demonstrates that the primary vulnerability of New Zealand's construction sector lies not only in operational weaknesses but in the repeated failure to embed crisis learning into permanent institutional structures. While many firms demonstrated impressive short-term flexibility such as through portfolio diversification, digital adaptation, collaborative procurement, or contractual innovations, these responses were rarely codified into formal industry standards, policies, or regulatory frameworks. Consequently, the sector remains at risk of repeating known failure patterns when exposed to future systemic disruptions. The absence of institutionalized feedback loops ensures that lessons from past crises remain fragmented and inconsistently applied.

The research makes an original contribution to the construction resilience literature by advancing a cross-crisis comparative framework that integrates both firm-level adaptive behaviors and sector-wide institutional learning failures. Unlike many prior studies that examine isolated crises or single vulnerability domains, this research synthesizes systemic weaknesses across multiple crisis events, highlighting the accumulation of unaddressed resilience gaps over time. This integrative framework provides both theoretical advancement and practical pathways for reform, offering policymakers and industry leaders a structured basis for embedding resilience into governance and practice. The analysis also offers detailed practical recommendations for financial buffering, adaptive contract design, workforce mobilization, supply chain diversification, and institutional learning mechanisms, all directly grounded in empirical findings and theoretically informed pathways for reform.

Despite its contributions, this study remains limited by its qualitative design, the retrospective nature of some of the data, and the specific national context of New Zealand. Future research would benefit from longitudinal studies tracking resilience interventions over time, cross-national comparisons of institutional learning frameworks in construction, and quantitative modeling of cascading disruption effects across supply chains, finance, and workforce systems. In particular, simulation-based modeling could offer valuable insights into how adaptive capacities might interact under compound crisis scenarios, while policy-oriented research could explore

how regulatory structures either facilitate or impede systemic learning within construction governance.

Ultimately, this study affirms that true resilience in construction sectors exposed to complex, compound crises requires not only technical adaptation but the systematic institutionalization of learning, memory, and policy reform. Without these mechanisms, even the most agile firm-level adaptations will remain vulnerable to the structural repetition of avoidable failures. Therefore, resilience must be reframed not as a temporary recovery function but as an institutional capability embedded within sectoral governance.

Limitations

The primary limitation of this study was constrained participant availability, as some interviewees faced illness, caregiving responsibilities, or work-related pressures during the COVID-19 period. Repeated scheduling attempts were declined, limiting broader engagement with frontline staff and operational workers.

The study used a qualitative design based on 16 expert interviews, which, while rich in depth, limits statistical generalizability. Although thematic saturation was reached and detailed insights were obtained, the absence of quantitative modeling or longitudinal tracking restricts the empirical strength of causal claims. There is also a risk of response bias, as most participants were in senior roles, possibly skewing perspectives toward strategic and managerial responses while underrepresenting site-level experiences. The study was geographically confined to New Zealand's construction sector, which may limit the international applicability of findings despite the country's relevance as a case for small, import-reliant economies. Additionally, the comparison between crises was constrained by differences in available data: the COVID-19 case relied on primary interviews, whereas earlier crises were assessed through secondary literature, introducing potential variation in data richness and analytical depth.

Future research should explore mixed-method approaches, including large-scale surveys or simulation-based modeling to measure the cascading impacts of supply disruptions more precisely. A longitudinal study tracking the implementation and effectiveness of resilience strategies over time would also help understand whether short-term adaptations evolve into long-term system transformation.

Moreover, future studies could extend the application of Resilience Engineering frameworks by integrating them with quantitative risk assessment tools, to provide predictive indicators for supply chain failure points. Investigating cross-national comparative models (e.g., Japan, Canada, Scandinavia) could offer additional

insights into scalable strategies for small, import-reliant construction economies.

Funding

This work was supported by the New Zealand Ministry of Business, Innovation and Employment (MBIE), Endeavour Programme Research Grant, contract MAUX2005.

Data availability

Due to the sensitive nature of the data (e.g., involving confidential or proprietary information), the data are not publicly available. However, de-identified data may be made available from the corresponding author upon reasonable request and subject to institutional and ethical approvals.

Declarations

Disclosure

The authors declare that they have no known competing financial interests or personal relationships that could have appeared to influence the work reported in this paper.

Human ethics and consent to participate declarations

All participants in this study provided their informed consent prior to participation. They were fully briefed on the purpose of the research, the voluntary nature of their involvement, and their right to withdraw at any stage without penalty. Participants were assured that their identities would remain confidential and that all data would be reported in aggregate form only. Written consent forms were obtained from each participant in accordance with the approved ethical guidelines. Ethics approval for this project was formally obtained prior to data collection. From Massey University's Code of Ethical Conduct for Research, Teaching, and Evaluations involving Human Participants' point of view, the proposed research was assessed as meeting the criteria for a low-risk study. The committee assessed this research as low risk. Ethics notification # 4,000,023,852 applies to this research and is approved. To protect participants' confidentiality, all data were anonymized, and no identifying information was included in the transcripts or analysis. Informed consent was obtained prior to participation, with participants clearly informed about the study's purpose, their right to withdraw at any time, and how their data would be securely stored and used. All digital data were stored in password-protected devices.

Consent for publication

This study reports only de-identified qualitative data and includes no images or other materials that could lead to participant identification. Therefore, consent for publication is not applicable.

Declaration of AI-Assisted Technologies

During the preparation of this work the authors used ChatGPT, developed by OpenAI (2024 version) in order to enhance the readability and language of the manuscript. After using this tool/service, the authors reviewed and edited the content as needed and take full responsibility for the content of the published article.

Competing interests

The authors declare no competing interests.

Received: 17 September 2025 / Revised: 4 December 2025 / Accepted: 16 December 2025

Published online: 27 January 2026

References

1. Statista.com (2022) Gross Domestic Product (GDP) of the Construction Industry in New Zealand from 2017 to 2022 [Online]. Available: <https://www.statista.com/statistics/1026508/new-zealand-construction-industry-gross-domestic-product/> [Accessed 27/08/2022]
2. Statista.com (2024) Number of Enterprises in the Construction Industry in New Zealand from 2014 to 2023 [Accessed Online]. Available: <https://www.statista.com/statistics/975753/new-zealand-number-of-businesses-in-the-cons>

- truction-industry/#:~:text=In%25202023%252C%2520there%2520were%2520around,industry%2520enterprises%2520in%2520the%2520country.
3. Bundy, J., M. D. Pfarrer, C. E. Short, and W. T. Coombs (2017) Crises and crisis management: integration, interpretation, and research development. *J Manage* 43:1661–92
 4. Pearson, C. M. and J. A. Clair (1998) Reframing crisis management. *Acad Manag Rev* 23:59–76
 5. Selcuk, E. (2025) Impact of the COVID-19 pandemic on construction project performance: challenges and strategic responses. *J Asian Archit Build Eng* 1–18
 6. Iftikhar, R. and R. Müller (2019) Taxonomy among triplets: opening the black box. *Int J Manag* 10
 7. Macdonald, J. R. and T. M. Corsi (2013) Supply chain disruption management: severe events, recovery, and performance. *J Bus Logist* 34:270–88
 8. Hallegatte, S., J. Rentschler, and J. Rozenberg (2019) Lifelines: the resilient infrastructure opportunity. World Bank Publications
 9. Aksoy, C. G., M. Chupilkin, Z. Koczan, and A. Plekhanov (2025) Unearthing the impact of earthquakes: a review of economic and social consequences. *J Policy Anal Manag* 44:1450–71
 10. Basco, S., G. Felice, B. Merlevede, and M. Mestieri (2023) Financial crises and the global supply network: evidence from multinational enterprises. CEPR Discuss Pap
 11. Pamidimukkala, A. and S. Kermanshachi (2021) Impact of Covid-19 on field and office workforce in construction industry. *Proj Leadersh Soc* 2:100018
 12. Ogunnusi, M., M. Hamma-Adama, H. Salman, and T. Kouider (2020) COVID-19 Pandemic: the effects and prospects in the construction industry. *Int J Real Estate Stud* 14
 13. Leal Filho, W., L. L. Brandli, A. Lange Salvia, L. Rayman-Bacchus, and J. Platje (2020) COVID-19 and the UN Sustainable Development Goals: threat to solidarity or an opportunity? *Sustainability* 12:5343
 14. Queiroz, M. M., D. Ivanov, A. Dolgui, and S. Fosso Wamba (2020) Impacts of epidemic outbreaks on supply chains: mapping a research agenda amid the COVID-19 pandemic through a structured literature review. *Ann Oper Res* 1–38
 15. Alaloul, W. S., M. Liew, N. A. W. A. Zawawi, and I. B. Kennedy (2020) Industrial Revolution 4.0 in the construction industry: challenges and opportunities for stakeholders. *Ain Shams Eng J* 11:225–30
 16. Fisher, G., R. Stevenson, and D. Burnell (2020) Permission to hustle: igniting Entrepreneurship in an organization. *Journal of Business Venturing Insights* 14:e00173
 17. Stevenson, J. R., H. Kachali, Z. Whitman, E. Seville, J. Vargo, and T. Wilson (2011 March 22) Preliminary observations of the impacts of the 22 February Christchurch earthquake had on organisations and the economy: a report from the field (22 February- Bull N Z Soc Earthquake Eng. 44:65–76
 18. Yonson, R., I. Noy, V. C. Ivory, and C. Bowie (2020) Earthquake-induced transportation disruption and economic performance: the experience of Christchurch, New Zealand. *J Transp Geogr* 88:102823
 19. Tierney, K. J. (1997) Business impacts of the northridge earthquake. *J Conting Crisis Manag* 5:87–97
 20. Xiao, Y. and S. Van Zandt (2012) Building community resiliency: spatial links between household and business post-disaster return. *Urban Stud* 49:2523–42
 21. Worldbank (2009) *Doing Business Report 2009*. New York: World Bank
 22. OECD (2009) OECD Economic Surveys New Zealand. Organization for Economic, Paris Co-operation and Development
 23. Battisti, M., D. Deakins, and M. Perry (2013) The sustainability of small businesses in recessionary times: Evidence from the Strategies of Urban and Rural Small Businesses in New Zealand. *Int J Entrepreneurial Behav Res* 19:72–96
 24. De Vries, H. and R. Hamilton (2021) Smaller Businesses and the Christchurch earthquakes: a longitudinal study of individual and organizational resilience. *Int J Disaster Risk Reduct* 56:102125
 25. Olsen, A. H. and K. A. Porter (2013) Storm surge to demand surge: exploratory study of hurricanes, labor wages, and material prices. *Nat Hazards Rev* 14:247–57
 26. Market Economics Limited (2017) Economic impact of the 2016 Kaikoura earthquake - a report prepared for the ministry of transport. Available: <https://www.transport.govt.nz/assets/Uploads/Report/Kaikoura-Earthquake-MERIT-Report.pdf>
 27. Morris, G. D. (2020) 6 Critical COVID-19 risks for the construction industry [Online]. Available: <https://riskandinsurance.com/6-critical-covid-19-risks-for-the-construction-industry/> [Accessed]
 28. Filser, M., A. Brem, J. Gast, S. Kraus, and A. Calabrò (2016) Innovation in family firms-examining the inventory and mapping the path. *Int J Innov Manag* 20:1650054
 29. Bartik, A. W., M. Bertrand, Z. Cullen, E. L. Glaeser, M. Luca, and C. Stanton (2020) The impact of COVID-19 on small business outcomes and expectations. *Proc Natl Acad Sci* vol 117. pp 17656–66
 30. Ivanov, D. and A. Das (2020) Coronavirus (COVID-19/SARS-CoV-2) and supply chain resilience: a research note. *Int J Integr Supply Manag* 13:90–102
 31. Elhag, T., A. Boussabaine, and T. Ballal (2005) Critical determinants of construction tendering costs: quantity surveyors' standpoint. *Int J Project Manag* 23:538–45
 32. Kraus, S., T. Clauss, M. Breier, J. Gast, A. Zardini, and V. Tiberius (2020) The economics of COVID-19: Initial empirical evidence on how family firms in five European countries cope with the corona crisis. *Int J Entrepreneurial Behav Res* 26:1067–92
 33. Gupta, B. S. (2020) Supply chain disruption & plausible solution in the scenario of COVID-19 Pandemic
 34. Al-Arasi, S., O. Almahzoumi, and H. Alemady (2024) The statistical impact of the COVID-19 pandemic on the implementation of international contractual obligations. *J Stat Appl Probab* 13:891–902
 35. Nwadike, A. and I. E. Aigwi (2024) Impacts of the COVID-19 pandemic on building consents and construction sector activities in New Zealand
 36. Tagharobi Ms, M., M. Jelodar, and T. Susnjak (2025) Project cancellations in New Zealand's construction industry: assessing the impact of unpredictable events. In CIB conferences, pp 71
 37. Hollnagel, E. (2013) Resilience engineering in practice: a guidebook. Ashgate Publishing, Ltd
 38. Folke, C., S. R. Carpenter, B. Walker, M. Scheffer, T. Chapin, and J. Rockström (2010) Resilience thinking: integrating resilience, adaptability and transformability. *Ecol Soc* 15
 39. Li, J., H. Yu, and X. Deng (2024) A Systematic review of the evolution of the concept of resilience in the construction industry. *Buildings* 14:2643
 40. Moore, S. B. and S. L. Manring (2009) Strategy development in small and medium sized enterprises for sustainability and increased value creation. *J Clean Prod* 17:276–82
 41. Sharma, P., T. Y. Leung, R. P. J. Kingshott, N. S. Davcik, and S. Cardinali (2020) Managing uncertainty during a global pandemic: an international business perspective. *J Bus Res* 116:188–92. <https://doi.org/10.1016/j.jbusres.2020.05.026>
 42. Liguori, E. W. and T. G. Pittz (2020) Strategies for small business: surviving and thriving in the Era of COVID-19. *Journal of the International Council for Small Business* 1:106–10
 43. Ivanova, R. P. (2020) ISO 22301: 2019-a tool to increase the organization's preparedness to deal with crises. *Известия на Съюза на учените-Варна. Серия Икономически науки* 9:147–55
 44. Riglietti, G. (2023) Building supply chain resilience capacity: a business continuity management perspective
 45. Creswell, J. W. and J. D. Creswell (2017) Research design: Qualitative, quantitative, and mixed methods approaches. Sage publications
 46. Snyder, H. (2019) Literature review as a research methodology: an overview and guidelines. *J Bus Res* 104:333–39
 47. Tranfield, D., D. Denyer, and P. Smart (2003) Towards a methodology for developing evidence-informed management knowledge by means of systematic review. *Br J Manage* 14:207–22
 48. Liberati, A., D. G. Altman, J. Tetzlaff, C. Mulrow, P. C. Gøtzsche, J. P. Ioannidis, M. Clarke, P. J. Devereaux, J. Kleijnen, and D. Moher (2009) The PRISMA statement for reporting systematic reviews and meta-analyses of studies that evaluate health care interventions: explanation and elaboration. *Ann Intern Med* 151:W-65–W-94
 49. Cooper (2016) What is a "mapping study"? *J Med Libr Assoc* 104:76–78. Available: <https://doi.org/10.3163/1536-5050.104.1.013>
 50. Haddaway, N. R., M. J. Grainger, and C. T. Gray (2022) Citationchaser: a tool for transparent and efficient forward and backward citation chasing in systematic searching. *Res Synth Methods* 13:533–45
 51. Ayat, M. and C. W. Kang (2023) Effects of the COVID-19 pandemic on the construction sector: a systemized review. *Eng Constr Archit Manag* 30:734–54
 52. Naeem, M., W. Ozuem, K. Howell, and S. Ranfagni (2023) A step-by-step process of thematic analysis to develop a conceptual model in qualitative research. *Int J Qual Methods* 22:16094069231205789
 53. Pamidimukkala, A., S. Kermanshachi, and K. Subramanya (2023) Electronic material delivery in highway construction: a semi-structured interview. in transportation research board 102 Annual Meeting, pp 23–03844

54. Jervis, M. G. and M Drake (2014) The use of qualitative research methods in quantitative science: a review. *J Sens Stud.* 29:234–47
55. Sandelowski, M (1996) One is the liveliest number: the case orientation of qualitative research. *Res Nurs Health.* 19:525–29
56. Guest, G., A. Bunce, and L Johnson (2006) How many interviews are enough? An experiment with data saturation and variability. *Field Methods* 18:59–82
57. Glaser, B. G (2002) Conceptualization: on theory and theorizing using grounded theory. *Int J Qual Methods.* 1:23–38
58. Galvin, P. and S Tywoniak (2019) How Organizational Boundary Choices Impact Capability Development. *Construction Management and Economics* 37:712–26
59. Hennink, M. M., B. N. Kaiser, and V. C Marconi (2017) Code saturation versus meaning saturation: how many interviews are enough? *Qual Health Res.* 27:591–608
60. Obilor, E. I (2023) Convenience and purposive sampling techniques: are they the same. *Int J Innov Soc Sci Educ Res.* 11:1–7
61. Oliveira, M., C. Bitencourt, E. Teixeira, and A. C Santos (2013) Thematic content analysis: is there a difference between the support provided by the MAX-QDA® and NVivo® software packages. In Proceedings of the 12th European Conference on Research Methods for Business and Management Studies, pp 304–14
62. De Valence, G. and G Runeson (2011) On the state of the building industry after the GFC and the Euro Crisis. *J Constr Econ Build.* the 11:102–13
63. Thangaraj, R. K. and T. K Chan (2012) The effects of the global financial crisis on the Australian building construction supply chain. *Australas J Constr Econ Build.* 12:16–30
64. Bosio, E., S. Djankov, F. Jolevski, and R Ramalho (2020) Survival of firms during economic crisis. *World Bank Policy Research Working Paper*
65. Donahue, A. and R Tuohy (2006) Lessons we don't learn: a study of the lessons of disasters, why we repeat them, and how we can learn them. *Homeland Secur Aff.* 2
66. Parker and Steenkamp (2012) the economic impact of the canterbury earthquakes. *Reserve Bank of New Zealand Bulletin* 75:13–25
67. Brown, C., J. Stevenson, S. Giovinazzi, E. Seville, and J Vargo (2015) Factors influencing impacts on and recovery trends of organisations: evidence from the 2010/2011 Canterbury earthquakes. *Int J Disaster Risk Reduct.* 14:56–72. Available: <https://doi.org/10.1016/j.ijdrr.2014.11.009>
68. Rodrigo, N. and S Wilkinson (2020) Impact of post-disaster government policy on reconstruction: a case study of post-earthquake Christchurch, New Zealand. *Int J Constr Supply Chain Manag.* 10:172–93
69. Fadhil, G. A. and A. M Burhan Investigating the effects of economic crisis on construction projects in Iraq. In *E3S Web of Conferences*, 2021. EDP Sciences, pp 02005
70. Rodrigues, M., M. Franco, N. Sousa, and R Silva (2021) COVID 19 and the business management crisis: an empirical study in SMEs. *Sustainability* 13:5912
71. Kim, J. J., K. J. Elwood, F. Marquis, and S. E Chang (2017) Factors Influencing post-earthquake decisions on buildings in Christchurch, New Zealand. *Earthquake Spectra* 33:623–40
72. Vinnell, L. J., C. Orchiston, J. Becker, and D Johnston (2019) Pathways to earthquake resilience: learning from past events. *Australas J Disaster Trauma Stud.* 23
73. Nistorescu, T. and C Ploscaru (2010) Impact of economic and financial crisis in the construction industry. *Manag Mark Journal* 8
74. Becker, G. S (1964) *Human Capital: A theoretical and empirical analysis with special reference to education.* National Bureau of Economic Research, Inc
75. Fenwick, A (2012) *The value of lifeline seismic risk mitigation in Christchurch: Summary Report*, June, New Zealand Lifelines
76. Kiernan, G (2016) Repairing Kaikoura: the size, the speed, and the cost of delays[Online]. Available: <https://www.infometrics.co.nz/article/2016-11-repairing-kaikoura-size-speed-cost-delays> [Accessed]
77. Scanlon, K. and M Elsinga (2014) Policy changes affecting housing and mortgage markets: how governments in the UK and the Netherlands responded to the GFC. *J Hous Built Environ.* 29:335–60
78. Jüttner, U. and S Maklan (2011) Supply chain resilience in the global financial crisis: an empirical study. *Supply Chain Management: An International Journal* 16:246–59
79. Stevenson, J. R., J. Becker, N. Craddock-Henry, S. Johal, D. Johnston, C. Orchiston, and E Seville (2017) Economic and social reconnaissance: Kaikōura earthquake 2016. *Bull N Z Soc Earthq Eng.* 50:343–51
80. Leveson, N. G (2011) Applying systems thinking to analyze and learn from events. *Saf Sci.* 49:55–64
81. Lee, H. L., V. Padmanabhan, and S Whang (1997) The bullwhip effect in supply chains.
82. Simatupang, T. M. and R Sridharan (2008) Design for supply chain collaboration. *Bus Process Manag J.* 14:401–18
83. MBIE (2024) Improving residential construction firm resilience. Available: https://d39d3mj7qio96p.cloudfront.net/media/documents/ER88_-_Improving_residential_construction_firm_resilience_Aug24.pdf
84. Lloyd-Walker B, Walker D. (2015) Collaborative project procurement arrangements. Newtown Square, PA: Project Management Institute
85. Mosey, D (2009) Early contractor involvement in building procurement: Contracts, partnering and project management. John Wiley & Sons
86. Agyekum, K., A. S. Kukah, and J Amudjie (2022) The impact of COVID-19 on the construction industry in Ghana: The case of some selected firms. *J Eng Des Technol.* 20:222–244–244. <https://doi.org/10.1108/JEDT-11-2020-0476>
87. Herbane, B (2016) A business continuity perspective on organisational resilience. In: *IRGC resource guide on resilience.* Eds, Florin, M.-V., Linkov, I
88. Yao, E. C. A. A (2011) New Zealand's emergency liquidity measures during the global financial crisis. Reserve Bank of New Zealand. Available: https://www.rbnz.govt.nz/-/media/fae02461f6b949c387dcca06c562b87.ashx?sc_lang=en
89. Swartz, E. and D Elliott (2010) Business continuity management: a crisis management approach. Routledge
90. Chen, Z., A. W. Hammad, and M Alyami (2024) Building construction supply chain resilience under supply and demand uncertainties. *Autom Constr.* 158:105190
91. BCG (2025) Balancing cost and resilience: The new supply chain challenge. Available: <https://www.bcg.com/publications/2025/cost-resilience-new-supply-chain-challenge> [Accessed 04/12/25]
92. Deloitte (2024) Restructuring the supply base: Prioritizing a resilient, yet efficient supply chain.
93. Ding, M. J. and F Jie (2025) Mitigating the supply chain uncertainties and risks in the construction projects: case studies of Australian construction projects. *Cleaner Logist Supply Chain.* 16:100237. <https://doi.org/10.1016/j.clscn.2025.100237>
94. Mitansha, M. and R Potangaroa (2025) Exploring the interplay between individual and organisational resilience in the construction sector: A comprehensive analysis. *Sustainability* 17:7229

Publisher's Note

Springer Nature remains neutral with regard to jurisdictional claims in published maps and institutional affiliations.