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Embedding Safety in Design (SiD) within Construction Contract Law: Challenges and Opportunities for Improved Safety Outcomes

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Abstract

This paper explores the integration of Safety in Design (SiD) into construction contract law, with a focus on improving safety outcomes and risk management across New Zealand, Australia, and the United Kingdom. By examining case studies and legislation such as New Zealand's Health and Safety at Work Act (HSWA) 2015, this research identifies the challenges and opportunities in embedding SiD principles within construction contracts. Key challenges include regulatory vagueness, liability concerns, and economic barriers, while opportunities lie in proactive risk management, collaboration, and the use of emerging technologies like Building Information Modelling (BIM). The paper offers recommendations to strengthen regulatory frameworks, enforce SiD through construction contracts, and enhance safety collaboration. The findings highlight the transformative potential of SiD in shifting safety management from reactive measures to proactive risk mitigation in the design phase, aiming to improve safety and minimise legal disputes in the construction industry.

Keywords

Safety in Design (SiD); Construction contract law; Risk management; Health and Safety at Work Act (HSWA); New Zealand construction safety; Proactive safety management; Design phase risk mitigation

1. Introduction

1.1. Purpose

This paper examines how SiD is embedded within construction contract law, focusing on risk management and legal obligations. By analysing case studies from New Zealand, Australia, and the UK, the paper identifies challenges and opportunities for better integrating SiD into practice. It also provides recommendations for improving SiD through regulatory support, education, and technology.

The research also seeks to identify the challenges and opportunities in implementing SiD, with particular attention to how contracts manage risk and assign liability for safety-related issues. Additionally, the paper offers practical recommendations for better integrating SiD into construction practices, with an emphasis on regulatory support, education, and the adoption of emerging technologies. The ultimate goal is to guide industry professionals, legal experts, and policymakers in strengthening the enforcement of SiD principles, thereby enhancing safety outcomes and minimising the risk of accidents and legal conflicts within the construction industry.

1.2 Background

Traditional Safety, often referred to as Safety I, focuses on preventing accidents by identifying and eliminating hazards, controlling risks, and ensuring compliance with established safety procedures. The primary goal is to reduce the number of incidents by minimising human errors and enforcing strict adherence to rules and regulations (Hollnagel, 2014).

While Safety I focuses on preventing incidents through strict adherence to procedures, Safety II takes a more proactive approach, focusing on how systems can be designed to handle everyday operations and adapt to risks. Instead of focusing solely on what goes wrong, Safety II looks at what goes right, how work is typically carried out successfully

despite inherent risks (Dekker & Woods, 2021). It emphasises understanding everyday work practices, learning from successful outcomes, and enhancing the system's ability to adapt to changing conditions This approach values flexibility, learning, and resilience, recognising that safety is about managing the complex, dynamic nature of real-world operations(Hollnagel & Dekker, 2021).

The construction industry is inherently complex, with numerous risks that can lead to significant safety challenges(David and Hollnagel 2022). Traditionally, safety in construction has been managed during the construction phase, with risk mitigation strategies focused on site management and worker protection (Hassanain et al., 2022). In recent years, there has been a growing focus on incorporating safety considerations into the design phase. This proactive strategy involves identifying and mitigating potential hazards during the planning and design stages of a project, with the Safety II-focused goal of eliminating risks before they manifest on-site. SiD is not just becoming leading good practice; it is increasingly recognised as a legal obligation, especially within the context of construction contract law (Rajendran et al., 2013).

The construction industry in New Zealand has long been recognised as one of the most hazardous sectors, contributing significantly to occupational injuries and health issues. According to WorkSafe New Zealand (2023), the construction industry consistently accounts for a high number of workplace injuries and fatalities, with construction workers facing a 10% higher likelihood of being injured on the job compared to the average worker in other industries.

In addition to physical injuries, the construction industry is also linked to long-term health issues such as musculoskeletal disorders and respiratory problems, including silicosis caused by prolonged exposure to silica dust and other hazardous materials. A study by Bentley et al. (2021) revealed that 24% of construction workers in New Zealand reported chronic pain, which severely affected their quality of life and productivity. Incorporating SiD principles, as highlighted by Behm (2005), can significantly reduce fatalities by proactively addressing potential hazards during the design phase.

The paper by Dewlaney and Hallowell (2012) highlights that LEED-certified buildings, while promoting environmental sustainability, often involve higher injury rates due to the unique design features and construction methods required for certification, underscoring the need for enhanced safety measures.

Despite ongoing efforts to improve health and safety standards, the rate of workplace injuries and associated health outcomes in the construction sector remains concerning. The introduction of the Health and Safety at Work Act (HSWA) 2015 aimed to reduce these risks by requiring better safety management and more rigorous enforcement of safety practices. However, as noted by Lilley et al. (2020), while there has been some improvement, the construction industry still struggles with fully integrating safety practices, particularly in small to medium-sized enterprises where resources are often limited.

2. What is Safety in Design

At its core, SiD integrates safety considerations into every aspect of design. This means that architects, engineers, and designers are not only concerned with the aesthetics, functionality, and cost-effectiveness of their designs but also with ensuring that the structures they create are safe for those who will construct, maintain, and use them. By addressing safety from the outset, SiD aims to reduce the reliance on after-the-fact protective measures, which are often less effective and more costly (Gangolells et al., 2010).

The concept of SiD is supported by the hierarchy of controls, a well-established framework in occupational health and safety. This hierarchy prioritises risk elimination and substitution at the top, followed by engineering controls, administrative controls, and personal protective equipment (PPE) as the least preferred methods of risk management. The goal is to eliminate or reduce risks through thoughtful design choices, such as selecting safer

materials, designing for ease of maintenance, and ensuring that construction methods are as safe as possible (Ajslev et al., 2022).

SiD extends beyond technical and structural considerations, deeply incorporating human factors to ensure that buildings and systems are designed with the capabilities and limitations of people in mind. This approach involves creating spaces that are easy to navigate, making equipment accessible and user-friendly, and carefully considering how workers will interact with the design during construction and maintenance (Horberry, 2014). By prioritising these human elements, SiD aims to reduce the likelihood of human error, making environments safer and more intuitive for both workers and future occupants. For instance, clear signage and well-thought-out layouts can minimise confusion, while user-friendly equipment design helps prevent misuse and accidents, particularly in complex or high-pressure work settings (Furst, 2013).

Incorporating human factors into SiD also enhances collaboration and adaptability within construction projects. When designers consider how workers will engage with the design, it fosters a more inclusive approach that values input from those directly involved in the construction process. This collaboration helps identify potential safety risks early, allowing for the implementation of practical, on-the-ground solutions. Additionally, designs that take into account how people respond to unexpected situations—such as equipment failures or sudden changes in the work environment—are more likely to be resilient and adaptable. These features enable workers to operate safely even under changing conditions, ultimately leading to safer, more efficient project outcomes (Helander, 1981).

In practice, SiD requires collaboration across all phases of a project, involving not only designers but also clients, contractors, and other stakeholders. Under the HSWA, multiple Persons Conducting a Business or Undertaking (PCBUs) often have overlapping duties in the same project. To effectively implement SiD, it is essential that these PCBUs work together, coordinating their efforts to identify and mitigate risks from the design stage through to construction and beyond (WorkSafe New Zealand, 2019).

3. International focus of SiD

SiD is now a critical component of construction practices worldwide, driven by the need to integrate safety considerations from the earliest stages of project planning. In countries like Australia and the United Kingdom, robust legal frameworks have been developed to ensure that SiD is not an advisory practice but a mandatory element of the construction process. These regulations embed safety into the legal responsibilities of all project stakeholders, ensuring that risks are mitigated before construction begins (Hare et al., 2006).

The United Kingdom's Construction (Design and Management) Regulations 2015 (CDM Regulations) are among the most comprehensive globally, mandating that safety be considered at every stage of a construction project. These regulations assign specific responsibilities to clients, designers, and contractors to manage and coordinate safety risks, ensuring that SiD is a fundamental aspect of construction. For designers, this means incorporating safety solutions into their plans to protect those involved in the construction, maintenance, and use of the building (Winch & Carr, 2001). The CDM Regulations emphasise the duties of these key players throughout the project lifecycle, from design through to construction and use.

Key provisions of the CDM Regulations include:

- **Regulation 9**: Duties of designers to eliminate or reduce risks during the design phase.
- **Regulation 11**: Duties of the principal designer to plan, manage, and monitor the pre-construction phase, coordinating health and safety matters.

These regulations are legally enforceable, with severe penalties for non-compliance. Breaches can lead to enforcement actions by the Health and Safety Executive (HSE),

including fines and imprisonment, ensuring that safety remains a priority throughout the construction process. These penalties are comparable to those under New Zealand's Health and Safety at Work Act 2015 (HSWA), highlighting the global importance of stringent safety regulations in the construction industry.

Australia's Work Health and Safety Act 2011 (WHS Act) similarly requires designers to eliminate or minimise risks associated with construction projects. The WHS Act places a duty on designers to consider the safety of workers and the public throughout the entire lifecycle of a building or infrastructure. The act's stringent penalties for non-compliance highlight the importance of SiD in Australian construction law, reinforcing the need for safety to be integrated into every aspect of project design (Pirzadeh et al., 2020).

4. Key Legislation in New Zealand

The Construction Contracts Act 2002 is fundamental to the legal and contractual framework of construction projects in New Zealand. This Act sets out the rights and obligations of the parties involved in construction contracts, including provisions related to payment, dispute resolution, and the enforcement of safety standards. The Act promotes transparency in contracts and ensures that safety obligations, such as those mandated by the HSW Act and the Building Act, are embedded into the agreements between contractors, clients, and consultants. Dispute resolution mechanisms, including adjudication, are provided for within the Act (Construction Contracts Act 2002 (NZ)), allowing parties to resolve conflicts related to safety compliance or other issues in a timely and cost-effective manner. Contracts play a crucial role in allocating risk, establishing timelines, and ensuring that safety protocols are adhered to. By making safety obligations legally binding and enforceable, these contracts are key to maintaining high safety standards in an industry where risk management is of importance.

4.1 Health and Safety at Work Act 2015 (HSW Act)

The Health and Safety at Work Act 2015 is one of the cornerstones of New Zealand's construction law. It imposes obligations on all PCBUs, including designers, contractors, and construction firms, to eliminate or minimise health and safety risks "so far as is reasonably practicable." This legislation places a significant focus on SiD, ensuring that safety is embedded throughout the project lifecycle—from the design phase through to construction, operation, maintenance, and eventual demolition. The Act mandates that safety be considered at every stage, with legal penalties for non-compliance, including fines or prosecutions for breaches that result in injury or death.

Section 39 - Duties of Designers of Plant, Substances, or Structures

This section imposes a duty on designers to ensure, as far as reasonably practicable, that the plant, substance, or structure they design is without risks to health and safety when it is used for its intended purpose. This duty extends to considering potential risks during the design phase, making this section particularly relevant to SiD.

Section 40 - Duties of PCBUs (Persons Conducting a Business or Undertaking) that Design Plant, Substances, or Structures

Section 40 builds on the responsibilities outlined in Section 39 by emphasising the role of PCBUs who design plant, substances, or structures. It requires them to provide information to those who will use or manage the plant, substance, or structure, ensuring they understand how to do so safely.

Section 22 - Meaning of Reasonably Practicable

This section is crucial as it defines what is meant by "reasonably practicable" in the context of health and safety duties under the Act, including those related to SiD. It outlines the factors that must be considered in determining what is reasonably practicable in ensuring

health and safety, which includes the likelihood and severity of harm, and the availability and suitability of ways to eliminate or minimise the risks.

The impact of overlapping PCBUs in construction contracts is a critical consideration in ensuring effective SiD. When multiple PCBUs are involved in a construction project, such as designers, contractors, subcontractors, and clients, each has a duty under the HSWA Act to ensure, so far as is reasonably practicable, the safety of workers and others affected by the work.

These sections collectively establish the legal foundation for SiD within the HSWA framework. Designers and PCBUs are required to consider health and safety risks from the very beginning of the design process and to communicate these risks effectively to those who will interact with their designs.

4.2 Building Act 2004

The Building Act 2004 governs all building work in New Zealand, ensuring that structures are designed and constructed to be safe, healthy, and durable. The Act establishes the New Zealand Building Code, which sets out the performance standards for buildings. These standards include structural integrity, fire safety, access, and ventilation—each a critical element in ensuring the safety of both construction workers and future occupants of the building. Compliance with the Building Code is enforced through the building consent process, managed by local councils, which must review and approve building designs before construction can proceed. The Code's standards are legally binding and must be adhered to throughout the construction process.

Key provisions of the Building Code include:

- Structural Safety: The Building Code sets standards for the structural integrity of buildings, ensuring that they are capable of withstanding loads and stresses throughout their lifecycle. This includes provisions for earthquake resistance, wind loads, and other environmental factors that could impact the safety of the building.
- Fire Safety: The Code also includes specific requirements for fire safety, such as the use of fireproof materials, proper placement of fire exits, and the installation of fire suppression systems. These standards are vital in mitigating risks associated with fire hazards during both construction and occupancy.
- Access and Egress: Safe access and egress are critical components of the Building Code. The standards ensure that buildings are designed with adequate and safe entry and exit points, including provisions for accessibility in accordance with the Building Act and human rights legislation.

Designers are legally required to ensure that their designs meet the standards outlined in the Building Code, and local councils enforce compliance through the building consent process. Failure to comply with these standards can result in penalties, project delays, and increased liability for design professionals and contractors.

4.2.1 Role of Licensed Building Practitioners

The Building Act also establishes a licensing regime for building practitioners, as outlined in the Week 2 slides (Slide 60). Licensed Building Practitioners (LBPs) are required to carry out or supervise restricted building work, which includes residential design, construction, or alteration work that affects the primary structure, weathertightness, or certain fire safety designs of a home. This licensing regime ensures that only qualified professionals are involved in critical aspects of construction, further safeguarding the safety and quality of building work.

4.3 Standard Form Contracts and Industry Standards

In addition to legislative acts, New Zealand's construction industry frequently relies on standard form contracts that provide a structured framework for managing the obligations of all parties involved in a project. These contracts, often based on industry-recognised standards, ensure that safety, quality, and legal compliance are upheld throughout the construction process.

4.3.1 NZS 3910:2023 and NZS 3916:2013

The NZS 3910:2023 and NZS 3916:2013 standards are widely used in New Zealand's construction industry. They provide a contractual framework that defines the responsibilities of contractors, subcontractors, clients, and consultants. These standards integrate legal requirements for safety, ensuring that obligations under the HSW Act and the Building Code are adhered to within the contractual terms. NZS 3910:2013 is commonly used for traditional construction projects, while NZS 3916:2013 is applied to design and build contracts, where the contractor is responsible for both the design and construction phases. These contracts ensure that safety considerations are maintained consistently across both phases.

In NZS 3910:2023 the following sections are relevant:

> ***Section 5.2: Design Responsibilities***
>
> This section outlines the Contractor's responsibility for the design of parts of the Contract Works as stated in the Specific Conditions. It includes the necessary investigation, design calculation, and ensuring that design work is carried out with skill, care, and diligence.
>
> ***Section 5.8: Protection of Persons and Property***
>
> This section covers the Contractor's obligations regarding safety on-site, such as maintaining a safe working environment, identifying and managing risks to health and safety, and having procedures for dealing with emergencies
>
> ***Section 5.9: Site-Specific Safety Plan***
>
> This section requires the Contractor to prepare and submit a Site-specific safety plan, addressing how it will meet its safety obligations under section 5.8
>
> ***Section 8.6: Contractor-Arranged Professional Indemnity Insurance***
>
> This section deals with professional indemnity insurance for the Contractor's design, which includes coverage for liabilities arising from faulty design.

4.3.2 NZIA Standard Form Contracts

The New Zealand Institute of Architects (NZIA) produces several standard form contracts, such as the NZIA SCC (New Zealand Institute of Architects Agreement of Architect Services) 2018 (Standard Construction Contract) and the Agreement of Architect Services (AAS 2018). These contracts are specifically tailored to the roles of architects and design professionals, ensuring that their legal obligations regarding SiD are clearly outlined. They mandate that architects not only integrate safety considerations into their designs but also supervise construction to ensure that safety measures are implemented effectively.

4.3.3 Conditions of Contract for Consultancy Services (CCCS)

The Conditions of Contract for Consultancy Services (CCCS)(Association of Consulting Engineers New Zealand Conditions of Contract for Consultancy) is a standard contract used for engaging consultants, including engineers and other professionals, in construction projects. The CCCS establishes the legal responsibilities of consultants to ensure that their designs are compliant with safety standards. It also outlines the standard of care required from consultants, including their duty to mitigate risks through design and to advise clients on safety matters. It also notes that notes that consultants are required to perform their

duties with the level of skill, care, and diligence expected of a competent professional in their field. This often includes anticipating potential risks during the design process and incorporating safety measures to mitigate those risks. The standards also note that consultants are also responsible for advising clients on safety-related matters that may arise from their design. This includes highlighting any safety concerns and suggesting measures to ensure compliance with safety standards. Failure to meet these standards can result in liability for damages if negligence leads to safety breaches or project delays.

4.4. Risk Allocation and Implications of Multi-PCBU Responsibilities

Risk allocation in contracts involves assigning responsibility for various risks associated with a project to different parties. This can include financial risks, liability for safety incidents, and the responsibility for implementing safety measures during the design and construction phases.

Risk allocation in contracts is a critical aspect of managing construction projects, particularly when it comes to ensuring safety through SiD. Properly allocating risk ensures that each party involved in a project, such as designers, contractors, and clients, understands their responsibilities for managing safety risks and is equipped to take the necessary actions to mitigate those risks (Nasirzadeh et al., 2014).

Effective risk allocation in contracts supports SiD by ensuring that the responsibilities for identifying and mitigating these risks are clearly assigned and that the necessary resources and authority are provided to the responsible parties (Smith et al., 2014). The New Zealand construction law framework clearly delineates the responsibilities of various stakeholders involved in a project.

The New Zealand construction law framework clearly delineates the responsibilities of various stakeholders involved in a project(S. O. Ajayi et al. 2022).

- **Clients/Project Owners**: Clients or project owners also play a critical role in ensuring safety. Although they may not be directly involved in the design or construction phases, they are legally obligated under the HSW Act to verify that the professionals they engage are fulfilling their safety obligations. This includes commissioning safety audits, reviewing designs for compliance, and ensuring that safety remains a priority throughout the project lifecycle.
- **Design Professionals**: Architects, engineers, and other design professionals are required to apply SiD principles from the outset of a project. Their designs must comply with the HSW Act, Building Code, and the contractual safety obligations outlined in standard form contracts. They are also responsible for collaborating with contractors to ensure that safety measures are maintained throughout the construction process.
- **Contractors**: Contractors are responsible for executing the design in compliance with safety standards and ensuring that any modifications to the design do not introduce new risks. They must conduct regular safety audits, adhere to SiD principles, and ensure that all construction work meets the performance standards of the Building Code.

When multiple PCBUs are involved in a construction project, such as designers, contractors, subcontractors, and clients, each has a duty under the HSWA to ensure, so far as is reasonably practicable, the safety of workers and others affected by the work. Construction contracts must clearly delineate these responsibilities to prevent gaps in safety management. Contracts should include a comprehensive risk management plan that identifies and addresses potential overlaps and gaps in safety responsibilities, ensuring that all aspects of safety are covered without duplication of effort (Gadde & Dubois, 2010; Berglund et al., 2023).

4.5 Dispute Resolution and Enforcement

New Zealand's construction contract law provides robust mechanisms for dispute resolution, particularly through the Construction Contracts Act 2002. Disputes related to safety compliance, project delays, or breaches of contract can be resolved through adjudication or mediation, ensuring that conflicts are addressed quickly and efficiently. These mechanisms help prevent prolonged legal battles and ensure that safety standards are upheld. However, due to the effectiveness of these dispute resolution mechanisms, it is relatively uncommon for safety-related disputes to escalate to higher courts, making case law in this area less readily available.

However, resolving disputes over Safety-II aspects in construction contracts presents significant challenges. Unlike Safety-I, which relies on clear, prescriptive guidelines that are easier to regulate and enforce, Safety-II's flexible and adaptive approach to managing safety can be more subjective. Critical reviews of Safety-II argue that its focus on resilience and variability can lead to ambiguity in determining compliance, making it difficult for regulators to consistently interpret and apply the principles. This lack of clear-cut standards may result in conflicting interpretations of safety obligations among project stakeholders, complicating dispute resolution processes and potentially leading to protracted legal battles. As a result, Safety-II's innovative approach may face resistance from regulatory bodies accustomed to the more rigid frameworks of Safety-I, further complicating its integration into legal and contractual frameworks (Sarvari et al., 2024).

5. Challenges of Implementing SiD in New Zealand

While the benefits of SiD are clear, there are several challenges to its effective implementation in construction projects. Construction is a traditionally risk-averse industry(E. Bluff, 2014), and many stakeholders may be reluctant to embrace new practices that require a shift in mindset and processes. Overcoming this resistance involves demonstrating the tangible benefits of SiD through case studies, industry reports, and the sharing of best practices. Regulatory bodies can also play a role by providing clear guidance and incentives for adopting SiD. Implementing SiD in New Zealand presents several challenges that are specific to the local regulatory environment and industry practices.

5.1 Vagueness and Complexity of Regulatory Requirements

The HSWA emphasises proactive risk management through SiD, but one major challenge is the vagueness of the HSWA regarding what constitutes adequate SiD practices. As Guo et al. (2021) highlight, the lack of detailed guidelines and case studies leaves many industry professionals uncertain about how to effectively implement SiD to meet their legal obligations. This uncertainty can lead to inconsistent application of SiD across different projects.

5.2 Legal and Liability Concerns

Designers and other stakeholders often hesitate to fully engage in SiD due to concerns about increased liability(T. M. Toole, 2005). This issue is exacerbated by traditional construction procurement methods, such as design-bid-build, which separate the design and construction phases, placing the responsibility for safety predominantly on the constructor. Behm (2005) notes that this separation can limit the influence of designers on safety outcomes, as they might avoid incorporating safety measures into their designs due to fears of legal repercussions.

5.3 Economic and Practical Challenges

A key challenge with integrating SiD is the concern over increased upfront costs. Both designers and clients may worry that implementing SiD will raise project expenses and extend timelines. While SiD does lead to safer outcomes, as Dewlaney and Hallowell (2012) highlight, it can also increase initial costs due to the need for more comprehensive safety measures, detailed planning, and early involvement of multiple stakeholders. These

economic concerns are particularly challenging for smaller projects or companies with limited resources, where budgets and timelines are more constrained.

5.4 Lack of Knowledge or expertise

Another significant challenge is the lack of knowledge and expertise in SiD among designers and contractors. Despite the growing recognition of SiD as a critical aspect of construction safety, many professionals in the industry lack the training or experience necessary to effectively implement these principles. This knowledge gap can lead to inadequate risk assessments, poor design choices, and ultimately, safety failures. Addressing this challenge requires a concerted effort to improve education and training in SiD, both at the academic level and through professional development programs.

5.5 Lack of Collaboration Among PCBUs

In projects involving multiple PCBUs, overlapping responsibilities for health and safety can create complexity in defining who is accountable for specific safety obligations. Construction contracts must clearly delineate these responsibilities to prevent gaps in safety management.

Effective SiD requires collaboration among all PCBUs. Guo et al. (2021) emphasise the need for better coordination among designers, contractors, and other stakeholders to ensure that safety is integrated into the design phase and maintained throughout the project. Without this collaboration, critical safety issues may be overlooked, and the benefits of SiD may not be fully realised (L. E. Gadde and A. Dubois, 2010).

When multiple PCBUs are involved, there is a risk of either overlapping efforts (leading to inefficiencies) or gaps in safety management (leading to hazards being overlooked). Contracts should include a comprehensive risk management plan that identifies and addresses potential overlaps and gaps in safety responsibilities, ensuring that all aspects of safety are covered without duplication of effort (L. Berglund et al, 2023).

5.6 Challenges with Building Code

The Building Code provides a baseline for safety and durability, but it only sets out the minimum requirements. Compliance with the Building Code is legally mandated, yet simply meeting these minimum standards may not always be sufficient to address all potential safety risks in complex or high-risk projects. SiD principles often require going beyond these minimum standards to proactively eliminate or mitigate risks at the design stage, which can be challenging when the regulatory focus is primarily on compliance rather than innovation.

The Code also primarily focuses on physical aspects like structural safety, fire safety, and access/egress. However, SiD encompasses broader considerations, such as ergonomics, operational safety, and the long-term health impacts of design choices (e.g., exposure to hazardous materials like silica dust). These broader safety considerations are not always fully addressed within the scope of the Building Code, leaving gaps that must be filled by designers who are committed to integrating comprehensive SiD practices.

Designers are legally required to ensure that their designs comply with the Building Code, and failure to do so can result in penalties, project delays, and increased liability. This risk of liability can make designers and contractors more risk-averse, potentially leading them to prioritise compliance with the Code over the incorporation of broader SiD principles that might introduce new approaches or untested innovations. This can limit the effectiveness of SiD, especially in projects where more advanced safety measures are needed but are not explicitly required by the Code.

6. Role of Construction Contracts in Enforcing SiD

Typically, construction contracts include specific clauses mandating compliance with applicable safety regulations and standards, such as the HSWA. These clauses establish safety as a non-negotiable requirement, with legal consequences for non-compliance.

One of the critical functions of construction contracts in enforcing SiD is the allocation of risk. Contracts typically specify how risks associated with design flaws or safety failures will be managed and who will bear the financial and legal responsibility if these risks materialise. For example, an indemnity clause may require the designer to compensate the client if a safety-related issue in the design leads to an accident or damage. Such clauses incentivise all parties to prioritise safety during the design phase, as failing to do so can result in significant financial and legal liabilities.

To highlight the challenges in construction contracts with respect to enforcing SiD, it's important to recognize that while safety is a clear requirement in many contractual clauses, they often fall short of promoting a proactive, design-based approach to safety. The sections of NZS 3910:2023 do reference safety responsibilities, but they are not fully aligned with the comprehensive, preventative philosophy of SiD, which emphasises risk elimination during the design phase. Here are some key challenges:

Section 5.2: Design Responsibilities – This section focuses on ensuring designs are executed with "skill, care, and diligence," but does not mandate proactively addressing safety risks during the design phase. The challenge is that it does not enforce the responsibility to "engineer out" hazards before construction begins, which is key to SiD.

Section 5.8: Protection of Persons and Property – This section emphasises safety during construction, but not in the design phase. The challenge is that it addresses safety reactively, falling short of requiring proactive risk elimination through design.

Section 5.9: Site-Specific Safety Plan – This section focuses on managing safety on-site rather than embedding safety into the design. The challenge is that it tackles risks after the design is completed, rather than reducing them through design choices.

Section 8.6: Professional Indemnity Insurance – While this section covers liability for design failures, it is reactive, providing coverage after issues arise. The challenge is that it manages risk post-failure rather than encouraging safety through proactive design measures.

The overarching challenge is that these clauses are primarily reactive—they focus on managing safety *after* risks emerge, whether during construction or after an incident. In contrast, *SiD* requires that safety risks are identified and engineered out early, during the design phase, thus reducing the likelihood of safety issues arising during construction or use. Although NZS 3910:2023 provides mechanisms to address safety and manage risks, it does not go far enough in enforcing proactive safety management through SiD principles, which could make the built environment inherently safer. This gap illustrates how contracts, while effective in managing safety, need stronger provisions to enforce SiD as a foundational design requirement.

6.1 Safety I and Safety II in the development of contracts

The interplay between Safety-I and Safety-II is particularly interesting in SiD for construction contracts because it highlights the evolving nature of safety management in complex, high-risk environments like construction (J. B. Martins et al, 2022).

Safety-I oriented contracts would likely include strict clauses that mandate adherence to safety regulations, require exhaustive risk assessments, and impose penalties for non-compliance. This approach reinforces a defensive stance where safety is about preventing things from going wrong.

Contracts aligned with Safety-II might include provisions for continuous monitoring and feedback loops, allowing for adaptive risk management as the project progresses. This approach would focus less on rigid compliance and more on creating a culture of safety where all stakeholders are empowered to identify and address safety issues dynamically as they arise.

6.2 Risk Allocation and SiD

In construction contracts, risk allocation refers to how responsibilities and liabilities for managing risks are distributed among the various parties involved in a project. Contracts will typically include clauses that outline how each party is expected to discharge their duties related to safety and risk management. This helps clarify who is responsible for specific risks and how those risks are to be managed, controlled, or shared (Varghese and Koshy, 2023). Designers are often required to perform risk assessments during the design phase, identifying potential hazards and incorporating solutions to mitigate these risks. Contractors are responsible for implementing these safety measures on-site (Gambatese and Hinze, 1999), while clients must oversee and ensure that all parties comply with the safety requirements set out in the contract.

Contracts may also include specific provisions that address the potential for safety-related failures. For example, a contract might require the designer to carry out detailed risk assessments and obtain third-party safety certifications before the design is finalised. These measures help to mitigate the risk of design-related accidents and reduce the likelihood of costly legal disputes (Dentons Kensington Swan, 2022).

6.3 Legal Liability

The overlapping duties of PCBUs can lead to complex legal liability issues if a safety incident occurs. Contracts must address how liability will be apportioned among the PCBUs, especially in cases where multiple parties contribute to a safety failure. Indemnity clauses and insurance provisions are common mechanisms used to manage this risk, ensuring that financial responsibility is clearly defined.

Indemnity clauses typically require one party (often the designer) to compensate the other party (usually the client or contractor) for any losses incurred due to safety defects in the design. This shifts the financial risk associated with design failures onto the party best positioned to manage it, thereby incentivising them to take all necessary precautions during the design phase.

Furthermore, the legal implications of SiD in construction contracts are significant. Failure to comply with safety obligations can lead to breaches of contract, resulting in legal disputes, financial penalties, and even project termination.

The literature highlights that the successful integration of SiD into construction contracts not only enhances safety outcomes but also provides a clear legal framework for managing risks and resolving disputes. This intersection of SiD and contract law is essential for promoting a safety-first approach in the construction industry, where legal accountability drives better safety practices.

6.4 Regulatory Compliance

Regulatory compliance becomes more challenging with overlapping PCBUs, as each must meet their legal obligations under the HSWA. Contracts should explicitly require that all PCBUs adhere to relevant safety regulations and standards. Additionally, they should include mechanisms for monitoring and enforcing compliance, such as regular safety audits and inspections.

By embedding SiD requirements into construction contracts, stakeholders can ensure that safety considerations are systematically integrated into every stage of a project. This approach not only helps prevent accidents and protects workers and the public but also provides a clear legal framework for managing safety-related disputes.

Overall, construction contracts serve as the legal backbone for enforcing SiD, prioritising safety from the design phase and ensuring that the interests of all parties are protected. This contractual enforcement of SiD aligns with regulatory requirements across jurisdictions, driving better safety practices and providing a clear mechanism for resolving safety-related issues when they arise. By clearly defining who is responsible for safety-related risks, contracts encourage all parties to prioritise safety during the design phase and ensure that they have appropriate measures in place to manage these risks effectively. This not only helps to prevent accidents but also provides a clear legal framework for resolving disputes if safety failures occur.

The literature highlights that the successful integration of SiD into construction contracts not only enhances safety outcomes but also provides a clear legal framework for managing risks and resolving disputes. This intersection of SiD and contract law is essential for promoting a safety-first approach in the construction industry, where legal accountability drives better safety practices (Hallowell and Gambatese, 2009).

7. Successful implementation of SiD

While the following examples are drawn from projects from around the world and New Zealand, they offer valuable insights into the successful integration of SiD principles through construction contracts. These case studies demonstrate how robust contractual frameworks, when aligned with safety regulations, can lead to outstanding safety outcomes, even in complex and high-pressure environments. They also provide practical examples of how SiD can be enforced through legal obligations, offering potential lessons for the application of similar approaches in New Zealand. These examples underline the importance of integrating SiD from the design phase through to project completion, ensuring that safety remains a priority throughout the entire lifecycle of a construction project.

7.1 London Olympics 2012 (UK)

The construction of the London 2012 Olympic venues stands as a landmark example of SiD successfully integrated through construction contracts. This massive project involved the development of multiple venues and infrastructure, including the Olympic Stadium, Aquatics Centre, and the Olympic Village, all within a tight timeframe and under intense public scrutiny.

7.1.1 Contractual Enforcement of SiD:

The project contracts were governed by the Construction (Design and Management) Regulations 2007 (CDM Regulations), which were in place at the time and required that safety be prioritised from the design phase through to project completion. The Olympic Delivery Authority (ODA) played a pivotal role in enforcing these regulations, ensuring that SiD principles were embedded into every phase of the project (Health and Safety Executive, 2012).

The contracts included specific clauses mandating compliance with safety standards, regular risk assessments, and the appointment of a CDM coordinator to oversee health and safety (Health and Safety Executive, 2012). Furthermore, the integration of SiD was not limited to the initial construction but extended into the legacy transformation of the Olympic Park. Contracts explicitly required the use of health and safety files, ensuring that these documents were not only created but actively used throughout the project's lifecycle. According to the research reports, the continuity of safety management during the transition to legacy use was ensured through detailed health and safety files and ongoing collaboration between designers and contractors (Health and Safety Executive, 2011).

7.1.2 Outcome

The London 2012 Olympics achieved an exemplary safety record (Alruqi and Hallowell, 2019), with accident rates significantly lower than industry norms. The integration of SiD into

construction contracts was crucial to this success, as it ensured that safety was a contractual obligation, rigorously enforced throughout the project's lifecycle. The legacy transformation phase further demonstrated the effectiveness of these measures, with innovative safety solutions being implemented to facilitate the safe dismantling and repurposing of venues. This case clearly demonstrates how robust contractual obligations, combined with SiD principles, can lead to outstanding safety outcomes even in large-scale, complex projects.

8. What can we learn from New Zealand case law?

Given the nature of private arbitration and mediation often used in resolving construction disputes, there is limited case law available that directly addresses the interpretation and enforcement of SiD obligations under the HSWA. This scarcity of publicly accessible legal precedents means that industry professionals have fewer judicial examples to draw from when seeking clarity on how to meet their SiD responsibilities.

The HSWA requires that designers and other duty holders eliminate or minimise risks as far as is reasonably practicable, but the lack of judicial decisions makes it difficult to identify what constitutes adequate compliance. As a result, much of the interpretation of SiD practices remains within the context of industry norms and guidance documents rather than being firmly established through legal rulings. In the absence of extensive case law, contracts play a critical role in defining and enforcing SiD responsibilities.

Although case law is scarce, the few available legal precedents offer important lessons for industry professionals. One key takeaway is the necessity of embedding SiD obligations clearly within construction contracts. Cases such as *New Zealand Transport Agency (*New Zealand Transport Agency v Hutt City Council, [2022] NZEnvC 161) *and KiwiRail Holdings Ltd v Auckland Council [2020*] (KiwiRail Holdings Ltd v Auckland Council. New Zealand Environment Court,[2022] NZEnvC 149) demonstrate that ambiguities in contractual safety provisions can lead to significant disputes, particularly in large infrastructure projects where public safety is paramount. The lack of detailed SiD clauses in these contracts contributed to legal challenges, suggesting that construction contracts need to be more explicit in defining safety design responsibilities.

They suggest that when disputes do reach the courts, judges focus on whether all parties involved in a project have taken reasonable steps to identify and mitigate risks from the design phase onward. This underscores the importance of thorough documentation and a clear contractual framework to support SiD compliance, particularly in a legal environment where formal precedents are limited.

Another lesson is the importance of considering environmental and community safety as integral components of SiD, as seen in *Eyre Community Environmental Safety Society Inc v Canterbury Regional Council [2016] (* Eyre Community Environmental Safety Society Incorporated v Canterbury Regional Council & Waimakariri District Council, [2016] NZEnvC 178).

This case illustrates the gaps in the Construction Contracts Act, which primarily focuses on commercial aspects of construction without fully addressing the broader safety implications. The failure to incorporate comprehensive SiD measures, including environmental safety, led to community opposition and legal action, highlighting the need for contracts to cover a wider scope of safety considerations.

The case of *Queenstown Lakes District Council v Charterhall Trustees Ltd [2009](*Queenstown Lakes District Council v Charterhall Trustees Ltd, [2009] NZCA 374*)* emphasises the crucial role of rigorous design assessments and the enforcement of SiD during the design and consent phases. The Construction Contracts Act did not adequately enforce design responsibilities, resulting in safety oversights that could have been mitigated with stronger contractual obligations.

Overall, these cases reveal shortcomings in the Construction Contracts Act, particularly its limited focus on SiD. To prevent safety-related legal challenges and enhance project

outcomes, there is a clear need for legislative reform. Construction contracts must explicitly incorporate SiD principles, ensuring that safety is prioritised from the design phase through to project completion. By doing so, the construction industry can better protect public safety, reduce legal risks, and achieve more successful project outcomes.

9. Potential Solutions in Implementing SiD

Building on the challenges identified and the insights gained from this research, several solutions and recommendations can be put forward to enhance the integration of SiD into construction contract law and improve overall safety outcomes in the industry.

9.1 Strengthening Regulatory Frameworks

To address the vagueness and complexity of current regulations, policymakers should focus on updating and strengthening the existing regulatory frameworks. This involves making SiD an explicit legal obligation in all construction projects by revising legislation to mandate its implementation. Clear, detailed guidance should accompany these regulations to help industry professionals understand and apply SiD principles effectively. The 'Health and Safety by Design' by WorkSafe New Zealand, 2018 guidelines serve as a foundational framework for enhancing regulatory requirements. Expanding these guidelines to incorporate detailed case studies and practical examples would further support industry professionals in the effective implementation of SiD principles.

9.2 Incorporating SiD into Standard Form Contracts

Incorporating SiD requirements into standard form contracts is essential for ensuring consistent application across the industry. Industry bodies should work to embed SiD principles into widely used contracts, such as those provided by the New Zealand Institute of Architects (NZIA) and similar bodies in other jurisdictions. These contracts should include specific clauses that mandate compliance with safety regulations, require comprehensive risk assessments during the design phase, and clearly allocate liability for safety-related failures. By standardising these requirements, the industry can ensure that safety considerations are integral to every project (A. R. Atkinson and R. Westall,2010).

9.3 Involving Health and Safety Experts Early

A proactive approach to safety requires the early involvement of health and safety experts in the design and planning stages of construction projects. These experts should collaborate closely with designers and engineers to identify potential risks and ensure that safety is embedded into every aspect of the project from the outset. Construction contracts should include clauses that require the involvement of these professionals early in the process, guiding and supporting the implementation of SiD practices. This early integration can prevent costly redesigns and safety failures later in the project (R. Hasan et al, 2003).

9.4 Promoting Collaboration and Knowledge Sharing

Effective SiD implementation depends on strong collaboration between all stakeholders involved in a project, including designers, contractors, clients, and regulatory bodies. The construction industry should encourage greater collaboration through integrated project delivery methods and platforms that facilitate the sharing of best practices and successful case studies. Industry forums, conferences, and digital platforms can be utilised to promote knowledge sharing and raise the overall standard of SiD (H. Lingard et al, 2018).

CHASNZ (Construction Health and Safety New Zealand) is dedicated to fostering knowledge sharing and collaboration across the construction industry. They provide platforms and initiatives that bring together industry professionals, safety experts, and stakeholders to exchange ideas, share best practices, and collectively improve safety outcomes (Galvin and Donnelly ,2022).

CHASNZ facilitates collaboration through industry forums, workshops, and conferences, where participants can learn from each other's experiences and discuss innovative

approaches to SiD and other critical safety issues. By promoting open communication and joint problem-solving, CHASNZ helps to break down silos within the industry, encouraging a more integrated approach to safety management.

9.5 Leveraging Emerging Technologies

Emerging technologies, such as Building Information Modelling (BIM), have the potential to significantly enhance SiD practices. BIM allows for the visualisation and simulation of construction projects during the design phase, enabling designers to identify and mitigate safety risks more effectively (Ibrahim et al, 2022). Integrating BIM with SiD can lead to more accurate risk assessments, better communication among stakeholders, and improved safety outcomes. Future research and development should focus on exploring the potential of BIM and other digital tools in supporting SiD and integrating these technologies into construction contracts (Akram et al, 2022).

9.6 Finding harmony in Safety-I and Safety-II Approaches

Safety-I and Safety-II provide complementary perspectives that can enrich SiD in construction contracts. While Safety-I ensures that designs meet established safety standards and eliminate known risks, Safety-II complements this by fostering an environment where safety is maintained even when unexpected challenges occur. Contracts that integrate both approaches can create a robust safety framework that not only prevents accidents but also equips the project to handle variability and change effectively.

Safety-II's emphasis on adaptability and resilience can drive greater collaboration among project stakeholders. Contracts that incorporate Safety-II principles might encourage ongoing communication and cooperation, ensuring that safety is maintained even as project conditions evolve. This can lead to a more holistic approach to safety that goes beyond compliance and encourages continuous improvement (Bastan et al, 2018).

From a legal perspective, integrating Safety-II into contracts introduces new considerations around liability and risk management. It challenges traditional notions of responsibility, suggesting that safety is not just about avoiding harm but about ensuring successful outcomes through adaptive design and management practices. This can make contracts more dynamic and responsive to real-world conditions, potentially leading to safer, more resilient construction projects.

10. Conclusion

This paper has researched into the critical role that SiD plays within the framework of construction contract law, highlighting how SiD principles are embedded in contractual obligations and enforced through legal frameworks in various jurisdictions, including New Zealand, Australia, and the United Kingdom. By analysing regulatory environments and case studies, this research has underscored the importance of integrating SiD into construction practices to ensure that safety is a primary consideration from the very beginning of a project.

One of the key findings from this research is the necessity of embedding SiD obligations clearly within construction contracts. The cases analysed, such as those involving the New Zealand Transport Agency and KiwiRail Holdings Ltd, demonstrate that ambiguities in contractual safety provisions can lead to significant disputes, particularly in large infrastructure projects where public safety is paramount. These cases reveal that the lack of detailed SiD clauses in contracts can contribute to legal challenges, suggesting that construction contracts need to be more explicit in defining safety design responsibilities.

Moreover, the international example from the London Olympics, illustrates how robust contractual frameworks, when aligned with stringent safety regulations, can lead to excellent safety outcomes. These case studies demonstrate the effectiveness of integrating SiD into every phase of a project, from design to completion, ensuring that safety remains a priority throughout the lifecycle of a construction project.

SiD represents a transformative approach to construction safety, shifting the focus from reactive measures taken after accidents occur to proactive risk management embedded within the design phase of projects. HSWA has been pivotal in making SiD a statutory requirement in New Zealand, yet the industry faces significant challenges in fully realising the potential of SiD. These challenges are multifaceted, encompassing regulatory ambiguities, a lack of expertise among industry professionals, economic concerns, and resistance to change within the traditionally risk-averse construction sector.

The research also highlights the shortcomings of the Construction Contracts Act in New Zealand, particularly its limited focus on SiD. To prevent safety-related legal challenges and enhance project outcomes, there is a clear need for legislative reform. The Act currently focuses more on commercial aspects of construction, often leaving gaps in safety management. By explicitly incorporating SiD principles into the Construction Contracts Act, the construction industry can better protect public safety, reduce legal risks, and achieve more successful project outcomes.

This paper has identified several challenges in implementing SiD, including the vagueness of regulatory requirements, legal and liability concerns, economic and practical challenges, and the need for collaboration among multiple Persons Conducting a Business or Undertaking (PCBUs). These challenges highlight the importance of clear guidance, strong collaboration, and the early involvement of health and safety experts in the design and planning stages of construction projects.

In light of these findings, the paper offers several practical recommendations to enhance the integration of SiD into construction practices. These include strengthening regulatory frameworks, incorporating SiD requirements into standard form contracts, promoting collaboration and knowledge sharing among industry stakeholders, and leveraging emerging technologies such as Building Information Modelling (BIM) to support SiD practices.

The ultimate goal of this research is to encourage industry professionals, legal experts, and policymakers to rigorously adopt and enforce SiD principles, leading to improved safety outcomes and a reduction in accidents and legal disputes within the construction industry.

By embedding safety considerations into the design phase, construction projects can achieve higher safety standards, protect workers and the public, and ensure the long-term success and sustainability of the built environment. As the industry continues to evolve, SiD will become increasingly vital in ensuring that safety is integrated into every aspect of construction, from design to completion. The future of SiD depends on the collective efforts of all stakeholders to prioritise safety, safeguard workers, and create a safer built environment for everyone.

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