International Journal of Technology 12(5) 946-955 (2021)
Received August 2021 / Revised October 2021 / Accepted November 2021

International Journal of Technology

http://ijtech.eng.ui.ac.id

Green Building Practice in the New Zealand Construction Industry: Drivers and Limitations

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Abstract. Green Star NZ is New Zealand's primary rating system that determines and assesses how environmentally friendly non-residential buildings are. New Zealand portrays itself as a clean and green nation; however, its uptake of the Green Star NZ assessment tool has been slow. This research examines the current strengths and limitations of the New Zealand green new construction industry using primary data collected and analyzed from semi-structured interviews. The results fundamentally demonstrate a limited understanding of best green building practices and Green Star NZ on behalf of New Zealand's commercial construction industry. The research identified 12 key limitations mitigating green building in New Zealand's new construction. Four of these limitations were new ideas presented in the interviews, including supply chain inefficiencies, tools not tailored to New Zealand, unproven commercial feasibility, and lack of short-term benefits. Current contractor drivers were identified as basic operation-based strengths, which include waste segregation/waste management processes, basic resource efficiencies, occupant comfort, and increasing awareness. As New Zealand's green rating system uptake is still in its infancy, the country can learn from the teething issues of other countries that have progressed in sustainable built environment practices.

Keywords: Climate change; Green rating system; Green Star NZ; New Zealand

1. Introduction

Climate change is the most pertinent environmental issue of our time and one of the greatest challenges we face as a global community. The scientific evidence is irrefutable; climate change is affecting agriculture, native ecosystems, infrastructure, health, and biosecurity (MfE, 2019a). Recent studies have indicated that the construction and operation of buildings accounted for 39% of global emissions in 2017 (WorldGBC, 2017; Basten et al., 2019). Similarly, thinkstep (2019) published a report that attributed 20% of New Zealand's (NZ) greenhouse gas (GHG) emissions to built environments.

The NZ government has already implemented several goals and initiatives planning to align NZ with the greater global objectives ratified in the Paris Agreement by shifting to a low-carbon economy. The latest target that was set by the NZ government in 2011 under the Climate Change Response Act 2002 aims to reduce emissions to below 50% of the 1990 levels by 2050. The purpose of the Act is to provide a legal framework to insure that NZ

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doi: 10.14716/ijtech.v12i5.5209

meets its international obligations under the Paris Agreement (MfE, 2019b).

In 2007, the New Zealand Green Building Council (NZGBC) introduced the Green Star NZ rating system to mitigate the impacts of construction projects on the environment. For a project to become awarded a Green Star NZ rating, the design and construction processes must exceed basic building code compliance and prove efficiency in many assessment criteria. The criteria assess the project's focus on reducing GHG emissions, build management, indoor environment quality, energy, transport and water efficiencies, green material use, and land and ecology considerations. Since 2007, 150 projects have been certified (NZGBC, 2021).

As NZ is new to the initiative, little research is dedicated to practices, strengths, and limitations in the current NZ new green construction industry. The existing academic literature investigates popular green construction practices in larger countries such as the United States (US) and the United Kingdom (UK). However, relevant literature documenting the current issues impacting contractors and the progression of green new commercial construction in NZ is limited. Contractor concerns have been omitted from green construction research, and the literature has focused on environmental factors, developer requirements, or end-user needs. With many established commercial construction companies reportedly finding themselves no longer a going concern, it is essential for the industry to understand the strengths and limitations that contractors currently exhibit. Therefore, this research investigates the NZ green construction industry's current strengths and limitations, focusing on contractor limitations.

1.1. Green Building Overview

The Green building is becoming a popular practice globally, primarily due to the increased attention given to environmental issues and the role that construction must play in reducing greenhouse gas emissions (Masia et al., 2020). Although the words "green" and "sustainable" are often used interchangeably, academically, they are not the same. Green building practice typically holds the environment as the single focus, or a single pillar as described by Doan et al. (2017), compared to sustainable construction practice, which takes a more holistic view, with the addition of more pillars. Currently, sustainable construction focuses on three main pillars—the environmental, social, and economic issues of a building—and the context of its community (Kibert, 2016). In time, more pillars may be added as the concept of sustainability is interpreted more clearly.

NZ's primary green rating system (GRS), Green Star NZ, has seen a measured uptake compared to other existing systems used globally. Doan et al. (2017) deduced that Green Star NZ was potentially the weakest of all GRSs, as it can only focus on a single pillar of sustainability: the environment. Among the four different green rating systems—BREEAM, LEED, CASBEE, and Green Star NZ—only BREEAM comprises sub-categories for assessing the sustainability of a construction project in all sustainable pillars (Doan et al., 2017). However, only three and four sub-categories were allocated for economic and institutional pillars, respectively (Doan et al., 2017). It was concluded that none of the four systems examined (BREEAM, LEED, CASBEE and Green Star NZ) could assess a project in all aspects of sustainability (Doan et al., 2017).

1.2. Drivers and Limitations of Green Building in NZ

Despite many factors leading to the favorable adoption of green building practice—a marked increase in building consent numbers, the industry operating in a current boom cycle, and increased attention to improved environmental outcomes (PwC, 2016)—the NZ construction industry seems hesitant to adopt green building practices, assessed by NZGBC.

Isa et al. (2018) and Tharim et al. (2018) also highlighted the gap between agreement on the principle of green development and the actual modest certified projects.

Bond (2011), Building Research Association of New Zealand (BRANZ) (2018), and thinkstep (2019) all stated that increased policy implementation has spurred the industry into 'greener' development. This action was particularly apparent regarding energy efficiency through the introduction of the New Zealand Energy Efficiency and Conservation Strategy (NZEECS), a detailed plan for increasing energy efficiency, renewable resource use, and conservation. BRANZ (2018) provided direction and a framework for the future of NZ's construction and development, facilitating NZ's built environments' response to climate change. The potential for implementing a Climate Change Act, similar to that developed in the UK, was also discussed (BRANZ, 2018). However, at the local government level, few councils have their own emission-reduction strategies. An example of one strategy is Auckland's Low Carbon Auckland Plan, which aims to reduce emissions by 40% by 2040 (BRANZ, 2018).

Bond (2011) revealed the peculiar nature of NZ's GHG emissions profile and how that limits NZ's ability in typical GHG mitigation. Two of the highest contributing industries to NZ GHG emissions are agriculture and transportation. It is a challenge for both these industries to reduce emissions, unlike countries such as Australia, which can reduce its emissions profile by lowering the burning of fossil fuels and switching to more sustainable energy sources (Bond, 2011). Several authors (Bond and Perrett, 2012; BRANZ, 2018; Doan et al., 2019; Li et al., 2020; Masia et al., 2020) highlighted the common perception that there was high capital cost for building green among the market and a lack of market understanding, demand, and benchmark projects, which could be attributed to the infancy of green building practice in NZ compared to other developed countries. Bond and Perrett (2012) and BRANZ (2018) also identified a lack of incentives as a key barrier to green construction.

2. Research Methodology

Primary research was conducted using semi-structured interviews with influential personnel involved in the construction industry and those who have critical Green Star NZ experience. Semi-structured interviews are an effective way of gaining accurate and comparative data, allowing interviewees to freely share their views (Cohen and Crabtree, 2006). Suh interviews can also provide "deep and rich observational data" (Onwuegbuzie and Leech, 2005). The interview was carefully designed to stimulate discussion concerning issues of green construction faced during the interviewees' careers in green building.

A thematic analysis method was applied to the interview transcripts to identify the common themes, topics, ideas, and patterns that were discussed. This research adopted six steps proposed by Braun and Clarke (2006), including data familiarization, initial codes generating, themes searching, themes reviewing, themes defining, and report producing. To promote validity and reliability, member checking and triangulation methods were utilized. After each interview, the information was transcribed, and the transcripts were returned to the interviewees to verify before analysis, which is known as member checking (Birt et al., 2016). Second, the information collected was compared to secondary research to allow for an accurate and comprehensive collection of the subject matter (Sharan and Elizabeth, 2016).

This research adopted a targeted sampling method. Targeted sampling was chosen as a sample selection method to insure that the interviewees met the required criteria. The sample of interviewees consisted of five key people involved in the construction and development of a recent Green Star NZ Auckland project and other influential members of

the NZ commercial construction industry. The following characteristics identified the personnel as appropriate candidates:

- Experience with the Green Star NZ assessment tool/a NZ green assessment tool.
- A minimum of three years' experience in the NZ construction industry.
- Influential members of the construction process.

A minimum of three years' experience was required to insure that the interviewees had comprehensive knowledge in construction. Many previous interview studies in the construction field have considered three years' experience a key requirement (Daniel et al., 2017; Ogunmakinde et al., 2019; Saikah et al., 2019). Table 1 provides information about the interviewees.

Table 1 Demographics of interviewees

No	Position	Experience in construction	Capacity of Green Star NZ dealings
1	Site Engineer	7 years	Recent $50 million Green Star project
2	Project Manager	15 years	Recent $50 million Green Star project
3	Senior Architect	50 years	Large involvement with specification design for NZGBC and Green Star NZ
4	Safety and Sustainability Manager	3 years	Accredited Green Star NZ Practitioner
5	Project Manager	12 years	Involvement in Green Star and Homestar Project

Five interviewees participated in the research: one site engineer, two project managers, one senior architect, and one safety and sustainability manager. To insure the reliability and validity of the data, the interviews were required to have at least three years' experience in the NZ construction industry with principal roles and involvement in Green Star projects.

3. Results and Discussion

The findings are categorized under three themes: (1) current industry knowledge and awareness; (2) contractor drivers and limitations regarding green building practice; and (3) current barriers and limitations mitigating green building practice in NZ new commercial construction.

3.1. Current Industry Knowledge and Awareness

Four of the five interviewees described current industry knowledge of the Green Star NZ assessment scheme and general green construction principles as "limited." The fifth described the industry's knowledge as "increasing." Four interviewees had been actively involved with recent Green Star NZ projects and other projects involving green building elements, while the remaining interviewee held considerable experience consulting at a high level to the NZGBC.

Several explanations were offered concerning the deficit of knowledge within the industry. Interviewee #1 highlighted the infancy of the tool, who compared the Green Star NZ against LEED, having had experience in working in an overseas setting. Lack of training, poor training, and the scarce amount of industry professionals were also discussed as key industry shortcomings. Interviewee #2 described knowledge and compliance as mutually exclusive; the implementation of either did not necessarily equate to an acceptable or compliant work outcome concerning building green. Discussions surrounding industry experience indicated that accredited "green" professionals were often "green" in experience to construction. Furthermore, a single accredited employee could be a company/projects

depth of knowledge for the system, illustrating the current lack of industry awareness in NZ new construction.

Basic principles of the green building were considered common knowledge; however, knowledge of the requirements and processes involved in executing a Green Star NZ project successfully was absent. Interviewee #4 stated that "everyone understands the basic principles of green building such as efficient energy use" and described these types of principles as the "low hanging fruit" of green construction. Interviewees #2 and #5 discussed how they felt that green assessment requirements were often "forgotten" during the course of construction, as concern was often given to the intensive requirements of the build. It was commonly not until the end of the job that the assessment criteria would be given attention. This was viewed to be "an application" type process to be completed, likened to gaining a Code of Compliance Certificate (CCC) from the council. Interviewee #3 stated that for green construction to be carried out correctly, it should be an intensive process from start to finish.

Existing academic literature has also highlighted a lack of knowledge in the NZ commercial industry. Bond and Perrett (2012) stated that "a lack of practical understanding among building owners about energy efficiency and green building, including overestimates of the initial cost premium, hinders the implementation of sustainability measures." Even though this literature is dated, the triangulation of the collected primary data and secondary data shows little change in industry awareness. Bond and Perrett (2012) identified a lack of knowledge among building owners; however, the primary research indicates the professional construction industry appears to be in a relatively similar position of awareness. Research indicates a limited stock of accredited professionals. The remainder of the industry only holds a general understanding of green building processes rather than a practical knowledge of the processes involved with a Green Star NZ project. Doan et al. (2019) also highlighted Green Star understanding/skill as the most significant barrier to Green Star uptake. The research mentioned two views required for successful Green Star NZ uptake: first, practical knowledge of green project required deliverables, and second, an understanding of the financial benefits and financial feasibility of the green project. Interviewees held the viewpoint that green construction came at a cost premium and did not provide any financial benefit to developers other than a marketing aspect. BRANZ (2018) also documented skill and knowledge barriers, summarizing that the NZ building and construction industry may not be able to deliver net carbon buildings, not due to the lack of intent, but because of the lack of skills and knowledge to do so.

It can be concluded that the industry knowledge of Green Star NZ and green building is rudimentary compared to international standards. While most of the interviewees were able to name common green building practices, such as energy-efficient lighting and water reuse systems, practical knowledge of the NZ GRSs requirements was clearly missing.

3.2. Contractor Drivers and Limitations Regarding Green Building Practice

Table 2 shows that the interviewees could only identify a limited number of current contractor strengths. Basic resource efficiencies largely linked to the design stage of the construction process were a common thread of discussion. These included efficient energy use through LED lighting and efficient water use through water reuse systems such as rainwater harvesting, described by one interviewee as the "low hanging fruit" of the green construction industry. All interviewees identified waste segregation/waste management as a construction process impacted by GRSs, primarily Green Star NZ and Resource Efficiency in the Building and Related Industries (REBRI). This finding indicates an increased awareness of construction material heading to landfills. Contractors are required by Green Star NZ and other GRSs, such as REBRI, to minimize construction waste sent to landfills

(BRANZ, 2021). As a result, a market for waste management companies has been created that provides a waste segregation service to the green construction market. The interviewees considered this something contractors are particularly conscious of and has become common practice.

Table 2 Summary of contractor drivers and limitations

Strengths (% of responses)	Limitations (% of responses)
Waste segregation/waste management (100%)	Supply chain inefficiencies and availability of materials (60%)
Basic resource efficiency (60%) (LED lighting, water reuse)	High costs (100%)
Occupant comfort (20%)	Complex compliance regulations and framework (80%)
Increasing awareness (100%)	Lack of practical knowledge/training/experience (80%)
	Packaging (20%)

Interviewees were more vocal about contractor limitations than strengths. Three of the five interviewees discussed supply chain issues as a key limitation for contractors operating within the new commercial green construction market. NZ's isolation creates logistical issues affecting its supply chain. Limited product choice, long lead times, and high material costs all impact the contractor in today's market and were key issues raised in the primary data collection. Current NZ market conditions are extremely illustrative of these issues, with the Covid-19 pandemic greatly affecting imports and exports, causing huge material procurement issues for green construction projects. These conditions increase the risk held by contractors involved with delivering a project on both time and budget and discourage the use of green accredited materials.

BRANZ (2014) illustrated NZ's low level of water efficiency discussed previously in the literature review; however, interviewees identified rainwater harvesting and reuse as a common practice and a current contractor strength. This practice may be indicative of industry progress and the increasing adoption of green construction methods within the market.

Multiple interviewees discussed complex compliance regulations and assessment frameworks as limiting factors that hamper a contractor's ability to facilitate green projects successfully. Interviewee #1 described the idea of contractors feeling consumed by compliance and not always knowing how to appease compliance requirements, adding more stress to what is an already incredibly complex operating environment. According to interviewee #4, green compliance was compared to "opening pandora's box and not knowing what was going to come out," which suggests that the industry holds a sense of reluctance to embrace the additional requirements that GRSs impose on the industry. The construction industry already contains a large number of compliance bodies, each requesting criteria that the contractor must satisfy. These bodies aim to regulate areas of health and safety, building quality, environmental wellbeing, and now sustainability, leading to a complex and confusing industry framework. It was discussed that the compliance framework facilitating the construction industry needed to be consolidated and streamlined to remove its current inefficiencies. Interviewee #4 claimed that much of the information required by each compliance body was repetitive and that the layering of compliance was hugely inefficient for the industry.

The industry's lack of practical knowledge and training was a recurring theme, indicating a skills shortage in the workforce. Other less common issues identified during the interviews included the transient nature of the construction workforce and the

excessive packaging of materials. The transient nature of the construction workforce was problematic for contractors attempting to carry learning and training through from one job to the next. The reasons for this were not explored; however, it seems to be a global trend and is not peculiar to NZ. The excessive packaging of materials, especially appliances, was an uncontrollable factor for contractors who had no input into the amount of waste generated from the purchase and installation of these items in a project.

3.3. Current Barriers and Limitations Mitigating Green Building Practice in NZ New Commercial Construction

There is a common initial cost premium for building green in NZ. Table 3 shows that all respondents raised this matter, indicating the weight of the issue. Rehm and Ade (2013) disproved this common misconception after examining 17 green buildings against modeled cost estimates during 2006–2010 in NZ. However, this research has now become dated and does not align with the consensus of interviewee discussions. Further research is therefore required to identify whether the costs of building green in NZ new construction have increased since the 2013 study or whether there is a misconception of costs involved in a new commercial green project.

Table 3 Summary of contractor limitations in NZ new commercial construction

% of responses	Limitations
100%	Cost premium
80%	Lack of industry knowledge and expertise
80%	Supply chain inefficiencies and isolation
80%	Intense reporting requirements/complex/not user friendly
60%	Lack of legislation/incentives
40%	Tools are not tailored for NZ
20%	Unproven commercial feasibility
20%	A low number of projects and not enough time to illustrate benefits to the market
20%	Lack of short-term payoff/benefits

The continued theme of poor industry knowledge of green construction and Green Star NZ was prevalent in both primary and secondary research. Industry awareness was said to be improving; however, practical working knowledge of the NZ GRSs was scarce. Primary research concluded that the infancy of GRS tools in NZ and a lack of government legislation/incentives are responsible for the low levels of industry knowledge and can therefore also be seen as enabling factors for increasing professional knowledge on the subject.

Interviewee #3 described the isolation of NZ as a “blessing and a curse” when discussing supply chain limitations for the green building industry. Supply chain inefficiencies in the form of limited material choice, long lead times, and high cost are all factors mitigating the uptake of green construction in NZ. The limited availability of green-rated products within NZ often provokes an ironic situation in which green materials incur high carbon miles when sourced overseas. Interviewees who had experienced this described the process as frustrating. Further tailoring of the GRS to the NZ industry would increase the ability of contractors to use locally produced products.

Interviewee #3 described the current green frameworks as “not user friendly,” and when combined with an “incredibly complex building process” (interviewee #1), the process can be daunting. The interviewees concluded that the current GRSs employed in

the NZ new construction industry are inefficient and have not yet been "New Zealandised." The interviewees suggested that the current GRS systems need further development to better fit the NZ building industry.

Contrary to many comparably developed countries, NZ is conservative in its legislation and incentives promoting green construction. This limitation is not to be confused with the previously discussed complex nature of the compliance framework. Three of the interviewees felt that a lack of legislation and or government incentive was holding back the potential of NZ becoming proficient in green construction. Interviewee #3 discussed the legislation as being the cheaper and more appropriate way to align the industry with the overall sustainable objectives of NZ. Interviewee #5 suggested that incentivizing big-ticket items such as solar panel installation would encourage developers to take the next step toward more sustainable buildings.

3.4. Recommendations

Although Rehm and Ade (2013) concluded that the costs are not different between traditional and green buildings, the research results conflict with the interviewees' perspectives. The contractors all claimed that premium costs caused them limitations in the NZ construction industry. It is therefore recommended that cost aspects in green buildings should be investigated thoroughly to provide the cost details of green buildings and enhance the uptake of green construction. Interviewee #5 stated that "it would be good if there was incentive from the government to entice developers and builders to go the extra mile and adopt greener building style and habits."

Regarding the roles of NZGBC, interviewee #3 indicated that "once these green tools become further 'New Zealandised' rather than copied and pasted from foreign countries, they will become more appropriate." In other words, NZGBC should develop and streamline their tools to be more appropriate for the NZ condition. Regarding the contractors, interviewee #2 stated that "staff enjoy upskilling and will take learnings from these green projects on to the next ones," which would benefit the uptake of green construction.

According to interviewee #4, the involved parties should work together to have "a combined approach to tie all of these requirements together for the building industry." Doing so would help to "streamline and consolidate sustainability and green building with current building legislation, health and safety requirements" (interviewee #4). He added, "It feels like many different compliance bodies are asking for lots of different things, which makes it a confusing industry to navigate" (interviewee #4).

4. Conclusions

This research investigated the drivers and limitations of green building practices in the NZ new construction industry. Focus was given to the strengths and limitations of the contractor to determine the slow uptake of green construction in NZ. The primary data were triangulated against the academic literature to promote the research validity and highlight areas that were not previously identified.

The research identified 12 key limitations mitigating green building in NZ new construction. Four of these limitations were new ideas presented in the interviews, including supply chain inefficiencies, tools not tailored to NZ, unproven commercial feasibility, and lack of short-term benefits. Current contractor drivers, such as waste segregation/waste management processes, basic resource efficiencies, occupant comfort, and increasing awareness, were identified as basic operation-based strengths.

With its GRS uptake still in its infancy, NZ has the advantage of being able to learn from the teething issues of other countries that have progressed in their sustainable built

environment practices. Future research will incorporate a larger sample size to include the situation of key stakeholders regarding sustainable construction in NZ.

Acknowledgements

This research has been supported with Extra PBRF 2021 Funding by the School of Future Environments, Auckland University of Technology, New Zealand.

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