sustainability

Article

Institutional and Actor Network Perspectives of Waste Management in Australia: Is the Construction Industry Prepared for a Circular Economy?

Benson Teck Heng Lim, Bee Lan Oo *, Charlie McLeod and Pengqi Yang

School of Built Environment, University of New South Wales, Sydney, NSW 2052, Australia
* Correspondence: bee.oo@unsw.edu.au

Abstract: Waste management and minimization are touted to be two of the key drivers for greening the construction industry and a pathway to a circular economy. This research aims to revisit the attitudes and perceptions of project stakeholders towards construction and demolition (C&D) waste in the Australian construction industry and ascertain if the current state of play in construction would facilitate the transition to a circular economy. Statistical analysis was performed on an online survey dataset collected from 104 professionals within the Australian construction supply chain. The results reveal that construction professionals' attitudes and perceptions to C&D waste could be classified into normative, regulatory and cultural cognitive drivers. Also, the perceived barriers and strategies of C&D waste management vary across design consultants and principal and sub-contractors. Overall, the evidence is suggestive that the Australian construction industry seems not fully ready for a circular economy. In terms of research implications, clearer guidelines and mandatory approaches to C&D waste management, involving a balance of incentivization and dis-incentivization actions, and close and stronger collaborations between the industry and government, are deemed necessary for better C&D waste management performance and the realization of a greener industry.

Keywords: actor network; circular economy; construction and demolition waste; institutional theory; supply chain management; waste management

check for updates

Citation: Lim, B.T.H.; Oo, B.L.; McLeod, C.; Yang, P. Institutional and Actor Network Perspectives of Waste Management in Australia: Is the Construction Industry Prepared for a Circular Economy? *Sustainability* **2024**, *16*, 617. https://doi.org/10.3390/su16020617

Academic Editor: Syed Minhaj Saleem Kazmi

Received: 29 November 2023
Revised: 8 January 2024
Accepted: 8 January 2024
Published: 10 January 2024

1. Introduction

In Australia, the National Waste Report by the Department of Agriculture, Water and the Environment [1] highlights that Construction and Demolition (C&D) waste has considerably increased by 32% per capita from 2006/2007 to 2018/2019. Around the same time, research has also shown that 834 million and 600 million tonnes of C&D waste were generated across 36 European countries [2] and in the US [3], respectively. Evidence has shown that the amount of C&D waste generated is strongly associated with the social status of the population, the level of urbanization and economic development of countries [4]. This collectively adds weight to the World Bank's [5] conclusion that, without urgent and appropriate actions taken to minimize the impact of rapid urbanization and growing population on the current environment, the amount of C&D waste generated across the globe will increase considerably, by 70 percent by 2050. As Roche and Hegarty [6] suggested, in the context of the present research, C&D waste is defined as the surplus materials and damaged products, and other wastes that arise, from construction, renovation and demolition, as well as other construction activities.

Admittedly, C&D waste management is not new and has indeed been well researched in the construction domain, with recent research directions linking to the concept of circular economy [7–9]. Conceptually, waste management is related to the concept of circular economy in how waste could be recaptured as a form of resource for manufacturing new materials and products, and in how materials, products and services could be designed and reconfigured to be less resource intensive [10]. To this end, Ghaffar et al. [7] argue that an integrated management of C&D waste is an important step to a circular economy and share the views of Dainty and Brooke [11] and Ofori [12] that stronger and more comprehensive collaborations between scientists, policymakers and construction stakeholders are the gateway for effective C&D waste management and resource recovery before a circular economy could be realized. However, this seems an endless conundrum, whether construction stakeholders are culturally, commercially and technically prepared for better waste management effort and performance.

In reality, C&D waste management could be an ongoing issue, which deserves further attention considering the following: (i) the construction industry is one of the cannonading industries that contribute to a nation's economic and societal development, and it does not stop building projects; (ii) construction projects are increasingly becoming more complicated, involving different materials, products and techniques; (iii) client and governmental requirements, and societal and workforce expectations, are changing; and (iv) the business environment is becoming more volatile, and construction companies are increasing prone to external shocks and disruptions to their operations. Moreover, current research focuses seem relatively fragmented, in which most studies considered C&D waste management as either an isolated problem or the sole responsibility of individual project stakeholders, such as (i) design professionals (e.g., [13]); (ii) construction project managers and operatives (e.g., [14]) (iii) government bodies and authorities (e.g., [15]); and (iv) waste management specialists (e.g., [16]). Little or no empirical study has adopted the institutional and actor network lenses to revisit the attitudes and perceptions of stakeholders towards C&D waste management and if they are ready for a circular economy. Particularly, little is known about subcontractors' viewpoints. Collectively, these bring about the following questions:

- How are the attitudes and perceptions towards C&D waste management varied among construction stakeholders?
- Is the industry, as an institution, doing enough and the current C&D waste management being effective to facilitate the transition to a circular economy?

In addressing the above questions, this research aims to investigate the attitudes and perceptions of construction professionals across the Australian construction supply chain, by: (i) examining their attitudes and perceptions towards C&D waste management and (ii) determining if there are significant differences in the attitudes and perceptions among design consultants, principal contractors and sub-contractors towards C&D waste management. For ease of reference, the term 'design consultants' refers to architects and specialist consultants hereafter. These research objectives are particularly important due to the recent direction set by the Department of Climate Change, Energy, the Environment and Water (DCEEW) of the Australian government [9] towards building a circular economy by 2030. The research findings offer a more comprehensive and integrated perception of C&D waste management across the construction project supply chain, hence presenting an overall indicative status of waste management in Australian construction projects and the industry's progression to creating a circular economy. More importantly, the research helps to inform relevant authorities or professional bodies of the potential gaps and issues between respective stakeholders and, thus, enable them to configure targeted approaches towards bridging the perceived gaps, in turn, continually improving the overall C&D waste management performance in the Australian construction industry.

2. Literature Review

Over the past four decades, there has been ongoing discourse on the root causes of poor C&D waste management and the attitudes and behaviors of project stakeholders towards C&D waste management across Australia [17,18], China [13,19], Singapore [20,21], Malaysia [22], Hong Kong [23,24], the United Kingdom [25,26] and the US [27]. Furthermore, there is a replete list of recommendations for the construction industry to achieve improved C&D waste management for the effective implementation of sustainable construction and realization of a circular economy [7,8] Table 1 summarises a list of relevant factors identified in previous studies.

Table 1. List of factors identified in the literature.

Item Code	Description	Authors
	Attitudes	
A1	Waste is an inevitable by-product of construction activities	Teo and Loosemore [14], Osmani et al. [28,29]
A2	Waste has no value	Osmani et al. [28,29]
A3	My peers are responsible for waste management/minimization	Yuan et al. [30], Yuan [19]
A4	Waste management is less important than profit maximization	Kulatunga et al. [31], Udawatta [32]
A5	Time spent on waste management is a loss of production time	Kulatunga et al. [31], Osmani et al. [28,29]
A6	Waste management practices are only needed in large companies	Kulatunga et al. [31], Osmani et al. [28,29]
	Barriers	
B1	Lack of training, awareness and knowledge of C&D waste management	Shen and Tam [33], Osmani et al. [28,29], Lu et al. [34], Poon et al. [35], Park and Tucker [15], Mahpour [36]
B2	Waste is not receiving enough attention in design process	Osmani et al. [29], Yuan et al. [30], Yuan [37], Ajayi et al. [16], Udawatta et al. [32], Mahpour [36]
B3	Poor culture and attitude towards waste	Teo and Loosemore [14], Osmani et al. [28,29], Yuan et al. [30], Yuan [37], Ling [38], Mahpour [36], Udawatta et al. [18]
B4	Lack of recycling market	Yuan et al. [30], Poon et al. [35], Park and Tucker [15], Udawatta et al. [18], Mahpour [36]
B5	Lack of government support	Shen and Tam [33], Tam et al. [17], Yuan et al. [30], Yuan [37], Ling [38], Udawatta et al. [32], Park and Tucker [15], Mahpour [36]
B6	Lack of time	Teo and Loosemore [14], Poon et al. [39], Shen and Tam [33], Kulatunga et al. [31], Ling [38], Udawatta et al. [40], Mahpour [36]
B7	Site space constraint	Poon et al. [39], Yuan et al. [30], Yuan [37], Poon et al. [35], Udawatta et al. [18]
B8	Lack of client support and interest	Shen and Tam [33], Osmani et al. [28,29], Yuan et al. [30], Ling [38], Park and Tucker [15]
B9	Lack of managerial support and commitment	Teo and Loosemore [14], Shen and Tam [33], Yuan et al. [30], Poon et al. [35], Udawatta et al. [18], Mahpour [36]
B10	Financial burden	Teo and Loosemore [14], Shen and Tam [33], Kulatunga et al. [31], Tam et al. [17], Yuan et al. [30], Yuan [37], Poon et al. [35], Ajayi et al. [16], Udawatta et al. [18,40]
B11	Reluctance to use recycled materials	Teo and Loosemore [14], Tam et al. [17], Mahpour [36]
	Strategies	
S1	Promoting financial incentives	Dainty and Brooke [11], Osmani et al. [29], Tam et al. [17], Yuan et al. [30], Ling [38], Park and Tucker [15],
S2	Providing training and education on C&D waste management	Teo and Loosemore [14], Shen and Tam [33], Dainty and Brooke [11], Osmani et al. [29], Yuan et al. [30], Yuan [41], Poon et al. [35], Ling [38], Udawatta et al. [32], Park and Tucker [15]
S3	Establishing a waste recycling market	Yuan et al. [30], Yuan [19], Udawatta et al. [40], Park and Tucker [15]
S4	Implementing a waste management plan	Shen and Tam [33], Lu and Yuan [42], Ajayi et al. [16]
S5	Promoting onsite waste sorting for reuse and recycling	Shen and Tam [33], Dainty and Brooke [11], Poon et al. [23], Osmani [26], Yuan [19], Poon et al. [35], Ajayi et al. [43]
S6	Designing out waste	Dainty and Brooke [11], Osmani [26], Yuan [19], Poon et al. [35], Ajayi et al. [16],
S7	Using prefabrication	Dainty and Brooke [11], Tam et al. [44], Jaillon et al. [45], Li et al. [46], Ajayi et al. [43]
S8	Improving communication among project stakeholders	Shen and Tam [33], Poon et al. [23], Yuan [41]
S9	Reducing the number of design errors via the use of advanced technologies, e.g., BIM	Ajayi et al. [16], Udawatta et al. [40], Akinade et al. [47,48]
S10	Strengthening government legislation	Teo and Loosemore [14], Shen and Tam [33], Osmani et al. [28], Osmani [26], Ajayi et al. [16], Udawatta et al. [32,40], Park and Tucker [15]
S11	Implementing just in time procurement (JIT)	Poon et al. [23], Dainty and Brooke [11], Ajayi et al. [16], Ajayi et al. [49]

It is noted that a considerable amount of research has documented the perceptions of clients, principal contractors and recycling companies to C&D waste management processes and the perceived barriers to their implementation in construction projects. Unfortunately, after two decades, little has changed, with most of the recent findings tending to support the conclusions of Teo and Loosemore [14] and Lingard et al. [50], where the overall waste management attitudes among construction operatives were not negative but waste management was often neglected in the initial design and planning phase and lowly prioritized in construction processes, mainly due to human, resources, technology and institutional factors. For example, Kabirifar et al. [51] found that there is a lack of consensus and coordination among stakeholders in C&D waste management, while studies have also shown that the profit- and cost-driven mindset of construction firms has undermined the effective implementation of C&D waste management and overlooked the potential benefits of adopting closed-loop construction and re-using and recycling waste [7,35]. This indeed points to the following rhetorical question: "Are construction stakeholders ready to put aside their principal-agent relationship and fragmented business and project goals for more effective waste management implementation and better performance?" (c.f. [11,52]).

Nevertheless, to tackle some issues identified above, studies have proposed predictive and analytical waste minimization systems and frameworks (e.g., [53,54]), BIM-based tools and collaborative practices (e.g., [48,55]) and design and construction processes (e.g., [7,25]). Also, a considerable amount of research has explored the role of government and the effectiveness of prevailing legal frameworks towards minimizing the amount of C&D waste (e.g., [15]). More recently, Andersson and Buser [8] adopted the institutional perspective in examining the C&D waste management and readiness of the European Union in moving toward a circular economy and found that, despite the implementation of relevant legislations and action plans, little has changed in how the construction industry deals with C&D waste. This, thus, leads to the call for more research to explore the normative associations among construction stakeholders and their attitudes and perceptions towards C&D waste management.

2.1. Theoretical Perspectives of C&D Waste Management

In this study, three theories were integrated to help explain the attitudes and perceptions of construction stakeholders. These include the following: (i) Latour's [56] actor network theory; (ii) Jensen and Meckling's [57] agency theory; and (iii) Powell and DiMaggio's [58] institutional theory. Collectively, this provides a useful theoretical lens towards examining how project stakeholders' attitudes and perceptions towards C&D waste management are generated because of the sequential nature of construction activities and their contractual relationships within an ever-changing project environment.

As Cerulo [59] suggests, the actor network theory postulates that the social relations between people and their ideas are treated as agentic entities that form a broad network. Based on this perspective, this means that project stakeholders' (i.e., actors) attitudes and perceptions to C&D waste management should not be considered in isolation but as a complex web of association and domino effects, characterised by their thought processes, material and technical objects and choices across design consultants, principal contractors and sub-contractors. Particularly, in the light of the planning, design and construction phases, the actions and ideas of design consultants could shape the project design and, in turn, shape the planning and construction processes and ideas of principal contractors, who would outsource most of the construction work to their sub-contractors.

However, as the agency theory underpins, project stakeholders are often contractually involved in a principal–agent relationship and, in some cases, their relationship could be driven by risk management. As Ceric [60] and Eisenhardt [61] conceptualized, moral hazards could take place in construction projects, particularly when agents and principals have different goals, attitudes and perceptions towards particular business matters, and that, in some instances, the agents could focus more on maximizing their benefits and advantages rather than acting in the best interest of their principal and to the overall projects. To this, Ceric [62] and Hendry [63] also added that both the principals and agents could exhibit opportunistic and self-interested behaviors and, in turn, create hold-up and adverse selection problems. For example, in the context of construction, design consultants could have made prior commitments to waste management through their project designs, but principal contractors opted for more economically viable rather than environmental-friendly options and engaged less reliable and experienced sub-contractors to perform the respective tasks. This will eventually create hold-up and adverse selection problems. On the other end, if design consultants were not experienced nor aware of waste management and appropriate techniques, they could create hold-up problems for principal and sub-contractors in their waste management efforts. Regarding this, Beldek et al. [64] found that construction firms were often found to use less environmentally friendly practices and not aware of the consequences of sending C&D waste to landfill, while design consultants were not fully conscious of their design approaches towards influencing the use of more green materials and practices in construction projects.

From the institutional theory perspective, the construction industry could be considered as an institution that involves many actors (including those above-mentioned) whose behaviors and perceptions could be controlled by a set of norms, rules and values embedded in the industry, leading them to behave and perceive matters in certain homogeneous (but perhaps also non-rational) manners to building and maintaining their legitimacy [58,65]. As DiMaggio and Powell [58] highlight, these institutional specific forces are known as isomorphism, which could be further classified into the following: (i) coercive (i.e., regulative) isomorphism, which relates to the pressures exerted from critical project stakeholders such as government and regulatory bodies; (ii) mimetic isomorphism, which refers to the actions and pressures from other project stakeholders (i.e., competitors or counterparts) that force individuals and organisations to imitate; and (iii) normative isomorphism, which relates to the pressures and expectation from social circles and professional and industry bodies to adopt certain institutional practices and perceptions.

Based on the above, the following hypotheses were formulated:

H1. *Attitudes and perceptions of project stakeholders to C&D waste management could be classified along the dimensions of (i) regulativedrivers; (ii) normativedrivers; and (iii) cultural cognitive drivers.*

H2. *Attitudes and perceptions of C&D waste management could vary among design consultants and principal and sub-contractors.*

2.2. Research Method

An online questionnaire survey was undertaken across the Australian construction supply chain, involving design consultants and principal and sub-contractors. The online questionnaire survey was adopted because it removes the physical geographic barriers and increases the width of survey distribution, offers anonymity and is more cost effective to administer. More importantly, it was supposedly the best fit for the targeted respondents, who are busy construction practitioners, to complete the questionnaire based on their availability and preference [66].

However, it is also acknowledged that the online questionnaire survey does have its drawbacks: (i) low reliability and validity of survey data, and low response rate [67]; (ii) possible biases that arise from sampling and individual responses [68]; and (iii) lack of potential richness and insight into certain phenomena [69]. Of these, Tan [68] further adds that a low response rate is not uncommon in construction research and, thus, it is important for researchers to simplify their questionnaire. As such, various measures were adopted in this research to minimize these problems, including: (i) designing and pilot-testing the structured questionnaire to ensure the questions were clear and straightforward and the questionnaire was concise; (ii) including an instructional page on the online questionnaire survey, highlighting the research significance and reminding respondents to answer individual questions based on factual situations; (iii) ensuring them of anonymity and confidentiality of their responses; (iv) including motivational quotes and graphics on each page of the online questionnaire; (v) incorporating a progress bar in the online questionnaire; and (vi) including open-ended questions in the respective section to encourage respondents to share their opinions and experiences on some phenomena. This provided us with richer qualitative data to support our results.

In this study, the structured online survey questionnaire comprised four main sections. In the Section 1, respondents were asked to provide their background information, such as age, gender, role and the number of years of working experience in the current role. Thereafter, for Section 2 and Section 3, they were requested to rate statements, regarding: (i) their attitudes to C&D waste and its management and (ii) perceptions concerning the causes of waste and barriers and strategies for effective waste management, on a 5-point Likert scale, ranging from 1 "Strongly disagree" to 5 "Strongly agree". Despite being perceived as less reliable and accurate in its predictive capacity (see [70]), a 5-point scale was preferred here over the 7-point scale, mainly due to its ease of understanding and use for industry respondents who might take less time and effort when completing those questions using the former rather than the latter. Finally, the respondents were asked to rate the frequency at which they participated in configuring, implementing and enacting waste management strategies in their project, ranging from 1 'Never' to 5 'Always'. Furthermore, three open-ended questions were included to enable respondents to provide feedback and share their thoughts on additional causes of waste, barriers and strategies towards C&D waste and its management that they had experienced. The questionnaire was pre-tested and validated using a pilot study, allowing refinements before an industry-wide survey. See Table 1 for the measurement items used in the structured survey questionnaire.

A simple random sampling method was adopted in this research, whereby respondents were invited from the sample frame generated from the Master Builders Association (MBA) and the New South Wales Architects Registration Board. Initial email invites with the survey link were sent to the members reflected in these two registries, explaining the aim of the research and assuring anonymity and confidentiality. About two weeks after the initial invite, follow-up emails and calls were made to targeted respondents to improve the response rate. Overall, a total of 138 responses were collected. Of these, only 104 were considered valid for analysis. The rest were either incomplete or considered unreliable and biased due to the midpoint responses given by respective respondents across all questions; hence, they were omitted from the database.

Table 2 summarises the background information of the respondents. It is notable that, despite the extra effort by making follow-up phone calls in attempts to increase the response rate from targeted sub-contractor respondents, this group of participants appeared to be more resistant than their counterparts to participating in the questionnaire survey, which could mainly be due to their unavailability, time and resource constraints.

Table 2. Data sample structure.

Demographic Information		Frequency	Percentage
Role			
	Principal contractors	53	51%
	Subcontractors	13	12.5%
	Design consultants	38	36.5%
Gender			
	Male	87	84%
	Female	17	16%
Experience			
	<5 years	20	19.2%
	5–10 years	17	16.4%
	11–15 years	15	14.4%
	16–20 years	8	7.7%
	>20 years	44	42.3%

Prior to the data analysis, the dataset was first examined for normality using histograms, skewness, kurtosis, the Shapiro–Wilk (S-W) and the Kolmogorov–Smirnov (K-S) tests. The test results revealed that the dataset did not fulfil the normal distribution assumption, with the skewness and kurtosis values ranging from −1.471 to 1.558 and −1.069 to 3.959, respectively. Furthermore, the S-W and K-S test results were statistically significant at $p < 0.05$. It follows that several non-parametric tests were adopted in this study. First, the exploratory factor analyses (EFA) were undertaken to determine the dimensionality of respondents' perceived barriers, strategies and attitudes towards C&D waste management. Two indices were used to assess the convergent reliability and validity of measurement items within their respective dimensions, namely: (i) factor loading must be at least 0.55 (following Comrey's [71] definition of a good measurement item), and (ii) the Cronbach's alpha coefficient must be at least 0.70 [72]. A threshold factor loading of 0.55 was adopted, rather than the commonly accepted value of 0.70, mainly because this research was at its exploratory phase (following the techniques proposed in [21,73]). By doing so, some important measurement items characterising respective key dimensions would not be removed unnecessarily; hence, the convergent validity of those measurement items would not be compromised. To complement the EFA findings, the relative prevalence indexing (RPI) method was adopted to facilitate the relative comparisons of measurement items relating to respondents' attitudes and perceived causes of C&D waste and its management. The RPI method was used rather than the arithmetic average method because it enables relative comparisons of measurement items under each dimension and across the dimensions, which was not possible by directly comparing the arithmetic average of each item. To compare the prevalence of dimensions, the overall average RPI of each dimension was computed by averaging the RPI of all measurement items of each dimension (see [74,75]).

Next, the one-sample Wilcoxon Signed Rank (WSR) test was performed to determine if the median values of the sample were significantly different to the test median value of 3 (i.e., the midpoint of the 5-point Likert scale). This helps to reveal if there was significant consensus among the respondents about the perceived causes of C&D waste, perceived barriers, attitudes and behaviors towards C&D waste management. Next, to examine if there were significant differences in the attitudes, perceptions, and behaviors across the three groups of respondents reflected in Table 2, the Kruskal–Wallis H (KWH) and post hoc pairwise comparison tests were conducted, for which the Bonferroni correction procedure was adopted to counteract the problem of multiple comparisons by dividing the *p*-value (i.e., 0.05) over the number of pairwise cases involved (i.e., 3). This, thus, helps inform which pair of respondent groups adopted different stances towards C&D waste management.

3. Results and Discussions

Overall, as summarized in Table 3, it could be seen that perceived barriers and strategies, and attitudes, have Kaiser–Meyer–Olkin (KMO) and χ^2 values ranging from 0.625 to 0.780 and 162.71 to 421.68, which are significant at $p < 0.05$, respectively. These indicate that the dataset is sufficient and useful in explaining the EFA findings. It is found that respondents' attitudes, perceived barriers and strategies towards C&D waste and its management are multidimensional, whereby each dimension comprises at least two measurement items: (i) factor loadings of $\geq$0.55, ranging from 0.56 to 0.89; (ii) Cronbach's alpha value of $\geq$0.7, ranging from 0.70 to 0.83; and (iii) eigenvalues of >1, ranging from 1.19 to 4.26. These collectively provide confidence of convergent reliability of measurement items within their respective dimensions.

Table 3. Exploratory factor analysis results on perceived barriers, attitudes and strategies towards C&D waste management.

Item Code	Factor Loading	Eigen-Values	% of Variance Explained	Cronbach's Alpha (α)
Perceived Barriers [KMO = 0.682; χ^2 = 281.850, p = 0.000]				
Culture		3.13	28.43	0.70
B2	0.70			
B3	0.69			
B6	0.73			
B11	0.68			
Lack of commitment		1.63	14.83	0.72
B1	0.78			
B8	0.69			
B9	0.84			
Lack of market availability and incentives		1.49	13.57	0.76
B4	0.86			
B5	0.88			
Lack of resources		1.19	10.77	0.71
B7	0.87			
B10	0.85			
Attitude [KMO = 0.704; χ^2 = 162.71, p = 0.000]				
Value		2.55	42.53	0.70
A4	0.82			
A5	0.82			
A6	0.85			
Culture		1.49	24.80	0.76
A1	0.80			
A2	0.80			
A3	0.79			
Strategies [KMO = 0.625; χ^2 = 282.34, p = 0.000]				
Design and planning		3.17	31.68	0.70
S3	0.66 *(0.63)*			
S6	0.70 *(0.67)*			
S7	0.77 *(0.76)*			
S8	0.68 *(0.58)*			
Compliance and governance		1.50	15.00	0.71
S4	0.77 *(0.76)*			
S5	0.60 *(0.62)*			
S10	0.78 *(0.78)*			
S11	0.70 *(0.70)*			
S1	*(0.50)*			
Education and training		1.46	14.63	0.72
S2	0.89 *(0.89)*			
S9	0.83 *(0.83)*			

NB: Values in parentheses are the original factor loadings of respective items before the trimming process due to low factor loading of less than 0.55.

3.1. *Perceived Barriers towards C&D Waste Management*

Table 4 summarises the perceived barriers of C&D waste management. It is notable from Table 3 that the identified barriers could be classified and contextualized along the following dimensions: (i) culture; (ii) lack of commitment; (iii) lack of market availability and incentive; and (iv) lack of resources. The findings in Table 4 reveal that the industry's culture (i.e., cultural cognitive drivers) and lack of market availability and incentive (i.e., regulatory drivers) are the key barriers towards waste management, with an overall average RPI of 0.78. These findings are not unexpected but discouraging as the image of the construction industry being one of key contributors to landfill waste and its opportunistic and risk transfer cultures has not changed over the past two decades (see [73,76,77]). As shown in Table 4, the industry's culture could be characterized by: B3 'culture and attitude towards waste', B2 'waste is not receiving enough attention in design', B6 'lack of time' and B11 'reluctance to use recycled materials', with respective RPIs ranging from 0.73 to 0.82, and the respective median values of 4, significant at $p < 0.001$. Notably, this bleak phenomenon of perverse waste culture and behaviors is also present in the UK construction industry, as highlighted by Ajayi et al. [78], who point out the need for a cultural shift across five main stumbling blocks before better waste management performance could be realized. These include the following: (i) 'make-do' attitude and processes in construction before finalization of design; (ii) non-collaborative culture across project stakeholders; (iii) blame culture and risk transfer between designers and contractors; (iv) waste inevitability attitude and behaviour; and (v) averseness towards innovative approaches. Sadly, after almost two decades, our findings also tend to support the corresponding conclusions of Teo and Loosemore [14] and Osmani et al. [28] that construction operatives still perceive waste as an inevitable by-product of construction activities, and there is little collaboration among project stakeholders to reduce waste during the design process. To this, Lim et al.'s [79] survey of Australian quantity surveyors also shows that the lack of support and commitment from design consultants is one of the key hinderances towards the effective implementation of sustainable procurement and life cycle costing approaches. Collectively, the picture that emerges from here tends to support Ajayi et al.'s [49] claims that the design stage and role of design consultants are important drivers towards implementing an effective overall waste minimization strategy, but they have not been given sufficient attention. Their findings reveal that effective design attributes for waste minimization could be categorised into: (i) standardization and dimensional coordination; (ii) design for modern methods of construction; (iii) flexibility and adaptability; (iv) end-of-life consideration; and (v) BIM coordination. This further points to the above-mentioned importance of considering using prefabricated components, recyclable or recycled materials and products, and ensuring the correctness of dimensions of work components towards preventing off-cuts for improved waste minimization. In accepting this, Kabirifar et al. [51] and Osmani et al. [28] point out that construction stakeholders should embrace proactive rather than reactive approaches towards reducing waste, placing greater emphasis on the planning and design phase of a construction project with careful design detailing, specification and selection of reusable and recyclable materials, rather than implementing waste management and minimization strategies during the construction stage.

Table 4. Perceived barriers of C&D waste management and their differences perception across design consultants, principal contractors and subcontractors.

Code	RPI	Overall Average RPI of Respective Dimensions	WSR Test Median Value = 3		KWH Test				
			Median	Test Statistic	Mean Rank for D.C.	Mean Rank for P.C.	Mean Rank for S.C.	Test Statistic	Pairwise Comparison
B2	0.80	0.78	4	8.01 **	58.21	51.16	41.27	4.09	
B3	0.82		4	8.30 **	56.70	51.82	43.00	2.86	
B6	0.76		4	6.89 **	52.11	53.87	48.08	0.46	
B11	0.73		4	6.52 **	58.67	51.46	38.69	5.64	
B1	0.81	0.76	4	7.78 **	61.97	47.50	45.19	7.34 *	D.C. − P.C. = 14.47 *
B8	0.73		4	5.98 **	60.54	49.80	40.00	6.26	
B9	0.73		4	6.20 **	58.91	48.10	51.69	3.54	
B4	0.78	0.78	4	7.18 **	51.37	56.82	38.19	4.84	
B5	0.77		4	6.82 **	46.72	57.82	47.69	3.82	
B7	0.72	0.72	4	5.63 **	45.79	56.41	56.19	3.59	
B10	0.72		4	5.31 **	49.04	54.92	52.73	0.99	

NB: D.C., P.C. and S.C. denote design consultants, principal contractors, and sub-contractors, respectively. ** and * denote statistically significant at $p < 0.05$ and $p < 0.001$, respectively.

Ironically, in this study, stakeholders' reluctance towards using recycled materials (B11) and their perceived time constraints (B6) are found to be ingrained in the prevailing cultural issues. These phenomena could be partially due to: (i) the lack of specifications, technical, information and quality standards for recycled products [7,80]; (ii) government authority's disapproval [17]; (iii) higher initial cost of using recycled and green materials than conventional materials [81]; and (iv) lengthier approval process with the use of green materials and technologies [81]. Interestingly, some respondents added that:

> "The government wants too much tax levy. They do not want recycling or tax reduction. I had a bad experience with this. . ." Respondent 17 (principal contractor)

> "Sometimes companies not knowing of opportunities for recycling and re-use of materials to which they ascribe little value but which have value to others; some staff not wanting to bother to stop and think about cutting in ways that lead to least waste, doing anything but dumping all leftover materials in the bin, etc". Respondent 49 (waste specialist subcontractor)

> "I think architects are keen to reduce waste and use recycled/recyclable materials but perception by clients is that it's expensive or by builders that if they substitute for something cheaper, they can achieve a larger profit margin. . . part of the problem with D&C contracts is material substitution and lack of accountability". Respondent 98 (design consultant)

> "The material specification and detailing are poor, [and there is] very limited information from material suppliers". Respondent 67 (design consultant)

> "Demolition of buildings [and] lack of recycling of demolition materials [are key causes]. . . EPA classifications and rules do not enable soils 'contaminated with 'solid waste' or other impurities to be recycled and reclassified. The EPA wants all these materials taken to licensed landfills. . ." Respondent 16 (principal contractor)

The findings in Table 4 also suggest that the lack of market availability and incentives (i.e., regulatory drivers) could partially account for the current cultural issues, as the former is characterized by B4 'lack of recycling markets' and B5 'lack of government support', with corresponding RPIs of 0.78 and 0.77. This tends to support the findings of previous studies [82–84] that there is a considerable lack of government support and funding towards promoting the development of waste recycling plants. This, thus, makes recycling operations economically unviable and less competitive due to the extensive recycling treatment processes and the operation costs involved. Notably, Thornton's [85] recent report highlights that the Australian federal government has plans to invest AUD 190 million into new recycling infrastructure and attract about AUD 600 million in private investment for the development of the recycling market. The report further underlines the importance of prioritizing and implementing strategies to promote the culture and best practices of waste avoidance, reducing contamination and creating markets for recycled materials rather than simply having more recycling infrastructure, as the latter is not sufficient to solve the prevailing waste problems. This also tends to add weight to Liu et al.'s [54] conclusions that promoting appropriate waste management behaviors through the implementation of appropriate incentive policies is critical for the successful implementation of waste reduction and that governments play an important role in ensuring procedural fairness, where every firm is given equal access to respective public funding. Shooshtarian and Maqsood's [86] recent research also supported the latter and showed that the active engagement and collaboration of stakeholders, towards developing a circular economy among waste operators, waste producers, suppliers, communities and governments, are the keys towards achieving optimal waste recycling performance in Australia. In response to this, Respondent 64 (i.e., a principal contractor) interestingly commented that:

> "The waste industry seems to be profiteering and not providing practical solutions to reduce waste costs".

All these collectively point to the opportunistic and moral hazard behaviors of construction supply chain parties and to Ofori's [12] argument that greening and educating the construction supply chain are essential for effective waste management and so sustainable construction.

Table 4 further reveals that the lack of commitment from management and clients (i.e., normative drivers) is the third group of barriers, which is characterized by B1 'Lack of training, awareness and knowledge of waste management', B8 'Lack of client support' and B9 'Lack of managerial support', with RPIs ranging from 0.73 to 0.81 and the respective median values of 4 significant at $p < 0.001$. This tends to support Shen and Tam's [33] findings that a lack of trained staff and expertise was the major barrier to implementing environmental management in the Hong Kong construction industry. Agreeing with this, Tam et al. [44] points out that proper training and education are essential to changing operatives' attitudes and behaviors towards waste minimization, and Begum et al.'s [87] research has shown that operatives who had training tended to have more positive attitudes toward waste management then their counterparts who did not. The results also support the findings of Park and Tucker [15] and Udawatta et al. [18] that there was a lack of managerial commitment and client interest to waste management in construction projects in Australia. This unfortunately reveals that little has changed in the Australian construction industry over the past two decades, hence pointing to the need for a greater thrust towards educating and mandating the management of construction firms and clients of better waste management commitment and initiatives. To this end, some of our design consultant respondents criticized some aspects:

> "[There are] lack of legislation imposed stringent material usage requirements". Respondent 5

> "[There are] lack of guidelines and government regulations to mandate waste management". Respondent 104

> "[It is a] cost item to and laziness of contractors. . ." Respondent 62

The above could, thus, indicate that the prevailing voluntary approaches of waste management are not effective, as [15] and Ng et al. [88] also suggest, and that relevant mandatory guidelines and regulations should be implemented. For example, the building regulations of Australia and other sustainable rating methodologies or codes should go beyond energy and water efficiencies and focus on the recycling and reuse of construction materials. This is supported by Udawatta et al.'s [18] interview findings, in that there are no provisions for waste management in the National Construction Code (formerly known as Building Code of Australia) in terms of enforcement or as a review policy. It follows that government bodies or authorities could consider adapting and mandating the Green Star construction and demolition waste management credit framework towards promoting and rewarding practices that minimize the amount of C&D waste that will be disposed of as landfill. Like the Commercial Building Disclosure (CBD) program that mandates vendors or lessors of commercial office space to obtain and disclose a Building Energy Efficiency Certificate (BEEC), the government bodies or authorities could also make NABERS waste rating mandatory. Interestingly, as Shooshtarian et al. [89] points out, the non-compliance with international reporting obligations and increases in illegal dumping and administration cost for waste management across different states and territories could collectively hinder the recent thrust for the development of the Australian recycling market that is attractive for private investors.

The last category of barriers in Table 4 is established around the lack of resources, which is characterized by B7 'site space constrains' and B10 'financial burden', with an RPI of 0.72 and respective median values of 4, significant at $p < 0.001$. This tends to support the findings of previous studies [18,24,88] that the lack of space to segregate waste on site and cost were two of the key limiting factors in construction project waste management. This further points to the short-term profit and cost-driven nature of the construction industry. Particularly, if competitive tendering using the bid price as a key contractor selection criterion is the most common method of procurement in construction projects and there is a lack of client support or interest in project waste management (an item previously discussed), principal and sub-contractors are very likely to be cost conscious and be less motivated towards implementing on-site waste management strategies, unless there are incentives or penalties adhering to waste performance. This is strongly supported by Respondent 73 (i.e., a design consultant), who highlighted that:

> "[There is] little financial incentive to minimize waste on site [as] it often costs more to reduce waste than it does to buy new materials. Labor costs in Australia are high and waste minimization tends to take additional labor, e.g., more design time, more construction planning. There probably needs to be financial incentives for minimizing waste, or financial penalties for producing waste, although that could likely add costs to construction which will get passed on to clients. . ."

Complementing the above findings, out of the 11 barriers shown in Table 4, we found that there were significant differences among different project stakeholders in their perceived lack of training, awareness and knowledge of waste management (i.e., B1), with a KWH test value of 7.35 that is statistically significant at $p < 0.05$. The post hoc test results interestingly show that designer consultants are more likely to perceive B1 as a key barrier to waste management than principal contractors, with an χ^2 value of 14.47, significant at $p < 0.05$. This, indeed, could help substantiate the finding why B2 (i.e., waste has not received enough attention in design) has been found as the top three barriers of waste management, and there is a considerable amount of project management research focused on the role, importance and knowledge of architects and design consultants towards project waste management (e.g., [13,29,49]). Our findings also tend to support Kpamma and Adjei-Kumi's [90] survey findings of design consultants in Ghana that there was a generally low recognition of sources of waste in project design processes and little awareness of waste reduction tools and lean design management. In this regard, some of our respondents mentioned, which also showcased the fragmented nature and lack of communication across the construction supply chain, that:

> "The siloing of skills between building designers and builders. . . building designers are not generally aware of proprietary standard supply dimensions of materials on the market; thus, waste is created by the designers' dimensions. . ." Respondent 47 (principal contractor)

> "Waste management is considered as the contractor's issue and therefore is not considered by consultants other than the waste management consultant. This leads to waste management becoming a construction management issue rather than a design issue to be tackled by the design team. The design team is effectively insulated from this issue and therefore has less say on this issue hindering effective implementation of waste management in construction. . ." Respondent 65 (design consultant)

> "Suppliers always specify minimum quantities, e.g., full boxes of tiles when only half needed; [thus creating unnecessary wastage]". Respondent 73 (design consultant)

3.2. Waste Management Strategies

Table 5 summarises the test results regarding respondents' perceived strategies that could be adopted to improve waste management. Generally, it is found that their perceived strategies could be classified along the following dimensions: (i) compliance and governance; (ii) design and planning; and (iii) education and training (see Table 3). Of these, respondents tend to prioritize the importance of education and training (i.e., cultural cognitive drivers) for better waste management, with an overall average RPI of 0.80, and this is characterized by S2 'training and education on waste management' and S9 'reducing the number of design errors via use of advanced technology (i.e., BIM)', with corresponding RPIs of 0.84 and 0.76 and respective median values of 4, significant at $p < 0.001$. This tends to support the findings of Udawatta et al. [32] and Yuan [41] that training and education for all project stakeholders are the essential drivers of more effective waste management, as they will help to improve their awareness of resource saving and environmental protection through waste minimization and management, as well as their design, planning, technical and management skills. This was further reinforced by Yu et al. [24], who recommended that there is a need for closer collaboration between government authorities to provide and conduct training classes for construction operatives and stakeholders, particularly on the use of new technologies to facilitate flexibility in design for effective waste reduction and management. To this, Ganiyu et al. [91] points out the importance of developing the BIM competence of project stakeholders for the delivery of waste-efficient building projects, organizing training to develop their abilities to minimize design changes during construction by adhering to the models; generate construction waste-related information from design models; use visualized models to reduce rework; adopt modular construction techniques; and recognise and recommend reusable materials for respective construction activities. On a project level, as Foresight environmental [92] and McDonald and Smithers [93] suggest, project managers should also ensure that site-specific waste management induction and training are provided to all site operatives who will be briefed of relevant waste reduction and recycling initiatives and, in turn, be regularly updated of the project waste management status and performance.

Table 5. C&D waste management strategies and their differences across design consultants, principal contractors and sub-contractors.

Code	RPI	Overall Average RPI of Respective Dimensions	WSR Test Median Value = 3		KWH Test				
			Median	Test Statistic	Mean Rank for D.C.	Mean Rank for P.C.	Mean Rank for S.C.	Test Statistic	Pairwise Comparison
S3	0.83	0.78	4	7.69 **	54.05	55.02	37.69	4.25	
S6	0.78		4	7.04 **	60.36	50.32	38.42	6.55 *	D.C. − S.C = 21.93 *
S7	0.77		4	6.72 **	62.97	50.66	29.38	13.99 **	P.C. − S.C. = 21.28 * D.C. − S.C = 33.59 **
S8	0.75		4	7.21 **	55.63	53.08	40.96	3.32	
S4	0.81	0.76	4	8.34 **	53.74	51.68	52.23	0.14	
S5	0.79		4	7.85 **	56.74	50.21	49.46	1.69	
S10	0.76		4	7.12 **	54.76	53.09	43.46	1.77	
S11	0.68		4	4.63 **	52.46	51.58	56.38	0.32	
S2	0.84	0.80	4	8.56 **	49.99	54.33	52.38	0.58	
S9	0.76		4	6.53 **	43.59	59.79	48.81	7.46 *	P.C. − D.C. = 16.20 *

NB: D.C., P.C. and S.C. denote design consultants, principal contractors, and sub-contractors, respectively. ** and * denote statistically significant at $p < 0.05$ and $p < 0.001$, respectively.

Also, as shown in Tables 3 and 5, our respondents perceived that greater emphasis should be placed on the design and planning (i.e., normative driver) aspects of waste management (with an overall average RPI of 0.78), characterized by S3 'establishing a waste recycling market', S6 'designing out waste', S7 'using prefabrication' and S8 'improving communication amongst stakeholders', with RPIs ranging from 0.75 to 0.83. This tends to add weight to Yu et al.'s [24] recommendations that promoting stronger collaboration among project stakeholders, developing a more established waste and recycling market, designing and implementing an efficient platform for waste exchange and a comprehensive credit-earning building environmental assessment system could collectively help to provide more avenues for recyclable items at a lower cost and, more importantly, establishing a stronger degree of buy in from key stakeholders, incentivizing good waste practices and behaviors. Particularly, the WRAP's [94] research report underlined the importance of closer collaboration among key project stakeholders for designing out project waste, considering and implementing different design strategies around the following areas: (i) re-use and recovery; (ii) off-site construction; (iii) material optimization; (iv) waste-efficient procurement; and (v) deconstruction and flexibility. This is further reinforced by two of the respondents:

> "The industry needs to be given the opportunity and incentives to create a better system for recycling. . .not just those people in government offices who have never worked in the industry". Respondent 18 (principal contractor)

> "Government needs to spend the funds collected through waste on addressing the issues which relate to the amount and cost of waste". Respondent 32 (principal contractor)

> "Setting waste management as an objective as part of the brief and the tender by the client will push the industry to implement more effective waste management policies". Respondent 65 (design consultant)

Lastly, it is notable from Tables 3 and 5 that compliance and governance (i.e., regulatory drivers) for better waste management performance are essential, with an overall average RPI of 0.76, and could be characterized by S4 'implementing a waste management plan', S5 'onsite waste sorting for reuse and recycling', S10 'improving government legislation and compliance requirements' and S11 'implementing just-in-time procurement approach', with RPIs ranging from 0.68 to 0.81. This indeed reinforces our previous discussion around the lack of government regulations to mandate waste management in Australia and further points to the essential role of government towards driving waste reduction, recycling and reuse of materials. An interesting trend here is that S4 and S5 have been categorised along with S10, thus suggesting that there is a drive for government bodies to consider legalizing the implementation of a site waste management plan (SWMP) and provision of on-site waste-sorting facilities; particularly, there are no such legal requirements hitherto in Australia. Through this, principal contractors are mandated to submit a detailed SWMP for the construction certificate application and implement those waste reduction and recycling practices, which will subsequently be audited by certifiers. This is indeed reinforced by some of our design consultant respondents, who highlighted that:

> "Compliance is often not monitored. Waste Management Plans are usually required by Councils at Development Approval stage but should be applied at the Construction Certificate stage. Waste bins should be classified so that sorting could happen on construction sites and be monitored by Certifiers". Respondent 82

> "There need to be better legislation around packaging of products for manufacturers. . . the amount of plastic film wrap used in deliveries is insane and, crappy particularly the use of little plastic spacers and cable ties could not be recycled. . . It's appalling". Respondent 98

Our findings also tend to support Ajayi et al.'s [43] conclusion that the use of a Just-In-Time (JIT) delivery approach is important for mitigating waste through material procurement processes and material handling. However, it is not clear why S11 is the lowest-ranked strategy, as evidenced by its RPI of 0.68. Perhaps, as Ajayi et al. [43] explains, this could be due to the reason of economies of scale, whereby construction companies prefer purchasing and receiving construction materials in bulk rather than obtaining them whenever project teams need them. The authors, however, underline that the JIT arrangement is touted to be a more cost-effective approach than bulk delivery if the cost of waste prevention is considered, but that the main risk is that project teams need to be cautious of the schedule of respective tasks. To this, Respondent 49 (a waste specialist subcontractor) interestingly highlighted that:

> "Keeping to schedules requiring doing things the quickest way. . . even if more waste was generated by some methods or subbies, aka "time is money" orientation of large companies would prefer using them to those generated less

> waste...Thus, the culture has to change at biggest firms, including some who crow about their recycling records (but who are NOT getting great re-use out of materials, or handling them in the most environmentally efficient manner)... companies that deal with billion dollar projects see a few million dollars of waste as just "noise" that is not worth slowing down their major works for... thus having the client sign off on the site waste management plan may work, but even then, sometimes clients are just after the cheapest solution, rather than the one that is best environmentally..."

Notably, it is found that there are significant differences between design consultants and principal and sub- contractors in terms of the perception towards S6, S7 and S9, with the KWH test values ranging from 6.55 to 13.99, significant at $p < 0.05$. The respective pairwise comparison results show that design consultants (with mean rank = 60.36) are much more supportive in the designing-out waste concept than sub-contractors (with mean rank = 38.42), with an χ^2 value of 21.93, significant at $p < 0.05$. This is not unexpected, as clients, design consultants and principal contractors are often touted to be the key decision makers at the design stage of construction projects [94,95], and sub-contractors are usually not involved at that early stage and administrated by principal contractors in the subsequent construction phase for respective work packages. Furthermore, our study found that principal contractors (with mean rank = 59.79) tend to place greater significance than design consultants (with mean rank = 43.59) on reducing the number of design errors via the use of advanced technology (e.g., BIM), with an χ^2 value of 16.20, significant at $p < 0.05$. This is an interesting phenomenon, considering that design consultants have shown significant support for S6 over S9 and that a considerable amount of research has documented the benefit and use of BIM for designing out construction waste [48]. The overall picture that emerges from here is that design consultants tend to show reluctance to admit design errors, adding weight to Osmani et al.'s [28] conclusions that architects did not believe nor agree that waste is often generated during the early stages of design or due to design errors, and their strong disinclination was strongly criticized by contractors.

Furthermore, we found that that both design consultants (with mean rank = 62.97) and principal contractors (with mean rank = 50.66) show greater support and appreciation for using prefabrication than sub-contractors (with mean rank = 29.38), with corresponding χ^2 values of 33.59 and 21.93, significant at $p < 0.05$. These tend to support Lu and Liska's [27] findings that both design consultants and principal contractors are very supportive of using prefabrication, as this method could help to reduce the overall project schedule, increasing product quality and safety performance and reducing the number of skilled craft workers as well as the negative environmental impact of construction operations. To the other end, our finding also tends to support Goh and Loosemore's [96] claim that Australian subcontractors are skeptical of using off-site construction methods and that they perceive the overall industrialization trend towards prefabricated construction components as more of a risk rather than an opportunity due to the potential loss of specialized skills, reduced scope of work that is usually required for conventional builds, increased competition and reduced margins. To this, subcontractors appear to be a victim for the industrialization trend as well as a culprit for hindering the increasing use of prefabrication. It follows that there is a need for certain levels of a balancing act among key project stakeholders, striving to obtain subcontractors' buy-in towards using prefabrication and involving them as early as possible so that they can share their inputs and concerns. Particularly, as evidenced in the findings above, the role of relevant government bodies is crucial towards educating and motivating all stakeholders to be more waste conscious and environmentally friendly, incentivizing or disincentivizing good and bad waste behaviors and practices. This is further echoed by some respondents:

> "More government subsidy should be provided to support the use of prefabrication, and perhaps, more research and product development grants... Furthermore, there should be some forms of reward system to incentivize good waste practices and performance". Respondent 28 (principal contractor)

"It is important to incentivize pre-fabrication and create a healthier market of pre-fabrication options... Maybe it should be included as a requirement in some green certification tools". Respondent 43 (design consultant)

3.3. Attitudes to C&D Waste Management

Having discussed their perceptions, Tables 3 and 6 reveal respondents' attitudes towards waste and its management, which could be classified into the dimensions of values (i.e., normative drivers) and culture (i.e., cultural cognitive drivers). It is notable that respondents' attitudes are mainly driven by the industry's culture, with an overall average RPI of 0.60, and that most of them perceived waste as an inevitable by-product of construction activities (A1; RPI = 0.67; WSR = 3.96 at $p < 0.001$) but believed that it has certain degrees of value (A2; RPI = 0.49; WSR = 7.00 at $p < 0.001$). Although no consensus was detected, respondents showed tendencies towards pushing the responsibility of waste management or minimization to their peers (A3; RPI = 0.63; WSR = 1.77 at $p > 0.05$). This, thus, further sheds light on the waste management culture and the opportunistic behaviour and moral hazards that exist within the construction supply chain relationship in Australia.

Table 6. Attitudes to C&D waste management and their differences across design consultants, principal contractors and sub-contractors.

Code	RPI	Overall Average RPI of Respective Dimensions	WSR Test Median Value = 3		KWH Test			
			Median	Test Statistic	Mean Rank for D.C.	Mean Rank for P.C.	Mean Rank for S.C.	Test Statistic
A1	0.67	0.60	4	3.96 **	54.13	50.60	55.46	0.57
A2	0.49		2	7.00 **	51.83	51.65	57.92	0.63
A3	0.63		3	1.77	54.36	49.92	57.58	1.02
A4	0.49	0.44	2	4.37 **	43.79	56.92	59.92	5.62
A5	0.47		2	5.69 **	47.34	55.99	53.35	2.22
A6	0.37		2	8.44 **	47.91	53.93	60.08	2.31

NB: D.C., P.C. and S.C. denote design consultants, principal contractors, and subcontractors, respectively. ** and * denote statistically significant at $p < 0.05$ and $p < 0.001$, respectively.

On the other end, our findings tend to support those of Teo and Loosemore [14] in that respondents' attitude towards waste management is not negative, as evidenced by an overall average RPI of 0.44 for the 'value' dimension. Encouragingly, respondents tend to collectively dispute that waste management practices are only needed for large companies (A6; RI = 0.37; WSR = 8.44 at $p < 0.05$), time spent on waste management is a loss of production time (A5; RI = 0.47; WSR = 5.69 at $p < 0.05$) and waste management is less important than profit maximization (A4; RI = 0.49; WSR = 4.37 at $p < 0.05$). The overall image that emerges from here is that respondents are increasingly seeing the value of waste and waste management, particularly in this prevailing environment, as reflected in Loosemore and Lim [97,98], whose research shows that Australian and New Zealand construction supply chains were increasingly becoming aware of their business impact on the environment and placed top priorities on waste management practices towards showcasing their corporate social responsibility.

4. Summary and Research Implications

In summary, the overall results point to the multi-dimensional perspective of project stakeholders' attitudes and perceptions of C&D waste management. However, given that there are different dimensionalities across the respective attitudes and perceptions, Hypothesis H1 ('*Attitudes and perceptions of project stakeholders to C&D waste management could be classified along the dimensions of: (i) regulative-drivers; (ii) normative-drivers; and (iii) cultural cognitive- drivers*') is, thus, partially supported. Similarly, H2 ('*Attitudes and perception towards C&D waste management could vary across design consultants and principal and sub-contractors*') is partially supported since there are statistically significant differences among these project stakeholders for only some of the measurement items on their perceived barriers and strategies to C&D waste management (i.e., B1, S6, S7 and S9, see Tables 4–6).

Overall, the findings show that the respondents' attitudes and perceptions towards C&D waste management in the Australin construction industry are still largely driven by the industry's cultural cognition of risk transfer and opportunistic behaviors of project stakeholders, and that the principal–agent contractual relationship and power hierarchy are still the key barriers to effective C&D waste management. The survey respondents acknowledged and criticized the role and behaviors of respective stakeholders towards managing C&D waste, showcasing the underlying features of the actor network and agency theories and pointing to the fragmented but multi-disciplinary and dependent nature of the construction industry as an institution. Unfortunately, despite the increasing adoption and recent push of relationship-based contracting and procurement [73,77], the present findings tend to suggest that there is a lack of emphasis on how contractual parties could share the risks and benefits of effective implementation of C&D waste management and resource recovery throughout the planning, design and construction phases of a project. Perhaps further research could look at how construction contracts should be better configured to include waste management and minimization as one of the project objectives and setting up mechanisms in policing and benchmarking the waste generated, recycled and reused. Furthermore, we found that there is generally a lack of awareness and knowledge of C&D waste management, recycling and reusing practices, which collectively lead to the call for more training and development to be provided.

To exacerbate the above-mentioned adverse environment, the findings further show that clients and government bodies tend to act as an inhibitor rather than a catalyst to better waste management performance. Lack of interest and support from clients and company management, lack of government support, lack of waste recycling market and attitude towards using recyclable materials could collectively be seen as disincentives towards proactive waste management efforts. Our findings point to the need for clearer guidance and stricter legislation on waste management and minimization and stronger collaborations between industry and government, such as (i) mandating the submission of a detailed site waste management plan in the construction certificate application; (ii) adapting and mandating the Green Star construction and demolition waste management credit framework towards promoting and rewarding effective and innovative waste management practices; (iii) promoting, governing and incentivizing the use of recycled materials and prefabrication in all public sector projects; (iv) establishing a more cost-effective waste recycling market; and (v) promoting and establishing a joint working group between industry and government.

5. Conclusions

The responsibility for more effective C&D waste management should lie across all stakeholders instead of a single specific project stakeholder, starting from the initiation to completion stages of a construction project. This research investigated the attitudes and perceptions of design consultants and principal and sub-contractors towards C&D waste management in Australia. The results demonstrate the multi-dimensional perspective of project stakeholders' attitudes and perceptions towards C&D waste management, which could be classified along the dimensions of (i) regulative drivers; (ii) normative drivers; and (iii) cultural cognitive drivers. In addition, the attitudes and perception to C&D waste management vary across design consultants and principal and sub-contractors on their perceived barriers and strategies to C&D waste management. Our research offers a useful and integrated theoretical lens of multiple dimensions of C&D waste management and how different dimensions could predominate one another. Collectively, evidence has shown that, although there could be improvements in C&D waste management, the industry seems not fully ready for a circular economy.

However, we acknowledge that our findings are not conclusive but indicative. It follows that the findings could be interpreted with care and within the research limitations.

The sample size was relatively small, and the majority of the respondents were design consultants and principal contractors. Future studies should, thus, place more emphasis on increasing the overall responses, collecting the perception and attitude of sub-contractors and bringing in the perspective of project clients and government bodies. Also, this study did not attempt to model the effects of attitudes and perceptions on the behaviors or intention of project stakeholders, nor empirically examine the interrelationships between regulative, normative and cultural cognitive drivers towards implementing C&D waste management. These limitations could be potential areas for future research.

Author Contributions: Conceptualization, B.T.H.L. and B.L.O.; Methodology, B.T.H.L.; Formal analysis, B.T.H.L.; Investigation, C.M.; Writing—original draft, B.T.H.L.; Writing—review & editing, B.T.H.L., B.L.O. and P.Y.; Supervision, B.T.H.L. and B.L.O. All authors have read and agreed to the published version of the manuscript.

Funding: This research received no external funding.

Institutional Review Board Statement: This study was approved by the Human Research Ethics Committee of UNSW Sydney, Australia (HC190701, 2019).

Informed Consent Statement: Informed consent was obtained from all respondents involved in the study.

Data Availability Statement: Data is unavailable due to privacy or ethical restrictions.

Conflicts of Interest: The authors declare no conflicts of interest.

References

1. Department of Agriculture, Water and the Environment. National Waste Report. 2020. Available online: https://www.awe.gov.au/sites/default/files/env/pages/5a160ae2-d3a9-480e-9344-4eac42ef9001/files/national-waste-report-2020.pdf (accessed on 30 September 2021).
2. Eurostat. Waste Statistics. 2020. Available online: https://ec.europa.eu/eurostat/statistics-explained/index.php?title=Waste_statistics&oldid=589096 (accessed on 24 February 2023).
3. United States Environmental Protection Agency (EPA, 2023) What Is a Circular Economy? Available online: https://www.epa.gov/circulareconomy/what-circular-economy#:~:text=It%20is%20a%20change%20to,manufacture%20new%20materials%20and%20products (accessed on 24 February 2023).
4. Australia State of the Environment. Urban Environmental Efficiency: Este Generation and Recovery. 2016. Available online: https://soe.environment.gov.au/theme/built-environment/topic/2016/urban-environmental-efficiency-waste-generation-and-recovery (accessed on 30 September 2021).
5. World Bank. Global Waste to Grow by 70 Percent by 2050 Unless Urgent Action Is Taken: World Bank Report. 2018. Available online: https://www.worldbank.org/en/news/press-release/2018/09/20/global-waste-to-grow-by-70-percent-by-2050-unless-urgent-action-is-taken-world-bank-report (accessed on 30 September 2021).
6. Roche, T.D.; Hegarty, S. Best Practice Guidelines on the Preparation of Waste Management Plans for Construction and Demolition Projects. 2006. Available online: https://www.leanbusinessireland.ie/includes/documents/BPGConstructionand%20demolition.pdf (accessed on 30 September 2021).
7. Ghaffar, S.H.; Burman, M.; Braimah, N. Pathways to circular construction: An integrated management of construction and demolition waste for resource recovery. *J. Clean. Prod.* **2020**, *244*, 118710. [CrossRef]
8. Andersson, R.; Buser, M. From waste to resource management? Construction and demolition waste management through the lens of institutional work. *Constr. Manag. Econ.* **2022**, *40*, 477–496. [CrossRef]
9. Department of Climate Change, Energy, the Environment and Water (DCEEW) of Australian Government. Transitioning to a More Circular Economy. 2023. Available online: https://www.dcceew.gov.au/environment/protection/circular-economy#:~:text=All%20of%20Australia%E2%80%99s%20environment%20ministers,a%20circular%20economy%20by%202030 (accessed on 24 February 2023).
10. Environmental Protection Agency (EPA). Sustainable Management of Construction and Demolition Materials. 2023. Available online: https://www.epa.gov/smm/sustainable-management-construction-and-demolition-materials (accessed on 24 February 2023).
11. Dainty, A.R.J.; Brooke, R.J. Towards improved construction waste minimisation: A need for improved supply chain integration? *Struct. Surv.* **2004**, *22*, 20–29. [CrossRef]
12. Ofori, G. Greening the construction supply chain in Singapore. *Eur. J. Purch. Supply Manag.* **2000**, *6*, 95–206. [CrossRef]
13. Li, J.; Tam, W.Y.V.; Zuo, J.; Zhu, J. Designers' attitude and behaviour towards construction waste minimization by design: A study in Shenzhen, China. *Resour. Conserv. Recycl.* **2015**, *105*, 29–35. [CrossRef]
14. Teo, M.M.M.; Loosemore, M. A theory of waste behaviour in the construction industry. *Constr. Manag. Econ.* **2001**, *19*, 741–751. [CrossRef]

15. Park, J.; Tucker, R. Overcoming barriers to the reuse of construction waste material in Australia: A review of the literature. *Int. J. Constr. Manag.* **2017**, *17*, 228–237. [CrossRef]
16. Ajayi, S.; Oyedele, L.; Bilai, M.; Akinade, O.; Alaka, H.; Owolabi, H.; Kadiri, K. Waste effectiveness of the construction industry: Understanding the impediments and requisites for improvements. *Resour. Conserv. Recycl.* **2015**, *102*, 101–112. [CrossRef]
17. Tam, V.W.Y.; Kotrayothar, D.; Loo, Y.C. On the prevailing construction waste recycling practices: A South East Queensland study. *Waste Manag. Res.* **2009**, *27*, 167–174. [CrossRef]
18. Udawatta, N.; Zuo, J.; Chiveralls, K.; Yuan, H.; Zillante, G.; Elmualim, A. Major factors impeding the implementation of waste management in Australian construction projects. *J. Green Build.* **2018**, *13*, 101–121. [CrossRef]
19. Yuan, H. Critical management measures contributing to construction waste management: Evidence from construction projects in China. *Proj. Manag. J.* **2013**, *44*, 101–112. [CrossRef]
20. Hwang, B.G.; Yao, Z.B. Perception on benefits of construction waste management in the Singapore construction industry. *Eng. Constr. Archit. Manag.* **2011**, *18*, 394–406. [CrossRef]
21. Lim, B.T.H.; Ling, F.Y.Y.; Ibbs, W.; Benny, R.; Ofori, G. Empirical analysis of the determinants of organizational flexibility in the construction business. *J. Constr. Eng. Manag.* **2011**, *137*, 225–237. [CrossRef]
22. Ikau, R.; Joseph, C.; Tawie, R. Factors Influencing Waste Generation in the Construction Industry in Malaysia. *Procedia-Soc. Behav. Sci.* **2016**, *234*, 11–18. [CrossRef]
23. Poon, C.S.; Yu, A.T.W.; Jaillion, L. Reducing building waste at construction sites in Hong Kong. *Constr. Manag. Econ.* **2004**, *22*, 461–470. [CrossRef]
24. Yu, A.T.W.; Wong, I.; Wu, Z.; Poon, C.S. Strategies for Effective Waste Reduction and Management of Building Construction Projects in Highly Urbanized Cities—A Case Study of Hong Kong. *Buildings* **2021**, *11*, 214. [CrossRef]
25. Ajayi, S.O.; Oyedele, L.O.; Kadiri, K.O.; Akinade, O.O.; Bilal, M.; Owolabi, H.A.; Alaka, H.A. Competency-based measures for designing out construction waste: Task and contextual attributes. *Eng. Constr. Archit. Manag.* **2016**, *23*, 464–490. [CrossRef]
26. Osmani, M. Construction Waste Minimization in the UK: Current Pressures for Change and Approaches. *Procedia-Soc. Behav. Sci.* **2012**, *40*, 37–40. [CrossRef]
27. Lu, N.; Liska, R.W. Designers' and general contractors' perceptions of offsite construction techniques in the United State construction industry. *Int. J. Constr. Educ. Res.* **2008**, *4*, 177–188. [CrossRef]
28. Osmani, M.; Glass, J.; Price, A.D.F. Architect and contractor attitudes to waste minimisation. *Proc. Inst. Civ. Eng.-Waste Resour. Manag.* **2006**, *159*, 65–72. [CrossRef]
29. Osmani, M.; Glass, J.; Price, A.D.F. Architects' perspectives on construction waste reduction by design. *Waste Manag.* **2008**, *28*, 1147–1158. [CrossRef] [PubMed]
30. Yuan, H.; Shen, L.; Wang, J. Major obstacles to improving the performance of waste management in China's construction industry. *Facilities* **2011**, *29*, 224–242. [CrossRef]
31. Kulatunga, U.; Amaratunga, D.; Haigh, R.; Rameezdeen, R. Attitudes and perceptions of construction workforce on construction waste in Sri Lanka. *Manag. Environ. Qual.* **2006**, *17*, 57–72. [CrossRef]
32. Udawatta, N.; Zuo, J.; Chiveralls, K.; Zillante, G. Attitudinal and behavioural approaches to improving waste management on construction projects in Australia: Benefits and limitations. *Int. J. Constr. Manag.* **2015**, *15*, 137–147. [CrossRef]
33. Shen, L.Y.; Tam, V.W.Y. Implementation of environmental management in the Hong Kong construction industry. *Int. J. Proj. Manag.* **2002**, *20*, 535–543. [CrossRef]
34. Lu, W.; Yuan, H.; Li, J.; Hao, J.J.L.; Mi, X.; Ding, Z. An empirical investigation of construction and demolition waste generation rates in Shenzhen city, South China. *Waste Manag.* **2011**, *31*, 680. [CrossRef]
35. Poon, C.S.; Yu, A.T.W.; Wong, A.; Yio, R. Quantifying the Impact of Construction Waste Charging Scheme on Construction Waste Management in Hong Kong. *J. Constr. Eng. Manag.* **2013**, *139*, 466–479. [CrossRef]
36. Mahpour, A. Prioritizing barriers to adopt circular economy in construction and demolition waste management. *Resour. Conserv. Recycl.* **2018**, *134*, 216–227. [CrossRef]
37. Yuan, H. Key indicators for assessing the effectiveness of waste management in construction projects. *Ecol. Indic.* **2013**, *24*, 476–484. [CrossRef]
38. Ling, F.Y.Y. Strategies for construction waste management in Ho Chi Minh City, Vietnam. *Built Environ. Proj. Asset Manag.* **2013**, *3*, 141–156. [CrossRef]
39. Poon, C.S.; Yu, A.T.W.; Ng, L.H. On-site sorting of construction and demolition waste in Hong Kong. *Resour. Conserv. Recycl.* **2001**, *32*, 157–172. [CrossRef]
40. Udawatta, N.; Zuo, J.; Chiveralls, K.; Zillante, G. Improving waste management in construction projects: An Australian study. *Resour. Conserv. Recycl.* **2015**, *101*, 73–83. [CrossRef]
41. Yuan, H. A SWOT analysis of successful construction waste management. *J. Clean. Prod.* **2013**, *39*, 1–8. [CrossRef]
42. Lu, W.; Yuan, H. Exploring critical success factors for waste management in construction projects of China. *Resour. Conserv. Recycl.* **2010**, *55*, 201–208. [CrossRef]
43. Ajayi, S.O.; Oyedele, L.O.; Bilal, M.; Akinade, O.O.; Alaka, H.A.; Owolabi, H.A. Critical management practices influencing on-site waste minimization in construction projects. *Waste Manag.* **2017**, *59*, 330–339. [CrossRef] [PubMed]
44. Tam, C.M.; Tam, V.W.Y.; Chan, J.K.W.; Ng, W.C.Y. Use of prefabrication to minimize construction waste—A case study approach. *Int. J. Constr. Manag.* **2005**, *5*, 91–101. [CrossRef]

45. Jaillon, L.; Poon, C.S.; Chiang, Y.H. Quantifying the waste reduction potential of using prefabrication in building construction in Hong Kong. *Waste Manag.* **2009**, *29*, 309–320. [CrossRef] [PubMed]
46. Li, Z.; Shen, G.Q.; Alshawi, M. Measuring the impact of prefabrication on construction waste reduction: An empirical study in China. *Resour. Conserv. Recycl.* **2014**, *91*, 27–39. [CrossRef]
47. Akinade, O.O.; Oyedele, L.O.; Bilal, M.; Ajayi, S.O.; Owolabi, H.A.; Alaka, H.A.; Bello, S.A. Waste minimisation through deconstruction: A BIM based Deconstructability Assessment Score (BIM-DAS). *Resour. Conserv. Recycl.* **2015**, *105*, 167–176. [CrossRef]
48. Akinade, O.O.; Oyedele, L.O.; Ajayi, S.O.; Bilal, M.; Alaka, H.A.; Owolabi, H.A.; Arawomo, O.O.O. Designing out construction waste using BIM technology: Stakeholders' expectations for industry deployment. *J. Clean. Prod.* **2018**, *180*, 375–385. [CrossRef]
49. Ajayi, S.O.; Oyedele, L.O.; Akinade, O.O.; Bilal, M.; Alaka, H.A.; Owolabi, H.A.; Kadiri, K.O. Attributes of design for construction waste minimization: A case study of waste-to-energy project. *Renew. Sustain. Energy Rev.* **2017**, *73*, 1333–1341. [CrossRef]
50. Lingard, H.; Graham, P.; Smithers, G. Employee perceptions of the solid waste management system operating in a large Australian contracting organization: Implications for company policy implementation. *Constr. Manag. Econ.* **2000**, *18*, 383–393. [CrossRef]
51. Kabirifar, K.; Mojtahedi, M.; Wang, C.C. A Systematic Review of Construction and Demolition Waste Management in Australia: Current Practices and Challenges. *Recycling* **2021**, *6*, 34. [CrossRef]
52. Arain, F.M.; Assaf, S.; Low, S.P. Discrepancies between Design and Construction. *Archit. Sci. Rev.* **2004**, *47*, 237–249. [CrossRef]
53. Akinade, O.O.; Oyedele, L.O. Integrating construction supply chains within a circular economy: An ANFIS-based waste analytics system (A-WAS). *J. Clean. Prod.* **2019**, *229*, 863–873. [CrossRef]
54. Liu, J.; Yi, Y.; Wang, X. Exploring factors influencing construction waste reduction: A structural equation modeling approach. *J. Clean. Prod.* **2020**, *276*, 123185. [CrossRef]
55. Won, J.; Cheng, J.C.P. Identifying potential opportunities of building information modelling for construction and demolition waste. *Autom. Constr.* **2017**, *29*, 3–18. [CrossRef]
56. Latour, B. *Science in Action: How to Follow Scientists and Engineers through Society*; Harvard University Press: Cambridge, MA, USA, 1987.
57. Jensen, M.C.; Meckling, W.H. Theory of the firm: Managerial behavior, agency costs and ownership structure. *J. Financ. Econ.* **1976**, *3*, 305–360. [CrossRef]
58. Dimaggio, P.J.; Powell, W.W. The iron cage revisited: Institutional isomorphism and collective rationality in organizational fields. *Am. Sociol. Rev.* **1983**, *48*, 147–160. [CrossRef]
59. Cerulo, K.A. Non-humans in Social Interaction. *Annu. Rev. Sociol.* **2009**, *35*, 531–552. [CrossRef]
60. Ceric, A. Communication risk in construction projects: Application of principal-agent theory. *Organ. Technol. Manag. Constr. Int. J.* **2012**, *4*, 522–533.
61. Eisenhardt, K.M. Agency Theory: An Assessment and Review. *Acad. Manag. Rev.* **1989**, *14*, 57–74. [CrossRef]
62. Ceric, A. The nemesis of project management: The gaping non-contractual gap. *Procedia Soc. Behav. Sci.* **2014**, *119*, 931–938. [CrossRef]
63. Hendry, J. The Principal's Other Problems: Honest Incompetence and the Specification of Objectives. *Acad. Manag. Rev.* **2002**, *27*, 98–113. [CrossRef]
64. Beldek, T.; Camgöz-Akdağ, H.; Hoskara, E.; Camgoz Akdag, H.C. Green supply chain management for construction waste: Case study for Turkey. *Int. J. Sustain. Dev. Plan.* **2016**, *11*, 771–780. [CrossRef]
65. Scott, W.R. *Institutions and Organizations*; Sage: Thousand Oaks, CA, USA, 2001.
66. Bryman, A. *Social Research Methods*; Oxford University Press: Oxford, UK, 2016.
67. Robson, C. *Real World Research: A Resource for Social Scientists and Practitioner-Researchers*, 2nd ed.; Blackwell Publisher Ltd.: Oxford, UK, 2002.
68. Tan, W. *Practical Research Methods*, 2nd ed.; Pearson Education South Asia: Singapore, 2002.
69. Boynton, P.M.; Greenhalgh, T. Selecting, designing, and developing your questionnaire. *Br. Med. J.* **2004**, *328*, 1312–1315. [CrossRef] [PubMed]
70. Dawes, J. Do data characteristics change according to the number of scale points used? An experiment using 5-point, 7-point and 10-point scales. *Int. J. Mark. Res.* **2007**, *50*, 61–78. [CrossRef]
71. Comrey, A.L. *A First Course in Factor Analysis*; Academic Press: New York, NY, USA, 1973.
72. Nunnally, J.C. *Psychometric Theory*, 2nd ed.; McGraw-Hill: New York, NY, USA, 1978.
73. Lim, B.T.H.; Loosemore, M. The effect of inter-organizational justice perceptions on organizational citizenship behaviors in construction projects. *Int. J. Proj. Manag.* **2017**, *35*, 95–106. [CrossRef]
74. Loosemore, M.; Lim, B.T.H. Intra-organisational injustice in the construction industry. *Eng. Constr. Archit. Manag.* **2016**, *23*, 428–447. [CrossRef]
75. Loosemore, M.; Lim, B.T.H.; Ling, F.Y.Y.; Zeng, H.Y. A comparison of corporate social responsibility practices in the Singapore, Australia and New Zealand construction industries. *J. Clean. Prod.* **2018**, *190*, 149–159. [CrossRef]
76. Oo, B.L.; Lim, B.T.H. A review of Singapore contractors' attitudes to environmental sustainability. *Archit. Sci. Rev.* **2011**, *54*, 335–343. [CrossRef]
77. Loosemore, M.; Lim, B.T.H. Relationship quality in construction projects: A subcontractor perspective of principal contractor relationships. *Int. J. Proj. Manag.* **2021**, *39*, 633–645.

78. Ajayi, S.O.; Oyedele, L.O.; Akinade, O.O.; Bilal, M.; Owolabi, H.A.; Alaka, H.A.; Kadiri, K.O. Reducing waste to landfill: A need for cultural change in the UK construction industry. *J. Build. Eng.* **2016**, *5*, 185–193. [CrossRef]
79. Lim, B.T.H.; Zhang, W.; Oo, B.L. Sustainable procurement in Australia: Quantity surveyors' perception on life cycle costing. *Int. J. Integr. Eng.* **2018**, *10*, 1–6. [CrossRef]
80. Calvo, N.; Varela-Candamio, L.; Novo-Corti, I. A dynamic model for construction and demolition (C&D) waste management in Spain: Driving policies based on economic incentives and tax penalties. *Sustainability* **2014**, *6*, 416–435.
81. Hwang, B.G.; Ng, W.J. Project management knowledge and skills for green construction: Overcoming challenges. *Int. J. Proj. Manag.* **2013**, *31*, 272–284. [CrossRef]
82. Brown, C.; Milke, M. Recycling disaster waste: Feasibility, method and effectiveness. *Resour. Conserv. Recycl.* **2016**, *106*, 21–32. [CrossRef]
83. Caldera, S.; Ryley, R.; Zatylo, N. Enablers and Barriers for Creating a Marketplace for Construction and Demolition Waste: A Systematic Literature Review. *Sustainability* **2020**, *12*, 9931. [CrossRef]
84. Zhao, X. Stakeholder-Associated Factors Influencing Construction and Demolition Waste Management: A Systematic Review. *Buildings* **2021**, *11*, 149. [CrossRef]
85. Thornton, T. Waste Not, Want Not: Morrison Government's $1b Recycling Plan Must Include Avoiding Waste in the First Place. 2020. Available online: https://theconversation.com/waste-not-want-not-morrison-governments-1b-recycling-plan-must-include-avoiding-waste-in-the-first-place-142038 (accessed on 11 December 2021).
86. Shooshtarian, S.; Maqsood, T. Australia Needs Construction Waste Recycling Plants—But Locals First Need to Be Won over. 2021. Available online: https://theconversation.com/australia-needs-construction-waste-recycling-plants-but-locals-first-need-to-be-won-over-161888 (accessed on 11 December 2021).
87. Begum, R.A.; Siwar, C.; Pereira, J.J.; Jaafar, A.H. Attitude and behavioral factors in waste management in the construction industry of Malaysia. *Resour. Conserv. Recycl.* **2009**, *53*, 321–328. [CrossRef]
88. Ng, S.L.; Tam, L.W.; Shen, T.W. Constraints to 3R construction waste reduction among contractors in Penang. *IOP Conf. Ser. Earth Environ. Sci.* **2018**, *140*, 012103. [CrossRef]
89. Shooshtarian, S.; Maqsood, T.; Khalfan, M.; Wong, P.; Yang, R. Construction and Demolition Waste Management in Australia: Review of Differences in Jurisdictional Regulatory Frameworks. 2021. Available online: https://sbenrc.com.au/app/uploads/2021/03/P1.65-Construction-and-Demolition-Waste-Management-in-Australia-Review-of-Differences-in-Jurisdictional-Regulatory-Frameworks.pdf (accessed on 11 December 2021).
90. Kpamma, E.Z.; Kumi, T.A. Management of Waste in the Building Design Process: The Ghanaian Consultants' Perspective. *Archit. Eng. Des. Manag.* **2011**, *7*, 102–112. [CrossRef]
91. Ganiyu, S.A.; Oyedele, L.O.; Akinade, O.; Owolabi, H.; Akanbi, L.; Gbadamosi, A. BIM competencies for delivering waste-efficient building projects in a circular economy. *Dev. Built Environ.* **2020**, *4*, 100036. [CrossRef]
92. Foresight Environment. Construction Waste Management plan for Western Sydney Stadium. 2017. Available online: https://www.infrastructure.nsw.gov.au/media/1770/b49-wss-construction-waste-management-plan.pdf (accessed on 11 October 2021).
93. Mcdonald, B.; Smithers, M. Implementing a waste management plan during the construction phase of a project: A case study. *Constr. Manag. Econ.* **1998**, *16*, 71–78. [CrossRef]
94. WRAP. WARP Designing out Waste. 2016. Available online: http://www.modular.org/marketing/documents/DesigningoutWaste.pdf (accessed on 11 October 2021).
95. Zero Waste Scotland Limited. Designing out Construction Waste: A Guide for Project Design Teams. 2014. Available online: https://www.zerowastescotland.org.uk/sites/default/files/Designing%20Out%20Construction%20Waste%20Guide_0.pdf (accessed on 11 October 2021).
96. Goh, E.; Loosemore, M. The impacts of industrialization on construction subcontractors: A resource-based view. *Constr. Manag. Econ.* **2017**, *35*, 288–304. [CrossRef]
97. Loosemore, M.; Lim, B.T.H. Linking corporate social responsibility and organizational performance in the construction industry. *Constr. Manag. Econ.* **2017**, *35*, 90–105. [CrossRef]
98. Loosemore, M.; Lim, B.T.H. Mapping corporate social responsibility strategies in the construction and engineering industry. *Constr. Manag. Econ.* **2018**, *36*, 67–82. [CrossRef]