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# BRIDGING THE GAP: ENABLING A SECONDARY MATERIAL MARKET FOR CONSTRUCTION AND DEMOLITION WASTE

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## *ABSTRACT*

*Reintroducing construction and demolition waste (C&DW) to the construction supply chains in the form of secondary materials (SMs) has been in the global limelight over the past decades. However, the underdevelopment/non-existence of SM markets in developing countries stands as a significant barrier. Thus, this study aims to facilitate the widespread reuse of C&DW by reinforcing the SM market in Sri Lanka. The aim was accomplished by conducting an explanatory sequential mixed method research following the survey strategy. Initially, a quantitative questionnaire survey was conducted with 92 respondents, followed by a qualitative survey in the form of semi-structured interviews with 13 experts. Data were analysed through descriptive statistics and content analysis, respectively. Findings revealed that in Sri Lanka, C&DW are directed to landfills on 75% of the occasions, and only 14.47% are directed for reprocessing. Concrete, steel, and timber are the most used C&DW types as SMs. In Sri Lanka, using SMs is limited to post-disaster reconstruction, green buildings, and a few signature projects due to the absence of an established SM market. Therefore, it is crucial to overcome the limited scope and application of SMs and ensure widespread adoption across the CI by establishing a SM market characterised by a web-based digital database. Accordingly, this research contributes the realm of C&DW management, both practically and theoretically by scrutinising the role of the SM market in realising the closed loop and substantiating the ability of the SM market to bridge the gap.*

**Keywords:** *Construction and Demolition Waste (C&DW); Recycling, Repurposing; Reusing; Secondary Material (SM) Market.*

## 1. INTRODUCTION

The construction industry (CI) constitutes one of the main consumers of raw materials and producers of waste worldwide (Papamichael et al., 2023). Particularly, CI consumes about 50% of the global raw material, accounting for over 35% of the energy-related greenhouse gas emissions and generates about 35% of the world's solid waste (Nawaz et al., 2023). For example, in the European Union (EU), CI is responsible for over 35% of its solid waste (Gherman et al., 2023). The fundamental reason behind the accelerated

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construction and demolition waste (C&DW) generation is the reliance upon the linear economic model of "take–make–dispose" (Shooshtarian et al., 2022).

C&DW can be defined as "A resource material that arises from construction, renovation and demolition activities, which needs to be transported from the site and has the potential to be repurposed through downcycling or upcycling" (Caldera et al., 2020, p. 7). It often consists of materials such as concrete, wood, metals, plastics, and bricks, as well as hazardous substances such as asbestos and lead (Bokarde, 2021). Traditionally, C&DW have ended up in landfills, leading to environmental degradation, pollution, inefficient utilisation of lands, unnecessary depletion of natural resources, and habitat destruction (Lindhard et al., 2023). In response, the CI adopted the concept of reverse logistics (RL) to divert C&DW from landfills (Tennakoon et al., 2021). RL supply chain (RLSC) of C&DW is "a chain of activities followed in introducing salvageable material from DW, back to the forward supply chain" (Rogers & Tibben-Lembke, 1998, p 262). It consists of five stages, namely dismantling, sorting and segregation, reprocessing, secondary market operations, and residue disposal (Jayasinghe, Rameezdeen, & Chileshe, 2019). As C&DW passes through the RLSC, recoverable C&DW are converted into value-added resources and introduced to the secondary material (SM) markets, while unrecoverable C&DW are disposed methodically (Tennakoon et al., 2021).

A SM market refers to a structured and often digitalized system that enables the trade, procurement, and reuse of materials recovered from construction, demolition, and restoration activities. These markets serve as intermediaries connecting suppliers of recovered materials with potential users, thereby supporting reverse logistics and promoting circular economy practices in the construction industry (Victar & Waidyasekara, 2023). Using SMs decreases the dependency on virgin materials, minimises carbon emissions from raw material extraction and processing, and generates economic benefits from the C&DW (Bao & Lu, 2020). Despite these benefits, SMs are less popular, especially in developing countries such as Sri Lanka, Bangladesh, and Nigeria, where weak regulatory frameworks, limited awareness, and lack of market infrastructure hinder their widespread adoption (Jin et al., 2019). Importantly, significant gaps exist between waste generation, recovery, and SM markets including the lack of proper waste segregation at source, limited reprocessing capacity, poor integration between waste collectors and reusers, and the absence of centralised platforms to connect recovered materials with potential users (Tennakoon et al., 2021). Having a rapidly expanding CI, growing C&DW generation, and the notable absence of a structured SM market despite increasing interest in circular economy practices exemplifies the need of practicaal and systematic solutions in construction and demolition waste management (C&DWM in the Sri Lanka. In response to this SM market development emerged as a pivotal area of focus in the CI (Shooshtarian et al., 2022). However, there is a lack of research, especially in the Sri Lankan context, that scrutinises the role of the SM market in C&DWM (Victar & Waidyasekara, 2023). Therefore, this study addresses the research question: "How can the gap in C&DWM in Sri Lanka be bridged through the development of a SM market?". The gap refers to the lack of a structured system that enables the recovery, reprocessing, and reuse of C&DW. Thus, the study aims to facilitate the widespread reuse of C&DW by reinforcing the SM market in Sri Lanka. Accordingly, the objectives of the study are: (1) to examine the current practices and challenges in managing the C&DW in Sri Lanka and (2) to explore the industrial need for a SM market in Sri Lanka.

# 2. LITERATURE REVIEW

## 2.1 CONSTRUCTION AND DEMOLITION WASTE MANAGEMENT

C&DW can be categorised into two types: inert and non-inert (Caldera et al., 2020). Inert wastes are typically stable, non-hazardous, and suitable for repurposing in construction projects or disposal in public fills (Amararathne & Bandara, 2024). A significant portion of C&DW consists of inert waste, which is further divided into hard and soft inert waste. Hard inert waste includes materials such as rocks and shattered concrete, while soft inert waste includes soil, earth, silt, and slurry (Amararathne & Bandara, 2024). Contrariwise, non-inert waste may biodegrade, burn, or leak dangerous compounds, such as metals, glass, plastics, and wood (Ahmed & Zhang, 2021). Non-inert wastes are usually sent to landfills, considering handling and processing complexities, and negative environmental and health impacts. Therefore, waste segregation is essential for effective reprocessing and mitigating the associated risks (Ahmed & Zhang, 2021). This is further underpinned by the 3Rs: Reduce, Reuse, and Recycle that serve as the basis for C&DWM (Zhang et al., 2022). However, 3R strategy has now been shifted to 10R strategy: *R0-refuse, R1-rethink, R2-reduce, R3 reuse, R4-repair, R5-refurbish, R6-remanufacture, R7-repurpose, R8-recycle, R9-recover, and R10-regenerate* (Gherman et al., 2023).

Regulations have been implemented globally to reduce the negative impacts of C&DW and promote material recovery. For instance, the Waste Framework Directive (2008/98/EC) EU requires 70% of waste from C&DW to be recycled by 2020 (Shooshtarian et al., 2022). The law encourages resource efficiency and extended producer responsibility (EPR) by making stakeholders responsible for the whole lifecycle of materials. Similarly, in Japan, the Construction Engineering Materials Recycling Law mandates that wood, asphalt, and concrete materials be recycled, with the support of government incentives (Zhao, 2021). Although it is not exhaustive for all purposes, the Environment Conservation Act of 1995 in Bangladesh has a fair allowance for waste (Mustofa, 2020). Additionally, the Japanese government offers incentives for companies that utilise recycled materials, promoting a self-sustaining CE within the CI (Purchase et al., 2021). Similarly, in Korea, tightly regulated legislation on C&DWM has led to high reprocessing rates and reduced landfill dependency (Kim, 2021).

C&DW has become a major problem due to rapid urbanisation and accelerated infrastructure development in Sri Lanka (Liyanage et al., 2019). The lack of state mechanisms for collecting, sorting, and processing waste is one of the main obstacles to efficient C&DWM in Sri Lanka (Wijewansha et al., 2021). Though government initiatives encourage sustainability in the CI, they are constrained by inadequate policy enforcement, weak institutional frameworks, and limited stakeholder coordination (Weerakoon et al., 2023). As a result, significant gaps remain in Sri Lanka's approach compared to global best practices. However, the awareness of the economic and ecological benefits of sustainable C&DWM is gradually increasing, driving greater stakeholder involvement in C&DWM (Victar & Waidyasekara, 2023).

## 2.2 SECONDARY MATERIALS IN CONSTRUCTION

Wood, steel, and concrete are the most common C&DW that can be transformed into SM (Ginga et al., 2020). Reintroduction of waste into supply chains reduces reliance on virgin resources and makes a substantial contribution to resource efficiency (Liyanage et al., 2019). Additionally, permitting SM lessens the reliance on landfills, offers an economical alternative by lowering the demand for virgin resources, reduces the related extraction expenses, and fosters economic resilience within the construction sector (Haider et al., 2019). Table 1 below depicts the properties of virgin material vs SM.

*Table 1: Comparison of virgin material and SM*

| Property | Virgin Material | Secondary Materials | References |
|---|---|---|---|
| Mechanical Strength | Higher tensile and flexural strength. | Strength decreases with more reprocessing cycles due to polymer degradation.<br>The 20% virgin material combination produced the best mechanical characteristics. | (Rahimi et al., 2014) |
| Thermal Stability | Higher stability due to intact polymer chains. | Reduced stability with reprocessing cycles; degradation occurs faster, particularly under thermal-oxidative conditions<br>Compared to the virgin polypropylene (451.8 C), the recycled polypropylene had a higher maximum degradation rate temperature (457.1 C). | (Stoian et al., 2019) |
| Rheological Properties | Lower melt flow index (MFI), indicates higher viscosity and molecular weight. | Higher Melt Flow Index due to polymer chain scission and reduced molecular weight with each reprocessing cycle. | (Rahimi et al., 2014) |
| Impact Strength | Generally higher and more consistent across conditions. | Impact strength decreases significantly after the first few reprocessing cycles.<br>The impact strength of a material subjected to 20 reprocessing cycles decreased significantly, from 87.7 J/m to 14.2 J/m, yet its functionality remained within a 15% deviation from that of the virgin material. | (Chiu et al., 2018) |
| Flexibility | Virgin materials maintain better flexibility and strain at break. | Reduced flexibility and elongation at the break due to molecular degradation over cycles. | (Traxler et al., 2023) |
| Additive Compatibility | Compatible with most standard industrial additives. | Requires higher concentrations of additives (e.g., chain extenders) to restore properties to near-virgin levels.<br>recycled PET requires 15–20% higher additive content compared to virgin PET to achieve near-original tensile strength and thermal stability | (Chiu et al., 2018) |

Difficulties in sorting and segregating C&DW due to technological constraints result in inferior quality SMs that might not satisfy industry standards. Additionally, high manufacturing costs related to quality control, advanced reprocessing technologies, and the unpredictable supply of C&DW impact the quality, availability, and price of SMs (Wijewickrama et al., 2021). Ultimately, these constraints lower the market value of SMs and their ability to compete with virgin alternatives (Wijewickrama et al., 2021), resulting in less demand.

### 2.3 SECONDARY MATERIAL MARKETS

Establishing a SM market is identified as a sustainable solution to overcome the issues associated with SMs (Shooshtarian et al., 2020). Even though existing SM markets are not operating at the desired level (Jayasinghe, Chileshe & Rameezdeen 2019; Munaro & Tavares, 2023), several noteworthy efforts in establishing SM markets for C&DW can be identified globally. For example, Australia has three SM markets, namely, Buy Recycled, Business Recycling, and ASPIRE (Shooshtarian et al., 2020). Similarly, three SM markets can be identified in the US: 2Good2Waste, Materials Marketplace, and Austin Materials Marketplace. Further, Salza is an SM market operating in Switzerland, while France, Ireland, and India have Backacia, SMILE, and Mjunction, respectively (Shooshtarian et al., 2020).

Those global examples reveal that online platforms, together with digital techniques, thrive as effective SM markets due to their versatility and accessibility (Caldera et al., 2020; Shooshtarian et al., 2020). However, developing a SM market is challenging as it requires careful consideration of various interrelated aspects such as stakeholders' perceptions (Shooshtarian et al., 2020), material procurement, recycling process, plant management and market promotions (Caldera et al., 2020). Once established, SM markets can rapidly grow with the increasing supply of C&DW (Caldera et al., 2020). Moreover, they create numerous direct and indirect employment opportunities, thereby supporting the economy (Nadazdi et al., 2022). However, the absence of a proper SM market is a significant dearth in the Sri Lankan CI, which is mostly attributed to the less regulatory support for C&DW reprocessing (Victar & Waidyasekara, 2023). Therefore, it is essential to study the need for a SM market in Sri Lanka.

## 3. METHODOLOGY

The study was initiated by carrying out a background study to refine the research area. Next, the objectives of the research were established based on the research question. Research philosophy inspires the way of answering the research question (Saunders et al., 2009). Accordingly, this study adopted pragmatism research philosophy. Consequently, it adopted the ontological assumption that “reality is external and multiple at the same time and that a researcher chooses the view best serves his research purposes” (Saunders et al., 2009) and the epistemological assumption that “both observable phenomena and subjective meanings can provide acceptable knowledge dependent upon the research question” (Saunders et al., 2009). This research employed a mixed-methods approach, combining quantitative and qualitative methods. By conceptualising the ontological, epistemological and axiological stances, Maarouf (2019) concluded that pragmatism is the coherent and integrated paradigm for the mixed research approach. Furthermore, the study employed an ‘explanatory sequential mixed methods’ design, where the quantitative part was followed by the qualitative part to further explain the quantitative results (Maarouf, 2019).

Under the quantitative part of the study, a questionnaire survey was conducted by distributing the questionnaire via email among 175 construction professionals who were selected through purposive sampling. Accordingly, 92 responses were received, recording a response rate of 52.57%. The purpose of conducting the questionnaire survey was to gather broad insights from industry practitioners on C&DWM and SM usage in Sri Lanka to identify prevailing trends and key issues. The collected data were analysed using descriptive statistics. Microsoft Excel was utilised for this purpose. Key measures such as weighted arithmetic mean (Equation 1), median, and mode were calculated. Subsequently, a qualitative survey was conducted with 13 experts selected through purposive sampling, as shown in Table 2, to explore the findings in depth and to capture nuanced perspectives on the structural and institutional gaps hindering SM market development in Sri Lanka. The data were collected through semi-structured interviews and analysed using content analysis. NVivo 12 was used in data organisation, coding, retrieval, and data exploration. This study followed the open, axial, and selective coding.

$$\bar{x} = \frac{\int(f \times x)}{\int f} \qquad Equation\ (1)$$

Where f = frequency and x = midpoint of each class.

*Table 2: Interviewee profile*

| Interviewee | Profession | Criteria | | | |
|---|---|---|---|---|---|
| | | **CQ1** | **CQ2** | **AQ1** | **AQ2** |
| E1 | Quality Assurance Manager | √ | √ | √ | |
| E2 | Lecturer | √ | √ | | √ |
| E3 | Project Manager | √ | √ | √ | |
| E4 | Project Quantity Surveyor | √ | √ | √ | √ |
| E5 | PhD Scholar | √ | √ | | √ |
| E6 | Quantity Surveyor | √ | √ | √ | |
| E7 | Engineer, CEO | √ | √ | √ | |
| E8 | Senior Lecturer | √ | √ | | √ |
| E9 | Project Manager | √ | √ | √ | |
| E10 | Chartered Architect, Director | √ | √ | √ | |
| E11 | General Manager | √ | √ | √ | |
| E12 | Senior Lecturer | √ | √ | √ | √ |
| E13 | PhD researcher | √ | √ | √ | √ |

**Compulsory Qualifications**
CQ1 - Degree in construction related fields
CQ2 - Minimum 10 years working experience in construction projects
**Additional qualifications (At least one should be fulfilled)**
AQ1 - Involvement in Projects which use SMs
AQ2 - Research experience in C&DW management

# 4. FINDINGS AND ANALYSIS

## 4.1 METHODS OF MANAGING CONSTRUCTION AND DEMOLITION WASTE IN SRI LANKA

Survey findings revealed the levels of popularity of several C&DWM methods in Sri Lanka, as shown in Table 3.

*Table 3: Level of popularity of C&DWM practices*

| Method | Frequency | Percentage (%) |
|---|---|---|
| Incineration | 14 | 15.22 |
| Landfilling | 69 | 75 |
| Let it subcontractor bring out of the project | 01 | 1.08 |
| Maintaining dumping yards | 01 | 1.08 |
| Offsite disposal | 02 | 2.17 |
| Handed over to a licensed waste disposer | 01 | 1.08 |
| On-site segregation of waste | 60 | 65.22 |
| Recycling materials | 35 | 38.04 |
| Reusing materials | 38 | 41.30 |

Accordingly, landfilling (75%) is the most common method. On-site segregation of waste (65.2%) is also widely practised, indicating the tendency towards sustainable practices by separating reprocess able materials before disposal.

Subsequently, expert interviews explored the current C&DWM practices in depth. The findings showed the emergence of landfilling as the primary method. E2 stated, "*Landfilling is the most used method*," while E6 confirmed, "*the majority went to landfills*." Several respondents, including E5 and E13, emphasised the linear nature of current C&DWM practices. E7 described it as having "*no system in Sri Lanka*," highlighting the absence of organised C&DWM frameworks in many projects.

## 4.2 CONSTRUCTION AND DEMOLITION WASTE REPROCESSING IN SRI LANKA

Survey respondents were asked to identify the amount of C&DW typically directed for reprocessing from projects that they were involved in Figure 1.

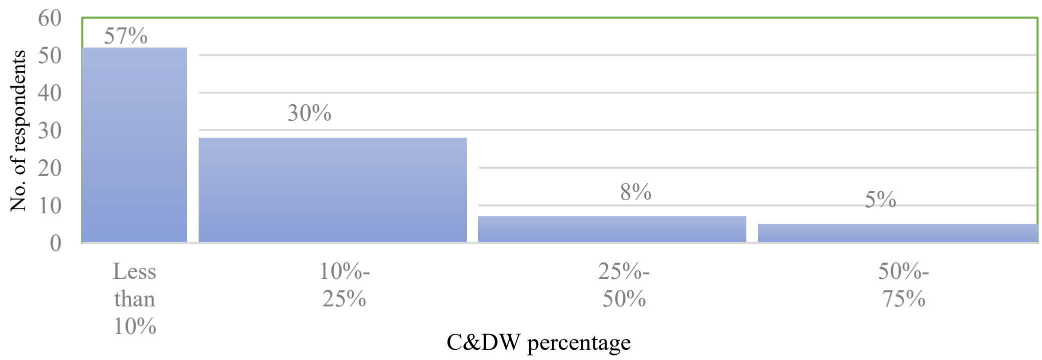


*Figure 1 - Percentage of C&DW typically directed for reprocessing*

According to Figure 1, occasions where at least one-fourth of the C&DW is directed for reprocessing are 13%. Moreover, as per Equation 1, the weighted arithmetic mean of the quantity of C&DW directed for reprocessing is 14.47%. Thus, despite the tendency towards segregation (as revealed in Section 4.1), only 14.47% of the C&DW is subjected to reprocessing, while the rest is discarded. Furthermore, limited public trust in the durability of recycled materials and the absence of life-cycle data on SMs restrict their wider acceptance.

Elaborating on this further, the findings of the expert interviews revealed that reprocessing initiatives remain limited in scope and applications. E1 noted, "*it is developing but not up to the required scale*," indicating gradual but insufficient progress. However, E5's observation that recycling was "*rare*" and E6's comment about "*very few recycling approaches*" confirmed that these efforts are not yet mainstream.

### 4.3 USAGE OF SECONDARY MATERIALS IN SRI LANKA

Figure 2 demonstrates the survey respondents' opinions regarding the importance of using SMs in construction.

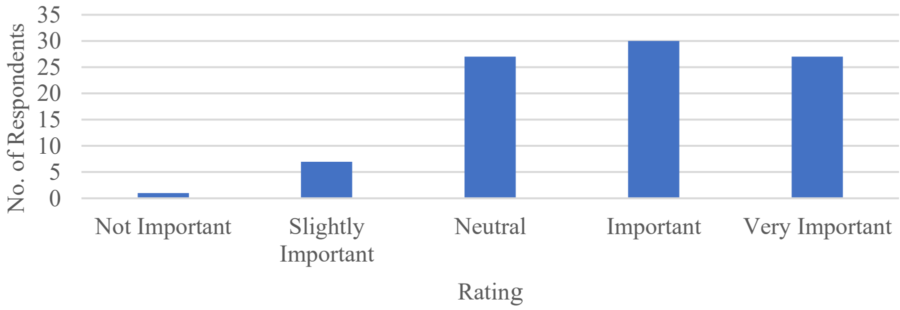


*Figure 1: Importance of using SMs in construction*

As per the findings, the mode of the data set is 'important', having 32.6% of the responses. Moreover, the 45.5$^{th}$ value holds the median position, which is 'important' as there are 34 responses up to 'neutral' and 64 responses up to 'important'. Accordingly, respondents held a positive attitude towards using SMs in construction. Additionally, 29.34% of the respondents remained neutral. However, despite the positive attitude, C&DW reprocessing is still nascent in Sri Lanka as discussed in section 4.2.

Intending an in-depth exploration of the survey results, the expert interviews focused on the different applications of SMs in the CI. The findings demonstrated varying levels of adoption across different material types. Concrete emerged as the most frequently recycled material, particularly in large-scale projects. E1 and E2 stated, "*in large-scale projects, it is concrete, concrete waste is the most reusable, recycled material*," with applications primarily in road construction as aggregate. E5 explained, "*demolished concrete waste was successfully used for low-volume roads via roller compacted concrete (RCC)*." Steel followed closely, with E12 noting its "*strong resale value*" and "*consistent recovery rates*". Timber reuse was widely reported (E3, E4, E8), though primarily limited to formwork and antique elements (E10). Furthermore, selective recovery of certain construction materials, though at limited scales, was reported. Bricks and roofing tiles showed partial reuse (E1, E7, E11), primarily in small-scale projects, while plastic recycling remained minimal due to technical constraints (E6). Materials such as gypsum are rarely recovered (E12), representing significant untapped potential. As E11 observed, "*we have reduced some of these things, but not for all*," highlighting the inconsistent adoption of material recovery practices across the industry.

Subsequently, the interviewees were questioned about the construction projects which used SMs in Sri Lanka. The responses revealed that while some projects demonstrated innovation, widespread adoption remains limited. Post-tsunami reconstruction (2004) marked early examples of using SMs. E2 noted, "*in Galle, some projects used SMs after the tsunami*," while E10 added, "*post-tsunami reconstruction incorporated salvaged timber and roofing sheets into new buildings*." These efforts highlight crisis-driven sustainability practices.

Recycling and reusing were emerging, albeit selectively. E3 shared, "*in Kadirana, a converted office block reused 30% of materials, roof tiles and timber for new construction*." Similarly, E7 observed, "*green buildings such as MAS factories and Guga hotel utilised recycled material*s," E8 mentioned, "*a hotel in Dambulla reused C&DW, though I can't recall specifics*." Meanwhile, E9 stated, "*our organization produces paving blocks from plastic and soil-cement blocks for low-rise buildings*." Referring to the Colombo Port City project, E4 reported, "*we reused excavated materials for reclamation*," and E11 elaborated, "*We recycled debris for piling. Our workshop had a dedicated plant*." Additionally, E6 mentioned the Construction Waste Management project funded by the EU (2005–2009) as "*a pilot recycling plant in Galle that processed mixed waste into road aggregates*."

As per the findings, emerging practices reflect shifting norms. Herein, E4 emphasised, "*NSBM Green University mandates waste segregation and sustainability reporting*," while E12 noted, "*some high-rise projects in Colombo pilot on-site recycling, but structured systems are still nascent*." However, E1 admitted, "*I have seen no 100% C&DW reused projects*" and E7 conceded, "*except green-certified buildings, other buildings do not tend to use recycled materials in their projects"*. E11 added, "*recycling is still rare and people do not fully grasp its benefits*." According to E12 Sri Lanka's C&DWM landscape is dotted with '*successful pilots*' but lacks systemic uptake. As E11 summarised, "*using SM at scale is rare*," underscoring the need for policy incentives and industry-wide adoption.

## 4.4 SM MARKETS IN SRI LANKA

Several interviewees identified market immaturity as the key obstacle. E3 reported, "*people think they [SMs] are degraded and superstitious,"* while E10 observed, "p*eople are not aware of the possibility of using SMs. Herein, e*xperts consistently highlighted the requirement for market development. E13 emphasised that "*we do not have established second-hand market...people always follow clients' requirements for virgin materials.* E7 noted that current usage is "*based on architects' vision, not policy,"* while E9 called for "*a platform"* to facilitate transactions. The accessibility of SMs in Sri Lanka remains limited, with respondents highlighting fragmented supply chains and a lack of formal market infrastructure. E1 noted, "t*here are no very good refinery places,"* while E4 described reliance on informal networks: "*it mostly depends on connections or paper advertisements."* E6 and E12 emphasised the absence of centralised platforms, with E12 stating, "*we do not have a centralised system for trading SMs"*. Most transactions occur through small-scale, informal vendors (E7, E9, E11), with E11 observed, "*You cannot buy 100 pieces of door frames"*. While few markets exist (e.g., Bellanthota for old doors/windows, E9), broader accessibility is hindered by poor awareness (E10) and a lack of digital databases (E13). Importantly, E5 contended that "*SM markets face accessibility issues."* Without organised hubs or online marketplaces, sourcing remains difficult, particularly for large-scale projects.

The analysis revealed that Sri Lanka's SMs market remains underdeveloped with systemic gaps. While environmental and economic pressures are creating demand (E5, E8, E12), comprehensive solutions addressing market infrastructure and awareness (E4, E9, E10) are needed to accelerate the adoption.

# 5. DISCUSSION

Agreeing with Caldera et al. (2020), Lindhard et al. (2023), and Shooshtarian et al. (2022) empirical findings of this study confirm that landfilling, which is found to be 75%, is the most common destination of C&DW. On the other hand, the level of on-site segregation, which is discovered as 65.2%, and the positive attitude of the construction professionals towards using SMs, support the claim of Victar & Waidyasekara (2023) regarding the rising efforts and tendency in diverting C&DW from landfilling. Nonetheless, the average reprocessing rate, which is less than 15%, statistically proves the findings of Tennakoon et al. (2021), who highlighted the gaps in C&DW flow between the RLSC stages. Comparatively, in Australia C&DW reprocessing rate is 60%, which is lower compared to other developed countries (Kabirifar et al., 2021). In developing countries such as Bangladesh and Nigeria, weak regulatory enforcement and limited infrastructure hinder effective C&DW reprocessing and the growth of SM markets (Jin et al., 2019).

Additionally, the findings reveal the varying levels of SM usage across different material types. Agreeing with Ginga et al. (2020), concrete was found to be the most common C&DW type, which is used as a SM, followed by steel and timber. Moreover, results reveal that using SMs is not yet mainstreamed in the CI, and the scope is mostly limited to post-disaster reconstruction, green buildings, and a few signature projects. Resonating with the findings of this study, Caldera et al. (2020) highlighted the influence of post-disaster phases. Importantly, findings reveal that most of the signature projects which incorporate SMs have onsite reprocessing facilities or established mechanisms for the reuse of self-generated C&DW. On one hand, this is a noteworthy practice that heading towards a self-sustaining culture. However, on the other hand, SM usage being limited to such projects indicates the immaturity of the SM market.

Thus, this study emphasises the critical requirement of a centralised, established platform which interconnects different RLSC stages of C&DW and thereby ensures the accessibility and timely availability of SMs. Confirming the findings, Victar & Waidyasekara (2023) contended that the absence of an established market discourages potential clients and thereby decreases the demand. Further, the results validate the findings of Caldera et al. (2020), and Shooshtarian et al. (2022) regarding the web-based online SM market and highlight the lack of a digital database for C&DW in Sri Lanka. Material passports, building information modelling (BIM), and Internet of Things (IoT) devices are some commonly practised mechanisms globally to address this issue (Caldera et al., 2020).

Overall, in Sri Lanka, not only is the proportion of C&DW heading to reprocessing aiming to close the loop limited, but also the number of beneficiaries who have the opportunity to enjoy the benefits of SMs is restricted. Findings reveal the reason as the absence of an established SM market, which is backed by a digital database. Therefore, a systemic uptake is essential to outflow the environmental, economic, and social benefits of using SMs in CI beyond the successful pilots.

To the best of the authors' knowledge, this ground-breaking research is the first of that kind which sheds light on a research niche and scrutinises the SM markets in the CI in Sri Lanka. Accordingly, the outcomes of the research greatly contribute to both theoretical and practical bodies of knowledge. Theoretically, this study offers a sound understanding of the role of the SM market in realising the closed loop. Practically, it statistically proves the poor performance of C&DWM in Sri Lanka and establishes the ability to bridge the gap via a SM market.

# 6. CONCLUSIONS AND RECOMMNEDATIONS

Despite the growing interest towards closing the loop by reintroducing C&DW to the construction supply chains, the effectiveness and efficiency of the entire circular supply chain are affected by the SM market. Thus, this study examines the current status of the C&DW in Sri Lanka and the industrial need for a SM market by following the explanatory sequential mixed method. According to the findings, landfilling is the most common destination of C&DW in Sri Lanka, which is practised on 75% of the occasions. Out of the total C&DW generated, only 14.47% of C&DW is directed for reprocessing. Despite the positive attitude among construction professionals towards SMs, their usage is limited primarily to post-disaster reconstruction, green buildings, and a few signature projects. This is mostly attributed to the absence of a SM market, as the absence limits the accessibility to SMs, thereby resulting in decreased demand for SMs. Accordingly, it is crucial to overcome the limited scope and application of SMs and ensure widespread adoption across the CI by establishing a SM market. Therefore, it is recommended to establish a SM market that is characterised by a web-based digital database for the desired outcomes. Even though this research is conducted in the Sri Lankan context, other developing countries in the region can adopt the findings in their contexts. Further, data collection for the study was limited to construction professionals and industry experts. Thus, future researchers can expand the study focusing on the other stakeholders of the construction supply chains. Further, the next step of the research is to develop a framework for establishing a SM market.

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