

Implementation of circular economy in construction projects: a procurement strategy approach

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Abstract

Purpose – The purpose of this study is to investigate the benefits and challenges of implementing circular economy (CE), as well as shed light on the influence of procurement strategy in CE implementation in construction projects.

Design/methodology/approach – A qualitative research approach with abductive reasoning was adopted. The empirical data were collected from the construction industry in the United Arab Emirates (UAE).

Findings – The results reveal that clients, consultants and contractors have limited awareness, knowledge and motivation to implement CE in construction projects. The absence of incentives to design projects following CE principles, lack of involvement of contractors and suppliers, non-use of materials that use CE principles and current procurement strategies are the main challenges for the implementation of CE in the UAE.

Originality/value – Previous research offers limited knowledge on CE and its implementation in construction projects particularly from a procurement strategy perspective. The findings of the study provide new knowledge of the benefits, challenges and role of procurement strategy for implementing CE. It is suggested that collaborative and partnering-based procurement methods are needed to facilitate the effective implementation of CE.

Keywords Circular economy, Procurement strategy, Circular economy implementation, Challenges, Construction, Project

Paper type Research paper

1. Introduction

Due to the rapid growth in global population and an increase in overall income, the human population continues to use more material resources. As such, numerous material resources are expected to become more scarce and more expensive to use; moreover, a large amount of these resources may become completely unavailable for future use (Adams *et al.*, 2017). The linear “take-make-disposal” economy is increasing the exposure of organisations to higher raw material prices, thereby making this a supply constraint (Pollice, 2018). Moving towards a circular economy (CE) can reduce the use of primary materials, protect material resources



and reduce the carbon footprint (Adams *et al.*, 2017). The concept of CE is becoming increasingly popular in Europe as a major policy agenda and is also highly relevant for the construction industry. Some major construction organisations are now aspiring to integrate CE into their business models and a few have already taken innovative and experimental initiatives; however, an extensive and comprehensive transition to CE is still at an early stage (Jones and Comfort, 2018).

The construction industry is the largest user of energy and material resources. The industry uses over three billion tonnes of raw material every year (Guerra *et al.*, 2021) and generates large quantities of solid waste (Rios and Grau, 2019). Non-renewable resources are most commonly used in construction projects, which has a major impact on the environment. The current use of material resources combined with population growth will likely result in the scarcity of certain materials, such as steel and copper, which are widely used in the construction sector (Rios and Grau, 2019). Although CE has garnered considerable attention among researchers, policymakers and businesses, its interpretation and application are diverse (Rizos *et al.*, 2017).

Procurement is the process by which firms acquire raw materials and other resources from suppliers to execute their operations (Chopra and Meindl, 2007). A procurement strategy outlines the key means by which project objectives must be attained (Love, 2008); at the level of the project-based organisation it represents organisational objectives in terms of total cost leadership, positioning the organisation positively in the value chain and creating growth opportunities (Bardy and Hillebrand, 2011). In addition to an organisational procurement strategy, a project can also have its own procurement strategy that plays a key role in the successful completion of construction projects (Ofori, 2007). The procurement strategy is implemented with a suitable procurement method that enables collaborative relationships with suppliers, which eventually contribute to acquiring the best materials and products for the project. The procurement strategy also influences project performance, because it helps to identify the appropriate delivery model and provides mechanisms to create optimal value over the project life cycle.

For large-scale projects, traditional procurement methods are ineffective because of the difficulties in dealing with sustainability problems (Ershadi *et al.*, 2021). Moreover, in the traditional construction procurement method, a contractor is often not involved in the project's planning and design stages (Moradi *et al.*, 2022); this lack of involvement hinders innovation and buildability in projects (Miller *et al.*, 2009). Therefore, a change in procurement methods to facilitate the adoption of sustainability thinking is being increasingly called for. In particular, the role of collaborative approaches to drive the change in procurement and governance of projects has attracted increasing attention (Eriksson and Laan, 2007). This collaborative procurement method enables the early involvement of major stakeholders, collaborative planning, shared risks, developing goals based on collaboration (Moradi *et al.*, 2022), creating solutions, determining new methods for implementation and problem-solving (Kapogiannis and Sherratt, 2018).

The construction sector is mostly based on a linear economic model (Tirado *et al.*, 2022) and, compared to other industries, CE thinking and its implementation are relatively new in construction projects (Chang and Hsieh, 2019). Yet, the construction industry needs to reduce greenhouse gas emissions (GHGs) and use of resources by adopting CE methods (Ghaffar *et al.*, 2020). Previous research has mostly focused on the drivers and advantages of CE, and limited research exists on its implementation in construction projects (Adams *et al.*, 2017). The procurement strategy may play a key role in enabling CE in construction projects, as all major stakeholders can be connected through the procurement process.

Research on CE in construction is growing but little consideration has been given for its implementation through a procurement strategy approach. An appropriate procurement strategy can play an important role in embracing CE in construction projects. In construction projects, various CE related requirements can be fulfilled through procurement. The procurement strategy could help organisations to identify opportunities to add strategic suppliers to collaborate and procure materials that consider waste minimisation, as well as reuse and recycling. However, a better understanding is required of how the procurement strategy influences CE implementation. Thus, the aim of this study is to investigate the benefits, challenges and implementation of CE through a procurement strategy approach. Accordingly, this research addresses the following research questions (RQs):

- RQ1.* What are potential benefits and current challenges of implementing CE in construction projects?
- RQ2.* How does the procurement strategy influence the implementation of CE in construction projects?

To answer this RQ, a literature review and empirical study in the construction industry of the United Arab Emirates (UAE) was conducted.

2. Literature review

2.1 Circular economy concepts and principles

Since 1990, many definitions for CE have been introduced. [Kirchherr et al. \(2017\)](#) collected 114 definitions of CE to provide a better understanding of the concept; however, a commonly accepted definition does not exist yet. However, many of these definitions indicate that “waste does not exist” ([Ogunmakinde et al., 2021](#)).

The CE principles are largely derived from several interlaced schools of thoughts. According to the principles resources are renewable, reusable and non-toxic. The resources are kept in use, maintained, repaired and upgraded to prolong their lifetime. Waste is recovered for reuse and recycling through waste utilisation and extended further use ([Thelen et al., 2018](#)). In many studies, CE has relied on 3R principles including reduce, reuse and recycle ([Jawahir and Bradley, 2016](#)). Later on, 5R principles were introduced by adding recovery and reclamation. Today, 10R is proposed with additional principles including refuse, refurbish, remanufacture, repurpose and re-mine ([Ghomi et al., 2021](#)).

Further, numerous practical challenges are associated with the implementation of CE, which require experts from various disciplines – including natural sciences, engineering, economics and management – to address and resolve them. The main challenge a lack of awareness on the part of customers, uncertainty in organisations, strict laws and regulations and a lack of adoption of new processes with established technologies ([Kirchherr et al., 2018](#)). Furthermore, public knowledge regarding CE and investments in CE remain insufficient ([Sariatli, 2017](#)). Specifications and standard requirements ([Purchase et al., 2022](#)), recovery and restoration of materials considered waste, lack of reuse markets and time constraints which encourage “demolition over deconstruction” are also challenges for CE implementation ([Torres-Guevara et al., 2021](#)).

CE implementation needs new business models, value chains and competences. Creating laws to promote CE would also be helpful. In this regard, China was one of the first countries that introduced the “Circular Economy Promotion Law” in 2009 ([Droege et al., 2021](#)). This was followed by the “Roadmap to a Resource Efficient Europe” in the European Union (EU) in 2011, supported by reports and action plans in 2015 and 2020, as well as the “European Green Deal” ([Hjaltadóttir and Hild, 2021](#)).

2.2 Circular economy in construction industry and projects

In 2016, the construction industry accounted for 6.2% of world gross domestic product (GDP) (Ruiz *et al.*, 2020). However, this industry generates the highest amount of waste globally, consumes more resources than any other industry and accounts for over 40% of the world's carbon emission (Pomponi and Moncaster, 2017). Sustainability issues in construction projects have become growing concern due to significant amount of waste generation and environmental effects (Ershadi *et al.*, 2021). The construction industry is one of the priority areas for the implementation of CE due to high raw materials consumption (Plebankiewicz, 2022). Moreover, over 50% of the waste generated in the construction industry is linked with end-of-life activities and operations, which are mainly from demolition activities (Osobajo *et al.*, 2020). Therefore, it is rather important to move to CE in construction projects (Pomponi and Moncaster, 2017). In construction, CE can help diminish waste, conserve approximately over \$100bn every year and enhance overall output (Guerra *et al.*, 2021). CE is particularly vital in the construction sector, as this field is closely related to the natural environment (Gorecki, 2019).

The CE and its implementation is relatively new in the construction industry (Chang and Hsieh, 2019). The construction sector has failed to develop strategies that prevent demolition and generation of solid waste once a building, infrastructure or facility reaches the end of its life (Rios and Grau, 2019). Waste management is not prioritised and is also difficult due to the diversity of organisations involved in construction projects (Esa *et al.*, 2017). As the construction industry is a major contributor to environmental problems, there is a need to include environmental impact as one of the success criteria in construction projects to ensure sustainable development (Aarseth *et al.*, 2017; Eriksson and Westerberg, 2011).

The construction industry produces 35% of waste to landfill (Ghaffar *et al.*, 2020) and consumes 32% of natural resources (Purchase *et al.*, 2022). Hence, construction industry has a large opportunity in implementing CE strategies to reduce the use of primary raw materials and energy, carbon footprint and waste (Hjaltadóttir and Hild, 2021). However, the industry has mostly focused on waste minimisation and recycling, and little research on CE from a systematic viewpoint has been conducted, including how to keep high residual values from materials by applying new business models (Afshari and Gorecki, 2019).

The adoption of the CE in the construction industry is challenging because of its complexity (Jones and Comfort, 2018). The required change in mindset is a major barrier. Lack of leadership support, traditional procurement approach, customer behaviour, lack of collaboration and lack of government support (Bechtel *et al.*, 2013) and competition for winning the project on the lowest bid are also challenges (Hjaltadóttir and Hild, 2021). Moreover, project-specific challenges include poor communication with clients, designers, subcontractors, lack of leadership skills and low acceptance of the idea of CE (Hossain *et al.*, 2020). Thus, it is vital that individuals at every organisational level understand CE (Droege *et al.*, 2021). To achieve the goals of CE, more coordinated actions among different levels (Suárez-Eiroa *et al.*, 2019), collaboration between different organisation functions and integration among external factors (Sousa-Zomer *et al.*, 2018), as well as joint efforts from all stakeholders are required (Jones and Comfort, 2018). Moreover, discussions between product designers and waste management operators are vital to make recycling easy. There is also a lack of stakeholders in material recycling to develop and process the waste (Salmenperä *et al.*, 2021).

Implementation of the CE in the construction industry needs dedication, enthusiasm and devotion of time and resources by management (Torres-Guevara *et al.*, 2021). Partnerships among different stakeholders (Gupta *et al.*, 2019) as well as leadership, policy support, regulatory reform and value chain engagement activities are also significant enablers

(Hart *et al.*, 2019). Adequate involvement of stakeholders helps managers to use all opportunities, improve benefits and deliver projects effectively (Nguyen *et al.*, 2019). Moreover, the stakeholders in construction projects are closely interconnected through formal or informal ties throughout the project implementation. Clients can encourage CE innovation in projects and can create demand for circularity in construction and real estate sectors. Designers can promote sustainable building methods and materials and design buildings that are easy to convert or dismantle (Zvirgzdins *et al.*, 2019). Moreover, public sector actors play a key role in creating conditions that enable stakeholder collaboration (Ramsheva *et al.*, 2020).

2.3 Role of procurement in advancing circular economy in construction

Procurement is one of the main functions for securing value for money and the organisation's success (Mitchell, 2015). Procurement is defined as the process by which firms acquire raw material, components, products, services or other resources from suppliers to execute their operations (Chopra and Meindl, 2007). Moreover, procurement is found as a significant activity of organisations to achieve its goals (Gyori, 2022).

Procurement in construction projects is conducted using a procurement strategy. Therefore, in construction projects, procurement strategies considerably influence the success of projects as they are formed to provide resolutions to specific requirements (Bima *et al.*, 2015). Without appropriate procurement approaches and practices that are tailored to the need of each project, the construction industry cannot flourish, as demand and supply are always in play on the part of stakeholders to attain project objectives. Procurement methods implemented in construction projects establish relationships, stakeholders' participation and contractual provisions, which impact the success of a project (Eyiah-Botwe, 2015). Likewise, through procurement process, collaboration between clients and suppliers can lead in the utilisation of raw material and promote sustainable development (Witjes and Lozano, 2016).

Procurement can be seen as a demand-side tool for innovation. Procurement strategies have substantial impact to influence requirements for more sustainable and circular goods and services. Procurement can be used with strategy plan to support innovation, effectiveness and diminish environmental impact (Cattolica, 2018). In particular, procurement can play a vital role for CE implementation in the selection of suppliers and partners that adopt or have, for example, green certifications. Therefore, it has been suggested that procurement methods should include the CE implementation as a specific section that concentrates on the applicability of CE, defined criteria, checklists and rankings for suppliers that are working towards CE (Al-Sinan and Bubshait, 2022).

Furthermore, successful operation of organisations that use CE is dependent on how these organisations manage their procurement and logistics (Bag *et al.*, 2020). For this and to reinforce interactions among project stakeholders, collaborations through partnerships are increasingly adopted, which encourage trust and teamwork. Collaboration is beneficial particularly because it supports the early involvement of key stakeholders in projects, and it also ensures that the CE related requirements and knowledge of different stakeholders are taken into account and integrated as early as possible. This early involvement helps to use key skills and competences right from the beginning of the project (Osipova and Eriksson, 2011).

There are different types of procurement methods involved in delivering a construction project and these are more complex compared to other industries due to their fragmented nature (Oyegoke *et al.*, 2009). Traditional procurement methods in the construction industry may result in a lack of involvement of major stakeholders, including the participation of

contractors at an early stage of the project – for example, in the design stage (Elhag *et al.*, 2019) – incomplete information, lack of management support, poor planning, changing requirements (Yu and Shen, 2013) and swarming cost, delay in completion and inadequacy (Bao *et al.*, 2019). Studies reveal that “traditional procurement processes reinforce socio-cognitive barriers that hinder team efficiency” (Mitchell, 2015, p. 8). According to El-Sayegh (2008), a major drawback of the traditional procurement method is that contractors are brought into the project at a later stage, after design is completed, which means that the design is not generally reviewed for constructability before it is completed. Matthews and Howell (2005) indicated four systematic problems in traditional procurement methods, including holding back of good ideas, limited collaboration and innovation, coordination inability and pressure for local optimisation.

To overcome and reduce time and cost overruns and disputes, alternative procurement methods such as partnering and alliancing have been encouraged (Davis *et al.*, 2008). Studies have identified relationship-based approach among clients and contractors to play a substantial role in project execution (Osipova and Eriksson, 2011). However, in construction projects, clients do not pay for innovation as part of their procurement process. Yet, a substantial effect on innovation could be achieved by moving away from traditional procurement methods (De Valence, 2010), as it has been claimed that the traditional procurement methods and contracts do not encourage effective collaboration in projects. Therefore, collaborations and partnerships have become more popular (Osipova and Eriksson, 2011). Moreover, to support innovation and sustainable development, clients’ procurement and contracting strategies are vital, yet further research is still needed on the forms of contracts that best support sustainable development and sustainable project practices (Lingegård *et al.*, 2021).

A collaborative approach in the procurement process requires organisations to define areas in which cooperation is required to have a significant impact. This approach can save time and be more cost-efficient, and it is observed that new procurement methods can even change the dynamics with the clients and relationships in the supply chain (Mitchell, 2015). Exchange of knowledge among stakeholders, increasing new knowledge and awareness (Klein *et al.*, 2020), partnerships (Gupta *et al.*, 2019) and innovative procurement methods, like creating public–private partnerships, can also be effective for implementation of the CE (Bao *et al.*, 2019).

Further, a collaborative procurement method has been proposed for disseminating the ideas of CE in construction projects, as such a method would encourage and enable stakeholders together define the importance of CE and identify the most important objectives and actions for its implementation. The implementation of CE also requires more discussion among network members (Karhu and Linkola, 2019). Another main challenge in the implementation of CE in procurement is the lack of standards for CE appraisal, both on the supplier and the product level. Instituting international standards to assess and certify the circularity of products and services should accelerate the adoption of CE in procurement (Al-Sinan and Bubshait, 2022). Moreover, circular procurement can also be understood as an approach that recognises the role that private and public authorities have in supporting the transition towards CE. Circular public procurement can significantly advance the adoption of circular business models by requiring green products and additional circularity goals in cooperation with suppliers (Tátrai and Diófási-Kovács, 2021).

3. Research method and data

A qualitative research approach with abductive reasoning is applied in this study, because the studied phenomenon is relatively new and a deeper understanding of it is required

before any potential hypotheses can be tested using quantitative methods. The qualitative research process involves investigation by using specific notions (Creswell and Poth, 2016). Moreover, qualitative research aims to increase the understanding of the research topic at hand and to capture the recognised reality as closely as possible. Abductive reasoning is productive for discovering new aspects rather than confirming existing theories (Dubois and Gadde, 2002).

3.1 Empirical context

The construction industry in the UAE is the context of our study. The UAE construction industry was selected due to its large size and potential for CE implementation, because the CE in the UAE is still its infancy and traditional procurement methods are widely used. Therefore, the UAE construction industry can be a potential market to implement the CE.

The UAE is a constitutional federation that has seven states. The major sources of revenue in the country are petroleum and natural gas. The construction industry plays a vital role in the country's GDP and growth. It provides a substantial contribution to employment, housing, commercial buildings and infrastructure. Moreover, the UAE is also considered one of the largest producers of waste and approximately 75% of this comes from the construction industry. It is predicted that construction and development activities and associated waste production will continue to rise in this region, thereby causing a negative environmental impact on soil, water, air and in the surrounding ecosystem as well as a depletion of finite resources. Most of the construction in the UAE depends on traditional procurement methods (Shafiq, 2021) that generate a competitive culture in the industry. Due to the extensive use of such methods, clients' understanding of traditional methods and cost certainty at the beginning of the project, clients are averse to exploring and adopting collaborative procurement methods.

3.2 Data collection and analysis

The first part of our study included examining the existing literature on the research topic. Thereafter, semi-structured interviews were conducted with different professionals from the UAE construction industry to obtain empirical data on their understanding and knowledge of the CE and its implementation in construction projects. The interview themes and questions (Appendix) were created based on the literature review. The interviews were conducted with key construction project stakeholders including clients, consultants and contractors. In total eleven professionals were selected for the interviews due to their extensive experience in procurement, contracts, supply chain, tendering and project management in construction projects. The interviews were conducted in 2022, and all interview data were transcribed and coded. Table 1 below presents the details of the interviews.

The obtained data were transferred to MS Excel for coding. The interview transcripts were carefully reviewed to create an initial insight of the data and extract all interviewees' perspectives on CE and procurement. Transcripts were read multiple times to extract all interviewees' comments and analyse emerging themes, including current procurement methods, role of procurement and challenges and benefits related to the implementation of CE through procurement strategy. Within this analysis process, the implementation of CE through the procurement strategy approach emerged as a major theme in the interview data.

4. Empirical results

4.1 Circular economy

Awareness of CE is key to implement it. Therefore, the awareness of the CE among the main construction project stakeholders in the UAE construction industry was analysed first.

Table 1.
Interview details

Respondent	Organisation	Duration	Position	Experience (years)
A	Client	37 min	Project controls manager	27
B	Contractor	74 min	Estimation manager	27
C	Consultant	69 min	Commercial manager	36
D	Consultant	75 min	Project controls manager	21
E	Consultant	26 min	Contracts manager	26
F	Consultant	38 min	QA/QC manager	22
G	Consultant	49 min	Senior quantity surveyor	34
H	Contractor	40 min	Contract manager	24
I	Client	36 min	Commercial manager	17
J	Client	61 min	Senior commercial manager	21
K	Client	74 min	Contracts manager	22

Source: Authors' own work

4.1.1 Awareness of circular economy. Most interview respondents had limited knowledge or awareness about the CE. For example, a client professional stated:

I would say that they [management] would not really understand that terminology circular economy. I am not aware of any sort of circular economy [at an individual level]. This circular economy is not talked about enough. I have not heard it many times before.

Thus, awareness and knowledge of CE is very limited at the organisation's management level. Moreover, at the individual level, there is little knowledge of CE among clients, consultants and contractors. For consultants, the findings reveal that only a few of them have knowledge but it is very limited. For example, a consultant professional said:

Somehow, I think basic concepts, not the details. I know the concept etc. I heard about somehow like [from] Google Internet but not in detail.

The findings also reveal that the clients and contractors do not have knowledge of the CE and this term is new to many people. Therefore, there is a need to spread awareness of CE among all stakeholders to implement it in construction projects.

4.1.2 Challenges of circular economy implementation. Table 2 below presents the challenges of CE implementation that were identified in the interviews.

4.1.3 Importance and benefits of circular economy. Empirical data reveal that all major construction stakeholders (clients, consultants and contractors) have acknowledged the benefits of CE. Reducing waste, environmental benefits, saving materials and creating employment were a few of the benefits highlighted by the interviewees. For example, a client professional stated:

I would say that that will be beneficial to the organisation because the concept revolves around reducing wastage and recycling the materials being used differently [...]. Definitely the cost of using recyclable material will be far lesser than when I buy new material, actually. So, I will be getting my project done at a lesser price than when I am doing everything from a fresh or a new raw material. So that way I can see that there is a cost benefit by adopting this subject.

It is evident that the interviewees acknowledged that CE is important and beneficial for construction projects. There will be huge benefits for implementing CE in construction projects, particularly by adopting actions and activities related to recycling and waste reduction.

Table 2.
CE implementation
challenges

Stakeholder	No. of interviewees	Identified challenges
Client	Four	Lack of CE objectives in organisations, difficult to change mindset, lack of awareness, educating people about CE, traditional procurement method, lack of expertise for recycling, fast-track nature of projects, change resistance, legal liability, role of all stakeholders, lack of criteria for reuse and recycling of materials and lack of circular procurement criteria in the organisation
Consultant	Five	Lack of circular procurement criteria in the organisation, quality, gap in policies, traditional procurement method, lack of innovative design ideas, time and resources, cultural barriers, lack of awareness, throwaway mindset rather than repair, motivation of stakeholders, lack of CE objectives in organisations and high cost
Contractor	Two	Difficult to change mindset, challenging to convince client, people reluctant to bring change, lack of awareness, need of cultural shift, education about CE, cost and lack of CE objectives in organisations

Source: Authors' own work

A few consultants also acknowledged the benefits of the CE, as evident from the following statement:

In my understanding, in the long run, while we are adopting these circular economy objectives, we are further supporting the environment [and] sustainable development. The outcome will be this, the development with sustainability, saving time and cost, and achieving the intended quality.

A contractor professional stated:

The benefit is very high, the value will be more, we can reduce the time; we can reduce [material use and] enhance quality [...] even the cost could be reduced. This could generate local employment.

The comments indicate that CE is important in construction projects. Such a model is beneficial for the environment and helps to save time and cost. CE also provides benefits in terms of economic aspects, generating employment for local people, waste reduction and sustainable development.

4.2 Procurement strategy

4.2.1 Procurement methods. Empirical data reveal that all respondents' organisations are mostly using traditional procurement methods. The contractors expressed concern that due to traditional procurement and their limited role in procurement, they are unable to procure materials which are sustainable, or which have the capability for reuse and reassembly. Furthermore, in the traditional procurement method, contractors are not involved in the design stage and it is, therefore, difficult for them to implement CE during the execution stage. In the traditional procurement method, organisations normally prefer to deal with what they know rather than things that are new. Unfortunately, most clients tend to be cost-driven and do not support innovative designs or promote new ideas. In the current procurement method, stakeholders – particularly contractors – play a limited role and are not able to include materials which are sustainable or which have the capacity to be reused or reassembled. Therefore, they use materials which are specified in the contract. A collaborative procurement method is one means to provide better products, buildings and designs to implement CE in construction projects.

4.2.2 Circular procurement criteria. Most studied organisations do not have circular procurement criteria to promote CE in their projects. CE is seen as a new idea. The interviewees' projects have some sustainability requirements that are aligned with authorities' requirements. Furthermore, most organisations do not have any waste management criteria in their procurement strategy, which shows lack of awareness and intention to promote recycled materials. Most respondents interact with consultants, architects, contractors and suppliers but none of respondents interact with organisations that are recycling materials or have any criteria to reuse materials.

4.2.3 Role of the procurement in circular economy implementation. Most respondents acknowledged that procurement could play a vital role for the implementation of CE in construction projects. Procurement is a key area that affects all project objectives, and organisations price their offerings based on these objectives. In construction, numerous aspects are based on the procurement strategy and tender documentation. The procurement strategy can support CE, because the types of materials used can be aligned with CE criteria through procurement. For example, a client professional stated:

So, I think procurement is the key, that's where it all would start [to implement CE].

A change in procurement approach can help introducing new ideas and supply chain relationships, which can be beneficial for CE implementation. Clients can be a major part of this change by adding technical and other requirements that are aligned with CE principles. The procurement process, policies, procedures and tender documents can also be developed based on CE principles.

The objectives and current procurement strategies of the studied organisations are inclined towards cost benefits rather than innovation and new ideas. It is important that all main stakeholders in construction projects work together and promote CE benefits during the design phase and through procurement in the tendering process (through procurement, organisations can require suppliers to provide CE-compliant materials). It was considered important that all main stakeholders, particularly clients and consultants, must be aware of the importance of CE. If CE principles are not included in the procurement strategy or procurement stage, it is difficult to implement circularity in construction projects.

4.2.4 Circular economy implementation through procurement strategy. Empirical data show that a procurement strategy that promotes CE and waste management does not exist in most organisations. The studied organisations only follow authorities' requirements. For example, a client professional stated:

We generally don't have a strategy [which supports CE], but our drawings or specifications are geared towards advising whoever is going to build to ensure that they fulfil the requirements of the [...] government [...]. We're not sort of really aware of how circular economy procurement really works within our company, whether it's a completely different procurement strategy, like I said, it's traditional route where we design the building, whatever that we're designing fully and then we tender it and then we build it now [...]. But I think that yes, the procurement strategy can be changed to implement [CE].

A consultant professional stated:

Procurement process is a tool to implement this circular economy [...]. The procurement process [strategy] will be greatly supporting to bring this circular economy objectives accomplished [...]. At current stage, the procurement strategy focuses on the project delivery with respect to sustainable development. While the circular economy principles are still to be incorporated [...]. The project owners, they are making their strategy to procure a project. They should also consider the principles of circular economy. The manufacturers shall adopt the integrity during their procurement and production phases [...]. Again, I would like to say that the procurement process is a key tool.

Creating appropriate procurement strategy and method was found to be important. Statutory authorities can play a vital role by integrating CE requirements in their policies and documents. A change in the overall procurement method is required, because in the traditional procurement method, contractors play a rather limited role in selecting materials and proposing new ideas. The client's role is very important. Clients provide material requirements through procurement strategy and tender documents. The clients were found to have the highest authority to implement CE, because they are the ones who mostly select the materials for their projects. Thus, the appropriate procurement strategy and collaborative procurement methods must be encouraged to achieve CE implementation objectives in construction projects.

4.2.5 Value chain and role of stakeholders. Interviewees highlighted that all construction stakeholders, particularly authorities and clients, play a significant role in CE implementation. These stakeholders drive changes and can make changes when they see them as beneficial. Therefore, all stakeholders should have the knowledge of CE and be aware of its benefits for construction projects. Furthermore, clients' objectives are short term and mostly linked with financial benefits. It was found that a cultural shift is also required, and without adequate awareness of CE and its benefits, most stakeholders may resist it.

5. Discussion

This study analysed the benefits and challenges of implementing CE and the influence of procurement strategy in the CE implementation in construction projects. A literature review on CE concept and its associated challenges, benefits and implementation, as well as implications of procurement were conducted. Our empirical research in the UAE construction industry revealed that the main reason for not implementing CE is a lack of awareness of it among the different stakeholders. Due to this lack of awareness of CE and its benefits, organisations do not currently include CE in their procurement strategies and criteria. It was discovered that the current procurement methods are not supporting CE and there is a lack of policies to integrate CE into the procurement strategies in construction projects in the UAE. Moreover, sustainable procurement strategies do not exist in the country due to the lack of clients and authorities' commitment and awareness, which is a major barrier for the CE implementation.

The objectives of the organisations that were studied are mainly financial, such as revenue and profitability. The CE implementation challenges also include the use of traditional procurement method, lack of contractors' involvement in design and procurement stage, change resistance and lack of expertise in recycled materials. None of the studied organisations had circular procurement criteria in their procurement strategy. Most organisations only comply with a few sustainability objectives that are enforced by the authorities.

Traditional procurement methods have been found to result in difficulties in dealing with sustainability menaces (Ershadi *et al.*, 2021). They limit contractors' input to planning and proposing new solutions, which hinders new innovations (Miller *et al.*, 2009). In our study, it was found that traditional procurement methods are mostly used in the UAE. These methods do not support contractor's contribution in material selection process and the creation of circular procurement criteria. It was also found that waste management, recycling and material reuse criteria in stakeholders' procurement strategy are currently non-existent. The current traditional procurement methods do not fully promote the implementation of new ideas and managerial innovations, such as CE in construction projects. Awareness about CE among the construction sector stakeholders is also a major challenge for its implementation. Another significant challenge in embracing CE in

procurement is the lack of standards for CE evaluation, both related to the suppliers and to the actual project product. This insight resonates with the recent findings about the industry actors' limited knowledge of the standard practices of CE within the construction sector (Adams *et al.*, 2017; Benachio *et al.*, 2020). Therefore, developing and institutionalising international standards to assess and certify the circularity of products and services has been suggested to accelerate the adoption of CE in procurement (Al-Sinan and Bubshait, 2022).

The primary contribution of this study is the analysis on how procurement strategy, methods and guidelines – such as procurement criteria – can influence CE implementation in construction projects. It was found that CE implementation can occur at the procurement stage by using tender documents as a tool to promote CE and its requirements in construction projects. Furthermore, to promote CE, both economic and environmental benefits must be highlighted. Procurement-related factors have significant effects on construction projects (Bima *et al.*, 2015) and procurement strategies adopted have a large influence on their successful completion (Ofori, 2007). Our literature and empirical study indicate that an appropriate procurement strategy and collaborative procurement method can advance CE in construction projects. For example, procurement criteria can be used as a tool to set CE requirements to suppliers right from the procurement strategy stage. Waste management, recycled materials and reuse of materials can be implemented through tender documents during procurement process. Although the idea of CE is becoming more and more legitimate within the construction sector, development of new knowledge and concrete tools is highly relevant for its practical adoption and application (Adams *et al.*, 2017). Therefore, significant changes in standard documentation and current procurement methods are required to accommodate CE requirements in construction projects.

It was also found that deeper stakeholder collaboration is required for CE implementation. This can be achieved through a procurement strategy which includes criteria that support collaboration and partnerships with strategic suppliers that produce products and services based on CE principles. The clients and authorities should be aware of CE, its importance and its benefits. The consultants can support CE by designing projects that promote its objectives. The contractors, in turn, can contribute by requiring stakeholders to collaborate. A collaborative model is needed, as one party alone cannot implement CE. Integrated and collaborative procurement is an attractive idea, but most people and organisations want to see its financial impacts. Thus, collaborative procurement methods could be sold both as a tool and a financial benefit to implement CE in construction projects. This can be only achieved if a proper procurement strategy is in place.

5.1 Managerial implications

The study findings show that awareness of CE is the biggest challenge for the implementation of CE in construction projects. Therefore, sufficient awareness is a necessity among all main project stakeholders. Current procurement methods and a lack of CE objectives in procurement strategies also prevent the implementation of CE in construction projects. The managers should learn about benefits of CE and include CE objectives in their procurement strategies. The managers involved in construction projects should also consider long-term benefits of CE rather than short-term financial objectives, and they should include CE principles in their procurement strategies. It is found that collective efforts are required from all major stakeholders involved in the construction projects. There is a need to replace traditional procurement methods with collaborative procurement methods, which can be achieved with an appropriate procurement strategy that supports these new methods.

6. Conclusion

Despite a large potential for CE initiatives, limited research has been conducted on CE implementation in construction projects. Our study contributes to the current body of knowledge by analysing CE implementation in construction projects through procurement strategy.

The construction industry typically tenders and awards project contracts based on lowest bids that emphasise only time, cost and quality and pay a little attention to sustainability and CE. The current procurement strategies are also lacking CE objectives. Therefore, it is important to include CE objectives in the procurement strategies, which helps to ensure all CE related objectives are clearly outlined and set in the entire procurement process, which will advance implementation of CE in construction projects.

Several challenges associated with CE implementation in construction projects were identified. Therefore, there is a need for awareness, knowledge, motivation, collaboration and technical and managerial skill development among all main stakeholders. Procurement is an important aspect in construction projects and procurement strategy can be used to advance CE implementation. Organisations should adjust their current procurement strategies to emphasise and instigate to introduce CE implementation goals in their projects. Furthermore, when preparing procurement strategy transition towards CE-based materials requirements should be prioritised.

All major stakeholders should work together, promote CE and create relationships with organisations that produce materials or services based on CE principles. In particular, clients and authorities should develop their procurement strategies and integrate circular procurement criteria in their projects. Through procurement, circular materials can be added as requirements through tender and contract documents. Moreover, the procurement methods must undergo a shift from traditional methods that hinder implementing CE in construction projects. There is a need to adopt collaborative procurement methods that enable each stakeholder to contribute to CE implementation.

According to our study, there is lack of CE awareness, motivation and objectives in organisations' procurement strategies. People should be aware of CE and its benefits to implement CE in projects. In the UAE region, most materials go to landfill, because recycling and material reuse criteria are not part of the procurement strategies of organisations. Very few organisations recycle construction materials. There is a need for expertise to design projects and develop materials that comply with CE principles.

Finally, it must be acknowledged that the study had a few limitations. While the literature review provided a global perspective on the studied phenomenon, the empirical research focused only on the UAE region. In addition, due to the limited number of participants, care should be taken when generalising the findings. Therefore, conducting similar studies in other regions and organisations is recommended for validation and comparisons.

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Appendix

(1) Section 1: General information:

- What is your organisation and what services does it provide?
- What is your role in the organisation and how long have you been working there?
- What type of projects does your organisation usually undertake or has completed recently?
- Can you please tell me about a project that you are currently working on?

(2) Section 2: Procurement:

- What type of procurement structure do you have at the organisation-level?
- How can you describe your own role in the procurement of the organisation or project?
- In your routine work, what type of other companies do you get in touch with? Please give some examples.

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- Does your organisation have any sustainable or circular procurement strategy or criteria to support CE? Can you share some examples?
 - Does your organisation have waste management system criteria in procurement strategy and what does your organisation do with waste material?
 - Can you briefly tell in which stage of the project you think your role is important?
- (3) Section 3: CE:
- In relation to the construction projects or the industry, is your higher management aware of the CE concept and principles?
 - Are you aware of the CE concept and principles in general?
 - Does your organisation have circularity or sustainability objectives?
 - What are your main objectives in your core business area?
 - How committed is your organisation is to these objectives?
- (4) Section 4: Procurement strategy and CE concept:
- Considering the CE thinking, what would you say about the procurement strategy of your organisation?
 - Can you please describe your (organisation's) role in the selection of materials for the project?
 - Can you please describe your (organisation's) role in the selection of suppliers for the projects?
 - Do you think the current procurement approach in your organisation is helpful to implement CE? Is there need for a change in procurement methods?
 - Do you think a change in procurement methods can bring new ideas and relationships in the supply chain?
 - How important it is for your project to adhere to the CE objectives? For example, if you compare them with the usual parameters of cost, time and quality.
- (5) Section 5: Adopting CE concept:
- During the procurement process, how do you ensure that the circularity objectives and the commitment of your organisation are conveyed to your suppliers and customers?
 - How often do you discuss circularity with your suppliers and customers in your meetings?
 - What would you say about other stakeholders' commitments to CE thinking in general? Is there something that you think is still missing?
 - Does your organisation have suppliers who use/produce recycled materials?
 - Does your organisation have any criteria to reuse materials?
 - Does your organisation provide staff training or courses related to sustainability and CE?
- (6) Section 6: Implementing CE principles (reduce, reuse, recycle and recover):
- In your opinion, what are the main challenges to achieve the circularity objectives? Please give examples.
 - In you your opinion, what reactions or challenges do you expect from your existing suppliers if you implement CE principles in your projects and procurement policies?

- How do you see the role of procurement in achieving sustainability and CE objectives? Please give examples.
 - How do you see the role of other stakeholders in achieving sustainability and CE objectives? Please give examples.
 - As a developer/consultant/contractor/supplier (as applicable) how do you see your organisation's role to implement CE in your projects?
 - In your opinion, what would be the benefits to your project if you implement CE objectives?
 - What happens in case you are unable to implement those objectives in a certain project? What steps would you take? Please give examples from a project.
- (7) Section 7: Concluding remarks:
- Would you like to add something you think is important to this research and has not been covered?

Source: Authors' own work.

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