**Transitioning from Green to Circular Procurement in Developing Counties: A Conceptual Framework for Ghana’s Construction Sector.**

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# Data availability Statement

The data that support the findings of this study are available on reasonable request from the corresponding author, [Ababio, B. K]. The data are not publicly available due to ethical restrictions on compromising the privacy of research participants.

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**Abstract**

Circular procurement (CP) systems are fast evolving and recently, regarded as a ‘golden-ring’ to be leveraged in promoting the circular economy. However, it appears that the construction sector of developing countries is yet to make any significant adaptions and improvements to its existing procurement practice. In this paper, we examine the state of procurement practice in such countries for opportunities to develop and implement CP. Using case analysis from the Ghanaian context, evidence on the status quo of existing green procurement system is sought to ascertain gaps and similarities between practice, policy and targets needed for CP implementation. Qualitative methods comprising the use of secondary data and interviews with stakeholders from three public tendered projects were adopted, and results analyzed to develop a conceptual framework for CP. The findings of the study reveal that government policy, circular strategy, circular sourcing and platforms are essential components that need to be developed for CP implementation. Hence, the developed framework proposes an integration of these aspects through the four-lens of people, process, policy and technology. The output of this research provides a collective roadmap for policymakers, practitioners, and academicians towards the attainment of more circular consumption patterns in emerging construction markets.

**Keywords:** Circular procurement, Green procurement, Circular economy, Construction sector, Developing countries, Ghana

# Introduction

Over the past few decades, circular economy (CE) has been promoted as a potential solution to resolving sustainability issues within the construction supply chain amidst growing concerns of climate change, depleting natural resources and excessive environmental pollution (Desmond and Asamba, 2019). CE, an economic system based on business models that replace the concept of 'end-of-life' with closed loop and reduction strategies for materials across a building’s lifecycle, calls for significant changes to be made in the supply chain management practices and delivery of construction activities (EMF, 2017). As a result, construction procurement systems are being strategically redeveloped to support closed loop production and consumption patterns, culminating in the emergence of the circular procurement (CP) concept. The United Nations Environment Programme (UNEP) defines CP as when the buyer purchases products or services that follow the principles of the circular economy, supporting the assessment of designing, making, selling, reusing and recycling products to determine how to get the maximum value from them, both in use and at the end of their life (UNEP, 2021).

CP is regarded as the procurement strategy undertaken by both public and private organizations to pursue CE (Neessen et al., 2021). It goes beyond the delivery of construction services and considers the larger and more complex network of stakeholders and supply chain activities from a whole-life perspective (Ababio and Lu, 2022). CP integrates eco-effective and circularity principles into client requirements during tendering, post award contract management as well as organizational and government procurement policies (Alhola et al., 2019). The implementation of CP is particularly promising for construction business as it ensures extensive and continuous stakeholder collaboration, creation and allocation of efficient roles, and development of new business models to improve material stock regeneration and restoration within a system (Marrucci et al., 2019). CP builds on desirable aspects of existing procurement methods such as value for money, quality considerations, environmental impacts etc. towards delivery system that closes energy and material loops within sustainability limits (van Oppen et al., 2018).

Due to its anticipated benefits and practical route to the CE agenda, CP application in construction has grown considerably in public procurement over the past years, with a greater proportion of its implementation and success stories occurring in developed nations (Kristensen et al., 2021). Though the advocacy for CP in construction appears to have gained more traction in developed countries, Ghisellini et al. (2016) posit that developing counties stand to benefit the most from its deployment given the sheer number of infrastructure projects that need to be completed in these counties. Yet, CP implementation in the construction sector of developing countries has been substantially slow. The construction sector in these countries relies heavily on linear-based procurement methods such as green procurement (GP) in advancing the CE transition (Bohari et al., 2020). This approach presents several limitations as the GP concept does not fully align with CE principles and is inherently designed to produce green/sustainable outcomes rather than circular ones (Alhola et al., 2019). For instance, whereas CP asserts reuse, repair and remanufacturing of materials to achieve zero wastage, GP would strive for the use of new environment-friendly materials. In spite of such disparities which exude limitations, GP presents a fundamental opportunity and a formidable foundation to further develop and streamline its idea towards CP for implementation in the construction sector (Sonnichsen and Clement, 2020).

Although several studies have discussed the development of CP as crucial to the CE agenda, there is still a dearth of explicit knowledge and guidance on how existing procurements methods can be remodeled towards the achievement of CE objectives within the built environment (Khan et al., 2021). Sprakel (2022) researched into the deployment of CP to help construction clients achieve circular objectives, however, the scope was limited to innovative approaches which ignored already existing sustainable practices that may prove to be beneficial. Moreover, no contextualization of CP has been provided in literature for emerging construction markets. Prior research on CP have mostly been localized and tailored to cases in developed regions, with little specificity towards developing regions or the construction industry. For instance, Sonnichsen and Clement (2020) examined the transition from GP to CP from a generalized organizational perspective, focusing solely on cases from developed parts of the world. Nonetheless, the peculiar nature of the construction industry requires an in-depth examination of its own GP practices towards the development of CP for the industry.

Driven by these considerations, the present study aims to examine the prospects of implementing CP in the construction sector premised on already existent GP mode of procurement. To frame this study, the focus of CP implementation was situated in Ghana, a developing Sub-Saharan African country that has shown commitment to sustainability by leveraging public procurement to ensure its climate change targets are met (UNDP, 2021). Ghana’s construction industry, like many leading developing countries, is deeply rooted in the globalization drive which aims to enable the spread of knowledge and best practice in relation to innovation and sustainability approaches, providing a perfect environment for such research to be undertaken (Lang and Tavares, 2018). In this paper, we attempt to offer detailed insight on the current practices that align with CE and develop guidelines towards the implementation of CP in construction markets of developing countries. The following question was therefore developed to guide the research:

1. *What opportunities and challenges exist for the implementation of CP in the construction sector of Ghana and how can already existing GP modes of procurement help?*

By employing qualitative research approaches, a conceptual CP framework is developed from case studies for Ghana’s construction sector. This was done through the use of document analysis and interviews to refine procurement processes and highlight key CP dimensions needed throughout the construction lifecycle. The current study makes several contributions. To the best of our knowledge, this is the first research attempt to develop CP in the construction sector from existing GP modes of procurement within the context of a developing country. First, it contributes to literature by advancing the understanding of circular procurement within the context of the construction industry – a new sustainability frontier expanding on the limits of classic linear-based sustainable procurement paradigms. Secondly, the study presents a unique contribution to both theory and practice by proposing a comprehensive CP framework for implementation in the construction sector which serves as a roadmap for Ghana and other West African counties.

# Background of Study

## ***Sustainable procurement paradigm in emergent construction markets***

The procurement function refers to the process through which goods, services and works are acquired within private and public organizations (Sanders, 2020). In the construction sector, the function carries a high potential to have critical impacts on the operational, financial, social, and environmental aspects of an organization. Hence, several research intersections have been modelled between procurement and sustainability concepts in previous literature in attempt to accelerate the attainment of UN sustainability goals in emerging construction markets (De Angelis et. al., 2018; Qazi and Appolloni, 2022). Prior studies have focused attention on Sustainable Procurement (SP) and Green Procurement (GP), highlighting how they can be utilized as a policy instrument to achieve ecological quality targets in construction (Brammer and Walker, 2011). Some have argued that SP is an integrative concept which encompasses all three aspects of sustainability: economic, social, and environmental pillars with particular attention to social issues along the supply chain (Witjes and Lozano, 2016), unlike the GP which focuses solely on environmental benefits via application of ecolabels, energy efficiency, emission intensity, and environmental management systems (Aldenius and Khan, 2017). According to Rainville (2021), by increasing the uptake of GP, construction markets are motivated to develop products (buildings) with minimum environmental impacts and ultimately make them the market standard. The performance of GP for construction work is much tangible and easily measurable compared to SP which is typically rated in compliance with predetermined standards (Andrecka, 2017). Despite their technical differences both concepts have been used to incorporate sustainability into the construction procurement system, with the GP being increasingly popular in developing regions (Khan et al., 2018).

According to Uyarra et al. (2014), the influence of these procurement processes on construction business models is typically liner – a paradigm that is characterized by over-specified tenders negotiated along the lines of price per unit and often ignores finite capacity of the earth and resource limits. Every year, approximately USD 10 trillion is spent through procurement of public works and services with close to 50% of the spend from developing countries like China, India, Brazil and Indonesia (World bank, 2019). Similarly, close to USD 20 billion of construction works are procured in a relatively smaller economy of Ghana by the public sector alone. The challenge however, is not the amount of spend but the magnitude of investment made through systems that support depletion of resources among other threats that face construction businesses and humanity (Kissi et al., 2020). Therefore, CP, a nascent and still emerging concept, is presented as a more effective procurement vehicle, drawing links between CE and procurement to propel the construction industry towards sustainability (Xu et al., 2022). With the pervasive demand for not only sustainable but circular outcomes, several construction organizations in developed and developing countries alike, are beginning to adapt their procurement processes to achieve CE goals and targets (Khan et al., 2022). In the Sub-Saharan region, Ghana has been proficient in transforming its public procurement to meet sustainable development targets through policy and legislation, followed by Senegal, Nigeria, Gabon and the Ivory coast (Saleh, 2020). Efforts to progressively amend procurement procedure and processes to require key construction stakeholders to consider circular aspects when procuring works have been influenced by both local and international initiatives as well as lessons assimilated from beneficial aspects of existing green procurement processes.

## ***Circular procurement in the public sector***

Public procurement accounts for up to 70% of total government expenditure across the world (Witjes and Lozano, 2016). According to Arlbjorn and Freytag (2012), the volume and value of public sector procurement over the past decades far exceeds that of the private sector in infrastructure development of developing countries. It is therefore not surprising that academic works on CP have largely focused on circular public procurement as a basis of developing the concept (Rainville, 2021). Alhola et al. (2019) characterizes CP in the public sector as a procurement of competitively priced products or services that lead to extended life spans, value retention, and/or remarkably improved and non-risky cycling of biological or technical materials. Scholars have argued that the extensive development of CP in the public domain will stimulate its uptake in private sectors by influencing new learning, partnerships and industry standards (Wang et al., 2018). Similarly, researchers have claimed that CP in the public sector can be utilized as and effective policy tool or instrument to address the current lack of support for innovative business models by both public and private actors (Sonnichsen and Clement, 2019). However, there are discrepancies in the literature regarding the strength of CP's impact on sustainability and green market creation in the construction sector. Some researchers have indicated the difficulty of managing CP throughout the building lifecycle which is typically a long period with potential changes in owners, occupiers and building use (Sprakel, 2022). Other scholars have raised concerns about the incorporation of CP into the different construction procurement methods and the effect of change on the holistic procurement procedure undertaken for public works. For instance, Aldenius and Khan (2017) emphasized the challenges that local government authorities are confronted with when they want to stimulate sustainable innovation in specific areas of the industry but lack explicit, comprehensive technical requirements. Moreover, some academic works have even questioned the feasibility of CP implementation for public construction works citing the numerous complexities associated with such projects as a hinderance to creating more sustainable construction markets (Christis et al., 2019).

Consequently, the conclusion of the literature review carried out on CP by Xu et al. (2022) is that there is little evidence on the real opportunities and strategies for CP implementation within the public sector. In construction, there has been little empirical research on this topic but a recent empirical study by Alhola et al. (2019) analyzed seven public construction projects and showed that public procurement can provide a favorable route to further development of CP. The research emphasized three illustrative strategies to CP implementation: procurement of improved products and services by introducing GP based circular criteria; procurement based on new business concepts such as pay-per-use buy-and-sell back etc.; and procurement that promotes industrial symbiosis and circular ecosystem. Tushar et al. (2022) posits that the extent to which CP can be implemented in the construction sector through the public procurement route depends on 1) the consideration of the construction lifecycle and its complexities, 2) precise definition of procurement criteria to guide its application, and 3) ease of assimilation for stakeholders involved in the procurement process. These studies hint at the relevant characteristics and tools needed to achieve CP implementation in public construction works (circular/green indicators, circularity criteria, business model propositions) and accentuate key opportunities for further pilots and experiments to be carried out in developing economies. Table 1 presents a comprehensive list of procurement indicators that point to the possibility of CE inclusion in an infrastructure project from existing literature, which formed good foundation for revealing such cases in Ghana for further investigations.

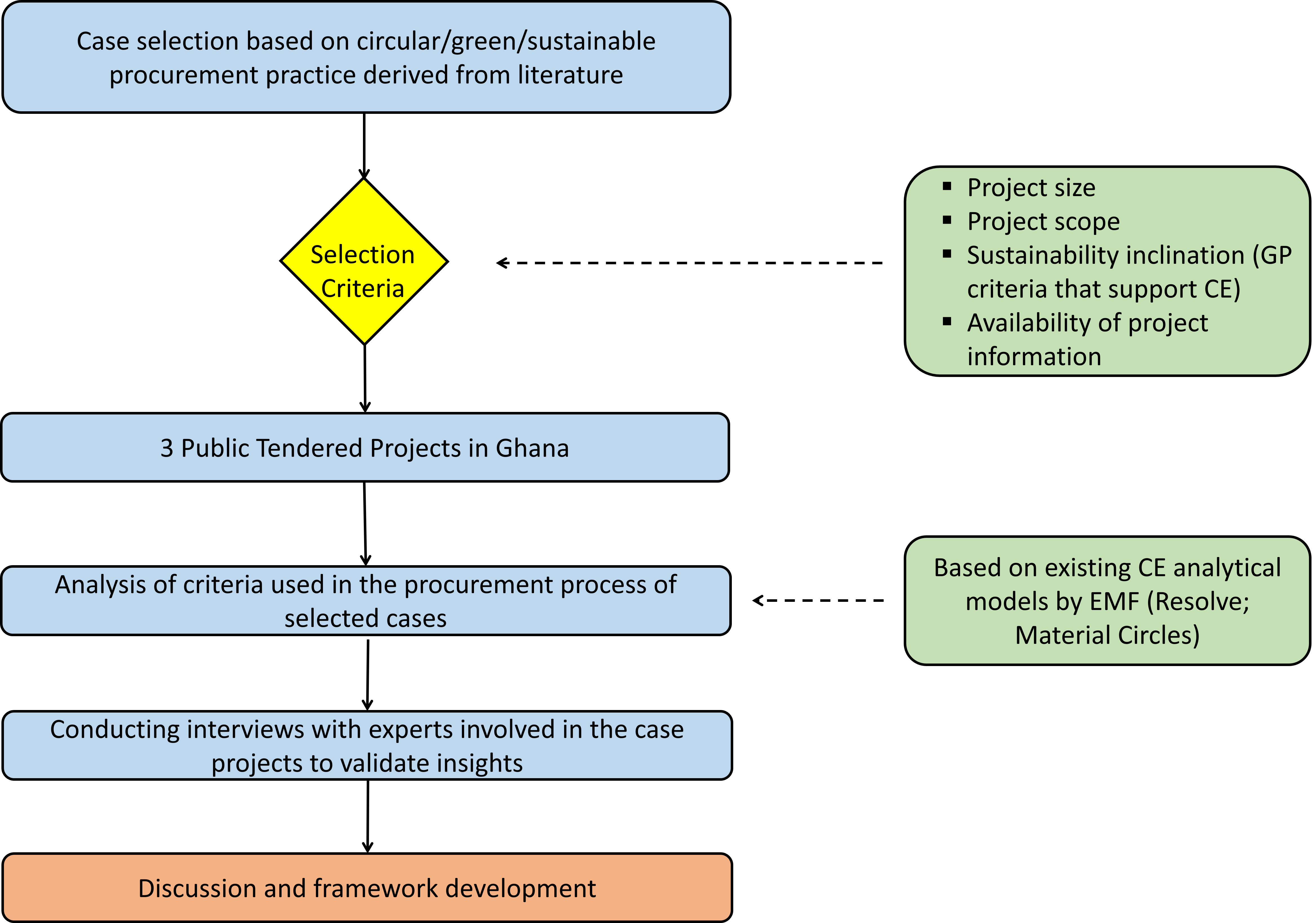
**Table 1:** Circular indicators from existing literature relevant to construction procurement

|  |  |  |
| --- | --- | --- |
| CP Indicator | Description | Source/Reference |
| *Design Stage* | | |
| Functional tendering | Encourage innovation by using procurement models in which procurer requests for functionality and performance instead of detailed product specification. | Ibem and Laryea, 2017 |
| Circular criteria | Build circularity criteria into tender qualification and evaluation using GPP and Eco-labels. | Alhola et al., 2019 |
| Transparency and validation | Facilitate the use of standards, documentation, certification, and alternative forms of knowledge sharing schemes that aid in the evaluation and verification of circularity aspects. E.g. cradle 2 cradle®. | Qazi and Appolloni, 2022 |
| Innovative process | Applying new procedure to create innovative solutions for products or service that was not previously available in the market. | Kristensen et al., 2021 |
| Incentivized revenue | Use revenue models that provide incentives for stakeholders to take circular actions, such as product service systems, buy-sell-back programs, among others. | Jones et al., 2017 |
| *Construction stage* | | |
| Reliance on renewables | The construction process focusses on the of renewable and alternative energy sources. | Popa and Popa, 2016 |
| Construction process optimization | Employing resource efficient strategies of production on construction sites such as lean construction, light weighting. | Bocken et al., 2016 |
| Circular design | Building and infrastructure are designed for life extension, biological cycle and resource conservation. | Kristensen and Mosgaard, 2020 |
| Circular supplies | Use of ecofriendly, renewable, recyclable materials and logistics that reduce environmental impact and carbon footprint. | Alhola et al., 2017 |
| Substitution | Eliminating the need for hazardous products by radical innovation and development of alternatives. E.g., de-materialization etc. | Kirchherr et al., 2017 |
| Industrial symbiosis | Transfer of construction waste or by products to other industries or related projects in order to improve resource efficiency. | Bocken et al, 2016 |
| Sufficiency model for local content promotion | Reducing absolute demand for imported construction resources by influencing and promoting local sustainable materials while mitigating consumerism behavior. | Ntsonde and Aggeri, 2021 |
| Durability and long life | Buildings remain in use for extensive life spans, through maintenance, adaptations, repurpose and enhancements. | Kristensen and Mosgaard, 2020 |
| Economic benefit | The use of the most sustainable and economically viable inputs considered through life cycle costing and total cost of ownership. | Xu et al., 2022 |
| *Operation and End-of-life* | | |
| Materials recycling | This includes upcycling, downcycling and functional recycling of parts or components of existing infrastructure. | Farooque et al., 2019 |
| Parts harvesting | Recovery and restoration if necessary, parts or whole of building components in order to reuse or transfer to another project. | Sprakel, 2022 |
| Reverse logistics | A logistical plan aimed to take back or collect component of constituent parts of an existing structure at EOL. | Adabre et al., 2022 |
| Cascading | Transferring components to another supply chain or different end user. | Kristensen and Mosgaard, 2020 |
| Extension and retrofitting | Processes to extend the value of building through maintenance, refurbrishment, repurpose and renovation of parts or entire building. | Deambrogio et al., 2017 |

# Research method

The epistemological position of this research is hinged on a pragmatism research paradigm. This approach was considered suitable as it enables the combination of both positivist and interpretivism positions in revealing multiple realities within the scope of a single research question. To explore the GP practices that could be useful in CP implementation, experiences from industry practitioners in Ghana was sought using inductive- based qualitative research approach. Inductive research consists of making broad generalizations from specific observations with the aim of developing new constructs, patterns or regularities in a given phenomenon. According to Eisenhardt et al. (2016), it is the most suitable approach for obtaining empirical evidence when little work has been carried out in the area of research. Therefore, to expand new knowledge on circular procurement and its implementation in construction markets, the inductive approach is used to derive insights from making specific observations from collective cases of public tendered projects in three of Ghana’s large cities. As indicated by Teegavarapu et al. (2008), a case study in research design can be used to analyze a phenomenon, generate hypothesis or to validate an observation. For this paper, we adopted case studies to provide contextual evidence on CP phenomenon in Ghana. Observations from the cases were analyzed for patterns towards the development of generalizable conclusions on CP implementation in the Sub-Saharan African region. A combination of qualitative data collection methods, including case analysis and interviews were deployed to achieve the aim of the study. The methodological flow of the research is presented in Figure 1. In the case analysis, procurement documentation and project information of the selected cases including, tender and contract documents, advertisements requesting for potential proposals, bids or quotations were reviewed in order to provide a deeper understanding of the application of various green criteria towards the development of CP. From this analysis, we generated characteristics of CP/ GP towards CP in construction. Insights from this activity were also used to frame further questions for interviews with projects participants from the cases selected.

From a methodological standpoint, Jamshed (2014) recognized that the use of interviews allows for the collection of more detailed information and specific opinions while considering nonverbal cues and emotional responses, hence interviews were the primary means of data collection for this study. A sample frame was formed from the procurement participants involved in the selected cases. From the case, three groups of key stakeholders were identified to be directly involved in the procurement process; the Client/Funder, the Consultant and the Contractor. Therefore, representatives of each of these groups were targeted to give their insights on GP towards CP practice. For each case project, the consultant was first identified through public records and an invitation sent to the procuring manager to partake in the interviews. We then relied on their referrals to locate key personnel with whom they worked from the other stakeholder groups. The recommendation of a participant was based on the extent of involvement in the procurement of the projects, knowledge/experience in circular/green aspects of procurement, and willingness to partake in the interviews. Overall, 2 respondents were conveniently sampled, after which 7 individuals were selected through snowballing technique, bringing the study’s total sample size to 9 participants. The sample size was considered to be adequate, as Galvin (2015) reports any number between 8 and 30 interviews as relevant to produce reliable knowledge for phenomenological studies.



**Figure 1**: Methodological flowchart of the study

### ***Case description***

The study adopted a multiple case-study approach to examine the integration of circular aspects into public procurement processes (Yin, 2013). Instead of gathering a statistically representative sample to arrive at generalized conclusions, the study sought to find cases with specific approaches of incorporating CE elements through existing GP criteria. Therefore, we mapped procurement cases in which certain tools had been used in the process to address circular elements through GP criteria such as life cycle costing as an indication of cost savings in resource use, ecolabelling, eco-design and recycled/ remanufactured products. (*c.f.* Kristensen et al., 2021). In addition, we searched for public projects in which contractors had been asked for innovative solutions to circularity requiring them to describe how materials were to be circulated (e.g. multiple purpose material; recyclability), what the end processes would be and its future markets prospects etc. Other considerations for case selection were project scope and size which was limited to building construction of not less than GHS 2.5 million in contract value, based on the premise that these make up close to 60% of the entire projects awarded within the region (Owoo and Lambon-Quayefio, 2020). Moreover, Mosgaard et al. (2013) posits that attention to sustainability criteria during procurement is relatively higher on projects with large contract sums. Thus, 3 public construction projects procured under the Ghana Education Trust Fund (GetFund) Scheme were purposively selected after satisfying the criteria above. The cases were chosen from an ongoing public procurement initiative that aims to promote sustainability and local innovation in the construction of educational facilities in Ghana. The choice was also influenced by the availability of project information in the public records database of the country. Details of the projects are summarized in Table 2 below.

**Table 2**: Green procurement cases with circular aspects included in the study

|  |  |  |  |
| --- | --- | --- | --- |
| Case # | Procuring Organization | Project Location | Procurement activity |
| 1 | GetFund | Tamale | Use of ramped earth and salvaged bricks in construction of a library complex for schools |
| 2 | GetFund | Sunyani | Construction of student residential complex with recycled aggregate and green concrete technology |
| 3 | GetFund/CSR-BRRI | Kumasi | Use of recycled plastic blocks for the construction of classroom facilities |

### ***Participants’ profile and interview process***

The interviews focused on industry practices regarding procurement of works, with a typical inclination to green and circular practices. With the aid of interview guides, semi-directive interviews were conducted with individuals involved in the procurement process of the case adopted. The guide was first tested as a pilot for one of the case projects and then revised accordingly before the main round. Three key clusters of stakeholders had been identified as the focus of the main interview process: The GetFund that initiated the project and public tender; the procurement consultancy responsible for detailing out specifications, executing and evaluating tender procedures as well as providing expertise on sustainability, and the contractors that won the projects. Out of the nine sampled participants, only eight were available to partake in the interviews (See Table 3). By adopting the funnel model (Hartwig et al., 2014), the interview questions began with broad open-ended questions such as motivations and context of the construction project, before delving into more specific issues about practices, tools and techniques employed, looking out for GP practices that compliment and develop CP. Collectively; the interviews allowed participants to 1) Relive their understanding of GP and CP in construction, 2) Identify opportunities for GP to CP transition, and 3) Discuss barriers to CP within the context of developing countries. Each interview session lasted not more than an hour and with the consent of interviewees, the discussions were recorded for ease of transcription and analysis. The collected data was manually coded and systematically analyzed, due to the relatively small sample size (*c.f.* Zuofa et al., 2023). The data was then sorted, organized and built into themes that explain significant trends from the interview. The themes were derived from similarity and disparity trends with regards to the responses from interviewees in relation to their evaluation of construction GP practices that are linked to CP implementation in the Ghanaian context. In the end, two major themes were derived from the analysis. These themes are consequently analyzed for circular opportunities by adopting the Materials circles and Resolve analytical models by the Ellen McArthur Foundation (EMF, 2017). After analyzing the study, the findings were validated through focused group discussions sectioned into two groups with five participants in each session. The participants included the interviewees, and two academicians with expertise in the field of research. In-depth deliberations from various perspectives of the generated themes as well as the challenges and strategies for promoting CP in construction were verified and confirmed.

**Table 3**: Overview of interview respondents

|  |  |  |  |
| --- | --- | --- | --- |
| Respondents | Organization | Interview type | Experience |
| G1: Program Director | GetFund | Face to face | >25 years |
| G2: Policy delivery Manager | GetFund | Virtual | 11-20 years |
| P1: Procurement Officer | Consultancy firm | Face to face | 11-20 years |
| P2: Contract Administrator | Consultancy Firm | Virtual | 5-10 years |
| P3: Manager | Consultancy firm | Phone | >25 years |
| C1: Projects Manager | Contractor | Phone | 5-10 years |
| C2: Quantity Surveyor | Contractor | Phone | 21-15 years |
| C3: Procurement Officer | Contractor | Phone | 11-20 years |

# Results

## ***Theme 1: Green Procurement Criteria Supporting Circular Economy***

The focus of this theme was to showcase the understanding of GP in relation to CE and elucidate current practice that could support CP implementation. All participants indicated an awareness to GP in the construction practice and described their perception of how it could influence the CE agenda. From the case analysis and interviews, all standard procurement documentations had been redefined to ensure requirements support resource reduction as well as some degree of product reuse and recycling. These criteria were introduced based on GP principles for the projects. However, to a far extent, they also support the “optimize”, “loop”, and “regenerate” aspects of the CE business model although other aspects such as “share”, “virtualize” and “exchange” appeared to be less emphasized within the criteria provided. The GP criteria adopted for the cases provide four distinct models that could be beneficial to the development of CP and consequently, the CE transition. The first model sought to extend the product life span placing great emphasis on durability of products used. These included requirements to consider components of materials, their ease of assembly or disassembly, among others. Secondly, the efficient use of resources was emphasized by the GP criteria adopted by adopting designs and methods of construction that lead to optimized use of resources. The third model focused on recycled content in the construction of the buildings and recyclability of materials used ensuring technical and biological cycles are improved and implemented. Criteria concerning the proportion of recycled/reused material (e.g., comprising 40% of recycled materials for partition walls) were categorically included in project requirements. Lastly, the criteria established a requirement for clean material cycles ensuring minimal impact to the environment by minimizing construction and demolition waste. The implementation of these GP criteria to the case projects resulted in deeper and closer interaction among the stakeholders to meet project requirements and objectives. Major changes could be identified in the timing of interactions between the consulting parties and contractors along the construction life cycle:

*“It is essential that interactions are made with potential contractors as early as possible, before or during product specification, so that collaborative decisions on material inputs and logistics provisions prescribed will be practical, easily accepted and less likely to produce conflicts” (P2)*

## ***Theme 2: Barriers and Opportunities for Circular Procurement***

With clarity on linking GP to CE, and an understanding of CP in the context of public works projects, participants provided insights on opportunities and present challenges that could impact the new CP development. It was agreed by most interview participants that the development of evaluation and qualification criteria steered the direction at the early stages of tendering in the case projects. The evaluation criteria were developed to reflect GP requirements for the project. Drawn from the provisions of the Public Procurement Act, and in consultation with relevant bodies including Ghana Green Building Council (GHGBC), key highlights were on environmental issues. Technical and biological characteristics of materials adopted for the projects were evaluated based on conformance to predetermined green standards. Other social aspects such as source or material, labor requirements etc., were addressed in the clauses of the agreement/contract.

*“We cannot provide every technical detail for all input into a building project, we only provide minimum acceptable requirements and monitor compliance to these standards. By doing this, a better alignment to green and even circular considerations in accordance with government’s sustainability strategy is stimulated” (G1)*

The evaluation of bids was based on price competitiveness, technical offer adequacy, and sufficiency of environmental and social plans. Tenders were evaluated against the GP criteria and at cost by lifecycle costing methods. In the GP criteria adopted in the case projects, sustainability was considered through properly documented plans of the tenderer to tackle environmental and social risks that may arise in the course of project implementation. Prospective bidders were required to demonstrate their competence in environmental management systems, indicating their experience, methods, and strategies adopted (i.e., optimizing, looping and regenerating). The case projects required provision of site-specific proposals for environmental management plans (EMP) as well as records of successful implementation of EMP plans over a period of at least 5 years.

*“For this project, we were required to submit environmental management plans and also provide proposals of how targets for 15% recycled contents were going to be achieved. This was a new challenge since it had not been a requirement for previous awards won.” (C3)*

The utilization of ecolabels as a GP tool was employed in the cases to validate environmental properties of materials or components employed in construction. This was enabled by GHGBC framework to incorporate of ecolabels and product certification into construction procurement. The consultants from the case acknowledged that there are significant benefits they have gained from using ecolabels:

*“Ecolabels have made our jobs a lot easier by reducing the need to check every single requirement for a specified product. Now, we simply group them under a particular label or standard and ensure contractors or suppliers deliver under that label to satisfy requirements for reduced impacts” (P3)*

Aside ecolabels, the organizations from the case progressively adopted market dialogue to involve contractors and suppliers ahead of the tender stage to gain knowledge of changes to the market, and what innovative capabilities were available to be harnessed. Additionally, existing government policies and legislative guidelines on sustainable procurement were considered in making procurement decisions for the case projects. However, due to the generic nature of these policy documentation, the procuring organizations had to develop internal policies and strategies to achieve specific green outcomes. All but one organization involved in the case had developed specific guidelines green/sustainable available based the business needs of the project. Some projects participants, however, acknowledged the need for an overarching policy instrument by the government as this would provide a clear national strategy on green procurement outcomes and improving prospects for circularity:

*“Our national procurement policy does not include any explicit GP objectives, and without a unified plan for procurement, projects must determine its own priorities for each tender, which may or may not give significant weight to green or circular issues further challenging the implementation of CP.” (G2)*

*It is often assumed that the procurement process will play a supporting role for targets set by policies, such as becoming CO2 neutral, but it is challenging when specific actions haven’t been defined to achieve or indicate how far to go in achieving these targets.” (P1)*

From the case, it appears that policy development is handled from a more micro-organizational perspective which has its own strengths however stifles political support, public sensitization and awareness creation among stakeholders for green and innovative procurement outcomes as posited by Ghisetti (2017). This highlights one of the key points of the study’s observation; a gap between existing government policies for GP and current GP practices in various organizations.

# Discussion of research findings

## ***Transition from green to circular procurement***

GP is considered a highly standardized linear process yet its literature streams have been closely linked to CE in terms of providing opportunities for environmentally desirable products (Opoku et al., 2022; Alhola et al., 2017). Observations from the Ghanaian cases reveal that GP is being used to craft ideal conditions that partially support circular business models indicating that certain aspects of the linear -based procurement overlap with the circular based procurement as posited by Alhola et al. (2019). GP aspects such as extending product lifespan through durability and adaptability, developing reuse markets and increasing use of modular components mirror expected outcomes of a developed CP system (Bohari et al., 2020). However, the existing GP criteria appears to lack an integration of lifecycle assessment tools which is necessary to create a whole-life perspective of the procurement process, a key defining factor for the development of the new CP paradigm (Xu et al., 2022). This diverges from the argument in literature that GP criteria is sufficient to promote CE (Wijayasundara et al., 2022), although local initiatives that are associated with GP to some extent simultaneously promote aspects of CP in construction. There is the need to strategically redefine and develop other aspects that have shortcomings in promoting principles of CE by incorporating reverse logistics, extended producer responsibility, and takeback systems into already existing GP criteria (Alhola et al., 2019). Circularity scorecard integration with GP criteria in evaluating construction tenders and supplier bids as proposed by Qazi and Appolloni (2022) is essential in ensuring this objective.

A whole-life approach is pertinent for highlighting the transformation processes needed to enable CP implementation in the construction process (Lemasson et al., 2010). According to Cheng et al. (2018), key considerations for GP to CP must include ecological motivation, modular design, and market development, all of which are enabled by supply chain collaborations. From the case, GP processes involved multi-stage corporation from value chain stakeholders, facilitating a collaborative role in favor of green or recovered materials. It is evident that stakeholder discussions aimed at such sustainable mechanisms at the early stages of project presents a strong GP backbone relevant for CP implementation in the industry (Testa et al., 2016). However, the nature and timing of stakeholder engagements and information flow needed for CP requires more deliberate efforts from a wider group of actors. Thus, incorporating circularity into GP criteria calls for flexibility and dynamism of among value chain actors to promote collaboration across the building lifecycle (Alhola et al., 2019). Bocken et al., 2016 suggests that CP seeks to consider a broader network of stakeholders during early stages of project management to determine what risks and opportunities exist and how to manage them appropriately to ensure desired circular outcomes. Competitive dialogue is required to orchestrate cooperation between diverse actors such as product suppliers, external consulting firms, contractors, and green promotion authorities to engage in the implementation of CP which is presently missing in existing GP criteria (Witjes and Lozano, 2016). Yet, the findings indicate that existing GP criteria, albeit lacking all crucial, is hinged on effective contract management and value for money principles which are vital for promoting long term commitment for CP development and implementation.

## ***Circular procurement in practice***

Table 4 summarizes a list of existing procurement criteria that supports CE and could be incorporated into GP – based models to develop an efficient CP system. An effective approach to CP implementation is improving existing GP-based procurement systems by introducing explicit circular criteria to the tender (Alhola et al., 2019). Witjes and Lozanno (2016) posits that better quality of materials and components in terms of recyclability, reusability, disassembly, and extended life span are promoted through this approach. However, the approach has been challenged as being inadequate for developing innovative business models (Molavi and Barral, 2016). Prior studies propose the adoption of completely new business models as an alternative route to CP implementation in construction (Lewandowski, 2016). It is argued that existing construction procurement models lack the fundamental building blocks to support the application of leasing concepts, product-as-a-service (PAAS), pay-per-use, and buy and sell back systems (Bocken et al., 2016). Yet, the study finds that incremental change is necessary to drive CP implementation in construction as many construction organizations are hesitant to adopting completely new business approaches. Although, CP implementation through GP-based models may not give a complete reflection of the full opportunities of a CP system, it is a gradually accelerated change, and serves as a good starting point especially in regions where change culture is more difficult to cultivate (Husgavel et al., 2022). This confirms Kristensen and Mosgaard’s (2020) argument that CP implementation ought to be practical in a way that encourages stakeholder reception. From the study, an alternative CP implementation approach in practice is the development of circular ecosystems where platforms are developed to support closed loops by creating networks in which waste from the other supply chain is used as raw material for construction and vice versa. This is a unique practice from one of the cases, where blocks are developed from plastic waste materials to reduce overreliance on virgin material stock and as a way of reducing waste from other supply chains. Even though, an alternative approach was used, the project still made use of CP criteria introduced into GP-based model through the utilization of secondary material flows and requirements for durability on the project.

**Table 4**: Procurement criteria that support circular procurement in construction

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| C/N | Procurement criteria that support CP | Case application | | |
| **Case 1** | **Case 2** | **Case 3** |
|  | **Criteria that support extended lifespan** | | | |
| 1 | Requirement for durability | x | x | x |
| 2 | Requirement for easy modification |  | x |  |
| 3 | Add-ons that extend lifespan | x |  | x |
| 4 | Life cycle cost-based calculations | x | x |  |
|  | **Criteria that supports efficient use** | | | |
| 5 | Reuse of materials | x |  | x |
| 6 | Easy assembly and disassembly |  | x |  |
| 7 | Standard sized product design | x | x |  |
| 8 | Requirements for minimum waste generation | x | x | x |
| 9 | Requirements for lean construction approaches | x |  | x |
| 10 | Resource optimization reporting |  |  | x |
|  | **Criteria that supports cycling of biological or technical materials** | | | |
| 11 | Requirements for using recycled materials |  | x | x |
| 12 | Requirements for utilizing secondary material flows | x | x | x |
| 13 | Requirements for recyclability of used materials | x |  | x |
| 14 | Requirements for extended product responsibility |  | x |  |
| 15 | Clear guidance on reuse and recycling options | x | x | x |
|  | **Criteria that supports clean production cycles throughout the process** | | | |
| 16 | Declaration of end location of waste |  | x |  |
| 17 | Requirements for use of non-toxic materials |  | x | x |
| 18 | Requirements that disallow emissive chemicals or products |  | x | x |
| 19 | Materials with environmentally friendly properties | x | x | x |
| 20 | Request for information for material recovery plans | x |  |  |

In all the implementation approaches, industry CP practice focused on waste reduction, resource efficiency and promoting the use of sustainable practices. Internal organizational policies on sourcing strategies had been revised to capture desired circular outcomes such as recycled content, recyclability of material, and service models for products. Typically, these highlight reuse capabilities of existing building components or materials such as bricks, concrete, steel and wood in construction new projects (Akanbi et al., 2018). The use of recycled content is a primary CP practice in construction, where criteria for a minimum quantity of recycled products is determined. Easy recycling and reuse are enabled by CE concepts such as Design for disassembly (DfD) and Design for Manufacture and Assembly (DfMA), where buildings can easily be disassembled for different purposes across the construction life cycle (Bao et al., 2022). In many instances where reuse and recycle capabilities are not desirable, the use of bio-based materials and local sourcing initiatives are employed as relevant CP practices. According to Jones (2017), bio-based materials like bamboo, natural fiber have lower environmental impact and can be replenished more quickly that those that are synthetically manufactured and hence are critical to the development of a CP system. Life-cycle costing is an economic strategy applied in CP to ensure viability by considering full life-cycle costs of construction materials employed in a project. As posited by Ntsonde and Aggeri, (2021), CP implementation should not only appeal to the environmental dimension of business objectives but must also satisfy economic sustainability. By incorporating these practices into GP-based procurement models, Liu et al. (2019) emphasize the creation of more sustainable and resilient procurement processes that will yield circular outcomes for the construction industry.

## ***Challenges of circular procurement practice in developing countries***

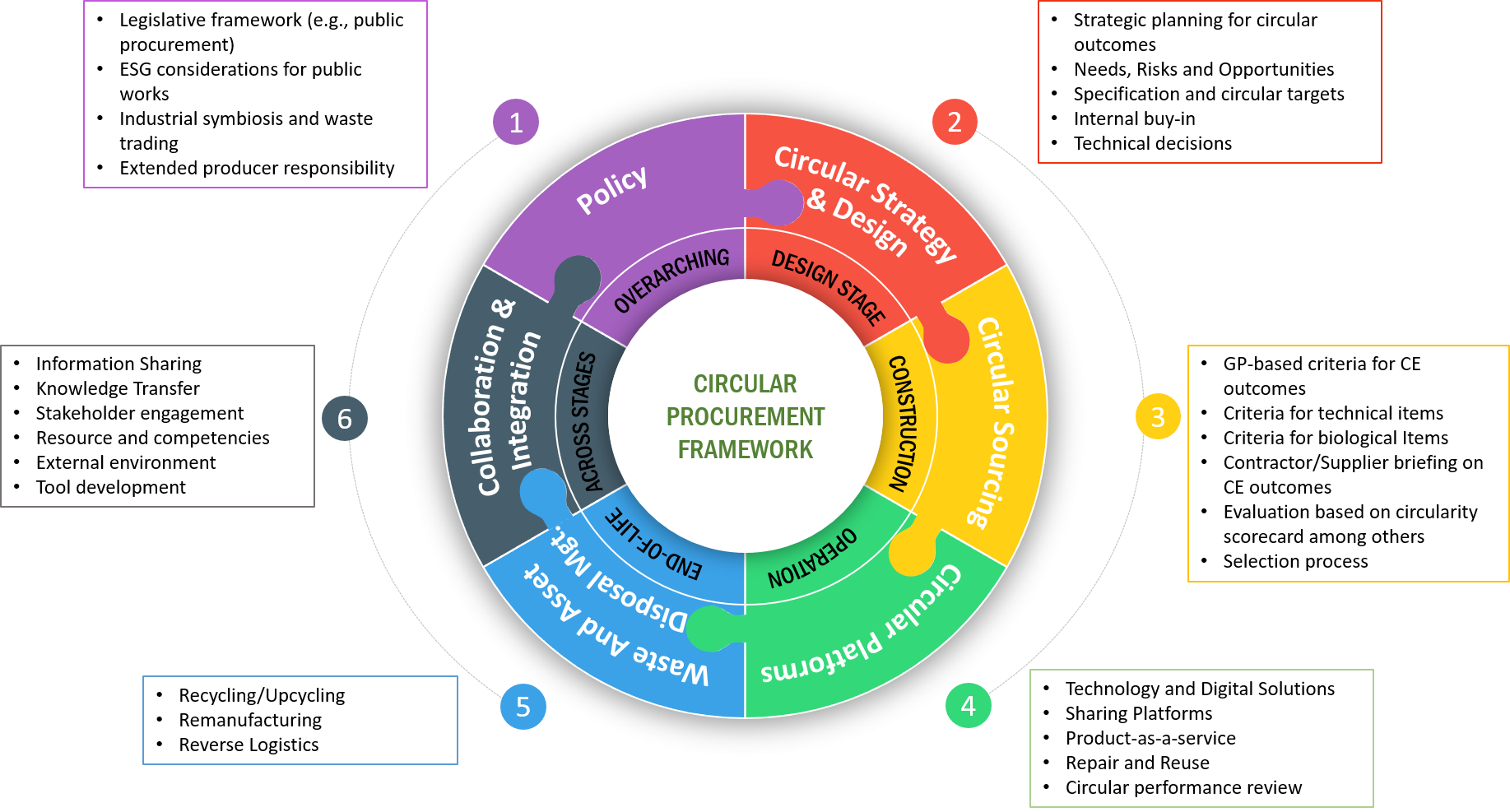
The implementation of CP is essential to advance sustainable outcomes in Ghana’s construction sector but can be challenging due to several factors. In order to elaborate on these factors, a classical three level model of CE; micro, meso and macro levels is adopted (*c.f.* Ababio and Lu, 2022). Micro level challenges associated with issues internal of organizations that try to integrate CE dimensions into their procurement function include internal strategy and process issues. Although an organization’s procurement strategy may incorporate a number of regenerative materials, it usually accounts for a rather small percentage of total materials procured by the entire industry (Sprakel, 2022). From the case, many organizational guidelines are not fully developed to source restored materials for construction projects due to the unavailability of circular products. Construction suppliers and partners do not yet offer circular products in quantities that meet project requirements, leading to large demand which drives cost higher (Wendt-Rasch et al., 2021). Unlike in cases from developed regions, existing sourcing strategies are often not fully planned for circular return of materials (Vegter et al., 2020). This complicates procurement arrangements in terms of logistical support and cost involved in setting up material return. Given that sourcing strategy usually emphasize cost and quality with little priority given to aspects like circularity (Delmonico et al., 2018), justifying such spend in the short term may prove difficult. Consequently, higher anticipated cost retards the adoption and implementation of CP in organizations with limited resources and increases the risk of contractors inflating contract sums (Mishra et al., 2018). In most public organizations as with the cases adopted for the study, stakeholders are not coordinating with each other at the earliest stage of need identification, which would create difficulty in arranging for circular material use.

CP requires extensive interactions with contractors, supplier, jobbers (third party for return), users, competitors etc. from a broad and complex supply chain network (Marrucci et al., 2022). The construction industry’s complex supply chain and long use product system makes information management and resource tracing more difficult. According to Alhola et al. (2019), challenges often arise from cultural differences among supply chain partners, conflicting goals between stakeholders, and lack of integration. From the study, contractors usually struggle to commit to circular aspects of the GP criteria due to lack of knowledge, information or expertise in achieving circular objectives. De Angelis et al. (2018) posit that these challenges often result in conflicts where each supply chain member strives for their personal objective making it impossible to work to achieve CP in such a silo-walled environment. Additionally, market-based challenges such as low cost of virgin material, uncertainty around quality of the materials from the return flow present a key challenge. The perception about circularity among procurers affects the market demand of circular based materials (Qazi and Appolloni, 2022). Other challenges include, unavailable technological resource to provide end-to-end visibility and help in integrating circular outcomes (Farooque et al., 2019). From a broader perspective, CP at the macro level is hampered by weak government incentive policies and a lack of overarching legislation that support circularity in the construction industry. From a socio-cultural point of view, many public organizations are not motivated to procure based on circularity which is partly fueled by the longstanding linear consumption paradigm and government’s lack of interventions to control these consumption behaviors. This calls for the institutionalization of incentives and a review of existing policies to include aspects that support not only circularity but innovative practices that drive (Zuofa et al., 2023). From the case, explicit policies and roadmaps for CP implementation is lacking. This is consistent with Kumar et al. (2019) assertion that existing regulations in developing countries do not capture essential aspects of CE for CP development and implementation.

# *Proposing a circular procurement framework for Ghana’s construction sector*

The study established different GP-based approaches to implementing CP for public construction works in Ghana. Given the many challenges presented by strictly adopting one approach over the other, there is a need holistic approach which considers various aspects that enable CP development and implementation within the construction supply chain. Based on the case analysis, we identified six (6) dimensions that are key in the implementation of CP, namely; circular strategy, circular sourcing, circular platforms, waste and asset disposal management, collaboration and integration, and policy instrument. The framework follows a clockwise sequence starting from policy interventions to collaboration and integration. Although there may be overlaps between the dimensions, they are effectively relevant at different stages across the construction lifecycle. The CP processes must consider both functional and technical specifications of the construction project at the early strategic planning stage where to allow for circularity to be framed into the tender criteria, bid evaluation process and contract award. According to Van Oppen (2018), planning for circularity is essential and must be carried out at the early stages of project development. Clear circularity criteria covering relevant aspects of closing loops, resource efficiency, and recovery need to be incorporated by considering the infrastructure need and risks associated at the design and planning stages of the infrastructure project (Nikolaou and Tsagarakis, 2022). However, Lema et al. (2021) posits that government policy plays a critical role in the adoption of sustainability paradigms by organizations in developing countries and these policies influence strategic plans at the organizational level. Thus, it is essential that government’s legislative framework and policy instruments guides the overall strategic planning of public firms for CP. Circular sourcing based on policy-informed strategic plans are executed by implementing technical and biological criteria for all project supplies and services. Here, we propose the incorporation of circularity scorecards as part of evaluation processes and an effective dialogue between procurers, contractors and suppliers on expected circular outcomes (Torgautov et al., 2022; Qazi and Appolloni, 2022).

The effectiveness of managing CP outcomes is dependent on quality assurance and performance control mechanisms employed throughout the procurement process (Xu et al., 2022). The outcomes are usually demonstrated in terms of economic and environmental performance. However, to address peculiar challenges in the Ghanaian context, it is essential for CP to reflect on social aspects by creating new business opportunities that can drive its adoption and implementation (Mani et al, 2016). The development of circular platforms driven by innovative business models through the use of digital and technological solutions lead to new market opportunities. Not only does the deployment of digital solutions create new business models for CP, they also aid in monitoring and tracking material cycles within the closed loop system (Oluleye et al., 2022) which simplifies the waste and asset disposal management processes at the end-of-life stages of the construction life-cycle. Due to the nascency of CP in the Ghanaian construction industry, it is essential that supply chain actors and other stakeholders collaborate to optimize resource use, share risks, build new networks of opportunities (Crespin-Mazet and Dontenwill, 2012). The incorporation of these six dimensions ensures that the CP processes transcend through the entire construction life cycle stages and beyond, maximizing regional opportunities and reducing implementation challenges. Figure 3 illustrates the conceptual framework for implementing CP in the construction sector. Key components of the framework are further explained as follows.



**Figure 2**: Conceptual framework for CP implementation-based findings in the Ghanaian context

## *Policy instrument and legislative support*

Policy is an essential component to establishing and communicating sustainability goals, obtaining stakeholder commitment, and encouraging knowledge to sought and shared among stakeholders within a system, as demonstrated by a number of environmental management frameworks (Bohari et al., 2020). To promote circular procurement in developing construction markets, a dynamic and comprehensive policy framework needs to be in place to 1) provide a reference point for guidance on circular objectives and targets; 2) form the basis on which CP is undertaken within the industry. 3) provide contextual support for enabling other components of the framework. It is essential that such framework addresses socio-cultural issues at the national, regional, and organizational levels of implementation. For example, the implementation of *closing the loop – An EU action plan for circular economy* in 2016 outlined the role of public procurement through the formation of regulations to emphasize green mechanisms which promote regenerative and restorative actions in the region’s procurement activities (Fuertes et al., 2022). Such interventions influence contracts and internal policies at the organizational level to develop new business opportunities and value propositions from circular aspects. Government plays a vital role in the implementation of CP, as Kirchherr et al. (2018) established hat the involvement of government raises awareness, interest and compliance in mechanisms that support CE. Support from government through allocation of funds to support environmental management systems and circular certification programs contribute to the development of much stronger institutions to support sustainable development (Shen et al., 2017).

## *Development of circular strategies and sourcing*

The existence of pro-environmental procurement frameworks means we do not need to reinvent the wheel when it comes to the development of CP for works, as many aspects coincide across various sustainable concepts. However, there is a pressing need to alter the sustainability discourse of construction activities from having less environmental impact to providing the most effective and efficient outcomes (Antwi-Afari et al., 2022). Therefore, CP strategies need to be intentional, restorative and regenerative by design, with the end-of-life preconceived and planned for at the beginning of life. It is established that the development of CP criteria in construction works need to include durability, return loops, minimal waste and improved performance requirements (Sönnichsen and Clement, 2020). Circular initiatives such as take back systems, specific circular targets, operating models etc. need to be reflected at each stage in the procurement process. CP requires strategic routes that allow for experimentation, innovation, risk taking, learning through dialogue with market and value chain actors, and pilot projects (Rainville, 2021). Indicators have been a good measure for characterizing sustainability issues with regards to procurement. Nonetheless, the lack of clear-cut indicators for CP, especially for construction works, present a challenge (Xu et al., 2022). Given that CP considers the entire lifecycle of the building and beyond its system boundaries, it is necessary to modify some existing indicators that are applicable, and develop new ones where necessary to fill the gaps for aspects that are not covered by green and sustainable procurement measures. Evaluation criteria for tenders should be revised to include, not only an environmental score as a lump, but rather specific breakdown for product composition, circularity, durability, and value proposition as well as business innovation for construction services.

## *Circular platforms and asset disposal management*

Information sharing along the value chain of a building’s lifecycle is vital for the objective of circular procurement to be realized. Procurement information should consolidate insights and data on construction inputs, service characteristics, environmental impact etc. that was gathered before, during and after the tendering process (Bao et al., 2019). The adoption of innovative tools such as tools like material passport (MP) and information sharing platforms and technologies like building information modeling (BIM) would ensure information continuity and integration along the lifecycle of an infrastructure. BIM offers a platform for developing, optimizing and monitoring material flow throughout the project lifecycle and end of life management (Rajeb and Appolloni, 2022). Integrating e-procurement technologies are also critical to any circular procurement system as they provide better information security, confidentiality, legality, and promote trust (Yevu et al., 2022). Such technologies include radio frequency identification (RFID) for construction supply chain and logistics, big data analytics and machine learning for optimizing procurement resource utilization, and blockchain technology for managing access to information flow. Digital technologies can be applied during market dialogue for CP implementation to facilitate decisions that enables reverse logistics for circular solutions and waste management practices (Kristensen et al., 2021). Circular platforms should therefore integrate digital technologies and human capabilities in providing effective solutions, process reengineering and procurement optimization.

## *Collaboration*

CP involves coordination of stakeholder in forward and reverse supply chains while creating value from services, products, and by-products over extended life cycles (Kristensen et al., 2021). Stakeholder values are instrumental to the built environment’s circular transitional period. Values such as commitment, trust, capabilities among others, drive stakeholders in the construction supply chain to cooperate in determining to which extent circular aspects are incorporated into the system (Bohari et al., 2017). Successful collaboration could result in joint competitive advantage which would create value and mutual gains for stakeholders within the supply and value chains (Mishra et al., 2019). A collaborative environment facilitates shared circularity goals and provides a fertile ground for CP implementation within the construction supply chain (Qazi and Appolloni, 2022). Consultations with relevant stakeholders throughout the CP processes should be prioritized. Although construction value chains are complex, comprising actors with different interest, early dialogue to develop common objectives along with continuous stakeholder engagements promote effective CP implementation. This is supported by Chong and Preece (2014), who posit that communication constitutes a crucial component of the construction procurement process, especially when complex processes are involved. Hence, the use of information and communication technology could be incorporated to play an integral part of the CP process (Damestichas and Daskalakis, 2020).

# Conclusion

This study examined and developed a framework for CP implementation in Ghana’s construction sector. It found that existing GP-based procurement criteria used in public sector construction works provides a good foundation to build circularity aspects for CP implementation. From the findings, GP provides a platform to further develop product specification, metrics and reporting to achieve circularity. Six key dimensions across the construction lifecycle processes are established in the study as necessary to develop Ghana’s GP-based procurement towards CP implementation: policy instrument; circular strategy and design, circular sourcing, development of circular platforms, waste and asset management disposal management, as well as collaboration and integration. The policy dimension of the framework is highlighted as the most essential component that drives awareness and interest in CP practices, indicating the government’s vital role of developing institutional support for the implementation of CP in the Ghanaian construction sector. The study revealed a connection between the policy dimension and strategy dimension, emphasizing the influence of legislation and regulations on organizational circular strategy. It also established that the collaboration dimension transcends throughout the construction lifecycle and contributes to the effectiveness of other dimensions. Without the holistic integration of the various dimensions, it would be difficult to overcome the key challenges pointed out in the study as a hindrance to transitioning from GP to CP which include regulatory barriers, limited stakeholder readiness and awareness, inadequate metrics and circular markets. The study’s developed framework ensures an effective transition through the use of favorable aspects of GP-based criteria and an introduction of circular mechanisms, management solutions as well as digital technologies to enable CP implementation in construction.

The research provides both theoretical and practical implications. It contributes to theory by articulating insights on CP implementation in the construction sector through the lens of other sustainability frameworks such as GP, and reveals prospects for its transition. The study provides an empirical basis for the development of several CP dimensions in emerging construction markets, by establishing key aspects of CP in the construction sector. The study also models the sequence of the established CP dimensions for effective implementation in the Ghanaian construction sector. In practice, the developed CP framework could be used as a reference tool based on which supply and value chain actors such as government department, procurement experts, contractors, facility managers, and waste recyclers can operationalize CP within the construction sector towards cleaner production and sustainability targets. From a managerial perspective, the research provides the much-needed information on the strategic use of GP-based public procurement to promote the implementation of CP in construction organizations. However. the study’s findings are influenced by the following limitations. First, the output of the paper is developed primarily through qualitative methods, which may not be an accurate statistical representation of the population. Further quantitative analysis is required in future research to explore the relationships between the dimensions in the framework and their impact on the construction procurement process. Secondly, the developed conceptual framework needs to be verified and validated by expert opinion, which was not done as part of this study. Some dimensions of the framework such as circular strategy and platform can be enriched, and refined towards a more robust framework for achieving circular procurement in construction. Finally, the geographical context of the study can be further expanded and framework tested in other developing countries. It is important to verify the applicability of the study’s findings to other emergent regions in order to extrapolate and promote CP to a larger extent in the construction industry.

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**List of Figures**

1. Figure 1 – Caption: *Methodological flowchart of the study*
2. Figure 2 – Caption: *Conceptual framework for* CP implementation based findings in the Ghanaian context

**Figure 1 alt text:** A flowchart of the research process adopted for this study. CP indicators are first identified to enable case selection on GP criteria that support CE, 3 public cases within the Ghanaian context are selected. The cases are then analyzed for coordinated insights and framework development.

**Figure 2 alt text:** An Integrated framework indicating the CP system for construction. It is founded on 6 key pillars: circular strategy and design, circular sourcing, circular platforms, waste and asset disposal management, collaboration and integration, and policy. Interconnections between these pillars are proposed across the construction lifecycle to enable successful implementation of CP within the construction sector of developing countries.

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