

Article

The Procurement Agenda for the Transition to a Circular Economy

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Abstract: The circular economy (CE) has emerged as an upcoming promising solution to global sustainability. Some policymakers have issued legislations to encourage the adoption of CE, and academics have published studies addressing CE from different approaches. However, adopting CE entails a disruptive shift from a linear economy to a closed-loop economy, where economic growth is decoupled from consumption growth. Though it is difficult to develop a uniform, structured approach for incorporating CE into procurement, this paper attempts to fill the current knowledge gap by proposing a holistic framework to embed CE into the procurement process. The procurement ecosystem is very complex, and this study accordingly dismantles the ecosystem into basic components. The integration of CE for each component is addressed separately. Propositions have then been developed for each element within the procurement ecosystem to embrace CE. The research findings suggest that governments can play an important role in promulgating laws and regulations that encourage CE within procurement. The buyer should be willing to pay a premium for circular products or services; training is needed to address CE when drafting the agreement and during the technical and proposal evaluation. In regard to the bidders' prequalification evaluation, a certain weight should be assigned to the adoption of CE. Furthermore, the bid-award system should give preferential treatment to circular materials or services.

Keywords: circular economy; circular procurement; procurement; procurement ecosystem; sustainability



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1. Introduction

The ever-growing need for materials, water, and energy, due to population growth, place an increased demand on infrastructure and industry [1]. The circular economy (CE) is one of the promising approaches to supporting a sustainable economy for the future [2]. In addition, CE can help in reducing greenhouse gas (GHG) emissions [3]. CE is different from a linear economy where goods are produced, sold, and disposed of. While the model of a linear “throw-away” society depletes our planet's resources, CE aims to maintain the value of resources for the longest period possible by slowing, narrowing, and closing the materials loop [4].

CE decouples economic growth from consumption and the overutilization of resources at the expense of the environment [5,6]. This leads to a distributive shift in the economy. CE is a new form of economy that is based on societal well-being. It is a radical shift from the conventional paradigm of industries [7]. CE entails re-engineering existing production and consumption practices [2]. Achieving CE requires cooperation between private companies, consumers, the public sector, and civil society [8].

Translating the CE concept into practice could be challenging. The public sector and multinational organizations, with their purchasing power, have an immense influence on the market. Therefore, public procurement plays an important role in implementing a

circular economy and proves to be a powerful enabler in achieving it. For example, in the EU, public procurement represents approximately 19% of the GDP [9]. Such purchasing power is not limited to the EU. The Organization for Economic Co-Operation and Development (OECD) estimates that the public procurement value within its member countries is around 12% of the gross domestic product (GDP). Furthermore, it reaches approximately 30% of the GDP in many developing countries [10]. With this procurement size, states can influence suppliers to adopt more circular business models. In addition, investors have shifted their interest from purely financial performance to nonfinancial indicators of sustainable development, such as environment, sustainable, and governance (ESG) ratings that lead many companies and manufacturers to give importance to the environmental impact and sustainability of their offerings [11]. CE has the potential to positively impact sustainability, thus likely promoting CE adoption in areas besides public procurement.

Based on the literature review, it appears that there is a divide among policymakers, scholars, and practitioners on how to embrace CE in general and in procurement in particular [5,12]. Many scholars and organizations report interesting concepts on how to embed CE in procurement [2,10,13–17]. However, these are fragmented and fail to provide a unified, structured practical approach [2,13]. Many successful circular procurement pilot cases can be found, but there still is not a singular systematic implementation regime [18]. One of the major challenges in embracing CE in procurement is the lack of standards for CE evaluation, both on the supplier level 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.

This paper attempts to fill the gap in the literature by proposing a holistic framework for implementing CE in procurement. The proposed framework for implementing CE in procurement provides an efficient, structured approach to embed CE in procurement seamlessly. It is not within the scope of this study to assess the effectiveness of CE on the economy. Furthermore, retail products and services purchased by individuals are not within the scope of this paper.

2. Methodology

This research is qualitative by nature. A literature review, expert interviews, and the authors' experiences were all drawn on, and inductive reasoning was used to develop a framework for implementing CE in procurement. Figure 1 shows a summary of the research methodology.

The literature review focuses on identifying CE implementation strategies and challenges in general and circular procurement in particular. Understanding CE implementation strategies and challenges is important to properly map effective CE implementation strategies into the procurement process during the development of the proposed framework. Section 2 of this paper presents a review of the relevant literature.

To develop a comprehensive, structured framework for circular procurement, it is essential to understand the procurement ecosystem. It is worth mentioning that the extant literature does not provide a comprehensive perspective of the procurement ecosystem. Accordingly, expert interviews were carried out, as these are the most commonly used qualitative interview methods, to gain information or explore a specific area of interest. The authors' experience is used alongside expert discussion to dismantle the procurement ecosystem to its base components as a prerequisite to developing the necessary propositions for a framework to embed CE in procurement. Section 3 of this paper covers the procurement ecosystem.

Relevant findings from the literature review are woven into the procurement ecosystem, as explored through this research, to develop the proposed framework inductively. Section 4 provides the proposed circular procurement implementation framework.

Finally, some general findings are discussed in Section 5, while the conclusion (Section 6) provides general recommendations.

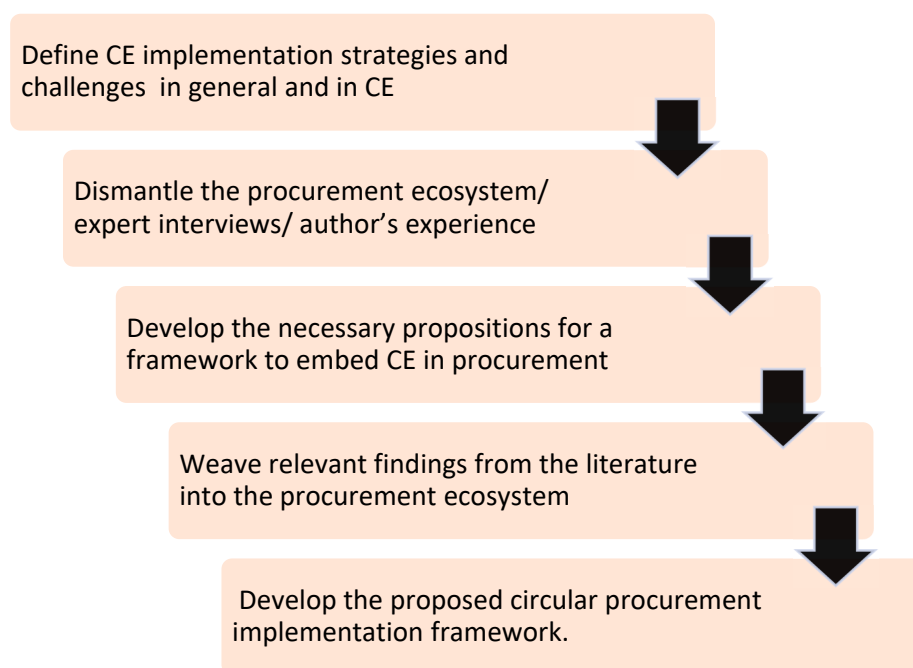


Figure 1. Research methodology.

3. Circular Procurement

3.1. Circular Economy

There is no unanimous definition for CE [8,19,20]. Geissdoerfer et al. [12] proposed a comprehensive definition of the circular economy as “a regenerative system in which resource input and waste, emission, and energy leakage are minimized by slowing, closing, and narrowing material and energy loops. This can be achieved through long-lasting design, maintenance, repair, reuse, remanufacturing, refurbishing, and recycling” [12].

The concept of the circular economy goes back to the 1960s. The term “circular economy” is relatively new. In 2008, China pioneered the adoption of circular economy law to promote the recycling of resources from waste. In the same year, the G8 environment ministers approved an action plan for the 3Rs: reduce, reuse, and recycle [17]. In 2015, the G7 Summit leaders declared the need for “sustainable supply chains” to protect workers and the environment. The concept gained popularity after the European Union (EU) introduced its vision for a circular economy in its 2014 report. This was titled, “Towards a Circular Economy: A Zero Waste Program for Europe” [21,22]. The report addresses construction, demolition, and plastic waste as specific waste challenges. To increase the recycling rate of construction and demolition waste, the European Commission recommended that markets for recycled materials and the inclusion of recycled content from construction waste in construction materials be a part of the framework to assess the environmental performance of buildings. The measures that the commission recommended for improving plastic waste management included increasing recycling and abandoning the process of landfilling.

In 2013, just prior to the EU releasing its 2014 report, the Ellen MacArthur Foundation published a report by McKinsey & Company titled “Towards the Circular Economy: Economic and Business Rationale for an Accelerated Transition” [22,23]. In 2015, the European Union adopted the Circular Economy initiative that included goals for food, water, and plastic reuse [1]. Following China and Europe’s footsteps, many countries around the world began to adopt CE [12,21]. Chinese and European companies and policymakers, thus, have a growing interest in adopting a circular economy [12].

According to Nikolaou et al. [24], the circular economy concept ignores the social dimension; however, it is a vital component of sustainability [24]. A circular economy does not guarantee positive social, economic, and environmental performance [24]. On the contrary, as per Cerqueira-Streit et al. [25], the principles of the CE represent opportunities

to bring environmental, social, and economic benefits to supply chains [25]. Kirchherr [20] reviewed 114 definitions of circular economy and found that only a few link CE to sustainability, and the social impact aspect is rarely even mentioned. Regardless, since the intention of CE is to preserve resources, CE augments sustainably [26].

According to Valverde et al. [26], a circular economy could be a tool to achieve the United Nations Sustainable Development Goals (SDGs) and vice versa [10,26]. Similarly, Morales et al. [27] concluded that there is a synergy between CE strategies and certain SDGs. The UN SDG goal 12, “sustainable consumption and production patterns,” recommends promoting sustainable public procurement practices in accordance with national policies and priorities [28]. According to Velenturf et al. [29], while CEs can augment sustainable development goals, both are diverging. While sustainable development goals give priority to people’s economic prosperity, circular economy focuses on technological solutions.

The International Standardization Organization (ISO) published its first version of the ISO 20,400 (Sustainable Procurement—Guidance) in 2017 to assist organizations that are interested in sustainable development to attain the United Nations SDGs since procurement in any organization plays an important role in contributing to sustainability. ISO 20,400 defines sustainability as the “state of the global system, including environmental, social and economic aspects, in which the needs of the present are met without compromising the ability of future generations to meet their own needs.” Although ISO 20,400 does not elaborate on how to introduce a circular economy in the procurement process, it defines the circular economy as an “economy that is restorative and regenerative by design, and which aims to keep products, components, and materials at their highest utility and value at all times, distinguishing between technical and biological cycles.” [30].

The British Standards Institution released a new standard in May 2017 titled, “BS 8001:2017—Framework for Implementing the Principles of the Circular Economy in Organizations—Guide” [31]. It provides general guidelines, advice, and recommendations but not specific requirements to be met. This makes compliance with the standard or developing certification assessments based on the standard unattainable [32].

A CE could result in social benefits by creating new jobs and increasing product lifetimes. Nevertheless, while policymakers try to implement CE at different scales, academics engage in conceptual discussions. Both policymakers and academics lack clear criteria to assess the impacts and benefits of CE initiatives. This leads to a focus on recovery strategies, in particular for recycling [7]. Most existing national and international regulations and initiatives focus on recycling and pay little attention to other renovation activities, such as reuse [5]. On the contrary, those who are skeptical of CE believe that its adoption is most likely to lead to a reduction in Gross Domestic Product (GDP), which, according to existing indicators, is a negative impacts on the economy [5]. Fletcher et al. [33] believe that decoupling “is a fantasy since there is no evidence that decoupling works, and even imagining its possibility is weak, not alone, it would be politically infeasible. ‘Decoupling’ defies the natural laws and even if it is possible, it remains difficult to achieve in financial terms” [33].

Hina et al. [34] identified organizational drivers and barriers to CE adoption. Table 1 shows the barriers to adopting CE. They are classified into internal barriers and external barriers.

Similarly, the drivers for adopting CE are classified into internal and external drivers. Table 2 shows the drivers needed to adopt CE [34].

In a circular economy, everything that is extracted is eventually returned into the cycle. The aim is to increase the duration of the life stages of each product through a continuous development cycle. This process conserves and supports the durability of natural capital [10]. Table 3 shows the general strategies to embrace CE [8,35].

Table 1. Barriers to implementing CE in organizations. Adopted from Hina et al. (2021) [34].

No.	Barriers	Description
1	Internal Barriers:	
1.1	Company policies and strategies	The absence of clear policies and approaches addressing CE restricts organizations from effectively adopting CE.
1.2	Financial	Adopting CE entails investments in innovative technology, employee training, and production, which could be financially infeasible.
1.3	Technological	The inability of organizations to have access to or the capacity for technology necessary to adopt CE.
1.4	Lack of resources	Lack of time.
1.5	Collaboration	Organizations are reluctant to share information because of competition, which hinders effective collaboration among organizations.
1.6	Product design	Introducing CE principles in product design could be challenging. For instance, substituting materials with recycled alternatives could lower quality.
1.7	Internal stakeholders	Lack of communication among departments when identifying departmental responsibilities towards CE.
2	External Barriers	
2.1	Consumer	Durable product design increases prices and encourages consumers to purchase such products. Consumers might not be willing to purchase recycled or refurbished products.
2.2	Legislative and economic	Frequent changes in government policies and the absence of regulations affect the establishment of remanufacturing companies.
2.3	Supply chain	Supply chains suffer from a fragmentation problem, which may prevent the chain's actors from knowing the activities of other actors.
2.4	Social, cultural, and environmental	Absence of people's involvement (or social inclusion) in CE implementation.

Table 2. Drivers for implementing CE in organizations, Adopted from Hina et al. (2021) [34].

No	Driver	Description
1	Internal Drivers	
1.1	Organizational	Leadership is considered to be the most critical element for the successful implementation of CE.
1.2	Resource availability and optimization	Knowledge and technological resources are important to embrace CE.
1.3	Financial factors	Reducing raw materials and producing remanufactured product revenues could encourage more investment in CE.
1.4	Product and process development	High-quality durable products and environmentally friendly products are appreciated by consumers.
2	External Drivers	
2.1	Policies and regulations	Governments, through their policies and regulations, could encourage consumers and businesses to implement CE via tax breaks, supporting funds, and subsidies.

Table 2. *Cont.*

No	Driver	Description
2.2	Supply chain	Collaborations between supply chain partners could promote waste management
2.3	Society and environment	CE supports addressing environmental safety concerns and minimizing business operation risks. Addressing environmental concerns benefits society.
2.4	Stakeholder pressure	Pressure from key stakeholders could drive a company to adopt CE.
2.5	Infrastructure	Physical infrastructure, such as utilities, buildings, and roads, is assumed to be an essential component of CE implementation.

Table 3. CE Implementation strategies, Adopted from Morales et al. (2021) and Shaharia (2018) [8,35].

No.	Strategy	Description
1	Reuse	When a product or its components have reached the end of their first use and are used for the same purpose for which they were conceived.
2	Repair	Fixing a fault in a product instead of replacing it.
3	Refurbish	Returning a product to good working condition by replacing major components and making changes to update its appearance.
4	Remanufacture	Returning a product or component to the performance specification of the original manufacturer.
5	Recycle	Reprocessing waste materials in a production process for their original purpose or for other purposes excluding energy recovery.
6	Reduce	Lowering resources used in and by the products from a lifecycle perspective.
7	Refuse	Preventing the use of raw materials.
8	Repurpose	Reusing a product for a different purpose.
9	Recover Energy	Incineration of residual flows.
10	Rethink	Rethinking the way products are produced.

The Organization for Economic Cooperation and Development (OECD) proposed five business models that could promote a circular economy [36]:

- **Circular Supply Models.** This model considers that materials of products do not eventually become waste. This model is often referred to as the “cradle to cradle” product design;
- **Resource Recovery Model.** This involves the production of secondary raw materials from the waste stream. It covers three forms: 1. downcycling, where lower-value materials or products compared with the source are generated; 2. upcycling, where a higher-value material or product, compared with its source, is generated; 3. industrial symbiosis, which is the direct circulation of waste streams from one firm into the production process of another;
- **Product Life Extension Model.** This model involves extending the useful life of products through repair, refurbishment, or remanufacturing. This requires manufacturers to adopt product-design strategies that enable such interventions through the design of the product for increased ease of repair and disassembly;

- **Sharing Model (Sharing Economy).** This involves using under-utilized consumer assets more intensively through either lending or pooling. One sharing model is co-ownership, which involves the lending of physical goods, and co-access, which involves allowing others to take part in an activity that would have taken place anyway, such as carpooling;
- **Product Service Model.** This model combines a product with a service, and it is known as the servitized business model. There are three variants for this model: 1. product-oriented product service systems where after-sale services are provided through repair offerings, extended product warranties, or take-back agreements; 2. user-oriented product service systems that involve providing access to the services associated with a particular good without having ownership of the good itself; 3. result-oriented product service systems where, instead of selling goods or assets, the services or outcomes provided by these goods are sold.

3.2. Circular Procurement

There is no specific definition for circular procurement [15]. The concept attempts to promote the circular economy through the procurement of products and services [9]. For example, when a product is procured, its reusability and recyclability should be considered [9]. Circular procurement entails considering durability, resource efficiency, reuse, recyclability, refurbishment/retrofitting, and buying recycled during the procurement process [9].

The European Commission (2017) defines circular procurement as “The process by which public authorities purchase works, goods or services that seek to contribute to closed energy and material loops within supply chains, whilst minimizing, and in the best case avoiding, negative environmental impacts and waste creation across their whole life-cycle” [14]. Green public procurement (GPP) has been recognized by European institutions as a tool to support the transition toward CE [19]. GPP is the procurement of goods and services with reduced environmental impact throughout their lifecycle. CE and GPP are related, but they are different in their objectives and execution [19].

Another definition of circular procurement [18] is “The procurement of competitively priced products, services or systems that lead to extended lifespan, value retention and/or remarkably improved and non-risky cycling of biological or technical materials, compared to other solutions for a similar purpose on the market”.

Jones et al. [9] suggested that promoting circular procurement requires focusing on three elements: (1) service instead of products (servitized); (2) the product’s design, use phase, and end of life; (3) market dialogue [9].

CE implementation should cover four categories [17]: 1. production; 2. consumption; 3. waste management; 4. from waste to resources. Table 4 shows the CE implementation categories.

Table 4. CE implementation categories, Adopted from Neubauer et al. (2017) [17].

No.	Category	Scope
1	Production	Promoting product eco-design
		Promoting waste management in the industrial sector
		Promoting extended producers’ responsibilities
2	Consumption	Increasing repair services
		Promoting waste prevention
		Promoting sharing/reuse/refurbishment
3	Waste management	Contributing to long-term recycling targets
		Monitoring of waste quantities

Table 4. *Cont.*

No.	Category	Scope
4	From waste to resources/recycled material	Improving/investing in waste management infrastructure
		Improving the quality of standards for secondary raw material
		Information flow on secondary materials
		Reducing the presence of hazardous substances in purchased products and services

Khan et al. [16] identified 12 enablers to implement CE in supply. Table 5 shows the 12 enablers, some of which are more CE implementation strategies (such as 2 and 6) than enablers. In addition, enabler number 1 (environmental awareness and education) and enabler number 11 (development of CE culture) are more or less the same.

Table 5. Enablers to implement CE in the supply chain, Adopted from Khan et al. (2022) [16].

No.	Enabler	Description
1	Environmental awareness and education	The organization should spread environmental awareness.
2	Design for longevity, reliability, and durability	The product should be designed to be durable and reliable.
3	Alignment of CE goals with strategic objectives	The organization's strategic objectives should be aligned with CE.
4	Synergistic partnerships	Develop collaboration between product users and producers.
5	Economic pricing for used product	The remanufactured, refurbished, or second-life product has a lower price, which encourages consumers to purchase it.
6	Cascading and repurposing	Cascading focuses on the consecutive utilization of products or materials and resources throughout the lifecycle through repurposing.
7	Transparency within the supply chain	Supply chain partners should create transparency to implement CE practices across the supply chain.
8	Effective relationships with logistic partners and suppliers	An organization needs to establish a good relationship with supply chain partners, logistics providers, and suppliers to ensure the high performance of the CE supply chain.
9	Takeback management	Takeback management consists of deposit systems that can take back new products, used products, and waste materials in an effective manner.
10	Long-term planning	The organization should have a long-term vision and short-term plan regarding the adoption and benefits of CE.
11	Development of CE culture	Creating a robust CE culture through training for effective adoption and implementation of CE practices.
12	Effective performance measure system	Organizations should develop and incorporate effective performance and feedback measures both upstream and downstream of the supply chain.

3.2.1. Circular Procurement Strategies

Organizations adopting formal policies to embrace procurement circularity is essential to introduce a circular economy. Pollice et al. [15] suggest that buyers should engage with the suppliers to identify circular solutions, and there should be a focus on product design to integrate the reduce, reuse, and recycle principles [15].

Circular procurement is an incentive for circular products and services. This could be achieved, for example, by assigning higher points to products with a higher percentage of recycled content or extended warranty (circularity) [8]. Another approach is to buy the functionality of a product by leasing instead of buying it [8]. This approach is also known as the servitized business model, and it entails translating the needs of product specifications into functional requirements [8].

Circular procurement could be implemented on three levels: 1. system level, 2. supplier level, and 3. product level. The system level is basically the contractual arrangement of the agreement; for example, leasing equipment rather than buying it, where the supplier takes back the equipment at the end of the agreement term to remanufacture or refurbish the product to resell it. The supplier level focuses on the supplier system and to what extent it embraces circularity. For example, the supplier has a system to reuse or recycle returned products. Finally, the product level focuses on the design and specifications of the product itself, for example, if the product can be recycled or disassembled after use [4].

To implement circularity in procurement, two strategies can be pursued [10]:

- Promoting circular supply chains by procuring more circular products, materials, and services;
- Promoting new business models based on innovative and resource-efficient solutions.

The first strategy entails developing and using “circular” procurement criteria in tender specifications. The criteria could cover the following:

- Meet specified resource efficiency levels on a whole lifecycle basis;
- Include recycled content;
- Incorporate the potential for reparability;
- Limit/eliminate the use of hazardous chemicals and ensure the nontoxicity of components;

In addition, product lifetime extensions can be promoted through the following:

- Reuse: if the lifetime of a product exceeds its contract term, it could be shared or sold;
- Repair/refurbish: refurbishing or repairing could be an option in the tender specification;
- Remanufacturing: At the end of the contract, products can be dismantled and renewed, and some of their components can be remanufactured;
- Recycle: materials can be extracted by components of a product for recycling.

The second strategy, which is promoting new business models based on innovative and resource-efficient solutions, includes shifting from ownership to “access to services.” The following options can be considered [10]:

- Product–Service System (PSS): customers do not demand products but seek the utility that is provided by products and services. PSS integrates products and services to deliver value rather than resources [37]. For example, instead of buying a printer, the customer buys printing services by leasing or renting the printer. This could decouple economic growth from consumption;
- Supplier take-back systems: this could be in the form of a “purchase and buy back” or “purchase and resale” agreement. It encourages refurbishment and remanufacturing or a third-party purchase of the product from the user and gives the product a second life;
- Sharing platforms/collaborative consumption and sharing economy services: optimizing the use of underused assets via shared use. Simplified access can consequently lower demand for new products.

In addition to the above strategies, there are a number of enablers that should exist [10]:

- Strengthening and adapting consumer information tools: consumer product information should include the product's durability, reparability, availability of spare parts, material recyclability, components, and the possibilities for reuse and remanufacture;
- Lifecycle costing and total cost of ownership methods: usually, lifecycle costing and total cost of ownership shows the preference for products or services that rely on fewer resources or maintenance in term of cost-effectiveness;
- Cooperating with other organizations: partnerships to pool products and service providers to set up sharing and reusing systems;
- Knowledge and information management systems: sharing experiences and initiatives can help in the adoption of circular solutions;
- Legal instruments: formalizing policy that addresses circularity in the procurement process is critical;
- Fiscal instruments: fiscal incentives should be provided to public procurement agencies since products and services that promote circular systems may have higher upfront costs than traditional ones.

3.2.2. Challenges Adopting Circular Procurement

One of the challenges of circular procurement is the lack of a standard that can be applied to all products, services, and circularity metrics [9]. The specifications and circularity of a product are up to the original equipment manufacturer rather than in the hands of the supplier or distributor. A shift from the manufacturer's business model could be risky and costly to the manufacturer. A number of measures could be taken to solve this dilemma, such as the following [38]:

- Provide suppliers with the opportunity to offer their circularity contribution without having to be the original equipment manufacturer (OEM). This could be in a proposal to reuse or disassemble the product after its lifecycle, which could later influence OEM;
- Establish standard cruciality metrics for certain products and services.

Mangla et al. [38] identified 16 barriers to implementing circularity in the supply chain, some of which are more relevant to developing countries. Though Mangla *et al.* addressed barriers to implementing CE within the supply chain in general, they are also applicable to procurement. Table 6 lists the barriers to implementing circular procurement with their descriptions [39].

Table 6. Barriers to implementing circularity into procurement, Adopted form Mangla et al. (2018) [39].

No.	Barrier	Description
1	Lack of industry incentives for green activities	Lack of financial support from government agencies to the industries.
2	Lack of environmental laws and regulations	Weakness or absence of laws and regulations that augment CE.
3	Lack of management commitment	Failure of management to demonstrate commitment to adopting CE.
4	Lack of preferential tax policies for promoting CE	Preferential loans and tax benefits for waste reduction could help promote circularity in supply chain concepts.
5	Lack of implementation of environmental management certifications and system	Environmental certificates could drive industries to be more proactive.
6	Lack of middle and lower-level managers' support and involvement in promoting 'green' products	Middle and lower levels of management play important roles in executing the vision of top management with regard to CE implementation.

Table 6. *Cont.*

No.	Barrier	Description
7	Lack of customer awareness and participation in circular supply chain activities	Unawareness of the circularity by the customer who decides purchasing preferences could hinder the acceptance of circular models in the supply chain.
8	Poor demand/acceptance for environmentally superior technologies	More advanced technology and upgraded equipment and facilities could accomplish circular initiatives in supply chains.
9	Lack of technology transfers	Adopting new technologies could improve CE in the supply chain.
10	Inadequacy in knowledge and awareness of organizational members about circular supply chain management initiatives	Inadequate knowledge and awareness of organization members in circular supply chain management hinders the promotion of circular products with higher reuse, recycling, remanufacture, and repair.
11	Lack of appropriate training and development programs for supply chain members	Skills and knowledge of circularity by the supply chain member are important to adopt a circular supply chain.
12	Lack of effective planning and management for circular concepts	Inadequacy in planning and management could mislead supply chain players from focusing on critical issues in circular supply chain adoption.
13	Lack of systematic information systems	The structure of the supply chain is very complex at the organizational level. There is a need to design and follow an information system network based on the system approach.
14	Lack of coordination and collaboration among supply chain members	Collaboration and coordination between suppliers and vendors are important since it is impossible for a business to have in-house arrangements for the reuse, recycling, and remanufacturing of all their by-products.
15	Lack of support and participation of stakeholders	Without active participation from stakeholders, it is difficult to implement any innovation in processes and technology or streamline the stakeholder's efforts in circular supply chain management implementation.
16	Lack of economic benefits in the short-run	A lack of economic benefits in the short-run, such as increasing short-term costs, could hinder adopting a circular supply chain.

Bressanelli et al. [5] identified a number of challenges to embedding CE in the supply chain. Table 7 shows some of the challenges of various CE strategies.

Table 7. Challenges within circular procurement strategies Adopted from Bressanelli et al. (2019) [5].

Item	CE Strategy	Challenges
1	Servitized business model	1. Cashflow pressure on suppliers since revenues will be collected over time. 2. Financial risk since the customer might stop utilizing the service before recovering the initial investment. Operational risk since the supplier will remain responsible for the repair, damage, and maintenance that may lead to careless product use by users who no longer feel responsible for correct product conservation.
2	Prolonging product lifespan (durability)	1. Reduction in future sales by increasing lifecycle duration 2. Unable to participate in the continuous technology improvements
3	Recycling	Product complexity in terms of materials contents.
4	Disassembling for remanufacturing	Customized products are designed for customers, which makes reuse or remanufacturing of the customized products more challenging.
5	CE regulations and incentives	Lack of policies and regulations that promote CE.
6.	Renovation processes	Recycling could be very expensive compared with linear production from raw materials.

Usually, the price is the main factor in the acquisition process. The cost of circular products could be higher because of their quality and durability. This could be a challenge when promoting CE in procurement [5]. In fact, even a procurer who is supportive of CE and willing to pay a premium for a circular product might find it challenging to determine whether the premium is worth it or not.

“Second-hand” or renovated products are perceived as being less reliable [5]. This makes the market for reused products competitive.

4. Procurement Ecosystem

As stated in the methodology section, an essential element of framework development is the synthesis of the ecosystem. The ecosystem under which the procurement process functions has multiple actors that influence it. These are internal or external actors. Internally, the procurement process is influenced by interactions among various elements, including procurement staff-level competencies, budget, procurement structure (i.e., centralized or decentralized), procurement policies and procedures, and IT solutions. Externally, the procurement process is influenced by market forces, the political environment, and socioeconomic and environmental factors [40]. In addition, interactions between the buyer and supplier impact the procurement process, which is the liaison between both parties. Figure 2 shows the procurement ecosystem and its various influencers. The three main components of the procurement ecosystem are the buyer, supplier, and procurement process. All of these components are influenced by external actors, and the effect of these external influencers varies from one component to the next. At the same time, each component has its own influencers.

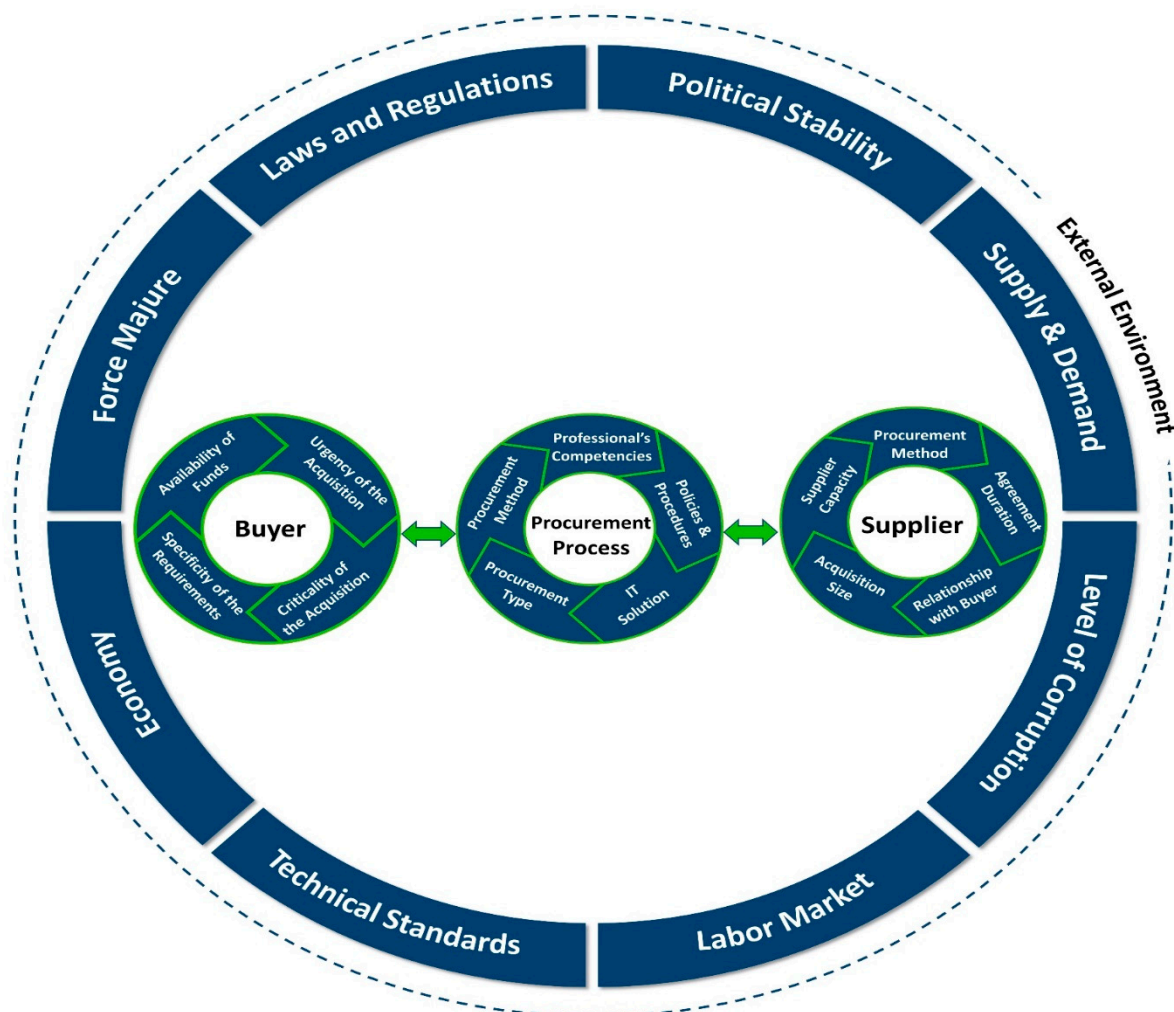


Figure 2. The procurement ecosystem.

Understanding the components of the procurement ecosystem and their elements is important for developing a comprehensive framework to embrace CE in the procurement process.

4.1. Procurement Process Lifecycle

Procurement is the process of acquiring materials (products) or services. Any purchase transaction between a buyer and a seller to acquire materials or services is a procurement process. The United Nations Procurement Manual defines procurement as “all actions necessary for the acquisition, by purchase or lease, of property, including products and real property, and of services, including works” [41].

The procurement lifecycle could vary across organizations and countries. However, there are certain steps and activities that are common across the world. The procurement process is the core function of the procurement department in any organization. When the procurement function is centralized, the procurement department acts to fulfill the needs identified by various departments within the organization. In some organizations, small value or nonstrategic procurements could be carried out by each department within the organization in a decentralized manner.

The lifecycle of the procurement process can be divided into three sequential phases: pre bidding, bidding, and post bidding. The term “bidding” is referred to more commonly as sourcing or tendering. A number of activities usually take place under each phase. Figure 3 shows the three phases of the procurement cycle.



Figure 3. Phases of the procurement process.

4.1.1. Pre Bidding

The inception of procurement emerges as the result of a need. The need that triggers the procurement process could be critical, functional, or strategic. Critical need relates to immediate requirements such as corrective maintenance. Functional need covers all required services and products that support the organization's operations, such as janitorial services. The criticality and priority of functional needs vary. Strategic needs include capital investment or soft requirements such as launching a marketing campaign. While critical needs cannot be deferred, strategic needs can be postponed.

During the pre-bidding phase, the priority of the need is determined, and the required funds or financing scheme is determined. Accordingly, the decision to proceed with procurement is made during the pre-bidding phase. In addition, the procurement approach is usually determined during the pre-bidding phase, including whether to lease or buy equipment. For example, bidding strategy (e.g., competitive bidding or single source), the duration of the agreement, and the magnitude of the procurement are some such considerations that have to be taken. The scope of work (statement of work), which is only one section of the purchase agreement, is usually developed in the pre-bidding phase.

4.1.2. Bidding

Once the decision is made to proceed with the procurement after concluding the activities required for the pre-bidding phase, the bidding phase usually begins. The bidding phase is carried out primarily by the procurement department (known in some organizations as the purchasing department, contracts department, or supply chain department) when the procurement function is centralized within the organization. The procurement department may participate in the pre-bidding phase and work closely with the end-user customer within the organization. The bidding phase usually consists of bidder selection, pro forma development, request for proposal development (RFP), proposal evaluation, and negotiation/agreement award.

The bidding process could be open bidding, selective bidding, or single-source bidding. The bidding strategy depends on the nature of the rendered service or purchased product. Open bidding means that a public announcement is issued, and any supplier can participate in the bidding, while in selective bidding, the buyer determines that certain suppliers should be invited to participate in the bidding. The suppliers might be required to be technically prequalified to be invited to the bidding.

The pro forma agreement or standard Purchase Order (PO) is usually issued along with the RFP in addition to the instructions to the bidders. In some procurements, suppliers are requested to submit a technical proposal in addition to the commercial proposal. Organizations that follow high ethical standards minimize subjectivity in bidding by developing pre-established evaluation criteria to eliminate any subjectivity. The public procurements in many countries still award the lowest bidder, provided the bidder or products meet the minimum requirements. However, some organizations and countries adopt weighted evaluations that are based on combined evaluation criteria. A weight is assigned to the technical evaluation along with the commercial evaluation. Recently, other considerations (ESG rating/local content percentage) have been incorporated into the

evaluation as well. After concluding the proposal evaluation and conducting negotiations (if applicable), the awarded bidder is determined. The bidding phase ends by signing the agreement award or PO approval.

4.1.3. Post Bidding

Following the bidding phase, the post-bidding phase begins when, in the case of a service agreement, a kick-off meeting usually takes place. The service contract administrator should ensure that the terms and conditions of the contract are fulfilled and enforced. In addition, progress payments or monthly payments will be processed, provided that the supplier fulfills all requirements.

In the case of purchasing material, after the PO approval, logistics and transportation could be the responsibility of either the supplier or the buyer. In the case of customized material, the buyer might be involved during manufacturing. Upon delivery of the material, the supplier will be eligible to process the payment.

The buyer usually monitors the performance of the supplier during the execution of the agreement and conducts performance evaluations. Poor performance evaluation could jeopardize future business opportunities between the buyer and the supplier.

4.2. Procurement Procedures

Procurement procedures form the framework under which the procurement process is carried out. OECD stresses the importance of procedures to enhance transparency, good management, prevention of misconduct, accountability, and control in public procurement [42]. In fact, the importance of procurement procedures is crucial in any public or private organization. Accordingly, governments, as well as large incorporations and organizations, usually have procurement procedures where a set of rules to be followed by practitioners is established.

5. Circular Procurement Implementation Framework

Based on the literature review in the context of circular procurement, it is obvious that there is no universal cookbook that can provide one comprehensive, structured approach to embracing CE. At the same time, to succeed in adopting CE in a chaotic ecosystem such as procurement requires turning this ecosystem into a more uniform one by dismantling it into its base elements and addressing each separately. Previous sections establish the bases for the proposed circular procurement framework. In general, the successful incorporation of CE into procurement should follow an up–down approach, where laws and regulations should be cascaded downward. Figure 4 shows the hierarchy of circular procurement embedding.

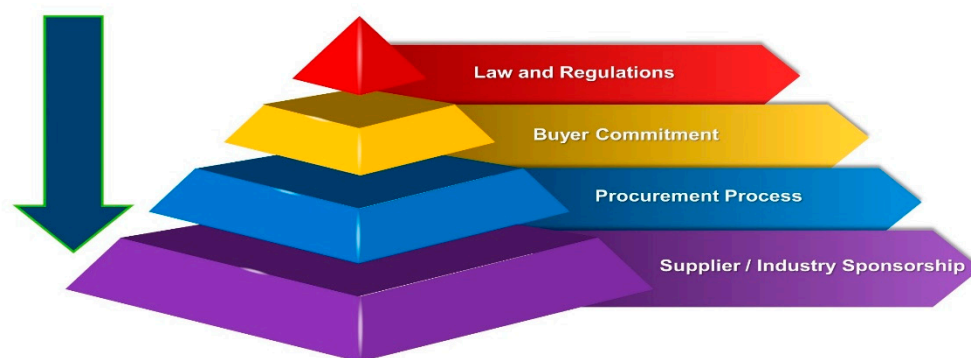


Figure 4. Circular procurement embedding hierarchy.

Each element of the procurement ecosystem, where CE should be integrated, is addressed in the following text. These elements are as follows:

- The CE procurement business environment;

- CE buyers;
- Procurement process enablers;
- Professional practitioners;
- Policies and procedures;
- IT solutions;
- Procurement process activities;
- Supplier prequalification;
- Technical evaluation;
- Award evaluation;
- Post awards;
- Suppliers.

5.1. CE Procurement Business Environment

The CE procurement business environment covers the external factors that influence the procurement process. These include, but are not limited to, laws and regulations, economy, labor market, level of corruption, political stability, force majeure, and technical standards (see Figure 1). To succeed in adopting CE, governments can play an important role in promulgating laws and regulations that encourage CE within public procurement and the industry via various schemes. These can include tax breaks for firms that embrace or support CE, such as recycling plants. Without government leverage, it would be difficult for any society to shift from a linear economy to a circular economy. Europe leads the way in implementing CE because it has issued various regulations that support CE implementation.

In addition, technical standards are also important in adopting CE in procurement. The standards should be specific so that they can be used as a basis for certification. Product certification in terms of its circularity is important. We cannot expect a procurement professional to conduct a lifecycle assessment for each product. Having circularity certifications or ratings issued by a credible institute can overcome one of the major challenges in adopting circular procurement. Some developed countries have a number of certifications and ecolabels. Australia, for example, has the Australasian Recycling Label (ARL), which is the certification for compostable and biodegradable plastics. Recycled content labels can indicate the percentage of recycled content and other certifications [4]. The Nordic countries (Denmark, Finland, Sweden, Iceland, and Norway) have ecolabel licenses that are requested for circular procurement [18].

Similarly, for service providers, there should be standards that can be used as bases for certification. While the certification for product suppliers should focus on the product level, the certification for service providers should focus on the organization, its business model, and its compatibility with CE principles and strategies.

With globalization, the certifications and standards should be on an international level rather than on a national level.

5.2. CE Buyer

The buyer should be willing to pay a potential premium for circular products or services. Governments, as public buyers, should allow for such premiums as an investment that will yield returns in the long run for the benefit of society and global sustainability. The private sector should contribute to supporting suitability via CE as well. There are indications that in some countries, especially developed ones, there is increased awareness among the public about the importance of suitability, and companies are shifting from focusing only on short-term monetary gains. This is exemplified by the popularity of ESG ratings among investors. Accordingly, companies that are interested in having a high ESG rating should incorporate CE within their policies and procurement procedures.

5.3. CE Procurement Process Enablers

The enablers to executing an effective procurement process are mainly 1. professional competencies, 2. policies and procedures, and 3. IT solutions. Figure 5 shows the pillars of the procurement process.

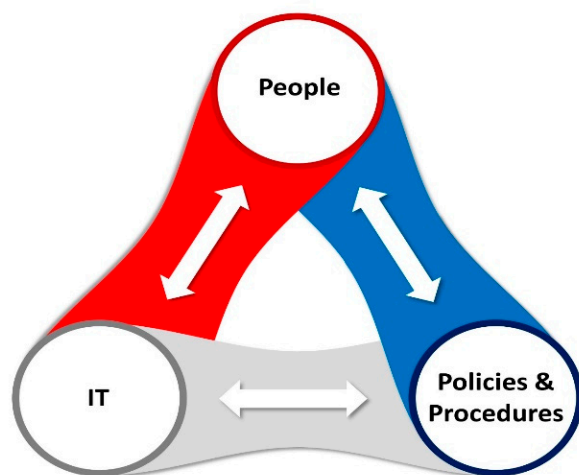


Figure 5. Pillars of the procurement process.

To succeed in embedding CE into procurement, the three enablers of the procurement process should be equipped to embrace CE, as the following sections explain.

5.3.1. Professional Practitioners

To embed CE in procurement, professional practitioners should be acquainted with CE principles through training in order to address CE in drafting the agreement pro forma and during the technical and proposal evaluation. Large organizations may hire CE subject matter expert (SME) or establish a group to extend consultancy support to the procurement team. This approach could be impractical for many organizations. Instead of hiring CE SMEs, procurement practitioners should receive training on CE principles and strategies.

5.3.2. Policies and Procedures

The procurement process should always be governed by established policies and procedures that practitioners have to comply with. Accordingly, the procedures should address CE and have a standalone section addressing the applicability of CE, the minimum acceptable criteria, a CE checklist, and preferential treatment of CE suppliers or products. In addition, the CE procedural requirements for each activity of the procurement should be addressed as well.

General governing principles should be established to assist the procurement professional, including CE. They should provide guidelines on how to select the appropriate CE strategies for each acquisition since strategies can vary from one acquisition to another. The procurement acquisitions can be divided into materials and services. The former could be either raw materials or products. The product could be made of one material, such as plastic containers, pallets, or pipes, or multiple materials, such as laptops and appliances. The services could be classified based on their breakdown of ingredients to the workforce, workforce/equipment service, and workforce/equipment/material service. Figure 6 shows an example of acquisition classification.

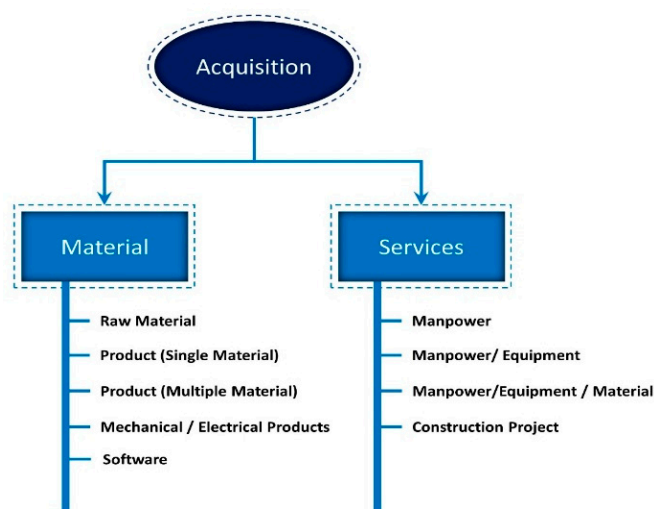


Figure 6. Acquisitions Classification.

This classification should help procurement professionals choose the Appropriate CE strategy relevant to their acquisition request.

The procedures should provide general guidelines on how to consider CE for each type of procurement based on acquisition type. For example, a workforce service agreement can be exempted from CE consideration, while any product purchase acquisition should be subject to CE-applicable requirements. Table 8 shows an example of CE strategies to be covered in the procurement procedures.

Table 8. Example of the CE strategies to be included in the procurement procedures.

Acquisition Type	Strategy	Example
Raw material	Reduce	Sand, cement
Product with a single material	Recycle/refurbish/reuse	Pipe, pallets
Product with multiple materials (nonelectrical/nonmechanical)	Refurbish/Reuse/disassemble	Furniture
Mechanical/electrical products	Repair, prolonged lifecycle, remanufacture, lease	Turbine/power generator/pump
Workforce service	N/A	
Workforce/equipment	Shared services	Transportation
Manpower/equipment/product	Servitized business model Shared services	Printing services
Construction project	Lifecycle assessment	

The procedures should allow the consideration of refurbished, remanufactured, and recycled products as alternatives to brand-new ones. This is important to develop the CE market, though it could be challenging and a major shift from the conventional mindset.

5.3.3. IT Solution

The Material Master Data-Management (MMDM) system could be used to retain the CE requirements at the product level. This could be an effective tool for procurement practitioners to set up the CE requirements in their Request for Proposal (RFP). In developed countries where ecolabels and product certifications are available, the MMDM could be used to retain CE requirements at the product level.

5.4. Procurement Process Activities

The procurement process consists of a number of activities. In some activities, such as supplier prequalification, technical evaluation, and proposal evaluations, CE should be integrated. The procurement procedure should address CE under each relevant procurement activity.

5.4.1. Supplier Prequalification

This activity is sometimes required for service providers more than material suppliers to ensure that the bidder is qualified to participate in the bidding. In some organizations, the prequalification evaluation is separate and different from the technical evaluation, while others combine both under one evaluation. Those organizations that segregate prequalification from technical evaluation focus only on the bidders' capabilities during the prequalification without any consideration of the work statement of the procurement. At the same time, the technical evaluation focuses on evaluating the bidders' capabilities in delivering the requirements of the agreement under procurement and the proposed allocated resources and method of delivering the requirements.

Accordingly, if supplier prequalification is required, a certain weight in the prequalification evaluation should be assigned to the adoption of CE within the supplier business model. The evaluation of CE adoption during the prequalification could focus on the supplier's awareness of CE, which can be substantiated by the number of suppliers' staff who have attended training on the CE concept, and previously provided services that can be considered circular, such as the servitized business model. Merely including CE as one of the elements in the prequalification will help promote CE among suppliers. This might be important in the transitional period where the industry is at the initial phase of embracing CE.

5.4.2. Technical Evaluation

Whenever a technical proposal is required besides the commercial proposal, and the CE requirement is applicable for the acquisition, bidders should be requested to submit a section within the technical proposal or a separate proposal for CE. The CE proposal should demonstrate the circularity of the deliverables as per the nature of the procurement. While the focus for material acquisition should be on the product (e.g., recyclability), the focus for services should be on the business model. When applicable ecolabels are available for certain purchased products, they can be used as one of the technical requirements.

For service procurement, the CE evaluation could address the business model or the proposed material. The proposed CE strategy for equipment could be maintenance programs or refurbishment of equipment after the agreement expires.

For construction projects, a standalone CE proposal and evaluation based on a thorough lifecycle assessment (LCA) could be requested from the bidders in a manner similar to when a value engineering proposal is required. The value and the procurement duration of construction projects justify this.

5.4.3. Award Evaluation

Some organizations award the lowest bidder, provided that the bidder passes the technical evaluation regardless of the score (pass/fail). However, some organizations use weighted evaluation criteria where both commercial and technical evaluation scores are considered. This means that organizations that choose to use weighted evaluation criteria are willing to pay a premium for higher quality. The weight for technical evaluations could be less than for commercial proposals (e.g., 40%). Similarly, to embrace CE, the award should give preferential treatment to circular materials or services. This preferential treatment could incur additional costs. The organization should establish a cap for the acceptable premium to prevent any abuse by the supplier. Determining the acceptable premium for a circular proposal versus noncircular or less circular ones could be challenging. Rating the circularity of a product or service without standard metrics could be misleading.

5.5. Post Award

After the agreement is awarded, the buyer should ensure that the suppliers comply with the circular requirements. For example, if the CE proposal mandates that the supplier refurbish the material after the agreement expires, the buyer should ensure that the supplier complies. Though the buyer will not directly realize any gains, they are excising their social responsibility, which was the original driver for CE. Failure of a supplier to comply with CE requirements could result in invoking a bank guarantee or assigning them poor performance, which will impact future business.

5.6. Supplier

The supplier of materials is, in most cases, either the distributor or seller. This makes the role of the supplier in providing circular products limited. The original equipment manufacturer (OEM) can play more roles in designing and engineering circular products. Therefore, a buyer with leverage such as public procurement should either directly establish a dialogue with the OEMs or with their distributors to encourage them to embrace CE principles during the design and production of their products. Communication between the suppliers and buyers is important to establish a CE supplier base. The need for communication and collaboration between the two is more important when there is a monopoly market, and the supplier has a better edge than the buyer.

6. Discussion

Embracing CE in procurement is essential to adopting CE. Suppliers and manufacturers will only embrace circularity once buyers start demanding circular products and services. The necessary investments to shift to a CE will be justified to the suppliers and manufacturers [43]. This shift will even unleash the creativity and innovation within the industry needed to launch innovative circular products and services.

The discrete pilot experiments, mainly implemented by public procurement carried out in some countries, cannot institutionalize circular procurement. Effective implementation of CE in procurement entails a structured approach whereby the circularity is embedded within each activity of the procurement process and within each procurement, as demonstrated by the proposed framework. This constitutes a major shift from the legacy practice. This shift requires a in management and training for stakeholders involved in procurement, including suppliers. In addition, CE should be covered by enabler tools, including standards, procedures, guidelines, and systems. Accordingly, establishing clear standards and guidance is important if CE is to be embraced in all procurement. The standards and guidelines should be generic overall as well as specific to certain services and products.

The proposed framework could be adopted in phases and would entail collective efforts from various stakeholders. However, as Figure 3 shows, the implementation process should be cascaded from the top. Laws and regulations that mandate adopting circular procurement can drive other stakeholders to play their roles in embracing CE.

Collective efforts among buyers to develop guidelines and standards for circular procurement will not only distribute the burden among them but will also establish uniform standards across the market. Civil society organizations (e.g., environmental organizations) could take the lead in bringing buyers together and coordinating their efforts to establish a circular procurement ecosystem.

Given the dynamics of the procurement process and time constraints, it is neither practical nor realistic to expect procurement practitioners to conduct LCA or a meticulous assessment of CE. Certification of products and services' circularity by a third party (e.g., an association) is essential for circular procurement.

With globalization, it is essential to have circularity certification, and standards should be acceptable globally. Nevertheless, the literature reveals that at the global level, there is a disparity in the maturity and interest in embracing CE among countries, especially between high-income countries and low-income countries [3,12,25].

7. Conclusions

A circular economy has gained attention among policymakers as an enabler to achieve sustainability, especially in developed countries. Translating CE into practice could be challenging. Procurement in general and public procurement could play a vital role in embracing CE in the market and industry. At the same time, practically incorporating CE into procurement is challenging as well because of the complexity of the procurement ecosystem. In addition, it is infeasible to develop a common strategy that could cover all types of acquisitions. For example, the strategies to incorporate CE into product procurement are different from what is applicable for services. Furthermore, each product is unique and should be considered individually.

The procurement ecosystem has been explained in this paper since understanding the procurement ecosystem is a prerequisite to developing a comprehensive framework to embrace CE. The procurement ecosystem has been dismantled into its components and the individual elements of each component. Propositions were then developed for each element within the procurement ecosystem to embrace CE. Some of the propositions of the proposed CE framework are beyond the procurement function of an organization, such as laws, regulations, standards, and CE certification programs.

The proposed framework is generic so that it could be implemented in any country provided that the enablers (e.g., regulations, standards) are established. The authors believe that organizations that are interested in implementing circular procurement can adopt the proposed framework and apply it in their circular procurement journey. The proposed framework for circular procurement implementation can be adjusted by excluding some of the proposed requirements from some activities to serve high and low levels of circularity.

Future studies should focus on regulations and standards that can influence manufacturers and service providers to adopt CE. A buyer without a CE supplier who is interested in CE will not be able to implement it. This is when laws and regulations could play an important role in influencing suppliers, most likely in a more effective manner than the buyer. In addition, future studies should look into the effectiveness of circular business models, such as sharing, where the utilization could be higher, and the useful life of the equipment or device could be shorter. This trade-off needs to be studied to assess the effectiveness of such a model in supporting circuitry.

The following are recommendations based on the developed framework:

- Governments can play an important role in promulgating laws and regulations that encourage CE within public procurement and the industry via various schemes;
- Buyers should be willing to pay a potential premium for circular products or services. Governments, as public buyers, should allow for such premiums as investments that will yield returns in the long run for the benefit of society and global sustainability;
- Professional practitioners should be acquainted with CE principles through training to address CE in drafting the agreement pro forma and during the technical and proposal evaluation;
- General governing principles should be established to assist procurement professionals to include CE. These principles should provide guidelines on how to select the appropriate CE strategies for each acquisition;
- The Material Master Data-Management system could be used to retain CE requirements at the product level;
- Certification of products and services' circularity by a third party (e.g., an association) is essential for circular procurement;
- A certain weight in the bidders' prequalification evaluation should be assigned to the adoption of CE within the supplier's business model;
- The CE proposal should demonstrate the circularity of the deliverables, per the nature of the procurement. While the focus in material acquisition should be on the product, in services, the focus should be on the business model;

- For construction projects, a standalone CE proposal and evaluation based on lifecycle assessment (LCA) could be requested from bidders in a manner akin to a value-engineering proposal;
- The bid–award system should give preferential treatment to circular materials or services. This could incur additional costs. The organization should establish a cap for the acceptable premium to prevent any abuse by suppliers;
- Buyers should ensure that suppliers comply with the circular requirements;
- Communication between suppliers and buyers is important to establish a CE supplier base, especially when there is a monopoly market and the supplier has a better edge than the buyer.

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