The role of public procurement in implementing the circular economy in construction

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Abstract

The aim of this paper is to analyse how Polish procurers are taking advantage of the opportunities for the development of the circular economy offered by the tools available through public procurement. Appropriate regulations to support the implementation of circular concepts in construction do exist, an example being the regulation governing the determination of life-cycle costs of buildings. However, it is not used by contracting authorities. The reasons for this can probably be found in the range of data that must be prepared in the contract documents in order to correctly calculate the individual values. At the same time, the regulation leaves little room for action by contractors, who can only propose extended guarantee periods and lower energy consumption.

Keywords: circular economy; construction; public procurement.

Introduction

More than 200 different definitions of the circular economy exists in the literature. One of the most detailed definitions of the circular economy can be found on the Circular Academy website: “A circular economy is a transformative economy redefining production and consumption patterns, inspired by ecosystems principles and restorative by design, which increases resilience, eliminates waste and creates shared value through an enhanced circulation of material and immaterial flows.” (http://www.circular.academy/circular-economysome-definitions/)

The circular economy aims to increase environmental sustainability of the society and business through resource efficiency, conservation of natural resources, and increasing carbon neutrality (Ghisellini et al., 2016). It is strongly driven by innovation, as it requires companies and public sector to develop and adopt novel, more sustainable, circular products and processes, instead for linear, from virgin-to-waste ones (Prieto-Sandoval et al., 2018).

One of the priority sectors for the implementation of the circular economy is construction (Bukowski; Sznyk, 2019). One of the reasons is the fact that the raw materials used in construction (aggregates, concrete, or industrial limestone) are characterised by high consumption. The consumption of raw materials is, in turn, usually associated with the amount of waste generated. In Poland, construction is one of the main sources of waste. The construction industry is also affected by high greenhouse gas emissions, the source of which is fuel combustion, mainly to generate electricity and heat.

The main products of the construction sector include buildings and structures characterised by high sustainability, upgradeability, and reusability. As such, they are predestined to make use of circular economy concepts.

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Unfortunately, as recent economic history reveals, there is a tendency for the industry to move away from circular concepts. For example, non-renewable materials are used on an increasing scale, materials tend to be reused less often, and the life span of buildings gets shorter (Bukowski, Fabrycka, 2019). According to some studies, the results of the introduction of the circular model in the construction sector in the European Union alone, which can be achieved by 2030, amount to more than one trillion Euros compared to the current situation (Bukowski, Fabrycka, 2019).


Literature reviews show diverse factors influencing the transition towards a circular economy (Hossain et al., 2020; Adams et al., 2017; Munaro et al., 2020; Kooter et al., 2021). Charef et al. (2021) found knowledge, stakeholder engagement, asset lifecycle, procurement, policies, incentive schemes, and technologies to be important factors. Wuni, (2022) conducted an analysis of barriers that were mentioned in the scientific literature in 2018 to 2022. The study established ninety-five barriers to CE adoption in the construction industry. The top five most cited barriers include: (i) higher upfront investment costs; (ii) lack of CE knowledge, technical capabilities, and expertise in construction; (iii) lack of regulatory framework, appropriate policies, and sound legislations for CE in construction; (iv) limited stakeholder awareness of circular materials, products, services, and strategies; and (v) lack of government financial support mechanisms and tax incentives for circular business models.

The basic tool in overcoming barriers to the introduction of a circular economy appears to be public procurement, the value of which in Poland exceeds 12% of GDP and about EUR 2 trillion in the European Union. A significant part of this expenditure is related to public construction.

The European Commission has defined the term “circular procurement”, according to which circular procurement means “an approach to green public procurement which pays special attention to the purchase of works, goods or services that seek to contribute to the closed energy and material loops within supply chains, whilst minimizing, and in the best case avoiding, negative environmental impacts and waste creation across the whole life-cycle” (De Giacomo et al., 2019). On the other hand, in the case of circular public procurement, collaboration and innovation are crucial (Tátrai and Diófási-Kovács, 2021).

The aim of this paper is to analyse how Polish procurers are taking advantage of the opportunities for the development of the circular economy offered by the tools available through public procurement. Particular importance will be attached to the application of the life-cycle cost criterion in public works contracts.

1 Circular economy in public procurement in Poland

The basis of the circular economy is innovative technologies and solutions. The experience of other countries shows the importance of innovation support through public procurement for the emergence of new technologies. In Finland, for example, almost half of the commercialised technologies (48%) between 1984 and 1998 occurred through public procurement or regulations (Saarinen, 2005).

It therefore seems necessary to use public procurement as a driver for innovation and scale-up of the circular products market. In order to test the scale of the use of public procurement to source innovative solutions, the Reports of the President of the Public Procurement Office on the functioning of the public procurement system from 2018 to 2021 were analysed (UZP, 2018 – 2021), in terms of the integration of environmental and innovation aspects in procurement by contracting authorities. The results are shown in Table 1.
Table 1. Public contracts including environmental or innovative aspects

<table>
<thead>
<tr>
<th></th>
<th>2018</th>
<th>2019</th>
<th>2020</th>
<th>2021</th>
</tr>
</thead>
<tbody>
<tr>
<td>Number of contracting authorities that have awarded public contracts of an environmental or innovative character</td>
<td>322</td>
<td>333</td>
<td>384</td>
<td>663</td>
</tr>
<tr>
<td>Number of contracts awarded considering environmental or innovative aspects</td>
<td>1 469</td>
<td>1 511</td>
<td>1 544</td>
<td>2 050</td>
</tr>
<tr>
<td>Value of contracts awarded considering environmental or innovative aspects</td>
<td>9 826 823 760</td>
<td>6 158 203 111</td>
<td>12 323 813 757</td>
<td>8 413 138 031</td>
</tr>
</tbody>
</table>

**TOTAL**

| Share of green or innovative public procurement in the total number of public contracts awarded | 1,02% | 1% | 1% | 1,09% |
| Share of green or innovative public procurement in total value of public procurement awarded | 4,86% | 3% | 7% | 4,48% |

The results in Table 1 show that, both in terms of quantity and value, the share of green or innovative procurement in the total number and value of public contracts awarded, is small. Although the total number of contracts using green and innovative criteria has been increasing over the years, their value has not. Also, the percentage share of this type of procurement in the total number and value on average does not exceed 3%. The maximum value was obtained in 2020 and was 7%.

In a 2019 paper, Bukowski and Fabrycka present the results from a workshop survey on factors supporting innovation in public procurement. The workshop results were then contrasted with the results of a similar survey performed for UK companies.

For sources of innovation, market and regulatory changes were rated as the most important factors. Competition was found to be a far more important driver in relation to the UK survey results. Significant to the discussion earlier is the last place, in terms of the importance of sources of innovation in construction, given to public sector clients. This indicates the need for change and an improvement in the standards of public authorities for innovation to a level already existing in other countries. The inclusion of innovation requirements in public procurement was identified as the most important driver of innovation, followed by the consideration of full life-cycle costs.

Polish legislation ensures that they can be considered. The basis for this is Directive 2014/24/EU of 26 February 2014, based on which the Act of 11 September 2019 operates in Poland. Public Procurement Law (that is, Journal of Laws 2021, item 1129 as amended). In addition to the price criterion, the Public Procurement Law provides for a life-cycle cost criterion for buildings. In order to facilitate the application of the cost criterion to buildings, the Decree
of the Minister of Development and Technology of 23 November 2021 on the method of calculating life cycle costs of buildings and the manner of presenting information on these costs was issued (Journal of Laws 2021, item 2276). Table 2, based on the Reports already mentioned in this paper, summarises the number and value of public contracts in which the cost criterion was applied.

Table 2. Application of the cost criterion using life-cycle costing referred to in Article 91(3b) of the PPL Act

<table>
<thead>
<tr>
<th>Type of contract</th>
<th>2018</th>
<th>2019</th>
<th>2020</th>
<th>2021</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>No</td>
<td>value</td>
<td>No</td>
<td>value</td>
</tr>
<tr>
<td>Supplies</td>
<td>34</td>
<td>46 333 624</td>
<td>21</td>
<td>72 977 473</td>
</tr>
<tr>
<td>Construction works</td>
<td>3</td>
<td>1 772 091</td>
<td>0</td>
<td>0,00</td>
</tr>
<tr>
<td>Services</td>
<td>2</td>
<td>77 739</td>
<td>2</td>
<td>44 906 070</td>
</tr>
</tbody>
</table>

As can be seen in Table 2, despite the increasing number and value of supply and service contracts using the cost criterion over recent years, these are still marginal in terms of all public procurement. Construction contracts look very worrying in this respect. In 2018 and 2021 there were only 3 instances of procurement of this type per year, of negligible value, while in 2019 and 2020 none of the public works procurers chose to use the cost criterion.

2 Regulation

Despite the potential benefits of using life cycle costing as a criterion for evaluating tenders in public procurement and the existence of appropriate tools that can be used by the contracting authority, this criterion is not used in practice. The following section, therefore, examines the regulation on life cycle costing of buildings.

In accordance with the Regulation, the life-cycle cost calculation of a building is calculated by the contracting authority separately for each of the tenders submitted on the basis of the data provided by the economic operators in their tenders as the sum of acquisition, use and maintenance costs of the building, calculated according to the following formula:

$$C_g = C_n + C_uz + C_ut$$

where: $C_g$ – life-cycle costs of a building over its 30-year lifetime, referred to from now on as the “calculation period”, $C_n$ – acquisition costs, $C_uz$ – operating costs, $C_ut$ – maintenance costs.

The purchaser shall determine the acquisition costs based on the tender price.

Utility costs shall be calculated by the contracting authority as the sum of the products of the quantities of final energy or energy carriers and water consumed per year, the unit prices of final energy or energy carrier and water, and the calculation period, according to the following formula:

$$C_uz = 30 \cdot \sum_{k=1}^{n} (E_n \cdot C_{jn})$$

where: 30 – calculation period, n – each successive type of final energy or energy carrier and water, $E_n$ – quantity of the n-th final energy or n-th energy carrier and water consumed during the year, $C_{jn}$ – unit price of the n-th final energy or n-th energy carrier and water.

It is the responsibility of the contracting authority to specify in the contract documents the minimum energy performance of the building, the unit prices for final energy or energy carriers and for water, including sewage disposal. The contractor shall submit a bid for the anticipated amount of final energy or energy carrier and water,
including sewage disposal, to be used per year, considering the minimum requirements set by the contracting authority. To be able to verify the information provided by contractors, the contracting authority should specify the calculation method in addition to requiring the contractor to specify the above-mentioned quantities.

If the amount of final energy, energy carrier or water to be used per year, as indicated by the contractor in its tender, is lower than the maximum value indicated by the contracting authority, the contractor is obliged to present in its tender a solution, the application of which will ensure the achievement of the values indicated by the contractor.

The contractor may propose to reduce utility costs by, for example:

1. use of more efficient and economical solutions and equipment, for instance, in central heating or air conditioning (more efficient heat pumps, exchangers, pipe insulation, air conditioners, fan motors);
2. use of more energy-efficient wall construction materials, including: windows with better energy performance, entrance doors with low thermal transmittance, and insulation materials with higher insulation properties;
3. Energy-efficient lighting solutions for common areas (stairwells, cellars, landings), such as the use of motion detectors, low-current installations and led lighting;
4. more energy-efficient lift motors, cabin lighting, and lift controls;
5. high-efficiency gas and electric appliances.

The cost of maintaining the building in a proper technical and aesthetic condition during the building’s operation period will be calculated by the ordering party as the sum of the unit maintenance costs of the products in the calculation period, reduced by the value of the contractor's guarantee for a given product, according to the formula:

$$C_{ut} = \sum_{k=1}^{i} (A_i - B_i)$$

where: $i$ – each subsequent product, $A_i$ – maintenance cost of the i-th product during the calculation period, $B_i$ – value of the contractor's guarantee for the i-th product.

The maintenance cost of the i-th product during the calculation period is determined according to the following formula:

$$A_i = I \cdot K \cdot N$$

where: $I$ – number of product units, $K$ – cost of replacing the product unit, $N$ – number of product use cycles in the design period according to Annex 1 to the Regulation.

The value of the contractor's guarantee for the i-th product will be calculated according to the following formula:

$$B_i = (A_i \cdot O_g / 30)$$

where: $O_g$ – the guarantee period of the i-th product expressed in years.

In the specification of the terms of the contract, the contracting authority states the types of products considered when determining the cost of maintenance, the cost of replacing a product unit, the number of product use cycles and the number of product units. The contractor specifies in the tender the guarantee period for the individual products.

In summary, the legislator selected some cost components that will be included in the proposed method, namely, they included only those costs that can differentiate individual offers and only those costs that can be reliably calculated. In the method adopted, the legislator also did not consider the costs associated with the decommissioning of the building, in particular the costs of collection and recycling, as well as the costs attributed to the environmental
externalities associated with the life cycle. The former costs were probably omitted due to the assumed calculation period of the building’s life of 30 years, on the assumption that buildings in Poland are not yet decommissioned after this period, and the latter costs were considered too difficult to calculate.

Changes in costs over time and risks associated with changes in the cost of, for example, energy carriers have also been omitted.

3 Case study

A simple example of a works contract was chosen to analyse the regulation. The subject of the contract is the construction of a kindergarten building. The planned building is a two-storey building with an underground area of 360.00 m² and a usable area of 759.00 m².

In accordance with the assumptions of the regulation, the contracting authority has specified the necessary data defined earlier in this paper. It is up to the contractor to specify the bid price for the realisation of the investment, the amount of final energy and water consumed and the warranty period for the elements of the facility specified by the contracting authority.

Theoretically, several possible variants of the contractor's offer were assumed.

Variant I

Variant I assumed that the contractor's tender price is PLN 4 million net, and the contractor assumed the maximum values of energy and water consumption provided by the contracting authority for the calculations. The guarantee period for all the elements indicated by the ordering party is 7 years. Maximum energy consumption is 40 000 kWh/year. With these assumptions, the results of the life cycle cost calculation are as given in Table 3.

<table>
<thead>
<tr>
<th>Item</th>
<th>Types of cost groups</th>
<th>Costs – net [zł]</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>Acquisition costs</td>
<td>4 000 000,00</td>
</tr>
<tr>
<td>2</td>
<td>Operating costs</td>
<td>1 610 865,81</td>
</tr>
<tr>
<td>3</td>
<td>Maintenance costs</td>
<td>562 629,78</td>
</tr>
<tr>
<td>4</td>
<td>Total</td>
<td>6 173 495,59</td>
</tr>
</tbody>
</table>

Variant II

Variant II assumes that the contractor proposed a longer guarantee period than 7 years. The dependence of the obtained values of life-cycle costs on the assumed guarantee period is presented in Figure 1.
Figure 1. *The dependence of the LCC on the guarantee period*

**Variant III**

Variant III assumes that the contractor proposed a lower energy consumption 40,000 kWh/year. The dependency of the obtained life cycle cost values on the assumed level of energy consumption is illustrated in Figure 2.

Figure 2. *The dependence of the LCC on energy consumption*

**Variant IV**

Variant IV assumed that the contractor proposed a lower tender price then PLN 4 million net. The dependence of the obtained values of life cycle costs on the assumed tender price is presented in Figure 3.
Discussion of results

The analyses of the regulation on determining the life cycle costs of buildings reveals that when applying them, the contracting authority prefers the acquisition costs, which in the presented example amount to about 65% of the life cycle costs. Operating costs are about 26%, while maintenance costs are only 9% (Fig. 4).

The results of the analyses indicate that the contractor has the greatest opportunity to reduce life-cycle costs by lowering the tender price. In the example, a price reduction of 3%, results in a cost reduction of 2%. A much smaller impact is achieved by reducing energy consumption or including longer guarantee periods. It is important to note here that the introduction of the latter two solutions will usually have the effect of increasing the offer price at the same time.
5 Summary and conclusions

Despite the existence of regulations supporting the implementation of circular concepts in construction, in many cases they are not applied. "Green procurement" and innovation-related criteria can be used but they are not necessary. As analyses of public procurement show, without mechanisms to enforce certain behaviours, procurers do not make changes.

Appropriate regulations to support the implementation of circular concepts in construction do exist, an example being the regulation governing the determination of life-cycle costs of buildings. However, despite the many advantages of taking life-cycle costs into account in the evaluation of tenders for construction works, it is not used by contracting authorities. The reasons for this can probably be found in the range of data that must be prepared in the contract documents in order to correctly calculate the individual values. At the same time, the regulation leaves little room for action by contractors, who can only propose extended guarantee periods and lower energy consumption. However, these are largely theoretical activities, because attempts to make changes by the contractor usually result in an increase in the offer price, which has the greatest impact on the results.

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