

CIRCULAR ECONOMY AND ITS DISCLOSURE IN THE BASIC CONCEPTS OF IMPROVING PRODUCTION PROCESSES IN CONSTRUCTION

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order to achieve sustainable development, which implies ensuring environmental quality, economic prosperity and social justice to benefit present and future generations.

Many iterations of the existing definitions are likely to be further developed in the coming years, since we are now at the stage of exploring reality, when theoretical or paradigmatic clarity regarding the CE concept is still hypothetical (BLOMSMA, BRENNAN, 2017).

Particularly relevant is the reliance on the conceptual foundations of CE specialists in the construction industry, since the secondary use of building materials, as well as their optimal utilization, is quite important in modern economic conditions. Accordingly, the main concepts of improving production processes in construction should be based on research in the field of CE.

MATERIALS AND METHODS

A number of works devoted both directly to the concept of the implementation of the CE postulates and to the specifics of the applying the main developments in this area in the construction sector were considered. In the study, the analytical method was used.

RESULTS

At first, CE was aimed at implementing only a few cyclical practices: the so-called 3R strategies (Reduce, Reuse, Recycle). Recently, several authors have emphasized the importance of considering up to 10R strategies (R0 "rejection-rethinking", R1 "reduction", R2 "reuse", R3

INTRODUCTION

In recent years, the concept of a circular economy (CE) has become widespread as a prospect for solving major global problems, such as resource scarcity and waste management. It is considered as an alternative to the traditional linear economic model that promotes environmental sustainability. CE is often conceptualized as a general term encompassing both preventive strategies (e.g. functional replacement and dematerialization) and extending the life of resources (e.g. reuse, recycling, repair). Most definitions of CE are based on the definition proposed by Ellen MacArthur Foundation, according to which CE is a system that is restorative or recoverable taking into consideration intentions or plans (AKINADE, OYEDELE, 2019).

In the CE system, "trade of products and services is carried out in closed cycles and material flows are recycled at a high rate." It is also indicated in the literature that circular economy describes an economic system based on business models that replace the concept of "end of life" by reduction, alternative reuse, recycling and recovery of materials in production or distribution and consumption processes, so working at the micro level (products, companies, consumers), meso level (eco-industrial parks) and macro level (city, region, country and beyond) in

"repair/reconstruction", R4 "repair", R5 "restoration", R6 "reorientation", R7 "recycling", R8 "research of new applications" and R9 "repurpose").

Based on the "ladder" - the hierarchy of waste management proposed by A. Lansink, these strategies are ordered by priority depending on their level of cyclicity (R0 has the highest degree of closure). For example, a more reasonable production and use of products is usually preferable to extending the service life of both the products themselves and their components, which is preferable to the recuperation and recycling of materials.

In order to structure various R-strategies and identify their interrelationships, several scientists have proposed schemes that facilitate the transition of stakeholders to CE. However, such schemes have a number of disadvantages (BONES, LUDEKE-FREUND, 2013).

- (1) Firstly, some CE structures do not take into account many cyclical strategies that can be implemented. In fact, CE is most often presented as a combination of 3R, and the use of the 10R strategy scheme is practically not established, while CE requires a system shift. Therefore, all possible R-strategies should be taken into account, since three most well-established R-strategies are only a small part of the CE implementation process.
- (2) Secondly, in order to implement R-strategies, it is necessary to implement various interventions, such as education, research, information campaigns and financial support. To date, these types of interventions are insufficiently represented in most structures focused on CE interventions. This may hinder the process of transition to CE, since the efforts needed to support the implementation of R-strategies are not recognized, evaluated or monitored holistically.

These initiatives may come from stakeholders such as researchers, policy makers, etc. Since their potential contribution (e.g. research and development, law enforcement, customer awareness) do not find a place in existing structures, it can be difficult to identify and coordinate their roles (JESUS, MENDONCA, 2018).

As a result of the second flaw, critical comments were also made regarding the published indicators characterizing the CE process, emphasizing their inability to present its systemic and interdisciplinary nature. Ideally, following the structure in which they were conceived, cyclical indicators should inform how well the CE principles are applied to a product, service or system. However, it is believed that current indicators have only a narrow focus on measuring how closed the material cycles are.

The construction industry should be focused more on the conceptual foundations of the CE, since it produces the largest amount of waste compared to other economic activities around the world. In fact, it accounts for about 35% of it is still characterized by a linear economic model based on the principle of "take, create, dispose" (ELIA, GNONI, TORNESE, 2017).

After demolition building materials are often not subject to disassembly, reuse or recycling. Being obsolete, they are thrown away and mostly end up in landfills. Actions aimed at making the construction sector more closed include not only recycling, but also the following steps:

- (1) implementation of strategies aimed at reducing greenhouse gas emissions;
- (2) putting in place processes that minimize resource depletion;
- (3) refusal to use toxic materials;
- (4) decrease in the volume of waste disposal, as the capacity of landfills becomes limited (GENG, FU, SARKIS, XUE, 2012).

Achieving CE in the construction industry is a difficult task, as several obstacles must be taken into account. Researchers have identified more than twenty obstacles that hinder the transition from a linear economy to CE in the construction industry. These obstacles include technical issues, as well as inadequate policy and legal framework for waste management in the construction sector, insufficient awareness, lack of a general and clear understanding of CE in the management of construction waste, and lack of funding for the implementation of CE.

In addition, in order to overcome transitional barriers in this sector, it is necessary to develop effective CE models, strengthen control over the source of materials, strengthen supervision

and management, introduce innovative technologies and market models, and offer economic incentives.

The analysis of the scientific literature shows that a comprehensive assessment that takes into account many aspects (for example, design, environmental, social, economic, technological, political aspects, etc.) is mostly absent in the studies. Recent CE programs have focused primarily on the supply chain of materials and the recovery of building materials for direct reuse. Thus, it becomes obvious that a holistic approach is needed, conceptualized through structure. This structure should be aimed at many interrelated aspects, including awareness, legal framework and financing, and must use an interdisciplinary approach (HODGE, OCHSENDORF, FERNANDES, 2010).

Scientific contribution is key to the promotion of a research program that can support practitioners and society in setting common goals and coordinating actions towards a well-organized CE transfer.

DISCUSSION

The modern scientific literature on CE emphasizes the importance of creating a reference framework that allows for a systematic assessment of CE. However, the way of using a term "structure" in the literature is often confusing, especially when authors overlook the definition and interpretation of what a structure is. For the purposes of this paper, the structure can be referred to as a conceptual scheme used to classify interventions that can stimulate the transfer to CE.

Within the framework of the structural approach, the analyzed information sources were divided into two groups. Most of the articles (the first group) are devoted to CE business models, while the other part of the works (the second group) conceptualizes CE strategies more systematically. The authors of the second group of articles tried to develop a conceptual framework that classifies the various types of interventions that can support the transition to CE (INIGO, BLOK, 2019)

For example, one of the papers developed a framework for understanding the various aspects and scope of campus activities, as well as how to implement cyclical principles in the development of a campus. Despite the narrow scope of application (campus), the developed structure has gone beyond the scope of a single analysis of the R-strategies implementation. This gave way to the strategic level, which focuses on setting goals and policies, the tactical level (where processes are established and the implementation of goals is directed) and, finally, the operational level, at which goals can already be achieved.

In one more work, the authors investigated the identified practices (methods) of implementing R-strategies; they expanded the discussion to the importance of considering different points of view (conceptual, strategic and practical) to overcome the conceptual and practical phases in circular innovations.

Another group of researchers proposed a strategy of CE implementing, which concerns legislation, policy, infrastructure support, social awareness, joint business models, product design, supply chain, as well as information and communication technologies. A team of authors based on the ReSOLVE framework has developed a typology of circular intervention in city politics: a matrix combining the principles of a circular city (for example, "regenerate", "share", "optimize") and various strategies (for example, "knowledge development", "cooperation platforms", "business support").

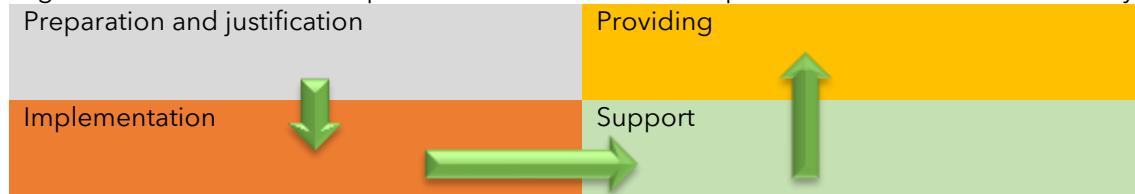
It is also important to note the role of various participants in the construction industry in CE (for example, governments, start-up entrepreneurs, researchers), and not only those who directly produce, consume or process products. For example, individual researchers proposed an integration framework and mentioned the role of various stakeholders (clients, government and legislation) as key driving forces for CE. Nevertheless, the conceptual schemes clearly and insufficiently emphasize that CE requires a systemic shift, changes in society and the behavior of entrepreneurs and should include cooperation, partnership and the participation of several stakeholders (scientists, professionals, enterprises, government agencies) (LEHTONEN, SEBASTIEN, BAULER, 2016).

Figure 1 shows the structure of the implementation of the CE concept within the construction industry. The framework describes four categories of interventions:

- (1) Preparation and justification
- (2) Implementation
- (3) Support
- (4) Providing

All categories belong to 10R strategies.

Fig. 1. The structure of the implementation of the CE concept within the construction industry.



Source: Search data.

The category "Preparation and justification" is aimed at recording the results of research by professionals and scientists who conceptualize CE and guide its implementation. This act is often omitted within CE. Researchers and professionals share and disseminate their knowledge about CE by publishing the results of their work.

By organizing negotiations, discussions and seminars, they encourage other interested parties to go through the CE transfer process. Research is included in the framework because it is the engine for the development of technologies that can make the system circular.

In addition, the researchers emphasize that the role and importance of non-economic actors, such as NGOs, in raising awareness of consumers and society as a whole is often ignored. And finally, the development of education and strengthening are necessary components that need to be taken into account when conceptualizing appropriate measures to increase the cyclical nature of the system.

The "Implementation" category covers the application of R-strategies, that is, the application, deployment or execution of CE strategies that specifically address the technical, material and biological aspects of CE. The development of R-strategies is what most frameworks include. This is undoubtedly a key component of the framework designed to categorize all types of interventions that move society towards CE. By definition, development refers to the action of starting to use a plan or system. The main goal of this effective execution is to achieve the only goal of the R-strategy under consideration.

The "Support" category covers the actions of organizations and governmental, local and regional authorities, whose role is key in promoting and advancing the transition to the CE. The researchers explain how in the scientific literature, "soft" institutional and regulatory factors are often referred to as factors contributing to CE. Special attention is paid to public policy measures (for example, the legal framework, taxes, incentives) aimed at eliminating failures of the construction market. As a rule, these are state policy measures aimed at creating tax incentives for the CE.

Other types of "Support" include infrastructure and environmental measures or government procurement for CE. The provision of subsidies, research grants and funds for the promotion and implementation of circular construction projects is also considered as means of "support". Jobs and employment, human capital, trade flows, as well as the inclusion of CE principles in tenders, quotas, tariffs and taxes are also recognized as means of "support".

Finally, the "Providing" category is aimed to cover initiatives and projects that enable the transition to CE and that have been found to be relevant for inclusion in the framework for evaluating various interventions leading to CE.

The factors of influence under consideration are bottom-up and social initiatives that can be implemented by organizations, enterprises or civil society. This may include platforms and networks for collaboration, as well as entrepreneurial activities and projects aimed at

expanding knowledge and providing companies or partners with the right tools to implement a closed cycle. Other stimulating measures are accelerators of startups in the construction field and CE incubators, social movements, CE business model advisory support schemes, deployment of tools such as documentation and tracking schemes, as well as innovative technologies such as building information modeling and building materials passports. CE directives, regulations and laws also contribute to the achievement of its objectives (for example, the prohibition of toxic materials or the imposition of the use of recycled materials) (POMPONI, MONCASTER, 2017).

All participants who can play a role in the transferring to CE (regardless of whether the transfer takes place in general or in a specific industry) fall under the purpose of the structure (for example, politicians, researchers, entrepreneurs, NGOs, project founders, etc.). At the same time, the structure could help overcome some of the existing barriers to achieving CE. In fact, by allowing participants to display their potential contributions according to an established structure, it can serve as a common communication tool and can foster interaction and partnership between the parties involved. In general, the framework could facilitate discussion of the various roles and agencies of the parties involved in the transition to the CE, so that no efforts will be marginalized, but instead will be recognized and supported.

In addition, these frameworks can be used by policy makers to achieve two main goals. First, policy makers can map the number and diversity of (local or national) CE participants based on their potential role, assess the resources currently available within established geographical boundaries, and determine if additional ones are needed. Second, policy makers can use this framework to categorize planned policies and expand their comprehensive coverage, potentially identifying policy elements that are missing for a systemic transfer.

Also, the structure can play a key role when opening applications for participation in CE research or application projects. The structure and its extension can be used by the founders of the project as a guiding tool for categorizing the required CE interventions and increasing the level of detail of their project description. This description of the project can help the reviewer of project applications to better understand how the candidates involved can make a systematic contribution to the transfer of CE.

In addition, the explicit expression of the agency can maintain trust between stakeholders and promote cooperation. Project applicants can then use the framework and matrix to show how all parties involved in the project can take responsibility for certain categories of interventions to contribute to a synergistic transition to CE.

Each of four categories of structure can be associated with any of the 10R strategies, and that high-level closure strategies should take priority.

CONCLUSION

The CE concept in the construction sector is rapidly gaining momentum and is used by many participants to coordinate their plans to build a more sustainable society. However, what exactly the CE entails remains unclear, and the actors involved in the transfer to the CE set different priorities depending on their capabilities and goals. The transfer to CE requires a more holistic approach and concerted efforts of all parties in the construction business.

The analysis of interventions evaluated in the construction sector confirms the general trend according to which the "Implementation" category is the most evaluated category. However, accumulating the knowledge of stakeholders, it is possible to develop additional categorizations for grouping the proposed indicators included in the constituent structures, for example, based on the differences between participants, processes and product levels. This additional level of categorization can facilitate the interpretation and application of indicators.

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Circular economy and its disclosure in the basic concepts of improving production processes in construction

Economia circular e sua divulgação nos conceitos básicos de melhoria dos processos produtivos na construção

La economía circular y su divulgación en los conceptos básicos de mejora de los procesos productivos en la construcción

Resumo

O artigo discute as características da economia circular e sua divulgação nos conceitos básicos de melhoria dos processos produtivos na construção civil. O conceito de economia circular (CE) tornou-se recentemente difundido como uma perspectiva para a resolução de problemas globais, como escassez de recursos e gestão de resíduos. O conceito de CE no setor da construção civil está rapidamente ganhando força e é usado por muitos participantes para coordenar seus planos de construir uma sociedade mais sustentável. No entanto, o que exatamente a CE implica, ainda não está claro, e os atores envolvidos na transição para o CE estabelecem prioridades diferentes dependendo de suas capacidades e metas. A transição para a CE requer uma abordagem mais holística e esforços conjuntos de todas as partes no ramo da construção civil.

Palavras-chave: Economia cíclica. Indústria da construção. Processos produtivos. Aperfeiçoamento.

Abstract

The article discusses the features of the circular economy and its disclosure in the basic concepts of improving production processes in construction. The concept of a circular economy (CE) has recently become widespread as a perspective for solving global problems such as resource scarcity and waste management. The CE concept in the construction sector is rapidly gaining momentum and is used by many participants to coordinate their plans to build a more sustainable society. However, what exactly CE entails, remains unclear, and the actors involved in the transition to the CE set different priorities depending on their capabilities and goals. The transition to CE requires a more holistic approach and concerted efforts of all parties in the construction business.

Keywords: Cyclic economy. Construction industry. Production processes. Improvement.

Resumen

El artículo discute las características de la economía circular y su divulgación en los conceptos básicos de mejora de los procesos de producción en la construcción. El concepto de economía circular (CE) se ha generalizado recientemente como una perspectiva para resolver problemas globales como la escasez de recursos y la gestión de residuos. El concepto de CE en el sector de la construcción está ganando impulso rápidamente y es utilizado por muchos participantes para coordinar sus planes para construir una sociedad más sostenible. Sin embargo, lo que implica exactamente la CE sigue sin estar claro, y los actores involucrados en la transición a la CE establecen diferentes prioridades dependiendo de sus capacidades y objetivos. La transición a ce requiere un enfoque más holístico y esfuerzos concertados de todas las partes en el negocio de la construcción.

Palabras-clave: Economía cíclica. Industria de la construcción. Procesos de producción. Mejora.