Yönetim Bilimleri Dergisi/Journal of Administrative Sciences
Cilt/Volume: 22, Sayı/No: 54, ss./pp.: 2302-2331
DOI: https://doi.org/10.35408/comuybd.1472116

-RESEARCH ARTICLE-

A STRATEGIC ANALYSIS OF CONSTRUCTION ORGANIZATIONS DURING THE INDUSTRY'S TRANSITION TO A CIRCULAR ECONOMY

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Abstract

The present methods of construction production have substantial environmental effects, which have led to worldwide concerns. Many governments, individuals, and organizations have taken action to prevent irreversible environmental damage. To reduce environmental impact, the circular economy is adopting circular business models to transform production. Multiple studies have identified construction activities as significantly harmful to the environment. The majority of construction procurement and production heavily depend on mineral raw materials obtained from natural sources. However, once these materials reach the end of their useful life, they become irreparable, non-reusable, and non-recyclable. This practice contradicts the principles of the circular economy. This study predicts that the construction industry will progressively embrace circular practices in response to increasing demands, legal obligations, and directives that advocate for environmentally sustainable production strategies such as the circular economy. The analysis suggests that construction companies must undergo substantial changes in order to prosper and endure during the shift towards a circular construction industry. The changes encompass the integration into intricate business networks, the adjustment to a service-oriented economy, the enhancement of management abilities, and the improvement of workforce competencies. Ultimately, it is crucial for the construction industry to transition towards a circular economy in order to align with worldwide sustainability objectives. This transition not only tackles environmental concerns but also provides competitive benefits and potential cost reductions. The results emphasize the necessity for strategic adjustment in the industry, emphasizing the crucial function of PESTEL analysis in directing these modifications. By adopting circular economy principles, the construction industry can greatly diminish its environmental impact and make a substantial contribution to a more sustainable future.

Keywords: *Circular Business Models, Circular Construction, Circular Economy, PESTEL Analysis.*

JEL Codes: *Q53, Q56, L74, L23, O33.*

Başvuru: *22.04.2024* **Kabul:** *14.09.2024*

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İNŞAAT SEKTÖRÜNÜN DÖNGÜSEL EKONOMİYE GEÇİŞ SÜRECİNDE SEKTÖRDEKİ KURULUŞLARIN STRATEJİK ANALİZİ[3]

Öz

Mevcut üretim yöntemlerinin tüm dünyayı olumsuz etkileyen ciddi çevresel etkileri bulunmaktadır. Bu durum, birçok otoriteyi, bireyi ve kuruluşu geri dönüşü olmayan çevresel zararları önlemeye yöneltmiştir. Bu soruna yanıt olarak döngüsel ekonomi, çevresel etkiyi en aza indiren döngüsel iş modellerini benimseyerek üretim yöntemlerini çevre açısından zararsız hale getirmeyi amaçlamaktadır. Çok sayıda çalışma, inşaat faaliyetlerinin çevreye zararlı olduğunu ortaya koymuştur. İnşaat sektöründe yapılan üretim faaliyetlerinin çoğunda doğal kaynaklardan elde edilen mineral hammaddeler kullanılmaktadır. Kullanım ömürleri sona erdiğinde, bu mineral kaynaklar onarılamaz, yeniden kullanılamaz ve geri dönüştürülemezler. Bu durum döngüsel ekonomi ilkelerine ters düşmektedir. Bu çalışma, inşaat sektörünün teşvikler, müşteri talepleri veya yasal zorunluluklar gibi nedenlerle döngüsel bir ekonomi haline geleceğini öngörmektedir. Bu nedenle, inşaat şirketleri ve mimarlar ve mühendisler gibi müşavir firmalar döngüsel ekonomiye uyum sağlamak zorunda kalacaktır. PESTEL analizi, organizasyonlar için makro çevresel değişiklikleri tahmin etmek için kullanılır. Bu nedenle çalışmada döngüsel ekonomiye geçiş sürecinde inşaat organizasyonları için PESTEL analizi yapılmıştır. Bu analize göre, inşaat şirketleri döngüsel bir inşaat sektörüne geçişte başarılı olmak ve hayatta kalmak için değişiklikler yapmalıdır. Daha karmaşık iş ağlarına entegrasyon, hizmete dayalı bir ekonomiye uyum sağlama, yönetim becerilerini geliştirme ve işgücü yeteneklerini iyileştirme bu değişiklikler arasındadır. Sonuç olarak, inşaat sektörünün döngüsel ekonomiye geçişi, küresel sürdürülebilirlik hedefleriyle uyum sağlamak adına zorunludur. Bu geçiş, sadece çevresel kaygıları gidermekle kalmaz, aynı zamanda rekabet avantajları ve potansiyel maliyet tasarrufları da sunar. Bulgular, sektördeki stratejik uyumun önemini vurgularken, bu değişimlere rehberlik etmede PESTEL analizinin kritik rolünü öne çıkarır. Döngüsel ekonomi ilkelerini benimseyerek, inşaat sektörü çevresel ayak izini önemli ölçüde azaltabilir ve daha sürdürülebilir bir geleceğe katkıda bulunabilir.

Anahtar Kelimeler: *Döngüsel İş Modelleri, Döngüsel Yapım, Döngüsel Ekonomi, PESTEL Analizi.*

JEL Kodları: *Q53, Q56, L74, L23, O33.*

"Bu çalışma Araştırma ve Yayın Etiğine uygun olarak hazırlanmıştır."

1. INTRODUCTION

Environmental concerns are increasingly prominent due to the broad impacts of climate change. The concept of circular economy has emerged as a solution to

[3] Genişletilmiş Türkçe Özet, makalenin sonunda yer almaktadır.

mitigate the negative environmental consequences. Although a universally agreed-upon definition of the circular economy eludes us, it is generally comprehended as a framework that advocates for the extension of product lifecycles by maximizing reuse, repair, and recycling, alongside the perpetual recycling of materials, the reduction of waste, and the regeneration of natural resources (Chizaryfard et al., 2021; Ellen MacArthur Foundation, 2023; Ghisellini et al., 2016; Benachio et al., 2020; Adams et al., 2017). This approach is not only crucial in various fields but also assumes a significant role within the construction sector.

The circular economy plays a crucial role in achieving global sustainability objectives. In this context, the United Nations Sustainable Development Goals (UN SDGs), particularly Goal 9 (Industry, Innovation, and Infrastructure) and Goal 12 (Responsible Consumption and Production), encourage the construction sector to adopt circular economy principles (United Nations, 2015). These goals provide guidance on building resilient infrastructure, promoting sustainable industrialization, and ensuring efficient use of resources.

The European Green Deal represents a comprehensive strategy by the European Union to transition to a sustainable economy, with the goal of making Europe the first climate-neutral continent by 2050. This ambitious plan directly impacts the construction sector by setting stringent targets for reducing carbon emissions and encouraging the adoption of circular economy practices. The Green Deal emphasizes the need for sustainable building practices, energy efficiency, and the use of renewable resources in construction. It also advocates for the renovation and retrofitting of existing buildings to improve their energy performance, which aligns with the principles of the circular economy. By integrating these objectives, the European Green Deal seeks to significantly reduce the environmental footprint of the construction industry while fostering innovation and competitiveness within the sector (European Commission, 2019).

The notion of the economy is significant in industrial economics, which presents a paradigm shift in the comprehensive management of resources. Recycling and reprocessing materials are emphasized in this model as a means to reduce waste and advance sustainability. It is defined by the renowned Ellen MacArthur Foundation, an organization in the field of economics, as the practice of extending the life of existing materials and products through reuse, rental, distribution, repair, renovation, and recycling. A framework entails utilizing resources in a manner that maximizes their value over the course of their useful lives, with the intention of recovering and replenishing products and materials at the conclusion of each cycle (Ellen MacArthur Foundation, 2023).

The increasing recognition of circular business models is contributing to their growing popularity across industries (Ellen MacArthur Foundation, 2023). Many businesses are coming to recognize the significance of reducing their environmental impact out of concern for the environment. The potential for modifications in

accordance with international environmental agreements such as the Kyoto Protocol also influences the course of this movement.

The environment-focused international agreements have prompted governments and industries across the globe to reconsider their strategies and explore alternative options. Sectors are strongly encouraged to consider implementing economic models as a strategic approach to simultaneously achieve global environmental objectives and sustain competitiveness (Abad-Segura et al., 2020). This mentality shift signifies a departure for businesses from the linear "take, make, dispose" model and toward a more sustainable approach that prioritizes recycling and resource durability.

There has been a recent trend in marketing strategies to incorporate environmental concerns into their strategies (Mostaghel et al., 2023). This phenomenon is characterized by a focus on satisfying the demands of an expanding clientele that places a premium on sustainability. This transition signifies a shift in consumer inclinations, as an increasing number of individuals are actively pursuing products and services that correspond to their values of sustainability and responsibility. As a result, businesses are modifying their marketing strategies to emphasize the features of their products that emphasize eco-friendly production methods and sustainable practices.

The circular economy concept contributes to the transition towards sustainable production methods. Organizations have the ability to reduce waste production by implementing economic principles (Atta & Bakhoum, 2024; Haque et al., 2024; Huang et al., 2018; Yadav et al., 2024). This provides competitive advantages in addition to aiding in the reduction of production impact (Husgafvel et al., 2018). By adhering to these principles, conscientious consumers are more likely to perceive the brand favorably, which in turn increases customer loyalty and reputation (Mostaghel et al., 2023).

Through resource utilization and waste reduction, organizations have the potential to substantially decrease expenditures, ultimately resulting in enhanced sustainability (Palea et al., 2023). The circular economy, which prioritizes the optimization of resource utilization and the minimization of waste, aligns with the growing consumer preference for environmentally friendly products, thereby establishing a harmonious relationship between ecological objectives and commercial feasibility (Husgafvel et al., 2018; Mostaghel et al., 2023). The convergence of consumer preferences and environmentally conscious business practices signifies a significant turning point in the industry, indicating an expanding dedication to ecological preservation and conscientious consumption (Rainatto et al., 2024).

One advantage of incorporating circular economy principles into industrial processes is a reduction in reliance on raw materials (Ellen MacArthur Foundation, 2023). This facet is significant across all sectors, organizations, and countries, as it tackles concerns pertaining to resource scarcity and sustainability. This benefit is

particularly significant in the construction industry due to its longstanding dependence on raw materials and its considerable environmental footprint (Mhatre et al., 2023).

Similar to other industries, the construction sector is undergoing a discernible transition toward adopting circular economy principles, including recycling, repairing, and reusing. The necessity of examining and adopting these principles is generally acknowledged. This construction methodology entails a reevaluation of material usage with a focus on durability in design, as well as the integration of recycling and reusing strategies to promote environmentally sustainable building practices (Agyekum et al., 2023; Tserng et al., 2021). The increasing prosperity of the construction industry signifies a transition towards environmentally conscious and productive methodologies, demonstrating a burgeoning recognition of the criticality of sustainable development in this domain (Agyekum et al., 2023).

The construction industry can reduce its dependence on waste-generating materials, aid in harm mitigation, and decrease reliance on materials by implementing circular economy principles, which include the utilization of recycled or upcycled materials and the design of detachable and repurposeable buildings (Agyekum et al., 2023; Garusinghe et al., 2023). Efficiency in the construction industry extends beyond mere resource utilization; it entails optimizing the long-term value of these resources. In order to achieve this, architects and builders must utilize components in the construction of infrastructure and buildings that are simple to repair, refurbish, or recycle. We can increase their usability by doing so. Minimize the requirement for additional materials (Garusinghe et al., 2023).

Furthermore, the circular economy drives a decrease in reliance on resources, which in turn has an effect. Industries benefit from enhanced resilience against supply chain disruptions and resource price fluctuations. This could potentially improve the economic stability of nations that heavily depend on imported construction materials while simultaneously reducing their environmental impact. Implementing large-scale practices to reduce resource dependence fosters a more equitable distribution of resources and contributes to the advancement of sustainability on a global scale. As stated by Adams et al. (2017), the implementation of economy-friendly practices not only yields environmental benefits but also boosts the competitive advantage of businesses and creates social benefits in the region.

Adopting circular economy principles, such as refurbishing and repairing products, could generate employment opportunities and reduce unemployment, according to the Ellen MacArthur Foundation. Employment opportunities may be created by skilled laborers who repair particular construction components.

As with industries as a whole, it is prudent to implement circular economy principles in the construction sector in order to safeguard resource security, economic stability, and environmental sustainability. This transformation signifies a reorientation in the perception and administration of resources, which has far-reaching consequences for

economies, industries, and the environment worldwide. When viewed from a particular perspective, each adjustment presents its own set of difficulties. Uncertainty surrounds the capacity of each organization to successfully adapt.

Therefore, the objective of this research is to predict the patterns in sustainable building methodologies and furnish a structure for strategic evaluation for organizations operating in the construction industry. By adopting this methodology, construction companies can proactively identify changes in the wider environment that could have an effect on their activities and efficiently execute plans to adopt sustainable building methods.

By employing the PESTEL analysis instrument, the research seeks to comprehend the impact of various external factors on the construction industry in order to accomplish the aforementioned objectives. An evaluation of political, economic, social, technological, environmental, and legal factors constitutes PESTEL analysis. Understanding the environmental changes in construction and their probable effects on businesses requires this framework. A thorough analysis of each of these elements can yield valuable insights into the external macroenvironmental factors that exert an impact on the process of strategic decision making.

2. LITERATURE REVIEW: CIRCULAR ECONOMY

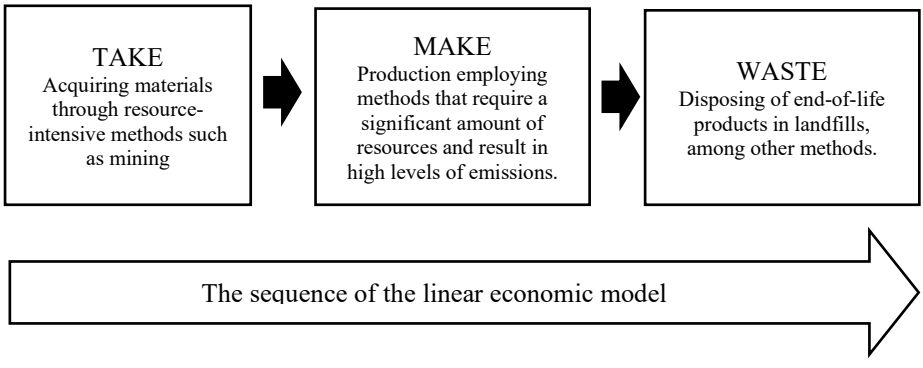
In its broadest sense, this section intends to present an overview of the circular economy. Furthermore, it examines the fundamental tenets that underpin the integration of circularity practices in the manufacturing industry and emphasizes the significance of the construction domain. This sector, renowned for its substantial consumption of natural resources, production of solid waste, and emission of carbon dioxide, significantly contributes to the promotion of circular economy principles.

Prior to discussing the circular economy model, it is crucial to provide an overview of the fundamental components that comprise the conventional linear economic model. The linear model, effectively summarized by the Ellen MacArthur Foundation (2023) as "take-make-waste," (Figure 01) involves the extraction of natural resources and often results in significant waste, particularly in the construction industry. This approach contrasts sharply with the circular economy, which aims to eliminate waste through reuse and to profit from the recycling of resources, marking a fundamental departure from the linear perspective (Lacy et al., 2020).

The circular economy seeks to enhance both technical and biological efficiency by creating "value circles" (Figure 02) that maximize the reuse of materials and products (Lacy et al., 2020). The circular economy can be seen as a new evolutionary stage that follows the industrial revolution, transitioning from mechanical production powered by water and steam to the current fusion of biological, physical, and digital technologies in the fourth industrial revolution.

These technological advancements have significantly boosted production efficiency and innovation, which are key to the circular economy.

Figure 1. The image illustrates the linear economic model, which demonstrates the conventional 'take-make-dispose' method where resources are extracted, converted into goods, and ultimately discarded as waste.



Ellen MacArthur Foundation (2023) delineates two discrete forms of circularity within the economy: (1) technical circularity and (2) biological circularity. Most materials used in the building industry can be categorized as technical. Technical circularity refers to the process of reusing construction mineral materials obtained from mines. Conversely, biological circularity pertains to biological material.

The construction industry has begun to adopt various Circular Economy (CE) practices to address the challenges of resource depletion, waste generation, and environmental impact. For instance, material recovery and reuse have become key strategies, where construction and demolition waste (C&DW) is recycled and repurposed as a resource for new construction projects. This approach not only reduces the demand for virgin materials but also minimizes the environmental footprint of construction activities (Guerra et al., 2021; Benachio et al., 2020).

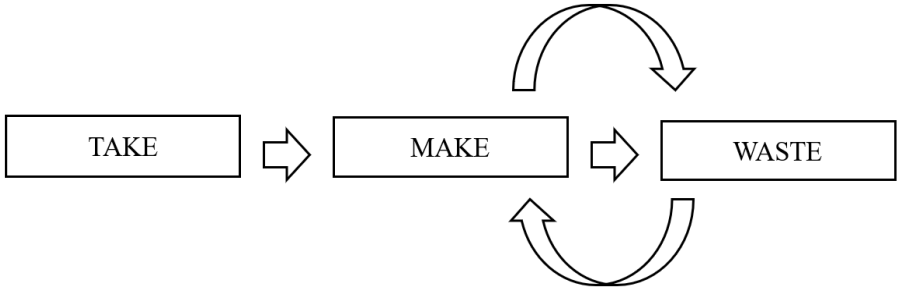
Another notable example is the implementation of modular and disassemblable design principles, which enable buildings to be deconstructed at the end of their lifecycle, allowing components to be reused in new structures. This practice supports the longevity of materials and contributes to a more sustainable built environment (Ghisellini et al., 2018; Adams et al., 2017).

Moreover, the adoption of efficient processes during construction, such as using material banks and reverse logistics, ensures that materials are managed effectively throughout their lifecycle. These strategies help close the material loops and promote resource efficiency, which are central to the principles of the Circular Economy in the construction sector (Guerra et al., 2021; ARUP, 2016).

Timber is a constituent of the biological cycle that is recycled by natural cycles such as the nitrogen cycle. In order to minimize the extraction of minerals from mines and

the generation of trash, it is necessary to create circles that clearly delineate the use of mineral materials. Concrete is an instance of construction material that is derived from minerals.

Figure 2. The image illustrates the linear economic model, which demonstrates the conventional 'take-make-dispose' method where resources are extracted, converted into goods, and ultimately discarded as waste.



As expected, Adams et al. (2017) observe that the implementation of the circular economic strategy in the construction industry is currently limited and mostly focuses on waste reduction and recycling promotion. According to the authors, the diverse attributes of construction processes negatively impact the adoption of circular economy methods. The complexity of the transition increases due to the substantial workload occurring on the construction site and the distinct safety protocols that are specific to such endeavors (Adams et al., 2017).

A distinct set of principles underpins the economic methods that are implemented (Ekins et al., 2020). These principles encompass various practices such as composting, recycling, maintenance, revamping, and remaking. The objective of these practices is to increase the longevity of materials and products so that they can be efficiently utilized in the economy. By maximizing resource efficiency and minimizing waste, the strategy outlined by the Environmental Protection Agency of the United States in 2023 intends to establish an ecologically sustainable economic model.

Ekins et al. (2020, p. 11) outlined the principles of the economy using the following headings:

Reuse: Reuse involves two components. To commence, the process entails repurposing a product through one of two means: modifying its function or substituting it with an alternative that more effectively or distinctively fulfills the intended purpose. Furthermore, it includes the utilization of a previously discarded item that remains functional for its intended purpose, potentially by another individual. This approach not only increases the product's lifespan but also diminishes the requirement for additional resources.

Rethink: Increase the utilization of products by employing strategies such as product sharing and item introduction.

Reduce: Improving how efficiently products are made or used by using natural resources or materials.

Repair: The repair and maintenance of a faulty product to enable its utilization in accordance with its intended purpose.

Refurbish: Revitalize and modernize a previously existing product.

Remanufacture: The utilization of components from discarded products in the creation of a novel product with similar functionality.

Repurpose: Utilize discarded products or their separate pieces in the creation of a novel product that serves a distinct purpose.

Recycle: The materials are processed in order to achieve a comparable or diminished level of quality.

Recover: The process of incinerating materials with the intention of recovering energy.

Guerra et al. (2021, p. 3) define circular business models for construction enterprises in the following manner:

Product as a Service: This paradigm reallocates production supply to service delivery. The duties of manufacturers are extended over the entire lifespan of the product. Manufacturers own the products and lease them out to users.

Circular Supplies: This model is based on the idea that all the inputs included to the process are suitable to circularity. For instance, they can be biodegradable, or reusable.

Product life extension: This approach emphasizes the duration of products' existence. The primary objective is to offer items that have a prolonged lifespan and increased value.

Resource recovery: Through the elimination of discarded materials, all potential resources are reintegrated into the circular production process.

Waste as a resource: Utilizing the waste from other manufacturing processes as resources for production is mentioned in this concept.

Sharing platform: Sharing platforms allow the utilization of the same goods by numerous parties.

Resell: This is an incentive to sell a non-operational substance to other entities who can prolong its lifespan by utilizing it.

Repair: Repairing a product extends its lifespan.

Remanufacture: Remanufacturing establishes a self-contained system in which products are brought back and reconstructed to their initial specifications. These components receive repairs and are subsequently reintegrated into the manufacturing process.

According to the Ellen MacArthur Foundation (2023), it is recommended to employ a hierarchical approach when picking sub-concepts, prioritizing their effectiveness in reducing environmental harm (Agyekum et al., 2023; Ghisellini & Ulgiati, 2020; Mhatre et al., 2023). For example, in this context, the practice of reuse is demonstrated to be more efficient than repair.

Contrary to the current state of construction as reported by Adams et al. (2017), it can be argued that circular production strategies or circular business models are anticipated to gain greater prominence in all industries, including construction (Giorgi et al., 2022; Zuofa et al., 2023). The adverse effects of the climate crisis have prompted the establishment of legal mandates that require construction companies to embrace circularity in their operations (Zuofa et al., 2023). Construction industry professionals are expected to require a redesign of construction methods.

While any modification to current procedures could make it difficult for practitioners to successfully adopt new procedures, adopting circular construction techniques presents opportunities (Giorgi et al., 2022; Mhatre et al., 2023). For instance, the limited availability of resources is a prominent factor driving the adoption of circular strategies, particularly due to the emphasis on environmental concerns in related works. By adopting circularity in industrial processes, the reduction in demand for raw natural materials can result in a direct decrease in expenses associated with them. The main components of the construction sector comprise cement, steel, lumber, and similar commodities (Ahmed et al., 2024). The appropriateness of raw materials for recycling is variable. Steel, for instance, is particularly conducive to the process of melting and subsequent replication (Compañero et al., 2021). Timber is appropriate for replacing or reusing as a main material in other processes (Finch & Marriage, 2019). The concrete (cement) recycling rate is rather low in comparison to other materials (Badraddin et al., 2021).

Ghisellini et al. (2018) argue that the successful implementation of a circular economy requires the introduction of innovative adaptations. These adaptations include: (1) a shift in mindset, (2) a reevaluation of waste as a valuable resource for construction materials rather than an environmental issue, and (3) a complete

transformation of the entire process of resource generation, consumption, distribution, and recovery.

European Commission, (2015) states that construction and demolition activities make a substantial contribution to waste generation in Europe. In the circular economy, waste is redefined to include not just physical resources but also wasted lifecycles, capabilities of products, and embedded values (Franco-García et al., 2019). Strategies in this model must be multifaceted, considering economic activity in a sustainable manner that promotes environmental and social well-being.

On a global scale, the building sector is responsible for almost 30% of the extraction of natural resources and 25% of the generation of solid waste (Benachio et al., 2020). The significant impact arises from the industry's traditional linear economic model ("take-make-dispose"), which leads to a substantial pace of resource consumption and development of waste (Benachio et al., 2020). This statement emphasizes the significance and potential advantages of transitioning to a circular construction industry. In addition, construction activities encompass procedures that extend beyond the boundaries of the sector itself. European Commission (2015) emphasizes the importance of procurement in building operations due to its involvement in several industries. All of these processes have a substantial impact on the environment. Hence, the selection of a procurement system holds utmost importance in the construction business.

The adaptation of the circular economy finds reflections at varying management levels (Lacy et al., 2020). At the operational level, previously mentioned circular economy strategies focus on optimizing resource use, reducing emissions, minimizing waste, reusing materials, and efficient water usage (Ghisellini & Ulgiati, 2020; Tserng et al., 2021). Organizational strategies may involve creating new business models like circular supply chains, recovery and recycling, product-as-service models, sharing platforms, and public-private collaborations to transform both working procedures and organizational culture (Shpak et al., 2021). Technological advancements, such as cloud networks, big data, modular design, and 3D printing, support these processes. Additionally, firms' capabilities in circular network supply, continuous customer engagement, and design for lifecycles and users play a crucial role in effectively implementing these activities (Lacy et al., 2020).

It is counterproductive to demonstrate bias by opposing the adoption of methods. Circular economy approaches aim to enhance the efficiency of businesses, foster innovation, and increase consciousness regarding the needs of consumers in terms of resources, materials, and services. These strategies contribute to environmental improvement through their focus on waste reduction and recycling. When implemented within the construction sector, these practices have the potential to contribute to the improvement of the industry's sustainability and productivity.

3. METHOD: PESTEL ANALYSIS

Utilizing the PESTEL framework as a strategic evaluation instrument, one can examine the environment in which a company or industry operates. The elements of the evaluation, namely technological, environmental, political, economic, and social aspects, are represented by this acronym (Washington State University Libraries, 2023). According to the findings of Turkyilmaz et al. (2019), PESTEL analysis is a method employed to delineate and assess the variables that influence the environment of an organization. According to Johnson et al. (2008), PESTEL analysis, as defined by Worthington and Britton (2009), is a framework that examines potential shifts in technological, political, economic, sociocultural, and political aspects within the broader operational and social contexts of an organization. It entails evaluating the potential impact of these changes on the performance of the organization. PESTEL analysis serves as a practical instrument for devising strategic decisions and is a technique for generating potential future scenarios (Worthington & Britton, 2009). Additionally, according to Yüksel (2012), the PESTEL analysis contributes to the strategic management of an organization in two ways: first, by identifying the external environment; and second, by collecting information and insights to inform future forecasts.

Worthington and Britton (2009) classify the environment of an organization into two distinct groups in their study. The environment, which includes suppliers, competitors, labor markets, financial institutions, customers, and trading entities, comprises the initial group. The second category comprises the contextual environment, which includes macroenvironmental elements that have an impact on business operations, including economic conditions, political factors, sociocultural trends, technological advancements, and legal implications. Yüksel (2012) categorizes the environment of an organization into two dimensions: the macro-environment and the sectoral environment. The macro-environment of an organization refers to the external factors that have an impact on the organization and are beyond its control. Turkyilmaz et al. (2019) define the macro-environment of an organization as the set of factors that influence the operational and survival conditions of organizations.

According to Yüksel (2012), the evaluation in PESTEL Analysis is characterized by a qualitative structure. This can be a subject of criticism due to the collection of comprehensive information for the purpose of making strategic decisions. According to de Sousa and Castañeda-Ayarza (2022), PESTEL analysis is not employed to evaluate strategies at the corporate, or industry level. Rather, it is utilized to analyze threats and opportunities. An assessment of possible threats and possibilities empowers us to make meaningful predictions for the future. The environment of an organization is undergoing continuous change. An example of a significant shift in the economic environment of construction organizations is the rise of the Circular Economy. Therefore, it is necessary to regularly apply strategic analysis techniques such as PESTEL Analysis in the field of strategic management. Similarly, our study aims to develop possible threats and opportunities that enables construction

organizations to effectively adapt themselves to circular economy. Hence, the qualitative limitations of the analysis do not pose a problem.

The following paragraphs provide a concise description of the titles of PESTEL analysis and assess their impact on the circularity of construction organizations (Pan Wei et al., 2019; Zorpas, 2020):

Political factors encompass a variety of subjects such as government regulations, trade policies, local and international regulations, tax policies, and related trends (Washington State University Libraries, n.d.). Political factors refer to the policies and regulations set by the government regarding sustainability and waste management. These factors have a direct impact on the adoption of circular economy practices. Political factors play a crucial role for construction organizations as they have the potential to enforce legal requirements for the adoption of circular business models.

Economic factors encompass various elements of the economy, such as growth, inflation, interest rates, employment, labor issues, and the global economy (Washington State University Libraries, n.d.). Economic factors encompass market trends, resource prices, and economic incentives or disincentives that influence the adoption of sustainable practices. The reluctance to embrace circular business models or the lack of motivation to adopt them will have significant economic repercussions for construction organizations, ultimately determining their economic viability.

Social factors encompass demographic variables such as age, gender, race, and family structure, as well as customer attitudes, perspectives, and purchasing patterns (Washington State University Libraries, n.d.). The factors taken into account also include the rate of population growth, employment trends, shifts in socio-cultural norms, ethnicity and religion trends, and disparities in living standards. Social factors refer to the ever-changing consumer preferences and societal attitudes regarding sustainability and environmental responsibility. The potential changes in customer preferences for circularly designed products in the construction industry may compel construction organizations to adopt circular business models.

Technological factors refer to the specific techniques and strategies used in the production, delivery, and communication of products (Washington State University Libraries, n.d.). The significance of technological factors is paramount, particularly in advancing more efficient recycling, upcycling, and sustainable construction methods. The adaptation of circular construction processes relies heavily on technological factors.

The importance of environmental factors stems from the growing scarcity of natural resources, the necessity to decrease pollution, the requirement for businesses to operate ethically and sustainably, and the goals of restricting carbon emissions (Washington State University Libraries, 2023). Environmental factors include the

ecological consequences, limited availability of resources, and the phenomenon of climate change. The emergence of the circular economy is a direct consequence of growing environmental apprehensions. Therefore, adaptability to environmental changes within organizational environments is of utmost importance from a circular economy standpoint.

Legal factors encompass various considerations, including legislation related to health and safety, opportunities for marginalized groups, protection of consumer rights, and ensuring product safety (Washington State University Libraries, 2023). Legal factors refer to the set of laws and regulations that dictate the use of resources, handling of waste, and safeguarding of the environment. These regulations can impact the operational landscape for businesses in the construction sector. Failure to conform to circular business models due to political and legal transformations may impede competitiveness across all industries.

4. RESULTS: FUTURE PREDICTIONS

The purpose of this section is to predict future changes in the macro-environment of construction organizations. The predictions are primarily derived from the reliance on linear production systems by construction practices. Furthermore, the transition towards implementing ecologically sustainable operational methods is progressively critical for construction companies, constituting the second cornerstone of this study.

The future trajectory of the construction industry is expected to be heavily influenced by international frameworks such as the United Nations Sustainable Development Goals (UN SDGs) and the European Green Deal. The alignment with UN SDG 9 (Industry, Innovation, and Infrastructure) and SDG 12 (Responsible Consumption and Production) will likely drive the construction sector towards more sustainable practices, emphasizing the need for resilient infrastructure, innovative approaches, and resource efficiency. These goals underscore the necessity for the industry to adopt circular economy principles to meet global sustainability targets.

In parallel, the European Green Deal will impose significant changes on the construction industry in Europe, with a focus on achieving carbon neutrality by 2050. The Green Deal's stringent environmental regulations and incentives for sustainable building practices will encourage the widespread adoption of circular economy models within the sector. This policy framework will not only push for the reduction of carbon emissions but also promote the renovation of existing infrastructure to enhance energy efficiency and sustainability. Consequently, construction companies will need to adapt to these evolving regulatory landscapes by integrating circular economy principles into their operations and strategic planning. The projections for the sector will be elaborated in the sections that follow.

An increasing number of sectors and industries have begun to implement environmentally sustainable production methods (Herrador, 2024; Medaglia et al., 2024). The detrimental effects of current manufacturing practices on the

environment are becoming progressively more evident (Berge and von Blottnitz, 2022). Evident are the observable repercussions of climate change and other detrimental outcomes resulting from production methods. Consequently, governmental bodies enforce regulations in an effort to promote the adoption of an environmentally sustainable stance by both corporations and individuals (Giorgi et al., 2022). Communities are being compelled to adopt a greener mindset as a result of the endeavors and shifting perspectives of individuals.

International arrangements such as the Paris Agreement (2015) and the Kyoto Protocol (1997) are compelling governments to enact legislation and implement strategies to reduce emissions stemming from resource wastage and unproductive production processes. Simultaneously, organizations are being obligated by stringent legal regulations to embrace a more environmentally conscious approach, which is exerting an increasing influence. Hence, construction firms may encounter the imperative to transition towards circular organizations in the foreseeable future. Illankoon et al. (2023) argue that the government's policy must be considered, and they propose that construction companies should embrace circular practices, such as incorporating recycled materials, complying with waste management regulations, and implementing lifecycle assessment requirements.

Similar to governments, individuals are demonstrating a growing awareness and concern for the environment. Environmental concerns are simultaneously altering consumer behavior in developed nations. Consumers hold elevated expectations for products that are manufactured using environmentally sustainable methods (Aboulamer, 2018; Boyer et al., 2021). Concurrently, there is likely to be an increase in the demand for buildings constructed in a circular way in the near future.

Currently, there is an ongoing process of evolution occurring in products and manufacturing systems due to the increased sensitivities of individuals and governments. Given the environmental problems caused by current production methods, it is logical to assume that the circular economy is increasingly becoming the prevailing approach to production. According to Guerra et al. (2021), organizations that adopt circular economy principles right from the outset may potentially gain a competitive edge. We can therefore expect the subsequent projections:

Future Prediction (FP) 1: Moving forward, the majority of manufacturing processes will be predominantly governed by economic principles.

FP 2: Companies that adopt the circular economy early will ultimately gain a strategic advantage.

An increasing trend was observed in the construction industry by Joensuu et al. (2020) toward placing greater emphasis on construction principles. These principles comprise tactics such as "designing for deconstruction" and adhering to the "R principles," which comprise remanufacturing, repair, and reuse. Design consultants

and contractors might be required to concurrently revise their methodologies in consideration of these developments.

FP 3: It is imperative that construction projects adhere to economic principles, which encompass strategies such as the "R" principles, which aim to promote sustainable production.

It is expected that the incorporation of circular economy principles into construction methodologies will lead to heightened intricacy and a greater need for specialized knowledge in manufacturing operations. As stated by Illankoon and Vithanage (2023); in order to adeptly manage the intricacies associated with the implementation of circular economy principles, organizations might find it necessary to forge partnerships or collaborate with other entities. Arup (2016) underscores the significance of establishing collaborative alliances, a practice that may impose limitations on design and construction companies that provide services utilizing their internal capabilities. Therefore, organizations that possess networks and the capacity to sustain partnerships will have an advantage in adjusting to the shift towards a circular industry.

FP 4: For construction firms to successfully navigate the complexities of implementing the economy, they must forge alliances and establish connections.

The shift from product ownership to a reliance on service-oriented offerings has already brought about substantial changes in specific sectors, most notably the music industry. An emerging phenomenon is the substitution of media purchases (e.g., cassettes or CDs) with subscription services (e.g., Spotify). According to Illankoon and Vithanage (2023), this transition has the potential to modify the dynamics of property ownership in the construction industry, consequently affecting the procurement procedures of the sector.

FP 5: Construction companies must proactively anticipate the consequences of transitioning to a service-oriented economy, which includes its impact on the service sector.

According to Kazmi and Chakraborty (2023), it is proposed that dilapidated or neglected structures could function as repositories for resources in accordance with the principle of material reuse and recycling. This notion is referred to as "material banks." (Guerra et al., 2021). Companies that implement a circular economy approach and successfully utilize materials in the construction industry can gain significant benefits.

FP 6: Construction firms will make every effort to acquire materials from demolished structures in accordance with the principles of "reuse" and "recycling."

One of the primary considerations in the context of the circular economy is the effective management of resources (Guerra et al., 2021). Resource management is improved across industries through the implementation of a variety of technologies

and software (Sudarsan and Gavali, 2023). The authors Illankoon et al. (2023) emphasized the significance of Building Information Modeling (BIM) software in driving advancements within the construction industry.

FP 7: The implementation of technologies like BIM will be crucial in the transition to a circular economy.

Joensuu et al. (2020) predict that as expertise increases, a greater variety of disciplines will be integrated into construction operations. Proficiency in the management and organizational intricacies of construction organizations might be necessary for this.

FP 8: Construction organizations have to develop and enhance their organizational and managerial competencies.

Implementing circular economy principles in organizations leads to a transformation of production techniques. For instance, instead of producing new products, circular practices encompass the utilization of repair and remanufacturing. Hence, Joensuu et al. (2020) predict an alteration in the existing manufacturing techniques utilized by the construction industry. The importance of refurbishing, restoring, and repairing existing structures is expected to grow in the future.

FP 9: The construction industry will focus more on restoring and repairing existing structures, which is a significant change from current manufacturing methods.

Construction operations have undergone technological advancements in various regions (Atta & Bakhoum, 2024; Sumikura & Katsumi, 2022). For example, reinforced concrete buildings with brick walls are the most common building materials used in Turkey today. The majority of these reinforced concrete structures ultimately become non-recyclable once they reach the end of their lifespan. Furthermore, the limited flexibility of the structural elements of concrete buildings hinders their ability to be reused and repurposed. Nevertheless, the current proficient labor force in the regional construction sector is well-acquainted with these essential recurring tasks. In order to effectively establish a circular economy, it is crucial to thoroughly assess and strategically coordinate the incorporation of the current proficient labor force. This could result in the establishment of vocational training initiatives or adjustments to the vocational education curricula.

FP 10: Current skilled labor is accustomed to operating within the confines of a linear manufacturing setting. In the construction industry, training the current workforce to implement circular economy business models is vital and should not be underestimated.

Localization within the context of the circular economy entails the modification of circular economy practices to suit particular geographic areas and local circumstances. This entails the formulation and execution of policies that are specifically designed to address the environmental, social, economic, and cultural

attributes of a given region. This approach emphasizes the importance of region facilitators, such as community-driven initiatives, waste-to-resource networks, and local food systems, in order to align strategies with the unique characteristics of each location. Localized approaches are distinguished by their connection to the specific local context and may necessitate substantial structural modifications in order to be implemented in alternative environments. The economic principle of localization centers on the optimization of resource utilization within a designated region, with active involvement of the local community and the development of tailored solutions that address the unique challenges and prospects of the surrounding environment and populace (Gravagnuolo et al., 2019).

FP 11: By integrating regionalized approaches, organizations can successfully transition to adopting a particular economic paradigm.

In an attempt to promote a more environmentally sustainable economy, Japan has implemented several regulations, including the "Law for Encouraging Separated Collection and Recycling of Packaging and Containers," the "Fundamental Environmental Law," and "Law for Encouraging Efficient Use of Recyclable Materials." As stated by the Reusable Packaging Association (2023), this endeavor aligns with the increasing tendency in the business sector to establish legal frameworks for the management of sustainability. This tendency is evident not solely in Japan, but also in the European Union, China, and the United States of America, among other nations and international organizations. There is an expectation that the implementation of this legal practice, which aims to advance environmental sustainability, will expand to further countries worldwide.

FP 12: Legal regulations are expected to promote and oblige organizations to adopt circular business models.

5. DISCUSSION

FP 1 and FP 2 assert the inevitable rise of the circular economy in the construction industry, as seen in other industries. Hence, undertaking research and making investments in the circular economy appears advantageous for construction organizations.

The practices derived from the implementation of circular economy differ from the current linear production practices. As stated in FP 3, the implementation of R principles, such as reuse and repair, as well as construction-specific strategies like design for demolition or material banks, requires adjustments in current construction and design procedures. Hence, construction organizations must embrace circular business models to remain competitive in the future.

The alignment of the construction sector's evolution with international frameworks such as the United Nations Sustainable Development Goals (UN SDGs) and the European Green Deal is not only strategic but also imperative for achieving long-

term sustainability. Specifically, the incorporation of circular economy principles within the industry is strongly encouraged by UN SDG 9, which focuses on building resilient infrastructure, promoting inclusive and sustainable industrialization, and fostering innovation. Likewise, SDG 12 emphasizes the importance of responsible consumption and production patterns, which directly align with the goals of reducing waste and optimizing resource efficiency in construction practices.

Moreover, the European Green Deal presents a formidable policy framework that will reshape the construction industry, particularly within the European Union. The Green Deal's emphasis on achieving carbon neutrality by 2050 necessitates significant adjustments in how the industry approaches building design, material usage, and overall project lifecycle management. These adjustments are expected to drive the adoption of more sustainable practices, including the renovation of existing structures to improve energy efficiency, thereby reducing the environmental footprint of the sector. The Green Deal's policy directives will likely serve as a catalyst for innovation and will push the industry towards greater integration of circular economy principles. As a result, construction companies that proactively align their strategies with these international frameworks will not only contribute to global sustainability goals but also secure competitive advantages in an increasingly regulated market.

FP 4 highlights the potential complexity of construction activities in the future and emphasizes the necessity for enhanced business networks. Therefore, construction organizations may be required to establish networks that include a sufficient number of highly skilled firms in order to enhance their ability to implement circular business models.

FP 5 anticipates a potential escalation in the level of service-oriented economic activity within the construction industry. Consequently, the design of the buildings must be reassessed to determine their suitability for leasing or renting. Furthermore, real estate developers might become a client of construction companies, necessitating adjustments to their marketing and contracting strategies.

FP 6 appeals to the increasing need for reusing and recycling initiatives. Therefore, construction firms must adapt their design and construction services to support the greater use of recycled building materials. This shift must incorporate the utilization of preexisting frameworks. Hence, construction firms must create plans for the repurposing of facilities and implement methods for recycling and reusing construction materials.

Multiple tools, software, and hardware are utilized in the design and construction of buildings. As per FP 7, the complex nature of circular construction activities necessitates the extensive utilization of these technologies. Hence, construction organizations must incorporate the utilization of cutting-edge technological advancements into their operations.

Circular construction activities are anticipated to be complex, which may necessitate construction organizations to cultivate specialized skills in organization and management. FP 8 states that the restructuring of the core organizations and project teams of construction firms may be crucial for their survival.

FP 9 states that the growing emphasis on reusing and repairing is a strategic change in organizational processes. Construction organizations must adapt new methods and make changes in their workforce as these processes differ from traditional building techniques used for new structures.

FP 10 focuses on the workforce's familiarity with traditional linear manufacturing processes. Construction workers often receive on-the-job training at construction sites, acquiring their abilities through practical experience rather than formal education. Engineers and technicians at higher levels receive training specific to the development of new structures. From a strategic perspective, construction-related companies may need to provide training for their personnel or hire individuals with appropriate education in order to effectively implement circular business strategies.

According to FP 11, engaging in local procurement of materials and labor serves as a preventive measure to minimize environmental harm. Utilizing local materials reduces carbon dioxide emissions associated with transportation and processing. Utilizing a local workforce reduces the necessity of relocating workers. Consequently, construction firms might gain advantages by proactively adapting their procedures to align with local practices.

FP 12 acknowledges that construction enterprises may be compelled to adopt circular business models due to legislative restrictions, regardless of their own preferences. If this future forecast materializes, businesses that are better prepared for adaptation will likely gain a significant competitive edge. The table below illustrates the correlation between future projections and their strategic implications.

The future predictions and their potential consequences are summarized in Table 1.

Table 1. Findings of PESTEL Analysis and their consequences.

	Description of the Future Prediction	**Future Prediction's Consequences for Strategic Management of the Organization**
FP 1	Circular economy principles will dominate industry.	Researching and investing in the circular economy may
FP 2	Early adopters of the circular economy will gain a competitive edge.	benefit construction companies.
FP 3	Construction must follow production techniques like the circular economy "R"	Construction organizations must embrace circular business models to remain

	principles.	competitive in the future.
FP 4	Construction enterprises need networks and collaborations to achieve the circular economy, which is hard.	Construction enterprises may need to form networks of highly skilled firms to implement circular business models.
FP 5	The circular economy's effects on the service economy must be considered by construction enterprises.	Building design must be reviewed for leasing or renting. Real estate developers may become construction businesses' clients, requiring marketing and contracting changes.
FP 6	Using 'reuse' and 'recycle' concepts, construction businesses will source materials from preexisting constructions.	Building enterprises must alter their design and construction services to employ more recycled resources.
FP 7	Adopting BIM-type technology will be essential for the shift towards a circular economy.	Circular construction requires substantial technology use due to its complexity.
FP 8	Construction companies must improve their organizational and managerial skills.	Construction enterprises may need to restructure their core organizations and project teams to survive.
FP 9	Construction will focus more on restoring and maintaining existing structures.	These approaches differ from standard building techniques utilized for new structures, therefore construction companies must adapt and adjust their staff.
FP 10	Modern skilled workers are used to linear manufacturing. Training the skilled construction crew to adopt circular economic business models is crucial.	Construction organizations may need to train or hire educated workers to apply circular business models.
FP 11	Local solutions can strategically push businesses into a circular economy.	Construction companies may benefit from aggressive localization.
FP 12	Legal regulations are expected to promote and oblige organizations to adopt circular business models.	Construction companies may have to adopt circular business models due to legislation, despite their inclinations. Businesses that can adapt rapidly will certainly have an advantage.

CONCLUSION

Production activities in the majority of industries contribute to damage to the environment. As the observable consequences of environmental damage increase, concerns about the environment deepen. These concerns have been influencing the methods of production in various industries. The concept of the circular economy is a developing framework that organizes not only production processes but also the initial design processes, ensuring that both are carried out with a strong focus on environmental considerations. This approach emphasizes designing and producing products with the least environmental impact and the longest possible lifespan, thereby promoting sustainability from the very beginning of the production cycle.

This study posits that industries, including construction, will need to adapt their production practices to a more circular process in the near future. This could become mandatory due to legal constraints or clients' requirements. Regardless of the underlying reasons, organizations in various industries, including construction, will need to implement the transition to a circular business model. Construction organizations may encounter challenges in operating autonomously in the future as a result of the intricate nature of circular business models. Organizations that possess extensive networks can benefit from adopting the principles of a circular economy. As organizations embrace novel business models, they might progressively depend on advanced technology for production, potentially resulting in the implementation of more complex procedures. Construction companies may allocate resources towards acquiring tools such as Building Information Modeling (BIM) software and 3D printers as a reaction to this trend.

There is an anticipation for an increased prevalence of practices such as reuse, recycling, and repair to be implemented in construction endeavors. Construction firms must prioritize the readiness of their personnel and machinery to ensure the long-term viability of their activities. Furthermore, in light of their strategic importance, these organizations may be compelled to acquire personnel and materials in addition to modifying their staff to operate in accordance with circular business models. Furthermore, a discernible shift towards a service-oriented economy is observed in the construction sector. As a result, construction companies must update their design and manufacturing procedures in order to accommodate clients who prefer to rent structures rather than purchase them.

In conclusion, the transition of the construction industry towards a circular economy is not only crucial for reducing environmental impacts but also aligns with broader international goals such as the United Nations Sustainable Development Goals (UN SDGs) and the European Green Deal. By adopting circular economy principles, the industry can contribute significantly to UN SDG 9, which advocates for resilient infrastructure and sustainable industrialization, and SDG 12, which focuses on responsible consumption and production. Additionally, the European Green Deal provides a robust policy framework that will guide the construction sector in Europe towards achieving carbon neutrality by 2050. These global and regional initiatives

underscore the importance of strategic alignment with sustainability objectives, positioning the construction industry as a key player in the global effort to combat climate change and promote sustainable development.

One limitation of the study is that it is based on assumptions about construction organizations. Most construction organizations are typically assumed to operate on a linear production model. Furthermore, construction organizations are expected to carry out conventional and widely used methods, such as constructing structures by pouring concrete on site and utilizing bricks for building partition walls. While it can be argued that this template represents the majority of construction organizations, it is important not to underestimate the variability among them. The study can assess the diversity of organizational structures, and the range of services or products offered across different locations.

İNŞAAT SEKTÖRÜNÜN DÖNGÜSEL EKONOMİYE GEÇİŞ SÜRECİNDE SEKTÖRDEKİ KURULUŞLARIN STRATEJİK ANALİZİ

1. GİRİŞ

İnşaat sektörü, projelerin maliyetleri ve zamanında tamamlanmasında karşılaşılan zorluklarla bilinir. Rekabetçi ihalelerde müteahhitlerin aşırı güven yanılgısına düşmesi, bu zorlukları daha da artırır. Aşırı güven, bireylerin kendi bilgi ve yeteneklerini abartmaları anlamına gelir ve bu, inşaat projelerinde "kazananın laneti" olarak bilinen olguyu tetikleyebilir. Kazananın laneti, ihaleyi kazanan tarafın, projeyi gerçek maliyetlerin çok altında bir teklif vererek üstlenmesi ve bu nedenle ciddi mali kayıplara uğraması durumudur. Bu çalışma, etmen tabanlı modelleme yöntemi kullanarak inşaat sektöründe aşırı güvenin kazananın laneti üzerindeki etkilerini incelemektedir.

Döngüsel ekonomi kavramı, özellikle çevre üzerinde minimum etkiye sahip sürdürülebilir iş modellerini benimseyen bir yaklaşım olarak ortaya çıkmıştır. İnşaat sektörü, büyük ölçüde doğal kaynaklara bağımlı olup, kullanılan bu malzemeler genellikle ömürlerini doldurduktan sonra geri dönüştürülemez veya yeniden kullanılamaz hale gelmektedir. Bu çalışma, döngüsel ekonomiye geçiş sürecinde inşaat sektöründeki kuruluşların karşılaşabileceği stratejik zorlukları ele alır ve PESTEL analizi ile bu değişikliklerin nasıl yönetilebileceğini araştırır.

2. LİTERATÜR TARAMASI: DÖNGÜSEL EKONOMİ.

Döngüsel ekonomi, malzeme ve ürünlerin ömrünü uzatmayı, yeniden kullanımı artırmayı, geri dönüşümü teşvik etmeyi ve atıkları minimuma indirmeyi amaçlayan bir ekonomik modeldir. Lineer üretim modelinin aksine, döngüsel ekonomi atık üretimini ortadan kaldırarak kaynakların değerini en üst düzeye çıkarmayı hedefler. Bu yaklaşım, inşaat sektörü gibi doğal kaynakları yoğun kullanan ve çevresel etkisi yüksek olan sektörler için özellikle önemlidir.

Döngüsel ekonomi ilkeleri, birçok inşaat firması tarafından atık yönetimi ve geri dönüşüm yoluyla benimsenmeye başlanmıştır. Ellen MacArthur Vakfı'na göre, inşaat sektöründe döngüsel ekonomi uygulamalarının yaygınlaşması, kaynakların verimli kullanımı, atıkların azaltılması ve yeniden kullanımın teşvik edilmesi açısından kritik bir rol oynamaktadır. Ancak, döngüsel ekonomiye geçiş süreci, sektördeki mevcut üretim alışkanlıkları ve güvenlik gereksinimleri gibi faktörlerle karmaşık hale gelmektedir. Bu süreçte, tasarım ve yapım süreçlerinin döngüsel ilkeler doğrultusunda yeniden şekillendirilmesi gerekmektedir.

3. YÖNTEM: PESTEL ANALİZİ

Bu çalışmada kullanılan PESTEL analizi, döngüsel ekonomi ilkelerinin inşaat sektöründeki uygulanabilirliğini ve karşılaşılacak zorlukları değerlendirmeyi amaçlamaktadır. PESTEL analizi, politik (P), ekonomik (E), sosyal (S), teknolojik (T), çevresel (E) ve yasal (L) faktörleri ele alarak stratejik bir çerçeve sunar. Bu analiz, inşaat firmalarının makro çevrelerinde meydana gelebilecek değişikliklere uyum sağlamaları ve bu değişikliklerin iş modellerine etkilerini değerlendirmeleri için kullanışlı bir araçtır.

Politik faktörler, hükümetlerin çevresel sürdürülebilirlik ve atık yönetimi konularındaki düzenlemelerini kapsar. Döngüsel ekonomi ilkelerinin benimsenmesi, inşaat firmalarının yeni yasal düzenlemelere uyum sağlamak zorunda kalacakları anlamına gelir. Ekonomik faktörler ise, kaynakların fiyatlarındaki dalgalanmalar ve çevresel sürdürülebilirliğe yönelik ekonomik teşviklerle ilgilidir. Sosyal faktörler, tüketici davranışlarındaki değişimleri ve toplumun çevreye duyarlılığını ifade eder. Teknolojik faktörler, geri dönüşüm süreçlerini iyileştirecek teknolojilerin gelişimini ve döngüsel yapım yöntemlerinin uygulanmasını etkiler.

4. BULGULAR: GELECEĞE YÖNELİK TAHMİNLER

Çalışmada elde edilen bulgular, inşaat sektöründeki döngüsel ekonomi uygulamalarının gelecekte daha fazla önem kazanacağını göstermektedir. Döngüsel ekonomi ilkelerinin benimsenmesi, inşaat firmalarının daha karmaşık iş ağlarına entegrasyonunu ve teknolojik yeniliklere yatırım yapmasını gerektirecektir. Ayrıca, inşaat projelerinde geri dönüşüm ve yeniden kullanım stratejilerinin yaygınlaşması beklenmektedir. Bu, özellikle aşırı güven yanılgısının neden olduğu maliyet aşımını engellemek için müteahhitlerin daha dikkatli kararlar almasını zorunlu kılacaktır.

Bulgulara göre, döngüsel ekonomi ilkelerini benimseyen inşaat firmaları, rekabet avantajı elde etme potansiyeline sahip olacaktır. Bu firmalar, daha düşük maliyetlerle projeleri tamamlama ve çevre dostu iş modelleriyle müşteri talebini karşılama konusunda avantajlı olacaklardır. Ancak, bu geçiş sürecinde firmaların karşılaşacakları zorluklar arasında iş gücünün yeniden eğitilmesi ve mevcut teknolojilerin döngüsel ekonomi ilkelerine uyarlanması yer almaktadır.

5. TARTIŞMA

Döngüsel ekonomi ilkelerinin inşaat sektöründe uygulanması, uzun vadede sektöre hem çevresel hem de ekonomik faydalar sağlayabilir. Ancak, bu geçişin başarılı bir şekilde gerçekleştirilmesi için firmaların stratejik kararlar almaları gerekmektedir. Aşırı güven yanılgısı, rekabetçi ihalelerde kazananın laneti riskini artırırken, döngüsel ekonomi ilkelerinin benimsenmesi bu riski azaltabilir. Yüklenicilerin daha gerçekçi maliyet tahminleri yapması ve projelerin uzun vadeli sürdürülebilirliğine odaklanması, sektördeki maliyet aşımı sorunlarını çözebilir.

Döngüsel ekonomiye geçişin başarıyla gerçekleştirilmesi, inşaat firmalarının teknolojik yeniliklere yatırım yapması ve iş gücünü bu yeni üretim modellerine uyum sağlayacak şekilde eğitmesi ile mümkündür. Ayrıca, inşaat projelerinde yeniden kullanım ve geri dönüşüm stratejilerinin yaygınlaşması hem çevresel etkileri azaltacak hem de firmaların maliyetlerini düşürecektir.

SONUÇ

Sonuç olarak, döngüsel ekonomi ilkeleri inşaat sektöründe hem çevresel hem de ekonomik avantajlar sağlayabilecek güçlü bir stratejik çerçeve sunmaktadır. Bu ilkelerin benimsenmesi, firmaların rekabetçi kalmalarını sağlayacak ve sürdürülebilirlik hedeflerine ulaşmalarına yardımcı olacaktır. İnşaat projelerinde aşırı güven yanılgısının yol açtığı kazananın laneti riskinin azaltılması için, müteahhitlerin daha dikkatli maliyet planlaması yapmaları ve döngüsel ekonomi ilkelerine dayalı iş modellerine geçiş yapmaları gerekmektedir.

REFERENCES

Abad-Segura, E., Fuente, A. B., González-Zamar, M.-D., and Belmonte-Ureña, L. J. (2020). Effects of Circular Economy Policies on the Environment and Sustainable Growth: Worldwide Research. *Sustainability*, *12*(14), 5792–5819.

Aboulamer, A. (2018). Adopting a circular business model improves market equity value. *Thunderbird International Business Review*, *60*(5), 765–769. https://doi.org/10.1002/tie.21922

Adams, K. T., Osmani, M., Thorpe, T., and Thornback, J. (2017). Circular economy in construction: Current awareness, challenges and enablers. *Proceedings of the Institution of Civil Engineers - Waste and Resource Management*, *170*(1), 15–24.

Agyekum, K., Amudjie, J., Pittri, H., Dompey, A. M. A., and Botchway, E. A. (2023). Prioritizing the principles of circular economy among built environment professionals. *Built Environment Project and Asset Management*, *ahead-of-print*(ahead-of-print), ahead-of-print.

Ahmed, S., Majava, J., and Aaltonen, K. (2024). Implementation of circular economy in construction projects: A procurement strategy approach. *Construction Innovation*, *24*(7), 204–222.

Arup. (2016). *The Circular Economy in the Built Environment*. ARUP.

Atta, I., and Bakhoum, E. S. (2024). Environmental feasibility of recycling construction and demolition waste. *International Journal of Environmental Science and Technology*, *21*(3), 2675–2694.

Badraddin, A. K., Rahman, R. A., Almutairi, S., and Esa, M. (2021). Main Challenges to Concrete Recycling in Practice. *Sustainability*, *13*(19), 11077–11092.

Benachio, G. L. F., Freitas, M. do C. D., and Tavares, S. F. (2020). Circular economy in the construction industry: A systematic literature review. *Journal of Cleaner Production*, *260*, 121046.

Berge, S., and von Blottnitz, H. (2022). An estimate of construction and demolition waste quantities and composition expected in South Africa. *South African Journal of Science*, 1–5.

Boyer, R. H. W., Hunka, A. D., and Whalen, K. A. (2021). Consumer Demand for Circular Products: Identifying Customer Segments in the Circular Economy. *Sustainability*, *13*(22), 12348.

Chizaryfard, A., Trucco, P., and Nuur, C. (2021). The transformation to a circular economy: Framing an evolutionary view. *Journal of Evolutionary Economics*, *31*(2), 475–504.

Compañero, R. J., Feldmann, A., and Tilliander, A. (2021). Circular Steel: How Information and Actor Incentives Impact the Recyclability of Scrap. *Journal of Sustainable Metallurgy*, *7*(4), 1654–1670.

de Sousa, G. C., and Castañeda-Ayarza, J. A. (2022). PESTEL analysis and the macro-environmental factors that influence the development of the electric and hybrid vehicles industry in Brazil. *Case Studies on Transport Policy*, *10*(1), 686–699.

Ekins, P., Domenech Aparisi, T., Drummond, P., Bleischwitz, R., Hughes, N., and Lotti, L. (2020). *The circular economy: What, why, how and where*. The OECD Centre for Entrepreneurship.

Ellen MacArthur Foundation. (2023). *What is a circular economy?* What Is a Circular Economy? https://ellenmacarthurfoundation.org/topics/circular-economy-introduction/overview

European Commission. (2015). *Closing the loop—An EU action plan for the Circular Economy.* European Commission. https://eur-lex.europa.eu/resource.html?uri=cellar:8a8ef5e8-99a0-11e5-b3b7-01aa75ed71a1.0012.02/DOC_1&format=PDF

European Commission. (2019). The European Green Deal. Accessed: August 25, 2024 https://commission.europa.eu/strategy-and-policy/priorities-2019-2024/european-green-deal_en

Finch, G., and Marriage, G. (2019). Non-orthogonal Light Timber Frame Design: Using Digital Manufacturing Technologies to Facilitate Circular Economy Architecture. In F. Bianconi and M. Filippucci (Eds.), *Digital Wood Design: Innovative Techniques of Representation in Architectural Design* (pp. 1087–1115). Cham: Springer International Publishing.

Franco-García, M.-L., Carpio-Aguilar, J. C., and Bressers, H. (2019). *Towards zero waste, circular economy boost: Waste to resources*. Cham: Springer.

Garusinghe, G. D., Perera, B. A., and Weerapperuma, U. S. (2023). Integrating Circular Economy Principles in Modular Construction to Enhance Sustainability. *Sustainability*, *15*(15), 11730.

Ghisellini, P., Ripa, M., and Ulgiati, S. (2018). Exploring environmental and economic costs and benefits of a circular economy approach to the construction and demolition sector. A literature review. *Journal of Cleaner Production*, *178*, 618–643.

Ghisellini, P., and Ulgiati, S. (2020). Circular economy transition in Italy. Achievements, perspectives and constraints. *Journal of Cleaner Production*, *243*, 118360.

Giorgi, S., Lavagna, M., Wang, K., Osmani, M., Liu, G., and Campioli, A. (2022). Drivers and barriers towards circular economy in the building sector: Stakeholder interviews and analysis of five European countries policies and practices. *Journal of Cleaner Production*, *336*, 130395.

Gravagnuolo, A., Angrisano, M., and Fusco Girard, L. (2019). Circular Economy Strategies in Eight Historic Port Cities: Criteria and Indicators Towards a Circular City Assessment Framework. *Sustainability*, *11*(13), 3512.

Guerra, B. C., Shahi, S., Mollaei, A., Skaf, N., Weber, O., Leite, F., and Haas, C. (2021). Circular economy applications in the construction industry: A global scan of trends and opportunities. *Journal of Cleaner Production*, *324*, 129125.

Haque, S. E., Nahar, N., and Haque, Md. S. (2024). A study on the waste generation rates and recycling potential for the construction and demolition waste in Dhaka, Bangladesh. *Environmental Monitoring and Assessment*, *196*(2), 183.

Herrador, M. (2024). Assessment of the first-ever circular economy framework of Cambodia: Barriers, international opportunities and recommendations. *Journal of Cleaner Production*, *438*, 140778.

Huang, B., Wang, X., Kua, H., Geng, Y., Bleischwitz, R., and Ren, J. (2018). Construction and demolition waste management in China through the 3R principle. *Resources, Conservation and Recycling*, *129*, 36–44.

Husgafvel, R., Linkosalmi, L., Hughes, M., Kanerva, J., and Dahl, O. (2018). Forest sector circular economy development in Finland: A regional study on sustainability driven competitive advantage and an assessment of the potential for cascading recovered solid wood. *Journal of Cleaner Production*, *181*, 483–497.

Illankoon, C., and Vithanage, S. C. (2023). Closing the loop in the construction industry: A systematic literature review on the development of circular economy. *Journal of Building Engineering*, *76*, 107362.

Illankoon, C., Vithanage, S. C., and Pilanawithana, N. M. (2023). Embodied Carbon in Australian Residential Houses: A Preliminary Study. *Buildings*, *13*(10), 2559.

Joensuu, T., Edelman, H., and Saari, A. (2020). Circular economy practices in the built environment. *Journal of Cleaner Production*, *276*, 124215.

Johnson, G., Scholes, K., and Whittington, R. (2008). *Exploring corporate strategy: Text and cases*. Essex: Pearson education.

Kazmi, R., and Chakraborty, M. (2023). Identification of parameters and indicators for implementing circularity in the construction industry. *Journal of Engineering and Applied Science*, *70*(1), 77.

Lacy, P., Long, J., Spindler, W., Lacy, P., Long, J., and Spindler, W. (2020). Introduction: The path to transformation is circular. *The Circular Economy Handbook: Realizing the Circular Advantage*, 1–14.

Medaglia, R., Rukanova, B., and Zhang, Z. (2024). Digital government and the circular economy transition: An analytical framework and a research agenda. *Government Information Quarterly*, *41*(1), 101904.

Mhatre, P., Gedam, V. V., and Unnikrishnan, S. (2023). Management insights for reuse of materials in a circular built environment. *Waste Management and Research*, *42*(5), 369–405.

Mostaghel, R., Oghazi, P., and Lisboa, A. (2023). The transformative impact of the circular economy on marketing theory. *Technological Forecasting and Social Change*, *195*, 122780.

Palea, V., Santhià, C., and Miazza, A. (2023). Are circular economy strategies economically successful? Evidence from a longitudinal panel. *Journal of Environmental Management*, *337*, 117726.

Pan Wei, Chen Le, and Zhan Wenting. (2019). PESTEL Analysis of Construction Productivity Enhancement Strategies: A Case Study of Three Economies. *Journal of Management in Engineering*, *35*(1), 05018013.

Rainatto, G. M., Lopes de Sousa Jabbour, A. B., Cardoso Machado, M., Chiappetta Jabbour, C. J., and Tiwari, S. (2024). How can companies better engage consumers in the transition towards circularity? Case studies on the role of the marketing mix and nudges. *Journal of Cleaner Production*, *434*, 139779.

Reusable Packaging Association. (2023). *Circular Economy Legislation: The International Experience*. https://www.reusablepackaging.org/insights/circular-economy-legislation-the-international-experience/

Shpak, N., Melnyk, O., HORbAL, N., Ruda, M., and Sroka, W. (2021). *Assessing the implementation of the circular economy in the EU countries*. *9*(1), 25–39.

Sudarsan, J. S., and Gavali, H. (2023). Application of BIM in conjunction with circular economy principles for sustainable construction. *Environment, Development and Sustainability*, *26*(3), 7455–7468.

Sumikura, Y., and Katsumi, T. (2022). Material reuse and recycling in construction works in Japan. *Journal of Material Cycles and Waste Management*, *24*(4), 1216–1227.

Tserng, H.-P., Chou, C.-M., and Chang, Y.-T. (2021). The Key Strategies to Implement Circular Economy in Building Projects—A Case Study of Taiwan. *Sustainability*, *13*(2), 754.

Turkyilmaz, A., Guney, M., Karaca, F., Bagdatkyzy, Z., Sandybayeva, A., and Sirenova, G. (2019). A Comprehensive Construction and Demolition Waste Management Model using PESTEL and 3R for Construction Companies Operating in Central Asia. *Sustainability*, *11*(6), 1593.

United Nations. (2015). Transforming our world: The 2030 Agenda for Sustainable Development. Accessed: August 25, 2024, https://sdgs.un.org/2030agenda

Washington State University Libraries. (2023). *PESTEL Analysis -Industry Research*. https://libguides.libraries.wsu.edu/c.php?g=294263&p=4358409

Worthington, I., and Britton, C. (2009). *The business environment*. Essex: Pearson education.

Yadav, J. S., Saini, A., Hussain, S., and Sharma, V. (2024). Estimation of ultimate bearing capacity of circular footing resting on recycled construction and demolition waste overlaying on loose sand. *Journal of Building Pathology and Rehabilitation*, *9*(1), 25.

Yüksel, I. (2012). Developing a multi-criteria decision making model for PESTEL analysis. *International Journal of Business and Management*, *7*(24), 52.

Zorpas, A. A. (2020). Strategy development in the framework of waste management. *Science of The Total Environment*, *716*, 137088.

Zuofa, T., Ochieng, E. G., and Ode-Ichakpa, I. (2023). An evaluation of determinants influencing the adoption of circular economy principles in Nigerian construction SMEs. *Building Research and Information*, *51*(1), 69–84.

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