TECHNOLOGY, CREATIVITY, IMPLEMENTATION

CIRCULAR ECONOMY: CONCEPT, PRINCIPLES AND PROSPECTS FOR IMPLEMENTATION AT PASSENGER TRANSPORT ENTERPRISES IN UKRAINE

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Summary

The article examines the concept of circular economy, its basic principles, barriers and opportunities for implementation at passenger transport enterprises in Ukraine. It is determined that the transition to a circular model in the transport sector is a strategically important direction of development. It helps to optimise the use of resources, increase energy efficiency, minimise waste and reduce the negative impact on the environment. The author examines the key advantages of circular business models, including the introduction of resource reuse technologies, the use of renewable energy sources, the development of environmentally friendly public transport, and the reduction of operating costs and the increase of competitiveness of enterprises. The article examines the key barriers that impede the transition to a circular economy in the transport sector. These barriers include high initial investment costs, technological limitations, outdated infrastructure, insufficient regulatory support, and social factors such as low public awareness and resistance to change. The article aims to explore the concept and principles of the circular economy model, as well as its barriers and potential for implementation in passenger transport enterprises. The following methods were used in the study: generalisation – in studying the essence of the concept and principles of the circular economy; analysis and synthesis – in the scientific substantiation of the implementation of the principles and business models of the circular economy at passenger transport enterprises; systematic approach – in the process of identifying barriers that complicate the transition to the circular economy in the field of passenger transport.

Key words: sustainable business models, transport modernisation, resource efficiency, economic potential, economic efficiency, green technologies, sustainable development.

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1. Introduction

At the current stage of global economic development, the traditional linear business model is increasingly losing its effectiveness due to several factors. Global environmental challenges, the depletion of natural resources, the growing volume of industrial and household waste, and heightened requirements for sustainable development all necessitate a shift towards

new economic models. One of the most promising alternatives is the circular economy, which is founded on principles of resource efficiency, waste minimization, and material reuse.

In Ukraine, the transition to a circular economy within passenger transport enterprises is highly relevant, as this industry plays a crucial role in ensuring population mobility and the functioning of urban infrastructure. However, the current model of passenger transport operations, which primarily follows the traditional linear economy principles, creates significant environmental, economic, and social challenges that require immediate attention. Despite these difficulties, transitioning to a circular economy in Ukrainian passenger transport is a strategically important step toward sustainable development. This shift will not only minimize the negative impact of transport on the environment but also enhance economic efficiency, promote technological modernization, and improve the quality of life for citizens. Implementing circular business models and investing in innovative transport solutions will enable Ukraine to make significant strides toward an environmentally sustainable future. Therefore, it is essential to analyse the concept of the circular economy, explore its principles, identify key barriers, and assess the prospects for its implementation in passenger transport enterprises in Ukraine.

The purpose of the article is to analyse the main directions of implementation of the circular economy, its concepts and principles, and the possibility of its adaptation to Ukrainian realities. The methodological basis of the study is based on the dialectical method of scientific knowledge and a systematic approach to the study of the conceptual foundations of the circular economy and the prospects for its implementation at passenger transport enterprises in Ukraine. In particular, the following methods were used: semantic analysis, methods of induction and deduction, general and specific in generalising the conceptual foundations of the circular economy, methods of analysis and synthesis, statistical groupings, and graphical representation to analyse the challenges and barriers to the implementation of circular economy principles and models at passenger transport enterprises.

2. The main goals of the circular economy

Today's global challenges, such as the depletion of natural resources, increasing waste, environmental pollution and climate change, require new approaches to economic development. One of the most effective mechanisms for addressing these challenges is the circular economy, which is directly linked to the concept of sustainable development. The circular economy is aimed at achieving economic efficiency, environmental safety and social responsibility, which allows for a long-term balance between production, consumption and environmental preservation.

The main Sustainable Development Goals *(United Nations)* that the circular economy is based on include:

– Goal 6: Clean water and sanitation. The circular economy promotes the efficient use of water resources, wastewater treatment, and reuse.

– Goal 7: Affordable and clean energy. The circular economy supports the development of renewable energy, reducing dependence on fossil fuels.

– Goal 8: Decent work and economic growth. The circular economy promotes the creation of new jobs in recycling, eco-design and the green economy.

– Goal 9: Industry, innovation and infrastructure. The transition to a circular economy requires innovative approaches to production, material recycling and resource management.

– Goal 11: Sustainable cities and communities. The circular economy helps cities become environmentally friendly, resource efficient and comfortable to live in.

– Goal 12: Responsible consumption and production. The main idea of the circular economy is to optimize production and consumption by reducing the use of resources and waste.

– Goal 13: Climate action. The circular economy helps reduce greenhouse gas emissions, which are one of the main causes of global warming.

– Goal 14: Life below water. The circular economy helps reduce ocean pollution from plastic, chemicals and industrial waste.

– Goal 15: Protecting land ecosystems. Sustainable use of natural resources helps to preserve biodiversity and ecosystems.

The circular economy is a crucial approach for achieving the Sustainable Development Goals, as it integrates economic development, environmental sustainability, and social responsibility (*Scholtysik, Koldewey, Rohde, Dumitrescu 2023)*. This is accomplished through the fundamental principles of the circular economy, which form its foundation and enable the creation of sustainable business models. These models promote the responsible and efficient use of resources while fostering the harmonious development of society *(Reike, Vermeulen, Witjes, 2018)*. The basic principles of the circular economy include the following key approaches:

– Reduce – reducing resource consumption and waste generation.
– Reuse – reuse of products and materials.
– Recycle – recycling and reuse of materials.
– Repair – repair, modernisation and extension of product life.
– Recover – use of renewable energy sources.
– Rethink – revising approaches to production and consumption through the introduction of new circular business models.
– Refuse – conscious refusal to use excessive materials, energy, and products.
– Remanufacture – modernisation and reuse of parts and components to create new products without the need to manufacture all elements from scratch.
– Repurpose – use of materials or products not for their original purpose, but in a new quality, without significant processing.

The circular economy is one of the key areas of sustainable development aimed at rational use of resources, minimising waste and reducing the negative impact of human activity on the environment. It shapes new economic approaches that allow businesses, consumers and governments to operate more efficiently, reducing dependence on non-renewable resources and contributing to building an environmentally responsible society. It is a multidimensional concept that integrates economic, environmental and social aspects of development and involves changing approaches to production and consumption, developing new business models and introducing technologies that reduce the use of natural resources, minimise negative environmental impact and ensure sustainable economic growth. The transition to a circular economy is a prerequisite for achieving global sustainable development goals, increasing the competitiveness of enterprises and improving the quality of life of the population.

3. Benefits of the circular economy for passenger transport companies

The adoption of circular business models in the passenger transport sector is essential for enhancing economic efficiency, ensuring environmental safety, and promoting greater social responsibility among enterprises. In today's context, where resource costs are increasing, environmental pollution is intensifying, and there is mounting international pressure to reduce

emissions, transitioning to a circular economy is not merely a trend; it is a strategic necessity. The main reasons for implementing circular business models in the passenger transport sector:

1. Cost optimisation and economic benefits.
2. Increase in environmental efficiency
3. Increase in resource efficiency
4. Compliance with international environmental standards
5. Improving the quality of services and competitiveness

The traditional transport system requires significant amounts of natural resources (oil, metals, rare earth elements, etc.) for the production and operation of vehicles. However, the exhaustibility of these resources and their high cost make it necessary to look for more efficient approaches to their use. Circular business models can optimize the use of materials through the reuse of vehicle components; reduce the cost of maintenance and renewal of vehicles through the implementation of durability and repair strategies; and manage the vehicle fleet more efficiently through the introduction of vehicle sharing (e.g., car sharing or ride-sharing).

Circular business models can enhance the profitability of transport companies by lowering operating costs through the adoption of energy-efficient transportation methods and renewable energy sources. They also encourage innovation and attract investment in the development of new technologies within the transport sector. Additionally, European and global trends indicate that transitioning to a circular economy can be financially advantageous. Many governments and international organizations provide grants, subsidies, and tax incentives for businesses that implement environmentally responsible strategies.

Circular models have a positive impact not only on the economy and the environment but also on the quality of transport services. They help to reduce congestion through the rational use of transport resources; improve passenger comfort through the use of new transport technologies, increase the efficiency of transport infrastructure; and create new jobs in the field of green technologies, which contributes to social development.

Thus, the transition to circular business models in the passenger transport sector is a key condition for economic growth, environmental safety and increased transport efficiency. Optimizing resources, reusing materials, introducing digital technologies and environmentally friendly transport solutions create a sustainable and profitable transport system of the future. The transition to circular business models in the passenger transport sector is not only an important environmental necessity but also a strategically beneficial solution for businesses, the state and society as a whole. Successful implementation of circular business models in the transport sector requires active cooperation between the state, business and society, as well as financial incentives, technological innovations and regulatory support. This will help create an efficient, sustainable and cost-effective passenger transport system that meets the challenges of the modern world.

4. Barriers to implementation at passenger transport enterprises

Despite the clear advantages of a circular economy for transport companies, implementing it comes with various challenges and barriers. These include economic, technological, regulatory, and social factors that impede the transport sector's transition to closed resource cycles (see Figure 1).

The move towards circular models in passenger transport enterprises encounters several technological obstacles that prevent large-scale implementation. The main challenges include:

– Outdated rolling stock and lack of modernisation technologies.

– Limited opportunities for recycling and disposal of vehicles and their components.
– Low level of digitalisation and implementation of intelligent transport systems.
– Lack of developed infrastructure for environmentally friendly transport.
– Inconsistency of technical standards governing circular processes.

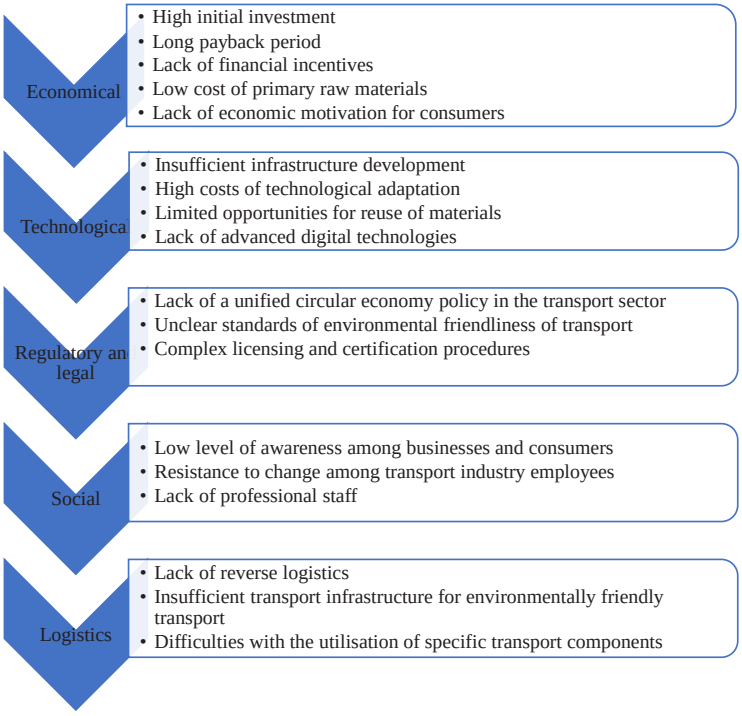

Fig. 1. Barriers to the implementation of circular economy principles and models at transport enterprises

Among the problems associated with regulatory barriers are the lack of a necessary legislative framework, outdated regulations, legal uncertainty in the recycling of materials, and insufficient incentives for the environmental transformation of transport companies. Overcoming these barriers will help make passenger transport more environmentally friendly, resource-efficient and cost-effective in the long term.

Implementation of circular economy principles and models in passenger transport enterprises faces numerous economic barriers, which are the most serious challenge on the way to sustainable development. Despite the obvious benefits of the circular economy, such as resource optimization, waste reduction and increased transport efficiency, economic difficulties often hinder this process.

The introduction of a circular economy in the transport sector is essential for reducing the environmental impact of transportation, optimizing resource use, and improving overall efficiency within the industry. However, this transition presents significant economic challenges, primarily due to the substantial capital investment needed to modernize rolling stock, develop necessary infrastructure, and implement advanced technologies. One of the main obstacles is the high initial cost associated with replacing traditional vehicles with more environmentally

friendly alternatives, such as electric buses, hydrogen buses, or vehicles powered by alternative fuels. The expense of purchasing these vehicles can be a heavy burden for businesses, particularly in regions with limited financial resources. Additionally, considerable funding is required to integrate modern technologies, including digital transport management systems, energy-efficient solutions, resource monitoring systems, and automated waste collection and recycling technologies. Embracing innovative approaches is crucial for the transition to a circular economy; however, their successful implementation demands long-term financing and adaptation to the specific conditions of each country or region.

An important barrier to adopting circular business models is the long payback period for such investments. While these models can lead to significant resource savings in the future, many businesses cannot afford to wait decades for a return on their investment. This concern is particularly relevant for small and medium-sized enterprises in the transport sector, as they often lack access to long-term loans or government subsidies. Additionally, the absence of government incentives further hampers the implementation of circular business models. The lack of tax breaks, grants, subsidies, and affordable loans for sustainable transport development diminishes businesses' motivation to invest in eco-friendly solutions. Furthermore, the low profitability of recycled materials, exacerbated by an unstable market and high processing costs, makes it economically unfeasible for transport companies to use recycled materials.

An important factor to consider is the lack of economic incentives for consumers. Environmentally friendly transportation often comes with higher fares, and mechanisms to encourage its use, such as discounts or loyalty programs, have not been adequately developed.

Consequently, economic barriers serve as a significant obstacle to implementing circular economy principles in the passenger transport sector. To address these challenges, a comprehensive approach is necessary. This should include financial support from the government, the establishment of a stable market for recycled materials, and the development of economic incentives for businesses and consumers. Only under these conditions can we achieve a transition to a sustainable and efficient transport system that aligns with the principles of the circular economy.

Implementation of circular economy principles in the passenger transport sector not only requires economic solutions, technical innovations and regulatory changes but also requires public support. When implementing the principles of the circular economy in the activities of passenger transport enterprises, certain problems and public opposition arise that slow down or even make it impossible to transform transport ecologically. The key challenges include low public awareness, resistance from industry employees, a lack of trust in new technologies, social inequality, and transport user habits. Many passengers and even transport workers are unaware of the benefits of the circular economy and its impact on quality of life, the environment and the economy. Due to this lack of knowledge, the population often does not support measures aimed at ecological modernization of transport, considering them unjustified or not bringing real benefits. Transitioning to a circular economy involves changing traditional business models, which can cause a negative reaction among transport workers due to fear of losing their jobs, the necessary retraining to work with new environmental technologies and their habitual use of traditional working methods. Due to these factors, employees may actively or passively resist environmental modernization, which complicates the process of implementing circular models. Overcoming these challenges will help make the circular economy a reality in the passenger transport sector, which will not only help to conserve resources but also improve the quality of life of citizens.

The introduction of circular economy principles and models in passenger transport enterprises is a necessary step towards achieving sustainable development, reducing environmental

impact and increasing resource efficiency. However, the barriers and challenges that accompany this process make it difficult to implement circular approaches in the transport sector. Overcoming these barriers requires a comprehensive approach, including the development of effective government strategies and incentive programs, financial support for businesses, active infrastructure modernization, improved regulation and public and business awareness, which will contribute to economic development, environmental safety and improved quality of transport services, which are key priorities of modern transport policy.

5. Conclusions

The circular economy is a strategically important area of development for the transport sector, as its implementation allows for more rational use of natural resources, reduced environmental pollution and increased economic efficiency of transport companies. In the face of growing environmental challenges and depletion of non-renewable resources, the traditional linear model of transport economics is becoming unacceptable. Instead, the circular approach involves reducing waste and pollution, extending the life cycle of vehicles and components, and introducing more environmentally friendly and resource-efficient technologies.

The application of the circular economy in the transport sector helps to expand the use of renewable energy sources, modernize infrastructure and switch to cleaner modes of transport. The implementation of such approaches not only reduces energy consumption and carbon dioxide emissions but also cuts costs for companies through the reuse of materials and the development of vehicle sharing.

At the same time, the implementation of the circular economy in transport enterprises in Ukraine faces several economic, technological, regulatory and social barriers. The high cost of initial investments, insufficient legislative support, limited access to financial resources, and low public awareness of the benefits of circular approaches significantly complicate the transition to sustainable business models. For the effective implementation of the circular economy in the transport sector in Ukraine, it is necessary to: develop a strategy at the state level that will provide financial incentives for enterprises implementing circular models; improve the regulatory framework by adapting it to European environmental standards; stimulate the development of innovative technologies in the transport sector, including the transition to alternative energy sources; and raise environmental awareness among the population and transport operators.

Thus, the circular economy is not only a necessary response to current environmental and economic challenges but also a promising direction for the development of Ukraine's transport industry. Its implementation will contribute to the creation of an efficient, environmentally sustainable and cost-effective passenger transport system that meets European standards and current trends in sustainable development.

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