

Jānis Zvirgzdiņš

THE FRAMEWORK OF FACTORS INFLUENCING THE IMPLEMENTATION OF THE CIRCULAR ECONOMY IN LATVIA

Summary of the Doctoral Thesis



RIGA TECHNICAL UNIVERSITY
Faculty of Engineering Economics and Management
Economics and Business Institute

Jānis Zvirgzdiņš

Doctoral Student of the Study Program “Management Science and Economics”

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Scientific supervisors
Professor Dr. oec.
INETA GEIPELE
Associate Professor Dr. oec.
SANDA LAPUŽE

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To be granted the scientific degree of Ph. D. in social sciences, the present Doctoral Thesis has been submitted for defence at the open meeting of RTU Promotion Council on December 20, 2024 at the Faculty of Engineering Economics and Management of Riga Technical University, 6 Kalnciema Street, Room 209.

OFFICIAL REVIEWERS

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Riga Technical University

Professor Dr. oec. Aina Dobeļe
Latvia University of Life Sciences and Technologies, Latvia

Associate Professor PhD Ivaylo Hristov Ivanov
University of Forestry, Bulgaria

DECLARATION OF ACADEMIC INTEGRITY

I, Jānis Zvirgzdiņš, hereby declare that the Doctoral Thesis submitted for review to Riga Technical University for promotion to the scientific degree of Ph. D. in Social Sciences is my own. I confirm that this Doctoral Thesis has not been submitted to any other university for promotion to a scientific degree.

The Doctoral Thesis has been written in Latvian. It consists of an introduction, 4 chapters, 12 sections, conclusions and proposals, a list of references, and 11 appendices. The Doctoral Thesis includes 65 figures and 23 tables; the total number of pages is 228, including appendices. The list of references contains 316 titles.

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INTRODUCTION

Resource depletion, climate change, loss of biodiversity, deforestation, desertification, air, water, and soil pollution are problems that directly and indirectly influence the standard of living of a large proportion of the world's population. From 1950 to 2021, the world population has grown 3.16 times, reaching 7.91 billion in 2021, and the world population is projected to reach 8.5 billion in 2030 and 9.7 billion in 2050. At the same time, society's desire for welfare and a more prosperous life has also increased, with one resident consuming 96 % more energy in 2021 than in 1950. As the world's population grows, so does the demand for basic needs such as food, housing, and transportation, which increases the pressure on natural resource stocks.

Up to this moment, the world economy has been linear, characterized by a “take-make-use-dispose” approach. In the long run, it turns planet Earth into a landfill, as most of the world's waste is disposed. A linear economy will not be able to provide future generations with goods and services similar to the consumption basket of today's society. Current development trajectories raise serious questions about the sustainability of planet Earth and demand urgent action.

The circular economy is a potential solution to global environmental issues that have arisen in the 21st century – resource depletion, climate change, loss of biodiversity, deforestation, air, water and soil pollution, etc. Along with the European Commission's statement on the progress towards the European Green Deal¹, it was determined that the promotion of Latvia's growth and decoupling from the use of natural resources requires a transition to a circular economy in various sectors of the national economy. According to the Action Plan for the Transition to a Circular Economy for 2020–2027, which was developed by the Ministry of Environmental Protection and Regional Development of Latvia, the following performance indicators are expected to be achieved in Latvia by 2027: 1) increase in resource productivity (from 0.90 EUR/kg to 1.55 EUR/kg); 2) increase in material circularity (from 6.6% to 11.0%); 3) increase in public awareness and participation in the implementation of the circular economy.² Although the transition to a circular economy in Latvia has begun through the political movement and the development of policy planning documents, the implementation of the circular economy is only at the initial stage. One of the major obstacles in the implementation of the circular economy is conceptual disagreement, as a result of which the circular economy means different things to different stakeholders. There is also a lack of

¹ European Commission (2019) [online]. *Communication from the Commission to the European Parliament, the Council, the European Economic and Social Committee and the Committee of the Regions “The European Green Deal”*. eur-lex.europa.eu [accessed 20 October 2023].

Available at: <https://eur-lex.europa.eu/legal-content/EN/TXT/?uri=COM%3A2019%3A640%3AFIN>

² Vides aizsardzības un reģionālās attīstības ministrija (2020) [tiešsaiste]. *Rīcības plāns pārejai uz aprītes ekonomiku 2020.-2027. gadam*. varam.gov.lv [skatīts 2023. gada 25. oktobrī].

Available at: <https://www.varam.gov.lv/lv/ricibas-plans-parejai-uz-aprites-ekonomiku-2020-2027gadam>

understanding of the circular economy concept in Latvian society.³ Local studies related to the circular economy in Latvia have studied various aspects of the circular economy, which are important steps in the transition to a circular economy in Latvia. However, it must be recognized that a large part of local studies focuses on the detailed research of certain elements of the circular economy – the composition of waste, individual waste streams, recycling options and waste management, the attitude of companies, students and society towards the circular economy and the implementation of related concepts, business models, employment in circular economy-related sectors, framework of R-strategies, consumption and other elements of the circular economy – without providing a systemic view on the conceptual framework of the circular economy. Therefore, the topicality of the Thesis is justified. In the Doctoral Thesis, there are identified the characteristic elements of the circular economy, which provide a systemic perspective and create a unified understanding of the circular economy concept. In addition, the retrospective analysis of the circular economy reflects the development of the concept of the circular economy, the origins of which can be traced back to 1945, which indicates that the circular economy is not a *fashion trend* of the last decade.

The implementation of the circular economy is a long-term transformative process of elements of political, economic, social, technological, environmental, and legal dimensions at macro, meso, and micro levels. In order to successfully implement the circular economy, it is essential to identify the influencing factors. Although various factors affecting the implementation of the circular economy have been identified in various scientific studies, a systematic framework of influencing factors in the transition to the circular economy has not been developed yet.

In the transition to a circular economy in Latvia, seven action directions of the Action Plan for the Transition to a Circular Economy for 2020–2027 have a significant role:

- 1) Transition from waste management to resource management;
- 2) Improving the productivity of resources in all sectors of the economy by promoting the development of research and innovation;
- 3) Creation of preconditions for the secondary use of goods;
- 4) Promotion of transition from buying goods to services;
- 5) Improvement of materials, processes, and waste management in priority sectors;
- 6) Strengthening the role of municipalities in the implementation of circular economy principles;
- 7) Public involvement, information, and education.⁴

In the conditions of limited financial resources, it is essential to find out which of the action directions have priority in relation to others in order to be able to determine financial priorities accordingly. Although the transition to a circular economy is systemic and affects all sectors of the national economy to a greater or lesser extent, it is important to determine the priority

³ *Aptauja: 48% Latvijas iedzīvotāju neko nezina par aprites ekonomiku* (2023) [tiešsaiste]. DelfinGroup AS [skatīts 2023. gada 15. oktobrī]. Available at: <https://delfingroup.lv/lv/pazinojumi/aptauja-48-latvijas-iedzivotaju-neko-nezina-par-aprites-ekonomiku>

⁴ *Vides aizsardzības un reģionālās attīstības ministrija* (2020) [tiešsaiste]. *Rīcības plāns pārejai uz aprites ekonomiku 2020.-2027. gadam*. varam.gov.lv [skatīts 2023. gada 25. oktobrī]. Available at: <https://www.varam.gov.lv/lv/ricibas-plans-parejai-uz-aprites-ekonomiku-2020-2027gadam>

sectors of Latvia's national economy in the transition to a circular economy. This will make it possible to identify the primary space and work area for the implementation of the circular economy.

The topicality derives from the problem of the limited resources of the planet Earth and the unsustainability of the linear economy, which leads to the systemic adoption of circular economy principles.

Research questions

1. What are the development periods of the circular economy concept?
2. What are the characteristic elements of the circular economy?
3. What is the progress of circular economy implementation in Latvia?
4. What factors influence the circular economy implementation in Latvia?
5. How to prioritize action directions, economic sectors, development directions, perspectives, plans or strategies in the transition to the circular economy in Latvia?

The **aim** of the Doctoral Thesis is to develop the framework of factors influencing the implementation of the circular economy in Latvia and to carry out its validation.

In order to achieve the aim of the research, the following **tasks** are developed:

- 1) to carry out a retrospective analysis of the circular economy concept;
- 2) to identify and validate the characteristic elements of the circular economy;
- 3) to analyze the definitions of the circular economy identified in the scientific literature;
- 4) to analyze the political framework of the circular economy implementation in Latvia;
- 5) to carry out an analysis of the circular economy in Latvia, using the most suitable framework of indicators for the evaluation of the circular economy;
- 6) to develop a framework of factors influencing the implementation of the circular economy in Latvia based on *PESTEL* factor groups;
- 7) to carry out an evaluation of the relative importance weights of the framework of factors influencing the implementation of the circular economy in Latvia in the focus group;
- 8) to carry out the validation of the framework of factors influencing the implementation of the circular economy in Latvia by evaluating the priority action directions of the Action Plan for the Transition to a Circular Economy for 2020–2027 and the priority sectors of the national economy of Latvia in the transition to the circular economy in Latvia;
- 9) to develop conclusions and proposals.

Hypothesis: Circular economy implementation in Latvia is influenced by a set of factors, from which economic factors have the greatest influence on the circular economy implementation in Latvia.

Theses for defence

1. The circular economy means different things to each of the stakeholders in the implementation of the circular economy; therefore, creating a common understanding of the circular economy through the identified elements of the circular economy and the definition of the circular economy is the basis for a successful transition to the circular economy in Latvia.

2. The transition to a circular economy in Latvia is promoted by accelerating the development of elements of the political, economic, social, technological, environmental, and legal dimensions.
3. The transition to a circular economy in Latvia is influenced by a set of political, economic, social, technological, environmental, and legal factors. The group of economic factors has the greatest influence on the circular economy implementation in Latvia.
4. In the transition to a circular economy in Latvia, it is essential to consider the transition from waste management to resource management, public involvement, information and education, as well as the application of circular economy principles in such sectors as water supply; sewerage, waste management and remediation, manufacturing, construction and transportation and storage.

Several **scientific novelties** were developed in the Doctoral Thesis:

1. For the first time in Latvia, *a framework of the retrospective analysis of the circular economy concept* has been developed, identifying the periods of development of the circular economy concept: 1) the period of awareness of global environmental problems and circular economy ideology (1945–1987); 2) the period of conceptualization of circular economy (1989–2010); 3) circular economy validity period (2011– ...).
2. *The characteristic elements of the circular economy have been identified and validated* using qualitative content analysis, bibliometric analysis, analysis of scientific literature, and expert interviews, which contribute to creating a common understanding of the concept of circular economy.
3. *A comprehensive analysis of the circular economy in Latvia* has been carried out, using the indicators of the European Commission's Circular Economy Monitoring Framework.
4. *The framework of factors influencing the implementation of the circular economy in Latvia* has been developed for the assessment of the implementation of the circular economy in Latvia. Analytic network process (ANP) and analytic hierarchy process (AHP) methods were used in the evaluation of the relative importance weights of the factors.
5. Prioritization of action directions of Action Plan for the Transition to a Circular Economy for 2020–2027 was carried out and identification and assessment of priority economic sectors (according to the NACE classification) in the transition to the circular economy in Latvia has been done, which can be used as support for decision-making related to the implementation of circular economy in Latvia.

The **research object** is the circular economy.

The **research subject** is factors influencing the implementation of the circular economy in Latvia.

The **theoretical and methodological basis of the Doctoral Thesis** is formed by researchers and organizations: Joseph Chelladurai Cornelius Kumarappa, Rachel Carson, Kenneth Ewart Boulding, Garrett James Hardin, Paul Ralph Ehrlich, Nicholas Georgescu-Roegen, Barry Commoner, Murray Bookchin, Donella Meadows *et al.*, Victor Josef Papanek,

Ernst Friedrich Schumacher, Ivan Illich, Françoise d'Eaubonne, André Gorz, Arne Næss, Herman Edward Daly, Bruce Charles Mollison, David Holmgren, Marcus Felson, Joe L. Spaeth, William Robert Catton, Jr., Walter R. Stahel, Gro Harlem Brundtland *et al.*, Robert Alan Frosch, Nicholas E. Gallopoulos, David William Pearce, R. Kerry Turner, Christopher John Ryan *et al.*, Hardin Tibbs, John T. Lyle, Robert Ayres, Udo E. Simonis, Leo W. Baas, Dale Rogers, Ron Tibben-Lembke, Raymond P. Côté, Edward Cohen-Rosenthal, Janine M. Benyus, Paul Gerard Hawken, Amory Bloch Lovins, Hunter Lovins, Mark Jacob Goedkoop *et al.*, Thomas Lindhqvist, Marian Ruth Chertow, Kenneth Geiser, William McDonough, Michael Braungart, Karl Henrik Robèrt, Daniel Guide *et al.*, Organisation for Economic Co-operation and Development (OECD), Rob Hopkins, Gregory Unruh, Lawrence Lessig, Serge Latouche, Tim Jackson, Gunter Pauli, Christian Felber, Julian Mark Allwood *et al.*, Zhang Wei *et al.*, Michael Löwy, Overson Shumba, Jeremy Rifkin, Otto Scharmer, Katrin Kaufer, Ashish Kothari *et al.*, Philippe Bihouix, Kepa Artaraz, Melania Calestani, Pope Francis, John Fullerton, Terry Irwin, Kate Raworth, Ted Trainer, Samuel Alexander, Patrick Schröder *et al.*, Janis Zvirgzdins, Janis Vanags, Qinghua Zhu, Yong Geng, Kee-hung Lai, Lothar Reh, Jose Potting, Marko Hekkert, Ernst Worell, Aldert Hanemaaijer, Inga Uvarova, Dzintra Atstaja, Tatjana Volkova, Janis Grasis, Iveta Ozolina-Ozola, Ineta Geipele, Sanda Lapuke, Kaspars Plotka, Ellen MacArthur Foundation, Mateusz Lewandowski, Chris Hann, Gennaro Iasevoli *et al.*, Arnold Tukker, Maija Senfelde, Sendhil Mullainathan, Richard Thaler, Olegs Linkevics, Ludo Waltman, Nees Jan van Eck, Ed Noyons, Sandeep Goyal *et al.*, Enric Camón Luis, Dolores Celma, José Luis Ruiz-Real *et al.*, Vítor Martinho, Paulo Reis Mourão, Jonathan M. Cullen, Feng Zhijun, Yan Nailing, Yiping Fang *et al.*, Qinghua Zhu *et al.*, Julian Kirchherr *et al.*, Rashain Perera, Ludwig von Bertalanffy, Thomas L. Saaty, Klaus Goepel, Prudence Plummer-D'Amato, Sue Wilkinson, Julius Sim, Jackie Waterfield, Andrew Parker, Jonathan Tritter, and others.

Literature sources used in the Doctoral Thesis: fundamental scientific studies and monographs, scientific publications published in scientific journals and conference proceedings, sources available in the scientific databases *Scopus*, *Web of Science*, *ScienceDirect*, *SpringerLink*, *EBSCOHOST*, *Google Scholar*, laws, regulatory documents, policy planning documents of the European Union and the Republic of Latvia, directives of the European Commission, Eurostat and other statistical data, materials of companies and other organizations, internet resources, and studies conducted by the author of the Doctoral Thesis.

Research methods used in the Doctoral Thesis: literature review, analysis of scientific literature, snowball sampling method, scientific triangulation, qualitative content analysis, bibliometric analysis, expert interview, document analysis, descriptive statistical data collection and analysis method, trend analysis, synthesis, expert method and focus group, *PESTEL* analysis method, analytic hierarchy process (AHP) and analytic network process (ANP) mathematical relative measurement methods. A combination of qualitative content analysis, bibliometric analysis and expert interview methods are used in the identification and validation of the characteristic elements of the circular economy. A combination of *PESTEL* analysis, analytical network process and focus group methods were used in the evaluation of the relative importance of the factors influencing the implementation of the circular economy in Latvia.

The main results of the Doctoral Thesis were discussed, justified and approved in the focus group and in scientific seminars.

Limitations of the research. The framework of the retrospective analysis of the circular economy concept has been developed based on the development of the circular economy concept from 1945 to 2020, although the period of validity of the circular economy continues beyond 2020. Considering the broad scope of the circular economy concept, the Doctoral Thesis provides a systemic management-level view of the characteristic elements of the circular economy. It is possible to increase the level of detail in the analysis of the elements of the circular economy in future studies. The identified political-legal framework of the circular economy in Latvia is based on the policy planning documents. Action Plan for the Transition to a Circular Economy for 2020–2027 is analyzed in detail. The analysis of other policy planning documents related to the circular economy does not reach an equivalent level of detail. Considering that the Action Plan for the Transition to a Circular Economy for 2020–2027 replaced the Circular Economy Strategy and the essence of the Strategy is included in the Action Plan, the Circular Economy Strategy is not analyzed in detail in the Doctoral Thesis. The analysis of the circular economy in Latvia was carried out based on the indicators of the circular economy monitoring framework of the European Commission and Eurostat data. Other sets of circular economy indicators have not been used in the evaluation of the circular economy in Latvia due to the lack of statistical data. The *PESTEL* framework of factors influencing the implementation of the circular economy in Latvia has been developed based on the investigated aspects of the circular economy, scientific publications, studies and the availability of information and data about the situation in Latvia. A higher level of detail in the description of the sub-factors of the *PESTEL* framework of factors influencing the implementation of the circular economy in Latvia is planned to be achieved in future studies. Focus group experts related to the circular economy do not represent the opinion of related organizations or companies but their personal opinion. The validation of the *PESTEL* framework of factors influencing the implementation of the circular economy in Latvia was carried out by evaluating the priority action directions of the Action Plan for the Transition to a Circular Economy for 2020–2027 and priority sectors of the national economy of Latvia in the transition to the circular economy in Latvia. Other development directions, plans or strategies, based on the developed *PESTEL* framework of factors influencing the implementation of the circular economy in Latvia, have not been evaluated. In the assessment of the priority sectors of the national economy of Latvia in the transition to the circular economy, the following sectors of the national economy are included: 1) manufacturing (NACE code: C); 2) water supply; sewerage, waste management and remediation (E); 3) construction (F); 4) transportation and storage (H). Although the principles of the circular economy are also applicable to other economic sectors, they are not included in the assessment of the priority economic sectors of Latvia in the transition to the circular economy and have not been analyzed in detail.

During the development of the Doctoral Thesis, the author was involved in the following projects:

- *Interreg Europe* programme's project "*PROMoting the Governance of Regional Ecosystem ServiceS (PROGRESS)*", 01.08.2019–31.07.2023.

- European Commission *Erasmus+* programme's project "*Design and Construction of Environmental High-Performance Hybrid Engineered Timber Buildings (HybridTim)*", 01.09.2020–31.08.2023.
- European Commission *Erasmus+* programme's project "*Circular Economy in Wooden Construction (Wood in Circle)*", 01.09.2020–30.11.2022. Within the framework of the project, the study module "Circular Economy in Wooden Construction" has been developed, which is integrated into the study process of 5 partner universities. As a result of the project, the register of study courses of Riga Technical University was supplemented with the study course "Circular economy in construction and real estate development", offering students diverse interdisciplinary educational opportunities.
- European Commission *Erasmus+* programme's project "*Sustainable Public Buildings Designed and Constructed in Wood (Pub-Wood)*", 01.09.2018–31.08.2020.

The results of the research were presented at 11 international scientific conferences and symposiums. The results of the Doctoral Thesis have been presented in lectures and seminars for students of Riga Technical University and experts in the real estate sector. The results of the research were approved and confirmed in the focus group.

The research results have been published in 10 scientific articles in scientific journals, conference proceedings and chapters of scientific books (1–10) and in 10 summaries in scientific conference abstract books (11–20).

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19. Plotka, K., **Zvirgzdiņš, J.** Circular Building Materials and Waste Management Strategies as Contributors to Achievement of Sustainable Development Goals. In: *“Scientific Problems of Engineering Economics of Construction and Real Estate Management, Regions and Territories Development ICEREE'2019” organized within 60th International Scientific Conference of Riga Technical University: Book of Abstracts*, Latvia, Riga, 27–28 September 2019. Riga: RTU Press, 2019, p. 34. ISBN 978-9934-22-369-3.
20. **Zvirgzdiņš, J.**, Geipele, S., Plotka, K., Zariņš, G. Sustainable Energy. In: *Scientific Conference on Economics and Entrepreneurship (SCEE'2018) organized within 59th International Scientific Conference of Riga Technical University: Abstracts*, Latvia, Riga, 18–19 October 2018. Riga: RTU Press, 2018, p. 26. ISBN 978-9934-22-141-5. ISSN 2256-0866.

Various research methods and approaches have been used to answer the research questions and achieve the aim of the Doctoral Thesis. The stages of the development logic of the Doctoral Thesis are reflected in Fig. 1.



Fig. 1. The stages of the development logic of the Doctoral Thesis (developed by the author).

The Doctoral Thesis has been developed in several stages in accordance with the developed aim and tasks.

Content of the Doctoral Thesis

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2.1. Identification of the characteristic elements of the circular economy: Qualitative content analysis

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APPENDICES

1. RETROSPECTIVE ANALYSIS OF THE CIRCULAR ECONOMY CONCEPT

The slogan heard among historians – “Who controls the past controls the future” resonates with the part about retrospective analysis of the circular economy concept, which covers a wide spectrum of topics and literature sources from the use of bones, human excrement and other waste to the 2nd encyclical of the Roman Pope Francis “*Laudato Si*”. In this chapter, the author of the doctoral thesis offers a retrospective analysis of the circular economy concept, indicating important paradigms and key turning points in the development of the modern circular economy concept.

The author of the Doctoral Thesis divides the most important studies of the analytical retrospection of the formation of the modern circular economy concept from 1945 to 2020 into three periods.

1. Period of awareness of global environmental problems and circular economy ideology (1945–1987).
2. Conceptualization period of the circular economy (1989–2010).
3. Validity period of the circular economy (2011–...).

The most important concepts and studies regarding the period of awareness of global environmental problems and circular economy ideology are summarized in Fig. 1.1. The most important findings and achievements are: 1) waste can be used as resources (Kumarappa, 1945); 2) awareness of the planetary boundaries and finiteness of resources (Meadows *et al.*, 1972; Illich, 1973; Næss, 1976); 3) emergence of the ideology of reuse and recycling (Boulding, 1966); 4) the algorithm of individuals’ actions in conditions of limited common resources and its negative impact on natural resource stocks (Hardin, 1968); 5) the influence of changes in the world population on the planet’s resource stocks (Ehrlich, 1968); 6) the influence of the speed of the economic processes on the generation of waste (Georgescu-Roegen, 1971); 7) the influence of the linear economy on ecosystems (Commoner, 1971; Bookchin, 1971); 8) development of the concept of design (Papanek, 1972); 9) the need to develop a new lifestyle with new production methods and new consumption models (Schumacher, 1973); 10) emergence of circular economy principles (Gorz, 1975; Felson and Spaeth, 1978; Stahel, 1982); 11) the need to reduce the consumption of industrialized/developed countries (Næss, 1976); 12) governmental decisions, laws and regulatory framework play a vital role in the conservation of natural resources (Daly, 1977); 13) application of ecosystem functioning principles to man-made environment and economy (Mollison and Holmgren, 1978); 14) the influence of society’s high energy consumption lifestyle on the environment (Catton, Jr., 1980); 15) emergence of the concept of sustainable development (Brundtland *et al.*, 1987).

The period of awareness of global environmental problems and circular economy ideology (1945–1987)



Fig. 1.1. The most important concepts and studies regarding the period of awareness of global environmental problems and circular economy ideology (1945–1987)
(developed by the author).

The most important concepts and studies regarding the conceptualization period of the circular economy (1989–2010) are summarized in Fig. 1.2. The most important findings and achievements are: 1) emergence of the concept of circular economy (Pearce and Turner, 1989); 2) application of natural ecosystem principles to industrial processes (Frosch and Gallopoulos, 1989); 3) the emergence of eco-design (design for the environment), which indicates the incorporation of circular economy principles in the product development stage (Ryan *et al.*, 1992); 4) the need to replace a linear flow of resources with a systemic cyclical flow of resources at the international level (Tibbs, 1993; Lyle, 1994; Geiser, 2001); 5) the impact of industry on waste generation and the need to reorganize it towards cleaner production and circular economy principles to reduce environmental impact throughout the product life cycle (Ayres and Simonis, 1994; Baas, 1995; Côté and Cohen-Rosenthal, 1998; Chertow, 2000); 6) the need for reverse logistics to regain the goods or their remains in order to apply circular economy principles to them (Rogers and Tibben-Lembke, 1998); 7) the positive impact of innovations inspired by nature on the implementation of circular economy principles (Benyus, 1998); 8) awareness of natural capital as the basis of the economy (Hawken *et al.*, 1999); 9) conceptualization of the product-service system (Goedkoop *et al.*, 1999); 10) conceptualization of extended producer responsibility (Lindhqvist, 2000); 11) separation of resource flows in biological and technological cycles (McDonough and Braungart, 2002); 12) conceptualization of a sustainable society that seeks to reduce consumption and conserve natural resources (Robèrt, 2002); 13) conceptualization of a closed-loop supply chain (Guide *et al.*, 2003); 14) necessity to move towards the use of renewable resources and biological processes to meet the needs of society (OECD, 2004); 15) conceptualization of the performance economy that seeks to provide prosperity with less resource consumption (Stahel, 2006); 16) localization of production of biological and technical products based on local resources (Hopkins, 2008; Pauli, 2010); 17) formulation of sustainable resource management principles (Unruh, 2008); 18) conceptualization of the sharing economy and the necessity to increase the intensity of use of existing physical assets (Lessig, 2008); 19) criticism of gross domestic product (GDP) as an indicator of social and economic development, from which follows the necessity to stop the economic growth (Latouche, 2009); 20) the necessity to prioritize economic activities with low greenhouse gas emission potential aimed at local community well-being (Jackson, 2009); 21) conceptualization of the cascade model (Pauli, 2010); 22) conceptualization of the economy for the common good (Felber, 2010).

Conceptualization period of the circular economy (1989–2010)

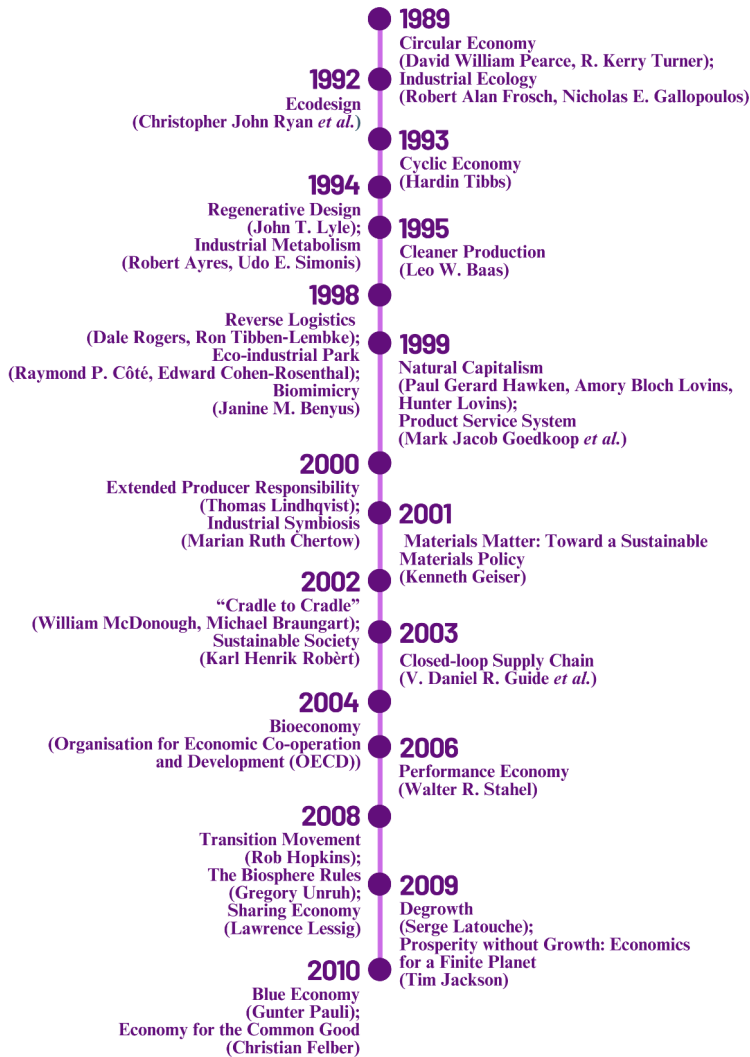


Fig. 1.2. The most important concepts and studies regarding the conceptualization period of the circular economy (1989–2010) (developed by the author).

The most important concepts and studies regarding the validity period of the circular economy (2011–...) are summarized in Fig. 1.3. The most important findings and achievements are: 1) development of the basic principles of material efficiency and increasing awareness

about importance of them (Allwood *et al.*, 2011; Löwy, 2011); 2) conceptualization of ecological civilization and actualization of the importance of “human-human”, “human-nature”, “man-society” symbiotic relationships (Wei *et al.*, 2011); 3) awareness of the value of the environment, actualization of the principles of environmental ethics and collective well-being (Shumba, 2011; Artaraz and Calestani, 2015; Pope Francis, 2015; Kothari *et al.*, 2014); 4) the necessity of thoughtful use of renewable energy resources (Rifkin, 2013); 5) actualization of the influence of psycho-emotional factors on consumption (Scharmer and Kaufer, 2013); 6) the actualization of low-level technologies (Bihouix, 2014); 7) the necessity to ensure succession and continuity of political decisions (Pope Francis, 2015); 8) conceptualization of regenerative capitalism (Fullerton, 2015); 9) conceptualization of transition design (Irwin, 2015); 10) awareness of the development space of sustainable social dimension (Raworth, 2017); 11) the conceptualization of voluntary simplicity and the necessity to reduce the environmental impact of the standard of living of the wealthy part of society (Trainer and Alexander, 2019); 12) human as an integral part of the circular economy system (Schröder *et al.*, 2020); 13) conceptualization of the model of sustainable development system (Zvirgzdins and Vanags, 2020).



Fig. 1.3. The most important concepts and studies regarding the validity period of the circular economy (2011–...) (developed by the author).

Based on the findings of the studies included in the retrospective analysis of the circular economy concept in the period from 1945 to 2020, it is concluded that the understanding of the modern circular economy has been formed by several generations of scientists, and it is time to bring this concept to life in the modern economic system and society. The framework of the retrospective analysis of the circular economy concept is the basis for more detailed research on the circular economy concept.

2. CHARACTERISTIC ELEMENTS OF THE CIRCULAR ECONOMY

2.1. Identification of the characteristic elements of the circular economy: Qualitative content analysis

Retrospective analysis of the circular economy reflects the vastness and multifacetedness of the concept. And yet the question remains open – what are the characteristic elements of the circular economy? The author of the Doctoral Thesis answers this question using qualitative content analysis.

Qualitative content analysis is a widely used qualitative research technique. This scientific approach is used to interpret meaning from the content of text data. In content analysis, coding categories are derived directly from the text data.⁵

The **aim** of the qualitative content analysis is to identify characteristic elements of the circular economy.

The scientific database Scopus was used for the selection of scientific publications for the qualitative content analysis.

Results of the qualitative content analysis (see Fig. 2.1) reflect the categories that correspond to the characteristic elements of the circular economy, arranged in descending order by the frequency of mentions in the sample of qualitative content analysis. Characteristic elements of the circular economy are R-strategies, waste, closed loops, design, business models, systems thinking, life cycle thinking, resource efficiency, consumption, value preservation, sharing, renewable energy, behaviour and industrial symbiosis.

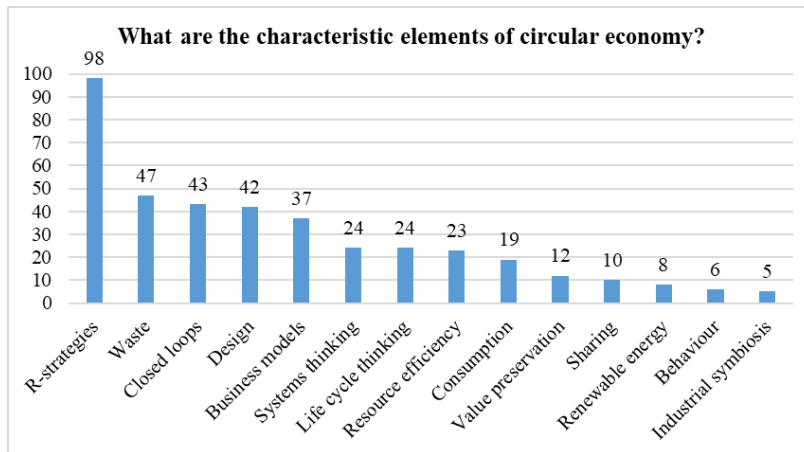


Fig. 2.1. The frequency of mentioning the categories in qualitative content analysis: characteristic elements of the circular economy (developed by the author).

⁵ Hsieh, H. F., Shannon, S. E. (2005). Three Approaches to Qualitative Content Analysis. *Qualitative Health Research*, 15(9), 1277–1288.

Results of the qualitative content analysis are published in the study “*Breaking Down the Concept of Circular Economy: Qualitative Content Analysis*”.⁶

From the results of the qualitative content analysis (see Fig. 2.1), it can be concluded that R-strategies (frequency of mentions – 98) is the central element of the circular economy, followed by the category “Waste” with the second highest frequency of mentions – 47.

Qinghua Zhu, Yong Geng, and Kee-hung Lai⁷ and Lothar Reh⁸ emphasize the different frameworks of the “R” (3R, 4R, 6R, 9R) as “key” operational or strategic directions of the circular economy and point to them as the central element of the circular economy. Although the first approximation is most often dominated by the 3R framework, which includes the principles of “Reduce”, “Reuse”, and “Recycle”, the European Commission proposed to expand the 3R through the *Waste Framework Directive* to the 4R framework, additionally offering the “Recover” principle.⁹ Several studies have proposed to extend the framework to 6R¹⁰ and 9R^{11,12}. According to Jose Potting, Marko Hekkert, Ernst Worell and Aldert Hanemaaijer, the 9R framework includes the following principles: “Refuse”, “Rethink”, “Reduce”, “Reuse”, “Repair”, “Refurbish”, “Remanufacture”, “Repurpose”, “Recycle”, and “Recover”.¹³ In all of the R-frameworks, there is a hierarchical relationship between R-strategies. For example, the “Reduce” strategy is a priority over the “Reuse” strategy, and so on.^{14,15} If within the 3R and 4R frameworks, the first strategy is “Reduce”, which refers to the reduction of resources in the production process of a product, then within the framework of 9R, the first strategy, more precisely, the strategy number 0, is “Refuse”, which indicates that it is not necessary to produce this product at all, allowing the function of this product to be replaced by another product. In the 9R framework, R-strategies of the circular economy, which are higher in the hierarchy, should be prioritized, applying R0–R2 strategies as a priority, R3–R7 strategies secondarily, and only then applying R8–R9 strategies (see Fig. 2.2). For each product or material, depending on which stage of the product or material life cycle it is, the most suitable R-strategy should be applied, so that with the least possible energy, labour and financial

⁶ Zvirgzdins, J., Geipele, S. (2020). Breaking Down the Concept of Circular Economy: Qualitative Content Analysis. In: *17th RSEP International Economics & Social Sciences Conference: Conference Proceedings*, Spain, Madrid, 6 April, 2020. Ankara: BC Publishing House, 24–35.

⁷ Zhu, Q., Geng, Y., Lai, K. (2010). Circular Economy Practices among Chinese Manufacturers Varying in Environmental-oriented Supply Chain Cooperation and the Performance Implications. *Journal of Environmental Management*, 91(6), 1324–1331.

⁸ Reh, L. (2013). Process Engineering in Circular Economy. *Particuology*, 11(2), 119–133.

⁹ European Commission (2023) [online]. *Waste Framework Directive*. environment.ec.europa.eu [accessed 31 July 2023]. Available at: https://environment.ec.europa.eu/topics/waste-and-recycling/waste-framework-directive_en

¹⁰ Sihvonen, S., Ritola, T. (2015). Conceptualizing ReX for Aggregating End-of-life Strategies in Product Development. *Procedia CIRP*, 29, 639–644.

¹¹ Van Buren, N., Demmers, M., Van der Heijden, R., Witlox, F. (2016). Towards a Circular Economy: The Role of Dutch Logistics Industries and Governments. *Sustainability*, 8(7), 647.

¹² Potting, J., Hekkert, M. P., Worrell, E., Hanemaaijer, A. (2017). Circular Economy: Measuring Innovation in the Product Chain. *Planbureau voor de Leefomgeving*, 2544.

¹³ *Ibid.*

¹⁴ Sihvonen, S., Ritola, T. (2015). Conceptualizing ReX for Aggregating End-of-life Strategies in Product Development. *Procedia CIRP*, 29, 639–644.

¹⁵ Potting, J., Hekkert, M. P., Worrell, E., Hanemaaijer, A. (2017). Circular Economy: Measuring Innovation in the Product Chain. *Planbureau voor de Leefomgeving*, 2544.

investments the material or product can continue to serve and ensure the fulfilment of the technical parameters, which is in accordance with the Stahel's inertia principle.

		Strategies	Explanation
Transition to circular economy ↑ Linear economy	Smarter product use and manufacture	R0 Refuse	Make product redundant by abandoning its function or by offering the same function with a radically different product
		R1 Rethink	Make product use more intensive (for example through sharing products, or by putting multi-functional products on the market)
		R2 Reduce	Increase efficiency in product manufacture or use by consuming fewer natural resources and materials
	Extend lifespan of product and its parts	R3 Reuse	Reuse by another consumer of discarded product which is still in good condition and fulfills its original function
		R4 Repair	Repair and maintenance of defective product so it can be used with its original function
		R5 Refurbish	Restore an old product and bring it up to date
		R6 Remanufacture	Use parts of discarded product in a new product with the same function
		R7 Repurpose	Use discarded product or its parts in a new product with a different function
	Useful application of materials	R8 Recycle	Process materials to obtain the same or lower quality
R9 Recover		Incineration of materials with energy recovery	

Fig. 2.2. 9R framework of circular economy strategies in the transition from a linear economy to a circular economy (developed by the author based on¹⁶)

Inga Uvarova *et al.* developed the 60R framework, which includes 60 R-strategies that are divided into 4 R-strategy groups: 1) “Reduce”; 2) “Reuse”; 3) “Recycle”; 4) “Reverse logistics”. It should be concluded that the 60R framework reflects in more detail the R-strategies that refer to the 3R framework and includes such reverse logistics strategies as “Return”, “Recollect”, “Recompensate with deposit”, “Retrograde”, “Resell” and “Resale”.¹⁷ It can be concluded that the frameworks of different R-strategies include the 3R framework and other elements of the circular economy.

Table 2.1 reflects the most important conceptual differences between linear economy and circular economy.

¹⁶ Potting, J., Hekkert, M. P., Worrell, E., Hanemaaijer, A. (2017). Circular Economy: Measuring Innovation in the Product Chain. *Planbureau voor de Leefomgeving*, 2544.

¹⁷ Uvarova, I., Atstaja, D., Volkova, T., Grasis, J., Ozolina-Ozola, I. (2023). The Typology of 60R Circular Economy Principles and Strategic Orientation of Their Application in Business. *Journal of Cleaner Production*, 409, 137189.

Table 2.1

The main conceptual differences between linear economy and circular economy (developed by the author based on ¹⁸ and the results of the Doctoral Thesis)

Aspect	Linear economy	Circular economy
Approach	“take-make-use-dispose”	Refuse, Rethink, Reduce, Reuse, Repair, Refurbish, Remanufacture, Repurpose, Recycle, Recover (R0–R9)
Product design	Focus on the customer needs and use, attractive packaging, “programmed” depreciation	Circularity in product design (easily replaceable parts, repairability, etc.)
Materials	Reliance on suppliers based on price and quality. Focus on natural resources as raw materials	Focus on recyclable materials or waste from other companies
Aim of the business model	To maximize profit	To maximize the life cycle of a product or material
Orientation of business models	Product-centric approach	Service-oriented approach
Consumption	Passive consumption and disposal	Thoughtful consumption, waste separation, promotion of recycling and extension of product life cycle
Logistics	From the factory to the consumer	Full product/material life cycle – from raw material extraction to consumer – from consumer to sorting point and secondary market (reverse logistics)
Energy	Competitive prices of energy resources, non-renewable energy sources	Transition to renewable energy sources
Communication	Brand development and promotion of recognition	Explanation of the need for a circular economy. Promotion of multiple use, recycling and sharing of products

It can be concluded that the transition to a circular economy simultaneously means a gradual abandonment of linear economy practices, where the focus is on attractive packaging, “programmed” depreciation in product design, natural resources as raw materials, profit maximization, non-renewable energy sources and promotion of brand recognition. Instead, the focus needs to be on the introduction and application of R-strategies to companies and sectors of the economy, circularity in product design, use of recyclable materials or waste from other companies, maximization of the product or material life cycle, service orientation, considering the full product or material life cycle, transition to renewable energy sources, explanation of the need for a circular economy and promotion of multiple use, recycling and sharing of products.

The transition to the circular economy is gradual (see Fig. 2.3), and its implementation can be influenced by various factors.

¹⁸ Auriault, C., Aze, F., Morgan, J., Sopelana Gato, A., Fifer Bizjak, K., Mauko, A., Mladenovic, A., Feirra, V., Canas Rojas, A., Costa Branco, P. M., de Oliveira Rodrigues, P., Cepria Pamplona, J. J. (2017) [online]. *Comprehensive analysis of the existing and emerging approaches of circular economy models in pulp and paper industry*, paperChain [accessed 14 November 2023]. Available at: <https://ec.europa.eu/research/participants/documents/downloadPublic?documentIds=080166e5b510caf8&appId=PPGMS>

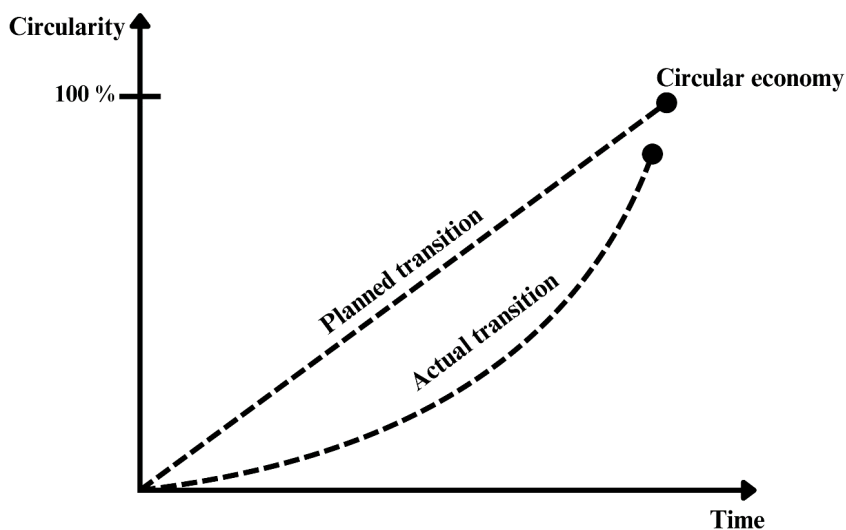


Fig. 2.3. Schematic representation of the transition to a circular economy (developed by the author).

Society will not experience a 100 % or complete circular economy because 100 % recycling of waste is not possible.^{19, 20} The concept of the circular economy in the context of its implementation should be viewed as a “lighthouse” to which the development course must be steered, achieving the greatest possible success in indicators related to the implementation of the circular economy.

2.2. Bibliometric analysis of the circular economy: Validation of elements, relation with the concepts of sustainability and sustainable development, the European Union and priority economic sectors in the transition to the circular economy

In order to get a more detailed view of the terms and concepts related to the circular economy, the author of the Doctoral Thesis conducted a bibliometric analysis.

In bibliometric studies, a lot of attention is devoted to the analysis of networks of documents, keywords, authors or journals. Mapping and clustering methods are often used to study such networks, which aim to provide insight into the structure of the network and to reflect the main themes or research sub-fields of a given scientific field, as well as to reveal the mutual relation between the topics or fields.²¹

¹⁹ Craig, P. P. (2001). Energy Limits on Recycling. *Ecological Economics*, 36(3), 373–384.

²⁰ Georgescu-Roegen, N. (1971). *The Entropy Law and the Economic Process*. Harvard University Press, Boston MA.

²¹ Waltman, L., Van Eck, N. J., Noyons, E. C. (2010). A Unified Approach to Mapping and Clustering of Bibliometric Networks. *Journal of Informetrics*, 4(4), 629–635.

VOSviewer is a free software tool for creating and visualizing bibliometric networks. Networks can include scientific journals, researchers, or individual publications and can be built based on keywords, citations, bibliographic groups, or co-authorship and author collaboration relationships. *VOSviewer* allows to create and visualize co-occurrence networks of important terms extracted from databases of scientific literature.^{22, 23}

The bibliometric analysis was carried out in 7 stages with the following sub-goals:

- 1) to validate the circular economy elements identified in the qualitative content analysis (Stage 1);
- 2) to analyze the relation of the circular economy with the concepts of sustainability and sustainable development (Stage 2);
- 3) to analyze the relation of the circular economy with keywords related to the European Union (Stage 3);
- 4) to analyze the relation of circular economy with such sectors as manufacturing (Stage 4), water supply; sewerage, waste management and remediation (Stage 5), construction (Stage 6), and transportation and storage (Stage 7).

The scientific database Scopus is used as the basis for the bibliometric analysis.

In order to validate the elements of the circular economy identified in the qualitative content analysis, the author of the Doctoral Thesis performed a bibliometric analysis using the *VOSviewer* bibliometric analysis tool. Using the keywords “circular economy” and the “Social sciences” thematic field (analogous to the literature source selection process of qualitative content analysis), the author of the Doctoral Thesis performed the selection of scientific publications in the scientific database Scopus according to the following search algorithm: ***TITLE-ABS-KEY (“circular economy”) AND PUBYEAR > 2003 AND PUBYEAR < 2024 AND (LIMIT-TO (SUBJAREA, “SOCP”))***. The sample includes studies from 2004 to 2023. As a result, 4888 scientific publications were selected, which were included in Stage 1 of bibliometric analysis.

Figure 2.4 illustrates the bibliometric map of the keywords of Stage 1 of the bibliometric analysis with keywords whose frequency of mentions in the sample is at least 50. The results reflect five keyword groups (clusters), which include keywords that have the greatest relationship with each other. Despite the fact that the clusters are not homogeneous, it can be concluded that they have a unifying thematic direction – environmental dimension (green), economic dimension (blue), waste management (yellow), strategic management (red), and sustainable development goals (purple).

²² Van Eck, N. J., Waltman, L. (2011). Text Mining and Visualization Using VOSviewer. *Cornell University Digital Libraries*. 1–5.

²³ *VOSviewer* (2023) [online]. [vosviewer.com](https://www.vosviewer.com) [accessed 2 December 2023]. Available at: <https://www.vosviewer.com/>

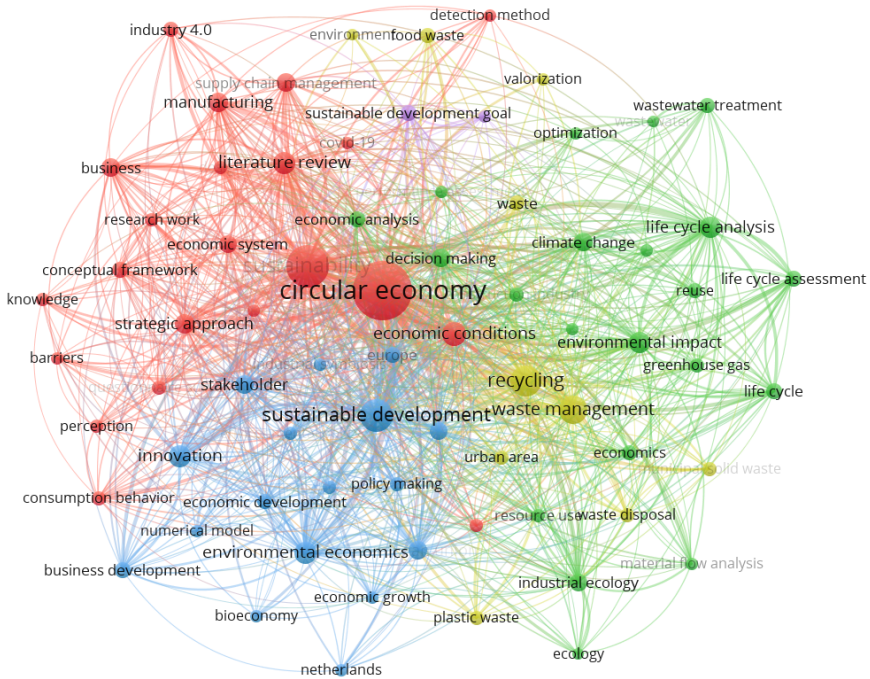


Fig. 2.4. The bibliometric map of the keywords of Stage 1 of bibliometric analysis with keywords whose frequency of mentions in the sample is at least 50 (developed by the author with *VOSviewer*, based on data from the Scopus database).

Table 2.2 reflects characteristic elements of the circular economy identified in the qualitative content analysis and related keywords identified in Stage 1 of the bibliometric analysis and their frequency of mentions. The table includes the keywords identified in bibliometric analysis whose frequency of mentions in the sample of 4888 scientific publications is at least 10, as well as the total frequency of mentions of keywords related to the relevant element of the circular economy. It can be concluded that all the characteristic elements of the circular economy identified in the qualitative content analysis are reflected as keywords in Stage 1 of the bibliometric analysis, which validates the correctness of the elements of the circulation economy identified in the qualitative content analysis.

Table 2.2

Characteristic elements of the circular economy identified in the qualitative content analysis and related keywords identified in Stage 1 of the bibliometric analysis and their frequency of mentions (developed by the author)

The characteristic element of the circular economy identified in the qualitative content analysis	Related keywords identified in Stage 1 of the bibliometric analysis and their frequency of mentions
R-strategies	"recycling" (516), "reuse" (82), "remanufacturing" (41), "recovery" (41), "repair" (26) – 706 (total frequency of mentions)
Waste	"waste management" (408), "waste" (93), "food waste" (84), "waste disposal" (73), "plastic waste" (73), "municipal solid waste" (71), "wastewater" (50), "electronic waste" (49), "solid waste" (45), "waste technology" (36), "packaging waste" (26) – 1008
Closed loops	"supply chain management" (144), "supply chain" (77), "material flow analysis" (54), "reverse logistics" (30), "circular supply chain" (19), "closed-loop supply chain" (14) – 338
Design	"design" (68), "product design" (40), "ecodesign" (32), "circular design" (26), "sustainable design" (16) – 182
Business models	"business models" (47), "circular business models" (36), "business model" (33), "circular business model" (33), "sustainable business models" (10) – 159
Systems thinking	"economic system" (127), "systems thinking" (16), "production system" (16) – 159
Life cycle thinking	"life cycle analysis" (212), "life cycle assessment" (107), "life cycle" (106), "life cycle costing" (10) – 435
Resource efficiency	"optimization" (58), "energy efficiency" (53), "resource efficiency" (48), "efficiency" (27), "material efficiency" (13) – 199
Consumption	"consumption behavior" (78), "sustainable consumption" (33), "consumer behavior" (24), "food consumption" (12), "consumer behaviour" (11), "consumption" (10) – 168
Value preservation	"value creation" (14) – 14
Sharing	"sharing economy" (24) – 24
Renewable energy	"alternative energy" (53), "renewable energy" (33), "bioenergy" (20), "renewable energy sources" (10) – 116
Behaviour	"consumption behavior" (78), "consumer behavior" (24), "consumer behaviour" (11) – 113
Industrial symbiosis	"industrial ecology" (136), "industrial symbiosis" (51) – 187

The characteristic elements of the circular economy identified by the qualitative content analysis and validated by the bibliometric analysis were approved in the expert interviews of ten experts related to the circular economy.

It should be noted that in Stage 1 of the bibliometric analysis, other keywords related to the circular economy were also identified. "Sustainability" and "sustainable development" were mentioned in the sample of scientific publications 1118 and 602 times, respectively; together with the keyword "circular economy" – 794 and 430 times, respectively, indicating the strong relation of the circular economy with sustainability and sustainable development. The keyword "innovation", which is located in the cluster of economic dimension, was mentioned in the sample 235 times, together with "circular economy" – 164 times. Keywords "policy making" and "policy implementation" were mentioned 77 and 52 times, respectively, together with "circular economy" – 60 and 38 times, respectively, which indicates the connection of the political dimension with the circular economy. In addition, both keywords "policy making" and

“policy implementation” are related to the keyword “European Union”, which was mentioned in the sample 149 times, 104 of which – together with the keyword “circular economy”.

In recent years, the interest of the scientific community in the circular economy has increased. With the application of bibliometric analysis, the elements of the circular economy identified in the qualitative content analysis were validated (Stage 1), the relation of the circular economy with the concepts of sustainability and sustainable development was analyzed (Stage 2), the relation of the circular economy with keywords related to the European Union was analyzed (Stage 3), and the relation of circular economy with such sectors as manufacturing (Stage 4), water supply; sewerage, waste management and remediation (Stage 5), construction (Stage 6), and transportation and storage (Stage 7) was analyzed.

2.3. Analysis of circular economy definitions

The concept of the circular economy has become more trending among scholars, practitioners and decision-makers. However, critics often point out that the concept of circular economy means different things to different stakeholders, and there is no common understanding of what the concept entails. The conceptual uncertainty of the circular economy is one of the biggest obstacles to its implementation.

A number of authors have pointed out in their research that the circular economy creates conceptual uncertainties.^{24, 25, 26, 27} Therefore, it is essential for each study to provide a definition of the circular economy, thus showing what the author means by it. It helps to understand the context and points of emphasis of the study. The definition is a short formulation of the content and the essential features of the concept or the subject.²⁸ In order to promote a common understanding of the circular economy concept among the stakeholders, which could contribute to the implementation of the circular economy at the national level, the author of the Doctoral Thesis conducts research and analysis of the definitions of the circular economy. As a result, the author of the Doctoral Thesis develops and offers his own definition of the circular economy.

Julian Kirchherr *et al.* analyzed 114 definitions of circular economy in their study. They indicated that 79 % of the definitions included recycling, 75 % – reusing, and 55 % – reducing. The definition of the circular economy proposed in the study is: “A circular economy describes an economic system that is based on business models which replace the ‘end-of-life’ concept with reducing, alternatively reusing, recycling and recovering materials in production/distribution and consumption processes, thus operating at the micro level

²⁴ Lieder, M., Rashid, A. (2016). Towards Circular Economy Implementation: A Comprehensive Review in Context of Manufacturing Industry. *Journal of Cleaner Production*, 115, 36–51.

²⁵ Blomsma, F., Brennan, G. (2017). The Emergence of Circular Economy: A New Framing Around Prolonging Resource Productivity. *Journal of Industrial Ecology*, 21(3), 603–614.

²⁶ Murray, A., Skene, K., Haynes, K. (2017). The Circular Economy: An Interdisciplinary Exploration of the Concept and Application in a Global Context. *Journal of Business Ethics*, 140, 369–380.

²⁷ Geissdoerfer, M., Savaget, P., Bocken, N. M., Hultink, E. J. (2017). The Circular Economy – A New Sustainability Paradigm? *Journal of Cleaner Production*, 143, 757–768.

²⁸ Definīcija (2024) [tiešsaiste]. Tezaurs.lv [skatīts 2023. gada 5. decembrī].

Available at: <https://tezaurs.lv/defin%C4%ABcija>

(products, companies, consumers), meso level (eco-industrial parks) and macro level (city, region, nation and beyond), with the aim to accomplish sustainable development, which implies creating environmental quality, economic prosperity and social equity to the benefit of current and future generations.”²⁹ It can be concluded that the proposed definition includes such elements of the circular economy as business models, life cycle thinking, R-strategies, systems thinking in different levels of governance and industrial symbiosis, which is one of the facets of eco-industrial parks. The definition includes the progress towards success in the main dimensions of sustainable development – environmental, economic and social – and also indicates the connection with future generations, which is essentially the main common goal of the circular economy and sustainable development – to develop and meet the needs of the present without compromising the ability of future generations to meet their own needs.

The author of the Doctoral Thesis, based on the definition of the circular economy by Julian Kirchherr *et al.*, offers specified definition of the circular economy, which has been discussed, corrected and approved in a focus group of ten experts related to the circular economy, in the following outline: “*A circular economy is a purposefully directed economic system that is based on transition to renewable energy sources and business models which replace the ‘end-of-life’ concept with refusing, rethinking, reducing, reusing, repairing, refurbishing, remanufacturing, repurposing, recycling and recovering in production, distribution, consumption and reverse logistics processes, thus operating at the micro level (products, companies, consumers), meso level (eco-industrial parks) and macro level (city, region, nation and beyond), with the aim to accomplish sustainable development, which implies preserving and improving environmental quality, ensuring economic viability and creating social equity, to the benefit of current and future generations.*”

²⁹ Kirchherr, J., Reike, D., Hekkert, M. (2017). Conceptualizing the Circular Economy: An Analysis of 114 Definitions. *Resources, Conservation and Recycling*, 127, 221–232.

3. IMPLEMENTATION OF CIRCULAR ECONOMY IN LATVIA – ANALYTICAL ASSESSMENT

3.1. Analysis of the political framework for the implementation of the circular economy in Latvia

Although the roots of the shift towards the implementation of the circular economy in Latvia can be traced back several decades, a major turning point at the political level was in 2019, when the European Commission announced the shift towards the European Green Deal.³⁰ This determined that the promotion of Latvia's growth and decoupling from the use of natural resources requires the transition to a circular economy in various sectors of the national economy.

In March 2020, the European Commission's announcement to the European Parliament, the Council, the European Economic and Social Committee and the Committee of the Regions "A New Circular Economy Action Plan. For a cleaner and more competitive Europe"³¹ was published. The new action plan indicated that the introduction of a circular economy in the member states will be one of the most important factors that will help to decouple economic growth from the consumption of natural resources by 2050 and will contribute to achieving climate neutrality.

The EU-level regulatory framework related to the transition to a circular economy, which refers to circular products, includes Ecodesign Directive,³² Ecolabel Regulation,³³ and Green Public Procurement Criteria.³⁴ However, their impact on the implementation of the circular economy is smaller, as compliance with the relevant regulations is voluntary, which does not impose an obligation to purposefully move towards a circular economy. It can be concluded that there is a lack of a comprehensive set of requirements that ensure the sustainability and

³⁰ European Commission (2019) [online]. *Communication from the Commission to the European Parliament, the Council, the European Economic and Social Committee and the Committee of the Regions "The European Green Deal"*. eur-lex.europa.eu [accessed 20 October 2023]. Available at: <https://eur-lex.europa.eu/legal-content/EN/TXT/?uri=COM%3A2019%3A640%3AFIN>

³¹ European Commission (2020) [online]. *Communication from the Commission to the European Parliament, the Council, the European Economic and Social Committee and the Committee of the Regions. "A new Circular Economy Action Plan For a cleaner and more competitive Europe"*. eur-lex.europa.eu [accessed 16 October 2023]. Available at: <https://eur-lex.europa.eu/legal-content/EN/TXT/?qid=1583933814386&uri=COM:2020:98:FIN>

³² Directive 2009/125/EC of the European Parliament and of the Council of 21 October 2009 establishing a framework for the setting of ecodesign requirements for energy-related products (2009) [online]. eur-lex.europa.eu [accessed 20 October 2023]. Available at: <https://eur-lex.europa.eu/legal-content/EN/ALL/?uri=celex%3A32009L0125>

³³ Regulation (EC) No 66/2010 of the European Parliament and of the Council of 25 November 2009 on the EU Ecolabel (2009) [online]. eur-lex.europa.eu [accessed 22 October 2023]. Available at: <https://eur-lex.europa.eu/legal-content/EN/ALL/?uri=celex%3A32010R0066>

³⁴ European Commission (2023) [online]. *Green Public Procurement Criteria and Requirements*. green-business.ec.europa.eu [accessed 20 October 2023]. Available at: https://green-business.ec.europa.eu/green-public-procurement/gpp-criteria-and-requirements_en

circularity of products produced in the EU and delivered to the EU market. Therefore, the New Circular Economy Action Plan includes progress in the following aspects at the product level:

- improving product durability, reusability, upgradability and repairability;
- increasing product energy and resource efficiency;
- increasing recycled content in products while ensuring their performance and safety;
- enabling remanufacturing and high-quality recycling;
- reducing the carbon footprint of a product;
- restricting single-use and preventing premature obsolescence;
- introducing a ban on the destruction of unsold durable goods;
- incentivizing “product as a service” or other models where producers keep the ownership of the product or the responsibility for its performance throughout its lifecycle;
- mobilizing the potential of digitalization in the transition to a circular economy;
- rewarding products based on their sustainability performance.³⁵

According to the New Circular Economy Action Plan, these aspects will be applied to the following product groups: electronics, information and communication technologies (ICT), textiles, furniture and intermediate products that have a large impact on the environment. This does not mean that these aspects cannot be applied and implemented for other product groups.

The European Commission’s transition towards the New Circular Economy Action Plan is an impetus for EU member states to develop national-level strategies and action plans. By order No. 489 (2020), “Action Plan for the Transition to a Circular Economy for 2020–2027” (Action Plan), which is a national-level medium-term policy planning document prepared by the Ministry of Environmental Protection and Regional Development (MEPRD) of Latvia, was approved. The aim of the Action Plan is to provide a policy framework for ensuring an operating environment that would promote the country’s transition to a circular economy while contributing to the implementation of the European Green Deal and the achievement of the Sustainable Development Goals ³⁶ of the United Nations.

As a result of the implementation of the Action Plan, the following performance indicators are expected to be achieved by 2027: 1) increase in resource productivity (from 0.90 EUR/kg to 1.55 EUR/kg); 2) increase in material circularity (from 6.6 % to 11.0 %); 3) increase in public awareness and participation in the implementation of the circular economy.

The action plan, which is in line with the EU priorities and approved policies, defines the action directions for the implementation of the circular economy:

³⁵ European Commission (2020) [online]. *Communication from the Commission to the European Parliament, the Council, the European Economic and Social Committee and the Committee of the Regions. “A new Circular Economy Action Plan For a cleaner and more competitive Europe”*. eur-lex.europa.eu [accessed 16 October 2023]. Available at: <https://eur-lex.europa.eu/legal-content/EN/TXT/?qid=1583933814386&uri=COM:2020:98:FIN>

³⁶ Apvienoto Nāciju Organizācijas Ģenerālā asambleja (2015) [tiešsaiste]. Apvienoto Nāciju Organizācijas samita noslēguma dokumenta projekts attīstības programmas pieņemšanai laikposmam pēc 2015. gada, pkc.gov.lv [skatīts 2023. gada 4. oktobrī]. Available at: https://www.pkc.gov.lv/sites/default/files/inline-files/Dienaskartiba%202030_0.pdf

- 1) Transition from waste management to resource management;
- 2) Improvement of resource productivity in all sectors of the economy by promoting the development of research and innovation;
- 3) Creation of preconditions for the secondary use of goods;
- 4) Promotion of transition from buying goods to services;
- 5) Improvement of management of materials, processes and waste in priority sectors;
- 6) Strengthening the role of municipalities in the implementation of circular economy principles;
- 7) Involvement of society, informing and educating.³⁷

The further planning of the action directions and the successful implementation of the activities require the active involvement of ministries of all sectors, municipalities, the private sector, non-governmental organizations and society.

The political framework of Latvia in the transition to the circular economy is reflected in Fig. 3.1.

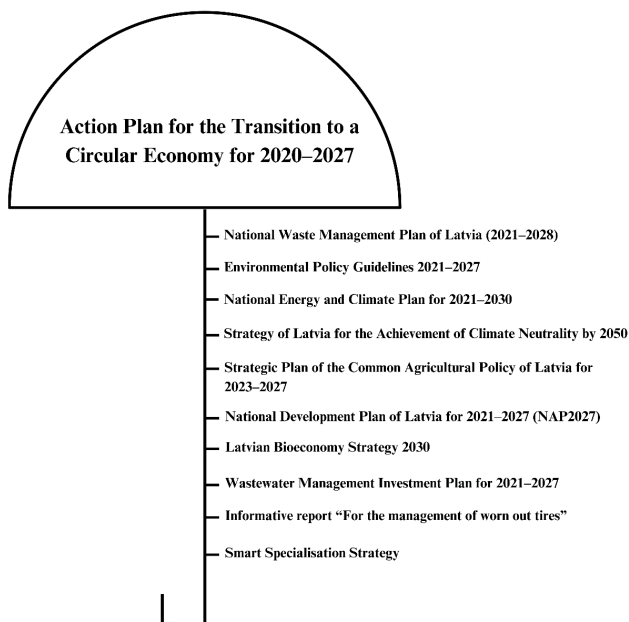


Fig. 3.1. The political framework of Latvia in the transition to the circular economy (developed by the author).

In the continuation of the summary of the Doctoral Thesis, the analysis of Latvia using the European Commission’s circular economy monitoring framework is reflected.

³⁷ Vides aizsardzības un reģionālās attīstības ministrija (2020) [tiešsaiste]. *Rīcības plāns pārejai uz aprites ekonomiku 2020.-2027. gadam*. varam.gov.lv [skatīts 2023. gada 25. oktobrī]. Available at: <https://www.varam.gov.lv/lv/ricibas-plans-parejai-uz-aprites-ekonomiku-2020-2027gadam>

3.2. Analysis of the European Commission’s circular economy monitoring framework: The case of Latvia

In order to understand the aspects related to the circular economy in Latvia, the author of the Doctoral Thesis conducted a macro-level analytical assessment of the circular economy in Latvia, using the circular economy monitoring framework of the European Commission and *Eurostat* data.

The circular economy monitoring framework of the European Commission (Monitoring Framework) includes five sections: 1) Production and consumption; 2) Waste management; 3) Secondary raw materials; 4) Competitiveness and innovation; 5) Global sustainability and resilience.

Table 3.1 summarizes the trends of indicators of the circular economy monitoring framework of the European Commission in Latvia. The increasing trends of the indicators are marked with “+”; decreasing trends of indicators are marked with “-”; the neutral trends of the indicators, which do not show increasing or decreasing trends in the analyzed time period, are marked with “+/-”. Indicator trends that negatively influence the transition to a circular economy are marked in red; trends marked in green have a positive influence on the transition to a circular economy; trends with a neutral character in relation to the transition to a circular economy are marked in yellow. It can be concluded that the indicator trends of the “Production and consumption” section of the circular economy monitoring framework of the European Commission in Latvia, which are characterized by an increase in material consumption and an increase in the volume of various types of waste, negatively influence the transition to a circular economy in Latvia. The only indicator trend of the “Production and consumption” section that has a positive influence on the transition to a circular economy is the indicator “Amount of food waste per 1 inhabitant”, which is characterized by a decrease in the indicator from 145 kg/inhabitant in 2020 to 130 kg/inhabitant in 2021, but it cannot be considered a strong trend. The trends of the indicators of the “Waste management” section of the Monitoring Framework in Latvia, which are characterized by an increase in the proportion of various types of waste recycling, have a positive influence on the transition to a circular economy. Although there is not an increasing trend in the recycling rate of separately collected electrical and electronic equipment waste, the stable position of the indicator within the range of 80–90 % is positively influencing the transition to a circular economy. The trends of the indicators of the Monitoring Framework section “Secondary raw materials” in Latvia, which are characterized by the stagnation of the circular material use rate in the range of 4.3–6.5 % from 2014 to 2021 and the increase in the volume of trade of recyclable raw materials, as well as the monitoring framework section “Competitiveness and innovation” indicators, neutrally influence the transition to a circular economy. Stable indicator scores of greenhouse gas emissions from production activities and material import dependency of the Monitoring Framework section “Global sustainability and resilience”, have a neutral influence on the transition to a circular economy in Latvia. However, the decreasing trend of the consumption footprint of Latvia from 2019 to 2021 has a positive influence on the transition to a circular economy.

Table 3.1

Indicator trends of the circular economy monitoring framework of the European Commission in Latvia (developed by the author)

Section	Indicator of the circular economy monitoring framework of the European Commission	Trend
Production and consumption	Material footprint	+
	Resource productivity	+/-
	Total waste generation per capita	+
	Generation of waste (excluding major mineral wastes) per GDP unit	+
	Generation of municipal waste per capita	+
	Generation of food waste per capita	=
	Generation of packaging waste per capita	+
Waste management	Generation of plastic packaging waste per capita	+
	Recycling rate of municipal waste	+
	Recycling rate of all waste (excluding major mineral waste)	+
	Recycling rate of overall packaging waste	+
	Recycling rate of plastic packaging waste	+
Secondary raw materials	Recycling rate of waste of electrical and electronic equipment (WEEE) separately collected	+/-
	Circular material use rate	+/-
	Imports of secondary raw materials from non-EU countries	+
	Exports of secondary raw materials to non-EU countries	+
Competitiveness and innovation	Imports of secondary raw materials from EU countries	+
	Proportion of private investment in circular economy sectors	+/-
	Persons employed in circular economy sectors	+/-
	Gross added value related to circular economy sectors	+/-
Global sustainability and resilience	Patents related to waste management and recycling	+/-
	Consumption footprint	=
	Greenhouse gas emissions from production activities	+/-
	Material import dependency	+/-

According to the Action Plan for the Transition to a Circular Economy for 2020–2027, it is planned to reach a resource productivity level of 1.55 EUR/kg and a circular material use rate of 11.0 % by 2027. According to the analysis of the trends of the indicators of the circular economy monitoring framework of the European Commission in Latvia, it can be concluded that both of these indicators have not shown increasing trends over the analyzed period. Therefore, it is necessary to introduce additional tools and activities to promote the increase of these indicators.

The macro-level analytical assessment of the circular economy in Latvia provides an insight into the position of Latvia among the Baltic states and selected EU member states and the trends of indicators of the circular economy monitoring framework of the European Commission. It cannot be considered a complete and comprehensive assessment regarding the implementation of the circular economy in Latvia because the circular economy monitoring framework of the European Commission does not include such elements of the circular economy as design, business models, sharing, renewable energy and industrial symbiosis. However, the availability of *Eurostat* data allows to carry out the analysis of the indicators of the circular economy monitoring framework of the European Commission in relation to the circular economy in Latvia, which is an advantage compared to other sets of circular economy indicators, the use of which for evaluating the circular economy in Latvia is limited by the inconsistency of the indicator sets with the macro level and the problem of data availability.

4. DEVELOPMENT AND VALIDATION OF THE FRAMEWORK OF FACTORS INFLUENCING THE IMPLEMENTATION OF THE CIRCULAR ECONOMY IN LATVIA

4.1. Factors influencing the implementation of the circular economy in Latvia: Development and analysis of the *PESTEL* framework

In order to promote the implementation of the circular economy in Latvia, it is necessary to identify the factors influencing the implementation of the circular economy. Therefore, the author of the Doctoral Thesis, using the *PESTEL* methodological framework, performs the identification of the factors influencing the implementation of the circular economy in Latvia. The identified factors are arranged in a system that corresponds to the *PESTEL* methodological framework and derives from the general systems theory, the founder of which is Ludwig von Bertalanffy. Bertalanffy pointed out that among the directions of systems theory development in cybernetics, information theory, game theory analysis, decision theory and topology, factor analysis is also included, that is, the isolation of factors using mathematical analysis in multi-factor phenomena in psychology and other fields.³⁸

The *PESTEL* methodology is based on the distribution and identification of sub-factors of 6 factor groups – political factors, economic factors, social factors, technological factors, environmental factors and legal factors. The *PESTEL* model is a situational analysis tool and is traditionally used for the evaluation of entrepreneurship. It is one of the most frequently used models for evaluating the dynamic external environment of entrepreneurship.³⁹ Although the *PESTEL* approach is usually used in strategic decision-making at the company level, the author of the Doctoral Thesis sees it as a suitable method for evaluating the influence of factor groups of the external environment on the implementation of the circular economy in Latvia.

Based on the *PESTEL* analysis method, the author of the Doctoral Thesis has developed sub-factors according to factor groups (factors) – political, economic, social, technological, environmental and legal factors. The terms “factors” or “factor groups” need to be understood as political, economic, social, technological, environmental and legal factors. On the other hand, the term “sub-factor” means sub-factors of factor groups (factors): P1, P2, P3, P4, P5, E1, E2, E3, E4, E5, E6, S1, S2, S3, S4, S5, T1, T2, T3, T4, T5, V1, V2, V3, V4, V5, Ti1, Ti2.

Table 4.1 reflects the framework of factors influencing the implementation of the circular economy in Latvia developed by the author of the Doctoral Thesis, which consists of 6 factors or factor groups and 28 sub-factors. The framework of factors influencing the implementation of the circular economy in Latvia has been discussed and approved in a focus group of ten experts related to the circular economy.

³⁸ von Bertalanffy, L. (1968). *General System Theory: Foundations, Development, Applications*. George Braziller: New York. 289 p.

³⁹ Perera, R. (2017). *The PESTLE Analysis*. Nerdynaut. 26 p.

Table 4.1

The framework of factors influencing the implementation of the circular economy in Latvia
(developed by the author)

Political factors	Economic factors
<p>P1 – The direction of the policy of the European Union towards the circular economy</p> <p>P2 – The direction of the Latvian government’s policy towards the circular economy</p> <p>P3 – The direction of municipal policies towards the circular economy</p> <p>P4 – Political leadership and decision-making speed in the implementation of the circular economy</p> <p>P5 – Participation of social partners and non-governmental organizations in the implementation of the circular economy in Latvia</p>	<p>E1 – Economic benefits from the implementation of the circular economy concept</p> <p>E2 – The need for structural changes in business models to move from linear economy to circular economy</p> <p>E3 – Financial support for initiatives related to the circular economy</p> <p>E4 – Economic viability of R-strategies and business models of circular economy</p> <p>E5 – The trust and willingness of companies to cooperate and share information in the conditions of the transition to the circular economy</p> <p>E6 – The readiness of Latvian economic sectors for the implementation of a circular economy</p>
Social factors	Technological factors
<p>S1 – Changes in the world population</p> <p>S2 – Mentality and habits of consumers</p> <p>S3 – The level of environmental awareness of society</p> <p>S4 – Culture and traditions</p> <p>S5 – The readiness of society to accept circular economy principles</p>	<p>T1 – Technological development and digitalization</p> <p>T2 – Product design</p> <p>T3 – Technological intelligence</p> <p>T4 – Infrastructure</p> <p>T5 – Research and innovation</p>
Environmental factors	Legal factors
<p>V1 – The movement towards the inclusion of environmental costs in the product price</p> <p>V2 – Solving the problem of resource scarcity</p> <p>V3 – Climate change mitigation</p> <p>V4 – Conservation of biodiversity</p> <p>V5 – Use of renewable resources</p>	<p>Ti1 – The regulatory framework of the European Union regarding the implementation of the circular economy in the member states</p> <p>Ti2 – The regulatory framework of the Republic of Latvia regarding the implementation of the circular economy in Latvia</p>

Evaluating the factors influencing the implementation of the circular economy in Latvia by *PESTEL* factor groups, it can be concluded that the factors are interconnected and interact with each other (see Fig. 4.1).

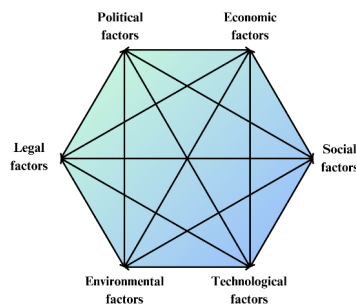


Fig. 4.1. Interdependence of the factors influencing the implementation of the circular economy in Latvia (developed by the author).

The mutual interaction among the factor groups influencing the implementation of the circular economy in Latvia, which has been discussed and approved in a focus group of ten experts related to the circular economy, is reflected in Table 4.2.

Table 4.2

The mutual interaction among the factor groups influencing the implementation of the circular economy in Latvia (developed by the author)

	Political	Economic	Social	Technological	Environmental	Legal
Political		E1, E2, E3, E4, E5, E6	S1, S2, S3, S4, S5	T1, T2, T4, T5	V1, V2, V3, V4, V5	Ti1, Ti2
Economic	P1, P2, P3		S2, S3, S5	T1, T2, T4	V2, V3, V4	Ti1, Ti2
Social	P1, P2, P3, P5	E1, E2, E4, E5		T3	V2, V3, V4, V5	Ti1, Ti2
Technological	P1, P2, P3	E1, E2, E4, E5, E6	S2, S3, S4, S5		V2, V3, V4, V5	Ti1, Ti2
Environmental	P1, P2, P3, P4, P5	E2, E3, E5	S2, S3, S4, S5	T1, T2, T3, T4, T5		Ti1, Ti2
Legal	P1, P2, P3, P4, P5	E1, E2, E3, E4, E6	S1, S2, S3, S4, S5	T1, T2, T4, T5	V1, V2, V3, V4	

Evaluation and validation of the relative importance of factors influencing the implementation of the circular economy in Latvia has been carried out in Section 4.2, by evaluating the priority action directions of the Action Plan for the Transition to a Circular Economy for 2020–2027 and the priority sectors of the national economy of Latvia in the transition to the circular economy in Latvia.

4.2. Evaluation and validation of the relative importance of factors influencing the implementation of the circular economy in Latvia: Evaluation of the priority action directions of the Action Plan for the Transition to a Circular Economy for 2020–2027 and the priority sectors of the national economy of Latvia in the transition to the circular economy in Latvia

Considering the analysis of the policy documents related to the circular economy and the analysis of the indicators of the circular economy monitoring framework of the European Commission in Latvia, it can be concluded that the implementation of the circular economy in Latvia is at an early stage. In order to achieve the goals set by the European Union regarding the implementation of the circular economy in the member states and the goals set by the Republic of Latvia, it is necessary to evaluate the priority action directions of the Action Plan for the Transition to a Circular Economy for 2020–2027 and the priority sectors of the national economy of Latvia in the transition to the circular economy in Latvia.

Therefore, the following **sub-goals** have been set for the conducted research:

- 1) to determine the priority action directions of the Action Plan for the Transition to a Circular Economy for 2020–2027;
- 2) to determine the priority sectors of the national economy of Latvia in the transition to the circular economy.

Achievement of the set sub-goals will support the promotion of the circular economy policy in accordance with the action directions of the Action Plan for the Transition to a Circular Economy for 2020–2027 and the implementation of activities according to the priority sectors of the national economy of Latvia in the transition to the circular economy. Assessment of priority action directions can be used as a support mechanism in decision making for the distribution of funding allocated to transition to the circular economy in Latvia.

For the determination of priority action directions of the Action Plan for the Transition to a Circular Economy for 2020–2027,⁴⁰ action directions included in the Action Plan for the Transition to a Circular Economy for 2020–2027 are used:

- 1) Transition from waste management to resource management (Action Direction 1);
- 2) Improving the productivity of resources in all sectors of the economy by promoting the development of research and innovation (Action Direction 2);
- 3) Creation of preconditions for the secondary use of goods (Action Direction 3);
- 4) Promotion of transition from buying goods to services (Action Direction 4);
- 5) Improvement of materials, processes, and waste management in priority sectors (Action Direction 5);
- 6) Strengthening the role of municipalities in the implementation of circular economy principles (Action Direction 6);
- 7) Public involvement, information and education (Action Direction 7).

Based on the statistical classification of economic activities in the European Community determined in the NACE classification, the following priority sectors of the national economy are proposed for the transition to the circular economy:

- 1) manufacturing (NACE code: C);
- 2) water supply; sewerage, waste management and remediation (E);
- 3) construction (F);
- 4) transportation and storage (H).

In order to achieve the set sub-goals, a combined methodology of *PESTEL* and *ANP* (Analytic Network Process) is used.

On the basis of the *PESTEL* analysis method, the framework of factors influencing the implementation of the circular economy in Latvia has been developed, which includes factor groups: political, economic, social, technological, environmental and legal factors.

The evaluation of the factors influencing the transition to the circular economy in Latvia by *PESTEL* factor groups was carried out based on the collective evaluation of ten experts related to the circular economy.

⁴⁰ Ministru kabineta rīkojums Nr. 489 “Par Rīcības plānu pārejai uz aprites ekonomiku 2020.-2027. gadam” (2020) [tiešsaiste]. Latvijas Vēstnesis [skatīts 2023. gada 16. oktobrī]. Available at: <https://likumi.lv/ta/id/317168-par-ricibas-planu-parejai-uz-aprites-ekonomiku-20202027-gadam>

In order to determine which action directions of the Action Plan for the Transition to a Circular Economy for 2020–2027 should be supported as a priority and in order to determine which of the sectors of the national economy should be prioritized in the implementation of the circular economy, the algorithm shown in Fig. 4.2 has been carried out.

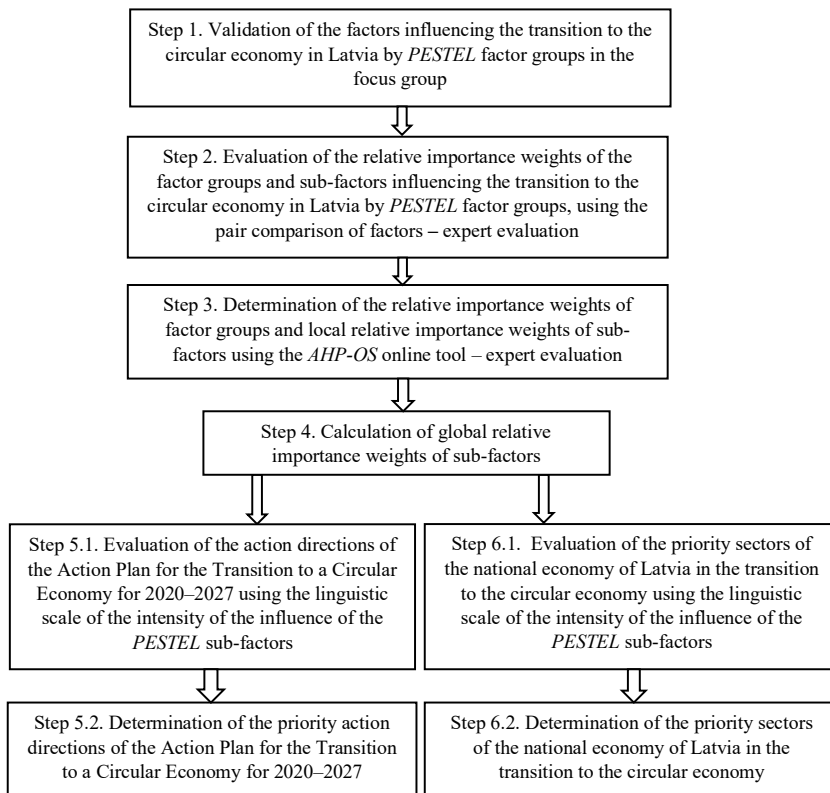


Fig. 4.2. Algorithm for determination of the priority action directions of the Action Plan for the Transition to a Circular Economy for 2020–2027 and the priority sectors of the national economy of Latvia in the transition to the circular economy (developed by the author).

In Step 1, the factor groups and sub-factors influencing the transition to the circular economy in Latvia in accordance with *PESTEL* (political, economic, social, technological, environmental, legal factors) factor groups were discussed and approved in the focus group. It was followed by evaluation of the relative importance weights of the factor groups and sub-factors using the pair comparison of factor groups and sub-factors in the focus group (Step 2) and determination of the relative importance weights of factor groups and local relative importance weights of sub-factors using the *AHP-OS* online tool (Step 3). In Step 4, the calculation of the global relative importance weights of the sub-factors was performed.

In Step 5, with the involvement of experts of the focus group, the priority action directions of the Action Plan for the Transition to a Circular Economy for 2020–2027 were determined. In Step 6, with the involvement of experts of the focus group, the priority sectors of the national economy of Latvia in the transition to the circular economy were determined.

Figure 4.3 reflects the evaluation scheme of priority action directions of Action Plan for the Transition to a Circular Economy for 2020–2027⁴¹ using *PESTEL-ANP* methodology in order to determine priority action directions of the Action Plan for the Transition to a Circular Economy for 2020–2027.

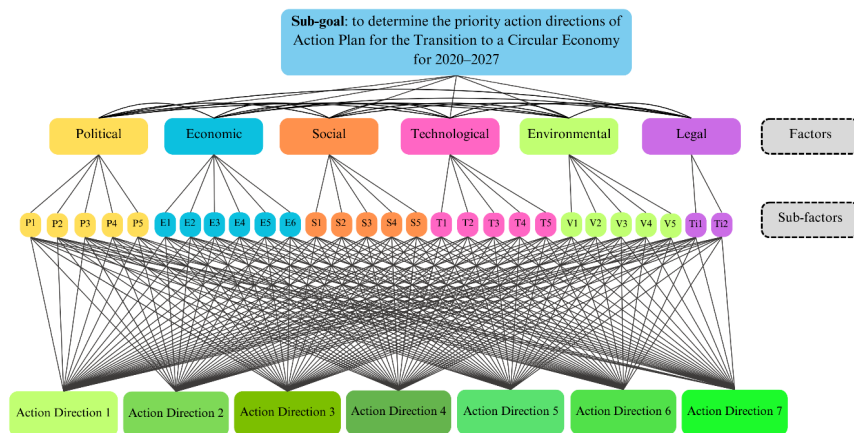


Fig. 4.3. Evaluation scheme of priority action directions of the Action Plan for the Transition to a Circular Economy for 2020–2027 using *PESTEL-ANP* methodology (developed by the author).

The author of the Doctoral Thesis, based on expert evaluations in the focus group and using the *AHP-OS* online tool, has analyzed *PESTEL* factor groups (political, economic, social, technological, environmental and legal), as well as sub-factors of each factor group.

The relative importance weights of the *PESTEL* factor groups determined using *ANP* and *AHP* methods are reflected in Table 4.3. The relative importance weights of the *PESTEL* factor groups obtained using the *AHP* method are added for the comparison of the results. Taking into account the interdependence of *PESTEL* factor groups, it should be concluded that the transition to the circular economy in Latvia is mostly influenced by economic factors (24.6 %; the hypothesis of the Doctoral Thesis is confirmed), followed by social (18.9 %), environmental (17.3 %), technological (15.9 %), political (13.6 %) and legal factors (9.7 %). Comparing the results obtained using the *ANP* and *AHP* methods, it should be noted that the amplitudes of the relative importance weights of the factor groups using the *ANP* method range from 9.7 % to

⁴¹ Ministru kabineta rīkojums Nr. 489 “Par Rīcības plānu pārejai uz aprites ekonomiku 2020.-2027. gadam” (2020) [tiešsaiste]. Latvijas Vēstnesis [skatīts 2023. gada 16. oktobrī]. Available at: <https://likumi.lv/ta/id/317168-par-ricibas-planu-parejai-uz-aprites-ekonomiku-20202027-gadam>

24.6 %, while the amplitudes of the relative importance weights of the factor groups using *AHP* method range from 7.0 % to 31.3 %. A significant difference can be observed in the factor group of environmental factors, which according to the results of the *AHP* method, is the 5th most important factor group ($W_g = 8.5\%$), but according to the results of the *ANP* method – the 3rd most important factor group ($W_g = 17.3\%$) in the transition to the circular economy in Latvia. This can be explained by the significant influence of other factor groups (political, economic, social, technological, legal) on environmental factors.

Table 4.3

The relative importance weights of the *PESTEL* factor groups using *ANP* and *AHP* methods (developed by the author)

Factor group	Weight (<i>ANP</i>)	Rank (<i>ANP</i>)	Weight (<i>AHP</i>)	Rank (<i>AHP</i>)
Political	0.136	5	0.125	4
Economic	0.246	1	0.313	1
Social	0.189	2	0.248	2
Technological	0.159	4	0.159	3
Environmental	0.173	3	0.085	5
Legal	0.097	6	0.07	6

Table 4.4 reflects the relative importance weights of the *PESTEL* factor groups and sub-factors influencing the implementation of the circular economy in Latvia. Relative importance weights of factor groups (W_g) and local relative importance weights were obtained using the *AHP-OS*⁴² online tool. The global relative importance weight (W_{gij}) is the multiplication of the relative importance weight of the factor group (W_g) and the local relative importance weight. It must be concluded that the following sub-factors have the greatest influence on the implementation of the circular economy in Latvia:

- 1) financial support for initiatives related to the circular economy (E3; global relative importance weight – 0.0834);
- 2) changes in the world population (S1; global relative importance weight – 0.0807);
- 3) the movement towards the inclusion of environmental costs in the product price (V1; global relative importance weight – 0.0670);
- 4) the regulatory framework of the European Union regarding the implementation of the circular economy in the member states (Ti1; global relative importance weight – 0.0647);
- 5) economic viability of R-strategies and business models of circular economy (E4; global relative importance weight – 0.0645);
- 6) technological development and digitalization (T1; global relative importance weight – 0.0612);
- 7) the direction of the policy of the European Union towards the circular economy (P1; global relative importance weight – 0.0517);

⁴² AHP Online System – AHP-OS (2023) [online]. bpmsg.com [accessed 25 November 2023]. Available at: <https://bpmg.com/ahp/>

- 8) mentality and habits of consumers (S2; global relative importance weight – 0.0497);
- 9) use of renewable resources (V5; global relative importance weight – 0.04);
- 10) the need for structural changes in business models to move from linear economy to circular economy (E2; global relative importance weight – 0.0394);
- 11) political leadership and decision-making speed in the implementation of the circular economy (P4; global relative importance weight – 0.0348);
- 12) product design (T2; global relative importance weight – 0.0329).

Table 4.4

The relative importance weights of the factor groups and sub-factors influencing the implementation of the circular economy in Latvia (developed by the author)

<i>PESTEL</i> factor group	Weight of factor group, W_g	<i>PESTEL</i> sub-factors	Local weight	Global weight, W_{gij}
Political	0.136	P1	0.38	0.0517
		P2	0.194	0.0264
		P3	0.104	0.0141
		P4	0.256	0.0348
		P5	0.066	0.0090
Economic	0.246	E1	0.039	0.0096
		E2	0.16	0.0394
		E3	0.339	0.0834
		E4	0.262	0.0645
		E5	0.127	0.0312
		E6	0.073	0.0180
Social	0.189	S1	0.427	0.0807
		S2	0.263	0.0497
		S3	0.122	0.0231
		S4	0.072	0.0136
		S5	0.116	0.0219
Technological	0.159	T1	0.385	0.0612
		T2	0.207	0.0329
		T3	0.156	0.0248
		T4	0.164	0.0261
		T5	0.088	0.0140
Environmental	0.173	V1	0.387	0.0670
		V2	0.164	0.0284
		V3	0.124	0.0215
		V4	0.094	0.0163
		V5	0.231	0.0400
Legal	0.097	Ti1	0.667	0.0647
		Ti2	0.333	0.0323

Using the summarized relative importance weights of the factor groups and sub-factors influencing the implementation of the circular economy in Latvia (Table 4.4) and the linguistic

scale of the intensity of the influence of the *PESTEL* sub-factors (Table 4.5), evaluation of priority action directions of the Action Plan for the Transition to a Circular Economy for 2020–2027 was carried out. The results have been discussed and approved in the focus group of ten experts related to the circular economy.

Table 4.5

The linguistic scale of the intensity of the influence of the *PESTEL* sub-factors⁴³

Degree of influence	Very high	High	Moderate	Low	Very low	No influence
Coefficient	0.42	0.26	0.16	0.1	0.06	0

Table 4.6 reflects the relative importance of action directions of the Action Plan for the Transition to a Circular Economy for 2020–2027 using the *ANP* method. For comparison, the relative importance of action directions using the *AHP* method is reflected.

Table 4.6

The relative importance of action directions of the Action Plan for the Transition to a Circular Economy for 2020–2027 using *ANP* and *AHP* methods (developed by the author)

Action Direction	Relative importance (%) (<i>ANP</i>)	Rank (<i>ANP</i>)	Relative importance (%) (<i>AHP</i>)	Rank (<i>AHP</i>)
1. Transition from waste management to resource management	16.67	1	16.53	1
2. Improving the productivity of resources in all sectors of the economy by promoting the development of research and innovation	13.60	4	13.60	5
3. Creation of preconditions for the secondary use of goods	13.46	5	13.76	4
4. Promotion of transition from buying goods to services	12.00	7	12.28	7
5. Improvement of materials, processes, and waste management in priority sectors	15.11	3	14.67	3
6. Strengthening the role of municipalities in the implementation of circular economy principles	13.31	6	13.15	6
7. Public involvement, information and education	15.85	2	16.02	2

Comparing the results of the *ANP* and *AHP* methods in the prioritization of the action directions of the Action Plan for the Transition to a Circular Economy for 2020–2027, the differences in the priority ranking of the action directions are between Action Direction 2 and Action Direction 3, with Action Direction 2 ranking in the 4th and 5th positions and Action Direction 3 ranking in the 5th and 4th positions according to the calculation results of the *ANP* and *AHP* methods, respectively. The priority ranking of other action directions according to the calculation results of the *ANP* and *AHP* methods coincides, which justifies the reliability of the obtained results.

The author of the Doctoral Thesis proposes to use the results of the relative importance of action directions as support for decision-making, with the help of which to determine how much

⁴³ Saaty, T. L. (1996). *Decision Making with Dependence and Feedback: The Analytic Network Process*. Pittsburgh: RWS publications.

funding to allocate to each of the action directions in the transition to the circular economy in Latvia.

Analogous to the evaluation of the action directions of the Action Plan for the Transition to a Circular Economy for 2020–2027, the evaluation of the priority sectors of the national economy of Latvia in the transition to the circular economy is carried out using the *PESTEL-ANP* methodology (see Fig. 4.4). The following priority sectors of the national economy of Latvia in the transition to circular economy are evaluated: 1) manufacturing (NACE code: C); 2) water supply; sewerage, waste management and remediation (E); 3) construction (F); and 4) transportation and storage (H).

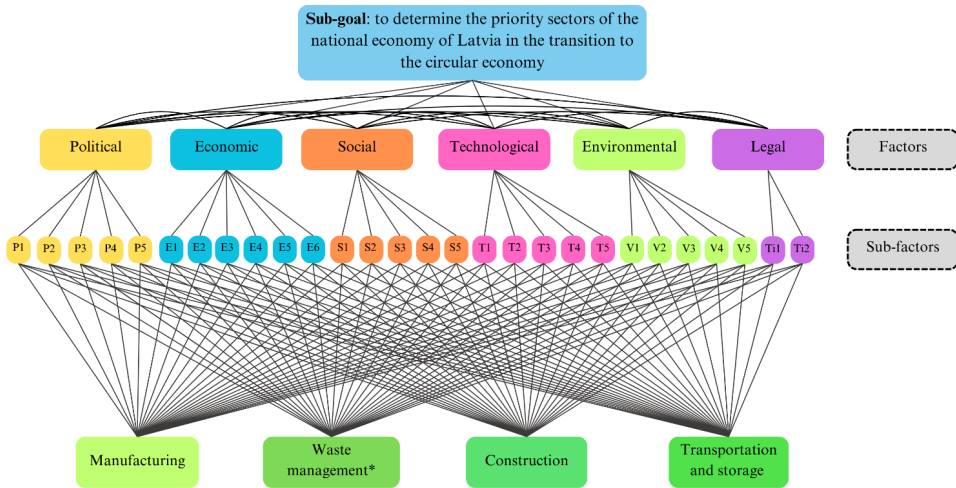


Fig. 4.4. Evaluation scheme of the priority sectors of the national economy of Latvia in the transition to the circular economy using *PESTEL-ANP* methodology (developed by the author).

Table 4.7 reflects the relative importance of the priority sectors of the national economy of Latvia in the transition to the circular economy using *ANP* and *AHP* methods. It should be concluded that according to the calculation results of the *ANP* method, the principles of circular economy should be primarily applied to water supply; wastewater, waste management and remediation sector (relative importance – 31.18 %), followed by manufacturing (28.00 %), construction (21.40 %) and transportation and storage (19.42 %) sectors. The calculation results of the *AHP* method confirm the ranking of the priority sectors of the national economy of Latvia in the transition to the circular economy, as they are consistent with the results obtained by using the *ANP* method.

Table 4.7

The relative importance of the priority sectors (according to the NACE classification) of the national economy of Latvia in the transition to the circular economy using *ANP* and *AHP* methods (developed by the author)

Sector	Relative importance (%) (<i>ANP</i>)	Rank (<i>ANP</i>)	Relative importance (%) (<i>AHP</i>)	Rank (<i>AHP</i>)
Manufacturing	28.00	2	28.07	2
Water supply; sewerage, waste management and remediation	31.18	1	32.01	1
Construction	21.40	3	20.55	3
Transportation and storage	19.42	4	19.38	4

It can be concluded that the priority sectors of the national economy of Latvia in the transition to the circular economy are directly related to the life cycle of products. The manufacturing sector covers the product manufacturing stage. The transportation and storage sector covers the logistics stage, which includes the transportation of raw materials to factories, the transportation of products to consumers and the transportation of product residues in accordance with the chosen R-strategy of the circular economy and the specifics and quality of the residues of product or material. The water supply; sewerage, waste management and remediation sector covers the last stage of the product life cycle and aims to return recycled materials back to the economic system and give them value. However, the construction industry represents the creation of the most resource-intensive products – buildings, which have a significant influence on the environment throughout the whole life cycle of the building.

With the evaluation of priority action directions of the Action Plan for the Transition to a Circular Economy for 2020–2027 and the evaluation of the priority sectors of the national economy of Latvia in the transition to the circular economy, the framework of factors influencing the implementation of the circular economy in Latvia has been validated. The framework of factors influencing the implementation of the circular economy in Latvia is adaptable and usable for the evaluation of various related action directions, sectors of the national economy and sets of strategies. By adapting the sub-factors of the *PESTEL* factor groups to the context of other countries and territorial units, it is possible to use the developed framework to evaluate the implementation of the circular economy at the national and regional level in other countries, evaluating the related action directions, sectors of the national economy, strategies and other elements of various clusters.

CONCLUSIONS AND PROPOSALS

During the development of the Doctoral Thesis, the following was achieved: 1) the development of the framework of the retrospective analysis of the circular economy concept was carried out: the main studies on the way to the conceptualization of the modern circular economy were identified and analyzed; the main development periods of the circular economy concept were developed: period of awareness of global environmental problems and circular economy ideology (1945–1987); conceptualization period of the circular economy (1989–2010); validity period of the circular economy (2011–...); 2) characteristic elements of the circular economy were determined: the characteristic elements of the circular economy were identified using the qualitative content analysis and validated using the bibliometric analysis and software tool *VosViewer*; a circular economy definition was specified and approved in the focus group; 3) an analysis of the circular economy in Latvia was carried out: the political framework for the implementation of the circular economy in Latvia was analyzed; the circular economy in Latvia using the indicators of the circular economy monitoring framework of the European Commission was analyzed; 4) the framework of the factors influencing the implementation of the circular economy in Latvia was developed and validated: the framework of the factors influencing the implementation of the circular economy in Latvia was developed based on the *PESTEL* factor groups; the relative importance weights of the factors influencing the implementation of the circular economy in Latvia were evaluated in the focus group; the framework of factors influencing the implementation of the circular economy in Latvia has been validated by evaluating the priority action directions of the Action Plan for the Transition to a Circular Economy for 2020–2027 and the priority sectors of the national economy of Latvia in the transition to the circular economy in Latvia.

The results obtained in the Doctoral Thesis justify the achievement of the aim of the Doctoral Thesis and confirm the hypothesis. Within the Doctoral Thesis, the framework of the factors influencing the implementation of the circular economy in Latvia was developed and its approbation was carried out. Circular economy implementation in Latvia is influenced by a set of political, economic, social, technological, environmental and legal factors, of which economic factors have the greatest influence on the circular economy implementation in Latvia, which is confirmed by the relative importance weights of the *PESTEL* factor groups influencing the implementation of the circular economy in Latvia.

The author of the Doctoral Thesis has developed the following **conclusions**:

1. The origins of the circular economy concept identified in the retrospective analysis of the circular economy can be traced back to 1945 when the Indian economist Joseph Chelladurai Cornelius Kumarappa emphasized the value and usability of waste. The main development periods of the circular economy are: 1) the period of awareness of global environmental problems and circular economy ideology (1945–1987); 2) conceptualization period of the circular economy (1989–2010); 3) validity period of the circular economy (2011–...).
2. The characteristic elements of the circular economy identified in the qualitative content analysis and validated in the bibliometric analysis are R-strategies, waste, closed loops,

- design, business models, systems thinking, life cycle thinking, resource efficiency, consumption, value preservation, sharing, renewable energy, behaviour and industrial symbiosis.
3. The concept of the circular economy is closely related to the concepts of sustainability and sustainable development, positively contributing to UN Sustainable Development Goals 1, 2, 3, 4, 5, 6, 7, 8, 9, 11, 12, 13, 14, 15, 16, 17, especially to the achievement of UN Sustainable Development Goals 6, 7, 8, 12 and 15.
 4. Keywords identified in the bibliometric analysis related to circular economy and manufacturing (NACE code: C), water supply; sewerage, waste management and remediation (E), construction (F), and transportation and storage (H) sectors are: “*circular economy*”, “*sustainable development*”, “*sustainability*” “*decision making*”, “*supply chains*”, “*waste management*”, “*waste*”, “*china*”, “*human*”, “*environmental protection*”, “*material flow analysis*”, “*carbon dioxide*”, “*life cycle*”, “*life cycle assessment*”, “*life cycle analysis*”, “*environmental impact*”, “*recycling*”. The most frequently mentioned unique keywords have also been identified, which can contribute to the development of more detailed studies about the sectors of the national economy in the transition to the circular economy.
 5. In order to create a common understanding of the circular economy, a circular economy definition was specified, which was discussed, corrected and approved in the focus group in the following outline: “*A circular economy is a purposefully directed economic system that is based on transition to renewable energy sources and business models which replace the ‘end-of-life’ concept with refusing, rethinking, reducing, reusing, repairing, refurbishing, remanufacturing, repurposing, recycling and recovering in production, distribution, consumption and reverse logistics processes, thus operating at the micro level (products, companies, consumers), meso level (eco-industrial parks) and macro level (city, region, nation and beyond), with the aim to accomplish sustainable development, which implies preserving and improving environmental quality, ensuring economic viability and creating social equity, to the benefit of current and future generations.*”
 6. The European Green Deal and the New Circular Economy Action Plan “For a cleaner and more competitive Europe” drive the implementation of the circular economy in the member states of the European Union, including Latvia. The political framework of Latvia in the transition to circular economy includes the Action Plan for the Transition to a Circular Economy for 2020–2027 and such related policy planning documents as National Waste Management Plan of Latvia (2021–2028) (NWMP2028), Environmental Policy Guidelines 2021–2027, National Energy and Climate Plan for 2021–2030, Strategy of Latvia for the Achievement of Climate Neutrality by 2050, Strategic Plan of the Common Agricultural Policy of Latvia for 2023–2027, National Development Plan of Latvia for 2021–2027 (NAP2027), Latvian Bioeconomy Strategy 2030, Wastewater Management Investment Plan for 2021–2027, Informative report “For the management of worn out tires”, and Smart Specialisation Strategy.

7. The developed circular economy indicator frameworks derive from the circular economy definition, measurement types, strategies, measurement scopes, scale, indicator type and dimension of indicators. At least 55 sets of circular economy indicators and at least 474 circular economy-related indicators have been identified in the scientific literature, indicating the wide range and scope of circular economy metrics. However, the use of a large proportion of circular economy indicators is limited by the lack of qualitative data sets, which is the greatest obstacle in measuring the progress of circular economy implementation. The indicators of the circular economy monitoring framework of the European Commission are the most suitable for the analytical evaluation of the circular economy in Latvia, although they do not include such elements of the circular economy as design, business models, sharing, renewable energy and industrial symbiosis.
8. The trend analysis of the circular economy monitoring framework of the European Commission outlines: the increase in material consumption and the increase in the volume of various types of waste, which negatively influences the transition to a circular economy in Latvia; an increase in the recycling rate of various types of waste (household, packaging, plastic), which has a positive influence on the transition to a circular economy in Latvia; the stagnation of the circular material use rate in the range of 4.3–6.5 % from 2014 to 2021, the increase in the volume of trade of recyclable raw materials, moderation of greenhouse gas emissions from production activities and material import dependency, which has a neutral influence on the transition to a circular economy in Latvia. It can be concluded that the objectives of the Action Plan for the Transition to a Circular Economy for 2020–2027 to reach a resource productivity level of 1.55 EUR/kg and a circular material use rate of 11.0 % by 2027 will not be achieved according to the analyzed indicator trends, which indicates the necessity to introduce additional tools and activities to promote the increase of these indicators.
9. The developed framework of factors influencing the implementation of the circular economy in Latvia includes 6 factors (factor groups) – political, economic, social, technological, environmental and legal factors and 28 sub-factors: P1 – The direction of the policy of the European Union towards the circular economy; P2 – The direction of the Latvian government's policy towards the circular economy; P3 – The direction of municipal policies towards circular economy; P4 – Political leadership and decision-making speed in the implementation of the circular economy; P5 – Participation of social partners and non-governmental organizations in the implementation of the circular economy in Latvia; E1 – Economic benefits from the implementation of the circular economy concept; E2 – The need for structural changes in business models to move from linear economy to circular economy; E3 – Financial support for initiatives related to the circular economy; E4 – Economic viability of R-strategies and business models of circular economy; E5 – The trust and willingness of companies to cooperate and share information in the conditions of the transition to the circular economy; E6 – The readiness of Latvian economic sectors for the implementation of circular economy; S1 – Changes in the world population; S2 – Mentality and habits of consumers;

S3 – The level of environmental awareness of society; S4 – Culture and traditions; S5 – The readiness of society to accept circular economy principles; T1 – Technological development and digitalization; T2 – Product design; T3 – Technological intelligence; T4 – Infrastructure; T5 – Research and innovation; V1 – The movement towards the inclusion of environmental costs in the product price; V2 – Solving the problem of resource scarcity; V3 – Climate change mitigation; V4 – Conservation of biodiversity; V5 – Use of renewable resources; Ti1 – The regulatory framework of the European Union regarding the implementation of the circular economy in the member states; Ti2 – The regulatory framework of the Republic of Latvia regarding the implementation of the circular economy in Latvia. Factor groups and sub-factors of the framework of factors influencing the implementation of the circular economy in Latvia have been discussed and approved in the focus group.

10. The implementation of the circular economy in Latvia is mostly influenced by economic factors (24.6 % – relative importance weight according to the *ANP* method), followed by social (18.9 %), environmental (17.3 %), technological (15.9 %), political (13.6 %) and legal (9.7 %) factors. The following sub-factors have the greatest influence on the implementation of the circular economy in Latvia: financial support for initiatives related to the circular economy (E3; global relative importance weight – 8.34%); changes in the world population (S1; 8.07 %); the movement towards the inclusion of environmental costs in the product price (V1; 6.70 %); the regulatory framework of the European Union regarding the implementation of the circular economy in the member states (Ti1; 6.47 %); economic viability of R-strategies and business models of circular economy (E4; 6.45 %); technological development and digitalization (T1; 6.12 %); the direction of the policy of the European Union towards the circular economy (P1; 5.17 %); mentality and habits of consumers (S2; 4.97 %); use of renewable resources (V5; 4.00 %).
11. Priority action directions of the Action Plan for the Transition to a Circular Economy for 2020–2027, which were determined using *PESTEL-ANP* methodology, are: Transition from waste management to resource management (Action Direction 1; relative importance – 16.67%); Public involvement, information and education (Action Direction 7; 15.85 %); Improvement of materials, processes, and waste management in priority sectors (Action Direction 5; 15.11 %); Improving the productivity of resources in all sectors of the economy by promoting the development of research and innovation (Action Direction 2; 13.60 %); Creation of preconditions for the secondary use of goods (Action Direction 3; 13.46 %); Strengthening the role of municipalities in the implementation of circular economy principles (Action Direction 6; 13.31 %); Promotion of transition from buying goods to services (Action Direction 4; 12.00 %).
12. Priority sectors of the national economy of Latvia in the transition to the circular economy, which were determined using *PESTEL-ANP* methodology, are: water supply; sewerage, waste management and remediation (NACE code: E; relative importance – 31.18 %); manufacturing (C; 28.00 %); construction (F; 21.40 %); and transportation and storage (H; 19.42 %).

13. The developed and validated framework of factors influencing the implementation of the circular economy in Latvia can be adapted and used for the evaluation of various related action directions, sectors of the national economy and sets of strategies. The framework can be used as a support tool in the decision-making process and promote the implementation of the circular economy in Latvia.
14. By adapting the sub-factors of the *PESTEL* factor groups of the framework of factors influencing the implementation of the circular economy in Latvia to the context of other countries and territorial units, it is possible to use the developed framework to evaluate the implementation of the circular economy at the national and regional level in other countries, evaluating the related action directions, sectors of the national economy, strategies and other elements of various clusters in the transition to the circular economy.

Based on the developed Doctoral Thesis and conclusions, the author of the Doctoral Thesis has developed the following **proposals**:

1. **The Ministry of Environmental Protection and Regional Development**, when developing informative materials for public information and educational measures to influence public behaviour patterns, and the **Ministry of Education and Science**, when preparing educational content proposals for the inclusion of circular economy in educational programs, professional development training and lifelong learning, should use the developed framework of the retrospective analysis of the circular economy concept and systemically identified set of circular economy elements. It will contribute to the promotion of awareness about the necessity for the transition to the circular economy.
2. **The Ministry of Environmental Protection and Regional Development** should use the specified circular economy definition or its adapted version in the next planning periods of the transition to the circular economy and in the development of policy planning documents, replacing the use of superficial definitions of the circular economy and promoting the formation of a unified systemic understanding of the circular economy among the stakeholders of circular economy implementation – ministries, municipalities, public sector institutions, companies, educational institutions, scientific and research organizations, non-governmental organizations and society.
3. **The working group for the development of future editions of the NACE statistical classification of economic activities in the European Community** should incorporate elements of the circular economy in the next editions of the NACE statistical classification of economic activities in the European Community and adapt these editions to the paradigm of the transition to the circular economy.
4. **The Ministry of Environmental Protection and Regional Development** should incorporate the raw material extraction stage in the next editions of the Action Plan for the Transition to a Circular Economy for 2020–2027 and the next planning periods.
5. **Ministry of Environmental Protection and Regional Development, Ministry of Education and Science, Ministry of Welfare, Ministry of Economics, Ministry of Finance, Ministry of Agriculture, Ministry of Climate and Energy** and other institutions involved in the planning, implementation and development of a policy framework for the transition to a circular economy in cooperation with research

organizations and circular economies experts should use the developed framework of factors influencing the implementation of the circular economy in Latvia as a support tool in the decision-making process in order to evaluate related action directions, sectors of the national economy, strategies and other elements of various clusters in the transition to the circular economy.

6. **Ministry of Environmental Protection and Regional Development, Ministry of Education and Science, Ministry of Welfare, Ministry of Economics, Ministry of Finance, Ministry of Agriculture, Ministry of Climate and Energy** and other institutions involved in the planning, implementation and development of a policy framework for the transition to a circular economy should use prioritized action directions of the Action Plan for the Transition to a Circular Economy for 2020–2027 as support indicators for decision-making, with the help of which decisions can be made about the structural distribution of the overall funding direction for circular economy by action directions, etc. in the transition to the circular economy in Latvia.
7. **Ministry of Economics, Ministry of Environmental Protection and Regional Development** and other institutions involved in the policy planning of sectors of the national economy of Latvia should use prioritized sectors of the national economy of Latvia in the transition to the circular economy as support indicators for decision-making in order to purposefully direct funding, activities and support measures for priority sectors of the national economy in the transition to the circular economy in Latvia. By promoting the application of circular economy principles in water supply; sewerage, waste management and remediation (NACE code: E), manufacturing (C), construction (F) and transportation and storage (H) sectors, the implementation of the circular economy in other sectors of the national economy of Latvia will also be promoted.
8. **Ministry of Environmental Protection and Regional Development, Ministry of Education and Science, Ministry of Welfare, Ministry of Economics, Ministry of Finance, Ministry of Agriculture, Ministry of Climate and Energy** and other institutions involved in the planning and implementation of the transition to a circular economy should consider and promote the transfer of good practices of waste management infrastructure, technology, support tools, approaches of influencing consumption patterns, industrial symbiosis and other circular economy elements from other countries of the European Union and the world to Latvia, thus promoting the implementation of the circular economy in Latvia.
9. **The governmental and administrative organizations of the European Union member states**, in cooperation with research organizations and circular economy experts, should adapt the sub-factors of the framework of factors influencing the implementation of the circular economy in Latvia to the local context and use the developed framework of factors influencing the implementation of the circular economy as a support tool in the decision-making process in order to evaluate related action directions, sectors of the national economy, strategies and other elements of various clusters in the transition to the circular economy.

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Jānis Zvirgzdiņš was born on July 9, 1993 in Limbaži. He graduated with excellence from Viļķene Primary School, named after Baumaņu Kārlis, and Limbaži District Gymnasium. He holds a Bachelor's degree in Electrical Science (2015) from Riga Technical University. In 2016, he supplemented his knowledge about aspects of global business at the Global Summer School in South Korea. He holds a Professional Master's degree in Economics and the qualification of Economist. He has worked at the Radiation Safety Centre of the State Environmental Service of the Republic of Latvia. For several years, he has been a researcher and lecturer at the Faculty of Engineering Economics and Management of Riga Technical University. He has participated in the implementation of *Interreg Europe* and *Erasmus+* EU program projects, as well as has been a member of the organizing committee of international scientific conferences. His main research areas are circular economy, green economy, sustainable development, environmental management, urban and regional economics, energy, and real estate management, reflected in more than 20 scientific publications.

The passion of Jānis Zvirgzdiņš for working with students can be characterised by Tupac Amaru Shakur's words: "I'm not saying I'm going to change the world, but I guarantee that I will spark the brain that will change the world."