

## RESOLVE MODEL IN MAPPING THE CIRCULAR ECONOMY INITIATIVES OF SILESIAN ENTERPRISES

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**Purpose:** Changes taking place in the modern world, caused by the depletion of natural resources, and the resulting need to search for such production methods that lead to the minimisation of extraction and processing of primary raw materials, point to the need for a paradigm shift in business towards the implementation of closed material cycles. The aim of this article is to assess the extent to which Silesian enterprises are implementing initiatives related to the implementation of a circular economy with the use of the ReSOLVE model, a research framework that facilitates an overview and mapping of activities that form the basis for building circular business models.

**Design/methodology/approach:** The study covered companies of different sizes (both SMEs and large entities) which operate in the Silesian Voivodeship. A non-probabilistic and purposive sample was selected, which ultimately included 36 companies (25 SMEs and 11 large companies).

**Findings:** The study shows that the surveyed SMEs are much more active (when compared to large enterprises) in taking measures that, according to the ReSOLVE model, fall into the categories of Regenerate and Share. In turn, the advantages of large enterprises relate to, among other things, designing products to ensure their longer life cycle, reducing waste production and using systems/equipment that optimise resource consumption, recovering raw materials, implementing virtual services, and upgrading existing or using new technological solutions. In relation to large enterprises, the respondents indicated legal barriers as the most important, while in the SME group, market barriers, including in particular higher costs associated with the production of circular products, were mentioned.

**Originality/value:** The study results presented in the article complement the previous literature on strategic directions, barriers and benefits while building circular business models. The key scientific contribution of the article is to confirm, in the reality of the Polish economy, the usefulness of the ReSOLVE model for identifying activities related to the implementation of a circular economy at the organizational level.

**Keywords:** circular economy; ReSOLVE.

**Category of the paper:** historical case study.

## 1. Introduction

There are many companies that have, for decades, operated according to a linear management model. In that model, little attention was paid to aspects such as how to maximize efficient management of waste generated in production processes, how to process it and how to design products and processes to facilitate those efforts. There has also been little thought given to what happens to the product after its lifetime, how many such products end up in the landfill, and what the environmental and social impacts of this would be. Most of these companies are still not yet equipped to change their current operating model (Puntillo, 2022). Nevertheless, the inevitable consequences of the predatory use of natural resources are contributing to the search for a new paradigm for managing the relationship with the environment. This applies both to the behaviour of people and companies, the enterprises they pursue and the attitudes of national governments towards the environmental issues (Mies et al., 2021; Khatami et al., 2023).

The ever-growing trend towards the development of a circular economy is meeting these demands. Evidence of the growing popularity of that matter can be seen in the fact that, over the past decades, the number of scientific publications on the topic has increased from 12 papers in 2008 to more than 2,300 in 2020. On the one hand, the research seeks to conceptualise the concept of a circular economy, to establish its relationship with existing theories and concepts in the management science and the implications for the creation of new business models, as well as their implementation in individual industries. On the other hand, research in the area of environmental engineering is focused on applications of CE strategies and the search for viable solutions to production and environmental problems (Alcalde-Calonge, 2022).

## 2. Background

A circular economy can be defined in many ways. As early as in 2017, more than 114 definitions of the concept were collected (Kirchherr et al., 2017). One indicates that a circular economy is seen as a combination of activities to reduce, reuse and recycle the waste produced (Kirchherr et al., 2017). Another portrays it as an economy that keeps products, components and materials in circulation for as long as possible. As they reach the end of their usefulness, they are reused, forming the basis for further value creation (EC, 2014). The key outcomes of implementing a circular economy are to reduce waste and minimise the extraction and processing of primary raw materials (Takacs et al., 2022).

It is sometimes explicitly emphasised that a circular economy is an alternative (to the linear view) model of sustainable production and consumption. It is defined as a growth strategy that enables the 'decoupling' of resource use from economic growth, thus contributing to the realisation of the concept of sustainable development (Reike et al., 2018; Jabbour et al., 2019). A circular economy is also interpreted as an economic system that requires a paradigm shift in the connection between society and nature. It aims to prevent the depletion of resources, energy and materials. These actions should be accompanied by successive ecological innovations in the ways of legislation, production and consumption in a sustainable society (Puntillo, 2022).

The implementation of a circular economy can be achieved in two ways: top-down, through the formal introduction of environmental policy standards at the national and/or international level (a macroeconomic approach), or bottom-up, through the development of initiatives taken by individual economic actors and/or small communities (a microeconomic approach) (Geng et al., 2019).

From a macroeconomic perspective, researchers mainly emphasise the role of an institutional change (Oluleye et al., 2022; Rizos, Bryhn, 2022) and, above all, the importance of the fiscal and monetary policy tools used by the state (Velenturf et al., 2018; Tedesco et al., 2022). Guided by this research perspective, one can also see the high place of the topic of a circular economy in the strategic documents of individual countries, including in particular Asia (Neves, Marques, 2022) and Europe (EC, 2014a, 2015a). The first European countries to undertake the implementation of initiatives, pilot programmes and policies on a circular economy were Denmark, the Netherlands, Germany, France and the UK (Blomsma et al., 2017; Murray et al., 2017; Reike et al., 2018). In these countries, there are a number of initiatives to promote and develop the circular economy embedded in the European Action Plan for a Circular Economy (EC, 2020). The implementation of circular economy solutions in conjunction with environmental challenges, is also an important direction from an application perspective, including in particular adaptation to the climate change (Yang et al., 2022).

From a microeconomic perspective, researchers emphasise the need for companies to build and implement circular business models in which, according to the definition most often used in the literature by Linder and Williander (2017, p. 183), 'the conceptual logic for value creation is based on utilising economic value retained in products after use in the production of new offerings'. In other words, a circular business model implies using business opportunities in such a way that the company can create value not only economically, but also socially and environmentally. Indeed, a key role of the circular business model is 'to incorporate the circular economy principles into a design or redesign of business activities and partnerships and to create a cost and revenue structure, which is compatible both with sustainability and with profitability' (Zucchella, Previtali, 2019, p. 275).

Implementation of the concept of a circular economy from a microeconomic perspective appears to be more effective and sustainable and to lead more quickly to the desired economic and social outcomes. Both large entities and SMEs play a significant role in the implementation

of a circular economy. SMEs account for 99% of all enterprises in the European Union (OECD, 2019; Tackas et al., 2022). This means that they contribute significantly to the pollution emitted into the atmosphere, hydrosphere and lithosphere, as well as to the uneconomic use of available resources. Hence, it is an important issue to determine the level of familiarity with a circular economy in that group of companies and to identify the necessary actions to be taken that would increase their commitment to improvement of the environment.

The analysis presented in this paper uses the ReSOLVE model, a research framework developed by the Ellen MacArthur Foundation (EMF, 2015b). The model provides an overview and mapping of the activities that underpin the building of circular business models by companies in the following thematic areas: Regenerate, Share, Optimise, Loop, Virtualisation and Exchange.

Regeneration (Re) encompasses a broad set of activities that lead to reclaim, retain, and restore health of ecosystems. The activities undertaken by companies relate, in particular, to shift to renewable energy and materials. Returning biological resources to nature, for example through composting, also falls into this category. Actions gathered under Share (S) relate to the key concept of the 'sharing economy' for the development of a circular economy and include practices leading to share assets, reuse, second hand, prolong life through maintenance, design for durability and upgradability. Optimise (O) is about removing energy and material waste in the production of goods and in supply chains, as well as in the process of using them. It also involves leveraging big data, automation, removes sensing and steering to increase performance, and efficiency of products. The Loop (L) set of activities relates to the reuse of used products and their components, through recycling and, more effectively, full or partial remanufacturing. The last two categories, Virtualisation (V) and Exchange (E), describe activities leading respectively to the design and implementation of virtual services by enterprises and the application of new technologies (e.g. 3D printing) and upgrading or replacing existing ways of doing things with new solutions (e.g. replace old with advanced non-renewable materials) (EMF, 2015b).

The described research framework is firmly established methodologically and has been used in a number of studies by, among others, Kouhizadeh et al. (2020) in relation to the application of blockchain technology and Jabbour et al. (2019) in the context of human resource management. While considering the sectoral context, the ReSOLVE model has been a research tool used in analyses of the forest industry (Tedesco et al., 2022), the textile industry (Warwas et al., 2021) and the construction and demolition sector (Superti et al., 2021), among others.

The aim of this paper is to use the ReSOLVE model to assess the extent to which Silesian companies are implementing initiatives related to the enactment of a circular economy. Making such a comprehensive assessment necessitates not only to identify the individual activities undertaken by the enterprises, but also to analyse whether members of the management team of the surveyed companies are interested (or not) in building circular business models. In other words, this article analyses the main barriers to the implementation of circular economy

initiatives at the organisational level classifying them, as recommended by many researchers (Ritzen et al., 2017; Kirchher et al., 2018; Jesus et al., 2018; Oluleye et al., 2022; Rizos, Bryhn, 2022; Takacs et al., 2022), within cultural, legal, technological and market barriers.

The implementation of the concept of a circular economy is associated not only with barriers that can be overcome by taking into account the organisation's strategy and its resources and competencies, but also with a number of benefits that can be achieved (Geng et al., 2007, 2008). Therefore, in order to complement the analysis carried out, it was also necessary to identify the main benefits that might accrue to companies by undertaking initiatives related to the implementation of a circular economy.

Despite the existence of a number of valuable articles on the concept of circular business models (Linder, Williander, 2017; Zucchella, Previtali, 2019; Pichlak, Szromek, 2022), as well as numerous previous research papers whose authors have identified and described the main factors and barriers to implementing the concept of a circular economy at the organisational level, there is a paucity of research papers in the available literature that could offer concrete insights into undertaking such practices in a specific research context, such as the Polish industrial region. This article fills that research gap.

The important theoretical contribution of the article is the confirmation, within the conditions of the Polish economy, of the usefulness of the ReSOLVE model for identifying and mapping activities that constitute the basis for the construction of circular business models by enterprises. Owing to that, the described research framework can be used not only in subsequent studies conducted in the Silesian Voivodeship, but also in other organisational contexts, taking into account the conditions of conducting business in Poland.

The results of the study also provide important, from the point of view of business practice, insights into the implementation of the concept of circular economy in enterprises located in the southern part of Poland, allowing for an empirical verification of the involvement of entrepreneurs in the matter. In addition, identification of the benefits and barriers to the implementation of such practices may help Polish enterprises to plan their strategies and then to build circular business models in the future.

The remainder of the article is divided into three sections: the first section describes the research method used, the second presents the results of the research, while the third includes a reference of the obtained results to the available literature, a summary of the results and an indication of further directions.

### 3. Methods

The quantitative research method was chosen to achieve the research objective indicated above, as it allows information to be collected in a comprehensive, efficient and generalising manner (Schutt, 2006). The survey was developed and made available with the use of SurveyGizmo, an electronic tool that allows for simultaneous data collection and analysis. This approach facilitates a lower cost of data acquisition, flexibility, a user-friendly format, ease of entry and better structuring of the analysed data (Granello et al., 2004). The structure of the questionnaire contained 28 single-choice and multiple-choice questions. The survey questionnaire was divided into three main parts; in the first part, respondents were requested to indicate which CE practices they applied in their organization and to assign them to the solutions described in the ReSOLVE model. In the second part, the importance of barriers in implementing CE solutions was assessed. Barriers were divided into three groups formal, market and internal. The third part of the questionnaire included statistical questions,

The survey was addressed to both members of the management team of SMEs and large enterprises (with more than 250 employees) operating in the Silesian Voivodeship. The purpose of selecting such a wide range of respondents was to determine what the current level of knowledge and degree of implementation of initiatives related to the implementation of the circular economy was. Six categories of activities (according to the ReSOLVE model) constituting the basis for building circular business models were analysed, as well as, complementarily, the barriers and potential benefits their implementation might create.

The first stage of the adopted research methodology was to develop a structured survey questionnaire consisting of 48 items. The survey questionnaire included closed questions (multiple choice and yes/no/don't know) and open-ended questions, and it was divided into four parts. The first part contained general questions to determine respondents' level of familiarity with the topics covered. Part two of the questionnaire was a tool to assess the degree of implementation of initiatives related to the implementation of a circular economy in the following thematic areas: Regenerate, Share, Optimise, Loop, Virtualise, Exchange. The third part of the questionnaire asked respondents to identify and assess the barriers that hinder (or prevent) the implementation of circular economy initiatives, as well as to identify the associated potential benefits. Finally, the metrics section of the questionnaire covered control variables, in particular company size (measured by number of employees) and industry of operation.

The study was carried out between June and July 2019. Due to the need to meet restrictive prerequisites (a company participating in the study should have belonged to the manufacturing sector, operating in the Silesian Voivodeship and supplying the market with at least one product manufactured using secondary raw materials), a non-probabilistic and purposeful selection of the research sample was decided upon. At the first stage, 127 companies from the Silesian

Voivodeship which fulfilled the initial conditions were selected, to which, at the next stage, an electronic survey questionnaire was sent. The research yielded 41 responses, but after the analysis and elimination of incomplete questionnaires at the third stage, 36 questionnaires remained, completed by members of the management team of 25 SMEs and 11 large enterprises which operate in the following sectors: energy, construction, medical, automotive, packaging and plastics and plastic products.

## 4. Results

As mentioned above, both large enterprises and SMEs play a significant role in the implementation of a circular economy. However, researchers (Rizos et al., 2015; Tackas et al., 2022) point out that, above all, the activities implemented by SMEs can solve many environmental problems, as a result of the overly extensive use of natural resources, increasing levels of pollutant emissions and a short lifespan of manufactured products and materials used.

The specifics of SME operations obviously differ significantly from those of large enterprises. Among other things, many SMEs are characterised by individualised leadership and management styles (Rizos et al., 2015), a less formalised organisational structure, and greater flexibility to adapt to changing environmental conditions (Jenkins, 2006). Tackas et al. (2022) also note that, SMEs (as opposed to large enterprises) tend to have a rather low level of knowledge about the concept of a circular economy. However, the results of the survey indicate that up to 75% of respondents know and understand the principles of such an economy. The topic of a circular economy was introduced to them as part of the educational activities conducted in their companies, including in particular training for newly hired employees, periodic training or position training on waste segregation. In addition, 76.9% of the companies surveyed conducted reviews/audits to identify where and why waste is generated. More complex activities, such as life cycle assessments, were implemented in only 2.9% of the companies.

### 4.1. ReSOLVE model analysis

The ReSOLVE model groups the core activities from a microeconomic perspective that form the basis for building circular business models into the following thematic areas: Regenerate, Share, Optimise, Loop, Virtualise and Exchange.

**Regenerate** - One of the measures conducive to the development of a circular economy is the use of renewable energy sources. The results of the study indicate that Silesian SMEs are far superior to large enterprises in this regard. As many as 30% of the SMEs surveyed use renewable energy sources, while for large enterprises the percentage is only 17%. Photovoltaic cells and solar collectors dominated among the indicated energy sources, although respondents

also mentioned heat pumps, biomass and cogeneration of biogas from methane fermentation of sewage sludge and biodegradable industrial waste.

**Share** - In terms of sharing available resources, both SMEs and large companies implement practices leading to the development of a circular economy. According to the survey, enterprises share their resources with other entities to a greater extent than they use such resources themselves (23% and 7% for SMEs, 50% and 17% for large companies, respectively). Furthermore, SMEs reuse products that are technically sound and approved for use (second-hand principle) to a much greater extent than large enterprises (40% and 17% respectively). On the other hand, taking maintenance measures to extend the life of used products is more characteristic of large enterprises (67%) than smaller companies (47%). Similarly, probably for financial reasons, large companies are more likely than SMEs to design products to ensure a long-life cycle (50% and 20% respectively).

**Optimise** - Optimisation measures are not insignificant for the development of a circular economy. These can take the form of, for example, the use of big data, automation, remote sensing, remote control systems, etc. (EMF, 2015b). The results of the study indicate that large enterprises outperform SMEs in all the issues analysed. They strive to increase the efficiency of product manufacturing, reduce waste production (100%), use systems/equipment that optimise the use of water, materials or energy (67%) and introduce activities leading to a reduction in resource consumption (67%). As part of optimisation, companies also aim to minimise losses, e.g. energy or material losses. Among the companies surveyed, both SMEs (43%) and large enterprises (67%) take such measures.

**Loop** - The possibility of reusing products (or their components) to create new ones is among the practices conducive to a circular economy. It is believed that the production of such products is associated with a reduced negative impact of production activities on the environment, e.g. through reduced consumption of raw materials, including energy, and reduced emissions of pollutants to air, water and soil. A significant proportion of the surveyed enterprises: 36% of SMEs and 67% of large companies, implement practices aimed at collecting used materials (mainly plastics, paper, metals and glass), as well as other waste, such as electro-waste (batteries, fluorescent lamps, light bulbs, accumulators), used oils, used filters (air, oil), cleaning cloths, etc. When assessing the activities of both groups of the surveyed entities in the area of waste collection, it can be concluded that it is at a comparable level. The analysis of the results also shows that 43% of the surveyed SMEs first dispose of the above waste to recycling plants and then sell it (30%). More often than not, these enterprises reuse products within their company (17%) or store them (10%). Large companies follow the same hierarchy, but on a larger scale: sending waste for recycling (67%), selling (50%) or reusing it within the company (17%). These companies additionally transfer waste to other entities that use it in their production processes (50%), which promotes the creation of external closed material cycles. It is noteworthy that 34% of the respondents stated that activities involving the use of materials from one or more products to create a new product do not contribute to lowering its quality. Therefore, for the purpose of production of new products,



both groups of surveyed companies use materials (waste) from their enterprises (this strategy is implemented in 20% of SMEs and 17% of large enterprises, respectively). As part of their activities, respondents also declare recovery of raw materials, understood as a process aimed at utilising part or entirety of waste, substances, materials and energy for reuse. Such activities are carried out by 30% of surveyed SMEs and more than twice as much of large enterprises (67%). Cardboard, pallets and plastics are among the most frequently mentioned types of recovered raw materials. Companies convert their own waste into granulates, reuse process water and rainwater (e.g. by creating closed cooling water circuits), and use waste heat or biogas to generate electricity. The surveyed companies also use electronic parts from old and worn machines to repair other equipment.

**Virtualise** - In terms of reduction of raw material consumption, the surveyed companies are increasingly implementing virtual services. These mainly consist of conducting meetings with the use of online communication and virtual workflows. According to the survey, 37% of SMEs and 100% of large companies use this way of working. Respondents mostly prefer web-based software that enables calls, meetings, conferences and training (e.g. via Skype, WebEx), as well as the exchange of short information (e.g. WhatsApp, Messenger). Entrepreneurs also use email to transmit, for example, e-invoices and other documents. Some of the respondents also use cloud computing, public clouds for document storage, measurement visualisation technologies, control systems, virtual connection systems to customer-operated equipment, and virtual advisors in the customer services.

**Exchange** - The last category of activities which leads to the realisation of the idea of a circular economy includes the application of new technologies and the modernisation or replacement of existing solutions with new ones. According to the survey, 30% of SMEs and 83% of large enterprises undertake such activities. Among the most frequently implemented new technologies, respondents indicated: automation of technological lines and processes, water-saving technologies, technologies which enable production of compostable packaging, printing of films with water-based paints, powder painting instead of solvent painting, the possibility of using energy-saving lighting, as well as specialised technologies, such as laser cutting of steel. The surveyed enterprises also declare the use of modern products and/or services (27% of SMEs and 33% of large enterprises, respectively). Furthermore, among the activities contributing to the replacement of worn equipment and the change of economically unprofitable and environmentally burdensome production methods, the respondents mentioned activities which comprised, as follows:

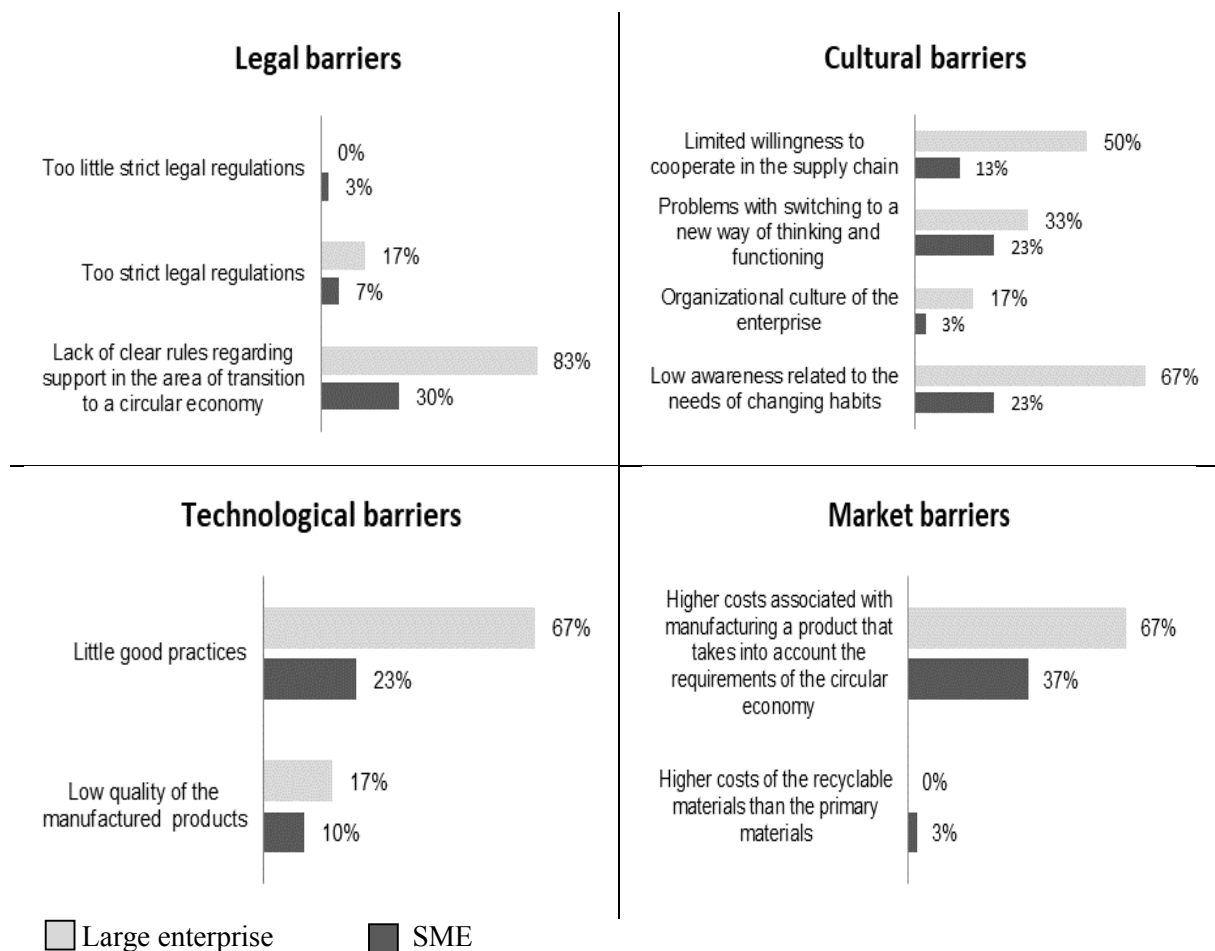
- constant search for new technical solutions for the construction and automation of technological processes,
- use of state-of-the-art materials and electronic solutions in products (signing a contract with a company that provides consulting services and then guidelines on new ways/methods of operation),
- use of compostable raw materials,

- implementation of modern IT systems, and
- use of telemetry for monitoring the district heating network.

All the above-mentioned activities are necessary and essential for the development of a circular economy, but their implementation may be hindered (or even prevented) by the existence of various types of barriers to execute them.

#### 4.2. Barriers and benefits of implementing circular economy initiatives

Both theoretical and empirical in nature studies whose authors identify and classify the barriers that hinder (or prevent) companies from implementing circular business models are new but increasingly popular research trend in the literature related to a circular economy. In this article, the barriers are grouped into the four most common areas related to a circular economy in the literature (Ritzen et al., 2017; Kirchher et al., 2018; Jesus et al., 2018; Oluleye et al., 2022; Rizos, Bryhn, 2022; Takacs et al., 2022). Prominent among these were: (1) cultural barriers; (2) legal barriers; (3) technological barriers and (4) market barriers, and Figure 1 highlights the issues that further characterize them.



**Figure 1.** Barriers hindering the implementation of circular economy initiatives by Silesian enterprises. Source: own study.

The results of the research presented in Figure 1 indicate that the impact of individual barriers on the implementation of the assumptions of a circular economy is different depending on the size of the surveyed enterprises. Thus, for large enterprises, the hierarchy of the main barriers is as follows (barriers have been ordered in descending order, guided by the number of responses): (1) lack of clear rules regarding support in the area of transition to a circular economy (legal barrier); (2) low awareness related to the need of changing habits (cultural barrier); (3) few good practices (technological barrier); (4) higher costs associated with manufacturing of a product that takes into account the requirements of a circular economy (market barrier) and (5) limited willingness of actors in the chain to cooperate (cultural barrier).

The obtained results indicate that appropriate institutional and regulatory support is one of the most important factors that support the implementation of circular economy initiatives by Silesian companies. The lack of clear political and legal rules to support the activities undertaken by companies (e.g. waste collection and sorting or quality assurance of secondary materials) is a key barrier to the implementation of circular business models. Similarly, insufficient awareness of management team members and employees related to the need to change habits, resulting, *inter alia*, from the lack of adequate knowledge management on a circular economy in enterprises, is a factor that significantly limits the search for and implementation of possible circular solutions. The identified barriers are all the more significant as they affect both groups of entities surveyed.

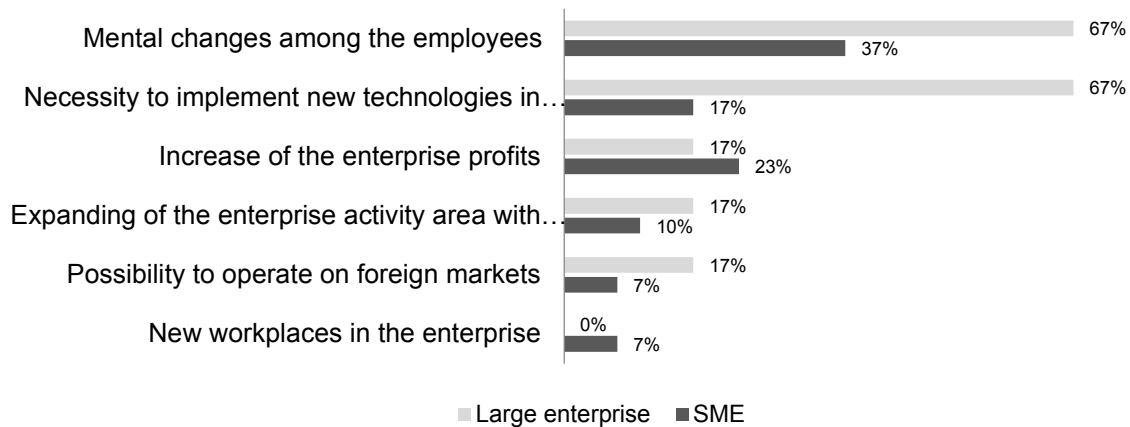
As far as the difficulties encountered by the surveyed SMEs in implementing initiatives related to the implementation of the closed loop economy are concerned, these are as follows: (1) higher costs associated with manufacturing a product that takes into account the requirements of a circular economy (market barrier); (2) lack of clear rules regarding support in the area of transition to the circular economy (legal barrier); (3) low awareness related to the need to change habits (cultural barrier); (4) problems in switching to a new way of thinking and functioning (cultural barrier) and (5) few good practices (technological barrier).

The results of the study confirm the findings of the literature (Oluleye et al., 2022; Rizos, Bryhn, 2022), according to which a lack of financial resources is one of the most frequently cited barriers for companies to implement circular business models. Although the level of investment needed to implement particular practices resulting from the ReSOLVE model may vary, some activities (e.g. the introduction of advanced high quality recycling technologies) require significant financial investment, which is a significant barrier, especially for SMEs.

To summarize, the surveyed companies perceive barriers in each of the four areas mentioned (cultural, legal, technological, market). In addition, it is worth noting that barriers belonging to the cultural area are most frequently mentioned, including, *inter alia*, limited willingness of entities to cooperate in the supply chain. Such results may be due to the fact that, compared to the linear model, building links that close product and material flows implies greater complexity in the supply chains. Moreover, it should be borne in mind that some of the markets for materials and components necessary for the implementation of closed-loop flows

are still in the development stage, which creates additional difficulties, especially for SMEs (Rizos, Bryhn, 2022).

Respondents were also asked whether they see benefits associated with building circular business models as a derivative of implementing the newly emerging trend of circular economy development. The results of this part of the survey are summarised in Figure 2 below.



**Figure 2.** Benefits flowing from the implementation of circular economy initiatives by Silesian companies.

Source: own study.

Analysing the obtained results, it can again be seen that they heavily depend on the size of the enterprise. The systematisation of benefits shows that, despite differently distributed percentages, both large enterprises and SMEs see the same benefits from building circular business models, yet with a notable difference that members of the management team of large enterprises do not see the prospect of new jobs being created in connection with the implementation of circular economy assumptions.

## 5. Discussion and conclusion

Despite increasing environmental degradation, most economies in the world (including the Polish economy) still operate based on a traditional linear model of economic activity, which does not take into account the environmental burdens generated by production and consumption processes and the natural limits of economic growth. This conclusion is based on the fact that, in 2020 and 2021, only around 10 per cent of the global economy met the requirements of a circular economy (Oluleye et al., 2022; Takacs et al., 2022), despite the assumed significant and measurable benefits.

It is estimated that the implementation of a circular economy (including, inter alia, eco-design, waste prevention and maximisation of reuse) can bring benefits in the form of economic growth, through the creation of new businesses and jobs, as well as resource, material

and energy savings and reductions in waste generation and emissions. The European Commission has estimated that the effect of implementing the aforementioned economic transformations could result in gains estimated at €600 billion for the EU manufacturing sector alone (EMF, 2013; Kalmykova et al., 2018). According to the European Commission (EC, 2019), as early as in 2016, sectors relevant to a circular economy employed more than 4 million workers, an increase of 6% compared to 2012. In 2016, circular activities such as repair, reuse or recycling generated almost €147 billion in added value, contributing to investments worth around €17.5 billion (Eurostat, 2019).

Although both practitioners and academics point to the necessity of implementing the concept of a circular economy, many businesses still find it difficult to comply. This is why research carried out at the organisational level, the results of which can help businesses plan their strategies and then build circular business models in the future, becomes so important. Guided by such a practical rationale, this paper assesses the extent to which Silesian companies are implementing circular economy initiatives with the use of the ReSOLVE model, a research framework widely accepted in the literature and used in many previous studies (Jabbour et al., 2019; Kouhizadeh et al., 2020; Superti et al., 2021; Warwas et al., 2021; Tedesco et al., 2022).

Developed by the Ellen MacArthur Foundation (EMF, 2015b), the ReSOLVE model groups circular activities undertaken by companies into the following thematic areas: Regenerate, Share, Optimise, Loop, Virtualise and Exchange. Within each of these areas, examples of specific implementation strategies are listed. Each strategy illustrates how, with the help of modern technology, existing activities can be changed to fit into a circular economy model. All these activities can be characterised by increased resource utilisation, extended resource life and a shift from the use of non-renewable resources to renewable ones (Kalmykova et al., 2018).

On the basis of the conducted research, the surveyed SMEs were found to be significantly more active (while compared to large companies) in the use of renewable energy sources (Regenerate) and the reuse of worn products that are technically sound and approved for use (Share). The obtained results are in line with the available literature (Sohal et al., 2022; Sohal, De Vass, 2022; Tedesco et al., 2022), both in the context of activities included in Share and Regenerate. With regard to the first group of activities, Neves and Marques (2022) highlight not only their relevance, but even indicate that a sharing economy can be captured as a sub-dimension of a circular economy. In contrast, with regard to the second group of activities, Cavicchi et al. (2022) emphasise the key role of energy management capabilities in the context of building circular business models by SMEs, while Sirin et al. (2022) highlight the need for institutional support for SME activities (e.g. renewable energy subsidies), so as to discount adverse macroeconomic conditions.

In contrast, the advantages of large enterprises are as follows: designing products in a way that ensures their longer life cycle (Share), reducing waste production and using systems/equipment that optimise resource consumption (Optimise), recovering raw materials (Loop), implementing virtual services (Virtualise), and upgrading existing or using new

technological solutions (Ex-change), among others. As part of the optimisation, large companies also seek to minimise losses, e.g. in terms of energy or materials. These measures mainly focus on the selection of equipment with low energy consumption and high efficiency. The operation of these facilities is subject to frequent monitoring, and any deviations within the operation are immediately corrected. Companies strive to use materials rationally, use recycled raw materials in production and order finished components/semi-finished products that do not require additional processing (reduction of energy consumption, own equipment, etc.). The use of such measures contributes to the optimisation of the working time of production equipment and employees, which consequently reduces the consumption of primary resources (Dev et al., 2020; Ghobakhloo, 2020).

The study shows that initiatives related to the implementation of a circular economy by Silesian enterprises may be hindered by the existence of many barriers, including cultural, legal, technological and market ones. These barriers are characterised by different strength of influence, depending on the size of the enterprise. In relation to large entrepreneurs, legal barriers were indicated by respondents as the most significant (lack of clear rules concerning support in the area of implementation of circular economy assumptions), while in the SME group the market barriers, including in particular higher costs related to the production of circular products, were pointed out most frequently. Other often mentioned barriers also included cultural issues, i.e. low awareness related to the need to change habits, problems with switching to a new way of thinking and functioning, and limited willingness of entities in the supply chain to cooperate with each other.

The results of the conducted research clearly indicate the need for specific remedy actions both at the company level and, in particular, from a macro-economic perspective. Indeed, the reduction of regulatory barriers can only be achieved through a coordinated action by policymakers, politicians and industrial practitioners to promote initiatives related to the implementation of a circular economy that are already being implemented by companies, and to establish strategies to implement practices that are still underutilised (Tedesco et al., 2022). Cultural barriers, on the other hand, can be overcome by promoting public dialogue and involving private and public media, non-profit organisations, as well as research and academic institutions (Oluleye et al., 2022). Moreover, organising seminars, trainings and workshops for entrepreneurs can lead to increased awareness of the benefits of implementing circular business models and thus overcome negative attitudes towards the need for change. The provision of funding for R&D and innovation projects, as well as the introduction of economic instruments (e.g. tax incentives for circular businesses), which can significantly reduce market barriers, especially for SMEs, should also be a key course of action to enable circular economy implementation initiatives by businesses (Rizos, Bryhn, 2022).

From the theoretical point of view, the results of the conducted research confirm, within the conditions of the Polish economy, the usefulness of the ReSOLVE model for identifying and mapping activities that constitute the basis for building circular business models by enterprises.

Thus, the described research framework can be used not only in subsequent studies conducted in the Silesian Voivodeship, but also in other organisational contexts which take into account the conditions of business environment in the Polish economy. Another postulated direction for future academic research is to complement the results described in this article with a detailed analysis of sectoral differences in terms of identified barriers and benefits of initiatives related to the implementation of a circular economy by Silesian enterprises. In addition, it would also be interesting to conduct representative quantitative research, the results of which would allow verification of the conclusions described in the article. This is particularly needed with regard to the Silesian Voivodeship, which is one of the most industrialised, second most populous and second most urbanised area in Poland (Eurostat, 2019a, 2019b; BDL, 2019).

Although the purpose of the current study has been achieved, it is burdened by several important limitations. The most important reservation is the low representativeness of the sample (which is a result of its purposeful selection) and its relatively small size, which significantly limits the universal validity of the conclusions drawn. Other limitations of the study include the focus exclusively on companies operating in the Silesian Voivodeship, as well as the significant level of generality in the description of activities undertaken by the respondents. Despite the above-mentioned limitations, this article provides important insights into the implementation of a circular economy concept in enterprises located in the southern part of Poland. In addition, identifying the benefits and barriers to the implementation of such practices contributes to a better understanding of how activities leading to closed product and material cycles should be promoted in the Polish economy

## Acknowledgements

This paper was carried out within the framework of the statutory work of the Central Mining Institute in Katowice (Poland), No. 11153019-340.

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