Journal of Cleaner Production 503 (2025) 145355

Contents lists available at ScienceDirect

Journal of Cleaner Production

journal homepage: www.elsevier.com/locate/jclepro

Exploring circular economy in the United Kingdom based on LinkedIn data from company profiles

Georgios Tsironis [a], Rylan Cox [b], Mark Jolly [b], Konstantinos Salonitis [b], Konstantinos P. Tsagarakis [c,*]

[a] Department of Environmental Engineering, Democritus University of Thrace, Xanthi, Greece
[b] Sustainable Manufacturing Systems Centre, School of Aerospace, Transport and Manufacturing, Cranfield University, UK
[c] School of Production Engineering and Management, Technical University of Crete, Chania, Greece

ARTICLE INFO

Handling Editor: Xin Tong

Keywords:
LDA
LinkedIn
Circular economy
Text mining
Topic modelling

ABSTRACT

This work explores the landscape of Circular Economy within the business domain through an innovative approach to topic modelling applied to 1396 LinkedIn company profiles in the UK. We explore thematic structures within a dataset curated through the LinkedIn search engine prompt for companies related to the Circular Economy. Leveraging Latent Dirichlet Allocation models, we identify topics that encapsulate the essence of circular and sustainable business practices. Our findings unveil key thematic clusters, including "Waste Management and Environmental Impact," highlighting companies at the forefront of waste reduction and eco-conscious industry practices. Another significant cluster, "Sustainable Solutions and Customer-Centric Approach," delves into businesses seamlessly integrating sustainability across product design and customer interactions. Lastly, "Green Technology and Community Building" sheds light on companies excelling in green technology and actively contributing to environmentally responsible global networks. Topic modelling is employed as a powerful tool for unravelling complex business narratives and fostering a holistic approach to sustainable practices.

1. Introduction

The drive towards a net zero world and sustainable future is under intense debate in government press, company sustainability reports, academic journals, and news outlets. The UK has been a significant contributor to carbon emissions throughout history. During the Industrial Revolution, before any indications of climate change, the UK was full steam ahead in generating emissions. Since the awareness of human impact on the planet has grown, the UK has committed to environmental targets to achieve net zero by 2050, having passed it as law in various binding documents (GOV UK, 2023; Kourmouli and Lesniewska, 2023). Net Greenhouse Gas (GHG) emissions have dropped by 48 % since 1998, however, the UK government has committed to a further 68 % by 2030 and 77 % by 2035 (GOV UK, 2023; Government, 2023). As of 2022, total UK GHG emissions per annum were 417.1 $MtCO_{2e}$, which needs to be reduced by a further 321.17 $MTCO_{2e}$. Although this number is a cumulation of emissions from the energy, transport, private, business, and public sectors there are many factors internal and external to the UK that drive change in emissions. In the UK it is understood that production, consumption, and waste of raw materials contribute a significant proportion of GHG emissions (Raabe et al., 2022). In mainland Europe, they account for 40 % of total GHG emissions, of which almost 50 % of this number is attributed to raw material collection and refining alone (Nelen and Bakas, 2021). Understandably, this is a significant cause for concern when material demand is increasing, potentially driving higher emissions from material mining, collection, and refining.

To target a reduction in emissions within these areas, the Circular Economy (CE) can be introduced as a strategy for always keeping material in the useable cycle and minimising the amount of virgin resources extracted by ensuring no valuable materials end up as waste whilst securing more jobs and boosting the economy (Ellen MacArthur Foundation, 2017; Nelen and Bakas, 2021). The amount of extracted material is expected to rise from 100 billion tonnes in 2020 to a predicted 190 billion tonnes by 2060 compared to 143 billion tonnes if more sustainable approaches are adopted (Oberle et al., 2019). Although the CE can dramatically reduce climate change, statistical findings indicate that due

* Corresponding author.
E-mail address: ktsagarakis@tuc.gr (K.P. Tsagarakis).

https://doi.org/10.1016/j.jclepro.2025.145355
Received 10 May 2024; Received in revised form 11 September 2024; Accepted 20 March 2025
Available online 21 March 2025
0959-6526/© 2025 The Author(s). Published by Elsevier Ltd. This is an open access article under the CC BY license (http://creativecommons.org/licenses/by/4.0/).

to the growing population and increasing demand for materials, materials re-entering has declined from 9.1 % in 2018 to 7.2 % in 2021 (Circle Economy, 2023). If total CE could be implemented, it would result in a drop of 34 % in material extraction emissions and limit the global temperature rise to 2 °C (Circle Economy, 2023). Focusing on the UK, an emissions reduction increase of 45 % would significantly benefit the UK's path to net zero targets (Sakrabani et al., 2023). The Waste Resources Action Plan (WRAP) states that a CE implementation could provide a financial benefit of up to £23 billion per annum if implemented correctly. CE in the UK mostly targets waste-to-energy (Gatto, 2023a) or automotive remanufacturing (Harris et al., 2023). Sakrabani et al. (2023) support that CE implementation within the agricultural sector strives to close nutrient, energy, and water cycles, reducing energy and fertiliser use resulting in a "Circular Nutrient Economy". For other sectors utilizing the CE, it becomes more complex due to a variety of reasons. In aerospace manufacturing, aluminium recycling is not directly feasible for recycling due to client requirements and regulations, an inherently complex alloying composition, and the requirement for very low impurities to maintain material performance and is therefore downcycled, (Das and Gilbert Kaufman, 2007; Yang et al., 2012a). Meanwhile, the lack of an available market for recycled materials, high cost, and lower quality of recyclates is a concern for other materials such as composites (Yang et al., 2012b). Therefore, there needs to be a strategy of implementation to enable CE to operate successfully in all sectors driven by innovation. Daglis et al. (2023) identified several CE implementation strategies by various international organizations such as the Ellen MacArthur Foundation, WRAP or Circular Europe (European Parliament, 2023). Yuille et al. (2022) discussed the requirement for a reorientation and reframing of UK government policy that systematically integrates different departments and strategies rather than following one strategy. Although the UK has slowly been transitioning from linear to CE, it has lacked unanimous agreement with its regulator policy among its four nations and within the nations themselves (Kourmouli and Lesniewska, 2023).

Further, the competitive nature between businesses has created a market for sustainable product development and manufacturing with resource efficiency being prioritised. The business model of CE can vary depending on which European policy is followed, however, Greer et al. (2023) identified that if businesses take a more holistic approach to the CE and incorporate more than one policy into their business approach, it will improve operational flexibility and reap the benefits of the CE. The CE appears to be an improvement for many businesses as it projects many positive outcomes, yet implementation and transition are where the major problem lies, hence, the CE is only beginning to emerge. Aguilar-Morales et al. (2023) pointed out that a minority of social groups are stepping up to tackle climate change and minimise waste, but overall, there is a lack of collective societal movement to fully enable recycling behaviour and therefore a total CE, admitting that society does not want change when it impacts them personally.

Social media such as X (formally Twitter) and LinkedIn have been massive influencers on climate change, with millions of people vocalising their opinions and spreading awareness to every corner of the world, but with limited action taking place or geopolitical issues hindering or at times reversing any positive impacts. Further, these sources are rich in data to identify qualitative information about what industries are doing in the form of LinkedIn as well as identifying personal profiles with high influence in various themes of work, (Chen et al., 2021; Kasturi et al., 2023; Tsironis et al., 2023). As of April 5, 2024, there are approximately 68,700,000 company profiles on LinkedIn with around 5, 960,000 stated to be in or have offices within the UK or 5,890,000 specifically within England, Scotland, Wales, or Northern Ireland. LinkedIn has a unique search filtering system ideal for understanding industrial trends and opportunities, from categorising jobs in certain locations to identifying company information and influential members within an organisation while confined to a single theme that can provide a clear picture of how industries are developing.

A rather essential aspect of CE investigation through social media data is the threat of misleading information provided by companies that want to promote a circular and sustainable profile without actually meeting the requirements, (Kwon et al., 2024). This strategy aims to the maximization of a company's revenue (Topal et al., 2020), through the advertisement of green and sustainable products, services, and business models that usually do not meet the real situation (Amin et al., 2024). In this context, different social media platforms serve as a fairground for the direct dissemination of such activities. On the other hand, the LinkedIn platform has a significantly business-oriented direction with larger companies trying to align with their official reports. On the other hand, a LinkedIn data-driven analysis follows a logic similar to survey analytics as the profiles include information similar to those that would be provided in questionnaires.

This work aims to investigate the readily available LinkedIn data of 1396 company profiles based within the UK that report to be active in CE. The current study will identify the locations of CE and quantify the number of companies within the UK. Further, it focuses on which sectors CE companies are focused on and what trends and descriptors are on offer in these sectors by conducting a keyword analysis which is a current gap within the UK alone. The study positions itself as a UK first for observing trends within the UK business landscape in identifying how companies practice CE and use social networks to advertise their role. It will provide the baseline comparison of how UK industries are tackling climate change through CE businesses, aiming to compare to other European and international companies. Previous studies have outlined the availability and potential of social media data through various studies, yet a research gap in using UK-based LinkedIn company profiles to explore CE trends within the working market will be filled with this study. LinkedIn data is quantified through several methods, including headquarters locations, company followers, employee numbers, and company sectors. Topic analysis using Latent Dirichlet Allocation (LDA) analyses company descriptions identifying keywords and CE themes. Previous studies have analysed LinkedIn data with a similar methodology but focusing on specific sectors or wider locations (Daglis et al., 2023; Tsironis et al., 2022, 2023; Tsironis and Tsagarakis, 2023), alongside different approaches like time-series analysis utilizing panel data (Daglis et al., 2023). The requirement of such a study will help various stakeholders among industries to identify areas lacking CE implementation, and help to streamline policy-making for CE adoption that aligns and merges net zero goals based on the themes and trends identified in the LDA analysis for all industrial sectors. Additionally, will help collaborative innovation for sectors already involved with CE implementation by linking with others that are not as aware of the benefits of a CE and how it can be implemented.

Following the introduction, Section 2 reviews the state-of-the-art literature of CE in the UK, Section 3 outlines the methodology used. Section 4 presents the data findings, Section 5 the discussion, and Section 6 closes the paper with conclusions.

2. Literature review

First, is discussed the implementation of CE followed by the literature on assessing its progress. Then, the role of social media in data mining is addressed.

2.1. Circular Economy's implementation

The CE has many interpretations and descriptions, and there are many factors to measure the success of implementation within a location (Greer et al., 2023; Hondroyiannis et al., 2023; Kang et al., 2023; Kostakis and Tsagarakis, 2022; Kourmouli and Lesniewska, 2023; Kuhl et al., 2023; Pusz et al., 2023; Schroeder et al., 2019; Yuille et al., 2022). For example, the implementation of CE within European countries including the UK was found to be highly influenced by several factors. Kostakis and Tsagarakis (2022) identified that when a country had a

relatively high GDP, higher level of fertility, and higher environmental taxing on waste then the country had an improved material circularity. Interestingly, the study found that the level of education, although expected to produce a positive outcome, provided no improvement in material circularity. Hondroyiannis et al. (2023) highlighted the requirement to move away from the linear model of material usage to a sustainable and resilient CE approach that focuses on circularity with lower resource utilisation. The evolution of CE implementation revealed several changing patterns regarding the performance of main economic sectors and circular strategies in the European Union. De Pascale et al. (2023) identified varying sectors excelling in both CE implementation and policy introduction within the EU such as the chemical and polymer sectors for the production of bioplastics or agri-food sectors by creating economic wealth through circular strategies of either resource saving or recycling back into the market, which links directly to the Ellen MacArthur definitions and benefits (Ellen MacArthur Foundation, 2017). This is largely driven by stakeholders such as legislators and policymakers in the EU circular transition. Pusz et al. (2023) evaluated the link that social enterprises have on the development and integration of CE within a UK city, Hull. They noted that competition between different organizations is a major factor for limited integration of the CE, although in other sources the CE is stated to provide positive competition, (Ellen MacArthur Foundation, 2017; Pusz et al., 2023). Furthermore, it was noted that without external institutional support, there will be a lack of CE execution (Pusz et al., 2023). Schroeder et al. (2019) stated that the contribution of CE goals aligns with Sustainable Development Goals (SDGs), but the effective execution requires more effort in skill development, innovation, and multi-stakeholder partnerships to reach the end goal of net zero, again highlighting the requirement of additional collaborative efforts. Bowen et al. (2023) reviewed the CE within a post-COVID-19 hospitality sector in the UK stating the sector was highly interested in engaging with the CE, but the initial capital cost could not be risked in a fragile sector, even with the future economic and environmental savings from implementing the CE. The study developed managerial frameworks for companies to implement the CE with local communities but stressed there is a lack of government-level policy and support in promoting the CE within the hospitality sector. For SME's to successfully implement CE into their business a core and feasible value proposition is required. This was highlighted by Arranz et al. (2024) stating the first problem with SME's CE integration is the feasibility of the business model which must be carefully monitored and controlled by senior management. Additionally, for a successful implementation, the company must convert barriers into challenges that cover a range of environmental benefits that follow the CE principles branching into multiple success routes.

2.2. Evaluating the circular economy

The CE has been discussed in many different publications and analysed in different sectors and countries using a range of different methodologies. Text-based reviews often have a vast amount of information within them but can often be hard to quantify themes or quantitative trends from qualitative data. Data Envelopment Analysis (DEA) has been used in previous studies to determine a country's level of material circularity. Wu et al. (2014) used super-efficient DEA within 30 regions of China to assess the country's total level of circularity based on three sub-systems namely Resource Saving and Pollution Reducing (RSPR), Waste Reusing and Resource Recycling (WRRR) and Pollution Controlling and Waste Disposing (PCWD), all of which align with the criteria put forward by the Ellen MacArthur Foundation (2015). Their study found that although CE has been an important policy since 2005, the sub-system RSPR requires more attention for the country's overall CE score to improve, highlighting a strategic method for improvement, (Wu et al., 2014). The composite indicator has also been used to quantify the level of water-to-energy management using a CE within 17 European countries including the UK. The method used three dimensions which were the ratio of waste-based power production, production efficiency of waste production plants, and average production capacity. Of all the countries examined it established that only four had positive total indicators which were the UK, Netherlands, Denmark, and Germany (Gatto, 2023b). Hondroyiannis et al. (2023) utilised the panel data method to evaluate 27 European countries including the UK on the relationship between several factors including material circularity rate. Their study found that the expected circularity rate increased with the amount of waste recycled and vice versa as expected but it implied that many countries were consuming more materials than they could recycle. This again revolves back to the increase in material consumption discussed earlier and requires new innovative methods of recycling and other CE "R" statements. Aguilar-Morales et al. (2023) used bibliometric analysis to review marketing strategies and their approach to waste management globally. It enabled a review of the literature to identify study themes, most productive authors, research lines within abstracts, and map locations of research outputs for a significant amount of unstructured data. Their study identified the impact of social implications on the level of CE when it affects someone personally. Tamasiga et al. (2023) used systematic-cum-bibliometric review to analyse keywords, observing both frequency and clusters/themes within a literature review. The study investigated green industry policy transition to sustainability and identified that CE matched under keywords such as green growth, sustainability, and energy efficiency. Kourmouli and Lesniewska (2023) identified that more interest should be focused on policy for the transition to a CE and expand more than just resource efficiency, recycling, and recovery rates. The change would mean the policy would link Key Performance Indicators (KPIs) such as efficiency, use, reuse, recovery, recycling, and recovery in the entire life cycle.

2.3. Social media data mining

Social media has been a tool mostly used for sharing opinions and connecting people worldwide; however, the information provides a plethora of opinions and views for various research and marketing campaigns. Pusz et al. (2023) highlighted that social networks and digital technologies have massively facilitated CE implementation to spread awareness. Previous studies that have used LinkedIn as a data source include works by several authors. One study analysed LinkedIn data using panel data time series analysis for the CE and sustainability within Europe. The study provided a critical methodology that is transferable to other audiences and social media platforms such as Instagram, X, Facebook, and TikTok that can directly determine if sustainability is directly linked to the CE (Daglis et al., 2023). A follow-up to this study identified 3727 companies that contribute to a CE within the same audience identifying the keywords and trending themes of CE within Europe (Tsironis et al., 2022). A second study investigated LinkedIn finding correlations between fashion, apparel, and textile industries with the CE across the globe. The paper reported that several companies specifically state key CE routes such as repurpose, reuse, renew, resell, regenerate, repair, and recycle. Still, it highlighted the amount of "greenwashing" that social media platforms may pose (Tsironis and Tsagarakis, 2023). Similarly, the study by Knäble and Tsagarakis (2023) evaluated the CE within Germany using LinkedIn. The study at the time of writing identified 514 companies that actively engage in CE activities and noticed the trend is rapidly increasing. Like the fashion study, the same CE "R" keywords were being broadcast by the 514 German companies finding similarities of themes and activities with what companies state they engage in. Another sector that was assessed was the transportation ecosystem within the EU to map sustainable practices and concepts using LinkedIn data. In this study, Tsironis et al. (2023) focused on medium to large enterprises at a total of 1628 companies and identified that as company size increased so did their focus on sustainability concepts. The work highlights the impact the supply chain has within the realm of sustainability noting some companies use keywords such as sustainable supply chain and that the

supply chain was the key focus within this sector with links to sustainable energy usage. Having reviewed the literature there is a clear gap for LinkedIn data exclusively in the UK to be evaluated. It is envisaged that the UK follows a similar path of focus within the CE regarding its key "R" terms regarding recycle, reduce, and reuse as other countries in the EU and the rest of the world. As the UK is a G10 country it is expected the level of CE should be at an elevated level compared to most of the other countries or there is an explicit effort by industry to transition into a CE specifically for sectors such as agriculture, food and raw material processing. It is envisaged with previous studies that LinkedIn data can shine an insight into these statements.

3. Methodology

This section contains every step towards the execution of the analysis, following the existing methodology of Tsironis et al. (2022) enhanced with additional analytical methods. The idea behind this work is to explore the current trends in CE in the UK. For this reason, 1396 LinkedIn profiles of companies that include the CE term and have been registered as UK-based or affiliated are investigated. We have included all the companies available on the LinkedIn platform specifically for June 2023. Apart from the CE concept mapping, LinkedIn data fitting to the LDA model is evaluated, extending previous works of the authors regarding analytical diversity.

3.1. Text mining and data overview

Data volume, diversity, and validity are some of the most essential aspects of data analytics. Considering the extensive literature in bibliometrics and survey analytics in the field of CE, an alternative methodological approach has been adopted, which includes the data acquisition from the LinkedIn social media networking platform with a strong business and organizational character (Tsironis et al., 2022). The steps taken for the needs of this work are depicted in Fig. 1.

This study delves into exploring company profiles sourced from LinkedIn, leveraging the LinkedIn search engine with a specific focus on entities associated with the term "circular economy". LinkedIn, a professional networking platform, serves as a rich source of information on companies, encompassing diverse industries, sizes, and geographical locations. The platform's search functionality allows to pinpoint companies actively engaging with or expressing interest in the CE, providing a targeted and relevant dataset.

The extracted data is structured in CSV files, with each row representing an individual company and columns containing various profile sections such as industry, description, staff count, etc. This semi-structured format captures the nuanced details of companies' engagement with CE principles. The dataset's diversity mirrors the real-world landscape of businesses committed to sustainability and CE, creating a comprehensive foundation for our analysis. Profiles within this dataset are dynamic, reflecting self-registered information managed by profile administrators, offering a blend of structured and unstructured data. This characteristic introduces a layer of complexity, as the data is not rigidly defined but rather shaped by the companies themselves, providing an authentic representation of their commitment to CE practices.

Text mining techniques were subsequently employed in the company descriptions, a pivotal section that encapsulates the essence of each company's mission, vision, and operational focus. By applying advanced natural language processing methods, we aimed to uncover latent themes and topics within these textual descriptions, providing a deeper understanding of how companies articulate their involvement in the CE. This methodological approach not only showcases the adaptability of text mining in gleaning insights from diverse datasets but also underscores the importance of exploring real-world, self-registered data to reveal the multifaceted landscape of corporate sustainability initiatives.

3.2. LDA model

LDA stands as a powerful and widely employed technique in the domain of natural language processing (NLP) and text mining, initially proposed by Blei et al. (2003). In this study, LDA was selected as the methodology of choice for several compelling reasons. LDA is a generative probabilistic model used for discovering underlying topics within a corpus of text documents (Blei and Lafferty, 2007). It operates on the principle that each document in the dataset is a mixture of various topics, and each topic is characterised by a distribution of words (Madzík et al., 2023). By employing LDA, latent structures within company profiles on LinkedIn related to the CE concept can be

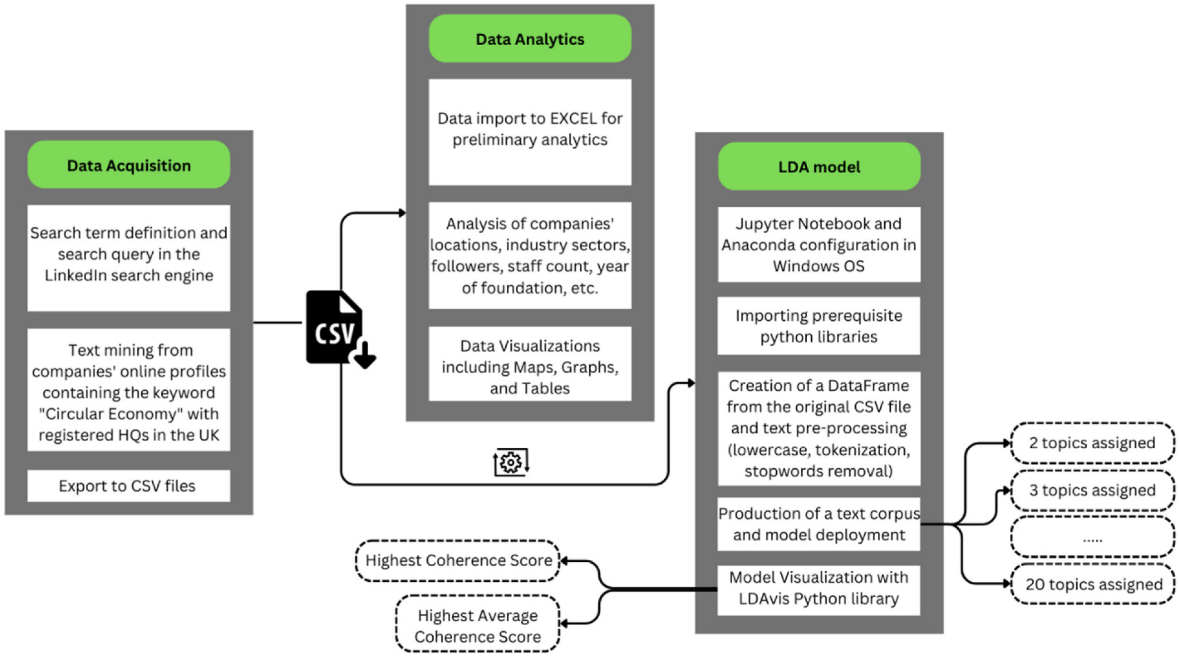


Fig. 1. Methodological framework.

uncovered. This technique enables the automatic extraction of topics from unstructured text data, thus offering valuable insights into the thematic landscape of companies' descriptions (Hagen, 2018). LDA's ability to handle large datasets, scalability, and proven track record in topic modelling made it a suitable choice for this study.

An LDA model is employed to unveil the prominent topics within company profiles. The model was systematically configured with a range of topics (2–20) to explore the optimal granularity for topic extraction (Syed and Spruit, 2017). This exhaustive exploration aimed to capture the nuanced thematic landscape present in these companies, providing a detailed understanding of the diversity and richness of their operational focus. Different hyperparameter configurations are systematically assessed to ensure the robustness of the topic modelling, specifically focusing on the alpha and eta (beta) values (Hasan et al., 2021). The alpha parameter controls the sparsity of document-topic distributions, while the eta parameter governs the sparsity of topic-word distributions. In Gensim's LDA implementation, the eta parameter corresponds to the beta hyperparameter, controlling the distribution of words in topics. Gensim uses eta instead of beta to stay consistent with the mathematical notation commonly used in LDA literature. A rigorous evaluation of coherence scores for each topic across diverse hyperparameter configurations identifies the most coherent and interpretable topics within the CE context. This thorough examination not only enhances the reliability of the findings but also sheds light on the sensitivity of the model to different hyperparameter settings, contributing to the methodological transparency and reproducibility of the study. However, Hasan et al. (2021) suggest that the coherence score can be misleading in some cases regarding the model fitting. This approach will be addressed in future research.

4. Results

In this section, the findings of the analysis are showcased. Section 4.1 includes the preliminary findings which describe in a general context the basic characteristics of CE-related companies facilitating in the UK. Section 4.2 explains the LDA model with the intermediate steps taken toward its deployment, and Section 4.3 concludes with a detailed interpretation of the results.

4.1. Preliminary findings

LinkedIn business profiles contain a wide range of qualitative and quantitative information that can effectively set the ground for diverse types of research. For a better understanding of the short-term evolution of the CE concept from the business perspective, an overview of the number of companies and job posts related to the CE in a two-year time frame is presented (Fig. 2). In this part, monthly observations are depicted, indicating the number of company profiles and job posts that contain the term "circular economy" in any part of the profile or post. The main reasons behind any monthly differentiation in companies may be the addition or removal of the CE term in their profile, the creation or deletion of a profile, and the addition or removal of the UK as a "headquarters" or "other locations" tag. According to these observations, the number of companies and job posts stabilized during the summer of 2023 with an increased gap between them compared to previous months.

4.1.1. Geographical distribution of companies

Initially, a descriptive analysis aiming to map the corporate presence of companies in the UK is performed (Fig. 3). Interestingly, only 157 companies are established outside the UK, which is 11.2 % of the total number of profiles found. The Netherlands, United States, Germany, and Ireland have the highest interconnection scores with 18, 16, 13, and 12 profiles, respectively. The geographical distribution is mainly concentrated in the EU-27 countries, with countries in Asia and Africa holding very low ranks (see Fig. S1 of the Supplementary Material file).

4.1.2. Mapping of the industry sectors in the circular economy

The CE is a multifaceted concept with many different applications across academic and industry sectors. Initially, 99 industry sectors were found among the company profiles included in our dataset (see Table S1 of the Supplementary Material file). Thus, aiming to highlight those industry sectors that are tangent to the CE, the companies' distribution across the industry sectors as the LinkedIn platform has classified them are visualized (Fig. 4). Interestingly, there is a high engagement of companies in the "Environmental Services", "Management Consulting", and "Renewables and Environment".

4.1.3. Evolution of the circular economy organizational landscape

The founding year of each company identified on LinkedIn was of particular interest. To assist the good visibility representations, organizations established before 1990 were excluded, aligning with the temporal boundaries utilised in similar research (Tsironis et al., 2022). Delving deeper, the founding date of these companies refers to their inception year, irrespective of when the term "circular economy" was incorporated into their profiles or even when their profiles were created in the platform (Fig. 5). For instance, a company might have originated in 2005, established a LinkedIn presence in 2018, and appended the term "circular economy" to its profile in 2021. Despite these varied timeline dynamics, the data highlights that the companies affiliated with the CE in the dataset predominantly emerged in the market landscape post-2014. This observation underscores the prevalence of numerous

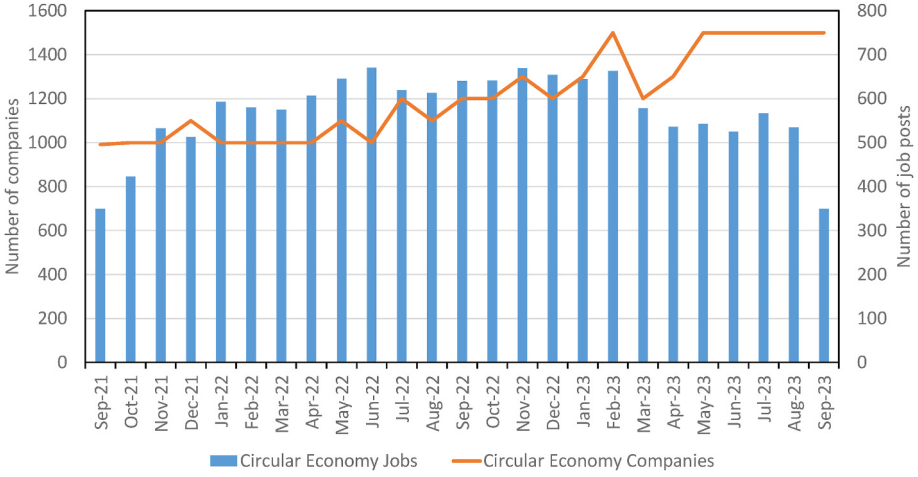


Fig. 2. The number of company profiles and job posts containing the term Circular Economy.

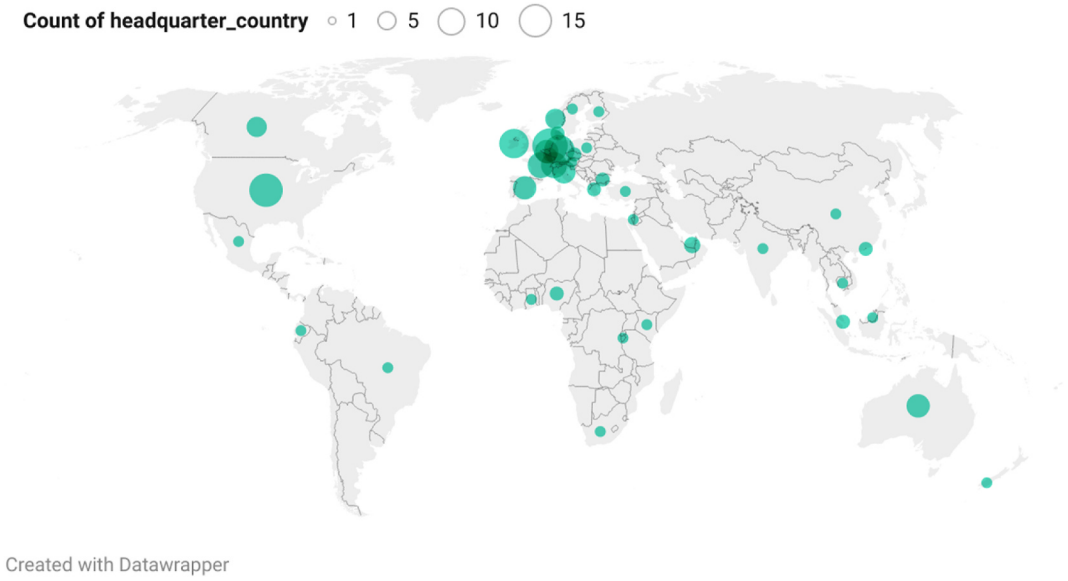


Fig. 3. Headquarters of companies with business activities in the United Kingdom.

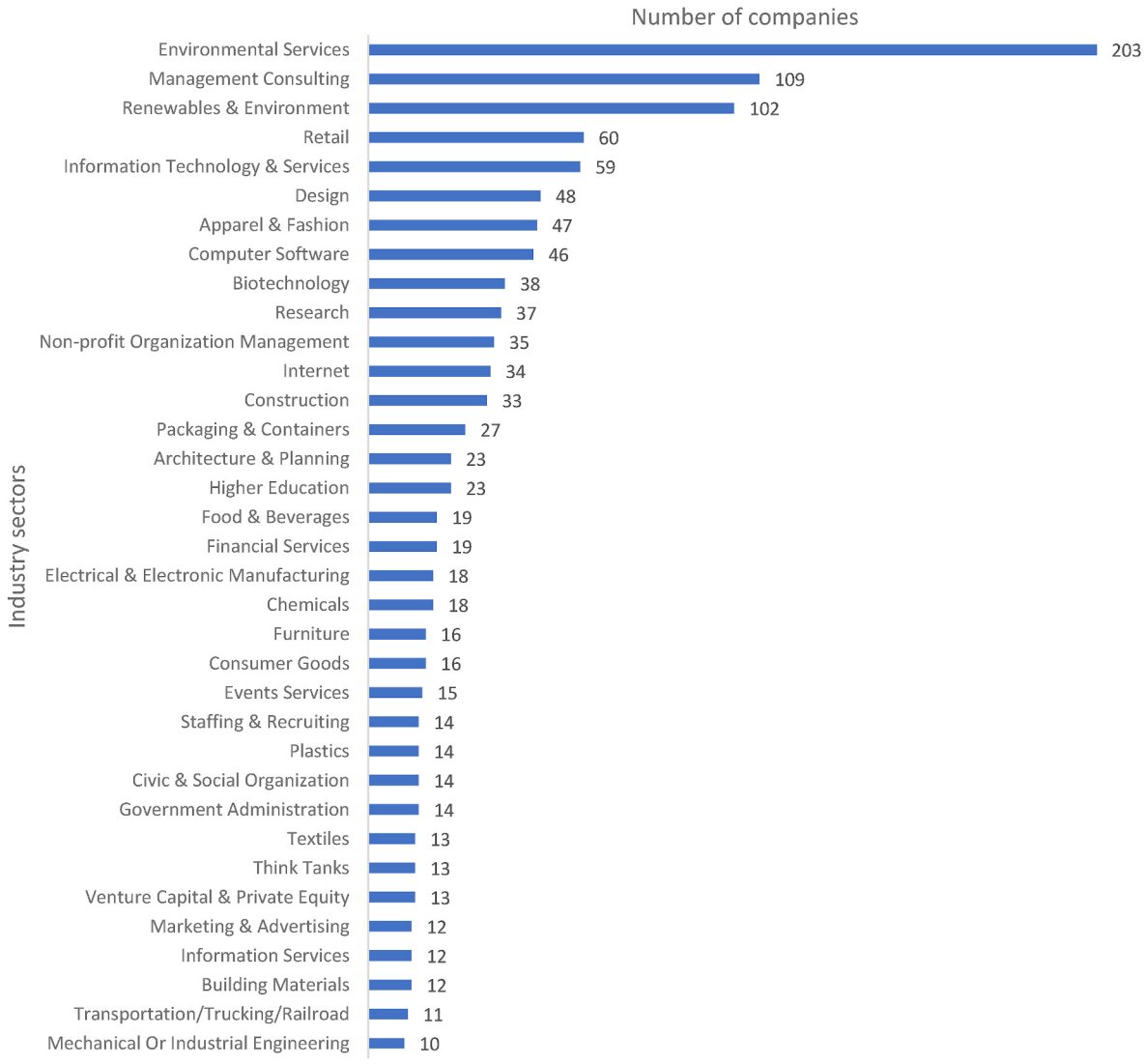


Fig. 4. Industry sector distribution for companies stating circular economy activities in UK.

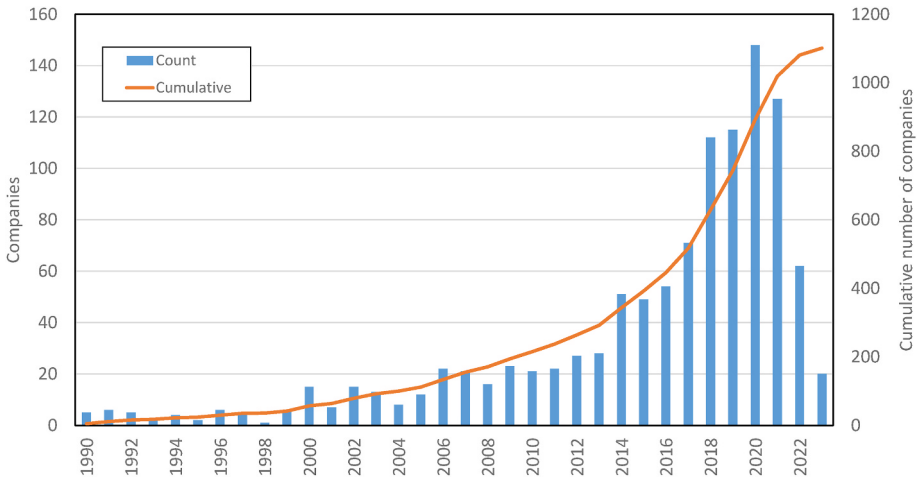


Fig. 5. Companies founded per year.

start-ups venturing into the CE sphere.

4.2. LDA model evaluation

Following the identification of the highest overall coherence observed in the 2-topic configuration, the stability and robustness of the identified topics were analysed. The average coherence for each topic was calculated, considering the scores emanating from different hyperparameter configurations (Fig. 6). This approach provides a nuanced understanding of the reliability and consistency of individual topics across various settings, ensuring a comprehensive evaluation of the model's performance in capturing the essence of the CE within the LinkedIn company profiles. It underscores the commitment to not only pinpointing the optimal configuration but also ensuring the reliability and interpretability of the identified topics across the broader spectrum of hyperparameter settings.

For the estimation of the most accurate model deployment among the different number of topics, there are some evaluation techniques involving the observation of the outputs or the multiple model deployment in the same number of topics to check whether there are similar results. Further, a quantitative metric is the calculation of the perplexity and coherence scores of the model. These two metrics can indicate the model performance in a comparative manner and not by absolute value. For example, an *X* model deployment with lower perplexity and higher coherence compared to a deployment *Y* means that *X* fits data more effectively than *Y*. As coherence is the most relevant metric in topic distribution, we considered the best-performing configuration in terms of coherence (see Tables S2–S20 of the Supplementary Material file). In this context, the model configuration with the highest average score has been the 3-topic which we further visualized and discussed in the following sections (Table 1).

The visualization process utilised the pyLDAvis library to transform complex topic modelling results into interactive and comprehensible visual representations. More analytically, pyLDAvis facilitates the exploration of topics' prevalence, inter-topic distances, and term distributions, offering a multi-faceted perspective on the underlying thematic structures. This interactive visualization tool significantly aids researchers and practitioners in navigating and interpreting the intricate relationships between topics, facilitating a nuanced understanding of the underlying data.

Fig. 7 encapsulates the theme of "Waste Management and Environmental Impact." A captivating interplay of circles reveals the prevalence of keywords within this topic, with words like "sustainable," "recycling," and "design" taking centre stage. The interactive nature of pyLDAvis enables users to hover over each circle, displaying the relevance and significance of individual terms. The size of the circles corresponds to the prominence of the terms within the topic, offering a visual hierarchy that aids in comprehending the thematic landscape.

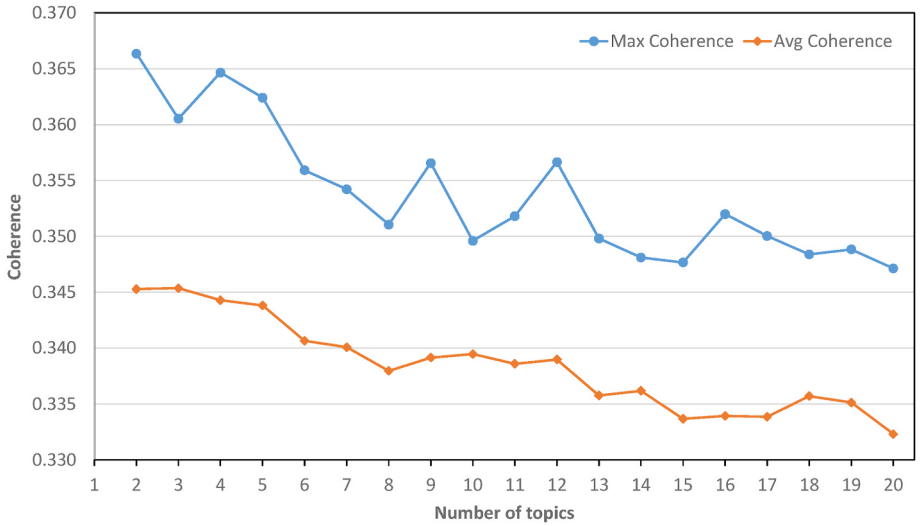


Fig. 6. Maximum and average coherence per topic configuration.

Table 1
Most salient topics' specifications.

Topic ID	Most salient words	Topic description	Percentage of tokens (%)
3.1	Waste, sustainable, product, sustainability, recycling, environmental, technology, plastic, material, resource, industry, impact, community, design, change, value, business, create, solution, energy, environment, service, global, reduce, carbon, social, fashion, company, innovative, market	**Waste Management and Environmental Impact** Companies in this topic focus on waste reduction and environmental sustainability. They leverage innovative technologies and materials to create solutions that positively impact communities and industries. By emphasizing recycling, sustainable design, and changes in industry practices, these businesses contribute to a global shift towards a circular economy.	40.3
3.2	Sustainable, product, solution, waste, design, customer, industry, carbon, energy, service, sustainability, environmental, material, technology, system, global, food, market, client, research, process, impact, business, environment, supply, value, social, create, community, project	**Sustainable Solutions and Customer-Centric Approach** This topic centres around companies that prioritize sustainability by offering products and solutions designed with a focus on the customer. Their business models encompass eco-friendly design, energy-efficient processes, and a commitment to reducing carbon footprints. These companies aim to make a global impact by integrating sustainability into every aspect of their industry, from research and development to market supply.	32.4
3.3	Sustainable, product, technology, material, energy, design, waste, solution, industry, global, customer, plastic, green, community, sustainability, process, platform, impact, company, environment, business, service, change, recycling, client, project, carbon, network, building, value	**Green Technology and Community Building** Companies in this topic excel in green technology, emphasizing the use of sustainable materials and energy sources. They focus on building a strong sense of community through projects that incorporate innovative processes and technologies. By providing sustainable products and services, these businesses contribute to a global network committed to environmental responsibility and positive societal change.	27.3

The second topic illuminates the thematic cluster centred around "Sustainable Solutions and Customer-Centric Approach" (Fig. 8). In this visualization, interconnected circles highlight keywords such as "sustainability," "design," and "customer," emphasizing the interconnectedness of these terms within the identified topic. As users delve into the interactive display, they can discern the prevalence of each keyword, gaining insights into the holistic integration of sustainability principles throughout the customer-centric business models depicted in this cluster.

Fig. 9 captures the essence of "Green Technology and Community Building." A symphony of circles showcases keywords like "green technology," "community," and "sustainable products." The visual representation underscores the cohesion of these terms within the topic, providing an intuitive understanding of the emphasis on green technologies and community-centric initiatives. This interactive visualization empowers users to explore the nuanced connections between keywords, offering a dynamic and insightful journey into the thematic fabric of sustainable businesses focusing on technology and community impact.

5. Discussion

The Ellen Macarthur Foundation (EMF) is regarded as one of the pioneers of the CE with the LDA analysis identifying that many companies in the UK are aligned with the framework proposed in their CE butterfly diagram (Ellen MacArthur Foundation, 2015). Topics' 1, 2, and 3 themes focus on waste management, green sustainable solutions, and utilizing sustainable materials, energy, and community building respectively. In the EMF butterfly diagram, each model topic overlaps with either the consumer wing or the collection wing through designing for sustainability ensuring processes have minimal waste and high efficiencies, and community building by raising awareness and working along the supply chain like the LDA themes. This study has highlighted several key themes that companies within the UK claim operations related to the CE. The LDA analysis has identified that many of the keywords and themes identified align with what is found within frameworks and concepts internationally and in various sources. The CE core concept is to keep material within a useable loop or simply prevent waste. The European Parliament's definition of the CE includes sharing, leasing, reusing, repairing, refurbishing, and recycling (European Parliament, 2023). The term waste was highlighted within the LDA analysis for each of the models and found in at least the top 10 of the most salient words as a trend to manage or sustainably deal with waste. Waste either minimising, reducing, or repurposing was the most popular term found across all companies evaluated aligning with what the CE aims to address. It was envisioned following the literature studies and trends of other countries within the EU and the rest of the world that the focus would revolve around waste management through Recycling, Reuse, or Renewal. Further keywords such as recycling or resources were found in the top 10 of Model 1 but started to decrease in popularity as a keyword when the company business topic or direction drifted to sustainable design and environmental improvement as in Topics 2 and 3. Interestingly as the models developed further, the trend of terms tended towards high-level related terms demonstrating the potential for companies to incorporate multiple CE categories within their LinkedIn profile to balance core information and keep the readers interested which was not anticipated when the study began.

The study has highlighted some of the geographical and numerical statistics of CE companies within the UK, based on the quantity, headquarters (HQs) location, job sector, and growth. A clear trend of growth with companies either transitioning into CE-focused tasks or developing CE start-ups and consultancies is shown in Fig. 5. Both Figs. 2 and 5 highlight an apparent reduction in growth for CE-related jobs and companies around the years 2020–2022. At the same time, the COVID-19 crisis and Brexit likely played a significant impact in this. In the UK, COVID-19 caused a dramatic fall in employment and economic activity. Hence, the drop in CE, like all other job types, is likely the result of COVID-19 (Powell et al., 2022). Additionally, Brexit has had a negative impact on the labour market due to the uncertainty, lack of trust in the UK government from companies, and lack of attractiveness for EU citizens to work in the UK (Spital and van Aerssen, 2023). It signalled a drop in jobs being filled and company creation, an estimated shortfall of 330,000 jobs could not be filled in the lower-skilled sectors according to one report (Springford and Portes, 2023). A recent study indicates the opposite with an increase in labour market efficiency, justifying this by a lack of international applicants, therefore, natives were accepted with

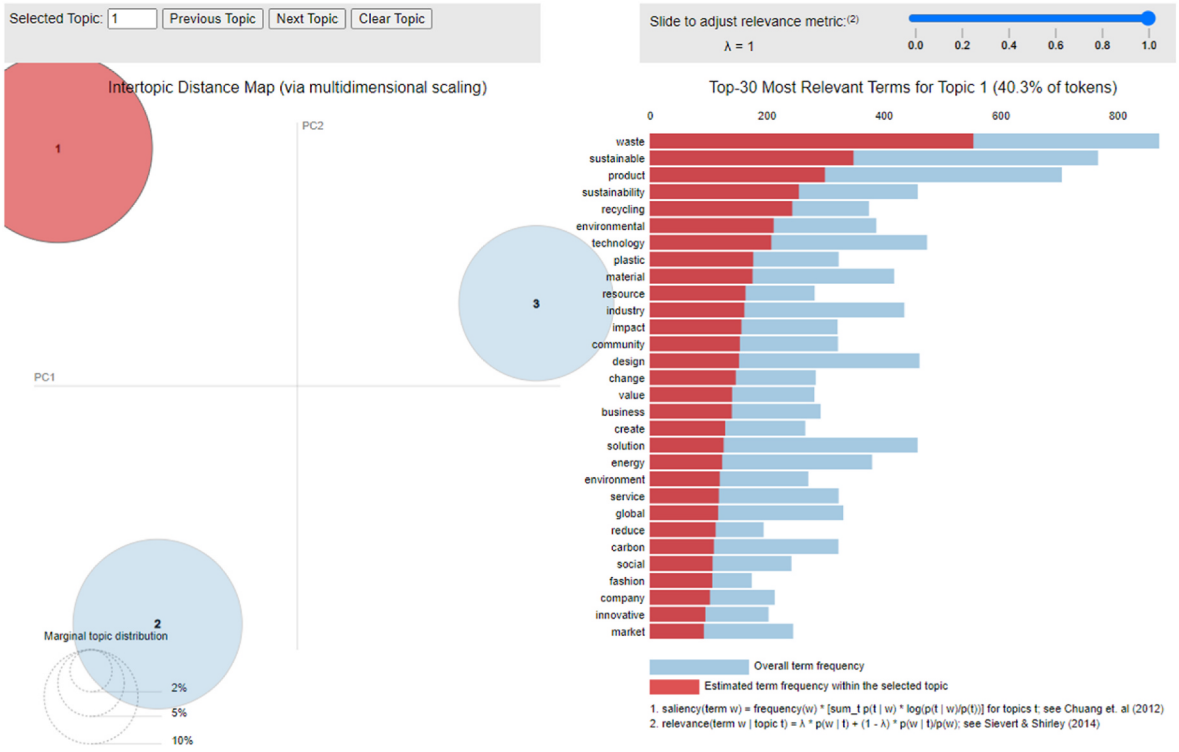


Fig. 7. Topic 1: Waste management and environmental impact.

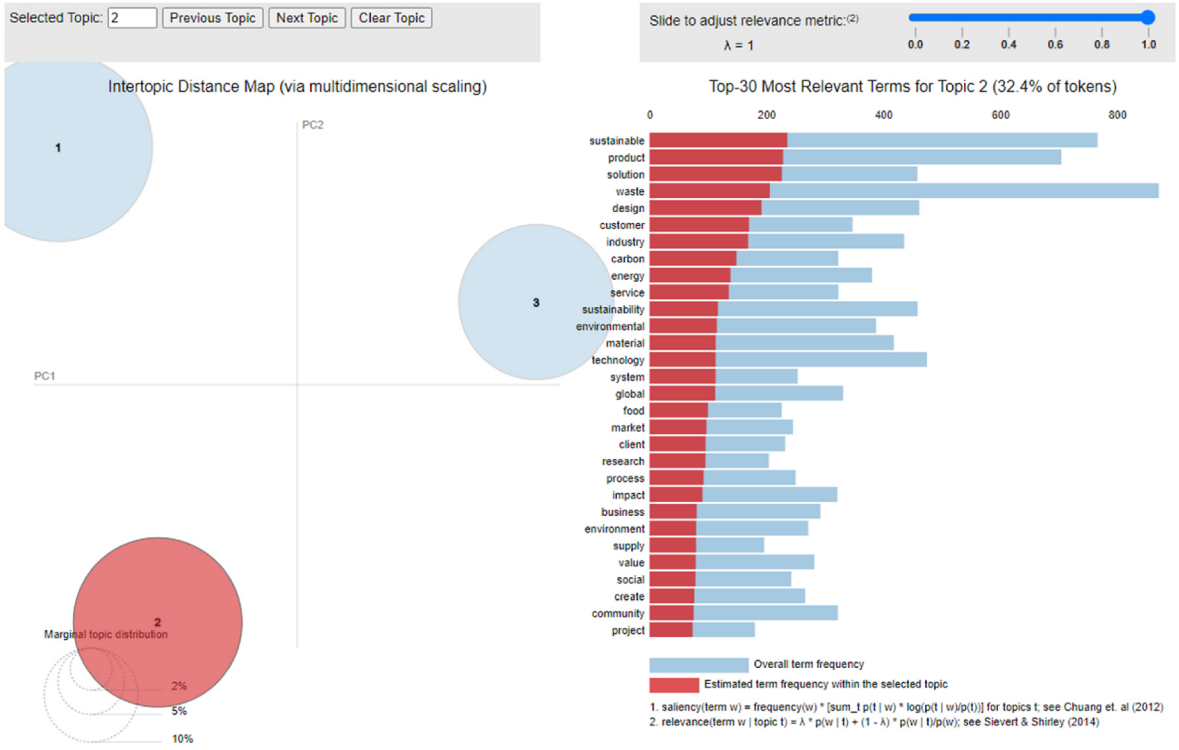


Fig. 8. Topic 2: Sustainable solutions and customer-centric approach.

specific sought-after skills which drove unemployment to low levels (Amuedo-Dorantes and Begen, 2023). Although unemployment was low, the reliance on EU migration meant there was a record high of jobs not being filled (Spital and van Aerssen, 2023). High-skilled jobs were mostly filled by non-EU nationals whereas the big gap of unfilled jobs was derived from lower-skilled jobs reliant on the EU labour market (Sumption et al., 2022). The HQs of the various companies are predominantly located within the UK. In terms of SMEs, this is common as they usually operate within the UK in one location, whereas larger corporate companies may have several bases of operations and even

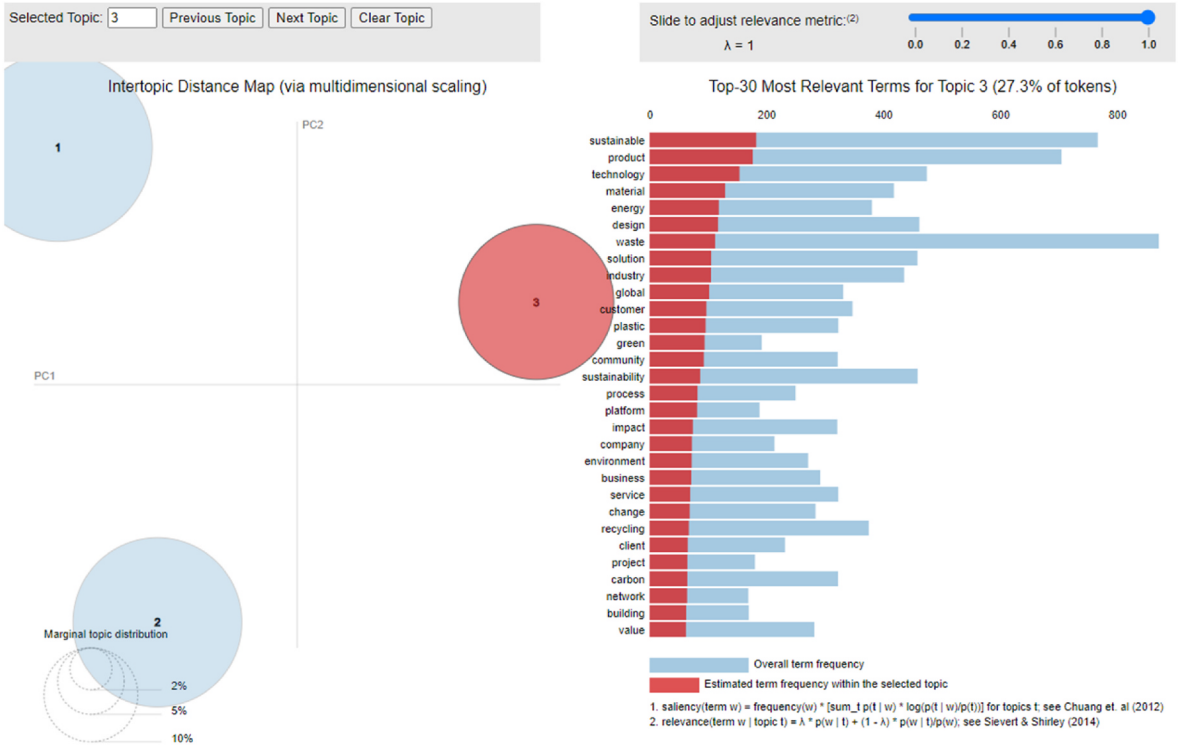


Fig. 9. Topic 3: Green technology and community building. (For interpretation of the references to colour in this figure legend, the reader is referred to the Web version of this article.)

have multiple HQ locations across the globe. Generally, a company even a significantly large corporation will locate its HQ in the founding country and branch out due to either economic, supply chain, or regulatory reasons (Baaij et al., 2015). Furthermore, the HQ locations outside of the UK are predominantly in countries with a higher GDP such as the USA or Germany in line with the literature where countries that have a higher GDP are more likely to have a higher material circularity rate (Kostakis and Tsagarakis, 2022). As expected, most countries related to the CE or with HQ in countries other than the UK are predominantly located in G10 countries. Ireland is an exemption with a high proportion of companies located here which is justified due to the proximity and pre-Brexit trade agreements.

A recent study by Tsironis et al. (2024) investigated the global trends of CE within LinkedIn profiles evaluating 7533 companies. The study reviewed the core 'R' principles used in company descriptions. According to the findings, the focus remained on Recycle, Reduce, Reuse, and Renew as the most common R terms. Interestingly, the present study focused more on sustainable development, sustainable products, and engagement of communities, businesses, and other stakeholders. LinkedIn profile data analysis can have a biased approach regarding what and how the company strategies are circular.

A UK Government timeline for implementing the CE within the UK was set out in 2019 with milestones up to 2050. Many of the milestones target jobs within sectors of waste management, responsible packaging systems, and incentivising improved recycling rates of all materials (HM Government, 2018a). Fig. 4 has similarities with the government report, yet responsible packaging was found halfway down the list whilst the plastic sector was further down in the list. Meanwhile, environmental services focusing on waste management, consultancy companies, and IT services that provide innovative solutions and environmental simulations for upstream changes and environmental impact were found to be the most popular sectors that correlate with the government report. EMF highlighted that the CE job sector in the UK is focused on plastics and packaged goods, fashion and textiles, food and agriculture, electronics, and automotive industries (Ellen MacArthur Foundation, 2020b). Fashion and textiles are high on the list of CE jobs within the LinkedIn analysis, yet the remainder stated by the EMF are not specifically listed or found mid to low down in Fig. 4. The interpretability of the results could explain why agriculture or automation is not stated on the list as some of the environmental services or management consulting may be specifically for agriculture or automotive. Fig. 5 shows that the emergence of CE within the UK began with companies established around the year 2000 when the exponential growth and transition of change in company themes began using R strategies and sustainability mentions.

A study investigating the evolution of CE within the UK finds that CE has been practiced since the 1980s. However, it was not technically called "circular economy" then, nor was there a drive for all materials to follow this process, with CE happening purely due to economic benefits rather than improving the environment (Hill, 2016). The study states that between 2013 and 2015 there was a range of think tanks and business partnerships that were ahead of the policy timeline including the EMF, RSA Great Recovery Project, and Green Alliance's Circular Economy Task Force, which coincides with the exponential spike of companies in Fig. 5 (Hill, 2016). The Department of Environment, Food and Rural Affairs (DEFRA) (2012) worked with Green Alliances Circular Economy to build their task force that worked with businesses in an effort for them to operate within a CE (Department for Environment Food and Rural Affairs & Department for Business Innovation and Skills, 2012). All these governmental and policy-driven changes can explain why a rapid spike in CE companies was exhibited around 2015.

LinkedIn is the largest professional social network used to find new jobs, internships, like-minded professional connections, and relationships (LinkedIn, 2024). From a business perspective, it is used in a similar manner as well as attracting potential customers and employees. This study has highlighted the growing competitive nature that the CE brings and that well-established companies will have to fend off small startup CE-minded companies for employees. The LDA analysis in the present study has identified the three topics that are highly mentioned within the UK for CE-related work. This finding can allow companies to focus on niche areas which were not covered as much as expected within

CE for the UK market. This, in turn, can leverage a market gap to exploit further financial benefit or publicity, highlighting how company A may offer a solution to a CE bottleneck that benefits a supply chain or product issue of company B.

The several key themes identified through the text and LDA analysis of LinkedIn data, allow various companies and stakeholders to build on these findings. Waste management, sustainable solutions and green technology are much of the commercial focus, according to the LinkedIn data. The EMF recently published several reports on where the CE focus should be within the UK to drive an improved CE which includes fashion, electrical, automotive, packaging, plastics, agricultural, and food. As stated by the report the CE is driven by three principles that are eliminating waste and pollution, circulating products and materials, and regenerating nature (Ellen MacArthur Foundation, 2020a, 2020b, 2020c, 2020d, 2020e).

- The food and agriculture sectors have a high focus on the waste management side but companies should lean further on the trend of sustainable solutions in other areas beyond packaging and waste management (Ellen MacArthur Foundation, 2020d). In many instances corporate or large-scale companies can work significantly well with the innovation and sustainable management driven by consultants and start-ups to develop circular business models and track progress or impact through Industry 4.0 technologies. Furthermore, many of these companies will be required in the continuing transition within the UK for a CE driven by policy changes that were not explicitly mentioned within any of the LDA analyses. The EMF report not only recommends innovative improvements but is a strong advocate of digitalisation awareness building within the community, which was found in the third theme of words in the LDA analysis (Ellen MacArthur Foundation, 2020d).
- Textiles and fashion have a significant environmental impact yet the resale of clothes in charity, car boot sales or online marketplaces are common within the UK. However, the EMF report focuses on clothing manufacture, recollection of worn fabrics, and implementing rental services in clothing (Ellen MacArthur Foundation, 2020c). In the UK the fashion industry has allowed short-term clothing hire for dresses and suits for several decades, yet long-term lease hire is only beginning to enter the market with companies such as HUUR, My Wardrobe HQ, and OnLoan. Yet as pointed out by the LDA analysis fashion enters the list low down in topic 1 keywords, it shows that there is an initiative to drive a circular fashion industry within the UK, but it lacks awareness and could be significantly benefitted by linking the connections between larger clothing manufacturers. On the other hand, fashion industries within the UK are designing for longevity and improving the number of recycled materials within new products. Regenerative sourcing and safer chemical use are among some of the major targets for the fashion industry according to the EMF. Again, if legislation were to drive a take-back agreement in a similar way to bread waste or electronic goods, between customer and supplier it would force the responsibility onto the manufacturers and keep material in a closed loop (Make UK, 2017; Narisetty et al., 2021). The difficulty to this would be the supply chain management where most of the clothes are produced in locations such as China and Vietnam.
- The plastics and packaging industries are by far the sectors that draw the most attention due to the global awareness of plastic oceans highlighted through graphical marine images. According to the LDA analysis plastics or polymers do not explicitly enter the frame in Topics 2 and 3 yet in Topic 1, plastic is found quite high on the list of companies' descriptions. The focus on plastics, according to WRAP, EMF, and the UK government, is minimising single-use plastics and enhancing the use of recycled plastic (Ellen MacArthur Foundation, 2020e; HM Government, 2018b; WRAP). The UK imports half of the polymers it uses, yet the amount that it recycles is minimal in comparison. Driving innovation and increasing consumer awareness is at the heart of CE change for the plastics industry (British Plastics Foundation, n.d.). Several innovative UK companies are developing sustainable products which are located within all the LDA themes, yet these companies focus solely on packaging which does not appear in the LDA analysis (Ellen MacArthur Foundation, 2020e).
- The electronics industry although not in the media as much as the plastic sector is another major area that the UK is focusing a CE implementation. Both businesses and consumers feel the effect of a linear economy in the electrical industry due to the rare earth metals, particularly in microchips that are in limited global supply alongside the geo-political tensions around these materials. The UK has a take-back agreement legislation with some electronic manufacturing including online-only merchants where the supplier must bear the entire cost of the shipment, (HM Government, 2018b). Yet there is still significant progress to be made and an opportunity in the market is highlighted within the lack of electrical or electronic words within the LDA analysis. One of the limitations in the electrical sector towards implementing a CE is that most of the manufacturers are overseas as the UK imports over half of its electronic goods (Make UK, 2017). One of the other routes for the electric market that is being implemented is extending the life of these products to ensure the material is not sent to landfill within a year of use. Further within an era of digitalisation, the demand for these electronic raw materials is rapidly climbing leading to an area for innovative solutions, recycling, and consumer awareness to be boosted (Ellen MacArthur Foundation, 2020b).

Although all these areas show signs of CE implementation within the UK, the current study highlights that they are not explicitly mentioned in all cases. The LDA analysis is open to interpretation in how phrases such as solutions, recycling, waste, and innovation fit into the sectors discussed above but it is open to the market to find the areas of CE in which a niche or gap is available to be exploited for financial reward that benefits the environment. The LinkedIn data mining was able to provide trends and an indication of the core CE activities and terms used to describe the company operations and derive direct links with other sectors to branch the CE network for future stakeholders to follow and grow new paths in alternative sectors that require further efforts or barriers to be overcome.

Social media is a rich data source that several studies have begun to tap into for research gains. The current study has used text mining alongside LDA analysis to identify the geographical and written trends within the UK and the CE. This methodology is one of the most commonly used for analysing views and opinions across social media (Kasturi et al., 2023). Chen et al. (2021) reported on several social media qualitative analysis methods including both symbol-based text mining and topic-based LDA analysis highlighting the limitations and benefits. Although these types of analysis are extremely useful, they also rely on man-hours to collect and analyse each data set; with the emergence of AI, the use of pre-trained language models and the ability to predict the probability of a certain word, phrase, or paragraph within a company or job profile using language models as the indicators can dramatically improve current methodologies used in the present study. In hindsight, AI-driven analysis can lead to interpretability challenges, and with research that could drive decision-making criteria, it could be a fundamental flaw of the methodology, Another limitation in using LinkedIn as a data source is that it is mostly based on what people "think" they are or do with little peer validation. In many cases, a solid profile can contain valid information with official credentials and endorsements. Normally, this process is only done through accreditation or people's CVs. Based on our previously published works utilizing the same methodology, we monitor the CE trending activities among diverse industries. In this context, we do not aim to validate whether the companies or organizations are fully implementing their statements but instead, provide trends in the CE landscape that can help stakeholders understand the current directions. The study follows a similar methodology to a survey

analysis where the interviewees can state everything they want and based on the inputs the researcher must extract some main insights. The company profiles are similar to People's (LinkedIn) profiles where many of the presented skills need to be further evaluated. Similarly, this methodology can give an initial view of the sector with main activities and aid in filtering out the company profiles that present specific characteristics in order to be reached. Additionally, this is a common issue in the domain of social media-based analytics even in sentiment analysis where the user may post a misleading comment (Zachlod et al., 2022). Thus, the value of this work is a deeper understanding of the interest in the business sector and where the business value currently exists (J. Yang et al., 2022). So based on the corporate and research aspects each organization chooses to showcase, this methodology provides a detailed overview of the CE sector in the UK. The specific analysis can be considered in parallel to business official reports and dedicated questionnaires for shaping more robust opinions regarding the CE.

It then leads back to a statement that "greenwashing" could be a clear problem. Some businesses will specifically lean on their sustainability credentials or refer to some sustainable aspect they claim to uphold to gain customer trust or new clients when the action has no sustainable benefit. Greenwashing in some instances can benefit a company's public profile, regardless of the amount of pollution a company contributes, its sector, or its size (Zhang et al., 2023).

Similarly, although this study focused on the UK, data availability in some countries may be scarce. For example, in 2011, China consumed more raw materials than 34 countries within the Organisation for Economic Co-operation and Development (OECD) combined at 25.2 billion tonnes, yet it does not use LinkedIn or have access to it (Mathews and Tan, 2016; Shroff, 2021). LinkedIn lots of available data, yet the search results are limited to 1000 profiles per section, spanning people, companies, and job tabs. This leads to many results being rounded down when the tab exceeds 1000. It therefore requires different filters to reduce the number of returns to less than 1,000, merging and removing duplicates, like many literature review methodologies using several databases (Rethlefsen et al., 2021). In this context, several companies may unintentionally filter results, potentially skewing the study outcomes.

Extending this research to encompass a broader geographical scope, including other countries or specific subregions within the UK, stands as a promising avenue. By delving into company profiles from diverse regions, this expansion could uncover nuanced variations in approaches to the CE. Such an analysis might elucidate regional disparities in sustainability practices, shed light on industry-specific trends, and offer insights into the influence of local policies and cultural factors on businesses' engagement with circular principles. Comparing and contrasting the strategies adopted by companies in distinct regions could not only deepen our understanding of regional sustainability landscapes but also provide valuable guidance for tailored interventions and policy frameworks.

Moreover, integrating LinkedIn data with scientific papers from esteemed repositories like Scopus or Google Scholar presents an intriguing opportunity. This approach could offer a comprehensive view of the alignment between business trends and scholarly research in the realm of the CE. Investigating overlaps or discrepancies between corporate practices and scientific insights might reveal synergies, potential gaps, or emerging areas for interdisciplinary collaboration. Additionally, exploring alternative topic modelling concepts beyond LDA could augment our understanding of the dataset, offering different perspectives or enhancing the accuracy of topic extraction. These avenues for future exploration promise to enrich our comprehension of sustainable business practices, foster cross-sector collaborations, and guide the integration of research and industry efforts toward a more circular and sustainable future.

6. Conclusions

In exploring the most recent trends in the CE landscape, this study utilised the publicly available data of 1396 LinkedIn profiles of companies in the UK. The findings suggest that the UK holds stronger interaction with the EU countries and the USA, while "Environmental Services", "Management Consulting" and "Renewables & Environment" are the most prominent industry sectors driving the CE. Further, this work sheds light into the main themes lying in the CE landscape with topic modelling. In this context, LDA modelling has been put to the test analyzing free-text data contained in the description field of those profiles. Initially, we point out that LinkedIn descriptions presented significant diversity regarding their context, including a wide variety of concepts, technologies, and business domains. Overall, the current trends in the CE from both the institutional and business perspectives, mainly revolve around waste management initiatives and their environmental impact, the sustainability strengthening by offering products and solutions designed with a focus on the customer, and finally the importance of the establishment of a strong community that will support the vision of a CE utilizing green technology.

Rapidly moving towards a data-centric era where companies and organizations seek high-level insights lying within diverse and large datasets, the importance of social media networking and business platforms is constantly increasing. From this perspective, this work complements our previously published studies on LinkedIn analytics specifically in the field of CE. Thus, this research acts as the enabler to gain essential insights on any industry sector, concept, or technology through optimized queries, data extraction, and quantitative and qualitative analytics. This can benefit different stakeholders ranging from companies, research institutes, governmental agencies, ministries, and educational institutions.

In conclusion, this methodology is highly adaptable through the customization of the embedded search filters offered by the LinkedIn platform. Future work is mainly focused on conducting comparative analysis among different countries and regions, aiming to explore the most important differences in the means of CE implementation and evolution. Additionally, different topic modelling tools will be applied such as generative models specifically designed for social media datasets. The increasing number of models, coding libraries, computing resources, and generative AI research accelerators are some of the most promising aspects regarding the future of optimized and accurate business intelligence as the connector between the corporate and scientific worlds.

CRediT authorship contribution statement

Georgios Tsironis: Writing – review & editing, Writing – original draft, Visualization, Validation, Software, Methodology, Investigation, Formal analysis, Data curation, Conceptualization. **Rylan Cox:** Writing – review & editing, Writing – original draft, Validation, Investigation. **Mark Jolly:** Writing – review & editing, Writing – original draft, Validation, Conceptualization. **Konstantinos Salonitis:** Writing – review & editing, Writing – original draft, Validation, Supervision, Conceptualization. **Konstantinos P. Tsagarakis:** Writing – review & editing, Writing – original draft, Visualization, Validation, Supervision, Software, Resources, Methodology, Formal analysis, Conceptualization.

Data statement

The data that support the findings of this study are available upon request.

Declaration of competing interest

The authors declare that they have no known competing financial interests or personal relationships that could have appeared to influence

the work reported in this paper.

Appendix A. Supplementary data

Supplementary data to this article can be found online at https://doi.org/10.1016/j.jclepro.2025.145355.

Data availability

Data will be made available on request.

References

Aguilar-Morales, S.Y., Negrete-Cardoso, M., Rosano-Ortega, G., Sánchez-Ruíz, F.J., Sánchez-Baltasar, L.B., Vega-Lebrún, C.A., Schabes-Retchkiman, P.S., 2023. Marketing strategies for waste recycling: a bibliometric analysis towards the circular economy. Environ. Sci. Pollut. Control Ser. 30 (25), 67565–67581. https://doi.org/10.1007/s11356-023-27040-y.

Amin, M.H., Ali, H., Mohamed, E.K.A., 2024. Corporate social responsibility disclosure on Twitter: signalling or greenwashing? Evidence from the UK. Int. J. Finance Econ. 29 (2), 1745–1761. https://doi.org/10.1002/IJFE.2762.

Amuedo-Dorantes, C., Begen, N., 2023. How did Brexit impact labour market efficiency in the UK? Appl. Econ. Lett. 1–5. https://doi.org/10.1080/13504851.2023.2208840.

Arranz, C.F.A., Arroyabe, M.F., Fernandez de Arroyabe, J.C., 2024. Organisational transformation toward circular economy in SMEs. The effect of internal barriers. J. Clean. Prod. 456, 142307. https://doi.org/10.1016/J.JCLEPRO.2024.142307.

Baaij, M.G., Mom, T.J.M., Van den Bosch, F.A.J., Volberda, H.W., 2015. Why do multinational corporations relocate core parts of their corporate headquarters abroad? Long. Range Plan. 48 (1), 46–58. https://doi.org/10.1016/j.lrp.2012.07.001.

Blei, D.M., Lafferty, J.D., 2007. A correlated topic model of Science. Ann. Appl. Stat. 1 (1). https://doi.org/10.1214/07-AOAS114.

Blei, D.M., Ng, A.Y., Edu, J.B., 2003. Latent dirichlet allocation michael I. Jordan. J. Mach. Learn. Res. 3, 993–1022.

Bowen, R., Dowell, D., Morris, W., 2023. Hospitality SMEs and the circular economy: strategies and practice post-COVID. Br. Food J. https://doi.org/10.1108/BFJ-10-2022-0932.

British Plastics Foundation. (n.d.). About The British Plastics Industry. Retrieved January 24, 2024, from https://www.bpf.co.uk/industry/Default.aspx.

Chen, H., Yang, C., Zhang, X., Liu, Z., Sun, M., Jin, J., 2021. From symbols to embeddings: a tale of two representations in computational social science. Journal of Social Computing 2 (2), 103–156. https://doi.org/10.23919/JSC.2021.0011.

Circle Economy, 2023. The Circular Gap Report.

Daglis, T., Tsironis, G., Tsagarakis, K.P., 2023. Data mining techniques for the investigation of the circular economy and sustainability relationship. Resources, Conservation & Recycling Advances 19, 200151. https://doi.org/10.1016/J.RCRADV.2023.200151.

Das, S., Gilbert Kaufman, J., 2007. Recycling Aluminum Aerospace Alloys.

De Pascale, A., Di Vita, G., Giannetto, C., Ioppolo, G., Lanfranchi, M., Limosani, M., Szopik-Depczyńska, K., 2023. The circular economy implementation at the European Union level. Past, present and future. J. Clean. Prod. 423, 138658. https://doi.org/10.1016/J.JCLEPRO.2023.138658.

Department for Environment Food and Rural Affairs, 2012. Resource Security Action Plan Making the Most of Valuable Materials. https://assets.publishing.service.gov.uk/media/5a79be1640f0b670a8025174/pb13719-resource-security-action-plan.pdf.

Ellen MacArthur Foundation, 2015. Circular economy diagram. https://ellenmacarthurfoundation.org/circular-economy-diagram.

Ellen MacArthur Foundation, 2017. What Is a Circular Economy? Ellen MacArthur Foundation. Ellen Macarthur Foundation. https://ellenmacarthurfoundation.org/topics/circular-economy-introduction/overview%0A. https://www.ellen.

Ellen MacArthur Foundation, 2020a. Circular economy growth potential by sector: automotive, transport and logistics. https://emf.thirdlight.com/link/2ru2psupvqq-mwokve/@/preview/1?o.

Ellen MacArthur Foundation, 2020b. Circular economy growth potential by sector: electronics. In: Finance. https://www.ellenmacarthurfoundation.org/topics/finance/sector-insights.

Ellen MacArthur Foundation, 2020c. Circular economy growth potential by sector: fashion and textiles. https://emf.thirdlight.com/link/edfkcc4cfn3e-cz2lin/@/preview/1?o.

Ellen MacArthur Foundation, 2020d. Circular economy growth potential by sector: food and agriculture. https://emf.thirdlight.com/link/mro2xgh6e68o-8w2jzh/@/preview/1?o.

Ellen MacArthur Foundation, 2020e. Circular economy growth potential by sector: plastics and packaged goods. https://emf.thirdlight.com/link/4v5yje6r74fn-6y87f3/@/preview/1?o.

European Parliament, 2023. Circular Economy: Definition, Importance and Benefits | News. European Parliament. https://multimedia.europarl.europa.eu/en/repair-reuse-and-recycle_V007-0034_ev.

Gatto, A., 2023a. Quantifying management efficiency of energy recovery from waste for the circular economy transition in Europe. J. Clean. Prod. 414, 136948. https://doi.org/10.1016/j.jclepro.2023.136948.

Gatto, A., 2023b. Quantifying management efficiency of energy recovery from waste for the circular economy transition in Europe. J. Clean. Prod. 414, 136948. https://doi.org/10.1016/J.JCLEPRO.2023.136948.

Gov, U.K., 2023. PM recommits UK to Net Zero by 2050 and pledges a “fairer” path to achieving target to ease the financial burden on British families - gov.UK. https://www.gov.uk/government/news/pm-recommits-uk-to-net-zero-by-2050-and-pledges-a-fairer-path-to-achieving-target-to-ease-the-financial-burden-on-british-families.

Government, H., 2023. Powering up britain the net zero growth plan. www.gov.uk/official-documents.

Greer, R., von Wirth, T., Loorbach, D., 2023. The circular decision-making tree: an operational framework. Circular Economy and Sustainability 3 (2), 693–718. https://doi.org/10.1007/s43615-022-00194-6.

Hagen, L., 2018. Content analysis of e-petitions with topic modelling: how to train and evaluate LDA models? Inf. Process. Manag. 54 (6), 1292–1307. https://doi.org/10.1016/j.ipm.2018.05.006.

Harris, R.S., Ijomah, W.L., Windmill, J.F.C., 2023. Evaluation and validation of Damage Assessment Tracking Criteria models within the sector of UK automotive remanufacturing. J. Clean. Prod. 414, 137494. https://doi.org/10.1016/j.jclepro.2023.137494.

Hasan, M., Rahman, A., Karim, Md R., Khan, Md S.I., Islam, Md J., 2021. Normalized Approach to Find Optimal Number of Topics in Latent Dirichlet Allocation (LDA) 341–354. https://doi.org/10.1007/978-981-33-4673-4_27.

Hill, J., 2016. Circular economy and the policy landscape in the UK. In: Taking Stock of Industrial Ecology. Springer International Publishing, pp. 265–274. https://doi.org/10.1007/978-3-319-20571-7_13.

HM Government, 2018a. Our waste, our resources: a strategy for england 1 our waste, our resources: a strategy for england our waste, our resources: a strategy for england 2. https://doi.org/10.1007/s43615-022-00194-6.

HM Government, 2018b. Our waste, our resources: a strategy for England 1 our waste, our resources: a strategy for England our waste, our resources: a strategy for England 2. http://www.nationalarchives.gov.uk/doc/open-government-licence/version/3/oremailPSInationalarchives.gsi.gov.uk.

Hondroyiannis, G., Sardianou, E., Nikou, V., Evangelinos, K., Nikolaou, I., 2023. Energy market dynamics and institutional sustainability: how affect the Europe’s circular economy. Circular Economy 2 (3), 100048. https://doi.org/10.1016/J.CEC.2023.100048.

Kang, S., Hong, Y.S., Kwak, M., 2023. Evaluating the circularity and multi-lifecycle green profit of product family design. Resour. Conserv. Recycl. 197, 107106. https://doi.org/10.1016/J.RESCONREC.2023.107106.

Kasturi, N., Totad, S.G., Ghosh, G., 2023. Research approaches for building analytics in social network towards crowdsourcing. In: 2023 IEEE 8th International Conference for Convergence in Technology (I2CT), pp. 1–7. https://doi.org/10.1109/I2CT57861.2023.10126479.

Knäble, D., Tsagarakis, K.P., 2023. ‘Made in Germany’ how companies approach circular economy on LinkedIn. Eur. Plan. Stud. 1–25. https://doi.org/10.1080/09654313.2023.2228343.

Kostakis, I., Tsagarakis, K.P., 2022. Social and economic determinants of materials recycling and circularity in Europe: an empirical investigation. Ann. Reg. Sci. 68 (2), 263–281. https://doi.org/10.1007/S00168-021-01074-X/TABLES/3.

Kourmouli, A., Lesniewska, F., 2023. Losing ground: targeting agricultural land take by enabling a circular economy in construction. Circular Economy and Sustainability. https://doi.org/10.1007/s43615-023-00293-y.

Kuhl, H.C., Skipworth, D., Bourlakis, M., Aktas, E.. The circularity of product-service systems: the role of macro-, meso-and micro-level contextual factors. https://doi.org/10.1108/IJOPM-01-2022-0055.

Kwon, K., Lee, J., Wang, C., Diwanji, V.S., 2024. From green advertising to greenwashing: content analysis of global corporations’ green advertising on social media. Int. J. Advert. 43 (1), 97–124. https://doi.org/10.1080/02650487.2023.2208489.

LinkedIn, 2024. What is LinkedIn and how can I use it? | LinkedIn Help. https://www.linkedin.com/help/linkedin/answer/a548441.

Madzík, P., Falát, L., Zimon, D., 2023. Supply chain research overview from the early eighties to Covid era – big data approach based on Latent Dirichlet Allocation. Comput. Ind. Eng. 183, 109520. https://doi.org/10.1016/j.cie.2023.109520.

Make UK, 2017. ELECTRONICS SECTOR BULLETIN.

Mathews, J.A., Tan, H., 2016. Circular economy: lessons from China. Nature 531 (7595), 440–442. https://doi.org/10.1038/531440a, 2016 531:7595.

Narisetty, V., Cox, R., Willoughby, N., Aktas, E., Tiwari, B., Matharu, A.S., Salonitis, K., Kumar, V., 2021. Recycling bread waste into chemical building blocks using a circular biorefining approach. Sustain. Energy Fuels 5 (19), 4842–4849. https://doi.org/10.1039/d1se00575h.

Nelen, D., Bakas, I., 2021. Improving the climate impact of raw material sourcing. https://doi.org/10.2800/722698.

Oberle, B., Bringezu, S., Hatfield-Dodds, S., Hellweg, S., Schandl, H., Clement, J., Cabernard, L., Che, N., Chen, D., Droz-Georget, H., Ekins, P., Fischer-Kowalski, M., Flörke, M., Frank, S., Froemelt, A., Geschke, A., Haupt, M., Havlik, P., Hüfner, R., et al., 2019. Global Resources Outlook 2019: Natural Resources for the Future We Want.

Powell, A., Francis-Devine, B., Clark, H., 2022. Coronavirus: impact on the labour market. https://researchbriefings.files.parliament.uk/documents/CBP-8898/CBP-8898.pdf.

Pusz, M., Jonas, A.E.G., Deutz, P., 2023. Knitting circular ties: empowering networks for the social enterprise-led local development of an integrative circular economy. Circular Economy and Sustainability. https://doi.org/10.1007/s43615-023-00271-4.

Raabe, D., Ponge, D., Uggowitzer, P.J., Roscher, M., Paolantonio, M., Liu, C., Antrekowitsch, H., Kozeschnik, E., Seidmann, D., Gault, B., De Geuser, F., Deschamps, A., Hutchinson, C., Liu, C., Li, Z., Prangnell, P., Robson, J., Shanthraj, P., Vakili, S., et al., 2022. Making sustainable aluminum by recycling scrap: the science of "dirty" alloys. Prog. Mater. Sci. 128, 100947. https://doi.org/10.1016/j.pmatsci.2022.100947.

Rethlefsen, M.L., Kirtley, S., Waffenschmidt, S., Ayala, A.P., Moher, D., Page, M.J., Koffel, J.B., Blunt, H., Brigham, T., Chang, S., Clark, J., Conway, A., Couban, R., de Kock, S., Farrah, K., Fehrmann, P., Foster, M., Fowler, S.A., Glanville, J., et al., 2021. PRISMA-S: an extension to the PRISMA statement for reporting literature searches in systematic reviews. Syst. Rev. 10 (1), 1–19. https://doi.org/10.1186/S13643-020-01542-Z, 2021 10:1.

Sakrabani, R., Garnett, K., Knox, J.W., Rickson, J., Pawlett, M., Falagan, N., Girkin, N.T., Cain, M., Alamar, M.C., Burgess, P.J., Harris, J., Patchigolla, K., Sandars, D., Graves, A., Hannam, J., W Simmons, R., 2023. Towards net zero in agriculture: future challenges and opportunities for arable, livestock and protected cropping systems in the UK. Outlook Agric. 52 (2), 116–125. https://doi.org/10.1177/00307270231178889.

Schroeder, P., Anggraeni, K., Weber, U., 2019. The relevance of circular economy practices to the sustainable development goals. J. Ind. Ecol. 23 (1), 77–95. https://doi.org/10.1111/jiec.12732.

Shroff, M., 2021. China: sunset of localized version of LinkedIn and launch of new InJobs app later this year. https://www.linkedin.com/blog/member/product/china-sunset-of-localized-version-of-linkedin-and-launch-of-new-injobs-app.

Spital, T., van Aerssen, K.F., 2023. The Impact of Brexit on UK Trade and Labour Markets.

Springford, J., Portes, J., 2023. The impact of Brexit on the UK labour market: an early assessment - UK in a changing Europe. https://ukandeu.ac.uk/the-impact-of-brexit-on-the-uk-labour-market-an-early-assessment/.

Sumption, M., Forde, C., Alberti, G., William Walsh, P., 2022. How is the end of free movement affecting the low-wage labour force in the UK? J. Soc. Pol. 41 (1). Cambridge University Press. https://migrationobservatory.ox.ac.uk/resources/reports/how-is-the-end-of-free-movement-affecting-the-low-wage-labour-force-in-the-uk/.

Syed, S., Spruit, M., 2017. Full-text or abstract? Examining topic coherence scores using latent dirichlet allocation. In: 2017 IEEE International Conference on Data Science and Advanced Analytics (DSAA), pp. 165–174. https://doi.org/10.1109/DSAA.2017.61.

Tamasiga, P., Mfuni, H., Onyeaka, H., Ouassou, E.H., 2023. Green industrial policy as an enabler of the transition to sustainability: challenges, opportunities and policy implications for developing countries. Environ. Dev. Sustain. https://doi.org/10.1007/s10668-023-03952-0.

Topal, İ., Nart, S., Akar, C., Erkollar, A., 2020. The effect of greenwashing on online consumer engagement: a comparative study in France, Germany, Turkey, and the United Kingdom. Bus. Strat. Environ. 29 (2), 465–480. https://doi.org/10.1002/BSE.2380.

Tsironis, G., Daglis, T., Tsagarakis, K.P., 2022. Social media and EU companies' engagement in circular economy: a LinkedIn approach. Sustain. Prod. Consum. 32, 802–816. https://doi.org/10.1016/J.SPC.2022.06.006.

Tsironis, G., Daglis, T., Tsagarakis, K.P., 2024. The 21 most practiced RE-s of circular economy from LinkedIn company profiles on a global scale. Resources, Conservation & Recycling Advances 21, 200202. https://doi.org/10.1016/J.RCRADV.2024.200202.

Tsironis, G., Karagkouni, A., Dimitriou, D., Tsagarakis, K.P., 2023. Mapping sustainable practices and concepts in the transportation ecosystem for the EU-27 countries, based on LinkedIn company profiles. Frontiers in Sustainability 4, 1268575. https://doi.org/10.3389/FRSUS.2023.1268575/BIBTEX.

Tsironis, G., Tsagarakis, K.P., 2023. Global online networking for circular economy companies in fashion, apparel, and textiles industries, the LinkedIn platform. Curr. Opin. Green Sustainable Chem. 41, 100809. https://doi.org/10.1016/J.COGSC.2023.100809.

WRAP. (n.d.). Plastic packaging | WRAP. Retrieved January 24, 2024, from https://wrap.org.uk/taking-action/plastic-packaging.

Wu, H.-Q., Shi, Y., Xia, Q., Zhu, W.-D., 2014. Effectiveness of the policy of circular economy in China: A DEA-based analysis for the period of 11th five-year-plan 83, 163–175. https://doi.org/10.1016/j.resconrec.2013.10.003.

Yang, J., Xiu, P., Sun, L., Ying, L., Muthu, B., 2022. Social media data analytics for business decision making system to competitive analysis. Inf. Process. Manag. 59 (1), 102751. https://doi.org/10.1016/J.IPM.2021.102751.

Yang, Y., Boom, R., Irion, B., van Heerden, D.-J., Kuiper, P., de Wit, H., 2012a. Recycling of composite materials. Chem. Eng. Process: Process Intensif. 51, 53–68. https://doi.org/10.1016/j.cep.2011.09.007.

Yang, Y., Boom, R., Irion, B., van Heerden, D.-J., Kuiper, P., de Wit, H., 2012b. Recycling of composite materials. Chem. Eng. Process: Process Intensif. 51, 53–68. https://doi.org/10.1016/j.cep.2011.09.007.

Yuille, A., Rothwell, S., Blake, L., Forber, K.J., Marshall, R., Rhodes, R., Waterton, C., Withers, P.J.A., 2022. UK government policy and the transition to a circular nutrient economy. Sustainability 14 (6), 3310. https://doi.org/10.3390/su14063310.

Zachlod, C., Samuel, O., Ochsner, A., Werthmüller, S., 2022. Analytics of social media data – state of characteristics and application. J. Bus. Res. 144, 1064–1076. https://doi.org/10.1016/J.JBUSRES.2022.02.016.

Zhang, K., Pan, Z., Janardhanan, M., Patel, I., 2023. Relationship analysis between greenwashing and environmental performance. Environ. Dev. Sustain. 25 (8), 7927–7957. https://doi.org/10.1007/s10668-022-02381-9.



https://dspace.org/

Exploring circular economy in the United Kingdom based on LinkedIn data from company profiles

Tsironis, Georgios; Cox, Rylan; Jolly, Mark R.; Salonitis, Konstantinos; Tsagarakis, Konstantinos P.

2025-04-25
Elsevier
https://doi.org/10.1016/j.jclepro.2025.145355
Tsironis G, Cox R, Jolly M, et al., (2025) Exploring circular economy in the United Kingdom based on LinkedIn data from company profiles. Journal of Cleaner Production, Volume 503, April 2025, Article number 145355

Downloaded from a DSpace repository. https://dspace.org/