Scarpellini, S., Kuba-Khoury, V., Aranda-Usón, A. (2026) "Circular accounting practices for the Spanish waste sector: an approach from the stakeholders' theoretical framework in a circular economy". MEDITARI Accountancy Research, https://doi.org/10.1108/MEDAR-04-2025-2982

Circular accounting practices for the Spanish waste sector: An approach from the stakeholders' theoretical framework in a circular economy

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Keywords: Circular economy accounting, Waste sector, Environmental accounting, Stakeholders, Circular economy, Circular accounting. Circular reporting

1. Introduction

The growing demand for a low-carbon and zero-waste economy has placed waste management for the circular economy (CE) at the core of sustainability strategies (Aranda-Usón *et al.*, 2020; Di Vaio *et al.*, 2022). The waste sector plays a fundamental role in the CE, contributing to waste reduction, material recycling, and resource valorization through multiple cycles to enable their reintegration into production processes as secondary raw materials (Ghisellini *et al.*, 2016). Today, CE principles gradually adopted in various sectors are transforming not only how companies operate and report CE-related activities (Arjaliès *et al.*, 2023; Wishart and Antheaume, 2021a), but also the accounting practices associated with the measurement and management of material loop closing (Aureli *et al.*, 2025; Marco-Fondevila *et al.*, 2023).

Recently, academic interest in the relationship between the CE and accounting has grown significantly, as indicated in the literature reviews by Salesa et al. (2022) and Vysochan et al. (2024). These studies reaffirm the central role of the waste sector in

advancing circularity. To date, the studies on this cover various geographical areas, focusing on countries such as the United Kingdom, China, Italy, and Spain (Vysochan *et al.*, 2024).

Historically, accounting systems have been designed for a linear production model (Arjaliès *et al.*, 2023; Kwarteng *et al.*, 2023). Thus, the transition to a CE presents the challenge of adapting these systems to close material loops, enabling the measurement and management of both financial and non-financial performance related to the CE while reflecting the impact of circular practices on the environment, society, and the economy (Aranda-Usón *et al.*, 2022).

Some scholars have examined internal accounting systems for CE measurements (Jesse *et al.*, 2023; Llena-Macarulla *et al.*, 2023), as well as applying material flow cost accounting (MFCA) to the CE (Aranda-Usón *et al.*, 2024). However, few studies have defined and analyzed the specific accounting practices introduced to support circularity within companies (Scarpellini *et al.*, 2020). Thus, this remains an understudied area of research.

To address this gap, our preliminary research objective is to define the main CE-related specific accounting practices and procedures that companies adopt when introducing the CE (RQ1a). Additionally, despite being a crucial sector for transitioning to the CE by closing material loops, the waste sector continues to be underexplored in the field of circular accounting(Di Vaio *et al.*, 2022). Thus, this leads to the second part of that objective, which is to investigate the adoption of specific CE-related accounting practices by waste management companies (RQ1b).

In terms of measuring CE resource flows, some scholars point to the lack of standardization in accounting systems as a main barrier to effective implementation of waste measurement (Amay Vicuña et al., 2020). General rules favor reducing material losses and, consequently, more efficient use of resources, as demonstrated by the accounting of material and resource flows (Schmidt *et al.*, 2015). However, gaps persist in the literature regarding the definitions of CE-related internal measurements and their intersection at the company level.

Although CE reporting is growing rapidly (Arjaliès *et al.*, 2023; Gallardo-Vázquez *et al.*, 2024), there is still little insight into the potential use of CE-related indicators to inform behaviors that promote circularity among customers or waste management companies (Jørgensen *et al.*, 2023). Research on the extent that companies disclose CE information has gradually increased since an initial study by Stewart and Niero (2018), but few studies have tackled the internal measurement and control processes that precede CE disclosure (Costa *et al.*, 2023; Llena-Macarulla *et al.*, 2023). Thus, our second research objective is to delve deeper into the sector measurement of CE and material flows for reporting in a circular model (RQ2).

Recent studies also highlight that stakeholder pressure, particularly from policymakers, is a key driver of sustainability and the CE (Baah *et al.*, 2022; Massari and Giannoccaro, 2023). From a theoretical standpoint, some scholars consider Stakeholder Theory (Freeman, 2011) as a foundation for the study of CE accounting (Aureli *et al.*, 2025; Gallardo-Vázquez *et al.*, 2024; Moneva *et al.*, 2023). This theoretical perspective underlies our third objective, which is identifying the stakeholders exerting the most significant influence on firm CE implementation and its internal measurement and reporting by waste management companies (RQ3).

As mentioned, although interest in CE accounting is growing, studies on firm internal accounting practices remain scarce. Thus, as a final integrated objective, we investigate, within a single analytical framework, the relationships among stakeholder pressure, CE adoption, and the implementation of circular accounting practices in the waste sector (RQ4).

Our study contributions are as follows. First, we address a gap in the literature regarding specific CE-related accounting practices adopted by waste management companies, enhancing our knowledge about the stakeholder role in this. Second, we extend environmental accounting research on costing, provisioning, and material flows to the context of circular business models. Third, for academia, we provide a foundation for the debate on the definitions of specific circular accounting practices, their level of adoption by waste companies, and CE reporting measurements.

Drawing on Stakeholder Theory, we offer empirical evidence of how various stakeholders influence the adoption of CE activities and the development of related

accounting practices. Through qualitative analysis, we observe that external stakeholder pressure constitutes a more immediate driver of circular accounting than the mere implementation of CE activities. Our analysis uncovers a statistically non-significant direct relationship between CE adoption and circular accounting practices, although the qualitative analysis suggests that they are indirectly related.

Our results also prompt an incipient debate on how CE implementation is impacting the transformation of accounting systems in companies adopting some circular practices or principles, especially in the initial phases. Notably, we offer novel empirical insights from this under-researched yet critical sector and national context. We draw on survey data and qualitative evidence to illustrate how accounting systems have only partially adapted to emerging circularity and sustainability reporting requirements, such as the Directive (EU) 2022/2464 as Regards Corporate Sustainability Reporting 82022 (CSRD) and the European Sustainability Reporting Standards (ESRS).

The rest of this paper is structured as follows. Section 2 presents the background on accounting in the CE, followed by a description of our methodology and sample in Section 3. The results are analyzed in Section 4, leading to our conclusions in Section 5.

2. Background

2.1 Accounting in a circular economy

The main circular accounting practices we analyze fall within the broader field of environmental accounting and encompass accounting practices directly or indirectly linked to firm adoption of the CE. These practices extend beyond traditional financial accounting by incorporating broader environmental accounting associated with closing material loops, also for measuring and reporting purposes.

Aureli et al. (2025) assert that a circular business model requires the transformation of accounting procedures, necessitating strong collaboration across the value chain and the active involvement of accounting professionals. This has been echoed by other scholars who highlight that adopting a circular business model entails significant internal changes in accounting practices. They emphasize that adapting accounting practices to

the CE is ongoing, as accounting has historically been designed for a linear production model (Kwarteng *et al.*, 2023).

As noted, despite the seminal study by Scarpellini et al. (2020) highlighting the accounting capabilities developed by companies when implementing the CE, our premise is that further research is needed to analyze internal accounting practices related to circular models (Llena-Macarulla *et al.*, 2023). Thus, we investigate how companies are adapting their accounting practices when introducing the CE.

The waste sector is often considered inherently linked to material loop closing, and therefore, to circular processes. Given that the core business of waste companies revolves around waste management, we may assume that they naturally engage in circular activities and that these interact with management accounting (Aureli *et al.*, 2025). However, we cannot assume that companies in this sector have introduced circular accounting practices per se. Thus, we need to identify the main circular accounting practices these companies adopt (RQ1a).

Circular accounting refers to the classification and calculation of costs linked to circular processes, the introduction of collaborative CE practices, specific budgeting, or the registration of expenditures and investments related to firm activities aimed at increasing material loop closing. As such, the role of controllers is crucial for measuring the impact of circular activities and exploring new environmental management control solutions, such as the MFCA adapted to the CE (Aranda-Usón *et al.*, 2024). Additionally, accountants can contribute significantly by collaborating with companies, sharing knowledge and ideas on innovative approaches, thereby helping establish circular accounting as a standard (Etxeberria *et al.*, 2023).

According to Halari and Baric (2023), cases in which accountants are directly involved in CE implementation remain rare, and firm accounting practices adopted explicitly for the CE are currently limited and highly applied in nature (Jesse *et al.*, 2023). Although progressing gradually, European small and medium enterprises (SMEs) are beginning to integrate sustainability into their accounting practices. This process is then internalized within the organizational environment, with sustainability and accountability concepts introduced into accounting routines (Rossi and Luque-Vílchez, 2020). Supriadi et al. (2025) reveal that mastering circular accounting can significantly contribute to

improving the competitive advantage among SMEs. Thus, analyzing CE practices and their accounting implications in the waste sector, central to circular processes, requires further attention.

Based on these considerations, from an accounting perspective, we address the relevance of specific circular accounting practices and their introduction in waste companies (RQ2). This fills the gap in the literature concerning CE implementation and its accounting implications, primarily stemming from the need to manage and internally account for the CE.

As such, we enhance the use of circularity metrics in managerial decision-making proposed by Aureli et al. (2025)and analyze the specific level of adoption of different circular accounting practices for the CE, beyond the MFCA, to reduce waste generation (Nishitani *et al.*, 2022). Thus, we broaden our understanding of how the need to manage CE activities drives the integration of environmental accounting practices specifically linked to the CE that integrate the circular accounting mindset.

2.2 Stakeholders and circular measurement and reporting

To date, the gradual increase in accounting literature related to the CE has led to various studies on circular reporting (Kuba-Khoury *et al.*, 2025; Moneva *et al.*, 2023; Rabasedas *et al.*, 2023). However, the significance of circular accounting cannot be directly assessed based solely on sustainability reporting trends (Zyznarska-Dworczak, 2020). Sustainability reports are categorized differently and follow diverse standards worldwide when applied to the CE (Kuba-Khoury *et al.*, 2025).

Today, CE disclosure has also been formalized within international standards, such as the Global Reporting Initiative (GRI) (Massari and Giannoccaro, 2023) and the Accounting Standards Board (SASB) (Sanches *et al.*, 2022). SMEs are now reporting resource reuse and recycling waste flows for internal purposes by applying GRI standards (Massari and Giannoccaro, 2023).

Between 2008 and 2018, the European Union (EU) implemented a drastic waste-reduction policy to promote the CE development (Agovino *et al.*, 2024). This has led to an increase in disclosure regarding waste recovery and recycling in the CE across all

sectors. Nevertheless, reporting on waste and material flows remains a significant challenge for companies under the EU’s Corporate Sustainability Reporting Directive (CSRD) (European Parliament and the Council, 2022), which establishes a regulatory framework and objectives for sustainability reporting. The CSRD is accompanied by the Commission Delegated Regulation (EU) 2023/2772 as Regards Sustainability Reporting Standards (2023), developed by the European Financial Reporting Advisory Group (EFRAG), which provides technical guidance for the effective implementation of the CSRD. This dual framework includes definitions and measurements of key CE metrics proposed for the waste sector as fundamental reporting indicators.

Consequently, we measure the extent that companies in the sector measure CE and material flows in a circular model (RQ2). and identify the stakeholders with the greatest influence on the CE introduction and reporting in waste companies (RQ3a).

Within the framework of the CE in accounting, research grounded in the Stakeholder Theory (Freeman, 2011) is increasing, as scholars recognize that stakeholders, directly and indirectly, influence its adoption and reporting (Aureli *et al.*, 2025). Some scholars highlight stakeholders as determining factors for the success of the CE through the external pressure they exert. However, as noted by (Hörisch *et al.*, 2020), many of the core ideas of this theory have generated limited interest in accounting research. Although many studies focus on the relationship between stakeholders and the CE's introduction in companies, specific accounting studies analyzing the stakeholder role in the introduction of circular accounting practices are still scarce.

Marco-Fondevila et al. (2021) suggest that companies interested in CE adoption do so primarily from an internal and proactive perspective rather than in response to external pressures or institutional frameworks. Notably, the effective adoption of the CE requires stakeholders to exert greater pressure and provide clear incentives for companies to adopt circular practices more efficiently. Wang et al. (2014) state that institutional pressure is a key driver for adopting circular practices, highlighting that the regulatory environment and societal expectations are determining factors in the transition to the CE.

Several studies support this by identifying the crucial role of certain stakeholders in adopting circular practices. Baah et al. (2022) classify stakeholders into three categories:

regulatory, organizational, and community; with policymakers using coercive power to impose regulations that force companies to adopt circular practices. Du and Kuo (2023) indicate that large companies, particularly those in environmentally sensitive sectors, are influenced to implement circular practices by stakeholder demands. Vitolla et al. (2023) identify factors such as company size and profitability as key determinants of CE disclosure, establishing a connection with stakeholder pressure.

Thus, according to the literature, stakeholders, particularly policymakers, play a decisive role in firm adoption of the CE. Therefore, identifying which stakeholders exert the most significant pressure on waste companies to adopt circular processes in the sector is of particular interest. We also examine stakeholder influence on internal measurements and reporting for the CE (RQ3b).

2.3 Stakeholders and circular accounting

From a theoretical standpoint, as stated, many scholars are analyzing the role of stakeholders in reporting activities carried out to close material loops (Kuba-Khoury *et al.*, 2025; Moneva *et al.*, 2023; Roberts *et al.*, 2023; Vitolla *et al.*, 2023). However, few studies have approached internal accounting practices for the CE from the Stakeholder Theory perspective (Aureli *et al.*, 2025; Gallardo-Vázquez *et al.*, 2024; Marco-Fondevila *et al.*, 2023). Extant studies question whether circular accounting practices are influenced not only by the level of the CE introduced by companies, but also by the pressure exerted by key stakeholders to ensure that accounting systems respond to the circular business model.

Scarpellini et al. (2020) reveal that environmental capabilities and accounting for the CE mediate the influence of stakeholders on the circular scope of companies. Aureli et al. (2025) explore how accounting can evolve to help businesses become accountable to all stakeholders, including the environment. Aranda-Usón et al. (2022) classify the main CE-related activities within the framework of sustainability accounting and the stakeholder perspective. Halari and Baric (2023) suggest that a multi-stakeholder collaborative approach could enable accountants to move toward the CE and overcome the negative stereotypes and perceptions associated with accountants. However, regarding its social

impact, this is an incipient issue; thus, it remains unclear how the CE will be considered in a more general sustainability accounting framework in response to stakeholder pressure (Scarpellini, 2022).

Today, there are still opportunities to further analyze whether stakeholders could be related to circular accounting practices introduced by companies. Thus, we approach the relationships among stakeholder pressure, CE adoption, and circular accounting practice implementation within a single framework of analysis of waste management companies (RQ4).

3. Methodology and sample

We apply a multiphase method to achieve our objectives, combining descriptive statistical analysis and qualitative methods using a screened company sample.

3.1 Data collection

We identify Spanish companies in the waste sector whose primary activity falls under Group 38 of the "Statistical Classification of Economic Activities in the European Community" (NACE), encompassing "waste collection, treatment, and disposal; material recovery" (Table I).

Table I: Detailed description of NACE group 38.

NACE	Description
3811	Collection of non-hazardous waste
3812	Collection of hazardous waste
3821	Treatment and disposal of non-hazardous waste
3822	Treatment and disposal of hazardous waste
3831	Dismantling of wrecks
3832	Recovery of sorted materials

The primary company data are from 2024 through the SABI database of Iberian companies, yielding a sample of 122 companies, with the selection limited to active companies with 50 or more employees. Company size is a relevant factor in the transition to a circular model in accounting research (Scarpellini *et al.*, 2020), with other scholars using a threshold of 50 employees for eco-innovation analysis (Aboelmaged,

2018; Triguero *et al.*, 2015; Wagner, 2007; Zhang and Walton, 2017). For company holdings, only parent company data were analyzed.

Our resulting sample is sufficiently representative as we include businesses from various primary activities, covering both the public and private sectors, and varying in age and size. Additionally, the sample ensures broad geographic coverage, with companies from 12 of Spain's 17 autonomous communities.

The geographic delimitation of the sector sample at the national level is based on the specifics of legislation aimed at ensuring the adequate treatment of both hazardous and non-hazardous waste. In Spain, the regulatory framework is established by Law 7/2022 on Waste and Contaminated Soil for the CE. This law, enacted in April 2022, aims to reduce the environmental impact of waste, encourage the efficient use of resources, and promote reuse and recycling in all sectors.

In the application of the EU waste hierarchy principle, public and private companies are required to minimize landfill use. Among the implementation instruments, the State Framework Plan for Waste Management serves as a general guideline that establishes a territory's development according to national legislation objectives and deadlines. Our primary data are gathered through a survey integrating the variables (Table II) related to CE adoption (Section A), stakeholder analysis (Section B), and accounting practices linked to CE adoption (Section C).

Table II: Summary of survey questions and variables

	Variable Code and Description	Type
Section A: *General questions*		
	COMP - Relevance of the CE in terms of business competitiveness	Likert scale (0 to 10)
	IMPL - Level of implementation of the CE in the company	Likert scale (0 to 10)
	ACTV - Relevant CE-related activities implemented and circular accounting	Open-ended question
	TIME - Expected timeframe for the CE to expand in the sector	Discrete variable
Section B: *Stakeholders, CE-related indicators and Reporting*		
RQ3	**[STKH]** - Relevance of different stakeholders in CE implementation	Likert scale (0 to 10)
	B1.1) Competitors; B1.2) Consumers/Clients; B1.3) Employees; B1.4) Regional/local administration; B1.5) National/EU; B1.6) Financial entities/Insurers; B1.7) Citizens/NGOs; B1.8) Media; B1.9) Partners/Shareholders; B1.10) Collaborators; B1.11) Suppliers; B1.12) Trade associations	
RQ2	**[INDI]** - Relevance and feasibility of CE-related measurements for reporting	Relevance:

	– Percentage of materials sent to landfill (not recovered) – Percentage of waste recycled within the company – Different types of recycled materials – Use of electric vehicles (internal/external mobility) – Collaborative actions with other companies for waste valorization (small-scale symbiosis) – Reduction of resource consumption in internal processes (recycling or similar) – Recovery of used products (end-of-life product valorization) – Consumption/generation of renewable energy for energy supply in facilities	Ranking from 1 to 8, with 1 the least relevant and 8 the most relevant Feasibility: Likert scale (0 to 10)
Section C: *CE introduction and circular accounting*		
RQ4	**[AGRM]** - Level of agreement with the following statements to measure the level of CE adoption – The implementation of the CE is considered a priority by the company's management or senior leadership – The implementation of the CE increases collaboration between companies in the entity's value chain to share goods and services – The implementation of the CE generates new jobs within the company – The company promotes the shared use of goods among employees (renting, corporate vehicle fleet, or similar) – The company communicates its environmental policy and CE initiatives to all employees – The company provides training on the CE to its employees – The implementation of the CE has reduced waste treatment and valorization costs – The company has a specific CE officer	Likert scale (0 to 10)
RQ1	**[CAP]** - Circular accounting practices implemented in the company linked to CE – SUBA - Accounting for environmental expenses in specific sub-accounts – PRVN - Provisions and contingencies for environmental actions – RCYC - Measurement and calculation of specific costs for waste recycling – FLWS - Detailed measurement and accounting of material flow costs – ISO5 - Implementation of the UNE-EN ISO 14051 standard – LCA - Use of lifecycle assessment tools – VALU - Specific valuation of recycled materials – INVT - Recording of specific inventories of recycled and eco-friendly materials	Discrete variable: (Yes, No; It is planned; Do not know; N.A)

The URL for an online survey was sent via email to 122 selected companies, along with information on the study purpose and an estimated response time of approximately 10-15 minutes. From this, we received 31 valid responses, resulting in a response rate of 25.41%, considered acceptable for this type of research and comparable to that in other survey-based studies in CE accounting focusing on single sectors or national contexts (Scarpellini *et al.*, 2020). Notably, other similar methodological approaches apply partial least squares structural equation modeling (PLS-SEM) to samples of around 10% (Llena-Macarulla *et al.*, 2023; Scarpellini *et al.*, 2017).

Our respondents are not anonymous, as the companies (Table III) provide their corporate name, thereby consenting to associate their responses with their primary

financial data. Subsequently, we match the qualitative (survey) and quantitative data (SABI database). This enhances the validity of the responses, mitigating the limitation of the small sample by ensuring a broad dataset through financial and business information integration.

Table III: Main characteristics of companies that completed the survey.

Variable	Categories	n	%
Main activity	3811	17	54.84
NACE	3812	1	3.23
	3821	7	22.58
	3822	1	3.23
	3831	0	0
	3832	5	16.13
Sector	Private	19	61.29
	Public	12	38.71
Age	Under 20 years as of 2024	6	19.35
	Between 20 and 35 years as of 2024	22	70.97
	Over 35 years as of 2024	3	9.68
Size	Between 50 and 100 employees in 2024	8	25.81
	Between 101 and 250 employees in 2024	12	38.71
	Over 250 employees in 2024	11	35.48

After an initial descriptive analysis providing insight into the dataset characteristics, we develop a model using PLS-SEM in SmartPLS 4 (Gallardo-Vázquez *et al.*, 2024). The measurement is conceptualized as a reflective model (Sarstedt *et al.*, 2016). In a reflective model, the indicators represent manifestations of the underlying latent construct, reflecting its presence and variability. This approach is well suited for our study, as it enables exploratory research without requiring data normality and works for small sample sizes (Gallardo-Vázquez *et al.*, 2024; Hair *et al.*, 2019).

We initially include 28 items in the model across three constructs as follows:

- Stakeholder Pressure (SP) → 12 items (STKH)
- Circular Economy Adoption (CEA) → 8 items (AGRM)
- Circular Accounting Practices (CAP) → 8 items (SUBA to INVT)

This step identifies patterns, correlations, and potential causalities within the analyzed variables.

3.2 Controlling bias

We adopt ex ante measures to prevent bias associated with data from the same respondents within the same measurement context using items with similar

characteristics (Chang *et al.*, 2010). We initially validate the survey through a panel of four experts and test it with two private companies to assess clarity and relevance of the main survey items. The panel includes one public administrator, one business association member, and two academic experts on the topic. After the validation, we further limit potential selection bias and common method bias in self-reported measures. Regarding selection bias, and following Armstrong and Overton (1977), we compared early and late respondents to the questionnaire in the observed variables (Table IV).

Table IV: Summary of T-Test results.

Variable	Early Respondents (Mean – SD)	Late Respondents (Mean – SD)	t-value	df	p-value	Significant
COMP	8.10 – 1.37	8.52 – 1.89	-0.71	24	0.49	No
IMPL	7.10 – 1.79	6.71 – 2.45	0.49	24	0.63	No
STKH	7.27 – 2.18	7.44 – 1.86	-0.21	16	0.83	No
INDI	7.13 – 2.20	7.67 – 1.80	-0.68	15	0.51	No
AGRM	6.21 – 1.71	6.32 – 1.97	-0.16	20	0.88	No

Social desirability bias refers to the tendency of respondents to answer questions in a manner viewed favorably by others rather than being entirely honest. This bias can be especially pronounced in non-anonymous surveys, in which participants may feel identifiable or judged based on their answers.

Given our non-anonymous survey, we employ a commonly accepted approach to indirectly assess potential response bias by comparing early and late respondents. As Armstrong and Overton (1977) propose, late respondents are often similar to non-respondents, who are assumed to be less engaged and potentially more candid or less concerned with social desirability. Therefore, if there are no significant differences between early and late respondents, systematic response bias, such as social desirability, is unlikely to have meaningfully influenced the data (Rivera-Torres *et al.*, 2015).

In our research, Welch's t-test reveals no statistically significant differences across key variables between early and late participants (Table IV). Although this does not eliminate the possibility of social desirability bias, it provides empirical evidence that such bias is not substantially distorting our key constructs.

4. Main findings

4.1 Circular accounting practices

Based on the literature (Aranda-Usón *et al.*, 2020, 2024; Scarpellini *et al.*, 2020), we defined and examined CE-related accounting procedures that could be introduced by waste companies while adopting the CE (part one of our first research objective). The selected circular accounting practices linked to closing material loops (CAP) are summarized in Table II and mainly relate to environmental accounting. For the second part of our objective, we summarize our analysis of the level of each circular accounting practice in the sector in Figure 1.

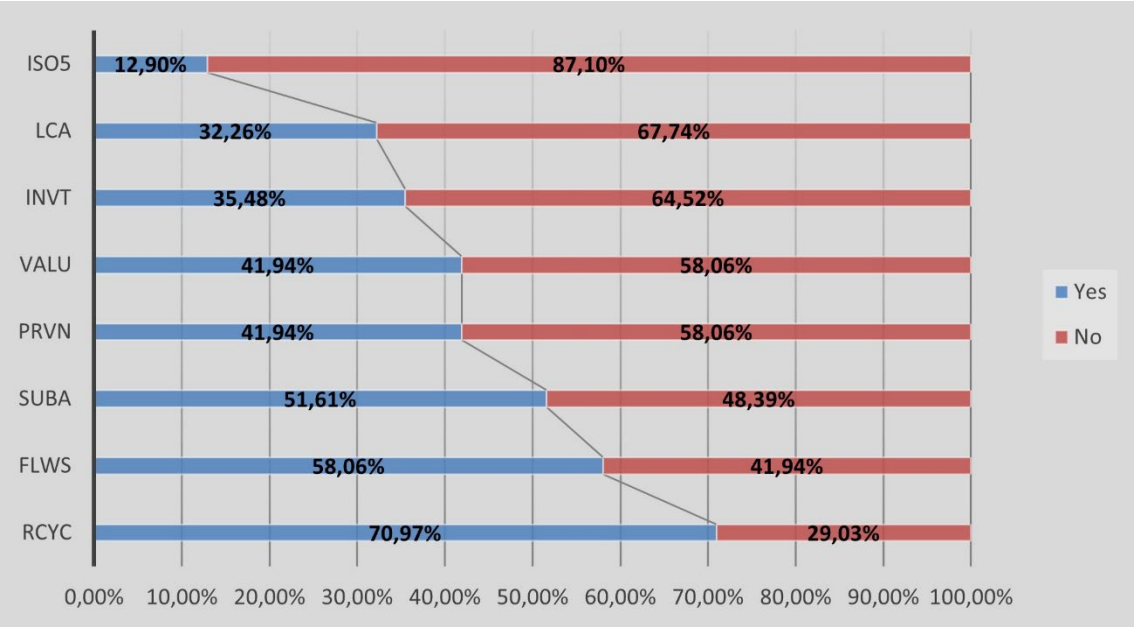

Figure 1: Circular accounting practices and their level of implementation in waste companies

First, we observe that among the most widely adopted CAP (with more than 50% positive responses) is the measurement and calculation of specific waste recycling costs (RCYC), likely because of its direct relevance to the sector's core activities and clear economic returns. Second, the detailed measurement and accounting of material flow costs (FLWS) and allocation of environmental expenses to specific sub-accounts (SUBA) stand out. In some open responses (ACTV), we observe that the introduction of specific sub-accounts for recording CE-related environmental expenses favors the subsequent incorporation of measurements into management control systems for decision-making purposes (Figure 1).

Third, the specific valuation of recycled materials (VALU) and environmental provisions and contingencies (PRVN) show moderate adoption, possibly because they involve technical complexity or regulatory uncertainty despite being relevant.

Conversely, recording specific inventories of recycled and eco-friendly materials (INVT) and using life cycle assessment tools (LCA) have lower adoption rates, possibly because of technical challenges, a lack of specialized personnel, or high initial costs.

The disaggregated sector analysis (Figure 2) shows significant differences between the public and private sectors in registering specific environmental expenses for the CE (SUBA). These are reflected in differentiating provisions and contingencies for environmental CE-related actions (PRVN), and in recording specific inventories of recycled and eco-friendly materials (INVT) (although the sector differences are less pronounced for the latter).

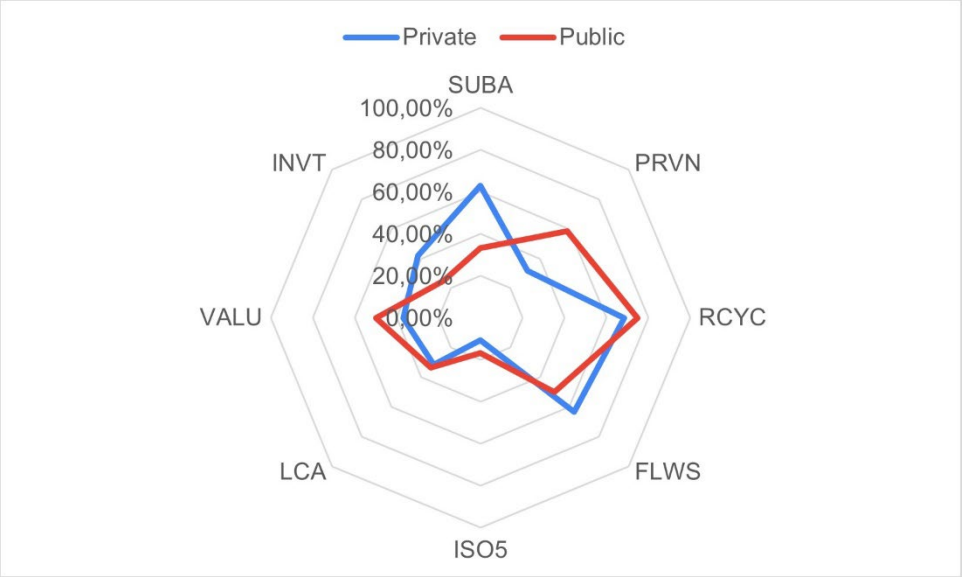

Figure 2: Level of implementation of circular accounting practices in public and private companies

We observe that public companies lead in five of the eight practices. However, the difference is minimal in the least frequently adopted practice, MFCA (ISO5). The results indicate very low implementation of the UNE-EN ISO 14051 standard, probably owing to the complexity of its application or the lack of clearly perceived returns associated with implementing these cost methodologies.

Other scholars have analyzed management accounting and control for the CE in case studies (Aureli *et al.*, 2025; Svensson and Funck, 2019), or have exemplified vernacular

accounting practices to contribute to developing practices for the CE (Heikkilä, 2023). However, those studies are based on anonymous cases and do not provide detailed information on internal accounting applications of circular practices. Although Barnabè and Nazir (2021) illustrate the success loops for Small Farm Ltd. and the performative role of accounting-based tools, they do not detail all the accounting steps that companies apply. Even in the accounting study of the CE-related IKEA case study, recently examined from a management control perspective through cloud technologies (Cinquini *et al.*, 2025), there are no clear examples of how circular business models are reflected in accounting practices. Ultimately, internal accounting remains a taboo subject in many companies, as it is closely linked to productive competitiveness.

An illustrative example is in the study of Aranda-Usón et al. (2024), in which some items relate to the MFCA classification and applied examples of companies that include accounting management of circular eco-innovation projects (Portillo-Tarragona *et al.*, 2025). These cases highlight the potential use of CE-related sub-accounts in journal entries, which can be achieved by using more digits in accounting groups. These practices enable the tracking of costs and valuation of recycled materials or waste for recycling, as well as accounting for work-in-process for reuse or revalorization, and remanufactured or reconditioned finished goods resulting from circular actions. However, principles for classifying these ledgers are needed, and the incipient phase of circular accounting lends itself to qualitative research on the detailed application of accounting tools and practices for the CE. Indeed, the expansion of social impact measurement practices into a broader framework of sustainability accounting in the waste sector remains understudied (Scarpellini 2022).

4.2 Measurement for reporting the circular economy in the waste sector

Our second study objective (RQ2) defined and measured the main CE metrics proposed for the sector as fundamental indicators for reporting (INDI). Thus, we assessed both the relevance assigned by the companies to the eight indicators (ranked from 1 to 8) and their feasibility in the waste sector (on a Likert scale of 0 to 10).

The results indicate that some CE measurements are perceived as highly relevant but have lower feasibility levels (Table V). End-of-life product recovery, which is highly relevant, shows limited feasibility, likely because of technological, financial, and implementation barriers.

Table V: Relevance and feasibility of CE-related practices according to surveyed companies.

Feasibility practices		Relevance			Relevance rank	Feasibility rank
		High (6-8)	Medium (3-5)	Low (0-2)		
Landfilled Waste	258	26	4	1	1	1
Recycled Materials	244	26	3	2	2	3/4
End-of-Life Product Recovery	222	24	6	1	3	6
Internal Recycling Rate	244	24	4	3	4	3/4
Renewable Energy Usage	251	23	6	2	5	2
Resource Consumption Reduction	231	22	6	3	6	5
Collaborative Waste Valorization	215	20	9	2	7	7
Electric Vehicle Use	193	16	5	10	8	8

In other cases, we see the opposite trend, where the perceived feasibility of a specific circular measurement exceeds its assigned relevance level. This is evident in the case of renewable energy consumption and energy supply generation in company facilities. Additionally, certain indicators, such as electric vehicle use, receive the lowest scores, possibly because of high initial investment costs, limited charging infrastructure, and insufficient incentives for industrial adoption. However, notably, despite these differences, none of the indicators score below 7 out of 10, reflecting a generally high perception of their relevance and feasibility within the business context.

4.3 Main stakeholders, the circular economy, and accounting

In our stakeholder analysis (RQ3), the most relevant stakeholders are regulators, policymakers, and customers (Figure 3).

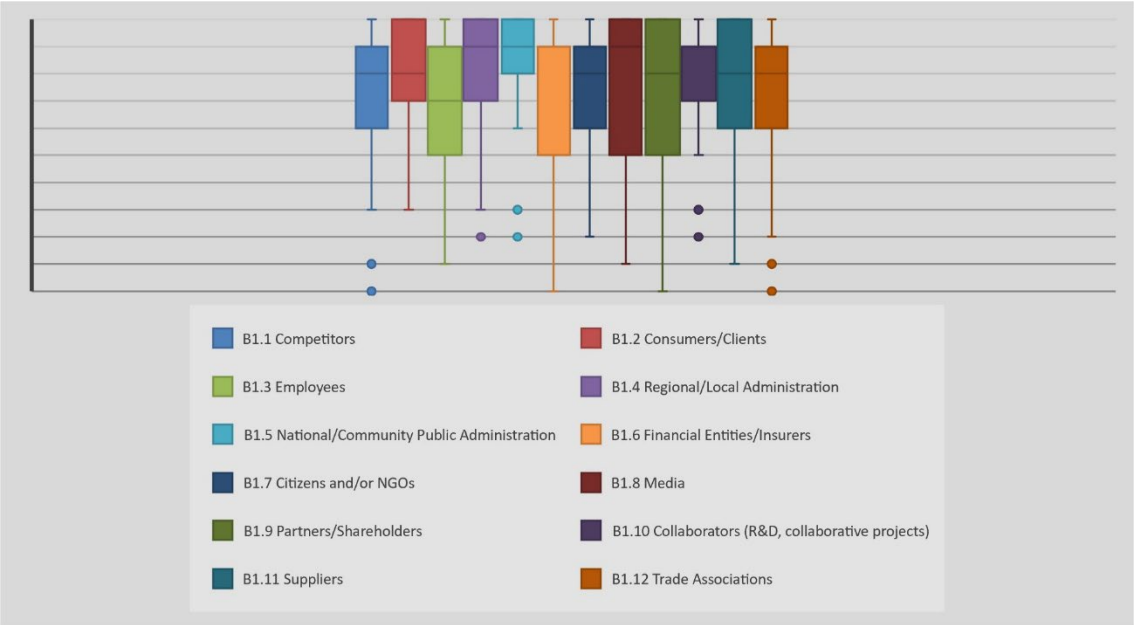

Figure 3: Summary stakeholder analysis

When grouping stakeholders into external and internal categories, external stakeholders score 74.44% of the maximum possible score, whereas internal stakeholders score 71.94%. Although the difference is minimal, this result corroborates the conclusions in Figure 3, highlighting that external actors are perceived as more relevant than internal actors.

After determining the main stakeholders related to the CE introduction in waste companies, we measure the extent that companies in the sector implemented the principles and activities most typical of the circular model, and which interest groups have the most significant influence on the introduction of CE (RQ3b).

The results highlight a strong interest among companies in CE principles as a competitive factor. The median score is 9 out of 10, with only one company reporting a score as low as 3, indicating an overall high recognition of the CE's significance. Similarly, regarding the CE adoption level (IMPL), 96.77% of the companies respond positively, although with some variation in their implementation levels. When grouping responses into three categories: low (0-4), medium (5-7), and high (8-10), the data reveal that 13 companies consider their CE implementation at a high level, whereas 14 companies classify their level as medium. However, only four companies indicate a low level of CE implementation, highlighting a general trend toward moderate to advanced integration of circular practices within the sector.

Specifically, in an open-ended question (ACTV), the responses underscore the diversity of CE-related activities at these companies. Some report a broad range of activities and advanced levels of closing material loops, integrating technological innovation into their circular strategies. Concurrently, others remain in the early stages of CE adoption, with limited integration of circular practices.

Based on these findings, we can classify the main CE-related activities (AGRM) by their relevance (Figure 4). The results emphasize the majority opinion that company management plays an active role in CE adoption and that there is a clear relationship among circular processes, job creation, and cost reduction in waste treatment and recovery (although the private sector rated most practices slightly higher).

However, we can point to some differences between sectors. The private sector emphasized CE policy communication and employee training, whereas the public sector rated the shared use of goods slightly higher. Notably, in both sectors (public and private), the presence of a dedicated CE manager received the lowest relevance, suggesting that this is not yet widely institutionalized. Finally, intercompany collaboration was valued as a key practice for enabling material loop closing, with similar appreciation from both sectors, reinforcing its perceived strategic role in the CE integration.

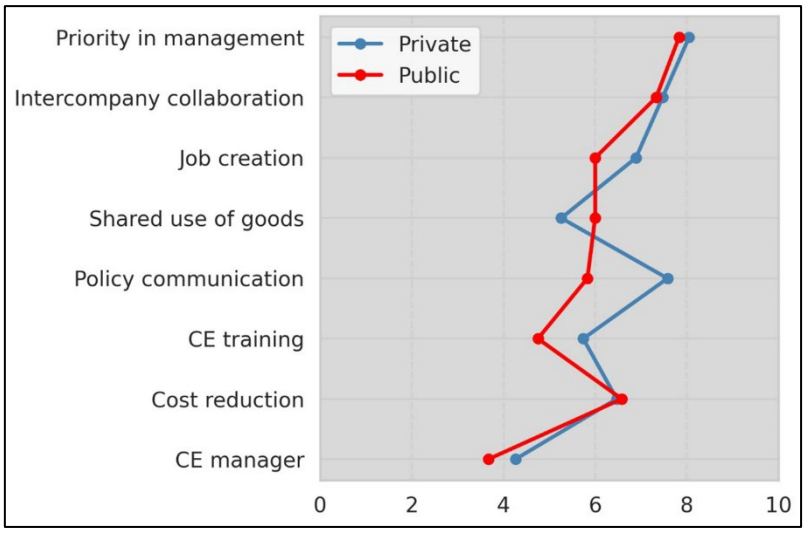

Figure 4: Average scores on CE adoption by public and private companies

In terms of stakeholder influence, Table VI suggests that companies with higher IMPL scores (level of CE adoption) also rate stakeholder-related questions (STKH) more positively.

Table VI: Stakeholder relevance across different levels of CE adoption.

CE adoption	Stakeholder												Average
	B1.1	B1.2	B1.3	B1.4	B1.5	B1.6	B1.7	B1.8	B1.9	B1.10	B1.11	B1.12	
Low (0-4)	6.00	6.00	5.00	6.25	6.25	4.75	6.00	5.75	5.75	6.25	6.00	6,00	5.83
Medium (5-7)	6.79	8.64	7.14	8.71	8.64	5.14	7.36	7.36	7.50	7.71	7.64	7.57	7.52
High (8-10)	7.31	8.69	6.69	8.54	8.85	6.92	8.23	7.85	7.31	8.15	7.23	6.77	7.71

The main results also corroborate the relationship between stakeholder pressure and the adoption of the CE in companies within the waste sector.

To jointly analyze the different constructs (RQ4) and contribute to our understanding of the relationships between SP, CAP, and CE adoption in waste management companies, we applied a PLS-SEM model. In the model, the reliability of the measurement instrument is evaluated by examining factor loadings that reflect the individual reliability of each item. A factor loading (λ) greater than 0.7 is recommended (Hair *et al.*, 2019). In our study, we retain some indicators with slightly lower values in the final model (Scarpellini *et al.*, 2020) because their removal would reduce content validity without materially improving overall reliability. Moreover, their impact on model validity and reliability is mitigated by the robustness of the other statistical analyses, allowing their inclusion in the measurement (Table VII).

We assess convergent validity complemented by calculating the average extracted variance (AVE) (Fornell and Larcker, 1981; Hair *et al.*, 2011). The AVE should be greater than 0.5 (Bagozzi and Yi, 1988). Our values meet the recommended threshold, confirming the satisfactory convergent validity of the model constructs.

We also evaluate internal consistency using Cronbach's alpha (CA) and composite reliability (CR) (Cronbach and Shavelson, 2004; Gallardo-Vázquez *et al.*, 2024). The minimum recommended CA value is above 0.7, and our constructs meet this

requirement. Moreover, the CR analysis yields acceptable values, following the recommendations in the literature (Gallardo-Vázquez *et al.*, 2024) that suggest CR values above 0.80. Therefore, we confirm the internal consistency of the constructs.

We examine the variance inflation factor (VIF) for collinearity to assess multicollinearity issues. We find that the VIF values remain below 5, in line with the recommendations (Gallardo-Vázquez *et al.*, 2024; Scarpellini *et al.*, 2020), ensuring that each item provides unique information to the model. We confirm discriminant validity using the Fornell-Larcker criterion and Heterotrait-Monotrait ratio (HTMT), demonstrating that the model constructs are conceptually distinct.

Table VII: Evaluation of measurement model.

Constructs	CA	CR	AVE
SP	0.765	0.840	0.514
CEA	0.765	0.835	0.505
CAP	0.864	0.897	0.591

Once the measurement model is adjusted, we evaluate the structural model. To ensure that our final model complies with the 10-times rule (Hair *et al.*, 2019), we structure the constructs and their indicators to ensure reliability and an adequate dataset. A commonly accepted guideline in PLS-SEM states that the dataset should be at least 10 times the maximum number of arrows pointing to any latent variable in the model (Goodhue *et al.*, 2012).

In our model (Figure 5), the maximum number of paths leading to a latent variable is one. Therefore, according to the 10-times rule, the minimum required sample size is 10. Given that the dataset includes 31 responses, the sample is sufficient for our analysis.

For the CE adoption (CEA) construct, the model explains 41.6% of the variance (R^2 = 0.416), and for the CAP construct, it explains 21.1% of the variance (R^2 = 0.211). Following the recommendations (Hair *et al.*, 2019; Scarpellini *et al.*, 2020), we use a bootstrapping procedure with 5,000 iterations to evaluate the statistical significance of the relationships between the constructs (Table VIII).

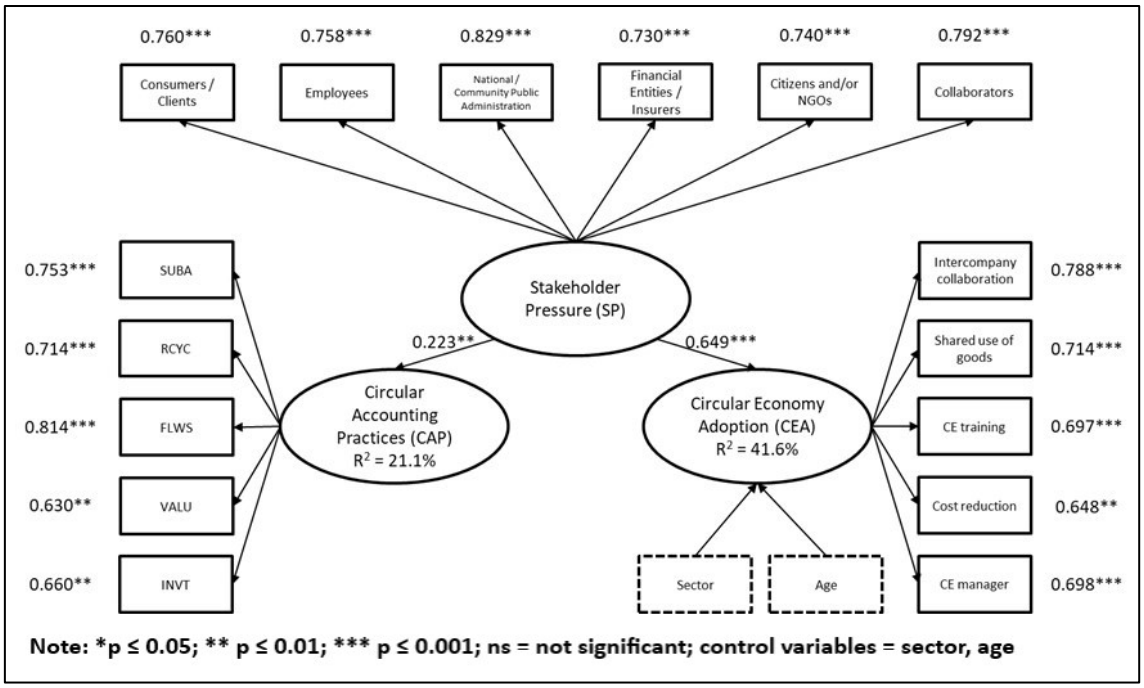

Figure 5: Structural model

Based on the results, we confirm that the direct relationship between stakeholder pressure and circular accounting is positive and statistically significant, with a coefficient of 0.223. This indicates that stakeholder pressure affects CE-related accounting practices (RQ4).

The relationship between SP and CEA is also positive and significant, with a coefficient of 0.649. This reflects that stakeholder pressure plays a crucial role in firm's adoption of the CE. In other words, the greater the stakeholder pressure, the more likely companies are to adopt circular practices. This supports the conclusions presented in Table VI and reinforces the positive relationship between stakeholder pressure and the level of CEA in waste management companies.

We find that the relationship between CEA and CAP is positive, but weaker. Because the difference is not statistically significant, we exclude this from the model. This suggests that applying PLS-SEM does not conclusively demonstrate the intuitive assumption that higher levels of CE adoption in companies correspond to greater implementation of circular accounting practices (Table VIII).

Table VIII: Structural model results.

Relations	Path coefficients	P-value	Decision
SP => CEA	0.649	≤ 0.001***	Accepted
CEA => CAP	-	-	Not accepted

SP => CAP	0.223	≤ 0.01**	Accepted

*Note: ** $p \leq 0.01$; *** $p \leq 0.001$; ns = not significant.*

Nevertheless, we detail the relationship between CEA and the implementation of CAP in Table IX.

Table IX. Average score assigned by companies to each CE-related activity (CEA), classified into two levels of implementation of circular accounting (CAP)

CE adoption average score per activity (CEA)	*Low level of circular accounting (score: 0-3)*	*Medium-High level of circular accounting (score: 4-8)*	
CE as a management priority	7.71	8.18	⇧
Intercompany collaboration	6.71	8.00	⇧
Job creation	6.07	6.94	⇧
Shared use of goods	4.79	6.18	⇧
CE communication to employees	6.79	7.00	⇧
CE training	5.21	5.47	⇧
Cost reduction	5.79	7.12	⇧
CE manager	2.93	4.94	⇧

A qualitative analysis of the average score given to the CEA construct indicators across the two levels of CAP highlights that the greater the implementation of CAP, the higher the average score on all indicators of CE implementation among the surveyed companies (CEA). At this stage of CE development, Table IX presents a very incipient analysis of the relationship between firm CEA and its implementation in specific accounting practices.

4.4 Discussion

Our study makes a novel contribution by defining the primary accounting practices associated with CEA by Spanish waste management companies (RQ1a). Some selected practices have already been recognized in terms of their CE importance by other scholars. However, we extend the literature to other CE-related practices by defining a broader mindset for circular accounting.

Among these CAP, we delve into environmental expenses for specific sub-accounts, expanding the analysis of CE-related investments and expenditures (Llena-Macarulla *et*

al., 2023). We also advance the internal measurement of CE activities (Marco-Fondevila *et al.*, 2023) and address the valuation of circular assets (Portillo-Tarragona *et al.*, 2024). We also specify the cost calculations for waste recycling to a greater degree (Aranda-Usón *et al.*, 2020) and enhance environmental accounting knowledge regarding LCA application and MFCA (Aranda-Usón *et al.*, 2024). In particular, we corroborate the low adoption of methodologies such as LCA and MFCA (Aranda-Usón *et al.*, 2024; Nishitani *et al.*, 2022). Specifically, few of the companies have adopted the UNE-EN ISO 14051 standard, which establishes the principles of MFCA, suggesting the need for incentive policies and training programs to support its effective integration in the waste sector.

Our results go beyond the interplay between the CE and management accounting examined previously, such as by Aureli et al. (2025) who identify that managers' decision-making processes essentially bypass the accounting function. Instead, such decisions rely on informal accounting and lifecycle analysis, stimulating a multi-stakeholder dialogue from a lifecycle perspective.

As a unique insight, we highlight how environmental accounting practices require further development among companies adopting CE principles or activities. The application of specific CAP should be further disseminated across sectors, particularly waste management, which plays a key role in closing material loops. Thus, greater accounting education remains critical in the implementation of the CE (Kwan Chung and Alegre Brítez, 2024).

The introduction of accounting practices adapted to the closing of material loops implies that companies will need to train and update their accountants and practitioners. Gallardo-Vázquez et al. (2024) confirm that involvement in the CE has a direct and positive influence on professional training and access to sustainability and CE-related information. The need to define adequate professional profiles adapted to the new requirements of the circular model (Scarpellini, 2022) also applies to accounting training or other crosscutting measures to improve accountants’ capabilities for cloud-based big data analytics (Cinquini *et al.*, 2025), artificial intelligence (AI) applications for the CE (Jesse *et al.*, 2023), and blockchain technologies (Bellucci *et al.*, 2022). Specifically, Halari and Baric (2023) emphasize that the CE remains largely peripheral within accounting. They identify collaboration as a potential enabler for engaging accountants in the CE.

Almost five years have passed since Larrinaga and Garcia-Torea (2022) raised their concerns regarding the CE. We do not question the merit of raising awareness about the need to avoid CAPs without verifying their limitations. Although not all their doubts about accounting facilitating the CE have been empirically resolved, our study increases the body of literature on this. Larrinaga and Garcia-Torea (2022) called for scholars to examine the specific roles that accounting could play in the CE. Subsequently, special issues in accounting journals highlighted several approaches to CE-related accounting (Arjaliès *et al.*, 2023; Etxeberria *et al.*, 2023).

Circular accounting scholars have now developed specific forms of accounting to support material loop closing in production and consumption patterns, even while bearing in mind the warnings of Larrinaga and Garcia-Torea (2022) not to be compelled by the need to facilitate the transformation of the linear economy into a circular one. Currently, scholars consider material loops as a distinct area within environmental accounting from both a theoretical and applied perspective. We do not imply that accounting should bear the political responsibility of transforming a linear economy into a circular one. However, environmental accounting scholars should contribute to original circular accounting concepts more broadly.

We do not address the critical arguments by Larrinaga and Garcia-Torea (2022) regarding the social and environmental limits of CE-related accounting; nor are we suggesting that accounting should contribute to decoupling socio-economic and biophysical systems (Wishart and Antheaume, 2021b). Nevertheless, our proposal for a clear mindset of circular accounting highlights the advantages of refining and specializing in environmental accounting to enhance the value of accountancy in response to the needs of companies adopting more circular models and principles.

However, our findings reflect a lack of awareness of these practices among companies, indicating an opportunity for capacity building and increased awareness of their importance. Notably, challenges remain because circular accounting offers significant opportunities to enhance organizational transparency, accountability, and resilience in the face of environmental risks and opportunities in a circular scenario. The circular accounting perspective of the sustainability paradigm offers broader advances in accountancy (Aranda-Usón *et al.*, 2022).

The landscape is undergoing a substantial transformation in the EU with the CSRD, which significantly expands the number of companies required to report their CE activities, establishes the mandatory use of the ESRS, and introduces the requirement for external and independent assurance of sustainability information. Thus, the CE measurements we define contribute to previous methodologies for measuring and reporting CE results. (RQ2) In the face of transitioning the CSRD into national laws, its implications for most European waste companies are that they will need to submit sustainability reports for external assurance.

The indicators for the measurement and reporting of CE we apply can also be used by SMEs to disclose relevant aspects of their progress toward circularity, in line with the results obtained from the application of GRI standards by Massari and Giannoccaro (2023). Although SMEs may have fewer resources to commit to the CSRD and sustainability reporting standards (Rossi and Luque-Vílchez, 2020), sustainability reporting, including CE-related information, is expected to become mandatory in the future (de la Cuesta-González and Morales-García, 2022). The fact that SMEs have been adapting to GRI standards suggests that, in the medium term, smaller companies will also introduce specific CE indicators in accordance with the EU and international standards. Despite the slowdown in the implementation of the CSRD by the “Omnibus Package” of the European Commission (2025), these companies are part of the CE progression and have the opportunity to increase their level of disclosure regarding the results achieved in closing material loops and in highlighting their role in the supply chain.

The results are also applicable to non-European companies, as they align with the proposal by Massari and Giannoccaro (2023) to adopt the GRI as a standardized approach for CE disclosure, particularly through the core indicators of the GRI 300 Standards related to the CE. Furthermore, they can be incorporated by companies reporting under the SASB framework, particularly when disclosing revenue from products or services aligned with the CE model, or reporting on company circular strategies implemented. The international applicability of these standards ensures the comparability, universality, and relevance of the reported indicators (Sanches *et al.*, 2022).

From a methodological perspective, notably, previous studies have employed methodologies similar to ours, such as those in Baah et al. (2022) and Scarpellini et al. (2020). Those authors also apply survey-based approaches using Likert scales to capture perceptions that cannot be obtained from databases, ultimately improving both response rates and data quality (Sachdev and Verma, 2004). In our study, the achieved response rate is comparable to, and in some instances higher than, those reported in previous studies. Moreover, we use a 0 to 10 Likert scale to enhance previous results, providing a broader range of responses.

The stakeholder results empirically confirm that regulators and policymakers are the primary drivers of CE adoption (RQ3). Thus, we extend the ongoing debate on the role of stakeholders in CE adoption, consistent with other scholars (Baah *et al.*, 2022; Witjes and Lozano, 2016). We also corroborate the positive impact of stakeholders on CE adoption, specifically in waste companies, an understudied and crucial sector. Our findings are also consistent with previous research on CE disclosure (Barnabè and Nazir, 2021; Esposito *et al.*, 2023), according to which the attention paid to recycling practices has anticipated the spread of CE models, driving circularity through the supply chain (Esposito *et al.*, 2023). The challenge remains to rapidly incorporate cloud-based big data analytics into accounting practices, AI applications (Jesse *et al.*, 2021), and blockchain technologies (Bellucci *et al.*, 2022), particularly for collaborative CE specifications.

Notably, our study empirically demonstrates the relationship between stakeholders and circular accounting. An increasing number of authors have addressed this relationship by focusing on reporting activities (Kuba-Khoury *et al.*, 2025; Moneva *et al.*, 2023; Roberts *et al.*, 2023; Vitolla *et al.*, 2023), possibly owing to the growing implementation of international standards. However, to date, only a few authors have approached internal accounting practices for the CE from the theoretical stakeholder perspective (Aureli *et al.*, 2025; Gallardo-Vázquez *et al.*, 2024; Marco-Fondevila *et al.*, 2023). Therefore, we extend the literature by empirically demonstrating that circular accounting practices are positively influenced by SP, revealing that external demands drive the integration of accounting practices adapted to circularity. Although part of our analysis might be empirically incomplete (RQ4), we apply the qualitative approach to

analyze the CE relevance for CAP levels. Moderate levels of CEA in companies do not necessarily imply significant changes in accounting system, which might be difficult to change (Halari and Baric, 2023). Therefore, a debate has arisen regarding the adaptation of environmental accounting practices to the CE, which requires further research.

5. Conclusions

This study expands knowledge on environmental accounting related to the CE, a topic in the early stages of research, from the stakeholder theoretical perspective. Based on the definition and measurement of unedited circular accounting practices in waste companies, we empirically demonstrate the central role of stakeholders in both the adoption of the CE and the development of CE-related accounting practices.

As a novel contribution, we also provide a qualitative analysis of the CE implications for accounting systems in the waste sector, although further empirical analysis is required. We could assume that the development of specific CE accounting practices depends on a more advanced stage of circular model implementation. However, other factors may be more critical than merely being at an early stage, such as organizational resources, knowledge, technical capabilities, accounting regulations, and pressure from regulatory stakeholders.

For scholars, these findings provide a foundation for debates on defining and measuring specific circular accounting practices from a stakeholder theoretical perspective. We set the stage for environmental accounting research to further analyze whether stakeholders are influencing the circular accounting practices introduced by companies, as a topic for further study. From our perspective on the CE, certain internal practices are explicitly implemented in response to circular activities, such as collaborative practices or the specific calculation of costs derived from closing material loops. Although these can potentially be classified under conventional environmental accounting practices, our study corroborates and enhances their CE specificity.

For practitioners, this study provides a novel definition and measurement of CE-specific activities for waste management companies and their related internal management and accounting practices. This may help companies better align their environmental

accounting practices with the sector application of circular actions. The results can be applied by accountants, chief financial officers, and managers to measure and report CE-related impacts in alignment with primary stakeholders. Capacity building and development of accounting standards are key elements that can support waste companies in effectively integrating circularity. In this regard, we call for the development of specific training plans to introduce circular accounting practices into environmental management tools, such as MFCA.

It is also important to maintain cautious and critical expectations, given the existing limitations and resistance to change arising from accounting regulations and the administrative burden associated with waste management. Our results should also be considered with caution, as our study focuses on companies of a specific size, and such changes may prove unfeasible for smaller companies. Our findings have relevant implications for accountants who collaborate with business associations and other agents who play an active role in integrating companies’ circular actions into their internal accounting systems. Accountants have the opportunity to tailor their accounting practices according to the extent that companies adopt the CE.

For Spanish public companies subject to sustainability and accountability regulations, this study suggests incorporating circular accounting practices and CE-related indicators into public accounting systems to monitor the implementation of climate strategies and action plans. Moreover, many projects financed by public funds require information about environmental impacts, promoting the adoption of circular accounting practices that ensure both the eligibility and traceability of resources in response to institutional stakeholders.

For national and international policymakers and accounting standard setters, the findings show that regulatory frameworks are necessary, but not sufficient, to ensure the implementation of circular accounting practices. Policies that acknowledge and actively support the development of these practices are more likely to drive company adoption. In this sense, the study underscores the need for closer alignment among policies, accounting systems, and the evolving demands of different stakeholders, as well as stronger incentives to facilitate the adoption of circular accounting practices beyond traditional sector-specific approaches. We also highlight the challenge of

reducing the bureaucratic burden associated with waste management, which currently hinders the complete introduction of circular practices.

Training in accounting is also necessary to highlight CE-specific requirements within environmental accounting, ensuring not only improved accountant-oriented activities but also planet-oriented decision making. In particular, collaborative communication along the supply chain can be strengthened through training based on applied examples, such as video demonstrations and cases of CE-related cost allocation, accounting for byproducts, reuse, or revalorization flows. CE-related training should also include AI, blockchain, and cloud-based big data analytics applications that support collaborative circular processes that must be integrated into accounting rules.

The limitations of our study are mainly associated with the geographical analysis and the number of companies surveyed in a single sector. The limited population of companies in the waste sector and their small size limit data collection. Nevertheless, the final sample includes companies from different regions and reflects sufficient diversity to minimize potential bias. Our analysis is also limited to Spain and cannot be directly generalized to other countries without appropriate adaptation to national contexts and regulatory frameworks. However, our findings related to the definition of accounting practices, stakeholders, and the methodology for measuring and reporting CE activities can be adapted to other geographic contexts and sectors, particularly where sustainability reporting standards are in place and waste-related indicators are considered essential.

Another potential limitation arises from the non-anonymous nature of the survey. The results should be interpreted as reflecting the perceptions of informed respondents, and some overstatements of CE adoption or circular accounting practice implementation cannot be ruled out. Although there were no clear indications of such bias, this does not eliminate the need to acknowledge this as a limitation. Future research could address this by employing fully anonymous surveys or complementing survey evidence with secondary indicators to triangulate self-reported information.

Future research could also explore the longitudinal impact of stakeholder pressure and CE adoption on accounting practices. Increasing the sample size and enhancing the geographic and sector diversity could improve the generalizability and applicability of

the results. Circular accounting still has a large space for development; therefore, the number of applied and theoretical studies is expected to rapidly increase in the future, deepening our understanding of the determinants across sectors.

This study focuses on environmental accounting aspects in the waste sector, but there is a need to expand circular accounting contributions at the micro level, in particular, to explore the effects of more advanced level of CE adoption in circular accounting practices. This expansion should be integrated into sustainability accounting, enhancing accountability, exploring new reporting practices within the value chain, and considering collaborative approaches.

Acknowledgments

This study was co-financed by the Spanish Ministry of Science, Innovation, and Universities (Ref. PID2023-146084OB-I00) and the Government of Aragon under Research Group S33_20R. We would like to acknowledge the valuable input of the companies that answered the surveys.

Declaration of generative AI and AI-assisted technologies in the writing process

In preparing this work, the authors did not use AI technologies, except in the final writing review through the "Grammarly" application.

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