



A survey of Circular Economy initiatives in Portuguese central public sector organisations: National outlook for implementation

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ABSTRACT

The Circular Economy (CE) is generally understood as an opportunity to transform the current unsustainable linear economic system by redesigning the way organisations provide goods and services rethinking how society consumes and uses those resources. In this context, the public sector is mainly recognised as an actor enabling the implementation of a sustainable CE through governmental interventions and policy initiatives. However, there is a lack of studies considering the public sector at an organisational level. CE in organisations includes a wide range of different practices that are important to examine in order to analyse the CE implementation process. Consequently, this study aims to characterise the current state of implementing circular practices and supporting strategies in central public sector organisations. To fulfil this aim, a questionnaire survey was sent to the organisations pertaining to the Portuguese Central Public Administration, as surveys are valuable tools to systematically collect information on various topics. The results demonstrate a relatively low level of implementation. Circular practices such as purchasing remanufactured or used items, using sharing platforms, increasing the efficiency of buildings, adopting green human resources and collaborative initiatives for circularity, and assessing and communicating about CE activities have presented low levels of adoption. At the same time, waste collection for recycling and dematerialisation practices showed good implementation levels. There is, thus, immense potential for further implementation of circularity in central public sector organisations in Portugal. This research contributes to deepening the understanding of the extent to which circular practices are embedded in public sector organisations and identifying the main implementation strengths and weaknesses. This research has the potential to help practitioners and researchers in the transition towards circularity in identifying circular opportunities in their organisations and in building a vision to further implement circularity in public sector organisations.

1. Introduction

The Circular Economy (CE) is generally understood as an opportunity to tackle the environmental and social challenges of the current unsustainable linear economic system (Moreau et al., 2017). Establishing a CE is expected to transform how companies and supply chains provide goods and services and bring a paradigmatic shift to how people and organisations consume and use those resources. The aim is to maintain the value of resources at the highest level for as long as possible in the system within the limits of the planetary boundaries (Desing et al., 2020; Merli et al., 2018b). CE is usually used as a set of strategies and practices to accelerate the transition towards sustainability (Blomsma

and Brennan, 2017; Geissdoerfer et al., 2017). The research and implementation of CE discerns different circularity levels, one of them, the micro level, is focused on organisations, consumers or products, as discussed by Kirchherr et al. (2017). The public sector or the government is mainly recognised as a significant driver to the CE transition (Ten Wolde, 2016), having the potential to enable the implementation of a sustainable CE at the macro level with the development of adequate public policies and governmental interventions impacting both companies and citizens (Kazancoglu et al., 2020). It is less emphasised that the public sector is also a significant purchaser, consumer and user of resources in the economy (Ball and Grubnic, 2007). For instance, Public Procurement (PP) represents globally between 15% and 20% of GDP

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(Hughes et al., 2019). It is, therefore, important to consider the public sector's organisational sustainability in addition to its leverage power in society and other sectors (Klein et al., 2020).

Additionally, understanding the nature and state of a transition towards a CE is essential for creating effective policies and organisational strategies (Masi et al., 2018). Kirchherr and Santen have pointed out that empirical research is needed to provide practitioners with evidence on how to make CE work and how to implement CE in practice (Kirchherr and Santen, 2019) and CE research on the public administration sector is scarce compared to CE research on the private sector (Sehnm et al., 2021). They have further designated a lack of empirical and quantitative studies (Kirchherr and Santen, 2019). Previous CE research has also shown that survey studies are an underexplored research methodology in the field, especially at the level of organisations (Masi et al., 2018). Surveys are incredibly convenient tools to systematically collect information on various topics (Gideon, 2012). Considering the multidimensional nature of CE and the multiple practices to consider in practice, it is important to examine the implementation process using tools that enable an overview of those different aspects of circularity. Consequently, survey research on Public Sector Organisations (PSOs) examining the current level of implementation would significantly contribute to filling the current gaps in CE research and to providing insights for practitioners on the present awareness and implementation of CE in the public sector.

To address this need to characterise the CE transition in the public sector, this study aims to characterise the current level of adoption of CE practices and supporting strategies in PSOs at the national level in Portugal. Accordingly, this study addresses the following question: **To what extent are central PSOs in Portugal implementing CE practices and supporting strategies at the organisational level?** A national web-based questionnaire survey (Rea and Parker, 2014) was developed and sent out to PSOs pertaining to the Portuguese Central Public Administration (PCPA). Portugal is engaged in the transition towards CE and has communicated its commitment with an Action Plan for the Circular Economy in Portugal 2017–2020 (Portuguese Ministry of Environment and Energy Transition, 2017), which includes several measures for the implementation of circularity practices in the public administration sector. Previous CE work has focused on Portugal as a case study (Droege et al., 2021a, 2021b; Klein et al., 2021a, 2021b). However, this is a first attempt to get a systematic overview of CE implementation in the entire central public administration of the country.

The remainder of this paper presents an overview of previous work and insights on CE-based practices and implementation of circularity in PSOs in section 2. The methodological process of the survey will be provided in section 3. Thereafter, the results and discussion of the survey answers will be introduced in section 4, and section 5 will put forward the conclusions and implications of the survey results.

2. Circular Economy initiatives and supporting strategies in public sector organisations

PSOs have functional and organisational characteristics that might differ to some extent from business companies (Ramos et al., 2007). PSOs are service-oriented organisations performing multiple functions as they deliver public services, facilitate resource reallocation, and/or undertake policy development (Aggestam-Pontoppidan and Anderneck, 2016; Figueira et al., 2018). In addition, PSOs pursue multiple, often complex and more vague political and social goals of public accountability requiring transparency and representation different from companies pursuing commercial objectives of profit-making (Parker and Bradley, 2000). Therefore, PSOs are subjected to political influences of the electorate, legal and institutional constraints with specific budget and governance limitations (Rainey and Bozeman, 2000). As a result, PSOs are described as having bureaucratic and hierarchical organisational structures with top-down chains of command, strict rules and

procedures, and clear attribution of tasks (Rainey, 2008; Van der Voet, 2014). This suggests that examining the implementation of CE in the public sector might reveal barriers to change and organisational aspects specific to PSOs in the change towards circular management of resources. The following sub-sections explore the literature on an array of circular practices and supporting strategies that will be the basis for designing the survey.

2.1. Circular economy initiatives in the public sector

Public Procurement (PP) is one means by which the public sector can incentivise supply chains to move towards sustainable and circular practices (Angelis et al., 2018; Grandia and Kruiyen, 2020). The literature on CE has frequently highlighted the potential of **Circular Public Procurement (CPP)** as a public sector tool to stimulate innovation, the creation of new markets in line with a CE and to accelerate the transition towards circularity (Dahl Sönnichsen and Clement, 2020; Ntsonde and Aggeri, 2021; Stahel, 2019). As an emerging field, CPP is debated regarding its links to Green Public Procurement (GPP) and Sustainable Public Procurement (SPP) whether CPP is a category of GPP and SPP (Grandia and Kruiyen, 2020) or whether it is substantially different needing a circular lifecycle thinking approach for procuring works, goods and services, and requiring new ways of collaborating and thinking about purchasing overall (Alhola et al., 2018; Witjes and Lozano, 2016). CPP refers to CE principles in PP processes that guide purchasing decisions. Kristensen et al. (2020) detailed different CPP concepts from the literature showing the diverse and often overlapping understanding of CE as seen applicable to PP. CPP strategies include criteria in tenders' specification such as recycled content of materials, potential for reparability and/or recyclability, reuse of products or components, repair/refurbishment, remanufacturing of products or equipment (Crafoord et al., 2018; Gåvertsson et al., 2018; UNEP, 2018). Other CPP strategies also entail strategies of larger scope considering the supplier and the system level rethink of purchasing to promote new business models with pay-per-use contracts, performance-based contracts or buy-and-sell back contracts (Öhgren et al., 2019; Stahel, 2019). Few studies have carried out empirical investigations of the implementation of CPP. Nevertheless, those studies have identified barriers to CPP implementation, such as the lack of knowledge and expertise on CE from the procurers and the organisational distances between centralised procurement departments and each individual PSO (Alhola et al., 2018; Kristensen et al., 2020). Conversely, top management's support is one of the main drivers (Kristensen et al., 2020). Studies on the impacts of CPP implementation have focused mostly on local authorities (Dahl Sönnichsen and Clement, 2020; Kristensen et al., 2020), whereas insights into national or central government cases are still missing. The product categories of procurement, the most prominently studied and explored for implementation include construction and furniture (Klein et al., 2020; Öhgren et al., 2019), as well as Information and Communications Technology (ICT) products and transportation (Gåvertsson et al., 2018; Lindfors and Ammenberg, 2020).

The operations and tasks performed in the public administration sector are diverse. It is recognised that the public sector delivers various types of services and infrastructure, such as wastewater treatment, water and energy supply, amongst many others (JRC, 2019). However, in this study, those are considered as output and outcomes of PSOs and thus, as out of scope for this research focused on the organisational level. Considering the present case of central PSOs in Portugal, operations tend to be, for the most part, of administrative nature, taking place in office buildings. Given the significant size of the public sector in the economy (Ball and Grubnic, 2007), implementing circularity in PSOs' operations is critical, along with circular purchasing. Previous work by Klein et al. (2021) has identified several types of CE practices relevant to operational areas of PSOs, including practices based on the R hierarchy (Reike et al., 2018), waste management, efficiency and optimisation of buildings, and dematerialisation practices. Regarding the **R-based practices**,

the results showed that CE implementation in the public sector at the organisational level is more suitable to be viewed from a consumer-oriented perspective centred around the use of resources. Therefore R-based practices such as refuse, reduce, reuse, repair and recycle are relevant rather than those oriented towards the design and production of products and materials suited to industrial or manufacturing companies, which also have practices such as remanufacture or refurbish (Klein et al., 2021a). As mentioned by Barreiro-Gen and Lozano (2020), there are very few insights on CE implementation in PSOs. Some studies examine the implementation of circularity in Higher Education Institutions (HEI) (Hopff et al., 2019; Mendoza et al., 2019a, 2019b; Nunes et al., 2018), which could be considered as PSOs if they are, for instance, public universities. The institutions studied do not explicitly reference the CE concept in organisational sustainability policies. Their environmental sustainability initiatives are mainly oriented toward **efficiency efforts** to reduce consumption, waste and thus carbon emissions. Energy efficient infrastructure and water efficient systems may reduce environmental impacts, but these practices still belong to the linear paradigm. The closed-loop management of energy for lighting and heating, water and other building resources have the potential to bring PSOs to higher levels of sustainability. The public sector might have the added challenge of preserving and managing historic buildings that might not allow for such efficiency upgrades (Klein et al., 2021a). A circular alternative could be to consider innovative or adapted reuse options of public buildings of cultural heritage nature or historical value, as investigated by Torrieri et al. (2019) and Foster (2020).

Moreover, the implementation of **Environmental Management Systems (EMS)** or the strategic choice to improve environmental performance has been demonstrated to positively influence CE implementation in organisations (Fonseca et al., 2018). Several studies have highlighted the opportunity of EMS implementation to rethink organisational operations and strategic direction in line with CE principles (Kristensen et al., 2021; Merli et al., 2018a). Research has also noted the weak diffusion of EMS implementation and CE related initiatives in organisations, including PSOs and that further empirical work is needed to increase the level of integration between these two research topics (Marrucci et al., 2019).

Sharing economy practices represent a significant opportunity for the public sector to reduce its consumption and waste and practice circularity at organisational and systemic levels (Ganapati and Reddick, 2018). **Sharing practices** can be considered in the reduce or reuse categories of R-based practices as simultaneous use or sequential use of products or equipment or even donating goods, thus reducing waste and extending the life of products (Hobson and Lynch, 2016; Reike et al., 2018). Although sharing has been promoted as a CE practice suitable for the public sector, namely through the use of digital platforms to enable renting or peer-to-peer sharing of assets, the literature has pointed out several challenges that need to be addressed. Some of those challenges include the potential inequalities created related to time availability and access to resources between the different PSOs and the dependency on the platform (functionality and rules) and the providers (Ganapati and Reddick, 2018; Hofmann et al., 2019).

Consequently, if digital platforms are to be implemented as a practice enabling circular opportunities for sustainability (Antikainen et al., 2018), we should note that **dematerialisation, digitalisation or virtualisation efforts** have already been undertaken by the public sector even before the CE momentum for efficiency and economic reasons (Valdés et al., 2011). Nevertheless, the environmental impacts of digital platforms are still unclear, and further research is needed to evaluate the sustainability impacts of digital transformations (Konietzko et al., 2020a). The literature has raised issues of the potential increase in material used for digital hardware manufacturing and the risk of rebound effects related to the consumption of efficient digital technologies (Mirabella et al., 2013). Currently, other virtualisation practices include teleworking and virtual conferences and meetings (EMF, 2015).

Despite the need for further research in all areas of public

administration in which CE opportunities are seen, the public sector, including its leadership and public officials, are becoming aware of the potential benefits of CE for society and the economy by developing national CE strategic plans but also for their own organisational performance (EESC, 2019; Klein et al., 2021a). Nevertheless, Kazancoglu et al. (2020) highlight the need to increase the awareness of state officials on topics such as CE. Several studies have investigated the understanding of CE by the public sector. These have concluded that the public sector perceives CE as mostly revolving around the circulation of materials and reduction of waste through recycling and reuse of products and as a way of decoupling economic growth from resource extraction and degradation (Persson, 2015; van Langen et al., 2021). Suggestions to increase the awareness and knowledge of CE for public administrators include awareness raising and information campaigns (Przywojska et al., 2019; van Langen et al., 2021; Xue et al., 2010). Consequently, it is important to inquire about the understanding and awareness of CE and awareness raising activities within Portuguese central PSOs.

2.2. Strategies supporting change towards CE implementation in the public sector

Implementing CE practices in PSOs can be reinforced by identifying factors influencing the change process and implementing supporting strategies. Previous literature has pointed out important issues to address during a CE implementation process in organisations, including strategy and management, human resources, communication and assessment (Dahl Sönnichsen and Clement, 2020; Klein et al., 2020, 2021b; Kristensen et al., 2021).

Enabling factors or drivers for CE implementation can include internal **drivers** such as top management/leadership commitment, sustainability performance indicators, but also external factors such as favourable policies and legislative incentives, pressure from companies, the civil society or governments (Aloini et al., 2020; Jesus and Mendonça, 2018; Tura et al., 2019). For the public sector, drivers to CE implementation at the organisational level have not been specifically explored yet. On the other hand, as the absence of those factors might represent significant challenges, a part of the literature has focused on identifying **barriers** to overcome in order to accelerate CE implementation (Sopjani et al., 2020). For PSOs, the main barriers mentioned are lack of CE awareness, lack of CE knowledge, skills and training, especially in PP procedures (Alhola et al., 2018; Crafoord et al., 2018; van Langen et al., 2021) and the presence of bureaucratic mindsets, siloed and hierarchical structures hindering information flows and collaboration (Dahl Sönnichsen and Clement, 2020; Droege et al., 2021a). In addition, the lack of interaction and engagement with external stakeholders have also been emphasised in studies on CPP (Öhgren et al., 2019; Witjes and Lozano, 2016).

Having a leadership team that is supportive of and active towards CE at the organisational level has been emphasised by previous literature as one of the most important success factors for CE implementation in organisations (Klein et al., 2021b; Mendoza et al., 2019b; Millar et al., 2012). However, studies have shown that there is little to no leadership interest in organisational circularity in the public sector (Droege et al., 2021a). **Strategic initiatives and leadership commitments** are usually identified with CE statements, goals and targets in dedicated documents or other environmental/sustainability policies, plans and programs (Baumgartner and Rauter, 2016). In addition, Mendoza et al. (2019b) noted that having CE “champions” to challenge employees to think critically about CE and take appropriate actions across organisations is important to pursue and facilitate CE implementation in the workplace. This might be done formally by appointing someone to show and communicate to others or personally and voluntarily manifesting circular behaviour as an example. Consequently, to examine the CE implementation in PSOs, it is crucial to inquire for evidence of leadership on CE issues in PSOs.

Green Human Resource Management (GHRM) practices also have

the potential to improve the CE performance of organisations, including PSOs (Pham et al., 2019). The importance of employees and human resources is increasingly acknowledged urging the CE research community to pursue empirical work to provide insights into how GRHM practices impact organisational performance towards CE (Chiappetta Jabbour et al., 2019; van Langen et al., 2021). GRHM practices such as green recruitment, environmental training, involving employees to commit to CE activities, rewarding the employees' contribution in the achievement of a more sustainable organisation might have a positive impact in implementing CE, potentially creating favourable organisational culture, enabling the diffusion of circular practices, more employee satisfaction, empowerment, and better organisational performance (Marrucci et al., 2021). Nevertheless, GRHM practices oriented towards CE still need to be developed in organisations, especially PSOs, to assess their impacts on CE implementation.

CE is a systemic concept needing an ecosystem perspective (Konietzko et al., 2020a). Therefore, the implementation of CE requires increased **collaboration** among actors at inter-organisational and societal levels (Kristensen et al., 2021). In the public sector, this is especially highlighted in previous literature regarding the integration of CE in PP processes, where authors have emphasised the need for more and new collaborative initiatives among public organisations but also with external stakeholders, such as suppliers, universities, associations, companies, and citizens (Alhola et al., 2018; Kristensen et al., 2020; Rainville, 2021; Witjes and Lozano, 2016). While innovative collaborations might be hindered by several structural and cultural challenges, the literature calls for further research to provide tools for PSOs to increase the active engagement of a wide range of stakeholders to integrate circularity in their operations in the most appropriate and durable way (Bögel et al., 2019; Dahl Sönnichsen and Clement, 2020).

Assessment and communication have been highlighted as essential areas to focus on in the context of CE implementation in PSOs (Klein et al., 2020). Practices oriented towards monitoring, evaluating, assessing and reporting are fundamental for CE implementation (Mendoza et al., 2019b). However, Droegge et al. (2021a, 2021b) have demonstrated that few to no efforts in CE assessment and its reporting had been initiated in the public sector internally. Consequently, the few examples of CE assessment implemented, in practice, only reflect the increasing need for CE assessment, monitoring methods, and reporting and communication tools to be integrated into the public sector.

In summary, circular practices in PSOs have focused on integrating circular criteria in PP processes and rethinking circular purchasing processes, the main R-based practices of reduce, reuse and recycle, the use of sharing platforms, the potential of EMSs for CE implementation and dematerialisation of administrative procedures. Research on supporting strategies for organisational change towards circularity in the public sector is still in its infancy. Therefore, further work has been called for the influence of leadership, GRHM practices, collaboration, and communication and assessment on the implementation process of circular practices.

3. Methods

A survey research approach was used in this study to provide a quantitative description of trends, attitudes or opinions of a population (Creswell, 2014). In the present study, taking a survey research approach using a web-based questionnaire survey allows one to examine the current awareness and implementation of CE in the Portuguese Central Public Administration (PCPA).

The PCPA can be divided into two levels (DGAEP, 2018; EC, 2018; Figueira et al., 2018): (i) Direct State Administration (DSA); (ii) Indirect State Administration (ISA) comprised of public institutes and agencies. The Direct State Administration (DSA) consists of the Ministries and their central services, which have competency at a national level and only administrative autonomy (e.g. General Directorates, General Secretariats, General Inspectorates). The ISA consists of public bodies that

have administrative, as well as financial autonomy and with legal personality set up by public power to pursue specific State functions (EC, 2018). Only organisations pertaining to the DSA and ISA have been included in this study to fit the scope of the PCPA. To define the general population of the PCPA, a list of all the DSA and ISA organisations with national and central influence was established based on data searches made on Portugal's Information System for State Organisation (SIOE). It is a cross-sectional publicly available information database that characterises government public structures and human resources (EC, 2018). For every ministry, all the organisations from the following subsector of central administration were selected: General Directorates, General Secretariats, General Inspectorates and Public Institutes. As a result, 118 organisations were identified as the general population of the PCPA. Further details on the general population of the PCPA are presented in Table 1. As the SIOE system provides access to the emails of the organisations' directors or heads of management, the entire statistical population was surveyed. This sampling method and scope of the public sector is inspired by previous work on sustainability in PSOs using an online survey (Figueira et al., 2018).

An invitation was sent via email to the directors or top managers of the targeted organisations with a link to the online survey, and one response per organisation was requested. This study used an online survey because it is a cost-effective data collection method in regard to the administration and delivery of the survey, and it can conveniently contact a large number of potential respondents that are geographically dispersed (Mesch, 2012). Additionally, a web-based survey was used here as a method to ensure confidentiality and security while quickly gathering a substantial amount of data (Rea and Parker, 2014).

The survey was open for six weeks between October and November 2020. Before distributing the questionnaire, a questionnaire validation process was undertaken during July 2020 where the questionnaire was sent to five people working in Portuguese central PSOs to ensure the quality of the instrument in terms of clarity, understandability, and relevancy, as done in similar studies by Figueira et al. (2018) and Gusmerotti et al. (2019). The feedback received was analysed and considered for the final version of the questionnaire.

The questionnaire survey was composed of 26 questions that were categorised into 9 thematic groups fitting the different aspects of the implementation process of CE practices as observed in the literature and previous empirical studies (e.g. Droegge et al., 2021b, 2021a; Klein et al., 2021b, 2020) (see Table 2 for an overview of the themes raised in the questionnaire survey). Both open and closed-ended questions have been combined in the questionnaire survey. Closed-ended questions include dichotomous questions, Likert scale questions with options for comments. The questionnaire survey is available in Appendix A.

A total of 49 out of the 118 organisations approached answered the questionnaire, which corresponds to a response rate of 41%. More specifically, 16 General Directorates, 7 General Secretariats, 5 General Inspectorates and 16 public institutions responded to the questionnaire. The 5 remaining respondents were not identified. Compared to similar survey studies made for sustainability-related issues in PSOs, with response rates of 36% (Parker and Bradley, 2000) and 31% (Nogueiro and Ramos, 2014), this one can be considered as a high response rate for a survey directed to this kind of organisations. Descriptive statistics, including frequency analysis, was done in the SPSS software to measure the counts and percentages of answers for each response category

Table 1
Description of the PCPA surveyed.

Administration level	Organisation category	No. of organisations
Direct State Administration	General Directorates	48
Direct State Administration	General Secretariats	11
Direct State Administration	General Inspectorates	12
Indirect State Administration	Public Institutes	47
Total		118

Table 2
Summary of the structure and themes in the questionnaire survey.

Sections	Themes
General Background	COFOG functions Number of employees Internal structure of the organisation
Circular Economy in general	Awareness and understanding of CE Perceived importance of CE in the organisation
Circular Public Procurement	Responsibility of public procurement and criteria selection Procurement possibility of second-hand products and equipment Use of CE-based criteria or specifications in purchasing decisions
CE practices in Internal Processes and Operations	Environmental management systems (EMS) implementation Resource and energy efficiency for organisational performance improvements (including water use, lighting system, air-conditioning system, windows insulation, space use, use of servers' heat) Consumption reduction and product life extension practices including Refusing, Reusing, Repairing, Sharing and Donating Implementation of separated waste collection system of containers for safe disposal of waste, and recycling of materials, products, and equipment Dematerialisation and virtualisation of administrative processes
Strategy and Management	Adoption of strategic instruments and/or statements that include the term CE People leading by example as CE champions in the organisation
Human Resources	Staff training initiatives on CE-related issues Existence of a person in charge of managing sustainability or CE aspects of the organisation Establishment of guidelines for staff to adopt a common circular use and management of resources Installation of signs and instruction posts for staff to ensure the correct circular use and management of resources
Assessment and Communication	Establishment of staff awards competitions Awareness-raising events and conferences to disseminate knowledge on CE to external stakeholders Publication of formal reports on organisational CE performance aspects Use of CE-related indicators Adoption of a stock management system Use of digital internal questionnaires
Collaboration with other stakeholders	Establishment of external collaboration (e.g., citizens, local businesses, suppliers) and internal collaborative working groups
Influencing factors on circularity	Drivers/Enabling factors Barriers/Inhibiting factors

(Bryman, 2012; Rea and Parker, 2014). The mean value was used to compare the answers regarding the importance of selected drivers and barriers to CE implementation, thus indicating a score from 1 (not important) to 5 (extremely important). The tables of results for the frequency analyses are available in Appendix B. The missing cases (non-responses) were excluded from the analyses as per recommendations from Rea and Parker (2014). The variables analysed were mainly of nominal and ordinal scales; therefore, two non-parametric tests were used (Saunders et al., 2016). A Kruskal-Wallis H test was performed to identify potential differences in the distribution of CE practices and supporting strategies according to the three organisation's profile variables with a p-value < 0.05 (Laerd Statistics, 2015). A Spearman's correlation (r_s) test was performed to assess the strength of the potential relationship between the status of implementation of CE practices and supporting strategies examined on an ordinal scale (Laerd Statistics, 2018). Research limitations included the potential respondent bias in answering the questions as it is a self-completion survey (Bryman et al., 2021). Such limitation can be mitigated with complementary documents

analysis and interviews of people in the organisations. External validity was guaranteed by sampling the total population of the PCPA and with the resulting high response rate (41%). Moreover, a Cronbach Alpha test was performed for the reliability of the 4-point Likert scale used to inquire about the CE practices and the 5-point Likert scale on change strategies and validated with a score higher than 0.7, indicating the strong reliability of those scales. The tables of results of the Cronbach Alpha statistical tests are available in Appendix C (Table C1 and C2).

4. Results and discussion

The information obtained from the survey is divided partly according to the main thematic groups related to a CE implementation process in PSOs (Klein et al., 2021a) with some general questions: (i) general background; (ii) general understanding of CE; (iii) circular public procurement; (iv) CE practices in internal operations and processes; (v) Strategy and management; (vi) Human resources and communication; (vii) Assessment; (viii) Collaboration with other stakeholders; and (ix) Drivers and barriers to circularity adoption.

4.1. General background

The majority (47%) of the organisations provide *general public services*, and 18% deliver *economic affairs* related services. As shown in Table 3, representation of all the functions of government is covered by the responses except for the function responsible for *housing and community amenities*. Those categories correspond to the first level of Classification of the Functions of Government (COFOG) by the Organisation for Economic Co-operation and Development (OECD) (Eurostat, 2019).

The large majority (86%) of the responding organisations have a hierarchical organisational structure. In the case of the central Portuguese government, the hierarchical structure consists of nuclear units (departments) and flexible organic units (divisions), whereas a matrix-based organisational structure is formed of multidisciplinary teams with functional mobility led by a head of team (EC, 2018). This result corresponds to the traditional characteristics of the public sector. PSOs have generally been referred to as bureaucratic and hierarchical organisations with a structured and centralised chain of authority, constrained by legislation and political authority with clear, formal and rule-based specifications of duties and role descriptions as opposed to private companies that are subject to market controls with competition,

Table 3
Results for the background questions.

Question	Categories	N	%
Functions	General public services	23	47
	Economic affairs	9	18
	Environmental protection	3	6
	Health	3	6
	Education	3	6
	Social protection	3	6
	Public order and safety	2	4
	Recreation, Culture and Religion	2	4
	Defence	1	2
	Housing and community amenities	0	0
	Non-response	0	
	Total	49	100
	Organisational structures	Hierarchical	42
Matrix-based		4	8
Mixed		3	6
Non-response		0	
Total		49	100
Size of the organisations	1 - 49 employees	7	14
	50 - 249 employees	23	47
	250 - 499 employees	5	10
	500 - > 5000 employees	14	29
	Non-response	0	
	Total	49	100

and consumer and shareholder interests (Parker and Bradley, 2000; Rainey, 2008).

Finally, almost half of the organisations (47%) have between 50 and 249 employees. Then, 14% of them have less than 50 employees, while 29% of the organisations have more than 500 employees. This categorisation was chosen to correspond to the existing categories for private companies (Eurostat, 2016) as an equivalent classification doesn't exist for PSOs. The size of the majority of the PSOs responding would correspond to Small and Medium-sized Enterprises (SMEs), which according to the European Commission (EC), are defined as companies having less than 250 employees (Eurostat, 2016). The Kruskal-Wallis H test observed no significant differences with $p < 0.05$ in the distribution of the CE practices and supporting strategies except for the LED lighting system and for reward schemes (see Table C3 in Appendix C). There are statistically significant differences in levels of LED systems installed where the smallest PSOs (1–49 employees) have higher levels of implementation, and there are statistical differences in levels of reward schemes implemented where mixed structured organisations have a lower level of implementation of rewards schemes and award competition.

4.2. General awareness and understanding of CE

The vast majority of the respondents (96%) answered that they are aware of the concept of CE. This is a positive result, demonstrating the momentum of CE among public sector stakeholders. Furthermore, 71% have said that the term is mentioned/used in their organisations. In addition to those two questions, the PSOs were asked to explain what CE means to them with a sentence or some keywords. The most frequent terms used to describe CE were related to reuse, followed by recycling. Moreover, it seems that the respondents associate CE with a focus on resources, products, and materials and an emphasis on waste reduction. Such a perception of CE corresponds to previous literature on public sector perceptions of CE, which views CE as a practical solution to economic and social challenges, oriented primarily towards waste management issues and the circulation of resources for which increasing recycling and reuse is a significant component and for which CE is mainly referred to the basic R's options (Reduce, Reuse, Recycle) (Calisto Friant et al., 2021; Dagilienė et al., 2021; van Langen et al., 2021). Other keywords such as consumption, sharing and sustainability were mentioned to a lesser extent, highlighting an awareness of CE and as a system needing change for sustainability, and in consumption, aspects expanding from solely focusing on resource management in production processes. It reveals a more holistic view and extended scope of CE as promoted by several researchers (Hobson and Lynch, 2016; Moreau et al., 2017; Schulz et al., 2019).

Finally, respondents were asked to evaluate the importance of CE at strategic and operational levels. About 41% of the PSOs consider CE as moderately important for strategic activities (e.g., annual management plans), whereas 49% view CE as important at an operational level (e.g., administrative procedures or daily tasks). This might mean that more respondents regard CE as important at an operational level than a strategic level. This result would match the idea of CE as a set of operationalised strategies towards sustainability (Kirchherr et al., 2017; Suárez-Eiroa et al., 2019). CE is often defined according to different sets of operational principles such as collaboration or platformization (Konietzko et al., 2020b). Because the CE is being viewed as a practical solution to sustainability issues, hence the inclination of CE for operationalisation (Murray et al., 2017). However, CE is increasingly portrayed in the literature as a paradigm shift which is not only expected to apply specific principles but also to rethink the principles and adapt CE values according to the desired goals and considering a larger scope of the system (Konietzko et al., 2020a; Kristensen et al., 2021).

4.3. Circular public procurement

CPP has been emphasised in the literature as an effective instrument that can speed up the shift towards CE, stimulating the development of innovative solutions and new markets for a CE (Ntsondè and Aggeri, 2021; Stahel, 2019). Therefore, a section of the survey was dedicated to questions regarding the procurement conditions in the organisations of the PCPA and the adoption of a variety of CE criteria in purchasing decisions.

Overall, 84% of the respondent organisations have answered that they oversee their procurement procedures. In the case of the Portuguese central public sector, although PSOs might be undertaking purchasing activities, they are also obliged to act under large framework agreements which require them to purchase standardised items (EC, 2016). Therefore, allowing limited ability to select or create circular-oriented criteria. This is reflected in the answers to another question asking if the PSOs were allowed to purchase second-hand products. Many of the respondents (85%) answered that they were not allowed. Some respondents commented that their purchasing is centralised and needs to comply with and follow to guidelines of the framework agreements signed by the Government Shared Services Entity (ESPAP), which applies the criteria of the National Strategy for Ecological Procurement 2020 (ENCPE 2020) (APA, 2019). Moreover, previous research has highlighted that PSOs, especially small PSOs, have few possibilities and opportunities to decide on criteria or specifications when undertaking purchasing procedures (Dahl Sønnichsen and Clement, 2020). Throughout the questionnaire, several comments from respondents were provided, noting the constrained reality of procurers only being able to choose from environmental or sustainability criteria predefined by central purchasing organisations. This shows that the innovativeness in PP towards circularity and the diffusion of CPP in PSOs is impacted by top-down dynamics and leadership styles (Roman, 2017). Nevertheless, CPP is one of the key priorities of the national Action Plan for the Circular Economy showing leadership interest, and thus, there are ongoing efforts from the central purchasing organisations to develop more ambitious frameworks and criteria that promote circularity (Portuguese Ministry of Environment and Energy Transition, 2017).

A set of 13 criteria and requirements for CPP were included in the survey to cover the main principles and dimensions of CE. Each criterion was inquired according to their frequency of adoption in purchasing decisions (Fig. 1). Buying equipment with high energy efficiency is the criterion for which 56% of the respondents apply it often in their decisions. This was the highest score among all the criteria. After that, 51% of the participating organisations often rent or lease products, and 44% often require purchasing the service rather than the product. This shows an inclination for buying functionality or performance as a service, in agreement with CE proponents such the EMF (EMF et al. (2015)) and Stahel (2019), as well as highlighted in the literature for its great potential in PP for the transition to a CE (Öhgren et al., 2019). Conversely, the procurement of reused and remanufactured products is only made according to 36% and 22% of the organisations, respectively. This result coincides with the previous answer, which demonstrated that second-hand purchasing is not possible or not undertaken yet in the PCPA. However, this is contradictory to what is seen in the literature stating that it is common for the public sector, including in Portugal, to purchase remanufactured or reused products (Klein et al., 2020, 2021a). This might mean that these criteria are considered by PSOs and promoted for PSOs. However, in practice, it might not be as widely used as other criteria.

The product categories in which circular purchasing practices are the most applied in PCPA organisations are paper and printing material (75.6%), ICT equipment (73.3%) and vehicles (71.1%), as seen in Table 4. These sectors are compatible with general administration activities and office work requiring ICT equipment such as computers, paper and other office supplies (JRC, 2019). Moreover, those products groups might have more well-developed markets and support systems

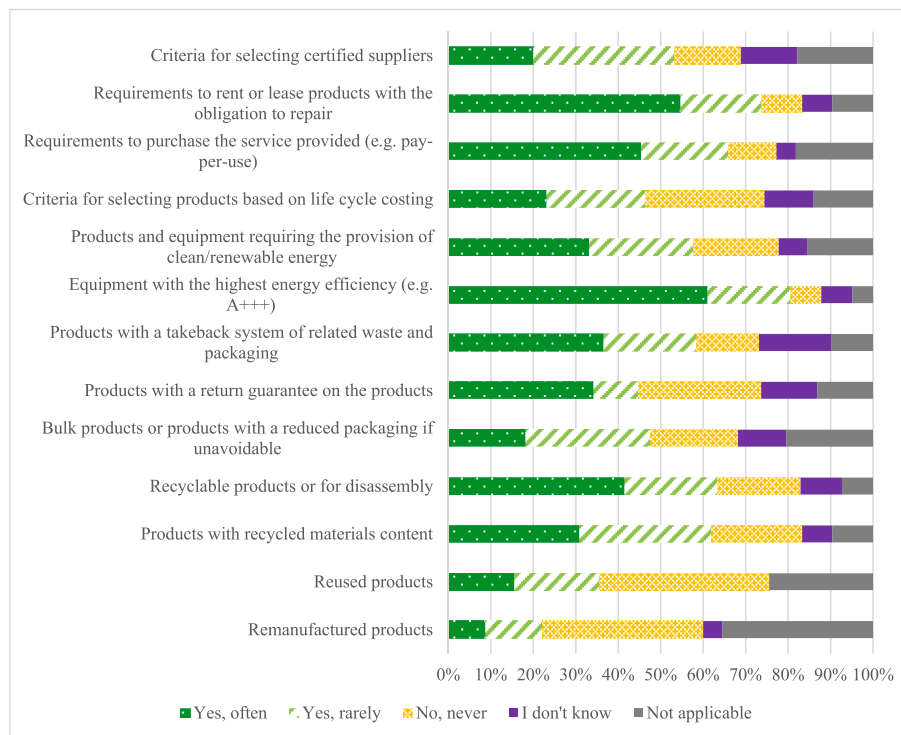


Fig. 1. Results on the adoption of circular public procurement practices.

Table 4

Results on the different product category(ies) in which CPP criteria is used by the organisations (there were 45 responses to this question).

Product categories	Number of respondents	%
Construction and Infrastructure	14	31.1
Furniture	11	24.4
Vehicles' fleet	32	71.1
ICT products	33	73.3
Waste management and sewage treatment	16	35.6
Food and catering	7	15.6
Textiles	0	0
Cleaning products	16	35.6
Print and Paper	34	75.6
Events, conferences, and meetings	9	20.0
Other (Facility management)	1	2.2

Multi answer: Percentage of respondents who selected each answer option (e.g., 100% would represent that all this question's respondents chose that option).

for recycling and/or reuse and circular elements in the procurement of those products might be more mature (Alhola et al., 2018). Nevertheless, these results are different from the product categories that are the most researched in CPP, the construction and furniture categories (Klein et al., 2020). The high percentage for paper and print might be related to a resolution approved in 2018 by the Portuguese Council of Ministers aiming at promoting the sustainable use of resources in public administration, which includes measures to pursue expenditure reduction objectives to reduce paper consumption and printing consumables (PCM, 2018).

4.4. CE practices in internal operations and processes

After the procurement stage comes the use phase. Internal operations and processes are a significant part of the circularity potential of the public sector. These correspond to all the activities and actions undertaken inside the organisations. Previous work by Klein et al. (2020) has identified several types of CE practices relevant to these operational areas of PSOs, including practices based on the R hierarchy (Reike et al.,

2018), waste management, efficiency and optimisation, and dematerialisation practices. This section presents the results according to these categories of practices.

R-based and sharing practices refer to actions linked to Refuse, Reduce, Reuse, Repair and Recycle, as seen in Fig. 2. Sharing practices are seen here as collaborative use or as sequential use of products or equipment (Ganapati and Reddick, 2018; Reike et al., 2018). The majority (66%) of the respondents have implemented a collection system for waste in their organisation, and 28% are in the implementation phase, while just 6% have no recycling system. Regarding the waste streams collected, as shown in Table 5, all the respondents (100%) are collecting paper, 84% of them are collecting plastic, and 60% are

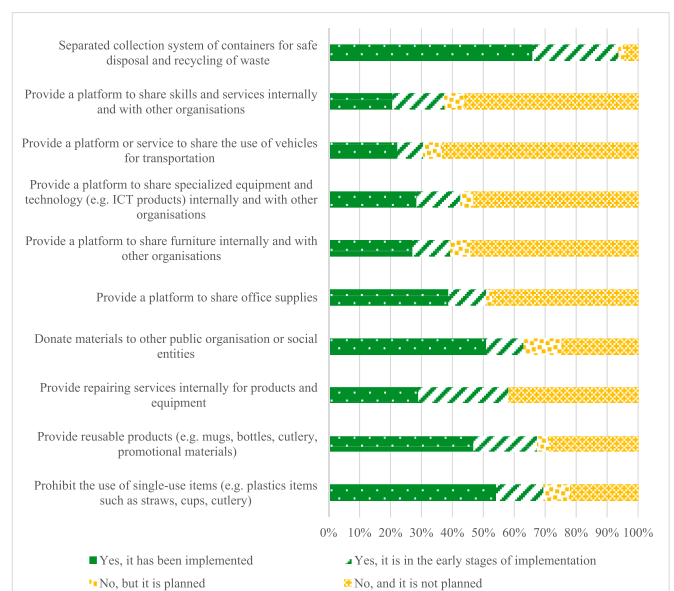


Fig. 2. Results for the R-based and sharing practices.

Table 5
Results on the waste stream(s) collected by the organisations of the PCPA (there were 43 responses to this question).

Waste streams	Number of respondents	%
Paper	43	100
Glass	26	60
Metal	22	51
Plastic	36	84
Batteries	24	56
Organic matter	15	35
Other	6	14

^a Multi answer: Percentage of respondents who selected each answer option (e.g., 100% would represent that all this question's respondents chose that option).

collecting glass. For the six "Other" responses, two organisations noted ink and toner cartridges as a specific waste stream, and the remaining three specified medical waste, cooking oil, and electric and electronic equipment waste. Paper and plastic as the main collected waste streams coincide with the emphasis of the ministerial resolution for adopting circular solutions in public administration on paper and plastic. Related to plastic reduction, most of the responding organisations (54%) prohibit single-use items, especially single-use plastics items such as straws, cups, cutlery and 51% donate to other organisations or social entities. Thereafter, almost half of the organisations (47%) also use reusable products such as mugs, bottles, cutlery and promotional materials. The existence of those practices in most of the organisations is probably due to the resolution approved in 2018 on the sustainable use of resources in public administration which, in addition to paper, also emphasises plastics, favouring the use of reused, reusable or refillable products for plastic consumables or prohibiting the use of disposable plastic bottles (PCM, 2018). The Spearman correlation test confirmed a statistically significant strong positive relationship between prohibiting single-use items and providing reusable items. A moderate relationship was also confirmed between prohibiting single-use items and providing a waste collection system (see Table C5 in Appendix C).

Sharing practices tend not to be implemented by organisations. Less than 30% have implemented a platform to share skills and services, to share vehicles, furniture, office supplies or specialised equipment and technology. One organisation commented that they do not have a platform to share furniture or skills; however, in practice, they already share furniture internally and with other PSOs or work in cooperation with other public entities on several projects. In addition, another organisation pointed out the existence of the State Vehicle Park Management System (SGPVE) for managing the car fleet. Also, the public procurement BASE Portal which centralises information on public contracts in Portugal, and includes information on movable assets, enabling the reuse of equipment between entities. These ambivalent results show that in some cases, there are platforms enabling the shared use of resources, but in general, the organisations of the PCPA might not adopt sharing practices and in other cases, there might not be any specific sharing platforms. However, organisations are already engaged in sharing practices through other means of collaboration. This mismatch might be due to a lack of communication and awareness of the different platforms and instruments available to PSOs. The Spearman correlation test confirmed statistically significant strong and moderate positive relationships between all the five sharing practices variables except between providing a platform for vehicle sharing and providing a platform to share furniture (see Table C5 in Appendix C).

Regarding the efficiency and optimisation initiatives (see Fig. 3), about half (47%) of the responding organisations have a centralised air-conditioning system as cooling/heating system and 17% are installing one; overall, 43% have double glass insulated windows and 16% are doing so, and 40% of the organisations are implementing LED lighting while 35% have installed LED lighting systems. Although it is encouraging that more than half of the organisations are engaged in optimisation efforts, as acknowledged by other studies (Mendoza et al., 2019a,

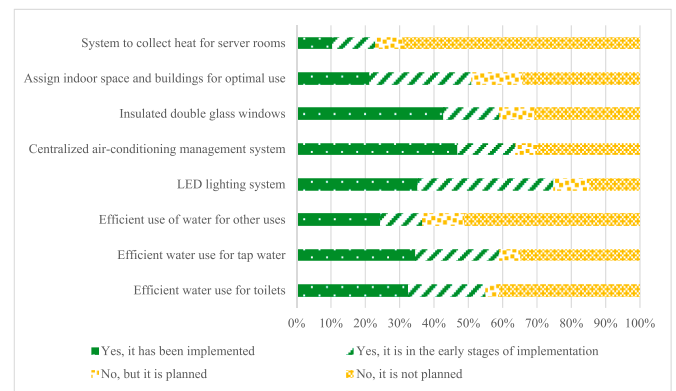


Fig. 3. Results for efficiency and optimisation practices.

2019b). There is room for improvement to aim for broader implementation and towards a closed-loop management of resources such as energy and water in the public sector. Indeed, only 23% of the organisations collect heat from servers and 36% focus on efficient uses of water other than tap water. Several organisations commented that they do not manage any of the measures on the buildings they work or that some PSOs are using historic buildings protected from being modified or upgraded. This is a limitation that oriented researchers and practitioners towards adaptive reuse as a way to find innovative solutions to reduce environmental impacts of historical buildings by giving them another value while still preserving their cultural or historical significance (Torrieri et al., 2019). The Spearman correlation test (see Table C4 in Appendix C) confirmed statistically significant strong relationships between the three water efficiency practices. Moderate relationships were also confirmed between the other efficiency practices, except between optimal space use and efficient water use for tap water and other uses, and except between recovering heat from the server room and other centralised air-conditioning and efficient tap water use.

Additionally, the surveyed institutions were asked whether they have implemented an EMS and, if yes, which management system specifically. Only 20% of the organisations are or have implemented an EMS. Four organisations indicated that they have implemented the ISO 14001 focused on environmental performance. In contrast, none are implementing the other indicated EMS such as EU Eco-Management and Audit Scheme (EMAS) or BSI 8001, a standard providing guidelines for CE implementation for organisations. This result shows a lot of untapped potential to improve CE implementation via the implementation of EMS and other related management tools (Fonseca et al., 2018; Kristensen et al., 2021). The Spearman correlation test (see Table C4 in Appendix C) confirmed statistically significant moderate relationships between implementing an EMS and all the efficiency practices variables, except between implementing an EMS and installing centralised air conditioning and implementing an EMS and double glass windows.

Finally, digitalisation or dematerialisation is seen as an important CE area of action for the public administrations' sector (EMF, 2015), and it is shown in the results of the survey with high levels of adoption (see Fig. 4). Indeed, most of the respondents of the PCPA organise virtual meetings (94%) and adopt teleworking practices (88%). One organisation has added as a comment that teleworking became compulsory in the context of the Covid-19 pandemic but has shown promising results in terms of work performance. In addition to being a safety measure during public health crises, one of the significant advantages of teleworking is from a mobility perspective. For instance, enabling the reduction of commuting distances and times and related environmental costs due to transportation (van Lier et al., 2014). Thereafter, approximately 73% of the organisations surveyed have implemented a digital system for smart document management and practice digital archiving, and more than half (57%) have implemented an interoperable platform for administrative procedures and communication. These results coincide with

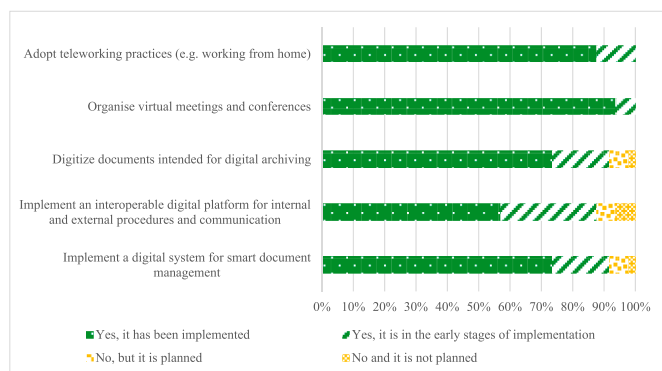


Fig. 4. Results for dematerialisation practices.

recent digital government reforms undertaken by the Portuguese government (EC, 2019). Dematerialisation of processes and procedures is also mentioned in the inter-ministerial resolution as one of the categories of practices for reducing paper consumption (PCM, 2018). The Spearman correlation test (see Table C6 in Appendix C) confirmed statistically significant strong and moderate positive relationships between all five digital documents' practices. A moderate positive relationship was also confirmed between adopting virtual meetings and teleworking practices.

4.5. Drivers and barriers to circularity adoption in PSOs

The organisations were asked to evaluate each driver and barrier according to their importance (on a scale of 1–5 points, from slightly important to highly important) in the process of adopting CE practices in the public sector. Considering the average score of all respondents, the most important driver, according to the responding organisations, was the leadership's commitment to the CE transition (4.4) (Fig. 5). This is in line with the literature stating that any organisational change starts with leadership interest (Millar et al., 2012). Following, the availability of financial resources (4.3) and wanting a good environmental and sustainability performance (4.2) were judged as more than very important factors motivating to adopt CE practices. Interestingly, pressure from companies (2.7) and citizens (3.3) were assessed as not as important as the pressure from the decision-makers (4.0), while the legislative circumstances (4.0) were viewed as very important. Pressure from companies and the citizens might be more relevant for the development of CE public policies rather than for their own organisational circularity transition. These results demonstrate the importance of the governance structure and institutional context whether the leadership is supporting CE transition, thus allocating budget to related initiatives and developing incentives and policies pushing for better performance towards

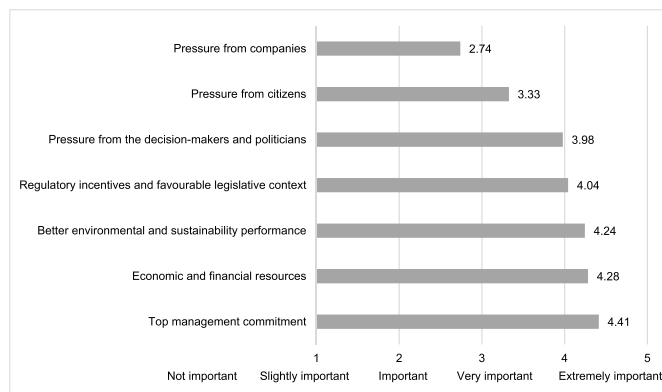


Fig. 5. Results on the main drivers to adopt CE practices in central PSOs.

sustainability.

One of the ways to promote change is to identify barriers to be overcome (Sopjani et al., 2020). Therefore, it is important to ask the organisations of the PCPA to assess a diverse set of potential barriers. Consistent with some of the literature (Tura et al., 2019), the most important barrier (4.1), according to the responding organisations, is the lack of financial resources to implement circularity in their organisation (Fig. 6). However, it should be noted that the lack of leadership support is comparatively assessed as less important (3.4). The lack of financial support usually goes hand in hand with no leadership support (Droege et al., 2021a). This reveals that leadership interest might be viewed as a driver rather than a barrier. Thereafter, the silo structures and rigid procedures were considered the next most important constraints (3.9). This is in line with the literature and the general trends in the results that the public sector is limited by rigorous and bureaucratic procedures and hierarchical organisational structures centralising the decision-making process, thus making it difficult to promote and encourage change at operational levels and even in an individual organisation (Dahl Sönnichsen and Clement, 2020). Moreover, the lack of educational initiatives and training (3.8), good communication (3.6) and data to assess progress (3.5) have been highlighted as the next important to very important issues to pay attention to according to the responding organisations. These barriers have been emphasised for the public sector, especially in PP processes (Alhola et al., 2018; Craford et al., 2018). The least valued barriers being the lack of stakeholders input (3.0) and interaction with suppliers (3.2) reveal that collaboration and stakeholder engagement is not considered as essential elements as the other barriers.

4.6. Organisational change strategies

The previous sections have shown varying levels of implementation depending on the CE practices and have presented the most important barriers and drivers according to the surveyed PSOs. Furthermore, it is important to address those factors and accompany the CE initiatives with supporting activities in different areas of PSOs, including strategy and management, human resources, and collaboration and assessment. This section will divide the results according to these dimensions, as proposed by Klein et al. (2020).

Including CE in strategic measures creates favourable leadership to accelerate the transition to circularity (Millar et al., 2012). Therefore, a

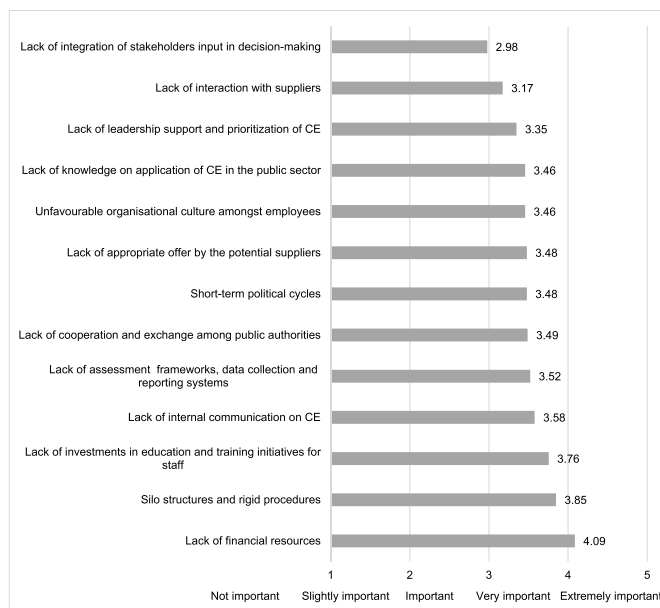


Fig. 6. Results on the main barriers to implement CE practices in central PSOs.

couple of questions were included around leadership initiatives supporting CE implementation in the PCPA. Near half of the respondent organisations (45%) have adopted strategic instruments and statements that include CE. Four of those PSOs have indicated that CE constitutes a separate strategic policy document, and 16 of them mentioned that CE is integrated into other environmental/sustainability policies, plans or internal recommendations of the organisation. Regarding individual leadership, the majority (65%) of the surveyed organisations have people showing and communicating circular behaviours, acting as CE champions leading by example. These results reveal that, even though there is not a systematic formal organisational leadership for CE in most of the cases, this finding seems to indicate that there are informal promotion and encouragement of circular behaviours internally. As discussed by [Mendoza et al. \(2019b\)](#), having people in the organisations acting as CE champions in daily operations is also an important aspect of leadership.

The influence of GHRM practices on improving organisations' CE performance have been acknowledged by several research works, e.g. [Marrucci et al., 2021](#). In this case, however, the survey reveals that only 31% of the responding organisations have a dedicated person in charge of sustainability or related CE issues in the organisation, against 69% of them that do not have such appointed staff. Additionally, it was also asked which department the Sustainability/CE Manager is attached to. A large variety of responses were registered indicating, for instance, that the sustainability/CE focal point belongs to a dedicated department or a working group on corporate sustainability, to the quality department, to the HR department, to the administrative and financial management team, to the procurement department or to the planning division or to the support structure for the Board of Directors with the Administrative Direction. One organisation mentioned the ministerial resolution (RCM n° 141/2018) in which the focal point of the Ministry of Economy and Digital Transition is a representative of its Secretary-General. This result might reflect the lack of strategic leadership mentioned previously, thus showing that some organisations are taking initiatives when possible and that the person responsible for the organisational sustainability/CE issues vary between the PSOs. This might correspond to the findings of [Marrucci et al. \(2021\)](#), demonstrating that CE implementation depends exclusively on the organisation's commitment to CE and not on external factors.

Furthermore, a few of the surveyed organisations (29%) have CE as a part of their environmental/sustainability training and only 4% organise CE-focused training workshops or presentations, while most of the organisations (67%) do not organise CE-related staff training. One organisation has given examples of themes such as "the regional Agenda for Circular Economy from Lisbon Region" or "Reuse practices when going shopping: alternatives or constraints?". Finally, as displayed, only 10% of the responding organisations have implemented or are implementing

competitions or reward systems to encourage staff to adopt CE practices, while 77% do not plan to implement ([Fig. 7](#)). Nevertheless, around half of the responding organisations (52%) have established or are implementing guidelines for staff to adopt a circular use of resources, and approximately half of them (44%) are or have installed instructions signs or flyers indicating, for instance, how to separate the different waste streams and when to favour the use of recycled paper. These slightly more positive results might be related to the fact that involving employees directly in changing the organisational culture is motivating them to change towards CE behaviours ([Marrucci et al., 2021](#)).

Several other educational and communication strategies have been inquired to identify to what extent CE might be promoted throughout the PCPA. Demonstrating similar trends of low implementation, around 15% of the organisations have organised or are organising events or conferences to disseminate CE knowledge and to promote their own efforts to the public and other stakeholders. Moreover, only 20% of the surveyed organisations publish reports or a specific section in reports about organisational CE performance aspects. Two of those organisations have a separate CE report. Seven organisations have reports such as sustainability, environmental performance reports or annual reports, in which CE is integrated, and one organisation that only mentions CE in its business plan. These results show an overall low level of formal and systematic promotion of CE throughout the PCPA and outside. Similar to conclusions from other studies, this might be caused by the fact that CE and its implementation is relatively new ([Marrucci et al., 2021](#)) and because the public sector has not yet strategically committed to CE internally ([Droege et al., 2021a](#); [Mendoza et al., 2019a](#)). The Spearman correlation test (see [Table C7](#) in Appendix C) showed statistically significant strong positive relationships between organising staff training on CE and organising promotional conferences and organising awareness raising events for external stakeholders. A strong positive relationship was also statistically significant between establishing guidelines for a common circular use of products and installing signposts for correct use of equipment. The Spearman correlation test showed statistically significant moderate positive relationships between some of the other awareness raising and practices (see [Table C7](#) in Appendix C).

Also, collaboration within and between PSOs is a crucial element to ensure a successful implementation process towards CE ([Klein et al., 2020](#)). Regarding internal collaboration, only 20% of the respondents answered to have collaborative CE working groups with other departments, and 9% said to collaborate on CE with other PSOs. While about 9% plan to do so, the majority (63%) do not plan to engage in CE collaborative activities. Such initiatives have been mentioned at the Portuguese Environmental Agency, in the context of the PAEC inter-ministerial coordination group and in IT, quality and legal departments of PSOs. Regarding collaboration with external actors, only 17% of the surveyed organisations establish collaboration, and 6% plan to, while the large majority (77%) are not planning any external collaboration. Out of the 8 organisations that have established collaboration, half of them collaborate with suppliers, business and retail associations, and city councils. Two organisations collaborate with NGOs, two with citizens and one indicated collaboration with local businesses. Considering these relatively low levels of collaboration, these results highlight the potential and need for the public sector to innovate, enhance and test collaborative initiatives for their own organisational circularity, as suggested by the literature ([Dahl Sønnichsen and Clement, 2020](#); [Witjes and Lozano, 2016](#)). The Spearman correlation test (see [Table C8](#) in Appendix C) showed that there is no significant relationship between external and internal collaboration activities.

Assessment initiatives are crucial to monitor and see the progress made by the PSOs towards circularity and sustainability. Overall, 62% of the responding organisations have adopted a stock management system to monitor the use of resources ([Fig. 8](#)). Such a high result might be because of a measure related to commissary management in the inter-ministerial resolution of 2018 requiring creating and managing the inventory of material, including paper/cardboard and printing

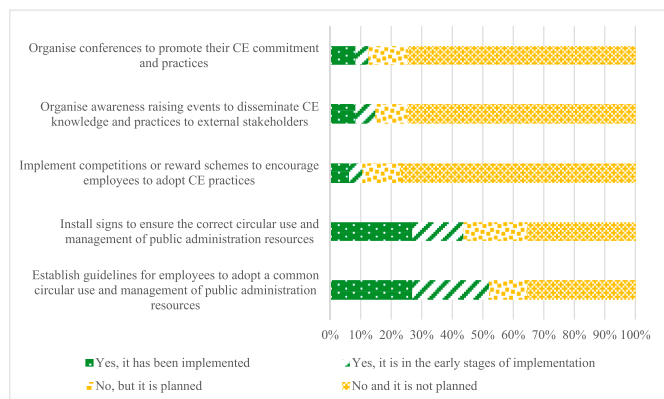


Fig. 7. Results on the implementation of awareness raising and educational activities.



Fig. 8. Results on the implementation of assessment practices.

consumables (PCM, 2018). On the other hand, only 27% of the replying organisations have used indicators to evaluate the CE organisational performance, 17% plan to do so, while 56% of the PSOs are not planning to use indicators for CE implementation. These responses seem to be in line with results from Droege et al. (2021a), demonstrating that there is no CE assessment done so far in PSOs in Portugal, which is also the main trend in other sectors and applications such as in corporate sustainability reporting (Opferkuch et al., 2021). The PSOs provided some examples of CE indicators used for paper, water, and energy consumption and for toners or ink cartridges consumption. Moreover, only 15% of the respondents use digital surveys to collect feedback and monitor progress towards CE implementation, and 17% are planning to do so, as opposed to the large majority of them (69%) who are not engaged in such feedback practices. Out of the seven organisations replying positively, two specified that they survey once a year, two on a monthly basis, one twice a year, one quarterly, and one sporadically. This last practice could be associated with employee involvement having the potential to empower employees to feel heard and valued in the organisations, thus, motivating them to embrace circular practices (Marrucci et al., 2021). The Spearman correlation (see Table C9 in Appendix C) test showed only a statistically significant strong positive relationship between the use of CE indicators and the use of digital surveys.

Finally, the organisations were asked to rank the overall implementation of circularity in their organisations and 42% of the responding organisations ranked the CE implementation state as poor at the initial stages of implementation. Nevertheless, 38% consider having a medium level, average implementation status, and 17% claim to have good implementation, which represents about half of the responding organisations (55%) that perceive a positive level of CE implementation.

5. Conclusions

Considering the existing research gaps in understanding the state of the CE transition in PSOs and the need for empirical insights in the public administration sector, this study aimed to characterise the implementation of CE practices and supporting strategies in PSOs, examining the case of the Portuguese central public sector. The results have shown diverse levels of implementation, demonstrating a generally low level of implementation. Circular practices such as purchasing remanufactured or used items, using sharing platforms, increasing the resource efficiency of public buildings, adopting GHRM strategies and more collaborative initiatives for circularity, and assessing and communicating about CE activities have presented relatively low levels of implementation. On the other hand, waste collection for recycling and dematerialisation practices showed relatively high implementation levels.

The survey results demonstrated that there is enormous potential for further implementation of circularity in central PSOs. Opportunities include expanding the ongoing work on CPP by integrating more CE

criteria in purchasing and proposing new purchasing models, focusing on communication, especially regarding sharing platforms to make sure employees use the resource made available to them. Furthermore, the existence of an inter-ministerial resolution seems to have pushed forwards certain circular practices related to paper and plastics consumption, demonstrating the effects of strategic measures and organisational policy initiatives. In relation to that, the PCPA seems to be aware of the driving potential of leadership commitment but, several barriers such as the bureaucratic and rigid nature of public organisational structures and governance dynamics, and the lack of human and financial resources were also acknowledged, which might explain the slow start of the PCPA in its CE implementation process. Therefore, rethinking the role of employees and the governance dynamics, such as the creation of a cross-ministerial or inter-ministerial group as seen in this case study, seems to represent the biggest opportunities to accelerate CE implementation, but also the main challenge considering the structural characteristics of the public sector.

The results of this Portuguese case study give examples of areas in central PSOs where CE practices might be noticed and implemented in their strategic and operational activities. One example is public procurement, where circularity has high potential to bring sustainability benefits in general. This case study highlights several general recommendations for public practitioners, including emphasising the power of employees and collaboration in a change process and the importance of a leadership presence, whether at an organisational or individual level.

Further research is encouraged to conduct the survey in public administration organisations in other countries and to open possibilities for comparative studies. It is important to clarify that this study's questions, circular practices, and supporting strategies were tailored to this specific case. Consequently, if replicated, the questions should be adapted to the case under scrutiny.

The results of this empirical study deepen the understanding of the extent to which circular practices are embedded in public sector organisations and identify the main implementation strengths and weaknesses. Furthermore, this research has the potential to help practitioners and researchers in the transition towards circularity, in identifying circular opportunities in organisations, and in building a vision to further implement circularity in public sector organisations.

Credit authors statement

Natacha Klein conceptualized the research, designed the methodology, collected the data, analysed the data and wrote the paper. Pauline Deutz and Tomás B. Ramos contributed to the design of the research, supervised during the whole research process (including preparation, execution and analysis), reviewed, and edited all versions of the manuscript. All the authors read and approved the final manuscript.

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.

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Appendix A. Supplementary data

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