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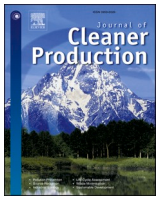

From linear to circular economy: The role of BS 8001:2017 for green transition in small business in developing economies

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ABSTRACT

Implementing Circular Economy (CE) strategies has recently become one of the essential strategies for sustainable development and corporate social responsibility. However, despite the promising role and potential benefits of the CE for companies and society, there has still been insufficient analysis examining the challenges for circular transition faced by micro, small, and medium-sized enterprises (MSMEs) and the role that standards, such as British Standard (BS) 8001:2017, play during the transition process from linear to circular economy practices. Given this context and to further increase our understanding of the factors preventing the transition from linear to CE, this study aims to assess the CE implementation in MSMEs in developing economies in light of BS 8001:2017 through a survey with Brazilian MSMEs. The primary findings emphasize that CE practices from the Administration dimension occupied top positions in the ranking of implementation, along with one practice from the Innovation dimension. However, the results show that several practices associated with Transparency and Product Optimization in the value chain held the last level of evidence of implementation. Findings suggest that assessing MSMEs through BS 8001:2017 is beneficial for aiding them in analysing and reconsidering their practices related to the conventional linear business models of take-use-dispose. Collectively, the findings improve our understanding of the level of adoption of CE components implementation, the most and the least adopted practices during the CE transition. The study also provides implications for policy, theory, and practical applications in cases where there is an interest in assessing the maturity of CE implementation within MSMEs in developing economies.

1. Introduction

The increased levels of environmental waste in society are linked to changes in consumption and disposal patterns, population growth, and other complex factors (Liu et al., 2021; Islam et al., 2020). Besides, climate change is one of the most pressing issues confronting the globe today (Bakos et al., 2020). One way to reuse urban solid waste is to recycle and dispose of materials to re-enter industrial production processes (Bui et al., 2022; Ezeudu et al., 2021). These strategies are some of the several Circular Economy (CE) practices to convert the disposed of materials by the linear model into valuable materials using regeneration, restoration, and renovation (Barnabè and Nazir, 2022; Salesa et al., 2022). This implies that CE transition assists in increasing the product life cycle and identifying new business opportunities (Wasserbaur et al., 2022; Prieto-Sandoval et al., 2018).

The concept of CE is the opposite of the prevailing linear economy model, which considers that the available resources are abundant for the use and production of goods, which can be disposed of after their use (Nowicki, 2020; Prieto-Sandoval et al., 2018; Roberts et al., 2022). Assuming a linear model, the world economy could lose between 3 and 6 trillion dollars by 2030 because of the scarcity of natural resources, resulting in a disruption in supply and thus increasing prices (Lacy and

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Rutqvist, 2015). Studies also show that extracting from determined primary material resources, i.e., minerals and metals, has been degrading the environment significantly, and the availability of reverses of those non-renewable resources is declining (Nyambuu and Semmler, 2023a, 2023b; Zou et al., 2023). Almost 4 billion people are expected to live in areas impacted by water scarcity by 2050 (Carvalho and Cencione, 2017). As a result, industrial firms face the challenge of redirecting their focus towards innovation rooted in technological advancements. This entails the development of new materials, cleaner production processes, and a continual commitment to creating and utilizing energy-efficient products. Some recent examples of such initiatives include Unilever's Material Innovation Factory (Unilever, 2018), DHL's comprehensive GoGreen Plus program, as well as their initiatives in Sustainable Marine Fuels and Electric Vehicles (DHL, 2023), among others (Xiong et al., 2020).

The CE concept is now prevalent in the political and business debate, where the industrial production paradigm will result in industrial changes (Wasserbaur et al., 2022; Korhonen et al., 2018). The CE has emerged as one of the most significant initiatives in establishing eco-friendly solutions for improving supply chain performance during the previous two decades (Sawe et al., 2021), and a determined group of actors play an essential role within the CE in this context. Governments, policymakers, companies, and academics need to orient their views toward circularity, norms, and the relationship of CE strategy with other sustainability concepts that are far from clear. This implies that all actors involved with the sustainability challenges need to have a real engagement now with the CE, or it will be left behind, unable to be used to its full potential to address society's problems (Reikea et al., 2018).

Additionally, there have been significant changes in the world concerning shared responsibility, the generation and disposal of waste, and reverse logistics practices (Puntillo, 2022). These challenges have stimulated the development of British Standard (BS) 8001:2017 to assist companies and governments in implementing CE principles into practice. The standard is not intended for certification purposes but to evaluate circular and sustainable business practices, allowing companies to align their CE vision with their strategy (Niero and Rivera, 2018). Most centrally, some developed economies have incrementally advanced towards circular practices (Rovanto and Finne, 2022). In Chile, for example, the legislation established an extended responsibility of producers for the negative impacts generated by their activities and estimulating people and companies to recycle was published in 2016 (Chile, 2016). In Brazil, the national solid waste policy, i.e., Law 12.305/2010, after two decades of discussions, provided basic principles already mentioned in international treaties, such as the edition of the Earth Chart in the Global Agenda 21 with the principles of prevention, precaution, and waste minimization (Brasil, 2010). However, despite the efforts, emerging countries still have a long journey to cross. Recent studies highlight that although Brazil has solid waste regulations, the country still needs to overcome essential challenges to CE transition (Cezarino et al., 2021). The transition challenges are not restricted to the government since large companies have been making efforts to track this path (Sanches et al., 2022).

However, extant research has consistently shown that companies, especially small companies, face several obstacles when implementing CE practices (Sharma et al., 2021; Sawe et al., 2021; Kumar et al., 2020), leading to a low percentage of material reuse in the value chain (Azevedo, 2015; Dey et al., 2020; Murray et al., 2017). This aspect is especially relevant when considering the magnitude of these companies in emerging economies. According to the United Nations (2023), more than 70% of job positions are from MSMEs. In Brazil, this percentage is higher than 80%.

In this context, the literature has concentrated on organizations of this type and their transition challenges toward CE in developing economies. Consequently, as highlighted by the literature (e.g., Mishra et al., 2022; Murray et al., 2017), sustainable strategies in MSMEs can potentially benefit the execution of sustainable and CE solutions. In fact, MSMEs can significantly contribute to sustainable development in society by gradually integrating sustainable principles into practice (Sharma et al., 2021; Prieto-Sandoval et al., 2018; Pacheco et al., 2017).

However, despite their promising potential, MSMEs face several difficulties in implementing CE principles (Sawe et al., 2021; Sharma et al., 2021; Prieto-Sandoval et al., 2018). Primary challenges are associated with high initial costs, the payback period of investments, or even high costs to achieve resource efficiency (Malik et al., 2022; Rizos and Bryhn, 2022; Sohal and De Vass, 2022), lack of information, including information on the estimates of costs of ecological procedures (Sawe et al., 2021; Lakatos et al., 2016), which can lead to uncertainties and harm the competitiveness of MSME companies (Jasch, 2006; Grimmer and Woolley, 2012); the lack of internal competences (Trianni and Cango, 2012); and the limited influence of MSMEs companies on the involvement of suppliers in sustainable activities (Eltayeb and Zailani, 2009; Wooi and Zailani, 2010).

In the specific context of Brazilian MSMEs, empirical studies are relatively scarce, primarily relying on case studies (e.g., Dantas et al., 2021; Barbieri and Santos, 2020). However, to our knowledge, no survey study assessing the implementation of CE in the context of BS 8001:2017 has been identified in the literature. This observation suggests a promising research opportunity in the area. There is a perceived gap between the advancements in the CE literature investigating the practical challenges of companies (Barreiro-Gen and Lozano, 2020). This is especially true for developing economies, including the Brazilian context. Therefore, based on the research gaps and empirical challenges affecting the sustainability in MSMEs, this research attempts to answer the following question: *What are the implementation levels of circular economy practices in MSMEs in developing economies?* The study examines the problem based on the following six dimensions according to BS 8001:2017: Systems thinking, Innovation, Administration, Collaboration, Product optimization in the value chain, and Transparency. A survey was administered to managers and owners of 87 Brazilian MSMEs, and the data analysis was established through the analytical Fuzzy TOPSIS method.

The article establishes the following theoretical and practical contributions. The study's empirical findings contribute to understanding the challenges for CE transition faced by MSMEs in developing economies. The article contributes to existing knowledge of the role that international standards play in supporting CE assessment by examining the potential of BS 8001:2017 in supporting companies and governments to understand their stage of CE implementation. Our findings add knowledge to the rapidly expanding research area of CE by indicating the practices that are best and least implemented in the six dimensions outlined above in a developing economy. Overall, the empirical findings shed light on the importance of CE and international standards such as BS 8001:2017 to facilitate the achievement of the Sustainable Development Goals (SDGs), especially Goal 12 (Sustainable Production and Consumption), Goal 14 (Life below Water), and Goal-15 (Life on Land). This study is expected to assist managers and policymakers in further enhancing their understanding of the factors that complicate CE implementation in MSMEs in developing economies.

The remaining parts of the paper are organized as follows. Section 2 reviews the literature on CE, the standardization proposed by BS 8001:2017, and the context of CE in Brazil. Section 3 details the research methods and the procedures adopted for data collection and analysis of the survey administered. Section 4 presents the results of the Fuzzy TOPSIS analysis to answer the hypotheses tested. Section 5 presents the research findings and the implications for theory, managers, and society. The paper closes with the research conclusions, limitations, and future agenda.

2. Theoretical background

2.1. From linear to sustainability and the circular economy

Sustainability has constituted recurrent relationships between all academic, business, and governmental segments at national and international levels, primarily due to socio-environmental ideas. It attempts to estimate the present usage and future demand regarding natural resources and the environment, thus maintaining the permanence and perpetuation of those resources in competitive consumption scenarios (Giannetti et al., 2020). According to the UN Brundtland Commission, sustainability can be defined as a way of life in which the individual must meet their present needs while ensuring the future generations' requirements (WCED, 1987). The definitions of sustainability, for the most part, are based on the idea that people consume only what they 'produce' by themselves without degrading the environment and compromising future generations. Sustainability and CE address environmental degradation problems and resource scarcity, thus providing a pathway towards sustainable development (Lahane and Kant, 2022; Chamberlin and Boks, 2018; Núñez-Cacho et al., 2018).

The CE, also frequently recognized as a restorative economy by nature, is a concept created in the 70s and gained momentum in the 90s. One of the mottos that best represents the CE is doing more with less (Carvalho and Cencione, 2017). Circularity can be achieved through reduce, reuse, and recycle cycles and in principles and deeper characteristics in cycles of products manufactured for consumers (Johansen et al., 2022). Some experts consider the CE a model that reduces limited initial stocks of inputs and recycles the waste produced (Suárez-Eiroa et al., 2021; Lewandowski, 2016; Arushanyan et al., 2017). On the other hand, other studies consider the CE to be an industrial economy that depends only on the capacity of natural resources (Figge et al., 2021; Montoya et al., 2017; Jo et al., 2018). However, one of the most accepted definitions of the CE, adopted in our study, comes from the Ellen MacArthur Foundation: "A CE is restorative and regenerative in principle. Its objective is to keep products, components and materials at their highest level of utility and value at all times, distinguishing between technical and biological cycles" (EMF, 2012, p. 2).

The CE is conceptually regenerative and reproduces nature to improve and optimize the systems through which it actively operates. In this case, there is no residue. Different product components, such as biological and technical components, are designed for the material cycle to have disassembly and a new purpose. Organic nutrients are non-toxic and can be put into the compost, whereas technical nutrients (polymers, alloys, and other artificial materials) are chosen for reuse with optimal energy consumption. The Ellen MacArthur Foundation (2012) states that the CE has three principles: (i) maintain and intensify natural capital through controlling finite stocks and balancing the flows of renewable resources; (ii) enhance resource yields by circulating products, components and materials at the highest level of utility at all times, both in the technical and biological cycles; (iii) increase the effectiveness of the system by separating negative externalities from the beginning. These principles are put into practice by selecting technologies and processes that present better performance or the use of renewable resources, also creating conditions for regeneration.

Extant literature also claims that CE promotes the development of sustainability in companies and consumers, boosts economic growth, and minimises waste (Akter et al., 2022; Dey et al., 2020; Prieto--Sandoval et al., 2018). One of the critical contemporary issues in our society is the circularity of materials (Prieto-Sandoval et al., 2018). This implies that the depletion of natural resources, the growth of stock in use, and the end of the life cycle of materials must be considered CE indicators. Material flow analysis methods can be used to track material resources (Rostek et al., 2022; Lee et al., 2021; Pauliuk, 2018). Thus, the CE model keeps the products or materials in circulation, in both the technical and the biological cycle, thus prolonging their useful life and intensifying their reuse. The CE has benefits in environmental, social, and economic areas. With the growth model, by 2025, urban waste will increase by more than 75 percent and industrial waste by 35 percent. If people and companies' cultures change, there is scope for potential growth in the CE by 2030, worth around $4.5 trillion globally (Carvalho and Cencione, 2017). Companies seeking growth must be limited to the closed circuit of resources and energy with the minimum emissions (Prieto-Sandoval et al., 2016). These solutions have been legally and financially reinforced over the last decade in regions and countries such as South Korea, the UK, the US, China, and the European Union (Murray et al., 2017). For instance, Japanese entrepreneurs resorted to masking their CE businesses to better relate with the surrounding linear system (Rovanto and Finne, 2022).

Although of the transaction challenges towards CE, thare are four characteristics that can stimulate the transformation and utilization of CE: (1) Circular product design and production: this is a key characteristic when companies need to develop a circular design, having a product vision that is restorative and regenerative in nature, thus having the recycling and cascading use of products; (2) New business models: replacing ownership with performance-based payments is key in changing products and projects for reuse into compelling value propositions, and these models guide the transformation of consumers into users; (3) Reverse cycle: in this pillar, a company pays attention from the beginning to the end of the cycle, creating a product cycle that is easily accessible to everyone and capable of maintaining the quality of materials to guarantee their use in cascade in several applications, even before they return to the ground; (4) Enabling factors and favorable systemic conditions: these are divided into education, preparing future professionals for a new economic paradigm; financing, governments can create financing incentives; collaborative platforms, effective collaboration between value chains and sectors, thus sharing information and partnerships for new products; a new economic framework, which is the longstanding plan for reallocating factor costs and adequately pricing the main externalities (EMF, 2012).

Nevertheless, significant challenges persist in the implementation of CE across various industries. These challenges encompass a paucity of policy instruments provided by governing authorities, constraints in adopting technological innovations, and a lack of effective coordination among stakeholders. A substantial body of literature delves into the discourse surrounding these CE challenges and endeavors to propose strategies for their mitigation. Noteworthy studies in this domain include Aminoff and Kettunen, 2016 examination of challenges in supply chain management within the broader context of CE. Furthermore, Sharma et al. (2019) focus on CE challenges in the Indian food supply chain, while Tsanakas et al. (2020) explore the integration of circularity principles in photovoltaics waste management. Abdul-Hamid et al. (2020) delve into the challenges posed by Industry 4.0 in the context of CE. These studies represent a portion of the academic discourse addressing the challenges inherent in adopting CE practices. Research also investigated the organizational and financial dimensions of the circular economy, emphasizing the impact of financial resources on its operations. A survey conducted in collaboration with the Spanish Ministry of Economy aimed to achieve this objective. The findings of the study revealed financial impediments to the transition from a linear to a CE (Aranda-Usón et al., 2019).

The current literature also suggests that the firm's size plays a significant role in influencing the extent to which CE practices are adopted. According to Bassi and Dias (2019), there is a positive correlation between the size of a firm and its engagement in at least one category of CE activities. Aranda-Usón et al. (2019) identified critical barriers to achieving circular system sustainability, including the size of the company, insufficient public support, and inadequate investments. These factors were found to be significant obstacles in the transition towards a CE. Šebo et al. (2021) have shown that larger firms are more inclined to employ CE technologies than smaller ones. Another research reveals that as a firm's size increases, its sustainability performance improves due to the adoption of CE practices (Saha et al., 2022).

The literature exploring the role of financing in facilitating the transition to the circular economy has offered valuable and interconnected insights. Ghisetti and Montresor (2020) have determined that self-financing is a more potent facilitator of CE practices than debt financing, underscoring the importance of the financial aspect in CE adoption. Scarpellini et al. (2021) examined the implementation of self-consumption in Spain, focusing on the economic and financial challenges posed by small-scale renewable energy systems for investors. In related studies on financial considerations, Marco-fondevila et al. (2023) explored the potential role of financial instruments in advancing the circular economy within the environmental accounting framework. Their analysis involved a detailed examination of rental contracts spanning 18 years, aiming to gain insights into how existing financial tools such as leasing and renting could support the expansion of circular economy initiatives by commercial banks and financial institutions. This research evidence collectively supports the argument that small enterprises encounter relevant challenges in their journey towards embracing CE. Therefore, based on the current literature evidence, there is a compelling need to focus on understanding the mechanisms of CE adoption within the context of MSMEs.

2.2. The BS 8001:2017 standard

Environmental standards are recognized as contributors to a company's environmental, financial, and social performance (Boiral et al., 2018; Nguyen and Hens, 2015). In this context, the significance of financial resources and constraints in influencing green innovation and circular patents has been emphasized. Scarpellini et al. (2021) demonstrated a correlation between green patents and the financial and economic performance of manufacturing companies in Spain and Europe. The study revealed that the primary financial and economic assets of these companies, coupled with their collaborative involvement in green patent research and development, led to extensive cooperation between companies and research and development centers. This collaborative effort resulted in a shared ownership arrangement for these patents, underscoring the effectiveness of the process. Moreover, some researchers have raised concerns about the uncertainty and complexity associated with assessing actual environmental performance. This uncertainty is attributed to the evolving nature of new environmental standards and the non-uniform diffusion of green innovations and technologies worldwide (Amini and Rahmani, 2023). Hence, different sustainability-driven standards are currently available. This research focuses explicitly on BS: 8001: 2017.

The BS 8001:2017 was developed by the British Standards Institution (BSI) and published in 2017 to define guidelines and recommendations for CE and sustainable management (BSI GROUP, 2017). The standard provides guidelines for migrating companies toward CE and sustainable businesses. Considering that limited guidance is available to companies on how to implement and evaluate the CE in business activities, the standard defines the CE as the "economy that is restorative and regenerative by design, and which aims to keep products, components and materials at their highest utility and value at all times, distinguishing between technical and biological cycles" (BSI GROUP, 2017; p. 10).

The standard aims to reconcile how to reach the CE through business routines. It encompasses an extensive listing of CE elements, principles, and a flexible framework for implementing the CE. It also describes the environmental, economic, policy, and financial aspects related to the CE (Pauliuk, 2018). According to the standard, six main dimensions (Systems thinking, Innovation, Administration, Collaboration, Product optimization in the value chain, and Transparency) and their supporting constructs can be considered minimum requirements rather than a complete list for the CE realization. By examining the constructs that compose the dimensions of the BS 8001:2017, it is possible to observe that the standard holistically covers different theories, including the systems theory, i.e., systems thinking dimension; the open eco-innovation, i.e., collaboration dimension; resource-based view and dynamic capabilities, i.e., innovation and administration dimensions.

Implementing the dimensions makes it possible to have a more strategic vision, observing how their business is doing, allowing them to be more circular, sustainable, and competitive in the market. This holistic perspective presented in the scope of BS 8001:2017 proves beneficial in dealing with the current practical challenges for CE induction. This potential is relevant since, despite industries progressively adopting CE practices, there is a misalignment with the envisioned incremental closure of material cycles outlined in the CE framework (Aranda-Usón et al., 2020). The authors conducted a qualitative analysis utilizing regional research to assess the extent to which firms have adopted CE-related activities and the level of their engagement in such practices.

These opportunities can arise within the organization throughout the value chain, even for using resources for new ways of working (BSI GROUP, 2017). Furthermore, the core of the standard is to connect the CE vision with strategic planning and provide a comprehensive framework for adapting to different maturity levels (Niero and Rivera, 2018). BS 8001:2017 was developed based on the latest CE implementation concepts and practices (Pesce et al., 2020). It was elaborated upon with the support of CE experts and is based on the experiences and lessons learned from a range of companies on the journey toward CE models (Niero and Rivera, 2018). Not constituting a normative element, the standard is intended to help organizations adopt and implement more sustainable and circular practices and reconfigure their business models, which has great relevance to a company's current and future competitiveness. The standard also helps organizations understand the CE better, showing questions about the dimensions and how to implement them, carried out through decisions and activities (BSI GROUP, 2017).

2.3. The circular economy in developing economies: the Brazilian case

Concerning the transition to a CE, differences between developed and developing countries underscore various advantages and disadvantages associated with developing economies. Shahzad et al. (2020) examined how export product diversification, extensive margins, and intensive margins affect CO_2 emissions in both developed and developing economies. They found that in developed economies, product diversification and intensive margin exert a noteworthy negative impact on CO_2 emissions. Also, the indices of export diversification substantially decrease CO_2 emissions across 63 developed and developing countries. The adverse effects of product diversification suggest that economic sophistication can serve as a mechanism for emissions reduction. In another study comparing contextual evidence between developing and developed economies, Guarnieri et al. (2023) examined current policies, strategies, and initiatives related to the CE transition. Their findings reveal that Italy demonstrates proactive behavior, a higher level of institutionalization, and coercive isomorphism associated with European regulations and strategies. Conversely, Brazil exhibits reactive behavior, a lower level of institutionalization, and is driven by mimetic isomorphism. Despite notable progress in recent years, Brazil's transition to a CE is still in its early stages compared to Italy's. Italy, as an EU member, follows standardized CE practices. Conversely, Brazil adopts CE strategies by observing best practices, particularly from European countries. This implies that coercive mechanisms, exemplified by European demands impacting CE policies for Brazilian exports, can facilitate Brazil's CE transition (Guarnieri et al., 2023).

In the Brazilian context, the Brazilian National Solid Waste Policy Law 12.305 establishes an instrument of economic and social development characterized by a set of actions, procedures and means aimed at guiding the collection and return of solid waste for industries, for reuse, in its cycle or other production cycles, or another environmentally appropriate final destination (Article 3, item XII of Law 12.305). However, the law establishes only a few cases, giving freedom to sectoral agreements and terms of commitment under the terms of Decree 7.404 of December 23, 2010. After the National Solid Waste Policy Law was launched in Brazil in 2012, the national authorities started to think

about the need to change the way of production by thinking about continuous reuse cycles.

According to data from the Ministry of the Environment, in 2012, Brazil generated nearly 62 million tons of solid waste, wherein only 2 percent of waste was turned into useful materials and returned to the production chain. Approximately 17.8 percent of waste in Brazil is disposed of in dumps, 24.2 percent in controlled landfills, and around 58 percent in sanitary landfills. Yearly, Brazil incurs costs of about R$ 8 billion for the non-reuse of solid waste. In Brazil, in 2008, the economy grew 5.2 percent, whereas urban solid waste increased by nearly 35 percent between 2000 and 2008. In the same period, the number of sanitary landfills increased from 931 to 1,723, indicating that waste in Brazil is treated as garbage rather than being reused. The volume of this waste destined for landfills could be mitigated using the CE (Correa, 2018). For example, when a company manufactures a polymer, a common styrofoam tray in Brazil, it is destined for common waste and goes to urban sanitary landfills, not putting the styrofoam to reuse. Waste disposal accounts for a total of 53 percent of global impacts on the environment (Dutra, 2018). Oliveira et al. (2018) examined how enterprises comply with the CE principles in product development activities in a Brazilian furniture cluster.

Empirical research also has demonstrated that: "Over the years, relatively little attention has been given to the concept of circular economy in many low-income and middle-income countries". (Halog and Anieke, 2021, p. 225). Widespread mismanagement is frequently observed in numerous developing countries, emphasizing the pressing necessity to address issues in these regions through comprehensive approaches and integrated assessments to attain effective solutions. Many developing countries experience open dumping in slum areas, coupled with challenges of high population densities and poverty (Halog and Anieke, 2021). Promoting CE models in developing nations offers a triple advantage. Firstly, CE can elevate productivity and stimulate economic growth. Secondly, it holds the promise of improving both the quality and quantity of employment. Lastly, CE can contribute to saving lives by mitigating environmental impacts such as air and water pollution while also addressing climate change (Schröder et al., 2019). Over the extended period, the shift transition CE, prioritizing practices like reuse, sharing, prolonged use, and recycling, is anticipated to diminish the necessity for primary material extraction (Schröder et al., 2019).

Oliveira et al. (2018) specify the means of disposal and final destination for the major solid wastes generated by companies. In Latin America, challenges in municipal waste management and recycling involve low recycling rates, the absence of recycled material markets, large untreated waste volumes in landfills, high informality in sorting and recycling, and a growing per capita waste generation trend from changing consumption patterns (Schröder et al., 2019). Still dealing with this matter, some companies are investing in technology and employees to minimize the environmental liabilities they generate, allowing waste to circulate within the production chain and be used by other companies. These practices make companies more competitive, innovative, and efficient and create value in attracting new customers (Sohal and De Vass, 2022).

3. Materials and methods

3.1. Research context and design

This study examined the role that BS 8001:2017 plays in transitioning from linear to CE in MSMEs, enabling the assessment of sustainable practices in these companies. The research was developed in collaboration with the Centre of Extension Productive and Innovation, a unit of the government Project Extension Productive and Innovation led by the government of Rio Grande do Sul in Brazil. The main objective of the project was to improve the competitiveness of MSMEs acting in different sectors of the economy in different areas, including productivity and sustainability.

This study implemented qualitative and quantitative methods because they are more suitable for addressing the research question examined. In this way, the research design was organized into five main stages. First, secondary data regarding the application of CE in the Brazilian context were obtained through literature. In the second stage, the database of companies served by the Centre of Extension Productive and Innovation was examined, and the sample of MSMEs was selected. At this stage, companies representing the Vale do Paranhana region were selected for the survey. In the third stage, the instrument used for data collection was developed. The survey was organized based on the dimensions and sub-dimensions proposed in BS 8001:2017. In addition, a five-point Likert scale. In the fourth research stage, the survey was administered via email, telephone, and face-to-face. Finally, the survey results were quantitatively analyzed to understand the level of CE implementation in light of BS 8001:2017.

3.2. Survey instrument development

The survey instrument used for data collection was based on the items of the BS 8001:2017 assessment (see Appendix A). The instrument was organized into six main categories, totalling 78 items examined. The first part of the instrument collected company data (company name, city, position of respondents, sector of activity). The second part collected information about the Systems thinking dimension and six items that measure the maturity level of companies in this dimension. The third part of the questionnaire measures the Innovation dimension, organized into 16 items. This dimension evaluated the continuous innovation processes for generating value by allowing viable resource management (e.g., business strategy, management of areas, decisions and opportunities, mapping, and analysis). This dimension assesses which practices companies apply and the internal and market relevance of such practices.

The fourth part of the questionnaire measures Administration, which comprises 13 items. This dimension measures the management practices adopted by companies and the relevance of these practices for the sustainable management of resources (e.g., business model, responsibility and risks, and product and business management). The fifth part examines the Collaboration dimension, organized into 17 items. This dimension assesses the practices applied by companies and the relevance of such practices to create value between partner companies in the business and for the market (e.g., awareness, knowledge, internal evaluation, selection of partners, working collaboratively, value creation, and strategies).

The sixth part examines the Optimization Value dimension with 14 items. This dimension assesses the practices applied by the companies and the relevance of such practices related to the use of all components and materials along the value chain (e.g., design, production, distribution, use, and final phase of use). The last part of the instrument includes the Transparency dimension, which is comprised of 12 items. Transparency refers to sustainable practices and information companies provide and their relevance (e.g., mapping of resources and information, communication).

3.3. Data collection and analysis

The questionnaire respondents were the owners or managers of MSMEs. The data was collected through an electronic survey sent to 110 companies, generating 87 valid answers. The final response rate was 79.1 percent, which is satisfactory compared to previous similar studies (Mishra et al., 2022). Three waves of follow-up with the respondents were made during the data collection stage with the purpose of reminder about the deadline to complete the survey. Moreover, to support this data collection stage, the researchers utilized telephone and face-to-face meetings to assist the respondents. The procedures for data analysis through Fuzzy TOPSIS are described in the following section.

3.4. Fuzzy TOPSIS analysis

The evaluation of data through Fuzzy TOPSIS (Technique for Order Preference by Similarity to Ideal Solution) was performed to determine the application level of the analyzed items and verify those most and least applied by the respondents. Chen (2000) proposed that Fuzzy TOPSIS expands the multicriteria decision technique TOPSIS, transforming linguistic variables into fuzzy numbers.

TOPSIS is a decision-making method and, as explained by Hwang and Yoon (1981), can be used to rank criteria that present conflicts between them. This attribute is relevant to our research objective. This method and its variations, such as Fuzzy TOPSIS, are largely used in the literature and can provide robust results with relatively low computational efforts (Zamani-Sabzi et al., 2016). These attributes are useful for our study proposal because they allow for consideration of imprecisions in the data under analysis. The method allows us to identify the alternatives closer to the fuzzy positive ideal solution and simultaneously farther to the fuzzy negative ideal solution. In addition, the use of Fuzzy logic is relevant to this research proposal, given its capacity to consider the uncertain character of respondents' answers (Chen, 2000).

In this study, the items related to the standard BS 8001:2017 were used as alternatives, and the respondents' classifications were used as the criteria. The steps conducted for Fuzzy TOPSIS were based on Chen's (2000) guidelines. A similar procedure was used by Tominaga et al. (2021).

The first step of the analysis was to establish the fuzzy triangular numbers for the linguistic variables related to respondents' answers. These fuzzy numbers are presented in Table 1.

The second step defined the procedure to classify the respondents according to their experience and background. For this, data regarding company size and respondents' job positions were considered. Regarding their job position, respondents received values of 1 for managers and coordinators, 2 for directors, and 3 for presidents and owners. For companies' sizes classification, the value of 1 was attributed to micro-enterprises, 2 to small companies, and 3 to medium companies. Considering these rankings, a Hierarchical Cluster Analysis (AHC) was conducted to group the respondents according to their similarities, as Xu and Wunsch (2009) described. The result of the AHC is presented in Appendix B.

Considering this grouping, it was possible to classify the respondents into three levels. According to the characteristics of the respondents in each group, they were classified as N1, N2 and N3. These groups were also transformed into fuzzy values, as presented in Table 2.

After establishing these two sets of fuzzy numbers, the calculus presented by Chen (2000) was performed. Matrix 1 was established using the fuzzy numbers obtained from the respondents' answers.

$$\widetilde{G}=\begin{bmatrix}\widetilde{x}_{11} & \widetilde{x}_{12} & \ldots & \widetilde{x}_{1n}\\ \widetilde{x}_{21} & \widetilde{x}_{22} & \ldots & \widetilde{x}_{2n}\\ \ldots & \ldots & \ldots & \ldots\\ \widetilde{x}_{m1} & \widetilde{x}_{m2} & \ldots & \widetilde{x}_{mn}\end{bmatrix};\ \widetilde{x}_{ij}=[a_{ij},b_{ij},c_{ij}] \quad \text{(Matrix 1)}$$

For the weights, established according to respondents classification, the fuzzy numbers were established in Matrix 2. The development of Matrices 1 and 2 composed the Step 3.

$$\widetilde{E}=[\widetilde{w}_1,\widetilde{w}_2,\ldots..\widetilde{w}_n];\ \widetilde{w}_j=[w_1,w_2,w_3] \quad \text{(Matrix 2)}$$

Table 1
Triangular Fuzzy numbers for respondents' responses.

Linguistic variable	Fuzzy numbers		
Totally agree	0.00	0.00	0.25
Partially agree	0.00	0.25	0.50
Indifferent	0.25	0.50	0.75
Partially disagree	0.50	0.75	1.00
Totally disagree	0.75	1.00	1.00

Source: Adapted from Chen (2000).

Table 2
Triangular Fuzzy numbers for respondents' grouping.

Linguistic variable	Fuzzy numbers		
N1	0.00	0.00	0.50
N2	0.00	0.50	1.00
N3	0.50	1.00	1.00

Source: Adapted from Chen (2000).

In Step 4, the matrix 1 is normalized through Equation (1).

$$\widetilde{r}_{ij}=\left(\frac{a_{ij}}{C_J^*},\frac{b_{ij}}{C_J^*},\frac{c_{ij}}{C_J^*}\right),\text{considering}\ \ C_J^*=\max\ (\mathrm{i})c_{ij} \quad \text{(Equation 1)}$$

The result of this normalization is the Matrix 3.

$$\widetilde{R}=\left[\widetilde{r}_{ij}\right]_{m\times n}$$

Matrix 3 is weighted according to Equation (2), considering the weights attributed by the respondent's groups (Matrix 2), and Matrix 4 is obtained (Step 5).

$$\widetilde{v}_{ij}=\widetilde{r}_{ij}()\widetilde{w}_j \quad \text{(Equation 2)}$$

$$\widetilde{V}=\left[\widetilde{v}_{ij}\right]_{m\times n}\ \mathrm{i}=1,2,\ldots.\mathrm{m};\ \mathrm{j}=1,2,\ldots\mathrm{n} \quad \text{(Matrix 4)}$$

Matrices 5 and 6 bellow present the positive and negative ideal solutions, respectively. Their values are used to calculate the distances of values of Matrix 4 and these solutions, according to Equation (3) (Step 6).

$$A^*=\left[\widetilde{v}_1^*,\widetilde{v}_2^*,\widetilde{v}_3^*\right]\quad \text{(Matrix 5) in which,}\ \widetilde{v}_j^*=\left[1,1,1\right]$$

$$A^-=\left[\widetilde{v}_1^-,\widetilde{v}_2^-,\widetilde{v}_3^-\right]\quad \text{(Matrix 6)}\ \text{in which,}\ \widetilde{v}_j^-=\left[0,0,0\right]$$

$$\mathrm{d}(\widetilde{m},\widetilde{n})=\sqrt{\frac{1}{3}\left[(m_1\ -\ n_1\ )^2+(m_2\ -\ n_2\ )^2+(m_3\ -\ n_3\ )^2\right]} \quad \text{(Equation 3)}$$

After obtaining the distances from positive and negative ideal solutions through Equation (3), these distances for each alternative are calculated using Equations (4) and (5) (Step 7).

$$d_i^*=\sum_{j=1}^{n}d\left(\widetilde{v}_{ij},\widetilde{v}_j^*\right)\ \text{Sum of the distances from the positive solution} \quad \text{(Equation 4)}$$

$$d_i^-=\sum_{j=1}^{n}d\left(\widetilde{v}_{ij},\widetilde{v}_j^-\right)\ \text{Sum of the distances from the negative solution} \quad \text{(Equation 5)}$$

Finally, these sums are used in the calculation of the Closeness Coefficient (CC_i), as presented in Equation (6) (Step 8). The values of CC_i are used to rank the alternatives (Step 9).

$$CC_i=\frac{d_i^-}{\left(d_i^*+d_i^-\right)} \quad \text{(Equation 6)}$$

Finally, in this study, the rank obtained with the level of application of CE practices in MSMEs in Brazil provides an overview of the current reality of these companies and, consequently, provides the basis for planning future actions to improve the application of these practices.

4. Results

4.1. Fuzzy TOPSIS results

Before delving into the Fuzzy TOPSIS results, the analysis of the means obtained for the items validated in the model according to the respondents' groupings is presented in Appendix C. Analyzing the

frequencies of responses presented in these tables, it was possible to verify that despite the differences among the group evaluations, all the groups assigned good levels of application to almost all the analyzed practices.

In order to optimize the presentation of Fuzzy TOPSIS findings, this part of the research results focuses on the distances between positive and negative solutions and the values of the closeness coefficient. As presented in the methodological procedures, the alternatives were transformed into triangular fuzzy numbers, which were normalized and weighted before calculating these distances. Table 3 presents distances between positive and negative solutions and values of the closeness coefficient (Steps 7 and 8, respectively).

Considering the values of the closeness coefficients, it was possible to establish a rank, as Table 4 shows (Step 9).

In summary, these results obtained show some interesting findings (Table 4). First, it is possible to note that the first items ranked (A12, I2, A1, A11) can be considered comparatively, and the CE practices best implemented in the sample of MSMEs can be examined. Second, the results also indicate the sustainable practices that are the least implemented by the companies (V12, T5, V7) and need to be enhanced.

4.2. Analysing the BS 8001:2017 dimensions and circular practices

Regarding the practices better positioned in the analysis, it is possible to observe that 3 out of 4 belong to the Administration dimension. These practices refer to the need for training to ensure the efficient use of products or services (A12), the capacity of MSMEs to manage the direct and indirect impacts of decisions and activities (A1), and the ability of companies to develop initiatives to improve customers' needs and expectations also improving the quality of life of people and communities (A11). The study's major research findings, evidenced by the factors in the first positions of the ranking in this dimension, suggest that the analyzed MSMEs understand the role of organizational training, leadership and managing the direct and indirect impacts of decisions and activities as enablers of sustainable practices. In accordance with these findings, previous studies examining BS 8001:2017 also have demonstrated that the Systems thinking principle received the highest support from respondents from companies in China (Pesce et al., 2020). They also argued that the holistic understanding of the value chain is essential in the current CE standards because companies are beginning to consider themselves as components of more extensive social systems.

The dimension of Innovation assessed how companies continuously innovate to generate value by facilitating CE practices and sustainable resource management. Such innovations can be carried out by modifying the design of products/services or reconfiguring the existing business models, improving the sustainable practices in the company. This dimension helps to promote the transition toward CE and sustainable operations by changing existing production and consumption arrangements. Analyzing the first positions of the ranking obtained via Fuzzy TOPSIS shows that the leadership and commitment demonstrated by the companies (I2) is the aspect most salient among the companies examined. Furthermore, an interesting finding observed was that the factor processes are in place to ensure that successful change management (I14) ranks eighth among all the factors analyzed.

The Administration dimension assessed how companies manage the direct and indirect consequences of their decisions and activities within the value chain in which they operate. This dimension considers the company responsible for all aspects of its activities and decisions, from beginning to execution to disposal of products/services. Furthermore, it considers the impact of environmental, economic, and social issues on the supply chain and customers in the present and the long term. The results show that three of the four best-ranked practices belong to this dimension (A12, A1, and A11). These practices refer to the need for training to ensure the efficient use of products or services (A12), the capacity of MSMEs to manage the direct and indirect impacts of decisions and activities (A1), and the ability of companies to develop initiatives to improve customers' needs and expectations also improving the quality of life of people and communities (A11).

The measurement Transparency assessed how open businesses are about activities and decisions that impact their ability to transform toward more sustainable production and consumption. This dimension assumes that transparency must be encouraged to make information available proactively or on-demand as needed. According to BS 8001:2017, transparency does not necessarily imply making proprietary or privileged information, and it would not violate legal, commercial, protection, or personal privacy commitments. The analyzed companies did not have evidence of any factor of transparency in the first positions

Table 3
Distances from positive and negative solutions and values of the closeness coefficient.

Items	d_i^*	d_i^-	CC_i	Items	d_i^*	d_i^-	CC_i	Items	d_i^*	d_i^-	CC_i
P1	56.894	48.541	0.460	**A5**	59.215	45.192	0.433	**V1**	59.134	45.208	0.433
P2	57.209	49.068	0.462	**A6**	56.653	48.702	0.462	**V2**	56.647	49.119	0.464
P3	56.626	49.358	0.466	**A7**	56.672	49.293	0.465	**V3**	58.965	46.325	0.440
P4	57.305	48.603	0.459	**A8**	56.945	49.847	0.467	**V4**	62.266	41.303	0.399
P5	56.333	49.910	0.470	**A9**	58.232	47.073	0.447	**V5**	55.832	50.345	0.474
P6	57.335	47.414	0.453	**A10**	58.164	46.716	0.445	**V6**	59.846	44.526	0.427
I1	58.550	46.332	0.442	**A11**	55.743	51.042	0.478	**V7**	65.681	35.201	0.349
I2	54.530	52.033	0.488	**A12**	54.272	52.489	0.492	**V8**	56.437	49.759	0.469
I3	60.881	41.643	0.406	**A13**	57.949	45.911	0.442	**V9**	60.097	44.032	0.423
I4	59.551	44.270	0.426	**C1**	57.216	48.868	0.461	**V10**	60.130	43.097	0.417
I5	57.396	48.648	0.459	**C2**	56.359	49.465	0.467	**V11**	62.822	39.758	0.388
I6	56.773	49.199	0.464	**C3**	56.203	49.653	0.469	**V12**	64.184	37.378	0.368
I7	60.580	42.579	0.413	**C4**	57.323	48.705	0.459	**V13**	57.020	49.129	0.463
I8	56.985	49.389	0.464	**C5**	60.759	42.126	0.409	**V14**	59.731	44.541	0.427
I9	57.381	48.976	0.460	**C6**	57.478	47.951	0.455	**T1**	59.022	45.958	0.438
I10	57.309	48.801	0.460	**C7**	56.864	49.883	0.467	**T2**	58.287	46.873	0.446
I11	59.529	44.927	0.430	**C8**	57.016	49.085	0.463	**T3**	60.953	42.509	0.411
I12	56.475	49.530	0.467	**C9**	61.312	40.936	0.400	**T4**	60.737	43.347	0.416
I13	61.150	41.709	0.405	**C10**	61.359	41.542	0.404	**T5**	65.084	36.677	0.360
I14	56.491	50.041	0.470	**C11**	62.121	41.732	0.402	**T6**	60.493	44.240	0.422
I15	61.504	41.772	0.404	**C12**	56.677	49.867	0.468	**T7**	59.895	45.321	0.431
I16	57.231	48.773	0.460	**C13**	58.727	45.926	0.439	**T8**	58.625	46.242	0.441
A1	55.640	51.128	0.479	**C14**	56.032	50.482	0.474	**T9**	58.502	47.070	0.446
A2	57.129	48.330	0.458	**C15**	61.447	42.491	0.409	**T10**	63.367	39.293	0.383
A3	57.784	48.081	0.454	**C16**	57.058	49.164	0.463	**T11**	62.856	40.569	0.392
A4	57.902	47.406	0.450	**C17**	59.834	44.638	0.427	**T12**	59.563	45.027	0.431

Table 4
The rank of the CE practices.

Ranking	Item	CCi	Ranking	Item	CCi	Ranking	Item	CCi
1	A12	0.492	**27**	I9	0.460	**53**	I11	0.430
2	I2	0.488	**28**	P1	0.460	**54**	C17	0.427
3	A1	0.479	**29**	I16	0.460	**55**	V14	0.427
4	A11	0.478	**30**	I10	0.460	**56**	V6	0.427
5	V5	0.474	**31**	C4	0.459	**57**	I4	0.426
6	C14	0.474	**32**	P4	0.459	**58**	V9	0.423
7	P5	0.470	**33**	I5	0.459	**59**	T6	0.422
8	I14	0.470	**34**	A2	0.458	**60**	V10	0.417
9	C3	0.469	**35**	C6	0.455	**61**	T4	0.416
10	V8	0.469	**36**	A3	0.454	**62**	I7	0.413
11	C12	0.468	**37**	P6	0.453	**63**	T3	0.411
12	C2	0.467	**38**	A4	0.450	**64**	C5	0.409
13	C7	0.467	**39**	A9	0.447	**65**	C15	0.409
14	I12	0.467	**40**	T9	0.446	**66**	I3	0.406
15	A8	0.467	**41**	T2	0.446	**67**	I13	0.405
16	P3	0.466	**42**	A10	0.445	**68**	I15	0.404
17	A7	0.465	**43**	A13	0.442	**69**	C10	0.404
18	V2	0.464	**44**	I1	0.442	**70**	C11	0.402
19	I8	0.464	**45**	T8	0.441	**71**	C9	0.400
20	I6	0.464	**46**	V3	0.440	**72**	V4	0.399
21	C16	0.463	**47**	C13	0.439	**73**	T11	0.392
22	V13	0.463	**48**	T1	0.438	**74**	V11	0.388
23	C8	0.463	**49**	V1	0.433	**75**	T10	0.383
24	A6	0.462	**50**	A5	0.433	**76**	V12	0.368
25	P2	0.462	**51**	T7	0.431	**77**	T5	0.360
26	C1	0.461	**52**	T12	0.431	**78**	V7	0.349

of the ranking obtained in our results.

Results also show that the other two practices that were ranked in the top 10 positions and that should be highlighted belong to the Collaboration dimension. The practices of this dimension are related to how companies collaborate externally and internally to generate shared value through formal or informal agreements. The dimension assumes that cooperation among businesses (e.g., in supply chains and cross-sector) and different parties are essential to create significant progress toward more circular and sustainable operations. The analysis of the practices suggests that MSMEs examined understand that collaboration changes the management of risk and resource opportunities (C3) and what success is in the company (C14). This result may be partially explained by the fact that MSMEs are often more flexible and responsive to market needs than large companies (Mishra et al., 2022; Pacheco et al., 2017).

This evidence accords with earlier observations, which showed that MSMEs also often have a less bureaucratic and more dynamic internal structure than large companies (Rizos and Bryhn, 2022; 2018). Furthermore, these observations seem consistent with previous research suggesting that the companies are indifferent to accepting collaboration principles (Pesce et al., 2020). The research findings help explain this because although we have observed seventeen items related to collaboration strategies toward the CE, only two (C3 and C14) are positioned among the first positions in the ranking obtained (Table 4). Therefore, it is possible to assume that internal and external collaboration toward the CE should be built on a shared approach and trust. This is because the absence of straightforwardness, deficient management, etc., are some of the most influential barriers preventing collaboration (Pesce et al., 2020).

Lastly, the measurement of Product optimization assessed how companies ensure that all products, materials, and components are of the maximum value and utility along the value chain. This dimension is critical because the CE is concerned with regenerating and exploiting value by converting so-called waste or system wastes into valuable inputs and identifying their potential benefits. According to the CE, this value can be obtained through cost savings (e.g., providing access to inexpensive materials and lowering waste management costs), new income channels (e.g., providing additional products, materials, and components), or even less quantifiable value (e.g., improved customer relationship or resilience).

The research findings for Product optimization in the value chain dimension suggest that the MSMEs consider how products/services are designed to maximize the life span (V5) and that they carry out manufacturing and distribution activities to avoid waste generation (V8). This evidence broadly supports the other work in this area, in which the assessment of the companies demonstrated criticism from respondents concerning value optimization and collaboration concepts (Pesce et al., 2020).

In our analysis, although fourteen factors examined were related to Product optimization in the value chain, only two factors (P5 and P3) were positioned in the first positions of the ranking of closeness coefficients (Table 4). Admittedly, value optimization is critical to CE realization, but it can be difficult for companies to execute due to its complex nature. One of the reasons for this is that adopting value optimization strategies through the value chain may necessitate significant changes in how goods, processes, and income streams are created. Consequently, these variations impose significant risks, and resources and capabilities are required for proper perception and implementation (Pesce et al., 2020). The following section discusses the main findings and the research implications.

5. Discussion and implications

5.1. Barriers and enablers for CE implementation: the role of BS 8001:2017

This study investigated how small firms from developing economies can analyze the implementation of CE through the BS 8001:2017 requirements to improve business sustainability. Regarding the challenges for MSMEs in developing economies implementing CE, it was possible to verify that the last four ranking positions obtained via Fuzzy TOPSIS are occupied by two main dimensions (Transparency, and Product optimization in the value chain). Regarding the dimension of Transparency, findings indicated that providing the necessary information about known product issues, such as environmental and health hazards (T10), and accessing relevant information for the sustainable management of resources (T5) is the most critical. This finding was unexpected and suggested that there are opportunities for MSMEs in developing

economies to learn more and implement the BS 8001:2017 requirements linked to information transparency to adhere more to the CE vision.

Regarding the dimension of Product optimization in the value chain, it was evidenced that MSMEs face a number of challenges. These include communicating value optimization requirements to the value chain, billing for material procurement and monitoring (V7), and providing products containing parts or components with the possibility of having value in the final phase of use (V12).

Taken together, the integrative analysis of the findings regarding the most and least prominent CE practices observed provides additional support for the assumption that the collaboration strategies in the value chain play a vital role as an enabler of innovations during the CE implementation. Recent studies in developing economies found that employee training and a lack of experience are barriers preventing the CE transition (Sharma et al., 2021). The same authors found other impediments to CE adoption, including a lack of understanding of CE concepts, recyclability concerns, financial challenges, customer acceptability, and SMEs' poor management vision.

Comparing our findings with those of other studies on BS 8001:2017 (Pesce et al., 2020), it is possible to suggest that MSMEs in developing economies need to pay special attention to understanding the role of the collaboration principles as an enabler of the CE to the company and the value chain. In this regard, a contemporary study supports that "CE also has to be implemented outside the organizations, in a more holistic way, for example, through better collaboration with stakeholders on CE efforts and activities" (Barreiro-Gen and Lozano, 2020, p. 3484). Thus, collaboration strategies along the value chain are hypothesized to minimize some barriers for MSMEs to realize the transition from the linear model to the CE.

Overall, our empirical evidence suggests the potential of BS 8001:2017 to assess the CE implementation, facilitating the transition from a linear model of operation and enabling circular practices. In particular, the research findings contribute to our understanding of the role of BS 8001:2017 in assessing the CE implementation in MSMEs in developing economies (Prieto-Sandoval et al., 2018), supporting the transition from linear to circular models through the establishment of an overview of MSMEs companies in Brazil. These findings answer the first research question, which examined the role of BS 8001:2017 in supporting MSMEs from developing economies during the transition from linear to CE. Lastly, the study also answered the second research question that examined the most and least CE practices implemented in MSMEs in the context of a developing nation. This article contributes to extending the knowledge to the rapidly expanding research field on adopting standards such as BS 8001:2017 to facilitate the CE transition (Sawe et al., 2021; Pesce et al., 2020; Nowicki, 2020).

5.2. Practical implications for small firms

This study offers valuable implications for decision-making within MSMEs. The amalgamation of these findings enhances managers' comprehension of the significance of BS 8001:2017 in evaluating the implementation of CE. This understanding, in turn, can assist them in shaping decisions for the successful implementation of CE, pinpointing key challenges that impede the adoption of CE, and optimizing the economic value derived from CE practices, encompassing both tangible and intangible aspects.

Furthermore, this study found that the factors related to the implementation of required training to ensure the product or service is used efficiently (A12) and to the leadership and commitment demonstrated by the companies (I2) are the most salient aspects of CE adoption in the companies examined. These outcomes suggest that active leadership and commitment within MSMEs are essential for effective CE in the context of developing economies. Moreover, this research provides additional evidence to the literature that emphasizes that several gaps remain in our understanding of the role that people-driven factors play in adopting CE practices in SMEs' supply chains (Sawe et al., 2021; Murray et al., 2017). Critical aspects of the CE adoption include training and information exchange, employee involvement, management and leadership, and strategy alignment (Sawe et al., 2021).

Small businesses often encounter challenges in securing funding for CE initiatives due to limited access to credit and investment opportunities. Additionally, these enterprises may lack familiarity with CE practices, impeding their transition toward more sustainable and circular processes. Our findings suggest that an evaluation based on the criteria outlined in BS 8001:2017, spanning various dimensions and aspects, can guide internal and external assessments of the firm operations, ultimately mitigating this knowledge gap, particularly in the long-term. Furthermore, adherence to environmental regulations and achieving compliance standards represent intricate and costly endeavours for smaller companies that may lack dedicated compliance teams. We argue that ongoing assessments following the principles of BS 8001:2017 can enhance their preparedness for these regulations.

This study also suggests practical implications for decision-makers. Global business is experiencing turbulence and instabilities caused by the new normal landscape in society after the recent COVID-19 pandemic and current geopolitical tensions (e.g., USA and China) and conflicts (e.g., Russia-Ukraine war). Currently, companies are trying to determine what principles or strategies they need to take to run their regular business and sustain themselves in the competitive global market. Given this challenging situation, this study contributes to shed light on the importance of the CE and BS 8001:2017 to establish sustainability-oriented strategies and achieve the SDGs (Lahane and Kant, 2022; Giannetti et al., 2020), both in companies and as an effect, in the society. In this regard, the findings are expected to help industrial managers and policymakers further enhance their understanding of the factors that complicate CE implementation in MSMEs.

The empirical results also support the idea that CE requirements in developing economies include management commitment, technology upgrades, employee training, innovation, motivation, and appropriate policies (Sharma et al., 2021). The article extends previous works (Oliveira et al., 2018), which analyzed the strategic guidelines for CE product development in a local productive arrangement in Brazil based on conception, production process and post-production. Therefore, the research findings complement the recent CE literature on developing economies, suggesting that the assessment through BS 8001:2017 can improve the management vision of MSMEs toward CE realization. To conclude, the integrative analysis of the empirical findings provides additional support for the assumption that small firms need to gain more understanding of the role of collaboration principles during the CE transition.

5.3. Theoretical contributions

The findings of this study have implications for the research on CE transition in small firms from a theoretical point of view. Firstly, this study has examined the level of adoption of CE components implementation along with the challenge and leverage points for circularity in developing economies in the Brazilian MSMEs context in light of BS 8001:2017. Most of the extant literature focused on the importance of CE principles and barriers to CE adoption under BS 8001:2017 with the help of qualitative surveys. However, different from the extant knowledge base, this research is an initial attempt to examine the CE implementation phenomena in MSMEs and the role of BS 8001:2017 by combining qualitative and quantitative methods of investigation. This type of integration for CE implementation in the context of MSMEs has not been proposed in the extant literature (Pauliuk, 2018; Pesce et al., 2020).

Accordingly, this article has also addressed some methodological gaps in the existing CE research, according to the claim of prior studies (Sharma et al., 2021; Barnabè and Nazir, 2022). These studies have outlined the importance of more research on CE adopting quantitative approaches such as multicriteria decision models to support appropriate

decisions on CE transition. Therefore, the insights gained from this study contribute to the literature, strengthening this research agenda. Secondly, the research findings complement some related studies on MSMEs (Murray et al., 2017), providing additional evidence about the factors contributing to CE implementation in developing economies. Specifically, the past and contemporary literature on CE reveals significant knowledge gaps concerning the elements and strategies that lead to CE adoption, especially in developing economies (Sanches et al., 2022). These elements can be classified as soft factors like human resources or hard ones like technologies, strategies, and regulations (Sawe et al., 2021). Therefore, the structure of analysis based on the BS 8001:2017 proposed in this article may assist researchers from other developing economies in better understanding the theoretical aspects of CE adoption in MSMEs, a recognized knowledge gap in the literature (Prieto-Sandoval et al., 2018; Murray et al., 2017).

In this same vein, the paper offers theoretical implications for the literature examining the CE transition in developing countries. Recent works have shown that although the academic community has focused extensively on the concept of CE, there remains a need to systematize and establish a hierarchical structure for sustainable CE strategies (Oliveira et al., 2018; de Campos et al., 2021; Wasserbaur et al., 2022). Moreover, there is a paucity of research examining business sustainability in emerging economies (Sanches et al., 2022). Overall, our empirical findings suggest that CE-oriented standards such as BS 8001:2017 can also help managers in developed economies, which are commonly unaware of CE challenges and best practices despite operating with some sustainable initiatives. The research framework proposed in the present article improves our understanding of how MSMEs in developing economies can identify enablers and challenges for implementing CE practices in six relevant analytical dimensions (Mishra et al., 2022; Sharma et al., 2021; Kumar et al., 2020). In this regard, the study shows that the constructs composing these dimensions are related to different theories, such as the systems theory, the open eco-innovation theory, the resource-based view and dynamic capabilities theories.

Lastly, given that the body of literature about BS 8001:2017 is still in its nascent stages of development and there is a dearth of implemented cases, recent research has indicated the need for further investigation to elucidate the more precise utilization of the holistic approach of CE (Niero and Rivera, 2018). We assert that there remains a lack of clarity regarding how managers can fully grasp the intricate interconnections among the constituents of the value chain and the fundamental variables of a company, such as capabilities, investments, and personnel. To address this deficiency, developing models that integrate BS 8001:2017 with life cycle sustainability assessments in the form of operational support tools can effectively mitigate this issue. We argue that adopting robust and quantitative methodologies can aid companies in prioritizing the selection of the most feasible options for implementing CE practices (Niero and Rivera, 2018; Pauliuk, 2018). In sum, this paper contributes to the growing body of knowledge in the rapidly expanding research field that focuses on the utilization of standards, like BS 8001:2017, to assess CE implementation.

5.4. Social and policy implications

The empirical research findings also contribute to the knowledge base for policymakers to develop strategies to assist CE adoption in small firms. Undeniably, the concept of CE involves transforming the traditional linear economic model into more circular systems. This transition enables the creation of goods with multiple usage cycles, serves to protect the environment, diminishes dependence on natural resources, and eradicates waste across all sectors, encompassing both production and consumption. By identifying the primary challenges and the most commonly adopted CE practices within MSMEs in developing economies through the framework of BS 8001:2017, this article provides insights for policymakers. These research insights can assist policymakers in developing strategies to support MSMEs in addressing their CE challenges, ultimately leading to reduced CO_2 emissions and enhanced competitiveness.

Some aspects emerging from our research results contribute to developing a more structured framework for addressing specific United Nations Sustainable Development Goals (SDGs) in the context of Brazil. This implies that policymakers can consider the less evident CE practices identified in our study to enhance their CE initiatives or devise new strategies aligned with the SDGs (Lahane and Kant, 2022). For instance, concerning optimizing products within the value chain, our study reveals that companies face challenges in analyzing the fate of products in the final phase of their use (V11), generating added value in the final phase (V12), and effectively communicating value optimization requirements to the value chain (V7). One of the principal transparency-related challenges pertains to providing essential information about known product issues, such as environmental and health hazards (T10), and determining the manufacturing process for creating chemical components (T5). These results show that small firms have limited control over their supply chains, making it challenging to ensure that materials and products are sourced and managed sustainably and circularly. These less evident practices observed are, in turn, linked to recycling, redesign, reduction, and reduced dependence on natural resources, which are aimed at improving sustainable patterns of production and consumption. These aspects directly align with Goal 12 (Sustainable Production and Consumption). Additionally, Goals 14 (Life below Water) and 15 (Life on Land) are closely aligned with some of the CE principles covered by the BS 8001:2017 instrument. Consequently, this study contributes to the enrichment of the CE literature, which is indispensable for achieving the SDGs.

Moving forward, the research findings provide insights into investigating the CE phenomenon within the framework of developing economies. Previous studies have primarily focused on SMEs in developing economies, such as India and Tanzania (Sawe et al., 2021), and specific regional contexts, like Prayagraj in the Naini Industrial Estate, India (Sharma et al., 2021). In the context of small firms in Brazil, historically, there have been limited studies, primarily relying on case studies (Dantas et al., 2021; Barbieri and Santos, 2020). However, we did not come across any surveys in the literature that comprehensively analyze the reality of these MSMEs. This notable gap between the advancements in the CE literature and the practical experiences of companies is especially prominent in the Brazilian context (Barreiro-Gen and Lozano, 2020). To the best of our knowledge, this is the first survey focusing on small firms specifically exploring the role of BS 8001:2017 regarding CE practices. Therefore, by offering specific insights from the Brazilian context, this study contributes to establishing CE knowledge of small firm's challenges in developing nations.

In sum, this article is expected to help stakeholders in developing economies achieve different SDGs and address minimising climate risks by generating economic value with minimum resource depletion. Various nations are confronted with a scarcity of natural resources today and have been challenged to attend the SDGs. We argue that if we persist in following the current "take, make, and dispose" paradigm, our planet will be inundated with waste, posing significant impediments to regular and sustainable business operations. Thus, societies will benefit from developing and adopting CE practices, and MSMEs in developing economies play a key role in achieving SDGs. The conclusions, limitations and suggestions for future research to enlarge this research area are discussed in the next section.

6. Conclusions and future research

This study investigated the role of BS 8001:2017 in assessing the transition from a linear to a CE in the context of MSMEs from developing economies. The study also discerns the CE practices that exhibit varying levels of implementation, identifying those with the highest and lowest adoption rates. We employed a well-structured quantitative technique,

Fuzzy TOPSIS, to evaluate, rank, and identify the most and least significant activities concerning the implementation of CE in the context of BS 8001:2017. The research findings generally assessed the degree of adoption of CE practices within MSMEs across various structured dimensions and sub-dimensions of analysis. Among the key findings, it became evident that certain factors within the Administration dimension received the highest emphasis and were recognized as the best-implemented practices for the transition to a Circular Economy.

The study highlights the challenges confronted by MSMEs in developing economies when it comes to implementing CE practices, with a particular focus on transparency and product optimization. Transparency assumes a critical role, encompassing aspects such as disclosing information related to product issues and sustainable resource management. The challenges associated with product optimization revolve around effective communication, billing procedures, and maximizing end-of-use value. Furthermore, the research underscores the significance of collaboration within the value chain as an essential factor for achieving CE principles. The results show that barriers to CE adoption include lack of training, understanding, recyclability, and financial constraints. One of the implications of these findings is that MSMEs should focus on collaboration principles to enhance CE adoption. The study discovered that BS 8001:2017 could contribute to the shift towards more sustainable models. This finding contributes to our comprehension of its role in bolstering CE implementation within MSMEs in developing economies.

The findings of the article enhance previous research on CE in the context of small companies by emphasizing the significance of BS 8001:2017 in facilitating decision-making in MSMEs. It offers insights into challenges related to implementing circular strategies and optimizing economic value through CE practices. In terms of critical factors for CE adoption, the study highlights that leadership commitment and training play pivotal roles in influencing CE adoption in MSMEs, especially in developing economies, underscoring the importance of proactive leadership.

Regarding implications and boundary-spanning research for ongoing research in the area, the study reveals persistent gaps in understanding people-driven factors influencing CE practices in SMEs, including training, information exchange, employee involvement, management, leadership, and strategy alignment. Moreover, it emphasizes that limited credit access and unfamiliarity with CE practices impede funding for MSMEs' circular initiatives. Finally, in the context of global challenges such as COVID-19 and geopolitical tensions, the study underscores the role of CE and BS 8001:2017 in contributing to sustainability-oriented strategies, supporting SDGs, and assisting industrial managers and policymakers in navigating complexities.

Overall, this study may enlighten companies about the necessity to prioritize collaboration as a facilitator of sustainable practices within the value chain. This study also contributes to the CE literature by proposing an approach based on a multicriteria decision-making tool, namely TOPSIS, under a fuzzy environment to determine the level of adoption of CE implementation along with challenges and leverage points for circularity in developing economies. In conclusion, the article shows how the BS 8001:2017 standard can positively assist MSMEs in analyzing their internal and external sustainable practices regarding the traditional linear business models of take-use-dispose. This analysis can enable managers to reflect on the changes needed in the business toward circular models based on recycling, reuse, and remanufacturing strategies.

6.1. Limitations and future research agenda

As with any research, some limitations need to be acknowledged. These limitations can be seen as a starting point for future research that will expand the research on how MSMEs in developing economies can assess the level of implementation of CE practices and understand the key enablers and challenges for these enterprises when implementing CE. First, it is noted that this study is limited by the focus on the specific context of a developing economy, which can prevent the generality of the results for other contexts. To address this limitation, we recommend that further studies attempt to replicate the research design utilized in this article in the context of other developing economies. The main objective of such replication is to identify patterns of results about the role of BS 8001:2017 in supporting MSMEs during the transition from linear to CE and to understand the CE practices presenting the most and least implementation levels. The second main research limitation is related to the sample examined, which represents the southeast region of Brazil. In this regard, one future line of research could explore the similarities and differences between the current results by comparing them to other regions in the country.

Furthermore, the findings highlight future research areas that need knowledge consolidation in the literature on the CE and standardizations, such as BS 8001:2017. Given that the research examining the role of standards such as BS 8001:2017 to support the CE transition is still in its early stages of development, we suggest further investigation to explain how companies can utilize BS 8001:2017 appropriately. Given that this study relied on a survey instrument with a single informant, we acknowledge the potential for biases in the perspectives of the experts who participated in the survey. Future investigations could consider replicating our survey using a multi-informant approach to address this potential limitation. Regarding the methodology utilized in the study, it is important to acknowledge that respondents' perceptions may introduce some level of uncertainty in the results. To address this aspect, we employed fuzzy logic for data analysis. However, it is worth acknowledging that replicating this study in other contexts employing different multicriteria methods could prove valuable for comparing and validating our results. In conclusion, this study underscores the importance of advancing our understanding and theories related to topics with significant societal interest. Additionally, it encourages the exploration of policy implications stemming from these findings.

CRediT authorship contribution statement

Diego Augusto de Jesus Pacheco: Conceptualization, Data curation, Investigation, Methodology, Resources, Supervision, Validation, Writing – original draft, Writing – review & editing. **Izabela Simon Rampasso:** Data curation, Formal analysis, Methodology, Resources, Software, Writing – original draft, Writing – review & editing. **Guilherme Schafer Michels:** Conceptualization, Data curation, Formal analysis, Investigation, Methodology, Project administration, Writing – original draft, Writing – review & editing. **Syed Mithun Ali:** Formal analysis, Investigation, Writing – original draft, Writing – review & editing. **Julian David Hunt:** Investigation, Validation, Writing – original draft, Writing – review & editing.

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.

Data availability

Data will be made available on request.

Appendix A

Table A1
Constructs and items examined in the survey.

Constructs	Code	Items in the survey [(5) Strongly Agree (4) Agree (3) Neuter (2) Disagree (1) Strongly Disagree]
Systems Thinking	P1	The company implement an approach to understanding individual decisions and activities within the system.
	P2	The company implemented a future vision for a more circular and sustainable mode of operation.
	P3	The company understand that the component relationships affect one another.
	P4	The company implement actions to achieve a system view.
	P5	The company understand that the decisions and activities affect system-wide decisions.
	P6	The company understand that there are unintended consequences when exists a proposal action.
Innovation	I1	There is in the company continuous innovation process to create value.
	I2	Leadership and commitment are demonstrated by the company.
	I3	The company determined the goals of the circular economy.
	I4	The circular economy is part of the business strategy.
	I5	There is a culture of innovation promoted at all hierarchical levels in the company
	I6	The circular economy is part of the innovation in the company' process.
	I7	The types of innovation within each area are managed in the organization.
	I8	Innovation in the company is collaborative.
	I9	Customers' expectations and satisfaction levels are understood.
	I10	The company determines and selects improvement opportunities.
	I11	The decisions and activities in the company are associated with the circular economy to serve customers.
	I12	The company's decisions and activities are innovative, transformative or process improvement.
	I13	The company identified which companies within the value chain are critical to achieving the circular economy goals.
	I14	Processes are in place to ensure successful change management.
	I15	The company consider the timescales for implementation of circular economy goals
	I16	Organizational processes have been put in place to ensure change management is successful
Administration	A1	The company manages the direct and indirect impacts of decisions and activities.
	A2	The top-level management sufficiently demonstrates leadership and commitment with respect to taking responsibility for its decisions and activities
	A3	The business model of the company is resource-dependent
	A4	The company is affected by the ability to create, deliver and capture long-term business value.
	A5	The company determined and evaluated the economic risks and opportunities associated with the use of resources throughout its value chain.
	A6	The company knows and understands the issues associated with chemical ingredients that pose significant risks to human health and/or significant risks.
	A7	These significant risks are eliminated or diminished.
	A8	The decisions and activities associated with the company' circular economy objectives will change current and future resource risks and opportunities
	A9	The company implement actions to mitigate resource risks and opportunities during sourcing, manufacturing, distribution, usage or end-of-life management.
	A10	The company demonstrates responsibility for addressing upstream and downstream impacts
	A11	The company' initiatives improve customers' needs and expectations are met in a way that improves the quality of life of people and communities
	A12	The training required is implemented to ensure the product or service is used efficiently
	A13	The company implement strategies and plans for the management of products and materials at end of life
Collaboration	C1	There is internal and external collaboration to create mutual value.
	C2	The collaboration helps the company' transition to a more circular and sustainable mode of operation
	C3	Collaboration changes the management of risk and resource opportunities.
	C4	There is in the company a policy for sharing information with partners.
	C5	The company identifies potential partner companies for circular economy objectives.
	C6	Partner relationships were identified in the company.
	C7	The organizational structure is adequate and capable of providing flexibility for collaborative workivo.
	C8	Collaborative education, training and recruitment programs are implemented in the company.
	C9	The company has a formalized process for selecting partners
	C10	The company assesses whether the relationships are in line with the circular economy objectives.
	C11	All partners of the company are selected with clear criteria
	C12	The company's top leadership supports all collaborative work.
	C13	The company understands that relationships are managed.
	C14	The company understands what is success.
	C15	Values are created through collaboration.
	C16	The company is able to identify problems and areas for improvement.
	C17	The company has alternatives strategies for each of the relationships.
Product otimizationin the value chain	V1	The company maintains all products, components and materials at a high value and utility level throughout the value chain.
	V2	Products, components and materials are designed to be of greater value and utility.
	V3	The reuse or recycling value is considered at the materials level.
	V4	The design of the products allows for the disassembly and separation of components.
	V5	Products/services are designed to maximize the life span of the product or service.
	V6	The company estimates the economic benefits for the circular economy.
	V7	Value optimization requirements are communicated to the value chain, billed on material procurement and monitored.
	V8	The company carries out manufacturing and distribution activities to avoid waste generation.
	V9	The company adopts strategies to extend the life of products and materials (eg, extended warranties, standardization and compatibility, designs are designed to be upgradeable, etc.).
	V10	It is easy to repair the product if all or part of it stops working.
	V11	The company analyses what happens to the products in the final phase of use.
	V12	Parts or components of the company's products generate added value in the final phase of use.
	V13	The company is able to separate components and materials into manageable, uncontaminated flows to facilitate reuse and recycling.

(*continued on next page*)

Table A1 (*continued*)

Constructs	Code	Items in the survey [(5) Strongly Agree (4) Agree (3) Neuter (2) Disagree (1) Strongly Disagree]
	V14	Relevant information and data are accessible throughout the company to ensure that products, components and materials can be properly managed at the end of their useful life.
Transparence	T1	Transparency about decisions and activities encourages the transition to a more sustainable and circular business model.
	T2	Communication in the company is made in a clear and transparent way about the products we use.
	T3	Resource usage is mapped into the value chain.
	T4	The company is able to determine the chemical composition of chemical materials and ingredients.
	T5	The company is able to determine the manufacturing process to create the chemical components.
	T6	The company has access to relevant information for the sustainable management of resources.
	T7	The company uses new technologies to increase transparency.
	T8	The company is transparent about the materials and chemicals used in the products.
	T9	Instructions for proper use of the products are provided in an understandable form for users.
	T10	The company provides the necessary information about known product issues (e.g. environmental and health hazards)
	T11	The company provides instructions to customers on product end-of-life management.
	T12	The company's products would resist any examination, analysis and standardization in case of complaints.

Appendix B

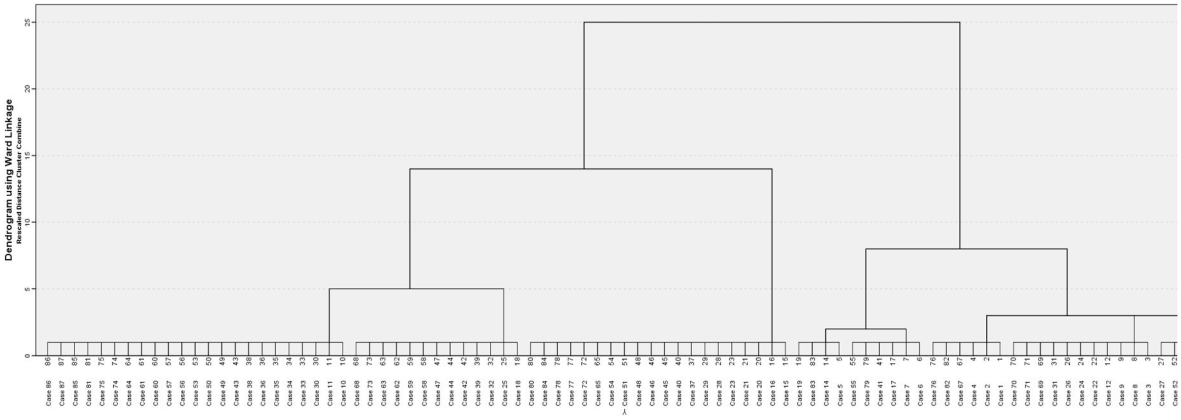

Fig. B1. Hierarchical Cluster Analysis (AHC) results.

Appendix C

Table B1
Frequency of responses – Group N1

#	P1	P2	P3	P4	P5	P6	I1	I2	I3	I4	I5	I6	I7	I8	I9	I10	I11	I12	I13	I14	I15	I16	A1	A2	A3	A4
1	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	7.4%	0.0%	0.0%	0.0%	0.0%	0.0%
2	0.0%	0.0%	0.0%	0.0%	7.4%	7.4%	22.2%	0.0%	25.9%	22.2%	0.0%	0.0%	14.8%	0.0%	0.0%	0.0%	22.2%	0.0%	22.2%	0.0%	0.0%	3.7%	0.0%	3.7%	0.0%	0.0%
3	14.8%	7.4%	7.4%	11.1%	0.0%	14.8%	0.0%	7.4%	14.8%	11.1%	14.8%	11.1%	18.5%	11.1%	7.4%	14.8%	7.4%	3.7%	22.2%	3.7%	40.7%	0.0%	0.0%	14.8%	18.5%	22.2%
4	44.4%	81.5%	51.9%	59.3%	44.4%	14.8%	37.0%	11.1%	14.8%	22.2%	59.3%	44.4%	40.7%	59.3%	85.2%	55.6%	37.0%	59.3%	29.6%	66.7%	48.1%	77.8%	59.3%	29.6%	66.7%	55.6%
5	40.7%	11.1%	40.7%	29.6%	48.1%	63.0%	40.7%	81.5%	44.4%	44.4%	25.9%	44.4%	25.9%	29.6%	7.4%	29.6%	33.3%	37.0%	25.9%	29.6%	3.7%	18.5%	40.7%	51.9%	14.8%	22.2%
	A5	**A6**	**A7**	**A8**	**A9**	**A10**	**A11**	**A12**	**A13**	**C1**	**C2**	**C3**	**C4**	**C5**	**C6**	**C7**	**C8**	**C9**	**C10**	**C11**	**C12**	**C13**	**C14**	**C15**	**C16**	**C17**
1	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	3.7%	0.0%	0.0%	0.0%	0.0%	0.0%	3.7%	0.0%	0.0%
2	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	7.4%	14.8%	11.1%	37.0%	0.0%	0.0%	0.0%	29.6%	7.4%	3.7%
3	40.7%	22.2%	7.4%	0.0%	25.9%	25.9%	3.7%	3.7%	33.3%	0.0%	3.7%	3.7%	7.4%	44.4%	14.8%	0.0%	0.0%	33.3%	33.3%	7.4%	0.0%	18.5%	7.4%	0.0%	0.0%	25.9%
4	44.4%	22.2%	63.0%	85.2%	48.1%	51.9%	44.4%	14.8%	7.4%	81.5%	48.1%	40.7%	74.1%	51.9%	51.9%	88.9%	51.9%	3.7%	48.1%	51.9%	81.5%	70.4%	40.7%	44.4%	63.0%	70.4%
5	14.8%	55.6%	29.6%	14.8%	25.9%	22.2%	51.9%	81.5%	59.3%	18.5%	48.1%	55.6%	18.5%	3.7%	33.3%	11.1%	40.7%	44.4%	7.4%	3.7%	18.5%	11.1%	51.9%	22.2%	29.6%	0.0%
	V1	**V2**	**V3**	**V4**	**V5**	**V6**	**V7**	**V8**	**V9**	**V10**	**V11**	**V12**	**V13**	**V14**	**T1**	**T2**	**T3**	**T4**	**T5**	**T6**	**T7**	**T8**	**T9**	**T10**	**T11**	**T12**
1	0.0%	0.0%	7.4%	7.4%	0.0%	7.4%	22.2%	0.0%	14.8%	7.4%	25.9%	11.1%	0.0%	11.1%	0.0%	0.0%	18.5%	18.5%	33.3%	18.5%	18.5%	0.0%	0.0%	25.9%	22.2%	18.5%
2	11.1%	7.4%	3.7%	18.5%	7.4%	7.4%	11.1%	7.4%	0.0%	7.4%	0.0%	25.9%	7.4%	0.0%	18.5%	11.1%	3.7%	3.7%	3.7%	3.7%	0.0%	22.2%	18.5%	11.1%	7.4%	0.0%
3	22.2%	7.4%	11.1%	7.4%	0.0%	11.1%	29.6%	0.0%	7.4%	7.4%	11.1%	14.8%	0.0%	18.5%	11.1%	11.1%	14.8%	7.4%	0.0%	3.7%	0.0%	7.4%	0.0%	0.0%	7.4%	7.4%
4	44.4%	33.3%	55.6%	66.7%	29.6%	48.1%	37.0%	40.7%	37.0%	22.2%	37.0%	25.9%	59.3%	44.4%	48.1%	55.6%	29.6%	40.7%	44.4%	51.9%	63.0%	29.6%	59.3%	40.7%	59.3%	33.3%
5	22.2%	51.9%	22.2%	0.0%	63.0%	25.9%	0.0%	51.9%	40.7%	55.6%	25.9%	22.2%	33.3%	25.9%	22.2%	22.2%	33.3%	29.6%	18.5%	22.2%	18.5%	40.7%	22.2%	22.2%	3.7%	40.7%

Table B2
Frequency of responses – Group N2

#	P1	P2	P3	P4	P5	P6	I1	I2	I3	I4	I5	I6	I7	I8	I9	I10	I11	I12	I13	I14	I15	I16	A1	A2	A3	A4
1	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	2.7%	0.0%	8.1%	0.0%	0.0%	0.0%	0.0%	0.0%
2	0.0%	0.0%	0.0%	0.0%	5.4%	10.8%	13.5%	0.0%	18.9%	13.5%	0.0%	2.7%	24.3%	0.0%	0.0%	0.0%	16.2%	0.0%	13.5%	2.7%	0.0%	5.4%	0.0%	5.4%	0.0%	0.0%
3	24.3%	8.1%	13.5%	16.2%	0.0%	13.5%	0.0%	0.0%	32.4%	16.2%	8.1%	8.1%	21.6%	2.7%	2.7%	8.1%	0.0%	16.2%	24.3%	0.0%	35.1%	2.7%	0.0%	8.1%	10.8%	18.9%
4	27.0%	62.2%	54.1%	70.3%	35.1%	16.2%	29.7%	10.8%	16.2%	27.0%	75.7%	62.2%	40.5%	78.4%	75.7%	78.4%	48.6%	43.2%	29.7%	62.2%	51.4%	54.1%	43.2%	45.9%	67.6%	51.4%
5	48.6%	29.7%	32.4%	13.5%	59.5%	59.5%	56.8%	89.2%	32.4%	43.2%	16.2%	27.0%	13.5%	18.9%	21.6%	13.5%	35.1%	40.5%	29.7%	35.1%	5.4%	37.8%	56.8%	40.5%	21.6%	29.7%
	A5	**A6**	**A7**	**A8**	**A9**	**A10**	**A11**	**A12**	**A13**	**C1**	**C2**	**C3**	**C4**	**C5**	**C6**	**C7**	**C8**	**C9**	**C10**	**C11**	**C12**	**C13**	**C14**	**C15**	**C16**	**C17**
1	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	5.4%	5.4%	0.0%	5.4%	0.0%	0.0%	0.0%	8.1%	5.4%	5.4%	0.0%	0.0%	0.0%	8.1%	0.0%	0.0%
2	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	5.4%	0.0%	0.0%	0.0%	0.0%	5.4%	0.0%	8.1%	5.4%	5.4%	13.5%	0.0%	5.4%	0.0%	13.5%	5.4%	8.1%
3	29.7%	18.9%	10.8%	0.0%	18.9%	24.3%	0.0%	0.0%	51.4%	5.4%	8.1%	8.1%	13.5%	51.4%	13.5%	0.0%	0.0%	40.5%	40.5%	5.4%	5.4%	27.0%	5.4%	0.0%	0.0%	18.9%
4	48.6%	21.6%	40.5%	91.9%	73.0%	40.5%	62.2%	8.1%	8.1%	73.0%	32.4%	35.1%	67.6%	29.7%	54.1%	78.4%	59.5%	13.5%	43.2%	62.2%	64.9%	54.1%	59.5%	64.9%	54.1%	73.0%
5	21.6%	59.5%	48.6%	8.1%	8.1%	35.1%	37.8%	91.9%	40.5%	16.2%	54.1%	51.4%	18.9%	13.5%	27.0%	21.6%	32.4%	32.4%	5.4%	13.5%	29.7%	13.5%	35.1%	13.5%	40.5%	0.0%
	V1	**V2**	**V3**	**V4**	**V5**	**V6**	**V7**	**V8**	**V9**	**V10**	**V11**	**V12**	**V13**	**V14**	**T1**	**T2**	**T3**	**T4**	**T5**	**T6**	**T7**	**T8**	**T9**	**T10**	**T11**	**T12**
1	0.0%	0.0%	5.4%	10.8%	0.0%	5.4%	16.2%	0.0%	16.2%	21.6%	18.9%	18.9%	0.0%	5.4%	0.0%	0.0%	8.1%	8.1%	35.1%	8.1%	8.1%	0.0%	0.0%	18.9%	8.1%	8.1%
2	5.4%	5.4%	0.0%	10.8%	5.4%	5.4%	13.5%	5.4%	0.0%	5.4%	0.0%	16.2%	5.4%	0.0%	5.4%	2.7%	2.7%	0.0%	0.0%	0.0%	0.0%	8.1%	8.1%	8.1%	8.1%	0.0%
3	24.3%	5.4%	8.1%	5.4%	0.0%	16.2%	32.4%	0.0%	5.4%	5.4%	24.3%	16.2%	0.0%	24.3%	10.8%	10.8%	24.3%	16.2%	2.7%	5.4%	0.0%	8.1%	0.0%	2.7%	10.8%	10.8%
4	27.0%	24.3%	59.5%	73.0%	21.6%	54.1%	37.8%	45.9%	48.6%	24.3%	37.8%	32.4%	54.1%	40.5%	40.5%	37.8%	21.6%	51.4%	48.6%	64.9%	67.6%	24.3%	54.1%	37.8%	70.3%	32.4%
5	43.2%	64.9%	27.0%	0.0%	73.0%	18.9%	0.0%	48.6%	29.7%	43.2%	18.9%	16.2%	40.5%	29.7%	43.2%	48.6%	43.2%	24.3%	13.5%	21.6%	24.3%	59.5%	37.8%	32.4%	2.7%	48.6%

Table B3
Frequency of responses – Group N3

	P1	P2	P3	P4	P5	P6	I1	I2	I3	I4	I5	I6	I7	I8	I9	I10	I11	I12	I13	I14	I15	I16	A1	A2	A3	A4
1	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	4.3%	0.0%	0.0%	0.0%	0.0%	0.0%
2	0.0%	0.0%	0.0%	0.0%	0.0%	17.4%	21.7%	0.0%	30.4%	21.7%	0.0%	0.0%	8.7%	0.0%	0.0%	0.0%	21.7%	0.0%	21.7%	0.0%	0.0%	8.7%	0.0%	13.0%	0.0%	0.0%
3	13.0%	0.0%	17.4%	8.7%	0.0%	4.3%	0.0%	13.0%	26.1%	26.1%	17.4%	17.4%	30.4%	13.0%	13.0%	13.0%	13.0%	8.7%	43.5%	0.0%	30.4%	0.0%	0.0%	8.7%	13.0%	30.4%
4	30.4%	87.0%	52.2%	69.6%	43.5%	30.4%	30.4%	4.3%	4.3%	21.7%	69.6%	52.2%	43.5%	60.9%	78.3%	69.6%	39.1%	56.5%	13.0%	69.6%	56.5%	73.9%	52.2%	30.4%	82.6%	52.2%
5	56.5%	13.0%	30.4%	21.7%	56.5%	47.8%	47.8%	82.6%	39.1%	30.4%	13.0%	30.4%	17.4%	26.1%	8.7%	17.4%	26.1%	34.8%	21.7%	30.4%	8.7%	17.4%	47.8%	47.8%	4.3%	17.4%
	A5	**A6**	**A7**	**A8**	**A9**	**A10**	**A11**	**A12**	**A13**	**C1**	**C2**	**C3**	**C4**	**C5**	**C6**	**C7**	**C8**	**C9**	**C10**	**C11**	**C12**	**C13**	**C14**	**C15**	**C16**	**C17**
1	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	8.7%	0.0%	0.0%	0.0%	0.0%	0.0%	8.7%	0.0%	0.0%
2	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	4.3%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	13.0%	0.0%	13.0%	0.0%	0.0%	0.0%	8.7%	0.0%	8.7%
3	43.5%	30.4%	21.7%	0.0%	30.4%	43.5%	0.0%	0.0%	39.1%	4.3%	13.0%	13.0%	8.7%	56.5%	21.7%	0.0%	0.0%	34.8%	56.5%	0.0%	0.0%	34.8%	0.0%	0.0%	0.0%	26.1%
4	56.5%	30.4%	47.8%	91.3%	60.9%	34.8%	60.9%	17.4%	21.7%	73.9%	43.5%	52.2%	73.9%	39.1%	65.2%	95.7%	60.9%	13.0%	26.1%	73.9%	73.9%	56.5%	69.6%	69.6%	56.5%	65.2%
5	0.0%	39.1%	30.4%	8.7%	8.7%	21.7%	39.1%	82.6%	39.1%	17.4%	43.5%	34.8%	17.4%	4.3%	13.0%	4.3%	39.1%	30.4%	17.4%	13.0%	26.1%	8.7%	30.4%	13.0%	43.5%	0.0%
	V1	**V2**	**V3**	**V4**	**V5**	**V6**	**V7**	**V8**	**V9**	**V10**	**V11**	**V12**	**V13**	**V14**	**T1**	**T2**	**T3**	**T4**	**T5**	**T6**	**T7**	**T8**	**T9**	**T10**	**T11**	**T12**
1	0.0%	0.0%	4.3%	13.0%	0.0%	4.3%	8.7%	0.0%	17.4%	21.7%	8.7%	13.0%	0.0%	4.3%	0.0%	0.0%	8.7%	8.7%	21.7%	8.7%	8.7%	0.0%	0.0%	17.4%	13.0%	8.7%
2	4.3%	4.3%	0.0%	4.3%	4.3%	0.0%	8.7%	4.3%	0.0%	0.0%	0.0%	4.3%	4.3%	0.0%	8.7%	17.4%	0.0%	4.3%	4.3%	4.3%	0.0%	13.0%	8.7%	8.7%	8.7%	0.0%
3	30.4%	4.3%	4.3%	4.3%	0.0%	21.7%	34.8%	0.0%	0.0%	4.3%	34.8%	17.4%	0.0%	26.1%	13.0%	13.0%	26.1%	21.7%	4.3%	4.3%	0.0%	8.7%	0.0%	4.3%	8.7%	8.7%
4	47.8%	21.7%	65.2%	78.3%	21.7%	65.2%	47.8%	56.5%	52.2%	30.4%	34.8%	43.5%	65.2%	52.2%	52.2%	43.5%	34.8%	47.8%	60.9%	65.2%	82.6%	39.1%	78.3%	43.5%	69.6%	30.4%
5	17.4%	69.6%	26.1%	0.0%	73.9%	8.7%	0.0%	39.1%	30.4%	43.5%	21.7%	21.7%	30.4%	17.4%	26.1%	26.1%	30.4%	17.4%	8.7%	17.4%	8.7%	39.1%	13.0%	26.1%	0.0%	52.2%

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