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**PEOPLE S AWARENESS OF CIRCULAR ECONOMY: SCALE DEVELOPMENT AND RELATIONSHIP WITH SOCIAL INFLUENCE, PSYCHOLOGICAL BARRIERS, AND FAVOURABLE EVALUATION OF SUSTAINABLE DEVELOPMENT**

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DEVELOPMENT

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Dedico esta tese aos meus pais Laercio Gonella e Lindalva dos Santos Leite Gonella que sempre me orientaram quanto a importância da educação e me deram todo o suporte necessário nesta caminhada.

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*"Feliz aquele que transfere o que sabe e aprende o que ensina"*

*Cora Coralina*

**ABSTRACT**

Circular Economy (CE) encompasses strategies that aim to decouple economic activity from finite resource consumption and eliminate waste from the system as a matter of principle. Supported by a transition to renewable energy sources, the circular model builds economic, natural, and social capital through three principles: eliminate waste and pollution from the start; keep products and materials in use in the supply chain; and regenerate natural systems. The transition to a CE must be initiated by a paradigm shift in the entire supply chain including people. Although this topic is being addressed in several research studies around the world, there are still some research gaps to be filled: (i) Lack of research that considers the analysis of the CE from the perspective of people (bottom-up level), without standardizing on the position these actors occupy in the value chain or the social context in which they are inserted; (ii) the level of depth that CE strategies are dealt with, since the literature points to studies that address specific strategies individually, without delving into the plurality that configures CE; (iii) a lack of a measurement scale to measure people's awareness of CE; (vi) lack of studies in the Brazilian context. Thus, this thesis aims to analyse the factors that interact with people's awareness of CE and their effects on people's favourable evaluation of sustainable development. First, we conducted a Systematic Literature Review (SLR) to map the literature on CE studies. Second, we built and validate a measurement scale to evaluate people's awareness of CE. After that, we used the validated measurement scale to test two theoretical models. The first presented as its objective assess the effect of Social Influence and Psychological Barriers on People's Awareness of CE. To support our theoretical model and to ground the constructs, we sought inspiration from the Theory of Behavioral Choice (TBC). The second, aimed the analyse the relationship between people's awareness of CE and Favourable Evaluation of people concerning the importance of efforts for sustainable development. To support this theoretical model, we sought inspiration from the Social Learning Theory, which suggests that people learn from their environment and the behaviours of others around them. A survey was applied to 1046 Brazilian respondents through non-probability sampling, and multivariate data techniques (PLS-SEM) were applied. The results of the first model showed that Psychological Barriers (Sunk Costs dragons and Limited Cognition dragons) restrict people's awareness of CE. Besides, it was found that Social Influence (family, friends, and celebrities) positively influence people's awareness of CE. The findings indicate that Social Influence mitigates the negative effect of Psychological Barriers on People's Awareness of CE. The results of the second model showed that people Awareness of CE positively influences favourable evaluation about the importance of Sustainable Development, and the engagement of people and the participation of institutions on Sustainable Development efforts.

**Keywords:** Circular Economy; People Awareness; Psychological Barriers; Social Influence; Favourable Evaluation; Sustainable Development.

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# SUMMARY

# 1. INTRODUCTION

This chapter introduces the subject, the study's importance and motivation are defined, and the research method selection is described.

## 1.1 Contextualization and Motivation

It is estimated that by 2030, the world population will reach 9 billion people, which means almost 3 billion more people who need resources, consume products and services, and generate waste for the planet (WEETMAN, 2019). The linear disposal production, consumption, and disposal model have implied social and environmental impacts, awakening efforts towards a sustainable consciousness (OGHAZI; MOSTAGHEL, 2018). In addition, other phenomena such as world population growth, rural exodus, and unbridled consumerism, have caused an ecological overload, i.e. the planet is no longer able to replace all the resources extracted and absorb waste, such as carbon dioxide (YANG et al., 2022). With the increase in inequalities, especially in developing countries, the environmental impacts have become more noticeable, such as global warming and the depletion of natural resources, endangering several species of living beings and air and water pollution (LAKATOS et al., 2021). This reality, combined with the growing environmental problems, demands a new paradigm of life (JAIN et al., 2023).

As shown in Figure *1*, the 20th century was marked by progress in the systematization of production processes, with the ascension of economic-focused strategies such as Total Quality Management (TQM) and Lean Production Management (ROSDOSDA et al., 2019). These management systems present as philosophy the search for quality and efficiency, reducing errors and redundancies in the process (KALMYKOVA; SADAGOPAN; ROSADO, 2018a; POP et al., 2022a). This shows that in that period, little was said about efforts in search of more sustainable means of production and consumption (CHEN; YILDIZBASI; SARKIS, 2023; LAHANE; PRAJAPATI; KANT, 2021).

Gradually the environmental impacts began to attract the attention of specialists and public policy makers (WARIS; HAMEED, 2020). Events such as the release of Rachel Carson's 1962 book "Silent Spring" and the United Nations 1st World Conference on the Environment (in Stockholm) focused attention on the harmfulness of the linear model (HENZ et al., 2018). Furthermore, the publication of the Brundtland Report, by

the World Commission on Environment and Development alerted on the incompatibility between sustainability and the current patterns of production and consumption, promoting reflections on the relationship between man and environment (LAKATOS et al., 2021). After this period, the concept of growth began to be replaced by development since growth is believed to be related to quantitative issues, without considering other variables such as education, health and equality (KAUPPI; LUZZINI, 2022; MAJERNÍK et al., 2021). In 1987, sustainability was defined as "[…] development that meets the needs of the present without compromising the ability of future generations to meet their own needs." (MAJERNÍK et al., 2021, p.1).

Such effervescences opened the way for other sustainable approaches such as Cleaner Production, Green Economy, Industrial Ecology, Cradle to Cradle and Regenerative Design, among others (MASI et al., 2018). The concept of cleaner production, which was coined at the Conference on the Environment (Rio 92), emerged as a preventive strategy for processes, products, and services to increase efficiency and reduce environmental risks (HOMRICH et al., 2018). The Green Economy concept has gained more visibility during the Rio+20 conference in 2012, as an attempt to balance economic value through the conscious use of natural capital (LOISEAU et al., 2016; ÜNAL; URBINATI; CHIARONI, 2019).

Within this context, the Circular Economy (CE) is considered one of the best options for sustainable development, once it represents a model for restructuring the ways of consuming natural resources by redesigning products, using biodegradable raw materials, reusing materials, and recycling (GRASSO; ASIOLI, 2020; SHARMA et al., 2021a). The concept was supported by schools of thought, such as "regenerative design" (LIEDER et al., 2017), "industrial ecology" (HOMRICH et al., 2018), "cradle to cradle" (GOMES; SILVESTRE; DE BRITO, 2020), "spaceman economy" (MAJERNÍK et al., 2021), widely disseminated in the in the last decades, aiming to encourage "closing the loop" patterns and proposing a systemic change that generates economic, environmental, and social opportunities. Figure 1 shows the timeline of the development of approaches related to sustainability.

Figure 1 - Timeline regarding the evolution of sustainable approaches
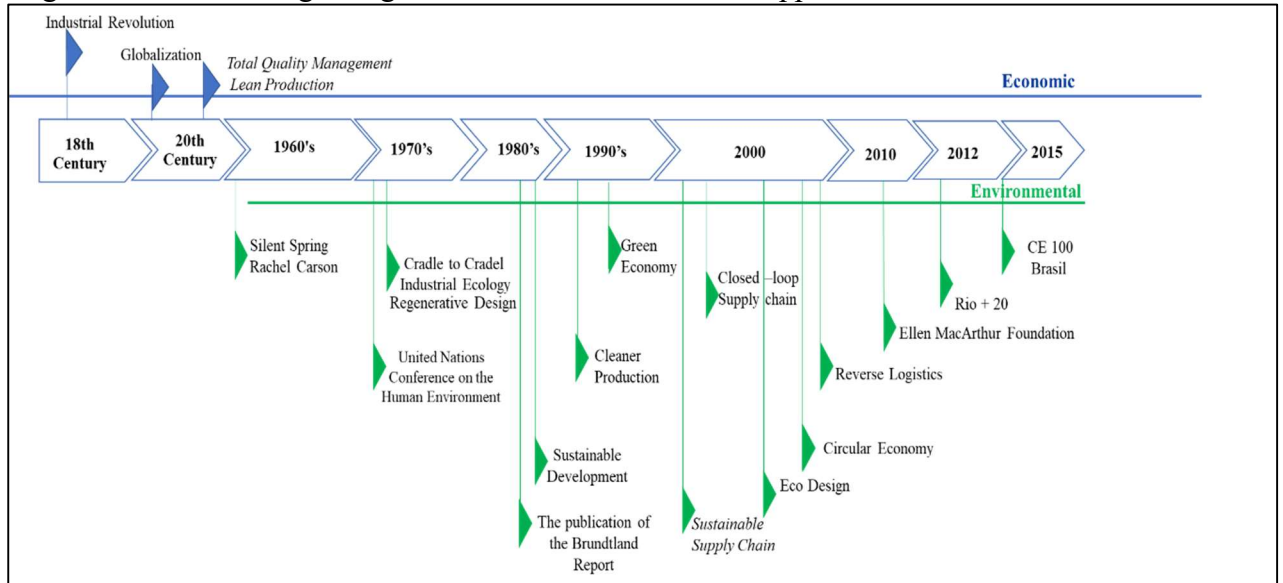


Source: Proposed by the author.

The CE principles are used as drivers of public policies oriented toward economic, social and environmental development in European Union nations (GENG et al., 2009; MASI et al., 2018), North America (SHAH; PATEL; BASH, 2010) and China (GUO-GANG; JIE, 2008; XUE et al., 2018). In Brazil, CE is in the process of maturation in the academic and business worlds, with efforts directed towards the search for regenerative production and consumption patterns, demanding articulated activities among researchers and stakeholders (SANTIAGO et al., 2017). A survey applied to 143 Brazilian companies to identify the main aspects of sustainability in the context of project management, revealed the need for more empirical studies related to sustainable management, which points to an emerging field of analysis (MARTENS; CARVALHO, 2017). Another study carried out in Brazil showed the strong potential of CE influence supply chains' key performance, which reinforces the importance of developing scientific research on CE in the Brazilian context (GODINHO FILHO et al., 2022).

The innovation program "Circular Economy 100" (CE 100), developed by the Ellen Mac Arthur Foundation, emphasizes Brazil's attractive scenario for exploring circular opportunities. However, despite the imminent opportunities for the concept's applicability in Brazil and efforts to develop it among institutions (GODINHO FILHO et al., 2022), there is little theoretical and empirical maturity, representing a research gap to be filled.

The transition from linear to circular economy depends on the public's willingness to voluntarily change their lifestyles and behaviours (TSALIS; STEFANAKIS;

NIKOLAOU, 2022). The first step for this to happen depends on raising people's awareness, as Karaeva et al. (2022) pointed out that awareness is a key determinant of sustainable development. Thus, the transition to a more regenerative economy involves the participation of various value chain agents at the top-down level (companies, government, and other institutions); and at the bottom-up level (consumers, students, people in general). Both approaches are needed to generate awareness among all actors in a value chain. However, the literature is made up of more top-down level studies, which is a problem, given the importance of people's involvement in sustainable development (DADDI et al., 2020). According to Almulhim and Abubakar (2021), implementing CE at the top down level involves rigid strategies that are difficult for people to assimilate. Based on this reality, our motivation is to focus on the bottom-up level (people) to understand the predictors related to CE awareness.

The literature presents several studies analysing CE approaches from the top-down perspective. Studies like Baharmand et al. (2016), Virtanen et al. (2019) and Cruz Rios et al. (2019) indicate business-oriented CE strategies. The study by Cusenza et al. (2019) concluded that reusing electric vehicle batteries changed the percentage between less than 4% (of cumulative energy demand) and 17% (in abiotic depletion potential), representing an essential effort towards a low-carbon economy. Similarly, Cruz Rios et al. (2019) propose a strategy for materials reuse in construction; Agyemang et al. (2019) adopt an exploratory approach to understanding the drivers and barriers to implementing CE in the automotive industry. However, the literature presents few studies that show people's awareness of CE.

Sustainable awareness is a condition for developing sustainable behaviours, i.e., the higher people's level of awareness, the more their choices will be directed to the preservation of the environment (HAN; YOON, 2015). In this way, awareness is revealed as a motivating factor for developing sustainable behaviours (LU et al., 2020). The study developed in Russia by Karaeva et al. (2022) showed that the low level of public awareness proved to be a barrier to developing renewable energy. Studies have shown that consumers do not have sufficient knowledge about the CE concept and applicability (SATTARI; WESSMAN; BORDERS, 2020). Thus, there is a risk linked to the efficiency of the assimilation of strategies by people and other actors in the value chain (LU et al.,2020). Bocken et al. (2014) shows that consumers are reluctant to reduce their consumption and ownership of products.

**1.2 Objectives**

**1.2.1 General objective**

Analyse the factors that interact with people's awareness of CE and their effects on people's favourable evaluation of SD.

**1.2.2 Specific Objectives**

Based on the context presented, this research presents the following specific objectives:

- Investigate the state of the art regarding research around the world that address the awareness, behaviour, and attitudes to people of CE;
- Develop a new multi-item measurement scale to measure people's awareness of CE;
- Assess the effect of Social Influence and Psychological Barriers on People's Awareness of CE;
- Analyse the relationship between people's awareness of CE and Favourable Evaluation of people concerning the importance of efforts for sustainable development.

Each of these 4 objectives will be accomplished in one chapter of our thesis. Table 1 present such relationship together with the main research method employed.

Table 1 - Objectives, Chapter and Research Method

| Objectives | Chapter of the Thesis | Research Method |
|---|---|---|
| *Objective 1:* Investigate the state of the art regarding research around the world that address the awareness, behaviour, and attitudes to people of CE. | People Awareness, Behaviours, and Attitudes of Circular Economy around the world: literature review and research agenda | Systematic Literature Review |
| *Objective 2:* Develop a new multi-item measurement scale to measure people's awareness of CE. | People's Awareness of the Circular Economy: Developing Constructs and Measures | Multi-method approach |
| *Objective 3:* Assess the effect of Social Influence and Psychological Barriers on People's Awareness of CE. | The effect of Social Influence on People's Awareness Of CE | Survey |
| *Objective 4:* Analyse the relationship between people's awareness of CE and favourable evaluation of people concerning the importance of efforts for sustainable development | From Awareness to Action: Understanding the relationship between Circular Economy and favourable evaluation towards Sustainable Development | Survey |

Source: Proposed by the author.

## 1.3 Justification, and an Overview of the Research Method

The growing risk of climate change, biodiversity loss, environmental pollution, resource scarcity, and other consequences makes adopting a sustainable development model increasingly critical (KAUPPI; LUZZINI, 2022). Many nations have been prioritising the search for alternatives to balance economic, social, and environmental development, being the CE one of the best options to support sustainable development. CE is a systems solution framework encompassing a series of closing-the-loop strategies (KARAEVA et al., 2022).

It is worth mentioning that the circular strategies mentioned in this thesis can also be called "CE strategies" (GUERRA; LEITE, 2021) "CE principles" (GERBER et al., 2010), "CE approaches" (RIBIC; VOCA; ILAKOVAC, 2017) or CE practices (MASI et al., 2018b). However, given the complexity and diversity of CE strategies and applications, this study focuses on the technical cycle strategies, which have more adherence and applicability in people's lives. On the other hand, the biological cycle strategies as Extraction of bio-chemicals and development of bio-based materials are adapted to the reality of companies and industries; therefore having no practical

relationship with people (KALMYKOVA; SADAGOPAN; ROSADO, 2018a) and out of scope of the present research. Thus, the focus on the technical cycle refers to a methodological choice given the specificity of the research.

The scientific process involves the choice of a topic guided by literature research. The CE theme was chosen given the relevance and importance of this approach for the transition to a regenerative future. This research is motivated by some research gaps found in the literature, as summarized below:

(i) Few researches considers the analysis of the CE from the perspective of people (bottom-up level), without standardizing on the position these actors occupy in the value chain (companies, government, consumers) or the social context in which they are inserted (student, politician, businessman/manager);

(ii) No studies were found that validate a measurement scale to assess people's awareness of CE;

(iii) To the best of our knowledge there is no research investigating the factors that interact with people's awareness of CE and their effects on people's favourable evaluation of SD considering multiple CE strategies;

(iv) There is little research that explores CE in the Brazilian context, especially from the perspective of people's awareness.

In addition to the research gaps the present research is motivated by an important and complex research problem, as it considers different variables that may interact with people's awareness of CE. For better understanding and clarity of the motivations, research problem and methodological process used in this thesis, Figure 2 illustrates a schematic representation that synthesises this information.

Figure 2 - Schematic representation of the research process

**Motivations**

**Analyse the factors that interact with people's awareness of CE and their effects on people's favourable evaluation of SD**

The linear disposal production, consumption, and disposal model have social and environmental impacts

*Specific Objective 1:* Investigate the state of the art regarding research around the world that address the awareness, behaviour, and attitudes to people of CE

Faced with this global problem, the CE has shown itself to be one of the best options for sustainable development

*Research gap*

The literature does not present complete studies that analyze people's awareness of CE, and there are no validated measurement scales.

CE

*Specific Objective 2:* Develop new multi-item measurement scales to measure people's awareness of CE.

Linear Economy (LE) → Circular Economy (CE)

The efficient transition from LE to EC involves the participation of various stakeholders in the value chain

The final scale to measure people's awareness of CE has 15 items reflecting 5 constructs:
- Waste Management (WM);
- Rational use of resources (RUR)
- Technical Cycle (TC)
- Sustainable Products or Packaging (SPP)
- Dematerialization and Collaborative Consumption (DCC)

Level

Top-down
- Companies
- Government
- Other Institutions

Bottom-up
- Consumers
- Students
- People

*Focus of most research* **Focus of our research**

Some variables can interact positively or negatively with people's awareness of CE.

*Specific Objective 3:* Assess the effect of Social Influence and Psychological Barriers on People's Awareness of CE.

Implementing CE at the Top-down level involves rigid strategies that are difficult for people to assimilate.

*Specific Objective 4:* Analyse the relationship between people's awareness of CE and favourable evaluation of people concerning the importance of efforts for SD

Our motivation is to focus on the Top-down level (people) to understand the predictors that relate to CE awareness.

Source: Proposed by the author.

As shown in Figure 2 the circular future is only possible if citizens and governments can change your awareness (CALCULLI et al., 2021). The awareness can influence sustainable behaviours, oriented toward CE. In this sense, Guo et al. (2017); Lieder et al. (2017); Macarthur (2021) corroborate with growing interest in studies focusing on sustainability, as well as Geissdoerfer et al. (2017) and Kirchherr; Reike; Hekkert (2017) describe the need for research focusing on CE.

When it comes to measuring public awareness, we have identified that literature contains research that specifies its analysis according to specific stakeholders such as consumers (CANAVARI; CODERONI, 2020; GRASSO; ASIOLI, 2020; HERBES; BEUTHNER; RAMME, 2018; JANG; KIM; BONN, 2011; NGUYEN et al., 2020; PETRY et al., 2011), managers (AHN; KOO; CHANG, 2012; DE FERREIRA; FUSO-NERINI, 2019; XUE et al., 2010), and students at a university (GUO et al., 2017a). The study developed by Guo et al. (2021) analyses the perception of the rural producer in relation to climate change, focusing on a specific stakeholder that is upstream in the supply chain. As mentioned, most studies focus on CE analysis at the Top-Down level (companies, government, other institutions), with few studies analysing CE awareness from the perspective of the people.

Considering that the transition from linear economy to CE is not possible if there is no people's active participation, as well as the scarcity of research with this focus, this research arises to fill this important gap in the literature (SHEVCHENKO et al., 2023). Studies that seek to demonstrate relationships between different predictors of people's awareness are important to overcome possible barriers that may arise along the way (IOANNIDIS; KOSMIDOU; PAPANASTASIOU, 2023). Thus, our research does not consider corporate and institutional strategies, but rather strategies and behaviours that people can adopt in their daily lives. The relevance of this study is to address a topic on the rise in the business context to the social context of people. Thus, strategies applied to the context of companies as (like customization/make to order; Design for disassembly/modularity, eco-design; Green procurement, among others) as addressed in the study of Velasco-muñoz et al. (2021) and Walker et al. (2021) are not adapted to people's reality, therefore, they were not considered in this study.

Another important research gap is about the scope of strategies used. Most papers investigate CE from the perspective of a specific approach, such as remanufactured products (SINGHAL; JENA; TRIPATHY, 2019); green product consumption (KHARE, 2015); buying an environmentally responsible service (HAN; YOON, 2015); eco-friendly

packaging (NGUYEN et al., 2020); plastic recycling (KHAN et al., 2020); buying green product (ALVAREZ-RISCO et al., 2021); and buying CE products and services (TRẦN et al., 2022). Thus, was not found more complete studies, i.e., that include more than one CE strategy to assess the variables that relate positively and/or negatively to CE.

The search for a more regenerative society is a shared responsibility, being a matter of interest for public entities, companies, and consumers (MACARTHUR, 2021). The search for peolpe awareness is fundamental to guiding circular strategies in companies. Some companies have already integrated their activities in reverse cycles such as CeA and Tarkett, introducing renewable resources in their production processes (KAKADELLIS; WOODS; HARRIS, 2021). Despite this, little research explores CE in the Brazilian context, especially from the perspective of people's awareness. Therefore, this research is relevant in the face of emerging demands of a society that is exploitative and dependent on natural resources.

To fill these gaps in the literature this thesis considers five different CE approaches: (i) Waste Management (WM); (ii) Rational Use of Resources (RUR); (iii) Technical Cycle (TC); (iv) Sustainable Products or Packaging (SPP); and (v) Dematerialization and Collaborative Consumption (DCC).

To achieve the objectives that guides this work, it was necessary to follow some steps. The first step was to develop a Systematic Literature Review (SLR) to map the literature on CE studies. The SLR offered a diagnosis of the current literature on studies addressing people's CE-oriented awareness and behaviours. In addition to this review, we used the study published by Kalmykova; Sadagopan; Rosado (2018), who developed a complete SLR with the main strategies and practices of CE. This study was important to support the definition of the constructs of this research. An important result of the SLR was that despite the existence of studies on the degree of knowledge and behaviour of people around the world regarding CE, there is heterogeneity in the way these surveys are conducted. Thus, there is no standardization in the scale used to measure people's awareness regarding CE. To fill this important research gap, a measurement scale was developed followed the sequence of steps proposed by DeVellis (2022), Lambert and Newman (2022), and MacKenzie et al. (2011).

The second step was the creation and validation of a measurement scale to assess people's awareness of CE, according Menor and Roth (2007) and De Vellis (2022). To this end, we carried out rounds of structured interviews with experts; the application of the Q-Sort method for the selection and ordering of the items; the use of statistical

methods to ensure inter-rater reliability; the application of the proportion of substantive agreement (PSA) and coefficient of substantive validity (CSV) measures to ensure apparent validity; the use of error measurement tools, such as the overall placement ratio (OPR), to ensure convergent and divergent validity; and the application of a pre-test with Exploratory Factor Analysis (EFA) to ensure the convergent and discriminant validity of the measurement of the constructs. The pre-test was applied to 144 people using non-probability sampling. Based on the results of the EFA analyses, we adjusted the scale items with problematic factor loadings. To complete the validation process of the measurement scale, we conducted a survey with 820 people. We adopted Confirmatory Factor Analysis (CFA) to ensure the constructs' reliability and convergent and discriminant validity. At the end of this process, the validated scale is composed of 5 constructs and 15 items to assess people's awareness of CE.

After that, we used the validated measurement scale to test two theoretical models. The first presented as its objective assess the effect of Social Influence and Psychological Barriers on People's Awareness of CE. To support our theoretical model and to ground the constructs, we sought inspiration from the Theory of Behavioral Choice (TBC). The second, aimed the analyse the relationship between people's awareness of CE and Favourable Evaluation of people concerning the importance of efforts for sustainable development. To support this theoretical model, we sought inspiration from the Social Learning Theory. A survey was applied to 1046 Brazilian respondents through non-probability sampling, and multivariate data techniques (PLS-SEM) were applied.

**1.4 Thesis structure**

This thesis is structured in seven chapters, being the third, fourth, fifth and sixth chapters in paper format. This choice was due to the intention streamline the process of publishing the contents organized and results verified in this work. The Figure 3 shows the complete structure of this thesis.

Figure 3 - Thesis structure



| Chapter 1 Introduction | 1.1 Contextualization and Motivation;<br>1.2 Objectives;<br>1.2.1 General Objective<br>1.2.2 Specific Objectives<br>1.3 Justification, and an Overview of the Research Method<br>1.4 Thesis Structure |
| Chapter 2 Conceptual Background | 2.1 Circular Economy<br>2.2 People's Awareness of Circular Economy |
| Chapter 3 SLR | People's Awareness, Behaviours and Attitudes towards Circular Economy around the world: literature review and research agenda |
| Chapter 4 Measurement Scale | People's Awareness of the Circular Economy: developing constructs and measures |
| Chapter 5 Survey | The effect of Social Influence on People's Awareness of CE |
| Chapter 6 Survey | From Awareness to Action: Understanding the relationship between Circular Economy and favourable evaluation towards Sustainable Development |
| Chapter 7 Conclusions | Implications, Limitations and Future research |

Source: Proposed by the author.

## 2. CONCEPTUAL BACKGROUND

To achieve a more efficient contextualization of the topics covered in this research, this section will present a brief conceptual background of Circular Economy.

### 2.1 Circular Economy (CE)

The world population quadrupled in the twentieth century, leading to several changes such as rural exodus, reduction of the average price of resources and relocation of manufacturing units to developing countries (WEETMAN, 2019). The improving production systems boosted the linear system of production and consumption, promoting an unprecedented ecological burden (POP et al., 2022). This linear model has been contributing to the depletion of the planet's resources since the 17th century, a period in which several scientific and technological innovations occurred that ignored the limits of the environment (PRIETO-SANDOVAL; JACA; ORMAZABAL, 2018). The growing risk of climate change, biodiversity loss, environmental pollution and resource scarcity, becomes increasingly necessary adopting a sustainable development model (SHEN et al., 2022; WARIS; AHMED, 2020). Reflections on the linear economy have gained more visibility due to environmental impacts observed on a global scale, such as resource scarcity (ZVIRGZDINS; PLOTKA; GEIPELE, 2020a).

In that sense, the economic development, population growth, technological innovations and changes brought by capitalism reflected changes in people's lifestyles (KAKADELLIS; WOODS; HARRIS, 2021). The take-make-use-dispose model produces negative externalities such as greenhouse gas emissions, unsustainable levels of water extraction, and ecosystem pollution. Besides making resources increasingly scarce, this production model is unsustainable and costly (NANDI et al., 2021). These threats are generating collective efforts towards sustainable development, expanding the debate on the reconciliation between economic, social, and environmental development (BROWN; BOCKEN; BALKENENDE, 2020). Sustainable development is increasingly incorporated into the political and strategic agendas of corporations, being the focus of several studies in the literature (KAKADELLIS; WOODS; HARRIS, 2021; MACARTHUR, 2021). Considering that the concept of CE is posterior to the theoretical discussions on Sustainable Development (SD), as well as the importance of the evolution of this concept for the understanding of CE, below is a brief history of the developments of SD in the world, as shown in Figure 4.

Figure 4 - The consolidation of the concept of sustainable development in the world
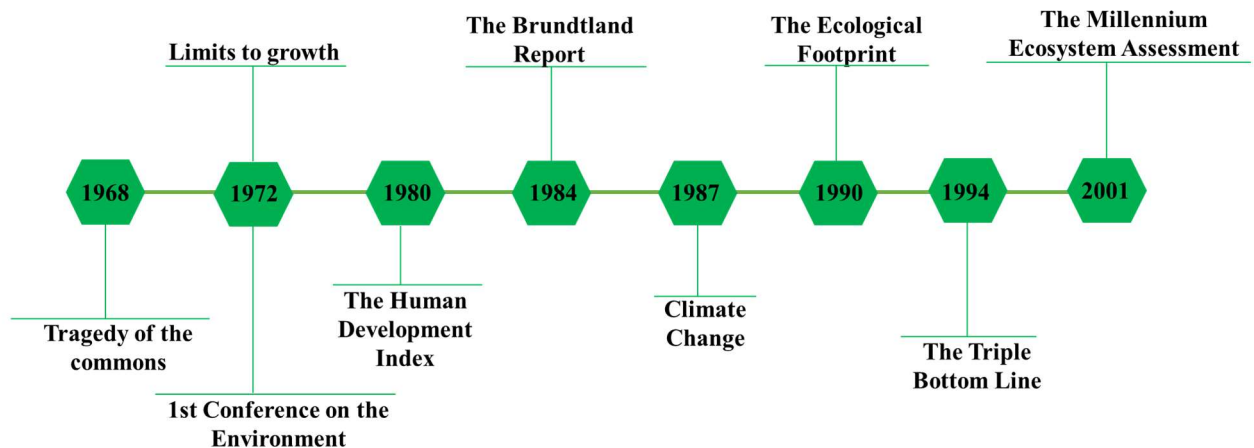


Source: Proposed by the author.

Starting in the second half of the 20th century, western society began to reflect on the relationship between human activities and environmental imbalance (KAKADELLIS; WOODS; HARRIS, 2021). Environmental and economic crises such as the American banking crisis, oil shocks, the debt of developing countries, global warming and the loss of biodiversity have erupted with devastating consequences for the planet (THACKER et al., 2019). These adversities have shown that individual actions goes against the common interests the communities, exhausting the planet's natural resources, as presented by the ecologist Garret Hardin in 1968 in the essay entitled Tragedy of the Commons (YOUMATTER, 2021). Thus, unlimited consumption of finite resources would extinguish those same resources (HUMMELS; ARGYROU, 2021). The book entitled the Limits to Growth showed that the interaction between the five dimensions - world population growth, industrialization, pollution generation, food production, and non-renewable resource depletion would cause an economic and social collapse at the end of the 21st century (MEADOWS; RANDERS; MEADOWS, 1972).

As the debates evolved, the first historical conferences were organized, such as the, Stockholm the UN Conference on the environment (FONSECA; DOMINGUES; DIMA, 2020). In addition to ensuring environmental preservation, there was a consensus for the development of integrated solutions for economic and social development, as is the case of Human Development Index (HDI) and The Ecological Footprint (FONSECA; DOMINGUES; DIMA, 2020). The ecological footprint refers to the upper limit of a person's consumption without compromising the Earth's ecological capacity (HUMMELS; ARGYROU, 2021). If society were able to keep the HDI and the ecological

footprint at acceptable levels, the planet would be on its way to a sustainable future, so that everything that is extracted will be able to regenerate itself (YOUMATTER, 2021).

In 1994 there was the rise of the concept of the triple bottom line, reconciling economic, social, and environmental development. (HUMMELS; ARGYROU, 2021). The report Brundtland (1984), also called "Our Common Future" was responsible for the consolidation of the widely accepted definition of sustainable development, considered as the human capacity to promote the development of the present without compromising future generations (KOCHAŃSKA; ŁUKASIK; DZIKUĆ, 2021). The International Panel on Climate Change was created by the UN Development Program and the World Meteorological Organization and aims raise awareness of the relationship of human activities with climate change, such as temperature increase through excessive $CO_2$ and methane production (KAKADELLIS; WOODS; HARRIS, 2021).

Environmental awareness emerges bringing important reflections on the preservation of natural resources and the condition of life of people (NANDI et al., 2021). In 2001, the Millennium Ecosystem Assessment identified that in addition to climate change, poverty is a reality affecting many communities, and that these difficulties would worsen over the 21st century (BONNET; COLL-MARTÍNEZ; RENOU-MAISSANT, 2021). In this sense, many nations have been prioritizing the search for alternatives to balance economic, social, and environmental development, being the Circular Economy (CE) is one of the best options for supporting Sustainable Development (TRÀN et al., 2022). The CE is based on the fact that planet Earth is a closed economic system, thus human activities must be based on a secure dual system. Many researches around the world propose to discuss the concept of CE, there are different ways to define it, and the most accepted definition involves the efficient use of raw materials/energy, minimizing the use of natural resources, in order to keep in circulation (use) the materials and waste (KEVIN VAN LANGEN et al., 2021; RAIHANIAN MASHHADI; VEDANTAM; BEHDAD, 2019).

The conceptual maturation on CE has been grounded in scientific studies around the world and derives from other concepts such as sustainable development (KEEBLE, 1988), industrial ecology (FROSCH; GALLOPOULOS, 1989) and cradle to cradle (ASHBY; VAKHITOVA, 2018; BLOMSMA, 2018). The regenerative system can be achieved through various strategies such as product design, material reuse, remanufacturing, and recycling (KOCHAŃSKA; ŁUKASIK; DZIKUĆ, 2021). One of the aims of the CE is to reduce/eliminate the use of non-renewable assets and to convert

waste and other materials into raw materials by providing utility to them in the value chain (GHERHEȘ; FĂRCAȘIU; PARA, 2022; KEVIN VAN LANGEN et al., 2021). The circular model is regenerative and restorative by principle, there is the substitution of the 'end-of-life' concept with restoration, adopting the use of renewable energy and eliminating the use of chemicals (KIRCHHERR et al., 2017; TRẦN et al., 2022). Figure 5 illustrates the continuous flow of technical and biological materials through the value circle.

Figure 5 - Butterfly Diagram
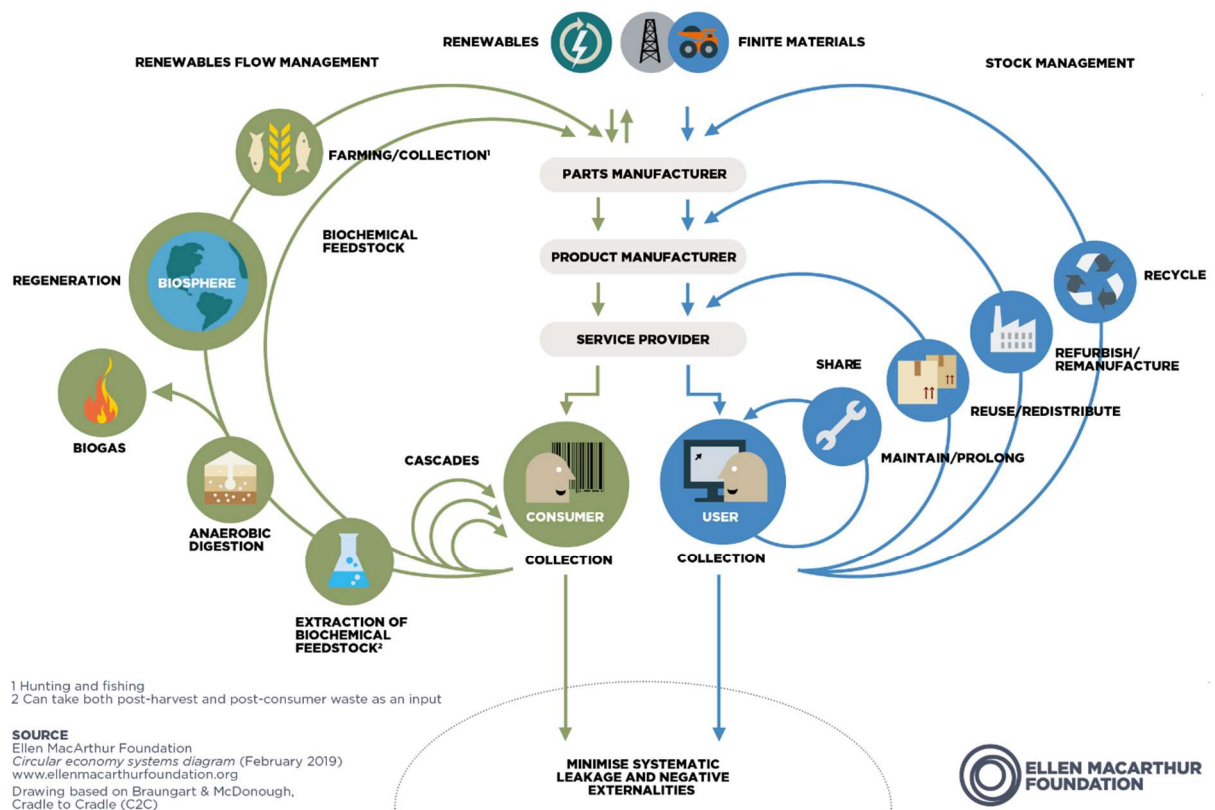


Source: Ellen Mac Arthur Foundation (2019)

The physical materials are finite, and to stay within a closed loop, some strategies are adopted such as haring, maintaining, reusing, remanufacturing, and recycling (GÜLSERLILER; BLACKBURN; VAN WASSENHOVE, 2022). The biological cycle comprises natural resources that regenerate naturally, including extraction of biochemical feedstock; anaerobic digestion, which refers to the degradation of organic matter that occurs in the absence of oxygen generating biogas and a mineral-rich liquid waste that

can be used as biofertilizer; and renewable energies, such as solar energy solar (BIANCHINI; ROSSI; PELLEGRINI, 2019). The biological and technical cycles complement each other since if the resource does not return naturally to the cycle, others closure strategies are used (VELENTURF et al., 2019).

The CE aims to decouple economic growth from resource consumption (FONSECA; DOMINGUES; DIMA, 2020). The resources that belong to the technical cycle are designed with the ability to be repaired and reused, besides having their useful life extended (LANAU; LIU, 2020). In a CE, planned obsolescence-oriented products should be replaced by more durable and reusable products. Thus, products that can no longer be repaired for their original purpose can be disassembled and their parts extracted to be used in other products (IBN-MOHAMMED et al., 2021). The assimilation of circular practices in society is influenced by global trends such as servitization, shared economy, reshaping the forms of production and consumption, impacting the construction of a more regenerative economy (LAHANE; PRAJAPATI; KANT, 2021). Thus, it highlights the importance of circular business models that expose supply chains to less risk, being a key point for poverty eradication, climate change mitigation, and economic growth (GUERRA AND LEITE, 2021).

The transition from linear economy to CE involves the participation of different stakeholders (companies, government, consumers), who must be attracted to, interested in and consequently aware of CE. Several studies in the literature have already considered environmental awareness in the business context (DUBEY et al., 2019; LIAKOS et al., 2019); from a consumer perspective (MARIOS; GIANNIS; DIMITRA, 2018) or students (CALCULLI et al., 2021). In the last decade, some studies (LAKATOS et al., 2016; SCHÄUFELE; HAMM, 2017; SMOL et al., 2018; ZOU; ZOU, 2012) proposed to assess people's environmental awareness. Our differentiator was to consider people's awareness raising without restricting our analysis to one specific stakeholder, considering five broad CE strategies.

Rather than advocating a preventive approach to production and consumption patterns, the CE proposes a shift towards a regenerative economy, which includes decoupling economic activity from the consumption of finite resources and eliminating waste from the system as a matter of principle (KEVIN VAN LANGEN et al., 2021). The CE included adaptation in all subsystems of society, and not only in production systems (CHEN; YILDIZBASI; SARKIS, 2023). Considering that CE involves a wide range of strategies and considering that this study focuses on people, it was important to delimit

the CE strategies that were prioritized to be considered in this thesis, as detailed in Figure 6.

Figure 6 - CE strategies considered in this thesis
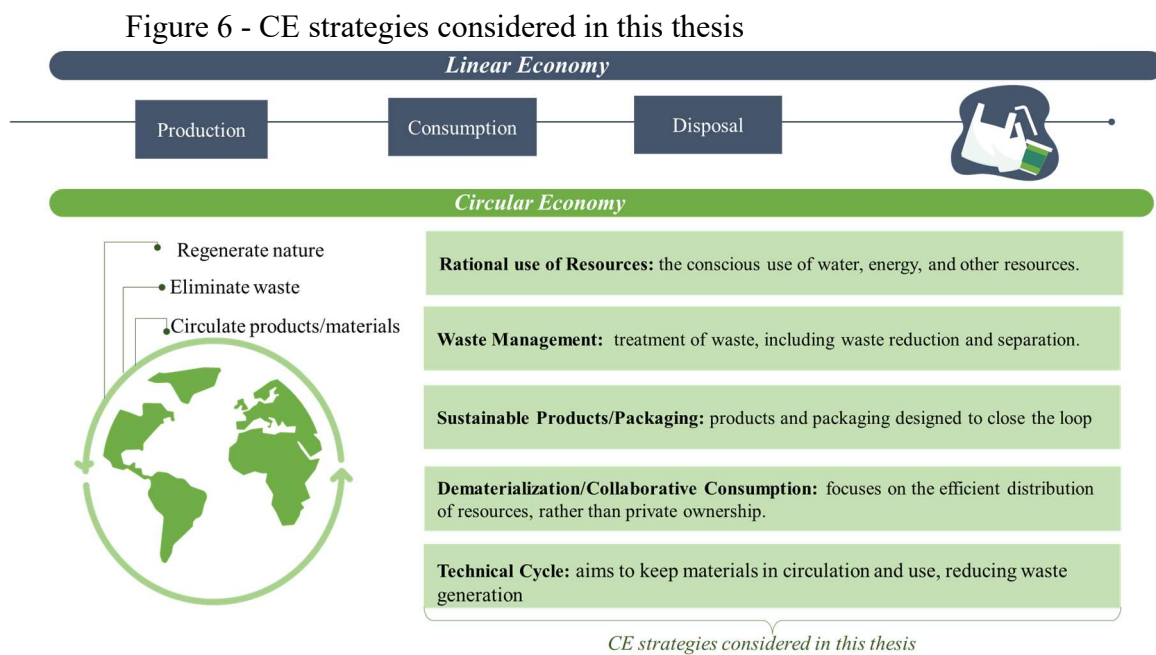


Source: Proposed by the author.

As demonstrated in Figure 6, the CE involves the principles necessary for the transformation of the linear economy into a regenerative, principle-based system: regenerate nature, eliminate waste and circulate products/materials. To reach the proposed objective, we considered CE strategies that are closer to people's reality, leaving aside other strategies that are more focused on companies and/or other actors in the supply chain.

If on the one hand production activities directly depend on the rational use of resources development on the other hand, sustainable management of these resources is an important part of economic development (KORYAKINA et al., 2021). This study considers the Rational Use of Resources refers to people's awareness of the benefits of this practice for CE principles, including saving water, energy and reducing the consumption of other resources. Waste management involves the treatment of waste such as separation (organic/recyclable), as well as waste reduction through actions such as composting and reducing the consumption of disposable products (products plastics such as cups and cutlery) (KANOJIA; VISVANATHAN, 2021).This study considers waste management from the perspective of people, including separation and reduction strategies.

The Sustainable Products and Packing are e eco-efficient and have reduced or zero carbon and plastic footprint, and are physically designed to optimize materials and energy. (CHEN; YILDIZBASI; SARKIS, 2023). This study including Environmentally certified products and Sustainable Products and Packing as important strategies for CE principles. New forms of sharing have sparked a sustainable consciousness in consumers. This trend is exemplified by websites that advertise vacation rentals (Airbnb) and transportation apps (Blablacar, Uber) (KOPNINA, 2015a). Kuah & Wang, (2020) assess consumer acceptance of three circular economy practices in East and Southeast Asia: use of sharing platforms, purchase of recycled goods, and purchase of remanufactured products. Dematerialization consists of replacing physical products and services with virtual ones (GAUSTAD et al., 2018). Many physical devices have been replaced by apps, such as reading apps, movie/series subscriptions (streaming), online shopping, and autonomous vehicles (DEV; SHANKAR; QAISER, 2020). This strategy is related to collaborative consumption, which involves obtaining, giving or sharing access to goods and services (DEV; SHANKAR; QAISER, 2020). The Technical Cycle involves actions so that no waste loses its usefulness and is not sent to landfills, that is, this waste gains a new use and returns to the supply chain (NAVARE et al., 2021). This research considers the strategies of remanufacture, reuse, repair and recycling that make up the technical cycle, as a way of contributing to the CE principles.

## 2.2 People's Awareness of Circular Economy (CE)

The advances in urbanization, industrial growth, and consumerism have led to severe environmental problems (ALMULHIM; ABUBAKAR, 2021). The driving force for the transition from a linear economy to a more circular economy lies in public awareness, since people's habits of life and consumption interfere with the sustainable dynamics of the planet (POP et al., 2022). The people are the main responsible for the environmental impacts and climate changes (JAIN et al., 2023). Thus, research oriented to people's awareness in the transition to CE becomes important for this transition to actually occur (CHOUDHARY; KUMAR, 2022).

Sustainable awareness is growing as environmental impacts become more and more present in the world (GUNARATHNE; TENNAKOON; WERAGODA, 2019). Research developed by the company ARUP and released by the California Academy of Sciences, showed that there is already a sharing economy, as young people are more willing to rent or, share products such as clothes, cars or houses (ARUP, 2016).

Consumers are more aware of how their purchasing behaviours can negatively affect the environment, giving preference to more sustainable products and services (ALONSO-ALMEIDA et al., 2020). Studies show that there is a growing number of consumers who prefer to buy sustainably remanufactured products (VENUGOPAL; SHUKLA, 2019). People already identify the added value of sustainable products and services as planet care, health improvements, or others (KUZMINA et al., 2019).

There is a gradual shift from linear economy to a circular model (CHOUDHARY; KUMAR, 2022). The literature shows a growth in the interest of research oriented towards understanding the sustainable awareness. Khan et al. (2020) and Alvarez-Risco et al. (2021), demonstrated of the predictors for companies to adopt CE practices in their business model. Afroz et al. (2013) hat assessed the public's knowledge of the impact of waste electrical equipment on people's health and the environment and willingness to pay for these products. The study by Miranda-Ackerman & Azzaro-Pantel (2017) reports people's awareness via the dissemination of eco-labels, as a sustainable supply chain strategy option. Mendoza et al. (2019) on the other hand, considered the analysis under a larger social context, assessing the public and the structure of municipalities to promote circularity in cities. However, they did not employ a comprehensive analysis of the factors that positively and/or negatively affect the level of people's awareness, considering various CE strategies.

Despite the low sustainable awareness cited by Grasso and Asioli (2020) others researches presented good prospects towards a more conscious society, such as Herbes et al. (2018), Lu et al. (2020) e Nguyen et al. (2020). Given the importance of consumers for the development of the CE, studies with this focus have been developed. A survey of 312 Norwegian consumers regarding the attributes of environmental packaging revealed that positive and negative emotions can cause effects on the intention to engage in conservation behaviours (KOENIG-LEWIS et al., 2014). Han & Yoon (2015), assess guests' intention when selecting an environmentally responsible hotel; Lakatos et al. (2016), assessed responsible consumption in promoting CE in Romania; and Borrello et al. (2017) considered consumers' willingness to engage with closed loops for food waste reduction. Similarly, research by Lease et al. (2014) assessed consumer acceptance for recycled water-based foods by considering beliefs and values that accompany environmental initiatives; and Khare, (2015) who considered environmental attitudes, personal environmental norms, social norms, and self-identity in Indian consumers' green purchasing behaviours.

There are studies that make other important contributions such as Grasso & Asioli, (2020), that analysed British consumers' preferences for new food products made with recycled ingredients and concluded that most consumers have never heard of recycled ingredients but would consider purchasing them. Focusing on consumer behaviours, Kopnina (2014) shows that consumption decisions are influenced by governments, regulatory agencies and companies, thus sustainable awareness is driven more by public actions than by individual private efforts. An example is the textile industry, which bears its share of responsibility for environmental imbalance since fast fashion paves the way for unbridled consumerism going against responsible consumption. According to Keith & Silies (2015) thousands of tons of clothes, shoes, and household items are discarded annually, and social issues such as labour exploitation are still neglected. Another study shows that individual consumer influence may be too small to promote significant change (KOPNINA, 2015a).

The literature consists of a few studies that explore variables that can relate to sustainable awareness. Prakash and Pathak (2017) confirmed that purchase intention for eco-friendly packaging is significantly influenced by personal norms, attitudes, environmental concerns, and willingness to pay. The studies by Smol et al. (2018) and Zou; Zou (2012) identified a positive correlation between the degree of awareness about the circular economy and the level of education of consumers. A similar conclusion was obtained in the study by Boesen et al. (2019) who conducted a study with young Danes.

Such evidence reinforces the need for research on people's awareness of CE. Understanding the level of awareness of people guides the course for restructuring in the ways of sustainable management by other agents in the supply chain such as government and business (YA; KONG; ZHANG, 2020). This study offers theoretical implications guiding the need for engagement between government, business, and consumers to apply alternatives that aim at a change in perception and awareness about production and consumption.

## 3. PEOPLE AWARENESS, BEHAVIORS, AND ATTITUDES TOWARDS CIRCULAR ECONOMY AROUND THE WORLD: LITERATURE REVIEW AND RESEARCH AGENDA

### 3.1 Introduction

Issues related to social and environmental development draw attention to its consequences for humanity (BOESEN; BEY; NIERO, 2019a; HOMRICH et al., 2018). A report released by the Lancet journal revealed that about 6 to 16 million people are exposed to high concentrations of lead (BENACHIO; FREITAS; TAVARES, 2020; OGHAZI; MOSTAGHEL, 2018; PRESTON; LEHNE, 2017) In addition, environmentally harmful activities are becoming greater than the capacity for absorption by the biosphere, as observed by the recurrent waste crisis faced by developing countries (JANG et al., 2020; BOESEN et al., 2019).

Pressures from consumers, governments and environmental advocacy groups have become a catalyst for changes in the production, distribution, consumption and disposal of products (Jang et al., 2020; Williams & Rangel-Buitrago, 2019). Considering the limitations of the linear production model, changes that challenge the current situation need to be made, in which the circular economy is a viable alternative for the transition process (ANDRETTA et al., 2018; BENACHIO; FREITAS; TAVARES, 2020; LAURENTI; MARTIN; STENMARCK, 2018).

Aiming to reconfigure the idea of "disposal" through changes in production, distribution and consumption strategies, the circular economy guides its results towards social and economic equity (GRASSO; ASIOLI, 2020; SMOL et al., 2018a). Strategies towards a circular production and consumption model generate new business opportunities, saving material costs, mitigating price volatility and sustainably inserting products/returns in supply chains (BENACHIO; FREITAS; TAVARES, 2020; OGHAZI; MOSTAGHEL, 2018). The circular economy (CE) is considered as an alternative replacing the old economic model "take-make-dispose" with a regenerative economic model (GAUSTAD et al., 2018; KALMYKOVA; SADAGOPAN; ROSADO, 2018a). The "ReSOLVE" structure contains the central principles of circularity, which culminate in six actions: Regenerate, Share, Optimize, Loop, Virtualize and Exchange (DEV; SHANKAR; QAISER, 2020; PRESTON; LEHNE, 2017).

Transition to the circular economy must be initiated by a change in paradigms and behaviors, supported by circular business models that have adherence through the links of supply chains, including companies and people (DE FERREIRA; FUSO-NERINI,

2019; EBERHARDT; BIRGISDÓTTIR; BIRKVED, 2019). Smol et al. (2018) emphasize that people's behavior is a significant factor in the transition from the linear to circular economy.

Considering the accelerated growth of the world population, there is an increasing need to address consumer behavior and attitudes through the consumption of global resources (LAKATOS et al., 2018). Behaviors and lifestyles play a fundamental role in achieving sustainable development (GUO et al., 2017b). Consumers, whether individuals or organizations, are the recipients of products and services necessary for human or business livelihoods. Kumar & Putnam (2008) affirm that the lack of awareness is noticeable concerning the value of the product for preserving the environment. Thus, the purchase profile and the level of awareness are central issues in sustainable development (PETRY et al., 2011). Thus, the importance of studies aimed at understanding people's awareness, behavior and attitudes regarding the CE is reinforced.

There are already surveys around the world that focus on this issue. The study by Lu et al. (2020) for example, concluded that people have a low degree of recognition for new materials for sustainable packaging. Wikström et al. (2019) claim that there is no evidence regarding consumers' perception of green packaging, especially in emerging markets. A study carried out by Lu et al. (2020) concluded that sustainable products can boost new businesses, which in turn can influence consumers' buying attitudes. Borrello et al. (2017) state that little is known about people's willingness to participate in the circular economy. Although there are studies addressing the topic, the literature lacks an overview of results achieved from this research. Thus, the research provides an overview of the state-of-the-art concerning the awareness, behavior and attitudes of people around the world in relation to the circular economy. Understanding people's needs and disposition towards circular practices in an integrated way is a step towards restructuring the forms of sustainable management in companies. Thus, there can be a contribution to the correct allocation of resources and the generation of sustainable opportunities that appeal to people (FARACA; TONINI; ASTRUP, 2019; SORKUN, 2018).

Therefore, our article presents the following contributions: first, it presents an overview of the main studies that address the degree of awareness, behavior and attitudes of people towards CE around the world; second it introduces a compilation of the main dimensions that can be translated into circular practices adopted by people; third, it maps out the main barriers, as well as the mitigation strategies for the transition to a more

circular economy; in addition to categorizing the behavioral perspective adopted by each study and mapping the theories used as the basis for the studies.

This research was carried out considering this contribution, aiming to boost the state-of-the-art regarding research around the world that addresses the degree of awareness, behaviours and attitudes of people regarding the circular economy. In this context, Albuquerque et al. (2019) indicate that future research must consider the development of innovative collaborations between different agents in the value chain. This will be done through a systematic literature review, following the steps of Tranfield et al. (2003). A scope review was carried out that shed light on the development of the following research questions:

Q1. What is the understanding of the circular economy construct for existing studies? In other words, what are the constructs and strategies of the circular economy analysed in the studies?

Q2. Under what behavioural perspective (consumers, people/public, managers, students) is the individual analysed?

Q3. What are the main theories that support people's behaviour towards the circular economy?

Q4. What are the main results of research on the awareness, behaviour and attitude of people around the world towards the circular economy?

Q5. What are the barriers that must be overcome for greater awareness, behaviour and attitudes of people around the world towards the circular economy?

The work structure is as follows: Section 1 comprises the introduction and research questions; Section 2 provides a description of the research method, which includes details about the method used to select the literature and all the stages involved in selecting and systematization the articles. The fourth section presents the main results derived from the research and its applications.

## 3.2 Research Method

The method used was the Systematic Literature Review, which uses sequential steps for selection and systemic analysis of articles (TRANFIELD; DENYER; SMART, 2003). In order to guarantee the reliability of the method, the present research is guided by existing studies in the literature that use this method, such as Lima et al. (2018) and Thomé et al. (2016).

**3.2.1 Review planning and problem formulation**

The literature indicates a growing interest in approaching the circular economy, focusing on definitions (CORONA et al., 2019; KIRCHHERR et al., 2018), strategies (KALMYKOVA; SADAGOPAN; ROSADO, 2018a; ROSADO; KALMYKOVA, 2019) and practices (PRIETO-SANDOVAL; JACA; ORMAZABAL, 2018) with different approaches. The present work focuses on the systematization of works that investigated the level of awareness, behaviour and attitude adopted by people towards a more circular and less linear economy, which includes changes in patterns of purchase, consumption and daily behaviour. presents the systematic review protocol, as well as a summary of the main steps used in the method.

Figure 7 - Systematic review protocol

| Problem Planning and Formulation | Literature Research | Codification and Systematization | Data Analysis, Synthesis and Interpretation |
|---|---|---|---|
| **Purpose:** to boost the state-of-the-art regarding research around the world that addresses the degree of awareness, behaviors and attitudes of people in relation to the circular economy. **Data base:** Web of Science and Scopus **Strings:** ("Circular economy") AND ("public awareness") OR ("compan* readiness") OR ("circular economy strategy") OR ("cradle to cradle") OR ("circular economy implementation") OR ("circular economy development") | Conducting the research inclusion/ exclusion criteria | Reading Review Systematization (Software Mendeley) | Bibliometric Analysis Content Analysis (Nvivo Software) |

Source: prepared by the authors

The definition of search strings was based on a scope review and other systematic reviews on the topic (BENACHIO; FREITAS; TAVARES, 2020; KIRCHHERR et al., 2018; PRIETO-SANDOVAL; JACA; ORMAZABAL, 2018). The circular economy appropriates knowledge from various other environmental fields, such as "green economy"(MADZIVIRE et al., 2019),"industrial symbiosis"(NASIRI et al., 2018) and "reuse"(DENSLEY TINGLEY; COOPER; CULLEN, 2017). However, it was decided not to include similar concepts, directing the focus to studies that address the circular economy with a focus on raising awareness of people/public.

In order to answer the research questions and map the situation of the literature on people's behavioural perspective, this review focused on empirical research on people's

awareness, behaviours and attitudes towards the circular economy, excluding theoretical articles such as systematic reviews.

### 3.2.2 Literature Research

The research stage in the literature involves conducting the review and defining the inclusion and exclusion criteria. According to the research objectives, it was decided to select studies that had circular economy analysis in their scope from the perspective of people, whether in the position of consumers, users, suppliers or managers.

The research was carried out in the Scopus and Web of Science databases. A time frame was not delimited, given the relatively contemporary character of the circular economy theme. Therefore, the selection of articles published in journals was delimited, excluding articles from events (proceeding papers), resulting in a total of 165 documents in the Scopus database and 180 in the Web of Science. The choice of these bases is based on the scope of scientific articles and journals of high impact for the academic community, having the largest database of abstracts and citations reviewed by peers (BRZEZINSKI, 2015).

After selecting the articles in the respective databases, the extension files were downloaded in Bibtex format and imported into the Mendeley bibliographic reference monitoring software. Importing the files into Bibtex format enabled us to identify 110 files in duplicate, totaling 235 articles.

Figure 8 - Steps of the methodological procedure for selecting the papers
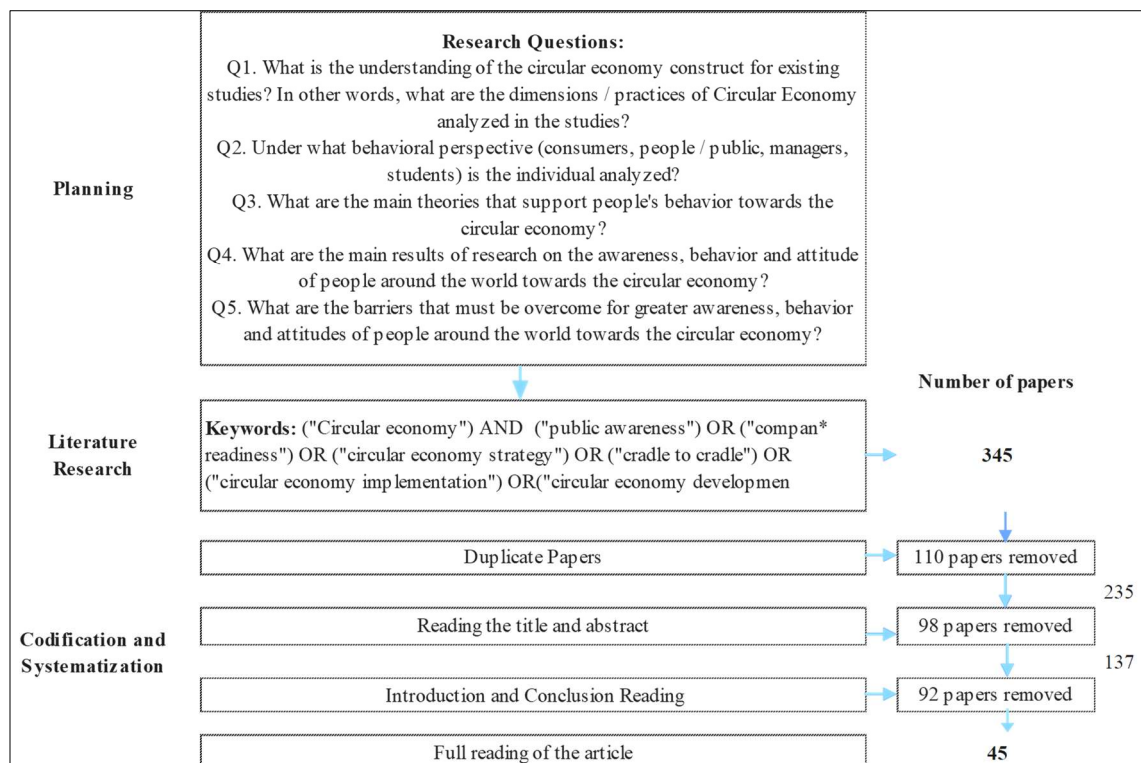


Source: prepared by the authors

### 3.2.3 Coding and systematization

In order to classify and systematize the articles, they were imported into the Nvivo software and codifications were created that led to grouping a set of key information to achieve the objective of this research. This qualitative analysis tool selects the codes, ensuring greater efficiency in the analysis of the results (ALAM, 2020). The codes were created according to the research questions, assigning encodings to different sections. Such coding facilitated the organization and interpretation of the final results (OZKAN, 2004).

### 3.2.4 Data analysis, synthesis, and interpretation

We adopted content analysis, following Tranfield et al. (2003) as a method to facilitate the grouping and interpretation of important information to answer research questions. In order to validate the review, three experts reviewed the coding and grouping of key information, judging the relevance of the coding and its relationship to answer research questions.

The codes were created according to the research questions. Thus, the codification process followed the orientation of the questions, which facilitated the organization and interpretation of the data.

## 3.3 Results

### 3.3.1 Circular Economy constructs and strategies analyzed in studies

This section presents the understanding of the circular economy construct for systematic studies. To do this, we classified the studies into two main constructs: (i) construct related to awareness of the circular economy and, (ii) construct related to behaviors and attitudes towards circular economy. Each of these two constructs comprises circular economy strategies, as shown in Table 2.

Table 2 - Dimensions and strategies of the CE

| CE Strategy | Description | References |
|---|---|---|
| CE understanding | CE development consists of government, enterprises, and the public, and awareness for promoting CE; | 62;92;25;83;82 |
| Environmental Awareness | Environmental awareness is a vital precondition for responsible consumer behaviour; | 78;30;2;1;27;57 |
| Buying recycling product | Buying recycled products that go through the process of collecting, disassembly, separating them into categories, and processing them as recycled materials. | 78;22;39;26;47;10;51;75;62;25;73;72;27;30;9;15;79 |
| Energy conservation | Energy saving is the effort made to reduce energy consumption using less than one energy resource. | 67;82;57;25;27;30;15;55 |
| Using sustainable packaging | Sustainable packaging is manufactured, transported and recycled using renewable energy, clean production technologies and best practices, and is physically designed to optimize materials and energy | 52;38;33;62;27;9;55;57 |
| Waste separation | Waste sorting can occur manually or automatically separating facilities or mechanical biological treatment systems. | 29;52;22;82;25;66 |
| Water saving | The purchase and utilization of water saving products, as well as regenerated products are encouraged in order to reduce waste generation and pollution emission. | 66;52;49;25;15;55 |

| | | |
|---|---|---|
| **Participate in shared economy** | In the sharing economy, the participants engage in sharing activities in the form of renting, lending, trading, bartering, and swapping goods, services, transportation solutions or space. Green products include buying recyclable materials, reducing water use, renewable energy and replacing chemical or toxic inputs. | 51;41;46;73;15;55;44 |
| **Buying green products** | Green products include purchase of recyclable materials, reduction of water use, renewable energy and replacement of chemical or toxic inputs. | 52;82;32;62;27 |
| **Reuse/Upcycling** | Reuse/giving new value to materials that are either discarded, or are not being used anymore. | 35;25;51;27;30 |
| **Buying waste- to-value (WTV) food** | Waste- to-value (WTV) food refers to the process that transforms excess residues or ingredients, obtained during the production of other foods, into other foods with greater nutritional properties. | 15;7;23;13 |
| **Buying remanufactured product** | Buying used products that go through the remanufacturing industrial process. | 73;44 |
| **Waste reduction** | Waste management include ecopoints, house waste treatment, incineration, and digitalization of the separation system. | 51;15;55 |
| **Using sustainable transport** | The broad theme of sustainable transport in the sense of social, environmental and climate impacts. | 67;15;55 |

| CE Strategy | Description | References |
|---|---|---|
| **Buying a product as a service** | Servitization is the concept of selling services instead of the product itself. | 60;78 |
| **Using Shopping Bags** | In order to mitigate the negative impacts caused by plastic, sustainable shopping bags are an alternative; | 82;24 |
| **Buying products with circular design** | Circular design is about creating products and services that no longer have a lifecycle with a beginning, a middle and an end. | 60 |
| **Buying labeled products** | Eco-labels and Green Stickers are labelling systems for food and consumer products. | 20 |
| **Buying second-hand product** | A second-hand item means that they can get a still-functioning product for a fraction of the price. | 44 |
| **Product's repair** | Bring damaged components back to a functional condition and prolong a product's life as it preserves the current state, energy and materials; | 46 |
| **Waste food reduction** | Waste generated during late stages of food supply chains, especially during marketing and consumption, are considered food waste | 10 |
| **Virtualize** | Digitization is the conversion of analog or physical products to digital resources. | 55 |

Source: prepared by the authors

Awareness of the various agents involved in the flow of products and services, which includes development, production, commercialization, consumption and disposal, is essential for closing the cycle in an economy oriented to circularity (SMOL et al., 2018b). The literature that analyses the degree of knowledge about CE basically evaluates this through two dimensions: (a) people's understanding of the concept of circular economy and/or, (b) people's knowledge of the general concept of sustainability.

It is widely accepted that people's choices, behaviours and lifestyles will play a critical role in achieving sustainable development (GUO et al., 2017). Attitude refers to the intention to behave in a certain way or a person's view of something and is influenced by past experiences. Behaviour is the result of attitude, resulting in the individual's rational choices, actions, conduct (AJZEN, 1991). Thus, a consumer, manager or student may become involved with these strategies, helping to close the cycle through an attitude that can transform into behaviours oriented towards the CE.

Regarding the behaviours and attitudes towards the CE, we found 20 CE practices that are used to measure people's behaviour and attitudes. Eight practices are mentioned at least in 5 different references. They are "Buying recycling product", "Waste separation", "Energy conservation", "Using sustainable packing", "Water saving" "Participate in shared economy", "Buying green products", "Reuse/Upcycling". Buying recycling products was the most recurrent strategy related to the construction of the circular economy. Waste separation and Recycling activities contribute to the reduction of emissions from production, in addition to putting materials into circulation in the supply chain, reducing waste generation (LIU et al., 2009). Research conducted by Guo et al. (2017) concluded a significant growth in the electronic recycling rate in a municipality in China. This behaviour was driven by a government program called "buy a new one with a used one", which encouraged the return of devices for recycling. To ensure high rates of e-waste collection, it is important to ensure consumer participation (RIBIĆ; VOĆA; ILAKOVAC, 2017). Therefore, co-regulation actions and agreements need to be promoted financed by the sector, government policies, awareness-raising marketing, economic incentives and selective collection facilities in public places such as shopping canters (KUAH; WANG, 2020).

Consumer behavior reflects a conscious decision by individuals not to engage in consumer activities that harm the environment, which shows the importance of raising people's awareness to implement circular strategies through behaviors (BOESEN; BEY; NIERO, 2019b). Many authors have listed energy conservation and water preservation as

a strategy that can influence circular behaviors, such as Guo et al. (2017) who detected a high awareness of people in terms of energy saving.

In addition to energy conservation, "Using sustainable packaging" was a strategy analyzed by several studies. The role of packaging and its environmental information is increasingly important to develop awareness and influence consumer behavior (JERZYK, 2016). Sustainable packaging must follow biological and technical cycles. Materials in the biological cycle must be returned to the soil by composting or anaerobic digestion, while materials in the technical cycle are designed to be recovered in order to reduce the amount of waste (NGUYEN et al., 2020).

The shared economy is a growing strategy, and is analyzed by seven articles. It is an economic model based on collaborative consumption and the activities of sharing, exchanging and renting goods (DE FERREIRA; FUSO-NERINI, 2019). The CE is based on the sharing economy, that is, obtaining, giving or sharing access to goods and services (MENDOZA; GALLEGO-SCHMID; AZAPAGIC, 2019). In the article by Smol et. al (2018), respondents indicated that half of them use sharing services such as BlaBlaCar and Uber, in addition to negotiating the rental of houses directly from owners, such as Airbnb and Couchsurfing. The research by Kuah & Wang (2020) demonstrated that Asian consumers resist participating in shared platforms due to a lack of confidence as this business model often does not fit perfectly into traditional legal categories (for example, contracts, guarantees, invoice, etc.). Given this context, some companies are committed to building and validating trusting relationships, increasing the identity of customers and suppliers, such as Airbnb that added identity verification to its platform providing more transparency (KUAH; WANG, 2020).

Buying green products, Reuse/Upcycling are strategies that are in the scope of activities of modern customers. Green products include purchasing recyclable materials, reducing water use, renewable energy and replacing chemical or toxic inputs, contributing to circularity.

It is interesting to notice that there is a large amount of CE strategies mentioned in the literature. For example, Kalmykova et al. (2018) identified 45 CE strategies. Despite there being several CE strategies, our literature review identified only 22 strategies that were studied in the context of people's awareness, behaviour and attitudes. This shows that there is a clear gap concerning the study of other CE strategies in the context of people awareness, behaviours, and attitudes.

**3.3.2 Behavioral perspective of the CE**

People´s awareness about sustainable approaches, whether as consumers or producers, implies changes in the daily decisions of livelihoods (NGUYEN et al., 2020). Individuals have multiple roles in society, as well as responsibility in the search for more regenerative living standards (PETRY et al., 2011). The study conducted by Smol et al. (2018) showed that 79% of consumers interviewed stated that the principles of the circular economy can be applied to their daily lives. To understand the degree of implementation of circular economy strategies/practices, it was analysed from which behavioural perspective these studies were considered. That is, what position do these agents occupy (consumers, people, managers, students) in the search for a more circular economy, as shown in Table 3.

Table 3 - Analysis of the behavioural perspective

| Authors and Year | Consumers | Public/People | Managers | Students |
|---|---|---|---|---|
| Roozen & De Pelsmacker (2000) | X | | | |
| Huang et al. (2006) | | X | | |
| Geng et al. (2009) | | X | | |
| Liu et al. (2009) | | X | | |
| Xue et al. (2010) | | | X | |
| Petry et al. (2011) | X | | | |
| Jang et al. (2011) | X | | | |
| Ahn et al., (2012) | | | | X |
| Park & Sohn (2012) | | X | | |
| Kopnina (2013) | | X | | |
| Tu et al. (2013) | X | | | |
| Afroz et al. (2013) | | X | | |
| Kopnina (2014) | X | | | |
| Koenig-Lewis et al. (2014) | X | | | |
| Lease et al. (2014) | X | | | |
| Keith & Silies (2015) | X | | | |
| Kopnina (2015a) | | X | | |
| Kopnina (2015b) | X | | | |
| Han & Yoon (2015) | X | | | |
| Khare (2015) | X | | | |
| Jerzyk (2016) | X | | | |
| Lakatos et al. (2016) | X | | | |
| Guo et al., (2017) | | X | | |
| Prakash & Pathak (2017) | X | | | |
| Ribić et al. (2017) | | X | | |
| Tesfaye et al. (2017) | X | | | |
| Borrello et al. (2017) | X | | | |
| Liu et al. (2017) | | | | X |
| Wang & Kuah (2018) | X | | | |
| Husgafvel et al. (2018) | | | X | |
| Smol et al., (2018) | X | | | |
| Singh et al., (2018) | | | X | |
| Lakatos et al. (2018) | X | | | |
| Herbes et al. (2018) | X | | | |
| Mendoza et al. (2019) | | X | | |
| Ferreira & Fuso-Nerini (2019) | | | X | X |
| Boesen et al. (2019) | X | | | |
| Coderoni & Perito (2020) | X | | | |
| Witzel & Peschel (2019) | X | | | |
| Schoden et al. (2020) | | X | | |
| Kuah & Wang (2020) | X | | | |
| Grasso & Asioli (2020) | X | | | |
| Lu et al. (2020) | X | | | |
| Nguyen et al. (2020) | X | | | |

Source: prepared by the authors

The analysis of the behavioural perspective can be observed according to two categories of work. The first strand focuses efforts on a single category of people. In this case, we focus on (a) consumers; (b) public; (c) managers; (d) students. The second category guided the analysis based on a double vision, including (c) managers and (d) students.

As shown in Table 3, more than half of the selected articles analysed awareness, behaviours and attitudes from the perspective of consumers. Consumers are agents who can drive or discourage actions, strategies and behaviour towards a circular economy. For example, in the study by Tesfaye et al. (2017) electronics recycling is emphasized from the consumers' point of view, since this type of recycling requires a high level of consumer awareness as they are responsible for returning waste to the appropriate collection canters. Similarly, research by Wang & Kuah (2018) addresses the consumption values of consumers, their purchase intention and their perceptions of quality and risk in remanufactured electronic devices. The study by Tu et al., (2013) revealed that the attitude of consumers towards the environment can improve green consumption. Roozen & De Pelsmacker (2000) evaluated the importance of ecological products from the perspective of Polish and Belgian consumers, concluding that consumers' perceptions about ecological purchasing, use and disposal of sustainable products are not always translated into behaviours.

In addition to the analysis from the perspective of consumers, eleven studies directed the analysis to people or the general public, as represented by Huang et al., (2006), Geng et al., (2009) and Kopnina (2013), who considered the public's awareness and willingness to pay for ecological products. Huang et al. (2006) analysed public awareness and performance in promoting the circular economy from the following perspectives: attitude towards garbage collection, sharing, and ecological purchasing behaviour. It is worth mentioning that people's behaviour can be influenced by socio-environmental norms that affect the environmental behaviour of individuals, as shown in the work of Park & Sohn (2012). The analysis from the public's perspective addresses everyday behaviours that can cause progress in the circular economy, such as waste separation and reuse. Guo et al. (2017) concluded that there was an increase in people's engagement in the separation of waste from 2008 to 2013, which reveals a temporal progress in the assimilation of circular practices. In addition, more than 94% of respondents reused water and more than 80% used sustainable light bulbs (Guo et al., 2017). Thus, people's level of engagement has a direct impact on the efficiency of a waste collection system, as presented by Ribić et al. (2017).

In addition to the analysis from the perspective of consumers and people, five studies considered behavioural analysis from the perspective of managers, as idealistic and enthusiastic

managers with circular practices positively influence sustainable initiatives, catalysing a more efficient transition to CE (HUSGAFVEL; LINKOSALMI; DAHL, 2018). Research conducted by Xue et al., (2010) showed that although most employees are aware of and understand the concept of the circular economy, about 16% of respondents said they did not know the term. Liu et al., (2017) considered the willingness of the construction worker to reduce waste based on the theory of planned behaviour, while Singh et al. (2018) studied managers of micro and small manufacturing companies in India.

Three studies carried out the analysis from the perspective of students, such as Ahn et al., (2012); Liu et al., (2017) and Ferreira & Fuso-Nerini (2019). Ferreira & Fuso-Nerini (2019) approached the analysis from the perspective of students and managers. Our study investigated the awareness of the CE, as well as an understanding of its meaning and benefits for students and managers at the University of Manchester.

### 3.3.3 Main theories that underpin people's behavior towards the CE

People are more aware of environmental problems, which have a direct impact on actions and purchasing behavior and lifestyle. The literature points out that environmental awareness is a vital precondition for the behavior of environmentally responsible consumers (HAN; YOON, 2015). Thus, studies are based on theories that support people's behavior towards a more CE.

Despite the existence of motivators that encourage people to adopt sustainable behaviors, the level of awareness can still be improved. The study conducted by Smol et al., (2018) revealed that a small portion of consumers believe that people are responsible for the applicability of the circular economy by reducing consumption. To better understand the interaction of these motivators, Table 4 was made, which presents the main theories that support people's behavior towards the CE.

Table 4 - Theories that support people's behaviour towards the CE

| Authors and Year | Theory | | | | | |
|---|---|---|---|---|---|---|
| | Theory of planned behavior | The theory of reasoned action | The theory of the postmaterialist values | Model of altruistic behavior | Utility theory | Ecological modernization theory |
| Park & Sohn (2012) | | | | X | | |
| Ahn et al., (2012) | | | | X | | |
| Kopnina (2013) | | | X | | | |
| Koenig-Lewis et al. (2014) | | X | | | | |
| Kopnina (2014) | | | X | | | X |
| Han & Yoon (2015) | X | | | | | |
| Khare (2015) | X | X | | | | |
| Prakash & Pathak (2017) | | X | | | | |
| Liu et al. (2017) | X | | | | | |
| Singh et al., (2018) | X | | | | | |
| Lu et al. (2020) | | | | | X | |

Source: prepared by the authors

The theory most used to explain people's behavioural interactions was the theory of planned behaviour. The theory of planned behaviour takes into account conditions that guide people's attitudes according to the following constructs (Liu et al., 2017): (a) Attitude; (b) Perceived Power; (c) Subjective norms; (d) Social norms; (e) Behavioural intention; and (f) Perceived behavioural control. Han & Yoon, (2015) proposes an expansion of TPB including 4 more variables (environmental awareness, perceived effectiveness and ecological behaviour and reputation) in explaining people's behaviour towards the CE.

Khare (2015) investigated green purchasing behaviour, based on the Theory of reasoned Action (TRA) and the Theory of Planned Behaviour (TPB). TRA argues that behaviour is a function of behavioural intention. Thus, conditions such as pro-environmental beliefs, environmental awareness and purchasing behaviour are influenced by past experiences, social norms and environmental awareness. The theory of planned behaviour examines the relationships between personal, social norms and beliefs of individuals in relation to ecological attitudes. In the study by Prakash & Pathak (2017), the TRA served as a framework to identify the main antecedents of the behaviour of packaging with ecological design and to determine its relative importance. This theory is formed by variables that can influence the purchase intention, which are: attitude, environmental concern, personal norms, willingness to pay. The individual's attitude has a positive impact on his behavioural intention. Thus, consumers who adopt positive attitudes towards ecological products are more willing to buy them. Personal

norms refer to the moral will to adopt altruistic and ecological behaviour and are related to the purchase of ecological products. The environmental concern refers to people's awareness of environmental impacts, as well as their willingness to adopt more sustainable behaviours, such as pro-environmental purchasing behaviour (PRAKASH; PATHAK, 2017). The study by Koenig-Lewis et al. (2014) also uses this conceptual basis and explains that people are rational when systematically using the available information and recognizing the importance of social influence in the rationality of individuals.

Another theory addressed in the articles was the Theory of the postmaterialist values, which uses the hierarchy of human needs proposed by Maslow. In this context, the theory reveals that people with higher socioeconomic status tend to be more concerned with the consumption of sustainable products, while the opposite would be true for people with lower socioeconomic status. According to this theory, as soon as all basic needs have been met, people will start to worry about more complex problems such as environmental conservation (KOPNINA, 2013).

Kopnina (2014) uses the Postmaterialist values theory and Ecological modernization theory as a conceptual basis. These theories express a relationship between a nation's wealth and its sustainable development. According to these theories, during the initial development process, economies exploit resources intensively until a stage is reached where their economic development allows the use of renewable and more sustainable materials (KOPNINA, 2014).

According to the altruistic behaviour model, the question is to convince people to follow sustainable standards (PARK; SOHN, 2012). This theory explains that an environmentally desirable behaviour comes from social norms, that develop personal norms and that guide sustainable behaviours. In addition, personal norms represent the attitudes and values of a group of people and are grouped into two categories: injunctive; and descriptive social norms. Injunctive norms refer to normative postulates, such as rules and beliefs that must be followed by people. while descriptive social norms guide a group of people and provide evidence about other people's behaviour (AHN; KOO; CHANG, 2012).

Another theory used to support people's behaviour towards the circular economy was the utility theory. In this theory, the consumer chooses only the option when the utility of the option is greater than that of other options. For example, when deciding how to spend a fixed amount, individuals buy the combination of goods/services that give them the most satisfaction, that is, people can consistently order their choices, depending on their preferences (LU et al., 2020).

**3.3.4 The main results regarding the degree of awareness, behaviour and attitudes of people around the world towards the CE**

The awareness of consumers in relation to the purchase of products and the possible environmental impact caused by them is an important condition for the development of the circular economy. On the other hand, consumers should be considered more sensitive to price and who are not willing to pay more for a sustainable product (KOPNINA, 2014). The study by Nguyen et al., (2020) showed that for the consumer, ecological packaging must be visually attractive and satisfy the environmental attributes in relation to packaging materials and the manufacturing process. Russell et al., 2019 classify awareness on a set of social factors in the implementation of circular economy practices.

Awareness relates to variables such as leadership, coordination, appeal and media influence, considered essential for the implementation of circular initiatives (PETRY et al., 2011). Given this context, Table 5 was prepared, which summarizes the main results of studies that explored the degree of awareness, behaviours and attitudes of people around the world towards the CE. For this purpose, the studies were classified as low, medium, or high degree of awareness, behaviours, and attitudes towards the circular economy. This classification was adopted based on the maturity of the circular economy addressed in the research results. Thus, the conclusion regarding the degree of awareness, behaviour, and attitudes towards the circular economy was adopted based on the results and conclusions of the articles. This analysis allows a general interpretation of the degree of awareness cited in the articles, however, it has limitations in terms of comparative analysis between countries, since most studies are carried out in specific regions, which makes it more difficult to generalize.

Table 5 - Degree of awareness of the CE by people

| Authors and Year | Country | Degree of awareness, behaviour and attitudes towards CE | | | |
| | | Low | Medium | High | An overview of the results |
| --- | --- | --- | --- | --- | --- |
| Geng et al. (2009) | China | | | X | Dailan citizens are relatively more environmentally conscious compared to other Chinese cities. |
| Ferreira & Fuso-Nerini (2019) | UK | | | X | There is a lack of awareness and understanding of the CE between staff and students at the University of Manchester |
| Herbes et al. (2018) | Germany, France, USA | | | X | Circular strategies such as packaging recycling are considered mature in western countries |
| Koenig-Lewis et al. (2014) | Norway | | | X | The results indicated that Norway has a high level of environmental awareness |
| Huang et al. (2006) | China | | X | | About 70% and 80% of respondents are interested in environmental improvement and are willing to buy environmentally friendly products, respectively. |
| Petry et al. (2011) | Netherlands | | X | | Consumers reflect on quality of life goals and the levels of consumption needed to achieve these in sustainable ways |
| Prakash & Pathak (2017) | India | | X | | Indian consumers are concerned with sustainability. In addition, morale and responsibility are important factors in influencing purchasing decisions. |
| Jang et al. (2011) | USA | | X | | The study revealed that generation Y cares about the consumption of ecologically healthy foods. |
| Han & Yoon (2015) | USA | | X | | Despite the gradual increase in public awareness of environmental problems, many individuals are not actively involved in ecological behaviour |
| Roozen & De Pelsmacker (2000) | Poland and Belgium | | X | | The biodegradability was considered the most important factor by consumers. |
| Jerzyk (2016) | Poland and France | | X | | More educated and younger consumers are more aware about ethical issues in their purchasing choices. |
| Smol et al., (2018) | Poland | | X | | The Circular Economy is known to the younger population, who are familiar with behaviours such as separating waste and buying recycled/remanufactured products. |
| Ahn et al., (2012) | South Korea | | X | | Despite the positive level of awareness, the study showed that awareness is not enough to transform personal norms into circular behaviours. |
| Lakatos et al. (2016) | Romania | | X | | Consumers have a positive attitude towards the importance of environmental protection, in general. |
| Borrello et al. (2017) | Italy | | X | | There is potential participation of consumers in closed loops inspired by the principles of CE. |
| Coderoni & Perito (2020) | Italy | | X | | 56% of respondents stated that they were willing to buy waste to-value (WTV) food. |
| Lease et al. (2014) | Australia | | X | | Australian consumers are likely to try foods that contain recycled water as long as they pass all required health standards |
| Mendoza et al. (2019) | Portugal | | X | | The sectors analysed in the study demonstrated initiatives towards the CE. |
| Liu et al. (2009) | China | X | | | Residents have limited awareness and a low understanding of CE programs. |
| Xue et al. (2010) | China | X | | | The research revealed that there are still doubts about the real applicability and meaning of CE. |
| Guo et al. (2017) | China | X | | | The survey revealed that only 41% of respondents know the concept of CE, which shows a limited degree of awareness about the concept. |
| Liu et al. (2017) | China | X | | | Although workers have a sense of waste reduction, this reduction behaviour is rarely seen in practice. |
| Lu et al. (2020) | China | X | | | Consumers have a less evident preference for material improvements for sustainable packaging |
| Kopnina (2013) | Netherlands | X | | | People only adopt ecological attitudes if this action saves money or time, increases comfort or confers some value, or social recognition, revealing low awareness. |

| Kopnina (2014) | Netherlands | X | | | The study demonstrated a low awareness of the Dutch associated with a lifestyle not conducive to the development of the CE. |
| Kopnina (2015a) | Netherlands | X | | | Despite low awareness, the Netherlands is able to maximize its circular capacity. |

| Authors and Year | Country | Degree of awareness, behaviour and attitudes towards CE | | | |
| | | Low | Medium | High | An overview of the results |
| --- | --- | --- | --- | --- | --- |
| Kopnina (2015b) | Netherlands | X | | | The new forms of sharing have awakened a sustainable awareness in people, but there is much to be improved in relation to people's awareness. |
| Khare (2015) | India | X | | | Green products are gaining attention from Indian consumers, however their level of awareness is still low. |
| Singh et al., (2018) | India | X | | | There is still much progress to be made in relation to the diffusion of the CE. |
| Park & Sohn (2012) | South Korea | X | | | The study found that there is a long way to go to achieve greater progress in reaching sustainability for people. |
| Grasso & Asioli (2020) | UK | X | | | There is heterogeneity in consumers, revealing that there is no mature awareness about CE. |
| Lakatos et al. (2018) | Romania | X | | | Consumers do not intend to adopt consumption practices and patterns based on the CE. |
| Tesfaye et al. (2017) | Finland | X | | | There is a low level of involvement of people with recycling due to an inadequate waste management system. |
| Husgafvel et al. (2018) | Finland | X | | | There is a need for greater awareness and capacity building to promote more proactive approaches to advancing a CE. |
| Boesen et al. (2019) | Denmark | X | | | A positive attitude towards sustainable packaging was identified. Consumers showed interest in the search for innovation in ecological packaging design. |
| Witzel & Peschel (2019) | Denmark | X | | | Danish consumers have shown resistance to waste-to-value (WTV) foods. |
| Nguyen et al. (2020) | Vietnam | X | | | Consumers have limited knowledge about sustainable packaging. |
| Wang & Kuah (2018) | China, India, Indonesia, Malaysia, Myanmar, Singapore, Thailand and Vietnam | X | | | Consumers do not show a high appreciation for the green concept of remanufactured products in Asia. |
| Schoden et al. (2020) | Germany | X | | | For greater public adherence to renewable energies, it is necessary to increase the level of awareness. |
| Keith & Silies (2015) | Scotland | X | | | There are many efforts that should be directed towards reducing waste and raising awareness among people in Scotland. |
| Ribić et al. (2017) | Croatia | X | | | Zagreb has a low level of recycling, inadequate management of non-industrial hazardous waste and inadequate landfill. |
| Kuah & Wang (2020) | East and Southeast Asia | X | | | Awareness of e-waste bins, recycling organizations, and sharing platforms is low, revealing that awareness about CE is scarce. |
| Tu et al. (2013) | Taiwan | X | | | The only way to alleviate environmental problems is to change the consumption pattern of consumers and increase their awareness. |
| Afroz et al. (2013) | Malaysia | X | | | Only 2% of respondents were involved in product recycling, which represents a major challenge to be overcome for more considered progress in the CE. |

Source: prepared by the authors

Studies carried out in some countries have shown a high degree of awareness and attitudes towards CE in some regions. They are: China; England; Germany, France and the United States; and Norway.

China is a nation that excels in promoting the circular economy as a model of development (XUE et al., 2010). The study developed by Geng et al. (2009) showed that the city of Dailan is a pioneer in adopting sustainable practices and that citizens are more environmentally conscious compared to other Chinese cities. In this context, the research by Huang et al. (2006) revealed public dissatisfaction in the Ningbo municipality regarding the environmental situation of the place. The interest in more sustainable shopping habits and the willingness to share environmental responsibility, reveals a degree of awareness among the Chinese. Kuah & Wang (2020) also conclude that awareness of electronic waste bins, recycling organizations and sharing platforms is low in China. Despite the above results, other studies report a low level of awareness of the circular economy in China. The study developed by Liu et al. (2017) showed that although people have a sense of waste reduction, this behaviour is rarely seen in practice. Moreover, Xue et al. (2010) revealed that people showed doubts about the real applicability and meaning of the concept, demonstrating a lack of public awareness. The study by Lu et al., (2020b) also showed that consumers have a marked preference for technologically improved solutions, but a less clear preference for improvements in materials that can contribute to greater circularity. Likewise, the results of the research by Liu et al. (2017) indicate that residents have limited awareness and a low understanding of circular economy programs. On the other hand, positive attitudes towards garbage collection were found for recycling and reuse. In addition, the results signalled that people's awareness of the circular economy has a positive correlation with their educational level, while their pro-environmental and resource conservation behaviour has a positive correlation with age (LIU et al., 2017). The research by Guo et. al (2017) on consumer attitudes and behaviours under the dimensions of waste reduction; recycling; water saving and energy conservation, revealed that more than 80% of the interviewees supported energy conservation, however 60% would only buy some appliance with low energy consumption if there was no additional value in the product.

Ferreira & Fuso-Nerini (2019) carried out an analysis of the current awareness of the circular economy at the University of Manchester, concluding the existence of low awareness and understanding of the circular economy among employees and students. A similar conclusion was reached in the work of Grasso & Asioli (2020), which revealed a low maturity in awareness among English consumers.

The study by Herbes et al. (2018) showed that circular strategies, such as packaging recycling, are considered mature in western countries. However, the results showed that in addition to concern for the environment, other attributes such as durability and convenience also influence the purchase decision of consumers in Germany, France and the United States (HERBES et al., 2018). The study by Schoden et al. (2020) developed in Germany revealed that the food, transport and energy sector require innovation and efforts towards circularity to increase the level of people's adhesion.

Koenig-Lewis et al. (2014) reported a high level of environmental awareness among citizens of Norway. In this study, the purchase intention was more influenced by the environmental concern than by the rational attributes of the packaging, just as positive and negative emotions promoted significant effects on the sustainable purchase intention (KOENIG-LEWIS et al., 2014).

The other countries studied did not show a high degree of awareness, behaviours and attitudes towards the CE, among these countries some resulted in a medium level of awareness, such as Holland; India; Poland and Belgium; Poland and France; Koreia; Romania, Italy; Australia and Portugal.

The Netherlands is considered one of the leading European countries in spreading the circular economy and has stood out as the nation with the second largest number of publications (KALMYKOVA; SADAGOPAN; ROSADO, 2018a). This position is strongly influenced by the Dutch government through the creation of policies to raise awareness and accelerate the circular economy (Russell et al., 2019). Despite this, some studies have revealed a low level of awareness among people linked to a lifestyle not conducive to the development of the CE (Kopnina, 2014). The study conducted by Kopnina (2013) showed that people only try an ecological product if it is of lasting use, saves money and/or time, increases comfort or confer some kind of value or social recognition. In addition, people tend to be more concerned with the well-being of people close to them than with the health of the planet in the distant future. Despite this negative outlook, the Netherlands can maximize its structure oriented towards the circular economy (Kopnina, 2015a). Another study showed that new forms and sharing have been raising sustainable awareness among people, but there is much to be improved (Kopnina, 2015b). The degree of implementation of the circular economy is related to education, which has an awareness role in the most sustainable consumption preferences, as demonstrated in the work of Petry et al. (2011).

India is a country that stood out in terms of publications. This fact can be explained by the country's emerging profile, which has experienced rapid economic and industrial growth

(KHARE, 2015). The study conducted by Singh et al. (2018) showed low awareness, reinforcing the importance of education programs (SINGH; CHAKRABORTY; ROY, 2018). In this context, the Khare (2015) revealed that variables such as green self-identity and past shopping behaviour influence the purchasing decision of Indian consumers. In addition, responsible behaviours influence a more sustainable and regenerative lifestyle. Prakash & Pathak (2017) understand that these behaviours can be influenced by ethics and morals, reformulating purchasing patterns more oriented to sustainability.

The research carried out by Roozen & De Pelsmacker (2000) analysed 232 students at the University of Antwerp, Belgium, and 104 students at the University of Gdansk, Poland. The results revealed that biodegradability was considered the most important factor in the transition to a more circular economy. However, no differences were identified between the two nations in the behaviour of purchasing sustainable products. A study carried out in Poland and France concluded that more educated and younger consumers are more aware and ethical in their purchasing choices (JERZYK, 2016). In that study, 40% of the people interviewed said they knew the term "sustainable packaging", which shows a moderate familiarity with the term. Smol et al. (2018) also concluded that the circular economy is known mainly to Poland's youngest population. This portion of the population tends to be more familiar with behaviours such as separating waste and buying recycled/remanufactured products. The findings further indicate that sharing and collaborative economy practices are becoming popular among residents due to the belief that these services create more economic, environmental and social benefits for users (SMOL et al., 2018). Similar to companies, consumers and public authorities, higher education institutions have shown an interest in developing academic curricula related to the circular economy.

The study by Jang et al. (2011) investigated the level of awareness of generation Y and their interest in consuming ecologically healthy foods in the United States. These consumers were divided into two groups: (i) health-conscious consumers; and (ii) adventurous consumers. The first group is concerned with the consumption of healthy foods less harmful to the environment, while the second group has shown a willingness to learn new sustainable consumption experiences (JANG et al. 2011). Despite the gradual increase in public awareness in the United States, many people are not actively involved in ecological behaviour, as shown in the results of Han & Yoon (2015).

Social norms guide a group of people inserted in a larger social context. Some studies consider social norms to influence pro-environmental or circular behaviours. Research carried out in Daegu, South Korea's third largest city, showed that social norms have a positive effect

on personal norms, which positively impacted people's ecological purchasing behaviour (AHN; KOO; CHANG, 2012). The study by Park & Sohn (2012) showed that social norms develop personal norms, which trigger sustainable behaviours. However, there is a long way to go to achieve further progress in achieving sustainability in South Korea.

The study by Lakatos et al. (2018) was focused on four macro-regions in Romania and reached 642 respondents segmented in three generations (X, Y, Z). Consumers agreed on the need to reduce resource consumption and encourage circular practices such as recycling and reuse. However, they do not and do not intend to adopt practices or consumption patterns based on the CE (LAKATOS et al., 2018). Another study developed by Lakatos et al. (2016) showed that consumers have a positive attitude towards the importance of environmental protection in Romania.

Consumer choices can support or hinder CE strategies. Thus, assessing consumer acceptability for sustainable foods such as waste-to-value (WTV) food is crucial to measure their success in the market (CODERONI & PERITO, 2020). The results of the research by Coderoni & Perito (2020) showed that 56% of Italian consumers interviewed stated that they were willing to buy this type of food, however food neophobia (individual resistance to try new foods) and technological neophobia (food aversion) processed) negatively influenced the likelihood of adopting a positive purchase intention. In addition, the study concludes that a profile of consumers tending to consume more sustainable products and interested in taxes such as the origin and nutritional values of the food tends to emerge. Research carried out by Borrello et al. (2017) assessed the degree of willingness of consumers to participate in closed cycle programs to reduce food waste in Italy, revealing a potential interest of these consumers.

The study conducted by Lease et al. (2014) showed that Australian consumers are prone to try foods that contain recycled water as long as they pass the required sanitary standards. Thus, the study suggests that water recycling in the food industry, when supported by quality standards, will have positive emotional and affective responses to consumer acceptance. Keith & Silies (2015), on the other hand, understand that people's awareness is related to orienting efforts to reduce waste. The sectors analysed in the study by Mendoza et al. (2019) demonstrate initiatives towards circularity in Portugal. Waste and water management in the cork industry are examples of success.

Finally, in some countries, only studies showing a low level of awareness have been shown, such as Finland, Denmark, Vietnam, Scotland, Croatia, Taiwan, Malaysia, Singapore, Myanmar, Thailand and Indonesia.

Studies developed in Finland demonstrated a low level of awareness of people with the CE, as pointed out by Tesfaye et al. (2017) that revealed a low involvement of people with recycling due to an inadequate waste management system. Thus, Husgafvel et al. (2018) show that greater awareness and training are needed to promote more proactive approaches to advancing the CE in Finland.

Denmark has an important history of public policies to promote the CE, such as the introduction of the first deposit refund scheme for beverage packaging in the 1980s. Boesen et al., (2019) analysed food packaging and found that Danish consumers have a positive attitude towards compostable packaging, moreover, they have shown an interest in the search for innovation in environmentally friendly packaging design. In this context, the study by Witzel & Peschel (2019) conducted with 491 Danes showed that the brand plays a role in determining the attitude of consumers. In addition, there was some resistance in accepting this type of product, in which women were more likely to consume ecological products, in addition to choosing vegetarian or vegan products (WITZEL & PESCHEL, 2019).

The study by Nguyen et al., (2020) categorized Vietnamese consumers' perception of sustainable packaging in three dimensions: packaging materials, manufacturing technology and market appeal. The study demonstrated that consumers have limited knowledge about ecological packaging, in addition, they expressed greater knowledge related to requirements such as biodegradability; and market appeal (such as attractive graphic design and good price). Although they have shown little knowledge about production technologies, consumers understand the importance of a sustainable process over an unsustainable process (NGUYEN et al., 2020). Another study conducted in Taiwan and other Asian countries showed that the remanufactured market is not yet mature (WANG; KUAH, 2018). The findings suggest that environmentally conscious consumers do not show appreciation for the ecological concept of remanufactured products in Asia (WANG; KUAH, 2018).

People's awareness is essential to success in many CE strategies. Waste management is a challenge that represents challenges for most municipalities in Croatia, mainly due to the legal obligations established by the European Union, such as landfill reduction targets (RIBIĆ; VOĆA; ILAKOVAC, 2017). Thus, making people aware of the risks to life resulting from inadequate waste management is a strategy towards a CE, especially in cities such as Zagreb, which has a low level of recycling and inadequate waste management (RIBIĆ; VOĆA; ILAKOVAC, 2017).

A study carried out in Taiwan showed that the only way to alleviate environmental problems is to change people's current consumption patterns and increase their level of

awareness (Tu et al., 2013). Other studies indicate that awareness is not the only determining factor in the transition to a more CE, since awareness is often not transformed into attitudes and behaviours. The results of the study by Afroz et al. (2013) showed that most people are aware of the seriousness of environmental impacts, stating that they consider them when buying a product. However, only 2% of respondents were involved in product recycling, which represents a major challenge to be overcome for more considerable progress in the CE.

**3.3.5 Barriers to be overcome by people for the transition to a CE**

The transition from the linear to the CE faces some challenges, as pointed out by Petry et al., (2011), who highlights the barriers faced by developing countries, where the engagement of people with sustainable behaviors can be hampered by financial restrictions.

In this context, many consumers can opt for cheaper products over sustainable options (KOPNINA, 2015b). In this sense, Table *6* presents the studies that bring the main barriers to a transition to the CE and the main strategies to mitigate them.

Table 6 - Barriers and mitigation strategies for transition to CE

| Barriers | Mitigation Strategy | Key References |
|---|---|---|
| Lack of financial support and infrastructure | Seek government support for the promotion of circular strategies, including political and corporate leadership; | Geng et al. (2009); Petry et al. (2011); Tu et al. (2013); Kopnina (2015b); Lakatos et al. (2016); |
| Lack of public awareness | Organize training and education programs for people and organizations; | Geng et al. (2009); Xue et al. (2010); Kopnina (2015a); Ferreira & Fuso-Nerini (2019); |
| Absence of legislation, technology and supervision | Implement waste disposal policy, industrial allocation and urban infrastructure; | Xue et al. (2010); Kopnina (2014); Husgafvel et al. (2018) |
| Transformation of awareness into behavior | Direct sustainable policies to promote collaborative education; | Roozen & De Pelsmacker (2000); Ahn et al. (2012); Liu et al. (2017) |
| Technological innovation and consumerism | Standardize the product collection processes for recycling and adoption of projects to promote CE; | Huang et al. (2006); Afroz et al. (2013); Keith & Silies (2015); Kopnina (2015b); |
| Unlink the idea of consumer ownership | Integrate sustainable consumption principles and incorporate circular patterns, highlighting its benefits; | Liu et al. (2009) |
| Sociodemographic and cultural disparities | Adopt cradle-to-cradle production and consumption structure and education and awareness programs; | Liu et al. (2009); Kopnina (2013); Khare (2015); Schoden et al. (2020); Herbes et al. (2018); Singh et al., (2018); Kuah & Wang (2020); |
| Price of products | Encourage public-private cooperation in order to reduce costs and the final price of products; | Prakash & Pathak (2017); Kopnina (2014); Lu et al. (2020) |
| The packaging plays a minor role in the purchase decision | Inform the ecological attributes on packaging and invest in marketing to raise consumer awareness; | Jerzyk (2016); Prakash & Pathak (2017); Boesen et al. (2019); Lu et al. (2020) |
| Lack of consumer confidence | Strengthen reputation through disclosure and access to information; | Lease et al. (2014); Smol et al., (2018); Wang & Kuah (2018); Witzel & Peschel (2019); Kuah & Wang (2020); Coderoni & Perito (2020); |

The lack of financial support and the need for greater awareness were shown to be predominant variables in achieving circularity (LAKATOS et al., 2016). In addition, many consumers are motivated by rational monetary factors and are resistant to changing their buying behaviour, which appears to be a barrier to the development of the CE (LAKATOS et al., 2016). The creation of websites and platforms is a suggested strategy to encourage public participation through the dissemination and awarding of best practices (KOPNINA, 2015b).

Promoting the development of the CE must encompass an innovation approach, and the government plays a leading role in this regard (GENG et al., 2009; XUE et al., 2010). Thus, incentive initiatives for the CE depend on more complex dynamics such as political and corporate leadership. Research by Xue et al., (2010) revealed that there is a need for government support to raise awareness of the CE as there are still doubts about the real applicability and meaning of the concept. Kopnina (2014) highlights the importance of the government because it is useless to be willing to use public transport, use a bicycle or buy sustainable cars if the government does not stimulate and make these alternatives available.

People represent the driving force for the development of the CE, just as companies play an influential role in Society (XUE et al., 2010). Rigid institutional structures, absence of legislation, technology and supervision can restrict the implementation of the CE (FERREIRA & FUSO-NERINI, 2019). In addition, the transformation of awareness into real behaviour is a challenge pointed out by Roozen & De Pelsmacker (2000); Ahn et al., 2012) and Liu et al. (2017). A strategy to mitigate these barriers is to develop a sustainable policy in companies, which includes marketing actions to inform the benefits of ecological products and use attributes to motivate sustainable purchasing behaviour. In addition, investing in the creation of new products and sustainable practices can encourage sustainable consumption (PARK; SOHN, 2012). In other words, companies will have to educate their customers to change their consumption patterns.

The technological innovation promotes systemic benefits to the means of production and the economic sector. On the other hand, this update is a challenge to conquer the CE, as it encourages consumerism. Research by Huang et al. (2006) showed that people from Ningbo, a municipality in China, exchange their electronic products due to the rapid technological update. Thus, the strategy of maintaining the products in use is not maintained in a desired way, making it a barrier to the transition to the CE. For this, the process of disposal, collection and recycling of electronic products requires planning/and standardization. In addition, political regulations are necessary to facilitate the creation of collection canters, organization of campaigns,

seminars and workshops to increase people's level of awareness (HUANG et al., 2006; AFROZ et al., 2013). In addition to technological innovation, other phenomena can encourage consumerism, such as fast fashion. This business model encourages production, consumption and disposal in an accelerated manner, which increases disposal and pollution at different production stages (KEITH; SILIES, 2015). The revolutionary movement towards dematerialization deserves attention as the western consumption style is considered as one of the biggest sources of unsustainability (Kopnina, 2015b). Thus, collaborative education seems to be a strategy of substituting linear business models for cycle models (KEITH; SILIES, 2015).

A study by Liu et al. (2009) showed that the question of property is a potential barrier to people's development towards the CE. When asked about the possibility of renting toys for children, 72.7% of consumers stated that they would not rent them, as they considered the idea of buying the product more inviting. To change this reality, a strategy is to show consumers the benefits of sharing and servitization, integrating sustainable consumption principles and incorporating patterns of daily behaviour.

Emerging economies face the challenge of progressing to a more circumscribed economy as a result of social and educational problems (KHARE, 2015). The studies developed by Kopina (2013) and Smol et al. (2018) showed that education is the sociodemographic variable that had a significant effect on different measures of environmental concern. Respondents of lower socioeconomic status showed little awareness and interest in sustainable products. Thus, one must consider sociodemographic and cultural disparities for the incorporation of the CE in Society (Schoden et al., 2020). The importance of environmental protection can have different weights for consumers depending on the culture, which can be considered as a barrier to the universalization of environmental awareness. In addition, institutional differences between countries, such as the availability of certain technologies or the existence of infrastructure can influence consumer behaviour (HERBES; BEUTHNER; RAMME, 2018). To face these barriers, it is suggested to adopt a structure of production and consumption from cradle to cradle and the development of awareness and education programs (Kopnina, 2013). Schoden et al. (2020) suggest that an important path for raising awareness about closed cycles is focused on raising awareness of early childhood education.

The price of ecological products can become a barrier to circular consumption, since consumers can be price sensitive (Prakash & Pathak, 2017; Lu et al., 2020). A study conducted by Xue et al., (2010) showed that almost half of the interviewees are not willing to pay more for ecological products. Thus, encouraging public-private cooperation to reduce costs and the

final price of products is a strategy to democratize ecological products, especially in emerging countries.

The literature has shown that sustainable packaging is not a determining attribute in product choice, which represents a challenge in adopting behaviours towards the CE (JERZYK, 2016). However, the study by Prakash & Pathak (2017) explains that personal norms proved to be a strong predictor in the purchase intention of young consumers, which reveals that investing in this consumer profile can be an alternative in building circularity. In addition, informing the ecological attributes on the packaging and investing in marketing for awareness are strategies to mitigate the challenges. The significant increase in electronic commerce and the consequent increase in demand for packaging show that technology is a potential strategy to avoid packaging waste (LU et al., 2020).

In a survey conducted by Smol et al., (2018), half of the interviewees do not use sharing services for renting houses and apartments because they do not trust this type of service. Thus, the lack of confidence is a barrier to the development of many circular practices, as pointed out in the study by Wang & Kuah (2018). The study by Kuah & Wang (2020), showed that the low reliability of recycled and remanufactured products is negatively related to the desire to buy, which represents a barrier. Trust building can be improved through the dissemination of circular practices and access to information. The marketing appeal for remanufactured products, for example, has proven to be an important path in the diffusion and acceptance of remanufacturing by consumers (WANG & KUAH, 2018). Lu et al. (2020) revealed that the concept of recycled ingredients is very new for consumers, which represents a barrier to be overcome. Therefore, appropriate information campaigns should be designed to increase consumer confidence and acceptance of new products and services.

## 3.4 Conclusions and Research Agenda

Understanding people's awareness toward the CE is a step towards restructuring the forms of production and consumption. Thus, this study provides an overview of the current composition of the literature on people's behaviour and attitude towards the CE around the world. These theoretical implications may influence the need for engagement between government, companies and consumers to apply alternatives that aim to change perception and awareness.

A brief descriptive analysis was carried out to understand the profile of these studies regarding the longitudinal distribution and the main research methods adopted. In addition to this analysis, the main dimensions/practices of the CE analysed in the studies were presented,

the analysis of the behavioural perspective, the main theories that underpin people's behaviour towards the economy, the main results regarding the degree of awareness, behaviour, and attitudes of people around the world towards the CE and the main barriers to be overcome by people in the transition to a CE.

The success of the CE depends on a complete reform of human activities, which includes the processes of production and consumption. In this sense, the dimensions and practices were analysed, concluding that CE was related to 20 practices, which can lead to more sustainable behaviours and attitudes, such as Using sustainable packing, Buying green products and Reuse/Upcycling. Regarding the behavioural perspective of the studies, we concluded that the majority address the awareness, behaviours or attitudes of people towards the CE from the perspective of consumers, who act as key agents in the search for more regenerative consumption habits. Other studies carry out this analysis from the perspective of managers, students, or in a more comprehensive way, adopting the nomenclature public/people.

In addition to the results mentioned above, we were able to obtain a sense of the degree of awareness addressed in the studies, with only four nations showing a high degree of awareness: China; UK; Germany, France and USA; and Norway. Other studies pointed to a medium and low degree of awareness, showing that even in more developed countries there is still much to be matured regarding the degree of awareness, behaviour, and attitudes of people towards the CE. In addition to the above conclusions, Table 7 presents a future research agenda for studies on people's awareness, behaviour and attitudes towards the CE based on the literature review performed.

Table 7 - Research agenda for studies on people's awareness, behaviour, and attitudes towards the CE

| Major aspects | Research Agenda | Key References |
|---|---|---|
| CE awareness | Further studies can be directed to understanding consumers' buying and awareness oriented towards the CE | Roozen & De Pelsmacker (2000); Lease et al., (2014); Tu et al., 2013; Liu et al. (2009); Han & Yoon (2015); Khare (2015); Lakatos et al. (2016); Prakash & Pathak (2017); Liu et al. (2017); Herbes et al. (2018); Schoden et al. (2020); Kuah & Wang (2020); Lu et al. (2020) |
| Green purchasing behaviour | Green purchasing behaviour should be studied for different product categories, such as food, recyclable, pharmaceuticals or durable products | Roozen & De Pelsmacker (2000); Khare (2015); Roozen & De Pelsmacker (2000); Grasso & Asioli (2020); Kuah & Wang (2020) |
| Public policies | Future studies should investigate the implications of sustainable public policies on people´s awareness, behaviours and attitudes towards CE | Huang et al. (2006); Afroz et al. (2013) |
| Education | Future research should investigate the relationship between education and people's degree of awareness of the circular economy | Petry et al. (2011); Kopnina (2013); Lu et al. (2020); Kuah & Wang (2020). |
| Cultural | Testing cultural influences on social and personal norms and circular behaviour | Ahn et al., (2012); Park & Sohn (2012); Singh et al., (2018); Smol et al., (2018); |
| Brand image and marketing | Future research should consider the effects of brand image and marketing on consumers' purchase intentions | Roozen & De Pelsmacker (2000); Jang et al. (2011); Koenig-Lewis et al. (2014); Kuah & Wang (2020); Nguyen et al. (2020) |
| Young consumers | Conduct a comparative analysis between the young and adult population in relation to awareness and degree of adherence to CE practices | Prakash & Pathak (2017); Guo et al., (2017); Boesen et al. (2019) |

Source: prepared by the authors

An important strategy for a transition to the CE is to change the pattern of consumption, aimed at reducing the depletion of natural resources (LEASE et al., 2014). Thus, future research should investigate the predisposition of consumers to adhere to new strategies for buying / renting sustainable products and services (TU et al., 2013). Liu et al. (2009) emphasizes the importance of examining the determinants of pro-environmental behaviour, to understand consumers' green buying behaviour (Khare, 2015). Similarly, Herbes et al. (2018) indicates that one must go beyond rational decision-making and investigate the emotional influences on the consumer.

Studies such as the one carried out by Prakash & Pathak (2017) and Roozen & De Pelsmacker, (2000), emphasize the importance of considering a wide range of products to understand the pro-environmental behaviour of consumers, as well as the relationship between the product and the packaging for different product categories, such as food, recyclable products, pharmaceutical or durable products. Future research should investigate different product categories to understand why some drivers are more influential in some products than others.

Influencing consumers to desire environmentally friendly products and services is challenging and proves to be a growing trend towards the success of closure strategies. (Kumar & Putnam, 2008). For circular strategies such as remanufacturing to be universally accepted, economic factors and regulatory pressures must be intensified so that users understand the benefits of circular practices (HUANG et al., 2006). Thus, future studies should investigate the implications of sustainable public policies and their influence on public awareness of the CE.

The main direction for circular change is education that will guide people to choose more regenerative buying and consumption habits, bridging the gap between intention and action (KOPNINA, 2013). Thus, future research should investigate the relationship between education and people's degree of awareness of the CE (PETRY et al., 2011). In addition to education, culture can play a significant role in building social and personal norms (SINGH et al., 2018). Therefore, future research can test cultural influences on social and personal norms and environmental behaviour (PARK; SOHN, 2012). In addition, it is necessary to replicate the effect of emotions in different cultural contexts and to assess the relationship between public awareness and progress towards the CE (AHN et al., 2012). Lu et al. (2020) suggest that future studies may collect data from various countries and explore the influence of culture on user preference for e-commerce overpackaging solutions.

Roozen & De Pelsmacker (2000) highlight the influence of advertising, product promotion and discounts on green shopping behaviour. Thus, future research should consider

the effects of the brand image on consumers' purchase intentions, helping to understand the complexity of consumer behaviour (KOENIG-LEWIS et al., 2014; NGUYEN et al. 2020).

Some authors recognize the younger generation as more likely to assimilate CE practices (GUO et al., 2017). Young consumers are more concerned with the current environmental condition and are more able to reflect their choices in ecological products Thus, future research can carry out a comparative analysis between the young and adult population in relation to awareness and degree of adherence to CE practices (BORRELLO et al., 2017).

The systematic review has some limitations. The definition of search strings was limited to the term "circular economy", not including other different terminologies such as "closed loop economy" and "zero waste economy", given the specificity of our research. In addition, we mention the temporality that presents the state of the literature referring to a period, representing a limitation.

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# 4. PEOPLE'S AWARENESS OF THE CIRCULAR ECONOMY (CE): DEVELOPING CONSTRUCTS AND MEASURES

## 4.1 Introduction

For centuries, industrialised products have had a similar life cycle: extracting raw materials from nature; manufacturing; use; and disposal (ALMULHIM; ABUBAKAR, 2021; VAUPEL et al., 2022). This model, called linear economy, has helped shape the habits of consumers around the world (MORSELETTO, 2020). However, the "extract, produce, use, and dispose of" linear model is reaching its physical limits, putting people's health and the planet's sustainability at risk (GUERRA; FERNANDALEITE, 2021). In a linear system, economic growth depends on the consumption of finite resources, which brings the imminent risk of raw material depletion. With fewer resources available, there are increasingly higher extraction costs, which will lead to instability in the future (GRASSO; ASIOLI, 2020; SUZANNE; ABSI; BORODIN, 2020).

Given society's growing concern with environmental preservation and the challenges inherent to climate change, a new production model is gaining attention: the circular economy (CE) (ROVANTO; FINNE, 2022; VAUPEL et al., 2022). CE has become a topic of growing interest for researchers, practitioners, and public entities, representing a field of research marked by a rising number of scientific articles investigating its purpose and applicability (KUAH; WANG, 2020). The CE model aims to retain resources that circulate within global boundaries so that no natural resources are needed to produce materials. Moreover, discarded materials are not seen as waste (GUERRA; FERNANDALEITE, 2021). In addition to promoting the circularity of resources in closed-loop systems, the CE model also advocates efficient resource management strategies such as reuse, recycling, remanufacturing, and product dematerialisation, among other strategies (GRASSO; ASIOLI, 2020).

CE is increasingly being incorporated into corporations' policy agendas and strategies, and is part of essential debates in universities and research groups (ALMULHIM; ABUBAKAR, 2021; MURRAY; SKENE; HAYNES, 2017).This interest is justified by the increasing institutional challenges and pressures to search for less harmful practices (LANAU; LIU, 2020). Kirchherr and Piscicelli (2019) focused on industrial economics, suggesting strategic bases such as waste prevention, raw material substitution, and regenerative systems, which can be achieved through product design, material reuse, and remanufacturing. There are

several studies that have included this theme as a central topic, such as that of Webster (2007), who advocated the reconfiguration of design in product development.

People are increasingly attuned to sustainable issues, generating greater public awareness about environmental impacts (KAKADELLIS; WOODS; HARRIS, 2021). In this sense, one of the main driving forces for the transition to a circular model lies in people's level of awareness; they often act as public policy drivers, impacting the decisions of company managers (SMOL et al., 2018a; VAUPEL et al., 2022). Moreover, people's level of awareness directly influences the search for a central and solid position in the applicability of CE practices (OGBONNAYA; TURAN; ABEYKOON, 2020).

It is widely accepted that people's choices represent different lifestyles and purchasing habits, influencing CE development globally (ALMULHIM; ABUBAKAR, 2021) However, a case study undertaken by Liu et al. (2009) indicated that people had limited knowledge of CE. Similarly, Otto et al. (2021) concluded that European consumers exhibit less sustainable purchasing behaviour than intended due to a low level of awareness about some circular strategies. Another empirical research in China revealed that people's interaction with CE practices is still incipient in driving the transition from a linear to a circular economy (LANAU; LIU, 2020).

Some studies have clarified the importance of the younger generation, who are considered more prone to the development of ecological awareness through consumption patterns, access to technologies, and attitudes (CALCULLI et al., 2021). Other studies have examined people's awareness of CE (ALMULHIM; ABUBAKAR, 2021; LAM; BAI, 2016; LIU et al., 2009; XUE et al., 2010) The research developed by Otto et al. (2021) revealed that people's increased awareness acts as a stimulus for circular behaviours. Moreover, these behaviours can support more sustainable purchasing behaviour.

Although various studies have analysed the degree of awareness of the specifics of some circular strategies, we found no studies analysing people's awareness from the perspective of multiple CE strategies or practices. Previously published studies have analysed people's awareness considering partial aspects of CE, such as green product consumption (KHARE, 2015), buying environmentally responsible services (HAN; YOON, 2015), and eco-friendly packaging (NGUYEN et al., 2020). Therefore, these studies have not considered all the facets of CE. It is worth noting that the CE literature also lacks a questionnaire that has undergone validation stages to ensure the reliability of the constructs and items, leading to greater measurement accuracy, which is considered an essential strategy in the methodological research procedure. Therefore, creating a valid and reliable scale is essential to fill this critical research

gap, serving as a model instrument for future studies. Thus, this paper aims to develop a measurement scale to assess people's awareness of CE.

When analysing the awareness of human beings regarding such an important topic as CE, we should consider different stakeholders, including company managers, suppliers in a supply chain, customers, and professionals (encompassing governments, educational/research institutions, service providers, and cooperatives, among others). Previous studies have analysed this topic from the perspective of consumers (CANAVARI; CODERONI, 2020; GRASSO; ASIOLI, 2020; HERBES; BEUTHNER; RAMME, 2018; JANG; KIM; BONN, 2011; NGUYEN et al., 2020; PETRY et al., 2011), managers (AHN; KOO; CHANG, 2012; DE FERREIRA; FUSO-NERINI, 2019; XUE et al., 2010), and students (GUO et al., 2017a). However, it is worth noting that our research focuses on creating a measurement scale to assess all people's awareness. These people are classified as the general public, regardless of their position in a supply chain (consumer, supplier) or how they are inserted in a social context (student, politician, businessman/manager). Therefore, our study is not restricted to a sector or group of specific people.

Our paper's relevance lies in bringing CE, which is a theme being much discussed in the business/industrial context, to the social and everyday context of people. Thus, our focus is on measuring the awareness of CE in people's reality in general, adopting a more accessible language. Thus, strategies more directed to companies/industries (such as customisation/make to order, design for disassembly/recycling, design for modularity, eco-design, and green procurement, among others), as addressed in the studies of Velasco-Muñoz et al. (2021) and Walker et al. (2021), were not considered for the development of our scale. Moreover, many strategies/practices of the biological cycle are more adapted to companies' daily operations, making it difficult/impossible to apply them to the reality of ordinary people. The extraction of bio-chemicals, for example, is a conversion of biomass into low-volume but high-value chemical products, thereby generating heat, power, fuel, or chemicals from biomass (KALMYKOVA; SADAGOPAN; ROSADO, 2018). Another example is the strategy of the development of bio-based materials, which is related to the use of bio-based materials for creating products and materials integrated into the biological cycle in the supply chain (WEETMAN, 2019). These two strategies are examples that are more adapted to the reality of companies/industries, and not therefore applicable to the reality of ordinary people.

This paper is organised as follows. This section has presented an introduction and contextualisation of the research. Section 4.2 presents a review of the concept of CE. Section 4.3 presents the description of the research method, including details about the steps for

developing the proposed scale to measure people's awareness of CE. Section 4.4 presents the discussion of the results. Finally, Section 4.5 presents the conclusions of the research.

## 4.2 Circular Economy (CE) concept

CE comes from other concepts established decades ago, such as the performance economy (STAHEL, 2008), industrial ecology (FROSCH; GALLOPOULOS, 1989), cradle-to-cradle (Sahel and Reday-Mulvey, 1981), the sharing economy (MERLI; PREZIOSI; ACAMPORA, 2018), design for circularity (TÜRKELI et al., 2019), green innovation (GARCÍA-QUEVEDO; JOVÉ-LLOPIS; MARTÍNEZ-ROS, 2020), product-service systems (SCHALLEHN et al., 2019), eco-innovation (BOCKEN et al., 2016), and green supply chain management (KALMYKOVA et al., 2018), among others. In recent years, the CE concept has gained more attention globally after some countries introduced its precepts into their national strategies for public policy formulation (DANTAS et al., 2021). The European Union and China are forerunners in applying cycle closure strategies, as this new model is a sustainable solution to various problems related to waste management in production and consumption activities (ZVIRGZDINS et al., 2020).

CE promotes the economic growth of manufacturing industries and societies and enhances the social and environmental performance of the industry (LAHANE; PRAJAPATI; KANT, 2021). Nations in the European Union have concluded that loop-closing actions can generate 600 billion euros of profit annually for manufacturing companies, playing a vital role in their societies' and industries' socioeconomic and ecological development (GARCÍA-QUEVEDO; JOVÉ-LLOPIS; MARTÍNEZ-ROS, 2020).

The circular model builds economic, natural, and social capital, based on the gradual decoupling of linear production and consumption activities, thus keeping resources circulating in the supply chain, founded on three principles: designing out waste and pollution; keeping products and materials in use; and regenerating natural systems (LAHANE; PRAJAPATI; KANT, 2021). Kirchherr et al. (2018) defined CE as an industrial system that employs principles such as the reuse, recycling, remanufacturing, reduction, repair, and redesign of products to keep materials in use and reduce waste. In addition to these definitions, the ReSOLVE framework includes six business actions: regenerate; share; optimise; loop; virtualise; and exchange (JABBOUR et al., 2017). This framework is based on strategies to decrease dependence on new materials and migrate to renewable energy systems (DEV; SHANKAR; QAISER, 2020).

The circular model distinguishes between the biological and technical cycles (LAHANE; PRAJAPATI; KANT, 2021). The biological cycle comprises the consumption of bio-based materials (such as food, wood, cotton) designed to return to the

system through practices such as composting and anaerobic digestion, thus regenerating living systems (VANHAMÄKI et al., 2020a). The technical cycle recovers materials through practices such as reuse, repair, remanufacturing, and recycling (JABBOUR et al., 2017).

Transitioning to CE is not limited to adjustments aimed at reducing the negative impacts of the linear economy (DANTAS et al., 2021). The benefits include increased resources and materials efficiency, enhanced value propositions, reduced waste generation, improved end-of-life strategies, and improved circularity design aspects (GARCÍA-QUEVEDO; JOVÉ-LLOPIS; MARTÍNEZ-ROS, 2020; LAHANE; PRAJAPATI; KANT, 2021).

The reformulation of traditional forms of production and consumption requires breaking old paradigms, including adapting all links in the supply chain (ROSADO; KALMYKOVA, 2019). Upstream players are the producers and industries that need to introduce circular production models, while downstream players are the consumers who must be able to demand the products, services, and behaviours arising from the circular model (DANTAS et al., 2021; LAHANE et al., 2021).

Although some studies have shown the importance of people for the transition to CE, as well as the growth of environmental awareness (mainly due to increased ecological discomfort and resource scarcity), other studies have indicated that environmental awareness needs to be improved and practised more in people's lives (GUO, 2017; SMOL et al., 2018). The results of the research by Lahane et al. (2021) showed that the main barriers that hinder the implementation of CE are lack of knowledge and awareness and lack of information, which reinforces the importance of people's awareness for a more efficient transition to the circular model. In addition, people's lifestyles, which include awareness, attitudes, and purchasing profiles, play a crucial role in achieving sustainable development (SUZANNE; ABSI; BORODIN, 2020).

Studies can be found in the literature that have investigated people's awareness of CE and sustainable products around the world (AFROZ et al., 2013; DE RIDDER, 2008; GUO, 2017; LU et al., 2020b; SZILAGYI et al., 2022; WIKSTRÖM et al., 2019; XUE et al., 2010). Kakadellis et al. (2021) showed that consumer education can contribute to the growth of biodegradable plastics commercialisation as an alternative to traditional polymers, revealing the importance of people's awareness in disseminating CE practices. However, we found no studies proposing to analyse people's awareness from the perspective of various CE strategies. In addition, the literature contains no articles that

have developed a valid measurement scale to assess people's awareness of CE. Our paper fills this research gap and proposes a universal scale to measure people's awareness of CE that can be replicated and applied to different contexts and realities.

**4.3 A Measurement Scale to Assess People's Circular Economy (CE) Awareness: Development and Validation**

The development of empirical research must overcome the challenges of reducing errors, providing greater data robustness, and guaranteeing the constructs' reliability and validity (MENOR; ROTH, 2007). Therefore, the scale development in this study followed the sequence of steps proposed by DeVellis (2022), Lambert and Newman (2022), and MacKenzie et al. (2011) adapted for the context of people's awareness of CE. These steps are illustrated in Figure 9.

Figure 9 - Steps to generate the scale for measuring people's awareness of CE
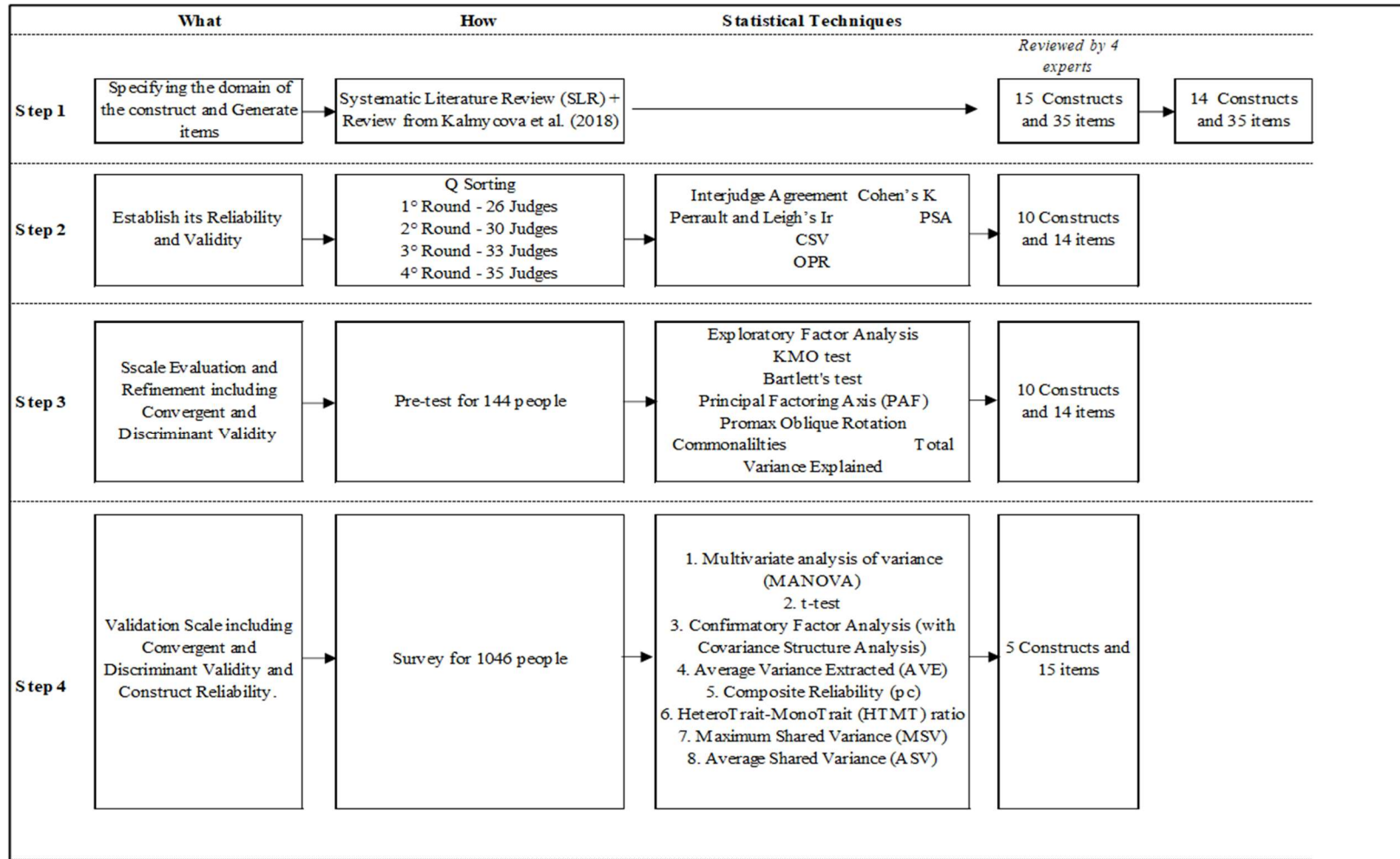


Source: prepared by the author.

**4.3.1 Step 1 – Specify the Construct Domains and Generate Items**

The first step in developing better measures involves specifying the domains of the constructs. This means defining what will be included or excluded from the concepts and generating items that capture the domains as specified (LAMBERT; NEWMAN, 2022; (PODSAKOFF; MACKENZIE; PODSAKOFF, 2016). This first step (specify the construct domains and generate items) was developed based on the 45 CE strategies defined by Kalmykova et al. (2018). Kalmykova et al. (2018) defined strategy as a method, means, or procedure to achieve a given objective. We used this study because it is considered a broad review, contemplating strategies for each of the actions of the ReSOLVE framework developed by the Ellen MacArthur Foundation. In addition to the article published by Kalmykova et al.(2018), we performed a systematic literature review (SLR) on people's awareness of CE worldwide. MacKenzie et al. (2011) emphasised the importance of achieving robust psychometric properties in validating measurement scales; therefore, the SLR is an essential step towards this.

Following these procedures, we identified 15 constructs: waste separation; water saving; energy conservation; remanufacturing; reuse/upcycling/restoration; recycling; buying second-hand products; waste reduction; using sustainable packing; sustainable products; buying environmental products; product-service systems; sharing economy; virtualisation; and socially responsible consumption. The item generation was based on the literature comprising studies that analysed people's awareness of sustainability or CE strategies. It is worth noting that the literature does not present validated scales to assess public awareness in relation to CE. These initial 15 constructs encompass Kalmikova's 45 items to measure people's awareness of CE.

These constructs and items were reviewed by four experts in the field of sustainability. This review was important to evaluate the constructs and items semantically and to eliminate confusing or repetitive items. After this semantic validation by experts, 10 constructs were confirmed to measure people's awareness of CE (see Table 8).

Table 8 - Circular economy (CE) constructs

| Constructs | Description |
|---|---|
| Waste management | Encompasses strategies for the correct treatment of waste, such as separation (organic/recyclable) and sending to collection centres (batteries, electronics), as well as waste reduction through actions such as composting and reducing the consumption of disposable products (plastic products such as cups and cutlery). |
| Rational use of resources | The rational use of resources encompasses behaviours that lead to water and energy savings. It also encompasses behaviours that generate waste and excess reduction, such as the conscious use of financial resources (money) and products in general. |
| Remanufacturing | Remanufacturing is a process that involves the steps of dismantling, rebuilding, cleaning, and replacing defective components with reusable ones. This strategy allows products to be recovered from the consumer after the end of their useful life and returned to the supply chain, reducing the generation of waste, contamination, and the emission of polluting gases into the atmosphere. |
| Recycling | Recycling is the process of reusing discarded materials. Its main objective is to reintroduce them into the production chain so that they generate value and be reused, thus reducing waste production, increasing the preservation of natural resources, and improving people's quality of life. |
| Reuse | Consists of direct secondary reuse, which extends the product's useful life for the same function or in several other uses. In this way, fewer products have to be produced, thus reducing the generation of waste, contamination, and the emission of polluting gases. |
| Repair/restoration/maintenance | These are efficient strategies to achieve a desired level of equipment performance, in addition to eradicating obsolescence and extending product life. |
| Use of sustainable products or packaging | Sustainable products and packaging are obtained, manufactured, transported, and recycled without the use of toxic components, being biodegradable by nature. It comprises clean production technologies and best practices, being physically designed to optimise materials and energy use. |
| Virtualisation | Virtualisation is the conversion of analogue or physical products into digital resources, thus reducing the generation of waste, contamination, and the emission of polluting gases into the atmosphere. |
| Sharing economy | The sharing economy takes place in organised systems or networks in which participants engage in sharing activities in the form of renting, lending, trading, and exchanging goods, services, transport solutions, space, or money. |
| Product-service systems | Occurs when ownership of the product belongs to the company that supplies it and is responsible for maintenance, repair, and recycling throughout its useful life. In this business model, the customer pays rent for the time of use. This strategy makes the manufacturer extend the life of the product as it is responsible for the maintenance costs, thus reducing the obsolescence of the product. |

Source: prepared by the author.

**4.3.2 Step 2 – Establish the Constructs' and Items' Reliability and Validity**

The second step is to establish the constructs' and items' reliability and validity as a measurement tool to assess people's awareness of CE. Four rounds of classification of the constructs and items were carried out with judges from the area of operations management. The criterion used for selecting judges was that they had prior knowledge regarding the concept of CE. This was an iterative process in which judges identified the constructs and items based on the definitions provided. According to these definitions, the judges associated each assertion with the construct that represented it the most. For each round, experts were instructed to carefully read the definitions of each CE construct and list each item (DEVELLIS, 2022; MACKENZIE et al., 2011). Four rounds were carried out with convenience samples of 26, 30, 33, and 35 judges (totalling 124 judges).

Each round was analysed using three inter-rater reliability estimators. First, *inter-judge agreement percentage* refers to the agreement ratio between all pairs of judges. This was calculated by the proportion of item classification and the total number of judgments (HANSON, 2022). The agreement percentage is the agreement ratio between pairs of judges. It was used as a baseline in conjunction with other reliability measures. Second, *Cohen's* kappa determines to what extent the frequency of exact agreements between judges exceeds what could be expected by chance (DEVELLIS, 2022; HANSON, 2022). It is an estimator that assesses the adequacy between ratters when the index between 0.40 and 0.60 is considered realistic, while kappa between 0.20 and 0.40 would be acceptable (HANSON, 2022; YAN; GONG, 2022). Finally, *Perrault and Leigh's* Ir indicate the probability that two judges both independently make a reliable judgment. This estimator indicates that values less than 0.6 or 0.5 need corrections (ROSSITER, 2011).

In addition to ensuring reliability, we assessed substantive face validity (MENOR; ROTH, 2007), which indicates the extent to which all scales would be judged valid (DeVellis, 2022). To this end, we used two substantive validity estimators. First, the proportion of substantive agreement (PSA); indicates the proportion of ratters who assign an item to the construct. This indicator ranges from 0 to 1, and the closer to 1, the greater the validity. Second, the coefficient of substantive validity (CSV), measures how judges relate an item to a construct rather than any other construct. The CSV ranges from –1 to 1, with more positive results indicating greater substantive validity (DEVELLIS, 2022).

In addition, to assess the number of items placed correctly in a construct, the overall placement ratio (OPR) was used. The OPR provides evidence of the classification of the items, and it is useful to detect measurement error. This indicator guiding decisions to be kept, revised, or deleted items. Measurements with results greater than 70% indicate high reliability (BANDALOS, 2018).

After each round, the above estimators were used to improve the multi-item scale to measure people's awareness of CE. For example, several items (low validity estimators, no consensus between judges, and/or redundant) were eliminated. After the fourth round, the reliability and validity estimators were considered acceptable. We obtained Cohen's $\kappa$ larger than 0.4, the average of Perreault and Leigh's Ir was greater than 0.7, and the validity estimators (PSA and CSV) were greater than 0.8 and 0.64, respectively. Finally, after the necessary analysis and modifications, an OPR greater than 0.70 was achieved (see Table 9 and Table 10).

Table 9 - Comparison of inter-rater reliability and validity estimators

| Reliability and validity estimators | First round | Second round | Third round | Fourth round |
|---|---|---|---|---|
| Inter-judge agreement percentage | 28%–52% | 36%–76% | 43%–80% | 53%–83% |
| Cohen's $\kappa$ | 0.27 – 0.51 | 0.33 – 0.70 | 0.41 – 0.68 | 0.47 – 0.82 |
| Perreault and Leigh's *Ir* | 0.43 – 0.69 | 0.52 – 0.86 | 0.60 – 0.89 | 0.78 – 0.90 |
| Proportion of substantive agreement (PSA) | 0.57 | 0.68 | 0.74 | 0.81 |
| Coefficient of substantive validity (CSV) | 0.36 | 0.54 | 0.47 | 0.70 |
| Overall placement ratio (OPR) | 51% | 59% | 66% | 78% |

Source: prepared by the author.

In this process, the constructs "waste separation", "waste reduction", "water saving", and "energy conservation" represented low rates in the first rounds, indicating that the judges had difficulty in distinguishing between these items. Therefore, these constructs were merged and renamed "waste management" (waste separation, waste reduction) and "rational use of resources" (water saving, energy conservation). The same happened for the constructs "using sustainable packing", "sustainable products", and "buying environmentally labelled products", which were changed to "use of sustainable products or packaging", generating positive results in reliability and validity.

In addition, the construct "buying second-hand products" was incorporated into the construct "sharing economy". The sharing economy refers to the collaborative consumption of goods and services, aiming for the redistribution and sustainable use of resources. This strategy encompasses practices for sharing spaces, means of transport, housing, and other practices to reduce costs and increase sustainability, such as purchasing second-hand (used) products.

Table 10 - Overall placement ratios (OPRs) for each construct

| Constructs | Overall placement ratio (OPR) | | | |
|---|---|---|---|---|
| | First round | Second round | Third round | Fourth round |
| Waste management | 49% | 51% | 60% | 78% |
| Rational use of resources | 52% | 73% | 88% | 87% |
| Remanufacturing | 56% | 55% | 69% | 74% |
| Recycling | 42% | 42% | 47% | 61% |
| Reuse | 59% | 67% | 78% | 80% |
| Repair/restoration/maintenance | 59% | 67% | 78% | 79% |
| Use of sustainable products or packaging | 44% | 64% | 68% | 82% |
| Virtualisation | 44% | 67% | 67% | 79% |
| Sharing economy | 54% | 58% | 60% | 90% |
| Product-service systems | 43% | 67% | 76% | 83% |
| **Average** | **48%** | **57%** | **69%** | **79%** |

Source: prepared by the authors

Refinements were made to other constructs and assertions to make them more understandable (LUSE; BURKMAN, 2022; MACKENZIE et al., 2011). These changes were made based on the results of each round. The main goal is to make the assertions clearer to the Q-Sort judges. In this sense, each round's results will improve the constructs and measures. Thus, after all changes, 10 constructs and 14 items were considered for use in the scale to measure people's awareness of CE.

### 4.3.3 Step 3 – Ensure Convergent and Discriminant Validity (Pre-test)

After development of measures and model specification, we collect data to conduct a pre-test to preserve scale evaluation and refinement (LAMBERT; NEWMAN, 2022; MACKENZIE et al. 2011). The pre-test was applied to a sample with similar characteristics to the target population of this study to guarantee universality. In this study, the pre-test was applied to people using non-probability sampling, in view of the

exploratory nature of the survey (FORZA, 2002). The SurveyMonkey platform was used to structure the items in a questionnaire format to assess people's awareness of CE. Through the SurveyMonkey platform, the 14 items were administered to a sample of 144 people.

The survey questionnaire was structured in three sections: the first section displayed the informed consent form; the second section gathered respondents' demographic characteristics; and the third section gathered information regarding the level of awareness regarding CE. A seven-point Likert scale was used (from 1 = strongly disagree to 7 = strongly agree). Thus, respondents were asked to choose their level of agreement with the assertions offered for each construct.

The informed consent form provided a brief description of the researchers and the research objectives. In this document, we guaranteed the confidentiality of the participants and the information they provided. In addition, we adopted a motivation strategy that consisted of the donation of R$0.50 for each questionnaire answered to an institution dedicated to sustainable causes.

The 144 responses received were evaluated to identify suspicious response patterns, such as the occurrence of straight lines, missing data, and multivariate outliers. To identify the multivariate outliers, we calculated the $Z$-score values (FAULKENBERRY, 2022). After screening the data, one case of a straight line and 13 multivariate outliers were found ($Z$-score > 2.58) and excluded, leaving 130 complete responses.

The profile of the 130 respondents can be defined as follows. Regarding gender, the respondents are segmented into 50% female and 50% male. In addition, 10% are 21 years old or younger, 59% are between 22 and 36 years old, 29% are between 37 and 56 years old, and 3% are 57 or older. Regarding the marital status of the respondents, 52% are single and 44% are married or in a stable union. In addition, 3% are divorced, and 1% did not provide details. Regarding monthly income, the sample is well distributed: 21% earn the minimum wage; 23% earn two to four times the minimum wage; 22% earn five to seven times the minimum wage; 24% earn eight to 11 times the minimum wage; 21% earn more than 11 times the minimum wage; and 13% did not provide details. Finally, regarding education, 55% of the respondents have completed post-graduate studies, 16% have incomplete post-graduate studies, 3% have completed higher education, 2% have incomplete higher education, 20% have completed high school, and 3% have incomplete high school education.

The pre-test was analysed using exploratory factor analysis (EFA) to evaluate the convergent and discriminant validity (third step) to examine the psychometric properties of the scale. This statistical technique can be utilized to examine the underlying patterns or relationships for a large number of items and to determine whether the information can be condensed or summarized in a smaller set of factors or components (FIELD, 2018; Denis, 2019; HAIR et al., 2019). The IBM SPSS version 28.0 was used to apply the EFA and several core metrics were evaluated such as the Kaiser–Meyer–Olkin (KMO) test and Bartlett's test of sphericity.

Regarding the interpretation of the KMO test, values lower than 0.50 are not acceptable, while values between 0.60 and 0.90 are considered excellent (FIELD, 2018; HAIR, et al., 2019; YAN; GONG, 2022). Our KMO test for the items measuring people's awareness of CE showed a value of 0.925 with a $\chi^2$ value of 975.779. From these results we can conclude that the KMO test satisfies the rule of thumb. Furthermore, Bartlett's test of sphericity was examined. This test identifies to what extent the covariance matrix is like an identity matrix to show that they do not correlate with each other (FIELD, 2018). Bartlett's test values with significance levels less than 0.01 indicate that the matrix is uncorrelated and favourable (HAIR et al., 2019). We found Bartlett's test showed a $p$-value equal to 0.000 < 0.01. It is noteworthy that all the indices of the anti-image matrix [measures of sampling adequacy (MSA)] are greater than 0.50, which confirms the satisfactory execution of the EFA method (SHUCK et al., 2017).

Hair et al. (2019) affirmed that EFA analyses the correlations between many variables, resulting in factors (common latent dimensions). Several methods can be used for factor extraction. In this paper, we use principal axis factoring (PAF) (WATTS et al., 2020). This method presents the factors that can explain most of the variance of the sample, making each construct more coherent (NGUYEN et al., 2019). To simplify the factor solution, we used the Promax oblique rotation method and eigenvalues greater than 1 (NGUYEN et al., 2019; WATTS et al., 2020). The rotation consists of building a matrix of the items, and this matrix is rotated until an optimal relationship between the data is found (WATTS et al., 2020). Such a rotation method allows the assumptions of independence between the factors to be removed, simplifying interpretation (DEDEOGLU et al., 2020; NGUYEN et al., 2019).

Table 11 - Communalities regarding the CE awareness construct

| Constructs | Initial | Extraction |
|---|---|---|
| CE AWR 1 | 0.539 | 0.541 |
| CE AWR 2 | 0.583 | 0.571 |
| CE AWR 3 | 0.608 | 0.915 |
| CE AWR 4 | 0.544 | 0.535 |
| CE AWR 5 | 0.512 | 0.533 |
| CE AWR 6 | 0.541 | 0.559 |
| CE AWR 7 | 0.621 | 0.652 |
| CE AWR 8 | 0.562 | 0.646 |
| CE AWR 9 | 0.647 | 0.679 |
| CE AWR 10 | 0.463 | 0.583 |
| CE AWR 11 | 0.376 | 0.369 |
| CE AWR 12 | 0.453 | 0.431 |
| CE AWR 13 | 0.576 | 0.722 |
| CE AWR 14 | 0.519 | 0.536 |

Source: Proposed by the author.

The communalities are the amount of variance (correlations) of each variable explained by the factors (FIELD, 2018). The higher the communality, the better the power of explanation of that factor. The literature indicates a minimum value of 0.5 for the communality to be considered satisfactory (DENIS, 2019; HAIR et al., 2019). As shown in Table 11, the communalities of most items presented values greater than or equal to 0.5. Some items, such as "CE AWR 11" and "CE AWR 12", presented values close to 0.5, but we chose to keep them for a conservative approach. Given these results, the "CE AWR 12" construct was rewritten and simplified as follows: "I am aware of the benefits of using virtual products instead of physical products for Circular Economy principles (e.g. buying eBooks instead of printed books; listening to music on Spotify instead of buying CDs; renting a game on a game streaming instead of buying a physical game)".

Hair et al. (2019) pointed out that the limit of the factorial load to be adopted depends on the sample size, and the larger the sample size, the lower the factorial load. Thus, the candidate items to be excluded were those with loadings lower than 0.50 (cut-off) and cross-loadings higher than 0.50 on the same factor and communalities lower than 0.50 (WATTS et al., 2020). In the present study, the analysis resulted in a diagonal matrix greater than 0.5, ensuring the adequacy of the sample.

The explained variance (sum of the squares of the explained variance values) describes how reliable the model that describes the observable phenomenon is (FURR,

2017). We obtained three factors extracted with eigenvalues greater than 1. People's awareness of CE explained the total variance of 58.37%, with the respective divisions of 48.17% (Factor 1), 5.22% (Factor 2) and 4.98% (Factor 3). Table 12 shows the distribution of the waves in each factor.

Table 12 - Distribution of loads in the extracted factors for the CE level of awareness

| Item | Code | Factor 1 | Factor 2 | Factor 3 |
|---|---|---|---|---|
| I am aware of the benefits of recycling products, components and packaging for Circular Economy principles. | CE AWR 8 | 0.888 | | |
| I am aware of the benefits of using sustainable products and/or packaging for Circular Economy principles. | CE AWR 9 | 0.731 | | |
| I am aware of the benefits of using environmentally certified products for Circular Economy principles. | CE AWR 10 | 0.723 | | |
| I am aware of the benefits of product restoration and repair for Circular Economy principles. | CE AWR 7 | 0.681 | | |
| I am aware of the benefits of reusing products, components or packaging for Circular Economy principles. | CE AWR 6 | 0.680 | | |
| I am aware of the benefits of buying, using, selling, sharing or donating second-hand (used) products for Circular Economy principles. | CE AWR 14 | 0.566 | | |
| I am aware of the benefits of practicing collaborative consumption (sharing economy) for Circular Economy principles (e.g. co-working spaces, Uber, Airbnb). | CE AWR 13 | | 0.866 | |
| I am aware of the benefits of using remanufactured products for Circular Economy principles (e.g. Amazon, which sells remanufactured printer toners). | CE AWR 5 | | 0.710 | |
| I am aware of the benefits of renting a product (paying for the use of the product rather than buying it) for Circular Economy principles (e.g. renting a coffee machine instead of buying it). | CE AWR 11 | | 0.616 | |
| I am aware of the benefits of rational energy use (electric; fossil fuels such as gasoline, diesel and natural gas; and renewables such as ethanol) for Circular Economy principles. | CE AWR 3* | | | 0.981 |
| I am aware of the benefits of the rational use of water resources (water) for the principles of the Circular Economy. | CE AWR 2 | | | 0.546 |
| I am aware of the benefits of reducing resource consumption (any item consumed by you) for Circular Economy principles. (e.g. electricity and water consumption, purchase of electrical and electronic goods, clothing etc.). | CE AWR 4*** | | | 0.430 |
| I am aware of the benefits of waste separation, disposal and reduction for Circular Economy principles. | CE AWR 1** | 0.391 | 0.264 | |
| I am aware of the benefits of using digital products instead of physical products for Circular Economy principles (e.g. buying ebooks instead of printed books; listening to music on Spotify instead of buying CDs; renting a game on a game streaming instead of buying a physical game) | CE AWR 12*** | | | 0.147 |
| **Percentage of variance explained** | | **48.17** | **5.22** | **4.98** |
| **Cumulative explained variance percentage** | | **48.17** | **53.39** | **58.37** |

Source: prepared by the author.

The candidate items to be excluded were those with loadings lower than 0.50 (cut-off) and cross-loadings higher than 0.50 on the same factor (WATTS et al., 2020). However, it is worth noting that the literature recommends caution in eliminating items in this phase of the EFA. Thus, even if the loadings represent inappropriate values in the factor extraction phase, it is vital to consider the item's significance in terms of the content (NETEMEYER; BEARDEN; SHARMA, 2003).

From a conservative perspective, we kept item "CE AWR 4" because we consider this item extremely important in evaluating people's awareness of resource consumption. Furthermore, with the help of an expert, we chose to divide item "CE AWR 1" in two items, namely "I am aware of the benefits of waste reduction for Circular Economy principles" and "I am aware of the benefits of waste separation and/or disposal for Circular Economy principles". The item "CE AWR 12" showed a loading lower than 0.5. However, its content is essential for constructing the scale, so we decided to rewrite this item and keep it. Thus, the scale is now composed of 15 items that measure people's awareness of CE. Given the rigour in the validation steps suggested by DeVellis (2022), Lambert and Newman (2022) and MacKenzie et al. (2011) We opted for a more conservative posture regarding eliminating an item from the scale in this purification step. We emphasise that we adopted a more rigid stance in the scale's reliability and validity assessment stage described in the next section.

## 4.3.4 Step 4 – Ensure Convergent and Discriminant Validity (Survey)

Based on the results of the EFA analyses, we performed a scale purification and refinement with problematic factor loadings (LAMBERT; NEWMAN, 2022; MACKENZIE et al., 2011). After these modifications, the questionnaire comprised 15 items. A new survey was conducted with people over 18 years old, distributed throughout the Brazilian national territory through non-probability sampling. As this is an exploratory study, this type of sampling is recommended (FORZA, 2002). We used the SurveyMonkey data collection platform, as in the pre-test phase. To facilitate data collection, we used social networks (Facebook and Instagram) to disseminate the questionnaires to the public. According to (DILLMAN; SMYTH; CHRISTIAN, 2014) Online questionnaires have several benefits, such as reaching distant respondents, reducing research bias, increasing the survey's response rate, and being more convenient for the respondents. The research instrument and the processes of planning, conducting,

and administering the survey followed the same procedures described in the pre-test phase.

After 40 days of data collection, we obtained 1,046 responses to validate these items. We identified 12 cases with missing answers, 34 cases of straight lines, and 170 multivariate outliers based on the *Z*-score values (FAULKENBERRY, 2022). Thus, we obtained a final sample of 820 respondents. As we obtained two waves of responses in this study, to evaluate non-response bias, we performed two statistical tests. First, we ran a multivariate analysis of variance (MANOVA) to detect this bias based on multiple characteristics (i.e., age and wage) and found no significant difference ($p > 0.05$) between them (CLOTTEY; BENTON, 2020). Second, to support this evidence, we ran a *t*-test comparing sample groups from early vs. late responders. Again, we found no significant ($p > 0.05$) difference between the two. From these results, we can assert non-response bias is not a threat to the validity of our findings (VOGEL; JACOBSEN, 2021). Subsequently, we tested for common method variance (CMV) by using a marker variables approach (MILLER; SIMMERING, 2022). The confirmatory factor analysis (CFA) results do not show a strong and significant correlation ($r = 0.038$) between a marker variable and the main constructs in the model. In addition, the goodness of fit indices (GOFI) produced by the CFA marker were poor (Miller and Simmering, 2022). From these two results we concluded that CMV is absent and not a threat in this study.

The profile of the 820 respondents can be defined as follows. Regarding gender, the respondents are segmented into 76% female and 23% male. Regarding the sample's age range, 48% are 58 years or older, 40% are between 37 and 56 years old, 10% are between 22 and 36 years old, and 2% are 21 years old or younger. Regarding marital status, 51% are married or in a stable union, 29% are single, 14% are divorced, and 5% are widowed. Regarding monthly income, the sample is well distributed: 33% earn two to four times the minimum wage; 22% earn five to seven times the minimum wage; 10% earn eight to 11 times the minimum wage; 11% earn more than 11 times the minimum wage; 10% earn the minimum wage; and 14% did not provide details. Finally, regarding education, 38% of the respondents have completed post-graduate studies, 30% have completed higher education, 12% have completed high school, 11% have incomplete higher education, 5% have incomplete post-graduate studies, and 4% have incomplete high school education. Regarding occupation, 29% are public servants, 26% are retired, 16% are individual microentrepreneurs, 10% are employees in private companies, 9% are unemployed, 6% are students, 2% are entrepreneurs, and 3% of the respondents did not

provide details. Regarding gender, the respondents are segmented into 76% female and 23% male. Regarding the sample's age range, 48% are 58 years or older, 40% are between 37 and 56 years old, 10% are between 22 and 36 years old, and 2% are 21 years old or younger. Regarding marital status, 51% are married or in a stable union, 29% are single, 14% are divorced, and 5% are widowed. Finally, regarding monthly income, the sample is well distributed: 33% earn two to four times the minimum wage; 22% earn five to seven times the minimum wage; 10% earn eight to 11 times the minimum wage; 11% earn more than 11 times the minimum wage; 10% earn the minimum wage; and 14% did not provide details.

To ensure the reliability and validity of the measurement scale, we performed covariance structure analysis (CSA) and evaluated the GOFI values generated by the CFA. Following previous studies in scale development (LUSE; BURKMAN, 2022; SHUCK et al., 2017; YAN; GONG, 2022), CSA is an appropriate structural equation modelling (SEM) approach and enables us to confirm and validate items of measurement. According to Jöreskog et al.(2016) and Whittaker and Schumacker (2022), this is a suitable SEM approach for testing latent factors with reflective indicators (as in our case for CE dimensions and subdimensions) and this method is useful for validating latent factors which are often theorized in the operation management literature. Finally, CSA considering measurement errors in the validation of scale development.

We use analysis of moment structure (AMOS) version 28.0 (ARBUCKLE, 2021), to execute our CFA model via the maximum likelihood (ML) estimator. First, through the Mardia's multivariate normality test, we obtained insignificant skewness and kurtosis values ($p > 0.05$). Based on these results, we conclude that our data satisfies the assumption of data normality (JÖRESKOG; OLSSON; WALLENTIN, 2016; WHITTAKER; SCHUMACKER, 2022) We support this assumption by using the Shapiro-Wilk test and obtained a similar conclusion ($p > 0.05$). The descriptive statistics for CE dimensions are depicted in Table 7. We obtained mean values for all constructs less than 7 and standard deviation (SD) not more than 2. Both do not exceed the maximum and minimum thresholds (FAULKENBERRY 2022). Hereinafter, the correlation value between latent variables mostly has been maintained at less than 0.6 and the sign is not reversed (see Table 7). From these results, we argue that our model is free from the issue of multicollinearity (HAIR et al., 2019). We confirm this conjecture by calculating the value of the variance inflation factor (VIF) for each predictor and wherein the obtained VIF values are less than 3.3 and therefore obeys to the rule of thumb.

We assessed the convergent and discriminant validity of the measurement scale. We performed CFA (NYE, 2022) and evaluated the standardized loading factor (SFL), average variance extracted (AVE), Heterotrait-Monotrait (HTMT) and HTMT 2 ratios, maximum shared variance (MSV) and average shared variance (ASV) to test convergent and discriminant validity. In Table 13, we obtained SFL values greater than 0.6 and the AVE values greater than 0.5. From these results we conclude that convergent validity is well established (BANDALOS; FINNEY, 2019; NYE, 2022). Complementary, we obtained values for the HTMT and HTMT2 ratios less than the 0.85 threshold based on the multitrait-multimethod (MTMM) matrix (Table 14). In addition, we obtained MSV and ASV values both smaller than the AVE values. Based on these results, we reach the conclusion that discriminant validity satisfies the rule of thumb (HENSELER, 2021).

Table 13 - Construct's reliability and validity

| Dimension | Subdimension | Item | SFL | AVE | MSV | ASV | $\alpha$ | $\rho_c$ |
|---|---|---|---|---|---|---|---|---|
| Waste management | Not applicable | AWR1 | 0.889 | 0.78 | 0.58 | 0.46 | 0.87 | 0.88 |
| | | AWR2 | 0.876 | | | | | |
| Rational use of resources | Not applicable | AWR3 | 0.831 | 0.65 | 0.54 | 0.49 | 0.85 | 0.85 |
| | | AWR4 | 0.807 | | | | | |
| | | AWR5 | 0.787 | | | | | |
| Technical cycle | Remanufacturing | AWR6 | 0.635 | 0.64 | 0.60 | 0.51 | 0.87 | 0.88 |
| | Reuse | AWR7 | 0.858 | | | | | |
| | Repair/restoration/maintenance | AWR8 | 0.813 | | | | | |
| | Recycling | AWR9 | 0.877 | | | | | |
| Use of sustainable products or packaging | Not applicable | AWR10 | 0.874 | 0.65 | 0.60 | 0.50 | 0.78 | 0.79 |
| | | AWR11 | 0.731 | | | | | |
| Dematerialisation and collaborative consumption | Product-service systems | AWR12 | 0.791 | 0.50 | 0.35 | 0.35 | 0.76 | 0.80 |
| | Virtualisation | AWR13 | 0.596 | | | | | |
| | Sharing economy | AWR14 | 0.630 | | | | | |
| | | AWR15 | 0.800 | | | | | |

*Note(s):* SFL = standardized factor loading; AVE = Average variance extracted; MSV = Maximum shared variance; ASV = Average shared variance; $\alpha$ = Cronbach's Alpha; $\rho_c$ = Composite reliability.

Source: prepared by the author.

Meanwhile, the internal consistency reliability of people's awareness of CE construct in this study was tested through Cronbach's alpha ($\alpha$) and composite reliability ($\rho_c$). Both measures are required to have a value greater than 0.7 (Nunnally and Bernstein 1994). In Table 6, we report both measures exceeding the recommended threshold, and therefore construct reliability was met. Finally, we evaluate and report Goodness-of-Fit Index (GOFI) values for our CFA model. We consider a number of GOFI values and

compare them with the required cut-off values for our CFA model. We generated the following GOFI values: Comparative Fit Index (CFI) = 0.942 > 0.90, Normed Fit Index (NFI) = 0.935 > 0.90, Tucker-Lewis Index (TLI) = 0.924 > 0.90, Incremental Fit Index (IFI) = 0.942 > 0.90, Relative Fit Index (RFI) = 0.915 > 0.90, Goodness of Fit Index (GFI) = 0.900 > 0.85, parsimony GFI (PGFI) = 0.604 > 0.60, parsimony CFI (PCFI) = 0.718 > 0.60, parsimony NFI (PNFI) = 0.713 > 0.60, Root Mean Square Residual (RMR) = 0.062 < 0.08 and Root Mean Square Error of Approximation (RMSEA) = 0.078 < 0.08. From these derived GOFI values, we reach the conclusion that our CFA model is perfectly fit (JÖRESKOG; OLSSON; WALLENTIN, 2016; KLINE, 2016; WHITTAKER; SCHUMACKER, 2022).

Table 14 - Discriminant validity: HTMT and HTMT 2

| Constructs | 1 | 2 | 3 | 4 | 5 |
|---|---|---|---|---|---|
| Waste management | *(0.85)* | 0.687** | 0.605** | 0.559** | 0.491** |
| Rational use | 0.556 [0.554] | *(0.85)* | 0.595** | 0.435** | 0.337** |
| Technical cycle | 0.637 [0.635] | 0.644 [0.642] | *(0.85)* | 0.372** | 0.456** |
| Use of sustainable | 0.454 [0.453] | 0.764 [0.762] | 0.514 [0.513] | *(0.85)* | 0.328** |
| Dematerialization | 0.342 [0.341] | 0.781 [0.780] | 0.513 [0.742] | 0.527 [0.526] | *(0.85)* |
| Mean | 6.69 | 6.63 | 6.52 | 6.52 | 5.90 |
| Standard Deviation (SD) | 0.91 | 0.97 | 1.01 | 1.04 | 1.43 |

*Note(s):* Brackets show the HTMT2 ratio. Diagonal and bold elements are cut-off values for HTMT and HTMT2. Below the diagonal are the HTMT values. The values above the diagonal show the correlation between latent factors. ** statistically significant at the $p < 0.01$ (two-tailed test).
Source: prepared by the authors.

The structure of the initial measurement model considered some key constructs that were defined throughout the scale validation process. These are: waste management; rational use of resources; remanufacturing; reuse, repair/restoration/maintenance; recycling; use of sustainable products or packaging; product-service systems; virtualisation; and sharing economy. However, after some items were excluded following the entire validation process, some CE strategies were being measured by only one assertion, which caused us to regroup these strategies into categories. Thus, the constructs remanufacturing, reuse, repair/restoration/maintenance, and recycling were regrouped in the dimension "technical cycle". In the technical cycle, products are kept in circulation in the economy through reuse, repair/restoration/maintenance, remanufacture, and recycling. When kept within a technical cycle, the materials will have uses and thus no waste is generated (TSALIS; STEFANAKIS; NIKOLAOU, 2022).

In addition, the constructs product-service systems, virtualisation, and sharing economy were grouped into the dimension called "dematerialisation and collaborative consumption". Dematerialisation consists of reducing the amount of resources used to meet production and consumption needs through strategies, such as virtualisation, product-service systems, and sharing economy (SINGH; CHUDASAMA, 2021). Product-service systems or products as a service consists of an innovative business model that supports the dematerialisation of the economy with a focus on selling services rather than products (KALMYKOVA et al., 2018). These new service-oriented business models encourage industries to increase product life, thus reducing maintenance costs, which are the company's responsibility and no longer the customer's. This practice fits the sharing economy concept, which encompasses collaborative consumption (renting, lending, and trading), thus reducing product idleness by adding services to the business model. Thus, the strategies of dematerialisation and collaborative consumption, which include virtualisation, product-service systems, and sharing economy, are the key to minimising material flows in the economy and increasing the capacity of ecosystems. These strategies have a complementary relationship, which justifies their grouping into a broader dimension in developing the scale.

## 4.4 Discussion

After performing all the steps for constructing and validating the measurement scale, we found a model considered the most adequate. Therefore, we can conclude that the measurement scale for measuring people's awareness of CE is composed of five constructs, measured using 15 items. It is worth mentioning that the initial 10 variables (waste management, rational use of resources, remanufacturing, reuse, repair/restoration/maintenance, recycling, use of sustainable products or packaging, product-service systems, virtualisation, and sharing economy) were derived from the SLR, as well as from the methodological validation process proposed by DeVellis (2022), Lambert and Newman (2022) and MacKenzie et al. (2011), which includes EFA and CFA.

After the interactive validation of the Q-Sort process, we observed that the judges had difficulties in distinguishing some items, since the constructs: "waste separation", "waste reduction", "water saving", and "energy conservation" represented low rates in the first rounds. Thus, we renamed the constructs and regrouped the items as

follows: "waste management" (waste separation, waste reduction); and "rational use of resources" (water saving, energy conservation). The constructs "using sustainable packing", "sustainable products", and "buying environmentally labelled products" also presented low inter-judge agreement percentage indices, so we decided to merge them into one construct ("use of sustainable products or packaging"), which solved the problem in the following rounds. In addition, the construct called "buying second-hand products" was incorporated into the construct "sharing economy". The sharing economy model refers to collaborative consumption and sharing activities, such as exchanging, giving, selling, and renting goods, transportation, food, services, money, space, etc. (KALMYKOVA et al., 2018). In this way, buying used products is considered an activity belonging to the strategy of the sharing economy model.

Throughout the methodological process to assess reliability and validity (item-sorting), we refined the items to simplify then. The rounds with experts aimed to make the constructs and items more understandable, increasing the scale's reliability (DEVELLIS, 2022; MACKENZIE et al., 2011). Thus, some items with low validity estimators, with no consensus between judges, and/or considered redundant were eliminated, and after the last round the estimators [inter-judge agreement percentage, Cohen's $\kappa$, Perreault and Leigh's $Ir$, proportion of substantive agreement (PSA), coefficient of substantive validity (CSV), and overall placement ratio (OPR)] were considered acceptable. After all the modifications, the scale was pre-tested with 15 items to measure people's awareness of CE.

In order to confirm sample reliability, and as recommended by DeVellis (2022) and MacKenzie et al. (2011), we applied a pre-test to 144 people, which resulted in 130 complete responses. We used IBM SPSS version 28.0 to apply EFA to identify underlying factors responsible for collinearity patterns. After the EFA statistical analyses, the communalities of most items showed values greater than or equal to 0.5. The literature suggests a minimum value of 0.5 for the communality to be considered satisfactory (Field, 2018; Hair *et al*., 2019). However, it is worth noting that some items presented values close to 0.5, but we adopted a conservative stance and chose to keep them. At this stage of the EFA, the literature recommends caution in the process of deleting items. Thus, some items were modified (item AWR 12 was rewritten, and item AWR 1 was divided into two items, namely "I am aware of the benefits of waste reduction for the principles of the Circular Economy" and "I am aware of the benefits of waste separation and/or

disposal for the principles of the Circular Economy"). After these changes, the scale consisted of 15 items to measure people's awareness of CE.

To complete the validation process of the measurement scale, we conducted a survey and received 820 valid responses. We utilized CFA to ensure the reliability of the measurement scale and ensure construct reliability, convergent validity, and discriminant validity. As mentioned above, we adjusted the scale throughout the validation process to make it more faithful to its purpose. Thus, the measurement model structure included 10 key constructs: waste management; rational use of resources; remanufacturing; reuse, repair/restoration/maintenance; recycling; use of sustainable products or packaging; product-service systems; virtualisation; and sharing economy. To improve understanding and improve the validation process, we chose to regroup these strategies into similar categories. Thus, remanufacturing, reuse, repair/restoration/maintenance, and recycling constructs were regrouped in the "technical cycle" dimension, and the product-service systems, virtualisation, and sharing economy constructs were grouped in the "dematerialisation and collaborative consumption" dimension.

Technical cycles refer to strategies and processes applied to the development of sustainable product cycles to eliminate waste and reduce resource extraction (FLEURIAULT et al., 2021). The strengthening of technical cycles requires the maturing of producers through the adoption of circular strategies (such as product life cycle design) and the awareness of consumers regarding their attitudes towards the purchase, use, and disposal of products. In this way, remanufacturing, reuse, repair/restoration/maintenance, and recycling strategies contribute to the creation of the cradle-to-cradle economy, so that products continue to circulate in the economy in order to increase natural capital, control finite stocks, and balance the flows of renewable resources (TSALIS et al., 2022).

The dematerialisation and collaborative consumption dimension encompass the strategies of product-service systems, virtualisation, and sharing economy. These strategies are related to activities focusing on producing common use values, the mutualisation of goods, and the organisation of people in networks or communities. In this way, the model transforms waste into added value by sharing products, services, spaces, etc. Thus, the goal is to keep products, components, and materials at their highest level of utility and value at all times, and to reduce waste generation.

The final multi-item measurement scale to measure people's awareness of CE has 15 items reflecting five constructs (see Table 15).

Table 15 - Final scale

| Dimension | Subdimension | Code | Items |
|---|---|---|---|
| Waste management | Not applicable | AWR1 | I am aware of the benefits of waste reduction for Circular Economy principles. |
| | | AWR2 | I am aware of the benefits of waste separation and/or disposal for Circular Economy principles. |
| Rational use of resources | Not applicable | AWR3 | I am aware of the benefits of rational use of water resources (water) for Circular Economy principles. |
| | | AWR4 | I am aware of the benefits of rational energy use (electric, diesel, natural gas, ethanol) for Circular Economy principles. |
| | | AWR5 | I am aware of the benefits of reducing resource consumption (any item consumed by you) for Circular Economy principles (e.g. electricity and water consumption, purchase of electrical and electronic goods, clothing, etc.). |
| Technical cycle | Remanufacturing | AWR6 | I am aware of the benefits of using remanufactured products for Circular Economy principles (e.g. Amazon, which sells remanufactured printer toners). |
| | Reuse | AWR7 | I am aware of the benefits of reusing products, components, or packaging for Circular Economy principles. |
| | Repair/restoration/maintenance | AWR8 | I am aware of the benefits of refurbishing and repairing products for Circular Economy principles. |
| | Recycling | AWR9 | I am aware of the benefits of recycling products, components, and packaging for Circular Economy principles. |
| Use of sustainable products or packaging | Not applicable | AWR10 | I am aware of the benefits of using sustainable products and/or packaging for Circular Economy principles. |
| | | AWR11 | I am aware of the benefits of using environmentally certified products for Circular Economy principles. |
| Dematerialisation and collaborative consumption | Product-service systems | AWR12 | I am aware of the benefits of renting a product for Circular Economy principles (e.g. renting a coffee machine instead of buying it). |
| | Virtualisation | AWR13 | I am aware of the benefits of using digital products instead of physical products for Circular Economy principles (e.g. buying ebooks instead of printed books; listening to music on Spotify instead of buying CDs; renting a game on a game streaming instead of buying a physical game). |
| | Sharing Economy | AWR14 | I am aware of the benefits of practicing collaborative consumption (sharing economy) for Circular Economy principles (e.g. co-working spaces, Uber, Airbnb). |
| | | AWR15 | I am aware of the benefits of buying, using, selling, sharing or donating second-hand (used) products for Circular Economy principles. |

**4.5 Conclusion**

The impacts of the linear production model have generated a series of damaging consequences for the planet's sustainability. Given this scenario, a more regenerative economy transition is becoming increasingly necessary. This transition requires a mental change in how we produce and consume in our society. This mental shift is linked to people's awareness in the supply chain. The transition to CE happens with a change in behaviours, supported by circular business models that have buy-in by the links in supply chains, including businesses and people.

This work aimed to develop and validate a measurement scale for assessing people's awareness of CE. To do so, we adopted a rigorous methodological process following four steps:

1. A SLR to define the constructs.

2. Item-sorting, performed in four different rounds, totalling 124 experts who participated in this process. We used the following reliability measures to analyse these results: Cohen's $\kappa$ (an estimator that assesses the model adequacy); Perrault and Leigh's $Ir$; the proportion of substantive agreement (PSA); the coefficient of substantive validity (CSV); and overall placement ratio (OPR).

3. A pre-test applied to 144 people, in which we used EFA to ensure the convergent and discriminant validity of the measurement of the constructs.

4. Survey application, using the CFA method for data analysis.

The present research is notable because it employs a robust and systematic method to validate a multidimensional measurement instrument to assess people's awareness of CE. This instrument is considered universal and can be applied to samples with diverse characteristics.

People's awareness represents a fundamental role in assimilating and adopting CE-oriented behaviours. Thus, the literature points out that changes and adaptations must occur in all supply chain links for a gradual change from linear to circular systems. This shows that, for industries, companies, and producers to invest in new circular business models, people must be prepared to assimilate and consume these new changes, justifying the importance of research that measures people's awareness of circular practices.

The SLR revealed a growing interest in research aimed at understanding people's awareness of circular strategies. However, we found no studies aiming to develop and

validate a measurement scale that is universal and applicable across different sampling contexts. This was the main motivation of our research.

Future research can use this instrument as a diagnostic tool to map people's awareness of the main CE strategies in different contexts. It is worth mentioning that the statements were developed throughout the study process to improve thinking about the feasibility of the practices in people's daily lives, always aiming to improve their understanding. In addition, the examples related to some constructs also facilitate the respondents' understanding.

It is worth mentioning that the final scale is composed of five constructs and 15 statements, making the application of the instrument less exhaustive and more agile, implying an increase in the response rate among respondents. From this perspective, the scale developed is consistent with discussions about the need for a global transition to an economy based on regenerative and circular consumption.

As opportunities for future research, we highlight the development of measurement scales that assess other supply chain actors or specific sectors. In addition, it is worth noting opportunities to develop measurement scales to assess awareness among companies/industries. Finally, future research can examine the relationship between CE awareness and emerging themes, such as Industry 4.0 technologies.

The scale is focused on measuring people's awareness from the perspective of CE's technical cycles, since the biological cycles present strategies/practices that are not externalisable to the daily life of people. Thus, future research may propose the development of scales focused on the biological cycle for people who are more involved with biological cycle strategies, such as professionals and academics in the agricultural field. For example, in Brazil, future research can analyse the biological cycle strategies in the context of the National Policy of Solid Waste to analyse the strategies applied in companies, cooperatives, associations, and other agents of the supply chain.

Eliminating negative externalities from the economy and decoupling economic development from finite resource consumption are goals that will be achieved through sustainable awareness. Thus, the search for awareness among people, companies, public entities, and other agents is the key to a gradual transition from a linear to a circular economy.

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# 5. THE EFFECT OF PSYCHOLOGICAL BARRIERS AND SOCIAL INFLUENCE ON PEOPLE´S AWARENESS OF CIRCULAR ECONOMY (CE)

## 5.1 Introduction

The Circular Economy (CE) is an approach used worldwide as a national strategy for Sustainable Development (SD), especially after the worsening of the environmental crisis (ALMULHIM; ABUBAKAR, 2021). The CE is a framework that promotes maximum efficiency in using finite resources, based on three principles: eliminate waste and pollution, circulate products and materials, and regenerate nature (FLEURIAULT et al., 2021; POP et al., 2022). Achieving a regenerative economy involves the interaction and participation of all links in a value chain, including various stakeholders such as producers, businesses, government, suppliers, and consumers (ALMULHIM; ABUBAKAR, 2021; KEVIN VAN LANGEN et al., 2021).

The literature has sought to analyse the transition to CE (CALCULLI et al., 2021; POP et al., 2022). However, most of these studies focus on analysis from the perspective of companies and industries operating within business-to-business models (GARCÍA-QUEVEDO; JOVÉ-LLOPIS; MARTÍNEZ-ROS, 2020; KIRCHHERR et al., 2018; RIZOS et al., 2016; SINGH; GIACOSA, 2019). Other papers emphasize the importance the government agencies and private companies in the CE transition (ALVAREZ-RISCO et al., 2021; KHAN et al., 2020). However, if the public is not aware of assimilating the new circular strategies/practices disseminated by businesses, government, and other actors in the value chain, the transition to CE will be compromised and subject to failure (ALMULHIM; ABUBAKAR, 2021). Thus, it is imperative to engage people to promote circular culture (DE FANO; SCHENA; RUSSO, 2022).

The people's awareness is an essential part of the transition to a more generative economy, as people have behaviours and lifestyles that can influence the transition to CE (ALMULHIM; ABUBAKAR, 2021; KEVIN VAN LANGEN et al., 2021). The analysis of people's awareness of CE or any other sustainable approach presents its challenges since the perception of environmental degradation is not immediately tangible (DE FANO; SCHENA; RUSSO, 2022). This perception evolves so slowly in people that it can take years to fully develop (DURSUN; TÜMER KABADAYI; TUĞER, 2019). On the other hand, even if people accept the existence of environmental impacts, they may feel psychologically distant from developing a sustainable awareness, given the unrealistic action of future risk (MCDONALD; CHAI; NEWELL, 2015). In this sense,

some variables can interact positively or negatively with people's awareness of CE (DESROCHERS; ZELENSKI, 2022). Our study considers two variables: Social Influence (SI) and Psychological Barriers (PB). To this end, the main goal of this paper is to assess the effect of Psychological Barriers and Social Influence on People's Awareness of CE.

Environmental psychology identifies several barriers (Psychological Barriers) that may explain how people adopt unsustainable practices and the resistance to pressures for change and increased awareness (DURSUN; TÜMER KABADAYI; TUĞER, 2019). However, to date, they have mainly been gathered to help explain why people do not take action to engage in sustainable change. Concerning Social influence is a significant predictor that refers to the actions practised by other people and can impact their way of thinking and acting (DESROCHERS; ZELENSKI, 2022). In this way, an individual is influenced by the expectations of a group of people or society to which they belong (KHAN et al., 2020). Liu et al. (2017) showed that co-workers, managers, and owners positively influence the intention to reduce waste generation by construction workers. Similarly, Alvarez-Risco et al. (2021) concluded that other companies and people participating in some sustainable strategy (plastic waste recycling) positively influenced the companies' intention to develop circular actions.

To incorporate these barriers into our model, we adopted the Theory of Behavioral Choice (TBC), which shares some elements with the Theory of Planned Behaviour but adds other elements, such as Social Influence and Psychological Barriers. These barriers prevent people's willingness to become more aware of the various ways of preserving the environment, such as CE (LACROIX; GIFFORD, 2018). Gifford (2011) calls these Psychological Barriers "dragons of inaction". This metaphor is used to express how barriers affect the achievement of human goals, such as developing sustainable consciousness in people (DESROCHERS; ZELENSKI, 2022).

People do not engage or engage less than they could with sustainable actions due to psychological barriers (GIFFORD et al., 2022). Gifford and Chen (2017) show that the less aware a consumer is, the less likely to choose behaviour aimed at environmental conservation. This justifies the importance of studies measuring people's awareness of sustainable approaches such as the CE. In addition, there is a lack of studies that analyse the awareness of the general public (people) regarding different approaches to CE, especially in the context of a developing country like Brazil. Marios et al. (2018) analysed the factors influencing the spread of CE in Greece, while Khan et al. (2019) studied

consumers' intentions towards plastic waste. However, these studies investigated people's awareness with a focus on just one dimension of CE approach, i.e., they adopted a more singular analysis.

Developing a clearer understanding of people's awareness of CE, including the Psychological Barriers and Social Influence is essential for achieving success in changing actions aimed at CE principles. However, to the best of our knowledge, there is no empirical research addressing the relationship between Social Influence, Psychological Barriers, and people awareness under the five dimensions of CE. Hoping to fill this literature gap, this study aims to assess the effect of Psychological Barriers and Social Influence on People's Awareness of CE.

The paper is structured as follows: after a brief introduction, section 5.2 presents the conceptual basis of CE and the concept of CE concerning people awareness; Theoretical Background and Hypothesis development are in section 5.3; Research methods are described in Section 5.4; The main findings and discussion are shown in Sections 5.5; Finally, section 5.6 provides some concluding remarks and recommendations for future research.

## 5.2 Conceptual Basis

Although the literature presents studies that investigate people's awareness of CE, this relationship is investigated singularly, i.e. considering one or another CE approach (ALMULHIM; ABUBAKAR, 2021; TESTA; IOVINO; IRALDO, 2020). CE is a very broad and comprehensive approach, and its concept comes from other schools of thought, such as industrial ecology, blue economy, and cradle-to-cradle (WEETMAN, 2019). Given its complexity, measuring people's awareness of CE is not easy, so we consider different approaches, as shown below.

## 5.2.1 The general concept of Circular Economy (CE)

CE is a worldwide strategy, where the linear structure is shifted to a closed loop structure through various strategies aimed at eliminating waste and pollution, circulating products and materials and generating nature (ALMULHIM; ABUBAKAR, 2021; HUGO; DE NADAE; LIMA, 2021). Thus, the objective is always to retain the highest utility and value of products, components, and materials (TESTA; IOVINO; IRALDO, 2020).

The CE is part of a resource-efficient, sustainable way of life and management that, in addition to reducing negative impacts along the supply chain, establishes sustainable living (POP et al., 2022). To achieve sustainable living, people must be aware and prepared to assimilate new practices into their daily lives (SMOL et al., 2018a). Growing awareness among policymakers and the public represents a driving force for the circular transition worldwide (ALARJANI et al., 2021). Therefore, raising people's awareness is one of the first steps towards achieving a self-sufficient and regenerative planet.

**5.2.2 The concept of Circular Economy (CE) concerning People's Awareness**

The uptake of CE strategies by nations requires long-term educational awareness-raising measures (GHERHEŞ; FĂRCAŞIU; PARA, 2022). In addition, some countries follow a centrally planned economy, making CE implemented through a top-down approach CE (ALMULHIM; ABUBAKAR, 2021). This approach starts with business, government, and other institutions (top), while people (down) are not adequately integrated at various levels for an efficient transition to CE (ALMULHIM; ABUBAKAR, 2021). Thus, in practice, the CE implementation plans involve rigid strategic actions that are difficult for the public to assimilate (TESTA; IOVINO; IRALDO, 2020). Thus, the people's awareness of CE is an important topic since the transition starts with people, who will adopt behaviours oriented to a more regenerative economy (CALCULLI et al., 2021).

There are CE strategies geared towards application in different supply chain contexts, such as customization/make to order; design for disassembly/recycling; design for modularity; eco-design; green procurement, and other strategies directed towards corporate management (VELASCO-MUÑOZ et al., 2021). In addition, the continuous flow of materials in CE can occur through biological or technical cycles (LAHANE; PRAJAPATI; KANT, 2021). The biological cycle is based on the premise that nature is restorative, so one species' waste is fed to another (VANHAMÄKI et al., 2020b). In practice, the biological cycle is composed of strategies such as: cascading, in which the waste from one process becomes input for another product; permanent agriculture, which aims to mimic natural forest ecosystems by applying strategies such as agroforestry planting, composting and anaerobic digestion (WEETMAN, 2019). However, these biological cycle strategies are more tied to producers, farmers, industries, and companies,

which are distant from people's everyday reality. This research considers CE approaches that are targeted to people's daily lives, i.e., approaches closer to people's reality.

The literature presents important predictors for analysing the relationships for creating sustainable awareness in people (JAIN et al., 2023; XU et al., 2022).However, these studies presented a more specific analysis, i.e., specializing in one direction to investigate people's awareness. Thus, studies analyse people's awareness according to a specific approach as remanufactured products (SINGHAL; JENA; TRIPATHY, 2019); buying an environmentally responsible service (HAN; YOON, 2015); eco-friendly packaging (NGUYEN et al., 2020); buying green product (ALVAREZ-RISCO et al., 2021).Others examples are Khan; Ahmed and Najmi (2019), who analysed people's awareness from the recycling perspective; or Trần et al. (2022), who considered awareness from the perspective of purchasing sustainable products or services. Therefore, the present study becomes a differential as it considers the diversity of the CE context, taking into consideration its five different approaches: (i) Rational use of Resources (RUR), (ii) Waste Management (WM); (iii) Sustainable Products and Packing (SPP); (iv) Dematerialization and Collaborative Consumption (DCC) and (v) Technical Cycles (TC), (see Figure 10).

Figure 10 - Circular Economy approaches used in the research
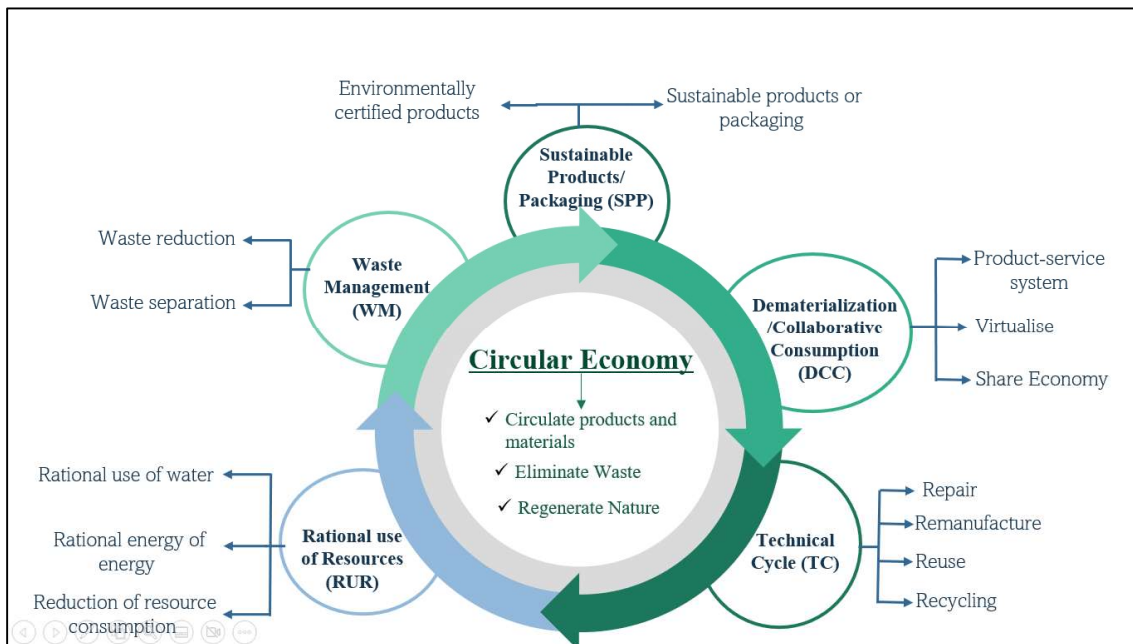


Source: Proposed by the authors

The Rational Use of Resources (RUR) involves activities aimed at preserving and conserving natural resources to ensure an ecologically sound environment for health and human life (KORYAKINA et al., 2021). When considering people's everyday reality, the Rational Use of Resources involves the conscious use of water, energy and other resources. Waste management (WM) comprises the treatment of materials, such as the collection, transportation, processing, recycling or disposal of waste materials, produced by human activity (FISHER et al., 2020). The Sustainable Products and Packing (SPP) are grown without the use of toxic chemicals and under hygienic conditions; these products can be recycled, reused, and can be biodegradable; they are eco-efficient and have reduced or zero carbon and plastic footprint (KOCHAŃSKA; ŁUKASIK; DZIKUĆ, 2021).

Dematerialisation involves quantitative reduction of resources to serve an economic function (VELENTURF; PURNELL, 2021). Collaborative consumption is a new approach to accessing goods, considered as a paradigm shift away from the linear economic model (sellers on one side and consumers on the other) (KOCHAŃSKA; ŁUKASIK; DZIKUĆ, 2021). Collaborative consumption involves cooperation, so that on a smaller scale, people can act as producers, sellers and consumers (KALMYKOVA; SADAGOPAN; ROSADO, 2018b). This new model focuses on the efficient distribution of resources, rather than private ownership, e.g. exchange, sharing, gift, loan and lease or rent (SINGH; CHUDASAMA, 2021). People can engage in Dematerialisation and Collaborative Consumption (DCC) activities, such as renting a product instead of buying (Product Service System), using digital products instead of physical products (Vistualise), and using sharing apps like uber and Airbnb (Sharing Economy) (CASAREJOS et al., 2018).

The Technical Cycle (TC) comprises a set of strategies and processes applied to developing closed loops. It aims to keep materials in circulation and use, reducing waste generation (FLEURIAULT et al., 2021). Furthermore, the repair and refurbishment aim to reuse products to extend their useful life (KALMYKOVA; SADAGOPAN; ROSADO, 2018b). So, people can repair a fan blade and change a blender glass instead of discarding them and buying new products (BIGERNA; MICHELI; POLINORI, 2021). Similarly, people may prioritize buying companies/brands/products with the most significant potential to be fixed or restored.

The remanufacture uses reverse logistics for returning old products to the factory, disassembling, and refurbishing (CHUN et al., 2022). The product has fulfilled its

functionality and is ready to be used again, instead of being disposed (CHUN et al., 2022). The success of remanufacturing for CE depends on people's awareness of returning products through reverse logistics and consuming such products (BAG; GUPTA; FOROPON, 2019). A study developed in Poland showed that people are interested in remanufactured products as long as the cost-benefit is positive (SMOL et al., 2018a). Another survey showed that consumers have a poor opinion of remanufactured products and are often not prepared to use them (HAZEN; MOLLENKOPF; WANG, 2017).

Reuse consists in extending the product's useful life for the same function or in several other possibilities of use, increasing its value (GHERHEŞ; FĂRCAŞIU; PARA, 2022). In the same way that companies can design their products to have a longer life cycle, people can reuse products, components, and packaging in other applications in their daily lives. Through selective collection, recycling reduces production costs, conserves resources, and keeps materials in use in the value chain (SHEN et al., 2022). In addition, recycled materials can be used as resources to create new products that are consumed by people (GHERHEŞ; FĂRCAŞIU; PARA, 2022). Thus, public awareness is paramount for CE because people must recognize the value and importance of recycling to consume recyclable products (SUJATA et al., 2019).

## 5.3 Theoretical Background and Hypothesis development

All the 3 hypotheses of the present research are supported by TBC.

## 5.3.1 Theory of Behavioral Choice (TBC)

Considering that there may be obstacles to the transition to CE, impeding people's efforts towards a more sustainable lifestyle, we sought to understand the relationship between Psychological Barriers, Social Influence and People Awareness of CE. To support such relationship, we drew inspiration from Theory of Behavioral Choice (TBC), proposed by Gifford; Lacroix and Chen (2018). The TBC is a theory that describes how individuals make decisions and choices based on different variables. The TBC improves upon the Theory of Planned Behavior (TPB) by incorporating others variables to understand the intention-behaviour gap  (GIFFORD; LACROIX; CHEN, 2018). The TBC model shares some constructs with TBP (Attitude, Perceived control and Social norms), adding others elements: Habit, Affect, Felt Obligation, Intention, Structural Barriers and Psychological Barriers. Our study draws on TBC by incorporating two

constructs from this theory into our theoretical model: Psychological Barriers and Social Influence.

### 5.3.2 Hypothesis development

Many individuals may engage in pro-environmental change but do not, or not as much as they can, because there are Psychological Barriers. Therefore, understanding the psychological barriers related to CE awareness is necessary to develop interventions needed to effect more sustainable behaviours. The Dragons of Inaction Psychological Barrier (DIPB) is used to explain why people do not contribute to sustainable development. Gifford (2011) described 30 psychological barriers (dragons) that hinder a person's desired actions and tentatively placed them into seven categories: (i) Social Comparisons, which refers to the fear of disapproval of some action by people close to them; (ii) Limited Behavior, is considered that it is already doing enough to contribute to sustainable development; (iii) Discredence, includes denial of environmental problems, as well as mistrust of the authorities; (iv) Ideologies, includes political ideologies, religion and a general belief that all will be well or that technology will save; (v) Perceived Risk, includes the perception of a variety of risks such as financial risks and functionality risks of new sustainable technologies; (vi) Sunk Costs, which considers conflicting interests concerning supporting sustainable development and giving up personal interests, considering involvement in sustainable actions as too expensive or time-consuming; (vii) Limited Cognition, related to the perception that the person does not have sufficient knowledge/skills to participate in actions directed towards sustainable development. The present study considers two categories of dragons in particular: Sunk Costs (lack of time and money) and Limited Cognition (Lack of technical/personal skills, lack of information and educational training).

The Sunk Costs Dragons explain that people have conflicting goals/ aspirations and are resistant to change, maintaining the current status quo, because they find it difficult to adopt sustainable strategies (DESROCHERS; ZELENSKI, 2022). The cost and time are inserted in the variable Sunk Costs when people consider supporting sustainable development as expensive or time-consuming. Khan et al. (2020), which identified lack of time as a barrier to separating plastic waste. Thus, a person would not spend time and/or money engaging in an environmentally friendly activity if that choice does not result in desired and personal benefits (LACROIX; GIFFORD, 2018). An example is the

acquisition of sustainable products or packaging using environmentally certified products, which can cost more than conventional products and therefore represent a barrier to people (LU et al., 2020a). Khan; Ahmed; Najmi, (2019) showed that needing to incur expenses to perform the disposal of materials for recycling might generate demotivation. This occurs primarily in developing countries which still lack standardization of public policies to promote sustainability.

The Limited Cognition Dragons (Lack of technical/personal skills, lack of information and educational training) refers to people perceive that they do not have sufficient knowledge and/or technical skills to adapt to and participate in strategies aimed at sustainable development. For example, in the study of Lacroix; Gifford and Chen (2019) considered the following dimensions to compose the construct Lack of Knowledge: "I don't understand enough of the details" and "I'd like to change, but I'm not sure where to begin". Bosone; Chaurand and Chevrier (2022) indicated a significant effect between intention to increase the use of eco-responsible transport modes and lack of knowledge, i.e. , the more participants reported not knowing conservation behaviour well, the less they were willing to change. Thus, this construct refers to people's perception concerning their lack of knowledge about the various strategies related to sustainable development (MCNICHOLAS; COTTON, 2019). Thus, our study considers Psychological Barriers as obstacles that people face and can interact negatively with CE awareness.

An emerging body of academic literature has sought to examine the barriers and drivers in the transition to CE (RUSSELL; GIANOLI; GRAFAKOS, 2020). These studies primarily focus on specific supply chain sectors, such as industry, as Van Buren et al. (2016) who highlighted institutional, social, and professional barriers and the need for a holistic and multi-stakeholder approach. Research by de Rizos et al. (2016) points to financial constraints, lack of government support and knowledge about CE as important barriers to circular transition in small and medium enterprises. A study on stakeholders' perceptions of the transition to CE in the European Union, reported that CE implementation is expensive for both businesses and consumers, which can be considered a constraining factor (KEVIN VAN LANGEN et al., 2021). Previous studies showed empirical evidence between Psychological Barriers and pro-environmental behaviour (DURSUN; TÜMER KABADAYI; TUĞER, 2019; LACROIX; GIFFORD, 2018). Dursun et al. (2019) showed that denial mechanisms impair energy conservation behaviour; Khan et al. (2020) concluded that barriers produced a negative result

concerning plastics recycling. Gifford (2011) considers the lack of knowledge/information as a Psychological Barrier that can lead to restrictions regarding sustainable actions. Despite these findings, the literature still lacks more studies focusing on Psychological Barriers and that consider other sustainable approaches such as CE. Moreover, understanding the relationship between Psychological Barriers and people's awareness of CE is necessary to promote and transition policies and strategies. Based on what was presented, we claim that people's awareness of CE would be diminished by Psychological Barriers. Thus, we formulate the following hypotheses:

*H1. The Psychological Barriers restrict people's awareness of CE*

To support hypothesis 2 and construct the Social Influence, we were also inspired by the TBC. The Social Influence is also called Social Norms. Social Influence is related to the influence of third parties on people, having direct relation with the construction of idea and formation of individual opinion, once people take into consideration the opinion and expectations of other people when deciding what is appropriate (KHAN et al., 2020). This construct is also present in other important theories such as the Theory of Planned Behavior (TPB) that has been used in research focused on the analysis of people within the sustainable context (YURIEV et al., 2020). Several researchers have already used the Social Influence for studies with a sustainable focus. Verma and Chandra (2018) studied the choice and environmentally friendly hotels by Indian. Chang and Yansritakul (2017) studied consumers' purchase intention for eco-friendly products; in addition, Khor and Hazen (2017) showed the purchase intention for remanufactured products in Malaysia. Xu et al. (2022) analysed the antecedents influencing consumers' use of used-clothing sharing platforms, while Jain et al. (2023) focused on analysing small and medium retailers concerning the marketing of second-hand clothes.

People can be influenced by several variables within modern society that help us understand the world and make decisions based on the information we receive (HOFFMAN; HENN, 2008). Sujata et al. (2019) showed peers influence and social media influence on recycling intention. Individuals need to feel aligned with the norms of their social group (CALCULLI et al., 2021). Social influence is a significant predictor for assessing people's awareness, as it represents other people's expectations (family/friends and celebrities) (POP et al., 2022). In addition, they refer to individuals' beliefs about how their reference groups perceive them. Social influence denotes that individuals interact

with others and can be influenced by them (XU et al., 2022). Other studies also name this construct Social Norms, such as Ghazali et al. (2019) who analysed the relationship of social norms with pro-environmental behaviours. It is important to note that studies in the literature use the traditional model of the of behavioural theories, incorporating additional variables to increase its explanatory power (DE FANO; SCHENA; RUSSO, 2022; KHAN et al., 2020; POP et al., 2022).

Social Influence shows that ideals and behaviours of family and friends, can affect the way people think and act on a certain issue, as pointed out in the study of Cheng et al. (2019), which showed that people listen to the opinions of acquaintances and general reputation when buying a product or service. The study by Khan; Ahmed and Najmi, (2019) revealed that individuals are more likely to participate in recycling activities if people who are essential to them promote and encourage recycling. Similarly, Pop et al. (2022) showed that the opinion of friends and family members positively influenced respondents' pro-environmental awareness. Thus, social influence significantly impacts people's behavioural change (POP et al., 2022). On the Other hand, Singh and Giacosa (2019) reveal that social influence can play a detrimental role in the transition to CE.

The consumerism-driven lifestyle, for example, is a factor that makes up the various layers of society and can guide a group of people and the society to adopt habits that go against the circular model (SINGH; GIACOSA, 2019). This ideology is the result of the capitalist system, based on the prerogative that consumption is gratifying and desirable and is a requirement for inclusion in a social group (HUGO; DE NADAE; LIMA, 2021). Thus, CE strategies such as Product Service System (PSS), Virtualise, and Share Economy contradict certain subjective norms rooted in people, such as possession and ownership. Thus, people may hesitate towards circular alternatives, influencing others to follow this thinking pattern (HUGO; DE NADAE; LIMA, 2021).

We consider that social influence is composed of the influence of family and friends and the celebrities people follow on social media. Thus, we want to identify in the context of a developing country whether social influence positively affects people's awareness of CE. Furthermore, we will seek to understand the moderation relationship between Social Influence and Psychological Barriers on people's awareness of CE. To this end, the following two hypothesis have been developed:

*H2. The people's awareness of CE is positively influenced by Social Influence;*

*H3. Social influence positively moderates the relationship between Psychological Barriers and people's awareness of CE;*

Based in these 3 hypothesis, we propose the theoretical research model, as shown Figure 11.

Figure 11 - Theoretical research model
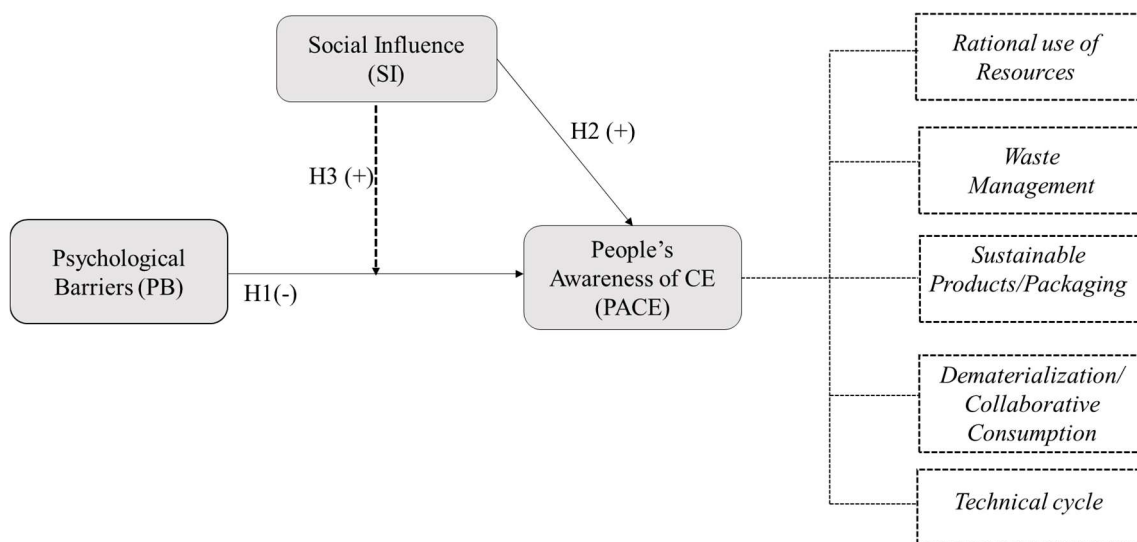


Source: prepared by the authors

## 5.4 Research Method

## 5.4.1 Measures and questionnaire development

A systematic literature review (SLR) was conducted to map these approaches to measure people's awareness of CE more fully. In addition, we used the literature review published by Kalmykova et al. (2018), which presented 45 strategies that can be applied to different value chain actors. To ensure reliability and validity after RSL, the survey questionnaire was validated using a systematic process determined by Menor and Roth (2007); DeVellis (2022) and Lambert and Newman (2022). First, these constructs and items were reviewed by experts through an item ranking process in four different rounds. We used three reliability estimators: Interjudge Agreement Percentage; Cohen's kappa and Perreault and Leigh's Ir. In addition, we use three estimators to ensure validity:

Proportion of Substantive Agreement (PSA); Coefficient of Substantive Validity (CSV); and Overall Placement Ratio (OPR) (DEVELLIS, 2022; MENOR; ROTH, 2007). We conducted a pre-test that was applied to 144 people and used Exploratory Factor Analysis (EFA) to ensure the psychometric properties of the scale. (WATSON, 2017). We used non-probability sampling, given the exploratory nature of the research (FORZA, 2002). The Kaiser-Meyer-Olkin (KMO) test and Bartlett's test of sphericity were used to ensure convergent and discriminant validity. In addition, we used Principal Axis Factoring (PAF) and Promax Oblique Rotation method (HAIR JR. et al., 2009; WATTS et al., 2020). We adjusted the scale items with problematic factor loadings based EFA. We conducted a survey with 1046 people and adopted Confirmatory Factor Analysis (CFA) to ensure the constructs' reliability and convergent and discriminant validity. This research method was necessary for the construction and validation of the scale to measure people's awareness of CE. After all these steps to ensure convergent and discriminant validity, 5 constructs and 15 final items were used to measure People's Awareness of CE (PACE) (see Table 16).

The survey questionnaire is composed of three sections. The first section was composed of questions necessary to characterize the respondent. The second section was composed of 15 items to measure people's awareness regarding five CE approaches (Table 16). The third section presented the assertive referring to Psychological Barriers and Social Influence (Table *17*). We used a 7-point likert scale, with 1 (strongly disagree) and 7 (strongly agree). In each statement, the respondent chose the degree of agreement concerning each item.

Table 16 - Constructs and Items for Measuring People's Awareness of CE (PACE)

| Dimension | Subdimension | Item | Code |
|---|---|---|---|
| Waste Management (WM) | Waste reduction | I am aware of the benefits of waste reduction for CE principles. | AWR1 |
| | Waste separation | I am aware of the benefits of waste separation and/or disposal for CE principles. | AWR2 |
| Rational use of resources (RUR) | Rational use of water | I am aware of the benefits of rational use of water resources (*water*) for CE principles. | AWR3 |
| | Rational use of energy | I am aware of the benefits of rational energy use (*electric, diesel, natural gas, ethanol*) for CE principles. | AWR4 |
| | Reduction of resource consumption | I am aware of the benefits of reducing resource consumption (*any item consumed by you*) for CE principles (e.*g. electricity and water consumption, purchase of electrical and electronic goods, clothing*). | AWR5 |
| Technical Cycle (TC) | Remanufacture | I am aware of the benefits of using remanufactured products for CE principles (*e.g. Amazon that sells remanufactured printer toners*). | AWR6 |
| | Reuse | I am aware of the benefits of reusing products, components, or packaging for CE principles. | AWR7 |
| | Repair | I am aware of the benefits of repairing products for CE principles. | AWR8 |
| | Recycling | I am aware of the benefits of recycling products, components, and packaging for CE principles. | AWR9 |
| Use of Sustainable Products or Packaging (USPP) | Environmentally certified products | I am aware of the benefits of using sustainable products and/or packaging for CE principles. | AWR10 |
| | Sustainable products or packaging | I am aware of the benefits of using environmentally certified products for CE principles. | AWR11 |
| Dematerialization and Collaborative Consumption (DCC) | Product-service-System | I am aware of the benefits of renting a product for CE principles. (*e.g., renting a coffee machine instead of buying it*) | AWR12 |
| | Virtualise | I am aware of the benefits of using digital products instead of physical products for CE principles (*e.g., buying eBooks instead of printed books; listening to music on Spotify instead of buying CDs; renting a game on a game streaming instead of buying a physical game*) | AWR13 |
| | Share Economy | I am aware of the benefits of practicing collaborative consumption for CE principles. (*Ex: Co-working spaces; Uber; Airbnb*) | AWR14 |
| | | I am aware of the benefits of buying, using, selling, sharing or donating second-hand (*used*) products for CE principles. | AWR15 |

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Table 17 - Constructs and items related to Social Influence (SI) and Psychological Barriers (PB)

| Dimension | Item | Code |
|---|---|---|
| Social Influence (SI) | My family and friends adopt habits or behaviours aimed at contributing to sustainable development | SI1 |
| | The celebrities I follow on social networks adopt habits or behaviours related to sustainable development. | SI2 |
| Psychological Barriers (PB) | I don't have time to develop sustainable habits or behaviours. | PB1 |
| | Developing sustainable habits or behaviours is expensive for me. | PB2 |
| | I do not have the technical and personal skills to develop sustainable habits or behaviours. | PB3 |
| | I have difficulty obtaining information about sustainable habits and behaviours. | PB4 |
| | I don't have enough educational background to develop sustainable habits or behaviours. | PB5 |

The survey was conducted in Brazil with people over 18 years old, using non-probability sampling. Data collection was carried out using the Survey Monkey platform and we used social networks (Facebook and Instagram) to disseminate the questionnaires to the public. The sample had 1046 respondents, and we applied statistical techniques to identify and eliminate suspicious response patterns, such as the occurrence of straight lining and outliers. We identified 22 cases without full completion, 12 cases with some missing data, 34 straight line and 119 Multivariate Outliers. According to Tabachnick and Fidell (2019) outliers may occur in unusual combinations of responses given by respondents. To ensure data reliability, we excluded the responses considered outliers, since this response pattern may interfere with the analysis of the results, making our data free of outliers. This screening process was important to avoid bias in the PLS parameter (FIELD, 2016). Thus, we obtained a final sample of 837 cases.

## 5.4.2 Sample Collection and Data Collection

The survey was conducted in Brazil with people over 18 years old, using non-probability sampling. Data collection was carried out using the Survey Monkey platform and we used social networks (Facebook and Instagram) to disseminate the questionnaires to the public. The sample had 1046 respondents, and we applied statistical techniques to identify and eliminate suspicious response patterns, such as the occurrence of straight lining and outliers. We identified 22 cases without full completion, 12 cases with some missing data, 34 straight line and 119 Multivariate Outliers. According to Tabachnick and Fidell (2019) outliers may occur in unusual combinations of responses given by respondents. To ensure data reliability, we excluded the responses considered outliers, since this response pattern may interfere with the analysis of the results, making our data free of outliers. This screening process was important to avoid bias in the PLS parameter (FIELD, 2016). Thus, we obtained a final sample of 837 cases.

Table 18 - Demographic composition of the study participants (n=837)

| Demographic Variables | Categories | Percentage |
|---|---|---|
| Gender | Male | 23% |
| | Female | 76% |
| Age | 21 years or less | 2% |
| | 22 - 36 years | 10% |
| | 37 - 56 years | 40% |
| | 57 years or more | 48% |
| Marital status | Single | 29% |
| | Married/Stable Union | 51% |
| | Widowed | 5% |
| | Divorced | 14% |
| Occupation | Public Servants | 29% |
| | Individual Microentrepreneurs | 16% |
| | Entrepreneurs | 2% |
| | Employees in Private Companies | 10% |
| | Unemployed | 9% |
| | Students | 6% |
| | Retired | 26% |
| Level of schooling | Incomplete High School | 4% |
| | Complete High School | 12% |
| | Incomplete Higher Education | 11% |
| | Complete Higher Education | 30% |
| | Incomplete Post-graduation | 5% |
| | Complete Post-graduation | 38% |
| South-eastern region of Brazil | North | 6% |
| | South | 23% |
| | Southwest | 61% |
| | Central-West | 3% |
| | Northeast | 7% |

Source: prepared by the author.

According to Table 18, in terms of demographic characteristics, the gender distribution between men and women shows a predominance of female respondents. The age range varies from 18 to 57 years or more, with the predominance of older respondents. As to other sample characteristics, such as marital status, most respondents are married or in a stable union. The sample is composed predominantly of respondents from the Southeast region. As for education, most of the sample has completed post-graduate studies. In addition, concerning occupation, most are civil servants and retirees.

We used the technical statistics and Modeling Structural Equations of Partial Minimum Square (PLS-SME) by Smart PLS statistical software, and bootstrapping

procedure to test the three research hypotheses. Its main function is the specification and estimation of models of relationships between variables (HAIR JR et al., 2014). This technique considers a combination of factor analysis and multiple regression analysis to analyse dependency relationships and is indicated to identify predictive relationships in exploratory research (HAIR et al., 2021; HENSELER, 2021). This technique is directed at evaluating predictive factors such as the relationship between psychological barriers, social influence, and people's awareness of CE (HAIR JR. et al., 2009). Furthermore, this method aims to evaluate the model's quality like multiple regression, which maximizes the explained variance (HAIR JR et al., 2014).

## 5.5 Results

Although the literature is scarce on the subject, previous studies have already concluded that transforming linear economies into circular ones requires initiatives that raise awareness among people, regardless of their position in the supply chain, in addition to sound legislation and incentive policies (CALCULLI et al., 2021).

The CE is a relatively new concept to people. Previous studies have shown a low level of understanding about the concept, often being limited to practices such as waste sorting or recycling (ALMULHIM; ABUBAKAR, 2021). Regarding the level of understanding about CE, our sudy showed that 34% of the sample demonstrated a certain level of ignorance about CE, with 11% having never heard of it and 23% having heard of it, but not really knowing what it is about. In contrast, 35% had a basic understanding of the concepts and principles of CE; 24% stated having an average understanding; and only 7% had complete mastery of the concepts and principles of CE.

### 5.5.1 Non-response bias and Common Method Variance (CMV)

In addition, the questionnaire items were randomly distributed to minimize bias. These procedures are important to ensure the reliability of the sample. (PODSAKOFF et al., 2003). As we obtained three waves of receipt, we tested the possibility of sample bias. In the first wave, we received 304 questionnaires; after 20 days we received 381 more and after 25 days we received 361 more responses. We performed the Kruskal-Wallis test, which determines whether there are statistically significant differences between two or more groups, in order to identify whether the sample originates from the same distribution. Thus, the test showed a value greater than 0.05, (p=0.3749) showing that

there is no difference between the samples, which presumes they are from the same population (CORDER; FOREMAN, 2011). Therefore, we conclude that the sample is significantly distinct from the rest of the population, as we found no difference ($p>0.05$) for all pairs between the two groups.

To conduct a careful analysis without biased estimates, we used the Harman's Single-Factor Test, considered the widely used test to examine the Common Method Variance (CMV) (MACKENZIE et al., 2011). This method assumes that a large amount of variance comprised by a single factor may indicate possible bias in the common method (AGUIRRE-URRETA; HU, 2019). The test comprises an exploratory factor analysis with all independent and dependent variables. The results of this test showed that the first factor accounted for 35.17% of the observed variance (which is presumed to present no bias), the expected value for this test being a value below 50%.

Hair et al. (2021) indicates a sequence of two distinct steps to obtain an accurate representation of the reliability of the indicators used: Assessing the formative measurement model and assessing the structural model, and testing Hypothesis.

## 5.5.2 Assessing the Formative Measurement Model

Assessing the formative measurement model is necessary to check construct validity, that is, to measure whether they are significant and have satisfactory reliability to estimate casual relationships in later steps of the model (HAIR et al., 2021). As detailed in section 4.1, the constructs and items for assessing people's awareness of CE (PACE) were created and validated according to Menor and Roth (2007) and DeVellis (2002). Furthermore, the items related to the construct named Social Influence (SI) and Psychological Barriers (PB) are detailed in Table 16 and Table 17.

Figure 12 - Measurement Model
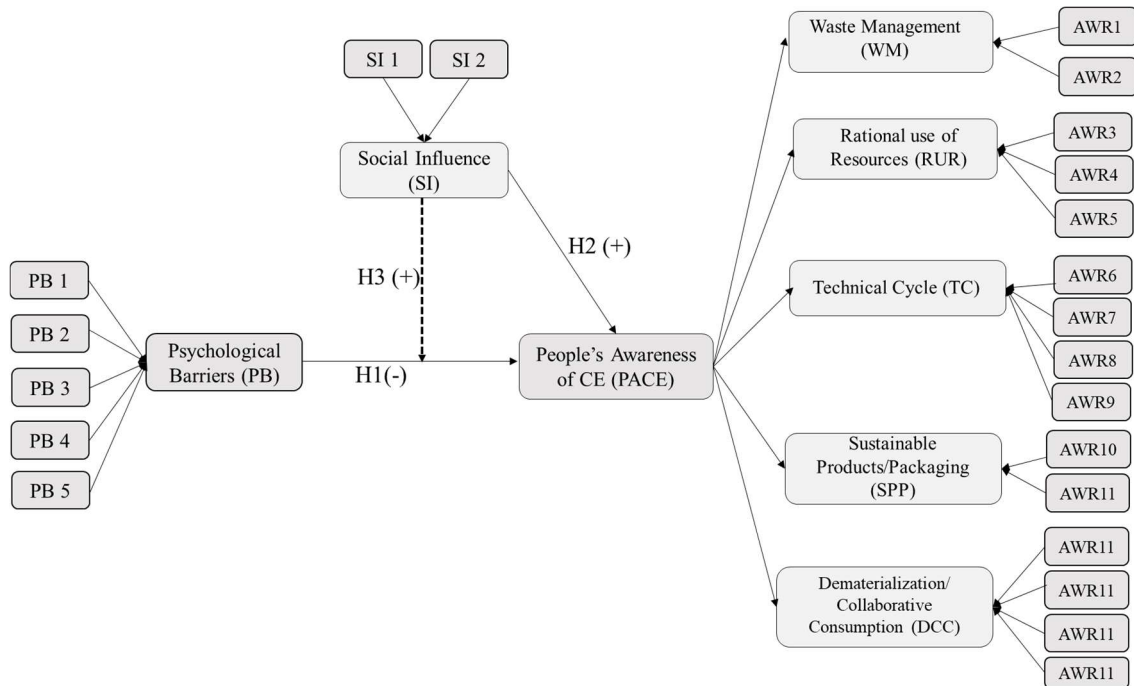


Source: prepared by the authors.

As shown in Figure 12, the measurement model is composed of formative constructs (SI and PB), whereas in measurement models the relationship goes from the items towards the constructs, indicating that changes in the items cause changes in the constructs (CHANG; FRANKE; LEE, 2016). Formative measurement was chosen based on the characteristics of the items, as they are not related to each other (CHANG; FRANKE; LEE, 2016; PETTER; STRAUB; RAI, 2007). As can be seen in Figure 12, the constructs Psychological Barriers (PB) and Social Influence (SI) are formed by the manifest variables PB1, PB2, PB3, PB4 and SI1 and SI2, respectively. In reflective models, the direction of causality goes from the construct to its indicators, so that changes in constructs cause changes in items (CHANG; FRANKE; LEE, 2016). The People Awareness of Circular Economy (PACE) construct was delineated as a second-order Reflexive-Formative construct.

To evaluate the formative measurement model and verify the absence of collinearity, we identified the VIF value. All items presented VIF <3.0, as described in Table 19. (CHANG; FRANKE; LEE, 2016; LEE et al., 2011). Subsequently, we ran the

bootstrap technique with 5000 subsamples. This procedure aims to identify the significance of each item (p<0.05), otherwise the loading value should be revised. For values greater than 0.05 there is a recommendation to maintain (HAIR et al., 2021). If the outer weight is not significant, the value of the outer loading should be checked. On the other hand, if the value of outer loading is high enough (>0.5), the item is essential for the construct and should be retained.

Table 19 - Validation of the Formative Constructs

| Construct | Code items | VIF | Outer Weight | | | Outer Loading | |
|---|---|---|---|---|---|---|---|
| | | | Original Sample | Sample Mean | p value | Original Sample | Sample Mean |
| Waste Managemen (WM) | AWR1 | 1,880 | 0,612 | 0,614 | 0,000* | 0,938 | 0,937 |
| | AWR2 | 1,880 | 0,476 | 0,475 | 0,000* | 0,895 | 0,891 |
| Rational Use of Resources (RUR) | AWR3 | 1,841 | 0,437 | 0,435 | 0,000* | 0,873 | 0,869 |
| | AWR4 | 1,850 | 0,342 | 0,340 | 0,000* | 0,839 | 0,836 |
| | AWR5 | 1,599 | 0,399 | 0,403 | 0,000* | 0,830 | 0,829 |
| Technical Cycle (TC) | AWR6 | 1,364 | 0,174 | 0,177 | 0,000* | 0,624 | 0,626 |
| | AWR7 | 2,460 | 0,306 | 0,306 | 0,000* | 0,877 | 0,874 |
| | AWR8 | 1,759 | 0,292 | 0,292 | 0,000* | 0,802 | 0,801 |
| | AWR9 | 2,265 | 0,435 | 0,433 | 0,000* | 0,894 | 0,890 |
| Sustainable Products or Packaging (SPP) | AWR10 | 1,360 | 0,706 | 0,704 | 0,000* | 0,929 | 0,926 |
| | AWR11 | 1,360 | 0,432 | 0,434 | 0,000* | 0,796 | 0,797 |
| Dematerialization and Collaborative Consumption (DCC) | AWR12 | 1,296 | 0,125 | 0,125 | 0,000* | 0,487 | 0,487 |
| | AWR13 | 1,283 | 0,077 | 0,076 | 0,013* | 0,418 | 0,417 |
| | AWR14 | 1,477 | 0,262 | 0,263 | 0,000* | 0,685 | 0,685 |
| | AWR15 | 1,276 | 0,771 | 0,770 | 0,000* | 0,943 | 0,942 |
| Psychological Barriers (PB) | PB1 | 2,251 | 0,352 | 0,339 | 0,020* | 0,849 | 0,825 |
| | PB2 | 1,953 | 0,264 | 0,261 | 0,032* | 0,785 | 0,765 |
| | PB3 | 2,503 | 0,169 | 0,168 | 0,370 | 0,819** | 0,797 |
| | PB4 | 2,046 | 0,465 | 0,456 | 0,002* | 0,839 | 0,815 |
| | PB5 | 1,926 | -0,055 | -0,063 | 0,785 | 0,635** | 0,612 |
| Social Influence (SI) | SN1 | 1,134 | 0,424 | 0,419 | 0,015* | 0,690 | 0,680 |
| | SN2 | 1,134 | 0,771 | 0,758 | 0,000* | 0,917 | 0,902 |

Where: *Sig. (p<0,05); **Outer Loading >0,5
Source: prepared by the author.

Table 19 shows that all formative constructs were validated; thus, the conceptual model and hypotheses were assessed for direct and indirect effects.

**5.5.3 Assessing the Structural Model and Testing Hypothesis**

We evaluated our structural model after generating the formative measurement models. The coefficient of determination ($R^2$) shows the percentage of variation of the dependent variables (endogenous) being explained by the independent variables (exogenous) (HAIR et al., 2021). $R^2$ measures how well a statistical model predicts an outcome (dependent variables), ranging from 0 to 1. It is a measure of variability accounted for by exogenous variables, i.e. it predicts the structural model with the influence of independent variables (HAIR et al., 2021). We found $R^2$ values for People's Awareness of Circular Economy (PACE) of 0.166. According to Hair et al. (2021), this value is included in the small category. Lower values are considered when measuring more unpredictable variables, such as surveys targeting peoples (HAIR et al., 2013).

The evaluation of the structural model includes path coefficients ($\beta$). We tested the direct hypotheses first before testing the interaction effect. Non-parametric bootstrapping involves random sampling that is repeated with replacements of the original sample, indicating standard errors for hypothesis testing. During this procedure, many samples are generated so that each sample represents the population. As recommended by Hair et al. (2019), we performed a bootstrapping procedure with 5,000 resamples and obtained the sign ($\beta$) and significance value (p-value) of the relationship between variables based on the 1% significance level (one-tailed).

The evaluation of the structural model also included testing the direct hypotheses, the moderation effect, and the indirect effects. In relation to the direct effects, we found that the PB→PACE and SI→PACE relationships were significant, with $\beta$ values of -0,269, 0,207, respectively (p< 0.01). Thus, H1 and H2 are fully supported. Concerning the moderating effects, we found that the relation "PB * SI→ PACE" was significant, with a $\beta$ value of 0.207. Hence, H3 is supported (Table *20*).

Table 20 - Testing direct effect and moderating

| Structural Relation | Coef (B) | SD | p values | Decision |
|---|---|---|---|---|
| PB→ PACE | -0,269 | 0,038 | 0,000[*] | H1 supported |
| SI→ PACE | 0,207 | 0,031 | 0,000[*] | H2 supported |
| PB * SI→PACE | 0,207 | 0,050 | 0,000[*] | H3 supported |

Note: [*] Statistically significant at the p <0,01.

Source: prepared by the authors.

The moderating effects are presented visually in Figure 13. Here, the upper line represents the relationship between PB and PACE when the moderating variable (SI) has high values (1 standard deviation above the average). For high values of SI, the PACE is less affected by PB. The lower line represents the relationship between PB and PACE when the moderating variable (SI) is low (1 standard deviation below the average). For low values of SI, PACE is more affected by PB.

Figure 13 - Moderating effect of Social Influence (SI)
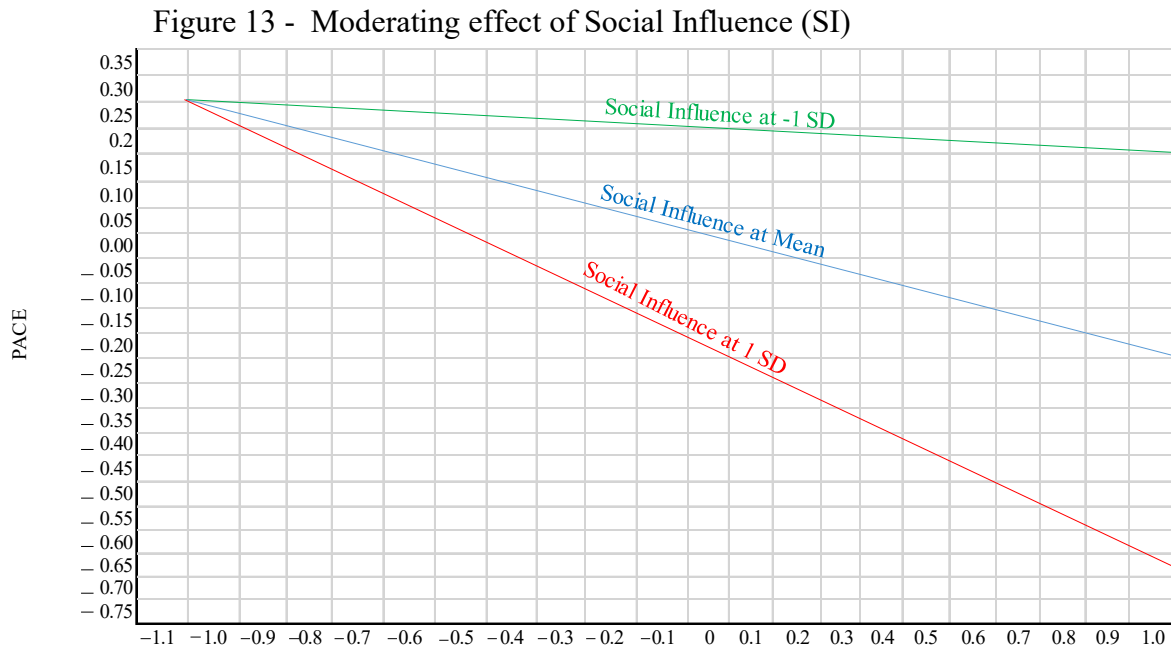


Source: prepared by the author.

After performing the direct hypothesis test, the moderation effect, we analysed the indirect effects, as shown in Table 21. We note that the construct Technical Cycle (TC) is the most affected by Psychological Barriers (PB), with a β value of -0,249 and $f^2$ of 6,138. The Technical Cycle is formed by a set of strategies and processes applied to develop sustainable product cycles aimed at reducing waste and waste generation (FLEURIAULT et al., 2021). We seek to bring the Technical Cycle closer to people's reality, seeking to understand their awareness of the importance of Remanufacture, Reuse, Repair, and Recycling to the principles of CE. Thus, our findings suggest that Unnecessary or ineffective and Limited Cognition affect people's awareness of the Technical Cycle strategy than the other strategies. These findings may be based on the lack of applicability of these strategies in people's daily lives, as Kevin Van Lange et al. (2021) concluded that the strategies Remanufacture, Reuse and Recycling still receive little attention in practice. Remanufacturing, for example, has a low acceptance among

consumers, as this strategy is more focused on the business-to-business model (MURANKO et al., 2019).

On the other hand, Dematerialization and Collaborative Consumption (DCC) was the construct least affected by Psychological Barriers (PB), with a β value of -0,229 and $f^2$ of 2,676. This construct is made up of the strategies Product-service-System, Virtualise and Share Economy. These strategies are closer to people's reality, involving interaction Business-to-consumer and Consumer-to-consumer. It encompasses activities such as renting a coffee machine instead of buying it, buying eBooks instead of printed books, listening to music on spotify instead of buying CDs, buying/using/selling/sharing or donating second-hand products, using platforms and apps such as co-working spaces, Uber and Airbnb. Moreover, the main motivation for adhering to strategies such as buying second-hand products is the economic factor (money-saving) (GULLSTRAND EDBRING; LEHNER; MONT, 2016), which may explain the smaller effect between Psychological Barriers and the Dematerialization and Collaborative Consumption (DCC). Similarly and corroborating our results, the study of García-Rodríguez et al. (2022) confirm that participation in collaborative consumption is motivated by factors such as economic benefits.

From the point of view of the indirect effects of moderating Psychological Barriers, Social Influence and People Awareness of CE, the construct that showed the highest attenuating effect of the Psychological Barriers by Social Influence was again the Technical Cycle (TC), with a value of β 0,192. On the other hand, the construct that felt the most the effect of the Psychological Barriers, even mitigated by Social Influence was Dematerialization and Collaborative Consumption with a value of β de 0,176.

Table 21 - Testing indirect effects

| Structural Relation | Coef (B) | SD | p values | $f^2$ | Decision |
|---|---|---|---|---|---|
| PB → WM | -0,238 | 0,036 | 0,000 | 3,556 | H1a supported |
| PB → RUR | -0,240 | 0,036 | 0,000 | 3,981 | H1b supported |
| PB → TC | -0,249 | 0,037 | 0,000 | 6,138 | H1c supported |
| PB → USPP | -0,234 | 0,035 | 0,000 | 3,177 | H1d supported |
| PB → DCC | -0,229 | 0,034 | 0,000 | 2,676 | H1e supported |
| PB * SI→ WM | 0,183 | 0,047 | 0,000 | - | H3a supported |
| PB * SI→ RUR | 0,185 | 0,047 | 0,000 | - | H3b supported |
| PB * SI→ TC | 0,192 | 0,048 | 0,000 | - | H3c supported |
| PB * SI→ USPP | 0,180 | 0,046 | 0,000 | - | H3d supported |
| PB * SI→ DCC | 0,176 | 0,044 | 0,000 | - | H3e supported |

Note: * Statistically significant at the p <0,01.

**5.6 Discussion**

The transition to CE requires changes in people's way of thinking. For this to happen, it is necessary to disengage from the current status quo, which means having awareness (SINGH; GIACOSA, 2019). People tend to believe that environmental problems are less serious locally than globally, undermining their level of awareness (LACROIX; GIFFORD; CHEN, 2019). We consider the People's Awareness of CE (PACE) as a construct similar to the idea, not being related to the actual adoption of behaviour (practice or action) by people concerning the different strategies that make up this construct. Thus, being aware means considering relevant and important the CE strategies for CE principles.

H1 postulated by our research showed that Psychological Barriers restrict people's awareness of CE ($\beta$= -0,269). Thus, individual´s efforts, like high personal cost in terms of time and money are considered dragons (Psychological Barriers) to CE awareness.

Previous studies have identified the effects of barriers such as high cost (KHAN; AHMED; NAJMI, 2019), lack of time (KHAN et al., 2020) and knowledge (LACROIX; GIFFORD; CHEN, 2019) concerning sustainability strategies. However, these studies did consider specific sustainable approaches, such as Khan; Ahmed; Najmi (2019), that investigate the consumers' behaviour intentions towards dealing with plastic waste. Bosone; Chaurand and Chevrier (2022) analysed the psychological barriers that prevent individuals from maintaining their current behaviours, even if they are harmful to the environment. Our study becomes a differentiator as it considers the relationship of Dragons of Inaction Psychological Barrier on people's awareness from the perspective of five different CE strategies (WM, RUR, TC, USPP, DCC). Supported by the literature, our study shows that hypothesis 1 is supported, i.e. Psychological Barriers interfere in ways that restrict people's awareness of CE.

Other studies have already shown the negative relationship between Psychological Barriers and pro-environmental behaviours, like Hoffman and Henn (2008), which showed that psychological barriers divert managers from responding to changes in the green building industry. The present research, on the other hand, differs in that it presents an approach focused on people without focusing on the position these actors occupy in the value chain (companies, government, consumers) or the social context in which they are inserted (student, politician, businessman/manager).

In keeping with these findings, our research contributes to the Theory of Behavior Choice (TBC) by suggesting that awareness of the importance of CE is an essential factor

in their decision-making process related to a more regenerative economy. This shows that the transition from linear economics to CE and people's behaviour towards the environment is influenced not only by perceived benefits, but also by people's awareness of the importance of CE for sustainable development. This would also suggest that interventions aimed at increasing people's awareness of CE as well as reducing psychological barriers could be an effective way of promoting more sustainable behaviour in people, contributing to mitigating the limited cognition dragons and sunk costs dragons. Furthermore, these results suggest that the implementers of CE strategies (top-down) should consider how to communicate the message to promote outreach actions and make it more attractive and identifiable in people's daily lives (bottom-up).

Moreover, as psychological barriers pose a risk to the transition from linear to CE, the low level of awareness about CE and other sustainable approaches may reduce the precaution in undertaking CE-oriented efforts, such as seeking information on sustainable development or separating waste properly (DURSUN; TÜMER KABADAYI; TUĞER, 2019). H1 also suggests that people's awareness of CE is influenced by information, technical/personal skills and educational background. This suggests that providing more education and information on the circular economy can effectively promote sustainable behaviour, reducing the limited Cognition dragons. These findings contribute to TBC by suggesting that the sunk costs dragons are a significant barrier to individuals taking action to CE. Thus, promoting facilitators to overcome this dragon and make CE more accessible and affordable (such as: tax exemption for electric cars, discounts on purchases in exchange for empty packaging) are necessary alternatives for people to adopt CE-oriented actions.

Social Influence denotes that individuals interact with people around them, influencing their thinking (XU et al., 2022). Our results (β=0,207) support H2, since we identified that Social Influence positively affected people's awareness of CE, i.e. actions taken by family, friends and celebrities influence people's awareness of CE.

Previous studies have shown that people are more likely to engage in specific actions when they believe that people close to them, such as friends and family, will value those actions (GHAZALI et al., 2019). In contrast, the study of Xu et al. (2022) showed that Social Influence did not affect people's intention to engage in sustainable fashion consumption behaviours. Gifford et al.(2022) showed that social influence was negatively related to intention, maybe because people wished to deny that they were under the

influence of friends and family. Croker et al. (2009) attribute the absence of a connection between intention and social influence on lack of awareness.

Our study contributes to this debate, once it shows the role of social influence in raising people's awareness from the perspective of different strategies. These findings contribute to TBC by suggesting that social influence plays a significant role in raising people's awareness and may contribute to people's intention to engage with CE. This suggests that interventions to increase social pressure, such as social marketing campaigns with digital influencers, might be one way to spark sustainable behaviours in people. In this sense, policymakers engaged in designing people's CE awareness strategies should give greater importance to social influence as they influence people's decisions and should be included in awareness campaigns and policymakers.

Regarding H3, our findings present evidence that Social Influence positively moderates the relationship between Psychological Barriers and People's Awareness of CE. Thus, there is a positive effect between the influence of friends, family and celebrities on people's opinion formation concerning the importance of CE principles. This finding is new to the CE literature, as no studies examine the moderating relationship between social influence and psychological barriers to people's awareness of CE. This finding also contribute to Theory as it indicates that Social Influence mitigates the negative effect of psychological barriers on people's awareness of CE, i.e. they help to mitigate sunk costs dragons and limited cognition dragons. In this sense, social influence acts as social pressure to reduce psychological barriers.

Although our study operates in the awareness field, not considering the adoption of CE-oriented behaviours (action), our results contribute to understanding the reduction of Psychological Barriers and the consequent reduction of inaction. Inaction comes from the lack of awareness of environmental problems, causing people not to change their actions towards sustainable development. Thus, our findings suggest that Social Influence can be used as an important opinion-forming and engagement strategy for people to create awareness of CE principles and subsequently in assimilating CE strategies into their daily lives. Therefore, activities such as waste separation, rational use of water and energy, reducing consumption, buying remanufactured and recycled products, reusing, repairing, using sustainable products and packaging or engagement with other consumption strategies such as Product-Service-System, Virtualise and Share Economy can be socially influenced.

The impact of Social influence is even more present today in the face of the globalised environment and the power of social media in people's choices (SUJATA et al., 2019). The study of Gifford et al. (2022) showed that Breaking a habit is the most difficult challenge people encounter. Thus, the variable Sunk Costs Dragons is a challenging Psychological Barrier to overcome, which reinforces the importance of Social Influence in alleviating Psychological Barriers to seek greater awareness in people. Thus, the role of Social Influence to reduce the impacts of Psychological Barriers presents an important finding for understanding future studies focusing on different stakeholders. Furthermore, this result shows the importance of Social Influence in formulating education and awareness strategies on environmental impacts and persuasion measures in adopting CE-oriented behaviours by people.

We summarize these main results and contributions in Table 22. This summary shows insight into the relationship between negative (Psychological Barriers) and positive (Social Influence) effects on people's awareness of CE.

Table 22 - Key findings and contributions

| Key Findings | Contributions to CE Literature | Theoretical Contributions | Practical Implications |
|---|---|---|---|
| Psychological Barriers (Sunk Costs dragons and Limited Cognition dragons) restrict people's awareness of CE. | Our study is the first to consider the relationship between Psychological Barriers on people's awareness from the perspective of five different CE strategies;<br><br>This research contributes to CE theory as it presents a people-focused approach without focusing on the position these actors occupy in the value chain or the social context in which they are inserted. | This finding contributes to the TBC by suggesting that awareness of CE is an essential factor in their decision-making process related to a more regenerative economy;<br><br>This study shows that the TBC theory can be helpful to understand the psychological barriers that restrict a person to CE awareness. | Business and government (top-down) should promote outreach actions more attractive in people's daily lives (bottom-up);<br><br>Providing more education and information on CE can be an effective way to promote sustainable behaviour, reducing the limited cognition dragons;<br><br>CE should be more accessible, adopting actions such as tax exemption for electric cars, discounts on purchases in exchange for empty packaging, and other incentives. |
| Social Influence (family, friends, and celebrities) positively affected people's awareness of CE. | This result shows the role of social influence in raising people's awareness from the perspective of different strategies of CE. This shows that the social influence may contribute to people's intention to engage with CE. | This result proves the role of social influence in raising awareness about CE, differently from other studies that evaluate it to understand behavioural intention regarding specific sustainable strategies; | Interventions to increase social pressure, such as social marketing campaigns with digital influencers, might be one way to spark sustainable behaviours in people. |
| Social Influence positively moderates the relationship between Psychological Barriers and People's Awareness of CE | This finding is new to the CE literature because it shows the moderating effect of social influence in reducing psychological barriers. | The study shows that social influence mitigates the negative effect of psychological barriers on people's awareness of CE and help to mitigate sunk costs dragons and limited cognition dragons. | This result shows the importance of Social Influence in the formulation of education and awareness strategies on environmental impacts and persuasion measures in the adoption of CE oriented behaviours by people. |

Source: prepared by the authors.

## 5.7 Conclusions

This study aimed to assess the effect of Social Influence and Psychological Barriers on People's Awareness of CE. Our study shows that Psychological Barriers interact negatively with people's awareness of CE. At the same time, Social Influence is a mitigator of these barriers, representing an essential contribution to the transition process from a linear economy to CE. Analysing people's awareness of sustainable approaches is challenging, as environmental degradation is not immediately tangible and can take a long time to mature in people individually. The literature presents studies that

sought to explain the relationship between aspects like what was presented in our research but kept the focus of the analysis only under a specific sustainable strategy. Our study is different in that it considers measuring people's awareness under more than one CE strategy, having people as the focus.

Our study is the first to study CE awareness using the theoretical lenses of TBC, suggesting that awareness of CE is an essential factor in their decision-making process related to a more regenerative economy. In addition, one should consider the lack of studies like this in Brazil, considered a developing country with great potential for CE development. Thus, our paper offers advice for policymakers, associations, cooperatives, and other institutions on how to face the challenges linked to the transition from linear economy to CE, as well as to promote engagement in individual and collective actions in favour of economic, social and environmental.

This study provides empirical implications. We show the importance of the influence of friends, family, celebrities, and society for people to understand, become conscious and be motivated to adopt CE practices. Thus, public entities should provide guidelines and policies to encourage society and help people create their own personal norms. Furthermore, by demonstrating how each element of the model interacts with people's awareness, our study offers insights into how to maximise the frequency of people's choices of circular behaviours.

Since combating climate change and other environmental impacts are extremely urgent issues on several nations' global agendas, our findings indicate that educational, preventive, and corrective actions should be taken to break these psychological barriers, considering the wide applicability of CE in people's daily lives. Furthermore, researchers, practitioners, and government can use the findings of our study to direct transition strategies from linear economy to CE towards, for example:

(i) Promote strategies to mitigate Psychological Barriers, which includes education, incentive, reward and communication programmes for the participation of the various links in the supply chain in CE activities;

(ii) develop actions at the Bottom-up level, facilitating people's participation in daily activities for circularity, since most nations use of the CE dimension are implemented at the Top-Down level, focusing on Institutions (such as companies and governments), which somehow makes it rigid and difficult for people to assimilate.

(iii) Similarly, companies can understand the role of social influence and use it in their communication strategies to raise the awareness of their current and potential

customers to accept better a product, service, or sustainable action developed by the company. Thus, although CE decisions are very complex, people's perceptions and awareness are very important variables in the level of acceptance of the strategies that have been directed by companies and public entities. Therefore, recognizing and incorporating CE approaches into people's daily lives encourages others to be aware as well.

Our study was developed in the Brazilian context. Thus, it is important to recognize that cultural values and other contextual specificities, such as national and local public policies, may influence public opinion and awareness construction. Another limitation is the generalization of our results, since we used non-probability sampling, recommended for studies of exploratory nature, and not subject to generalization to other contexts.

Culture-related variables may interfere with social influence. In this sense, future studies can investigate to what extent culture can interact in constructing awareness about CE. Our research considered Psychological Barriers from the following perspectives: Sunk Costs (lack of time and money) and Limited Cognition (Lack of technical/personal skills, lack of information and educational training). Future studies can expand on the factors that make up psychological barriers from a behavioural perspective. Future studies should associate the social influence in reducing the impacts of psychological barriers, considering the interaction between different stakeholders.

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# 6. FROM AWARENESS TO ACTION: UNDERSTANDING THE RELATIONSHIP BETWEEN CIRCULAR ECONOMY AND FAVOURABLE EVALUATION TOWARDS SUSTAINABLE DEVELOPMENT

## 6.1 Introduction

The most acceptable concept of Sustainable Development (SD) is the ability to reconcile economic, social and environmental development, meeting the needs of the present without compromising future generations (CHEN; YILDIZBASI; SARKIS, 2023). The growing risk of climate change, biodiversity loss, environmental pollution, resource scarcity and other consequences make it increasingly critical to adopt a more regenerative and balanced model (XU et al., 2022). Many nations are prioritising the search for alternatives for this balance, with the Circular Economy (CE) as one of the best options to support SD (CHUN et al., 2022).

The CE involves the efficient use of raw materials/energy, minimizing the use of natural resources, to keep in circulation the materials and waste (GHERHEŞ; FĂRCAŞIU; PARA, 2022). The transition of CE requires the involvement of all links in the value chain, such as companies, suppliers, consumers, and other stakeholders such as the government, institutions (Non-Governmental Organisations, Associations, Cooperatives, among others) and people in general (KEVIN VAN LANGEN et al., 2021). Govindan et al. (2022) showed that lack of public awareness is one of the barriers for companies to adopt CE. This indicates it is pointless for companies, government and other stakeholders to be committed to CE if people are not ready to assimilate the sustainable approaches in their daily lives (ALMULHIM; ABUBAKAR, 2021).

Several variables can interact positively or negatively for the success of CE. Daddi et al. (2020) investigated the effect of pressure on business mitigation and adaptation to climate change. Dubey et al. (2019) explained the relationship between external pressures and supplier relationship management practices in sustainable supply chains. Caldera et al. (2019) assesses the enablers and barriers for successful implementation of sustainable business practices in lean small companies. Our study considers People's Awareness of CE (PACE), considering five specific approaches: Waste Management (WM); Rational Use of Resources (RUR); Technical Cycle (TC); Use of Sustainable Products or Packaging (USPP); Dematerialization and Collaborative Consumption (DCC). To the

best of our knowledge, no empirical research addresses the relationship between People's Awareness of CE (PACE) and Favourable Evaluation (FE) concerning SD.

People Favourable Evaluation concerning SD refers to the people's positive judgement/opinion on its importance, on the engagement of people on SD actions and on and the participation of institutions (government and companies) on SD activities. People's mindsets can affect the way in which they assess thinking and actions in a wide range of sustainable issues. For example, people´s mindset affect how people assess the climate change problem, how they think about the solution (i.e. beliefs about climate change mitigation), how they are inclined to act (i.e. pro-environmental behavioural inclinations) and how they act (DUCHI et al., 2020). Within this context, this study aims to analyse the relationship between people's awareness of CE and favourable evaluation of people concerning the importance of efforts for sustainable development.

To support our theoretical model, we sought inspiration in the Social Learning Theory, which suggests that people learn from their environment and the behaviours of others around them (CANTERO-SÁNCHEZ et al., 2021). This psychological theory was proposed by Albert Bandura and assumes that environmental and cognitive factors interact to influence the way people think and act (WEDER et al., 2022). Therefore, we assume that as most people become aware of CE, the possibility of having a positive, favourable evaluation concerning SD is higher.

Previous studies showed the importance of sustainable awareness for a change in people's thinking (GHERHEŞ; FĂRCAŞIU; PARA, 2022). These studies focus on specific strategies such as: the use of energy-efficient home appliances (WARIS; AHMED, 2020); waste classification (SHEN et al., 2022); recycling (SUJATA et al., 2019); circular packaging (TESTA et al., 2020); green consumption (YUE et al., 2020). Although the importance of people's participation in CE is evidenced, the literature tends to focus more on just one aspect of CE (SZILAGYI et al., 2022). The differential of our research is focus on people, considering five approaches from CE. Another important research gap concerns the focus of analysis. Some research consider specific stakeholders, like consumers (CHUN et al., 2022); managers (KAUPPI; LUZZINI, 2022); students (GUO et al., 2017); researchers (KEVIN VAN LANGEN et al., 2021); companies (MASI et al., 2018); suppliers (DUBEY et al., 2019). The focus of our study is people in general, not limited to a specific position in the supply chain. Besides, previous research (AFROZ et al., 2013; ALMULHIM; ABUBAKAR, 2021; SCHODEN et al., 2020b) has assessed public awareness of sustainable approaches, without applying

a measurement scale validation method. Our questionnaire went through steps to ensure validity and reliability, as recommended by Menor and Roth (2007) and DeVellis (2022). Finally, most publications related to awareness of SD or CE were developed in European and Asian countries (DAHALAN; ABDUL RAHMAN; D'SILVA, 2020; GUO et al., 2021; KHAN; WANG et al., 2021; WANG; ZHANG; LI, 2014; YANG et al., 2022; YUE et al., 2020), while our research was developed in Brazil.

The paper is structured as follows: after presenting a brief contextualisation of the theme and research gap in the introduction in Section 6.1; Section 6.2 presents the theorical background and hypotheses development; Section 6.3 deals with the research method; Section 6.4 presents the results; Section 6.5 presents the discussion, and finally Section 6.6 presents the conclusions, highlighting the theoretical implications, limitations, and future research perspectives.

## 6.2 Theorical Background and Hypotheses development

People's acceptance of circular business models is a major concern (SATTARI; WESSMAN; BORDERS, 2020). In this sense, people must be equipped with appropriate thinking to create a collective consciousness in society (SZILAGYI et al., 2022). As pointed out by the Boesen; Bey and Niero (2019), the development of the CE depends on an understanding of people and the integration between several agents of the value chain, and isolated actions may not contribute to a real change (GARCÍA-RODRÍGUEZ et al., 2022). Evidence from Europe, USA, Japan and China indicates that CE helps optimize the exploitation of natural resources and promote shared efficiency among companies and consumers (ALMULHIM; ABUBAKAR, 2021). Therefore, we should consider that the more integrated the CE strategies are with the various stakeholders, the better the incorporation of circular strategies by the people as well as their favourable evaluation and development of potential sustainable behaviours.

As climate change is a global problem, many people believe they cannot do anything about it as individuals, maintaining a negative mindset towards SD strategies (DESROCHERS; ZELENSKI, 2022). In addition, Gifford (2011) highlights the presence of the so-called fatalism, in which people feel that nothing can be done, not only by the individual, but by collective human action, maintaining negative thinking concerning SD. In contrast to this idea of negative evaluation regarding different aspects of SD and the impact of this on awareness, we want to consider Favourable Evaluation.

People's level of awareness about CE is influenced by a number of factors that can result in a negative evaluation in relation to sustainability. Among them, we highlight external factors that encourage unsustainable consumption patterns (WEDER et al., 2022). These trends generate impacts that may go unnoticed by people, since they are distributed in space and time away from those who cause such impacts. In this context, people may have difficulty in establishing a positive judgment regarding the achievement of SD (ARJEN; WALS, 2009).

Considering that people's awareness of CE is conditioned by several factors, such as social influence, we draw inspiration from the Social Learning Theory. This theory explains human behaviour in terms of environmental, behavioural and cognitive influences, through observation, imitation, and reinforcement from the environment and other people's experiences (PAHL-WOSTL, 2002). Although this theory was initially developed to explain individual behaviour, it is also applied to understand collective patterns (ARJEN; WALS, 2009). Furthermore, although the social learning process is predominantly a pedagogical process, this theory has been used to understand other contexts, such as the development of sustainable behaviours (WEDER et al., 2022).

According to Weder et al. (2022), people breaking old unsustainable patterns can become a starting point in the social learning process that simultaneously promotes individual changes and collective sustainable actions. Furthermore, it is worth reinforcing that social learning is a process composed by social, cultural and institutional contexts that can influence people according to interests, values, beliefs and communication (CORNFORD, 2008). Duchi et al. (2020) understand that maintaining a positive mindsetassists in overcoming barriers towards environmental actions. In this sense, this research draws on Social Learning Theory, to analyse the relationship between awareness about CE and favourable evaluation of SD. To this end, the following hypothesis was developed:

*H1. People Awareness of CE positively influences favourable evaluation concerning SD;*

Several variables can contribute to the positive evaluation of and involvement with sustainability. A study in Pakistan showed that the lack of structure and incentives for recycling makes it difficult for people to engage in such activities (KHAN; AHMED; NAJMI, 2019). Sharma et al. (2021) showed that while the government's role is significant, it is insufficient to implement sustainable practices. Pazoki and Samarghandi (2020) highlight the importance of Corporate Social Responsibility (CSR) and the role of

companies as drivers of change, such as Hewlett-Packard (HP), through the "Solidarity recycling programme", which collects electronic waste and promotes the donation of food.

The study of Wu et al. (2022) named this favourable assessment as Green Emotion, referring to a favourable appreciation of variables such as the importance of using environmentally friendly products, waste of resources, adoption of environmentally responsible actions, among others. Similarly , Duchi et al., (2020), named this favourable assessment of the growth mindset, e showed that such favourable judgement could help overcome certain barriers to environmental action. Our research considers Favourable Evaluation as the positive opinion/judgement of people about: (i) the importance of SD (preservation of the environment and survival of future generations, economic and social development); (ii) Engagement of People; and (iii) Participation of Institutions (government and companies). Thus hypothesis 1 gave rise to other sub-hypotheses:

*H1a. People's awareness of CE positively influences favourable evaluation concerning the importance of SD*

*H1b. People's awareness of CE positively influences favourable evaluation concerning people's engagement in actions and behaviours towards SD.*

*H1c. People's awareness of CE positively influences favourable evaluation concerning institution's participation in efforts towards SD.*

The theoretical research model of our research is shown in Figure 14.

Figure 14 - Theoretical research model
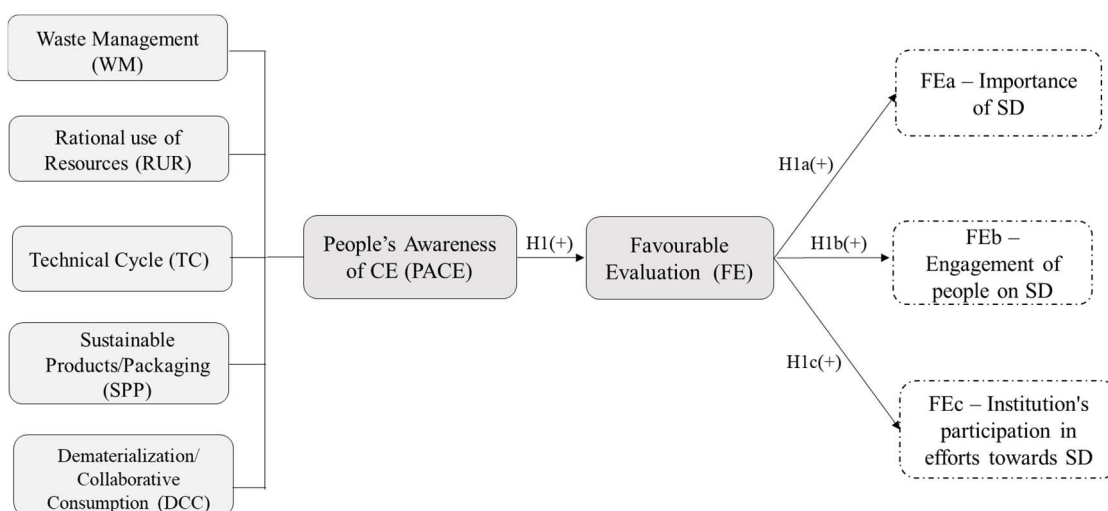


Source: prepared by the author

## 6.3 Research Method

This study used a survey for analyse the people's awareness of CE and favourable evaluation for SD. In this sense, our focus is on the analysis of the public (people) in general, without limiting it to specific stakeholders (consumer/customer, supplier, seller, etc.), or the way they are inserted in a social context (student, politician, manager).

### 6.3.1 Measures and questionnaire development

For the questionnaire, we used the closed-ended question format to allow for immediate analysis, being more recommended for this type of research. This instrument was developed using an initial set of constructs and items, found through a Systematic Literature Review (SLR), in addition to the extensive review published by Kalmykova et al. (2018). These constructs and items were reviewed by experts through four rounds of an item ranking exercise, as recommended by Menor and Roth (2007); DeVellis (2022) and Lambert and Newman (2022). The four rounds were analysed using three reliability estimators (Interjudge Agreement Percentage, Cohen's k and Perreault and Leigh's Ir) and three other validity estimators (the Proportion of Substantive Validity, Coefficient of Substantive Validity, Overall Placement Ratio). To ensure convergent and discriminant validity we conducted a pre-test with 144 people. The pre-test was analysed using Exploratory Factor Analysis (EFA) (WATSON, 2017). The Kaiser-Meyer-Olkin (KMO) test and Bartlett's test of sphericity were used. For factor extraction, we used Principal Axis Factoring (PAF) and used the Promax oblique rotation method and Total Variance Explained (HAIR JR. et al., 2009; WATTS et al., 2020).

After this validation process, we used the Survey Monkey platform to structure the items and subsequently make them available to respondents. The questionnaire was structured in three sections: the first section presented questions of respondent's characterization; the second section was composed of 15 items to measure people's awareness about five CE approaches (rational use of resource, waste management, sustainable products/packaging, dematerialization/collaborative consumption, and technical cycle); the third section presented the items referring to Favourable Evaluation.

In each item the respondent had to choose the degree of agreement. For this, we used a seven-point Likert scale, with 1 (strongly disagree) and 7 (strongly agree). Confirmatory Factor Analysis (CFA) applied to the 820 respondents to ensure the

constructs' reliability and convergent and discriminant validity. The structure of the survey questionnaire is described in Table 23 and Table 24.

Table 23 - Constructs and items for measuring People's Awareness of CE (PACE)

| Dimension | Subdimension | Item | Code |
|---|---|---|---|
| Waste Management (WM) | Waste reduction | I am aware of the benefits of waste reduction for CE principles. | AWR1 |
| | Waste separation | I am aware of the benefits of waste separation and/or disposal for CE principles. | AWR2 |
| Rational Use of Resources (RUR) | Rational use of water | I am aware of the benefits of rational use of water resources (*water*) for CE principles. | AWR3 |
| | Rational use of energy | I am aware of the benefits of rational energy use (*electric, diesel, natural gas, ethanol*) for CE principles. | AWR4 |
| | Reduction of resource consumption | I am aware of the benefits of reducing resource consumption (*any item consumed by you*) for CE principles (e.*g. electricity and water consumption, purchase of electrical and electronic goods, clothing*). | AWR5 |
| Technical Cycle (TC) | Remanufacture | I am aware of the benefits of using remanufactured products for CE principles (*e.g. Amazon that sells remanufactured printer toners*). | AWR6 |
| | Reuse | I am aware of the benefits of reusing products, components, or packaging for CE principles. | AWR7 |
| | Repair | I am aware of the benefits of repairing products for CE principles. | AWR8 |
| | Recycling | I am aware of the benefits of recycling products, components, and packaging for CE principles. | AWR9 |
| Use of Sustainable Products or Packaging (USPP) | Environmentally certified products | I am aware of the benefits of using sustainable products and/or packaging for CE principles. | AWR10 |
| | Sustainable products or packaging | I am aware of the benefits of using environmentally certified products for CE principles. | AWR11 |
| Dematerialization and Collaborative Consumption (DCC) | Product-service-System | I am aware of the benefits of renting a product for CE principles. (*e.g., renting a coffee machine instead of buying it*) | AWR12 |
| | Virtualise | I am aware of the benefits of using digital products instead of physical products for CE principles (*e.g., buying eBooks instead of printed books; listening to music on spotify instead of buying CDs; renting a game on a game streaming instead of buying a physical game*) | AWR13 |
| | Share Economy | I am aware of the benefits of practicing collaborative consumption for CE principles. (*Ex: Co-working spaces; Uber; Airbnb*) | AWR14 |

| | I am aware of the benefits of buying, using, selling, sharing or donating second-hand (*used*) products for CEprinciples. | AWR15 |
|---|---|---|

Table 24 - Constructs and items related to Favourable Evaluation (FE)

| Dimension | | Item | Code |
|---|---|---|---|
| **Favourable Evaluation (FE)** | FEa – Importance of SD | It is important that people develop sustainable habits or behaviours for the preservation of the environment and survival of future generations | FEa1 |
| | | Adopting sustainable habits or behaviour is a way of promoting economic development | FEa2 |
| | | Adopting sustainable habits or behaviour is a way of promoting social development | FEa3 |
| | FEb – Engagement of people on SD | There needs to be engagement between people to develop sustainable habits or behaviours | FEb4 |
| | FEc - Institution's participation in efforts towards SD | The Government should create incentive policies that result in actions with a positive effect on sustainable development (Ex: reduce tax on electric cars) | FEc5 |
| | | Companies should offer incentives to consumers that are aligned with sustainable development (Ex: HP, through the "Reciclagem Solidária" program, collects electronic waste and promotes the donation of food. "Every 1Kg of equipment is equivalent to 1Kg of food donated to those in need") | FEc6 |

## 6.3.2 Data Collection and Analysis

The questionnaire was structured and applied using the Survey Monkey platform. In addition, we used social networks to disseminate the survey questionnaire to the public. Using the non-probability convenience sampling method, we collected data from 1046 peoples. To make our data free of outliers and to ensure data reliability, we excluded the responses considered outliers, obtaining a final sample represented by 820 people (FIELD, 2016). Table 25 shows the detailed socio-demographic information. The respondents agreed to participate in the research and allowed their data to be used anonymously and confidentially.

Table 25 - Demographic composition of the study participants (n = 820)

| Demographic Variables | Categories | Percentage |
|---|---|---|
| Gender | Male | 23% |
| | Female | 76% |
| Age | 21 years or less | 2% |
| | 22 - 36 years | 10% |
| | 37 - 56 years | 40% |
| | 57 years or more | 48% |
| Marital status | Single | 29% |
| | Married/Stable Union | 51% |
| | Widowed | 5% |
| | Divorced | 14% |
| Occupation | Public Servants | 29% |
| | Individual Microentrepreneurs | 16% |
| | Entrepreneurs | 2% |
| | Employees in Private Companies | 10% |
| | Unemployed | 9% |
| | Students | 6% |
| | Retired | 26% |
| Level of schooling | Incomplete High School | 4% |
| | Complete High School | 12% |
| | Incomplete Higher Education | 11% |
| | Complete Higher Education | 30% |
| | Incomplete Post-graduation | 5% |
| | Complete Post-graduation | 38% |
| South-eastern region of Brazil | North | 6% |
| | South | 23% |
| | Southwest | 61% |
| | Central-West | 3% |
| | Northeast | 7% |

Source: prepared by the authors

Table 25 summarises the main demographic characteristics of the sample. It can be noticed the predominance of female participants, and regarding the geographical distribution, most of them reside in the Southeast region. As to age, most of the respondents are 57 years old or older; 40% are between 37 and 56 years old, 10% are between 22 and 36 years old and the minority (2%) is 21 years old or younger.

The statistical technique used was Structural Equations Modelling (SEM) and Partial Least Squares (PLS) via Smart PLS statistical software and bootstrap procedure (HAIR JR et al., 2014). PLS path modelling is widely used not only in management research but also in other research with a focus on sustainable management and CE (ALONSO-ALMEIDA et al., 2020; SZILAGYI et al., 2022). This technique is used to assess predictive factors such as the relationship between pressures, attitudes, and enablers. In addition, the technique assesses the model's quality through multiple regression (HAIR JR et al., 2014).

## 6.4 Results

For efficient transition from linear economy to CE, it is necessary that more individuals would decide to change their consumption habits, making voluntary changes in their lifestyle (HERMES; RIMANOCZY, 2018; TSALIS; STEFANAKIS; NIKOLAOU, 2022). The first step for this to happen depends on people's awareness of CE, as pointed out by the Karaeva et al. (2022) who concluded that public awareness has proved to be an essential factor in achieving environmental and social sustainability.

### 6.4.1 Non-response bias and Common Method Variance (CMV)

In order to reduce bias and ensure sample reliability, we randomly distributed the items through the Survey Monkey platform (PODSAKOFF et al., 2003). In the first wave we received 195 questionnaires, after 20 days another 381 questionnaires were received, and after 25 days a total of 261 questionnaires were received. We used the Kruskal-Wallis test to check whether there is bias in the sample, since this test identifies whether there are significant differences, besides showing whether the sample comes from the same distribution (MARTINS et al., 2019; PODSAKOFF et al., 2003). The Kruskal-Wallis test showed that there are no differences between the samples, which presumes they are from the same population, as it showed a value greater than 0.05, (p=0.3749).

To evaluate the Common Method Variance, we adopted Harman's Single-Factor Test, which uses the amount of variance comprised by a single factor may indicate possible bias (AGUIRRE-URRETA; HU, 2019; MACKENZIE et al., 2011). This test performs an Exploratory Factor Analysis with the dependent and independent variables (MACKENZIE et al., 2011). The results of Harman's test showed that the single factor variance was less than 50% (35.17) which is presumed to have no bias.

To obtain accurate reliability of the indicators we followed the steps proposed by Hair et al. (2021): assessing the formative measurement model and assessing the structural model and testing Hypothesis described in the following sections.

## 6.4.2 Assessing the Formative Measurement Model

In order to verify the significance and reliability of the constructs to estimate the model's casual relationships, we followed the Assessing the formative measurement model step (HAIR et al., 2021). As detailed in section 3.1, the items and constructs were created and validated according to the reliability recommendations proposed by Menor and Roth (2007) and DeVellis (2002).

Figure 15 - Measurement model
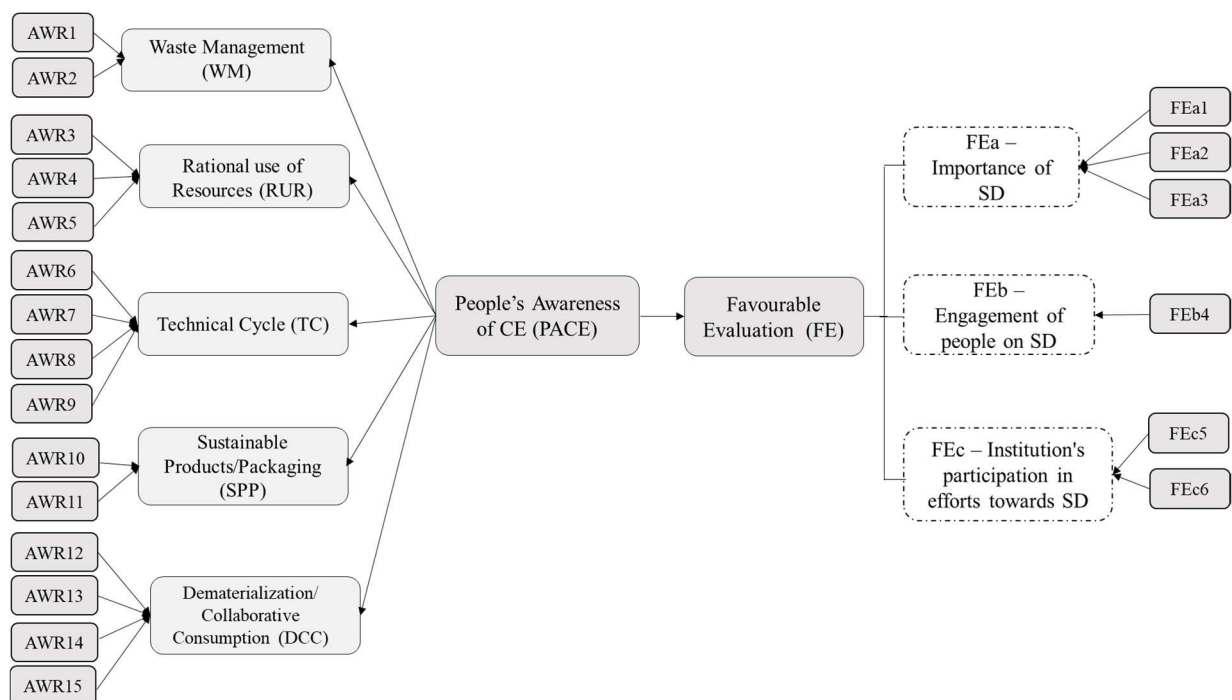


Source: prepared by the author.

Our measurement research model is represented in Figure 15, in which it present construct of a formative nature (Favourable Evaluation - FE). Formative constructs represent the relationship that runs from items to constructs, so that changes in items represent changes in constructs (ELGIZAWY; EL-HAGGAR; NASSAR, 2016; VAN BUREN et al., 2016). The formative constructs were chosen according to the characteristics of the items. In reflective models, causality moves from constructs towards items, in which changes in constructs promote changes in items (CHANG; FRANKE; LEE, 2016; PETTER; STRAUB; RAI, 2007). Figure 15 shows that the construct Favourable Evaluation (FE) is formed by the manifest variables FEa1, FEa2, FEa3, FEb4, FEc5 and FEc6. As presented in Figure 15, the People's Awareness of CE (PACE) construct was delineated as a second-order Reflective-Formative construct, given the arrangement of its constructs and items. The Pace construct is formed by other constructs that compose it (WM, RUR, TC, SPP and DCC), each of which is composed of other manifest variables.

We used the VIF value to identify the absence of collinearity and measure the formative measurement model (CHANG; FRANKE; LEE, 2016; LEE et al., 2011). We obtained VIF values <3.0, as shown in Table *26* - Validation of the Formative Constructswhich demonstrates absence of collinearity. After this procedure we performed the bootstrap technique with 5000 subsamples to identify the significance of each item. According to Hair et al. (2021) the values should be less than 0,05 (p<0,05) to ensure significance.

Table 26 - Validation of the Formative Constructs

| Construct | Code Items | VIF | Outer Weight | | |
| --- | --- | --- | --- | --- | --- |
| | | | Original Sample | Sample Mean | p value |
| Waste Management (WM) | AWR1 | 1,875 | 0,813 | 0,938 | 0,000* |
| | AWR2 | 1,875 | 0,776 | 0,894 | 0,000* |
| Rational Use of Resources (RUR) | AWR3 | 1,836 | 0,781 | 0,864 | 0,000* |
| | AWR4 | 1,846 | 0,765 | 0,846 | 0,000* |
| | AWR5 | 1,596 | 0,751 | 0,831 | 0,000* |
| Technical Cycle (TC) | AWR6 | 1,360 | 0,613 | 0,653 | 0,000* |
| | AWR7 | 2,468 | 0,831 | 0,751 | 0,000* |
| | AWR8 | 1,747 | 0,820 | 0,874 | 0,000* |
| | AWR9 | 2,262 | 0,755 | 0,805 | 0,000* |
| Sustainable Products or Packaging (SPP) | AWR10 | 1,359 | 0,824 | 0,878 | 0,000* |
| | AWR11 | 1,775 | 0,784 | 0,886 | 0,000* |
| Dematerialization and Collaborative Consumption (DCC) | AWR12 | 1,296 | 0,853 | 0,687 | 0,000* |
| | AWR13 | 1,281 | 0,395 | 0,466 | 0,000* |
| | AWR14 | 1,474 | 0,712 | 0,604 | 0,000* |
| | AWR15 | 1,275 | 0,917 | 0,777 | 0,000* |
| Favourable Evaluation (FE) | FEa1 | 1,399 | 0,740 | 0,834 | 0,000* |
| | FEa2 | 1,533 | 0,734 | 0,651 | 0,000* |
| | FEa3 | 1,769 | 0,765 | 0,862 | 0,000* |
| | FEb4 | 1,000 | 1,000 | 0,684 | 0,000* |
| | FEb5 | 1,355 | 0,651 | 0,872 | 0,000* |
| | FEc6 | 1,24 | 0,581 | 0,778 | 0,000* |

Where: *Sig. (p<0,05

Source: prepared by the author.

Our results show that all formative constructs were validated and thus, the conceptual model and hypotheses were assessed for direct and indirect effects.

## 6.4.3 Assessing the Structural Model and Testing Hypothesis

After evaluating the formative measurement model, we evaluate the structural model. According to Hair et al. (2021), the coefficient of determination ($R^2$) is an measure of variability and shows the variation of the dependent (endogenous) variables compared to the independent (exogenous) variables. We found $R^2$ values for People's Awareness of Circular Economy (PACE) and Favourable Evaluation (FE) of 0.170 and 0.364, respectively. This value is included in the small and moderated category (HAIR et al., 2021).

To test the direct hypotheses, we reread the bootstrapping procedure with 5,000 resamples, based on the 1% significance level (one-tailed). The bootstrapping technique is a non-parametric procedure needed to check whether the path coefficients (β) are

significant (ALVAREZ-RISCO et al., 2021). If representative (p<0.01), the calculation is repeated 5000 times. It can be seen in Table 27that the values are significant (p-values < 0.01).

The test of the direct hypotheses is part of the evaluation of the structural model. As such, regarding the direct effects, we found that the relationships PACE→FE, PACE→FEa, PACE → FEb, PACE → FEc were significant, with β values of 0.415, 0.887, 0.684 and 0.747, respectively (p < 0.01) (Table 27). Thus, H1, H1a, H1b and H1c are fully supported.

Table 27 - Testing direct effect and moderating

| Structural relation | Coef (B) | SD | p values | Decision |
|---|---|---|---|---|
| PACE --> FE | 0,415 | 0,063 | 0,000 | H1 supported |
| PACE --> FEa | 0,887 | 0,019 | 0,000 | H1a supported |
| PACE --> Feb | 0,684 | 0,035 | 0,000 | H1b supported |
| PACE --> FEc | 0,747 | 0,041 | 0,000 | H1c supported |

Note: * Statistically significant at the p <0,01.
Source: prepared by the author.

After testing the direct effects of the hypotheses and confirming the significance of the direct effects, we also tested the indirect effects, as detailed in Table 28.

Table 28 - Testing indirect effects

| Structural relation | Coef (B) | SD | p values | Decision |
|---|---|---|---|---|
| PACE --> FEa | 0,368 | 0,060 | 0,000 | Supported |
| PACE --> FEb | 0,284 | 0,047 | 0,000 | Supported |
| PACE --> FEc | 0,310 | 0,056 | 0,000 | Supported |

Note: * Statistically significant at the p <0,01
Source: prepared by the author.

Table 28 presents the indirect effects. It is noted that the construct Favourable Evaluation (FEa) is the most affected by People Awareness of CE (PACE), with a β value of 0,368. Having a favourable assessment of SD can make people more resilient and adaptable. Similarly, research by DUCHI et al. (2020), showed that maintaining positive thinking can help overcome barriers linked to the transition to CE. The construct least affected by People Awareness of CE (PACE), was Favourable Evaluation (FEb), with a β value of 0.310.

**6.5 Discussion**

For the CE to become effective, it is necessary for all the agents involved in the forms of production and consumption to adhere to it, promoting adaptations and new forms of people's living habits. Studies focusing on people's awareness are necessary to understand how this can drive or discourage people's to think positively concerning efforts towards SD (YANG et al., 2022). Empirical evidence suggests people's lack of awareness is one of the main barriers to SD, mainly due to the consumerist lifestyle (KIRCHHERR et al., 2017). So understanding people's awareness is one way for governments, companies and other institutions to target circular strategies (SATTARI; WESSMAN; BORDERS, 2020; SCHODEN et al., 2020).

H1 postulated that Favourable Evaluation about SD is positively influenced by People Awareness of CE. Previous studies have shown that positive assessment can increase people's awareness of energy saving (OIKONOMOU et al., 2009) and buying energy-efficient appliances (WARIS; AHMED, 2020). Our results showed that being aware of CE gives people a favourable assessment/judgement on SD.

People's lack of awareness about CE implies how people judge SD. Thus, keeping a favourable evaluation is related to the way people perceive different aspects around them. Khor and Hazen (2017) has showed that one of the biggest threats to closed-loop supply chain practices is consumers' lack of acceptance or negative evaluation. The research of Navare et al. (2021) showed that consumers have a negative evaluation of remanufacturing, judging its functionality negatively. This finding indicates that a negative evaluation/judgement towards an CE strategy can compromise awareness and behavioural intention. Thus, a paradigm shift in mentality is important to raise awareness and educate people to maintain a favourable evaluation concerning SD. This hypothesis acceptation supports the notion that increasing people's awareness of CE may help increase their favourable evaluation concerning SD. Therefore, this evidence can be used to inform policymakers about the need for investment in education and awareness about CE.

To better understand our theoretical model, we unfolded hypothesis 1 into sub hypotheses. H1a showed that people´s awareness towards CE positively influences favourable evaluation concerning the importance of SD, while sub hypothesis H1b and H1c showed that people´s awareness towards CE positively influences the favourable evaluation concerning respectively people's engagement in actions and behaviours

towards SD and also institutions' participation in efforts towards SD. Therefore, the three aspects of SD were found to be positively influenced by CE awareness.

To support our hypothesis, we used the Social Learning Theory, which suggests that individuals learn new behaviours and attitudes through observation, imitation, and reinforcement from the environment and other people's experiences (WEDER et al., 2022). In this case, individuals may learn about the CE and its importance through various sources, such as media, social networks, or educational programs, which can lead to a favourable evaluation of SD.

People may see their friends and family engaging in CE practices such as recycling, using of sustainable products or packaging. These observations can provide an expectation that sustainable practices are desirable and valued and encourage more people to have a favourable assessment and consequently adopt more regenerative behaviours. Furthermore, individuals may develop a favourable evaluation of SD by experiencing positive outcomes of CE practices. They may notice the cost-benefit ratio (save money by reducing waste, for example), feel healthier by using environmentally friendly products, or experience a sense of satisfaction from contributing to environmental preservation. These positive outcomes can reinforce their positive evaluation concerning the importance of SD and the participation of people and institutions on SD efforts, leading to further adoption of sustainable practices.

The favourable evaluation affects the way people interpret the world around them. Having a positive evaluation of SD is important to the adoption of more regenerative behaviours for the entire society.

Individuals who become aware of the circular economy and its potential benefits may develop a favourable evaluation of SD, including its importance and the engagement of people and participation of institutions on efforts towards SD. They may do so by observing and learning from others who value sustainability or by experiencing positive outcomes of sustainable practices. Our results showed that social learning theory suggests that individuals can develop a favourable evaluation of SD, including its importance and the actions of people and institutions, by observing and learning from others who value sustainability and experiencing positive outcomes from such practices. By becoming aware of the circular economy and its potential benefits, individuals can engage in a social learning process that leads to adopting sustainable practices and a greater sense of importance and engagement for SD.

Our research presents some critical contributions. Our results contribute to the knowledge base of the Social Learning Theory by providing a concrete example of how social learning processes can promote sustainable practices. We show that Social Learning Theory is applicable in the context of circular economy and SD. This can validate the theory and its application in other contexts as well. Furthermore, our findings also contribute to this theory showing the importance of the actions of people and institutions towards sustainability.

Concerning practical contributions, it highlights the importance of promoting awareness and education about the CE as a means of promoting SD. Organizations and governments can invest in educational programs and campaigns to increase public awareness and understanding of the CE and its benefits. Furthermore, governments and organizations should implement policies and programs that incentivize circular economy practices, such as recycling programs, and product design that promotes repairability and reusability. By engaging in circular economy practices and promoting awareness of the circular economy, individuals can contribute to more favourable evaluations of SD and help to create a more sustainable future. The results of the study by Muranko et al. (2019) showed that persuasive education positively impacted people's positive evaluation and behavioural intention towards remanufactured products. In this sense, it is important that all agents involved with the strategies of closing the cycle know that the CE, besides focusing on environmental development, also has a positive effect on economic and social development.

Overall, demonstrating the positive influence of people's awareness of the circular economy on their evaluation of SD can help guide policy and practice towards a more sustainable circular economy and encourage individual actions towards sustainability. Table 29 summarizes the theoretical and practical contributions of our research.

Table 29 - Key findings and contributions

| Key Findings | Contributions to CE Literature | Theoretical Implications | Practical Implications |
|---|---|---|---|
| People Awareness of CE positively influences favourable evaluation about the importance of SD, and the engagement of people and the participation of institutions on SD efforts. | 1) These findings are important to the CE literature by considering the role of social factors in promoting the adoption of circular economy practices;<br><br>2) This research supports the notion that the circular economy can be an effective means of achieving SD goals and highlights the importance of promoting awareness of the circular economy to achieve these goals;<br><br>3) Any research with this goal was found in CE literature. | 1) This finding contributes to Social Learning Theory by providing a concrete example of how social learning processes can promote sustainable practices;<br><br>2) Our findings also contribute to theory, showing the importance people´s and institution´s on efforts towards sustainability. | 1) Organizations and governments can invest in educational programs and campaigns that aim to increase public awareness and understanding of the circular economy and its benefits;<br><br>2) Companies can partner with institutions and cooperatives to create sharing networks or reuse centres, increasing people's involvement with these circular strategies. |

Source: prepared by the author.

## 6.6 Conclusions

The alignment of different value chain actors with the CE involves a complete and active integration of people, regardless of the position that these people act (managers, consumers, governors, etc.). It is worth noting that the present study differs by considering five different approaches of CE: rational use of resources (rational use of water, rational use of energy, reduction of resource consumption); waste management (Waste reduction, Waste separation), use of sustainable products/packaging (Environmentally certified products and Sustainable products or packaging), dematerialization/collaborative consumption (Product-service-System, Virtualise and Share Economy) and technical cycle (Remanufacture, Reuse, Repair and Recycling). To define these approaches, we conducted a broad systematic review of the literature, in addition to considering the study of Kalmykova et al. (2018), which mentions 45 CE strategies and includes all the strategies present in the framework model ReSOLVE.

Our results showed that people's awareness of CE is essential for maintaining a favourable evaluation of actions that contribute to SD. These results can foster strategic measures that focus on changing mentality paradigms, including environmental education

awareness-raising policies by policymakers that should be applied to different actors in the value chain.

By learning about CE and its importance through media, friends or educational programmes or other means, people tend to create a favourable evaluation about SD. The social learning theory proposes that individuals acquire new attitudes and beliefs through observing others, such as peers, authority figures, and media, as well as through direct experience. In this context, individuals may become aware of the circular economy and its potential benefits by observing others who value SD or through educational programs that promote sustainable practices. They may also develop a favourable evaluation of SD by seeing positive outcomes of sustainable behaviours and actions.

Our research has shown the importance of understanding social learning as a driver for SD. Furthermore, our results indicate the importance of educational programs and campaigns to increase public awareness and understanding of the circular economy and its benefits. These results could be further investigated and tested in future research to enhance our understanding of how social learning processes and people's awareness operate in the context of SD and the circular economy.

Our study, besides its merits, has some limitations. Our study focused on raising people's awareness, without considering the relationship between behavioural intention. Thus, future studies may consider the favourable evaluation in realising CE-oriented behaviours. In addition, our study is limited to the sample size of 820 cases, and the survey was conducted in Brazil. Thus, one should be careful about generalising the results. Future research should direct its analysis towards the relationship of these predictors in adopting behaviours, as knowing the planetary challenges may not be enough to change behaviours and engage with CE.

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## 7. CONCLUSION

This study Analyse the factors that interact with people's awareness of CE and their effects on people's favourable evaluation of SD. To this end, we followed four specific objectives: (i) Investigate the state of the art regarding research around the world that address the awareness, behaviour, and attitudes to people of CE; (ii) Develop a new multi-item measurement scale to measure people's awareness of CE; (iii) Assess the effect of Social Influence and Psychological Barriers on People's Awareness of CE; and (iii) Analyse the relationship between people's awareness of CE and favourable evaluation of people concerning the importance of efforts for sustainable development.

Given the large dimension that the circular model represents, it is a challenge to include all circular strategies in our research. Thus, we opted for strategies more directed to the reality of people's daily lives, in addition, we must consider the size of the research questionnaire. To achieve the objective of this thesis, a multi-method approach was adopted, as summarized in Table 30, which demonstrates the main contributions of each stage.

Table 30 -Summary of the main implications of each stage of the thesis

| Objectives | Method | Main Results | Contributions |
|---|---|---|---|
| Investigate the state of the art regarding research around the world that address the awareness, behaviour, and attitudes to people of CE. | SLR | It was proposed a list 22 constructs related to CE strategies; A research agenda was presented; | We provided a mapping of studies that focus on awareness, behaviours and attitudes; |
| Develop new multi-item measurement scales to measure people's awareness of CE. | Multi-method approach | This study employs a rigorous method including item generation, the Q-Sort method, surveys, and statistical analysis to propose a new robust scale; | The scale itself represents a theorical contribution, as it presents uniformity and can be applied in different contexts; For practical contribution, the scale can be used for several types of institutions, such as companies and governments, to measure the level of awareness of people of CE; |
| Assess the effect of Social Influence and Psychological Barriers on People's Awareness of CE. | Survey | Psychological Barriers (Sunk Costs dragons and Limited Cognition dragons) restrict people's awareness of CE. | This finding contributes to the TBC by suggesting that awareness of CE is an essential factor in their decision-making process related to a more regenerative economy; Educational, preventive, and corrective actions should be taken to break these psychological barriers, considering the wide applicability of CE in people's daily lives. |
| Analyse the relationship between people's awareness of CE and favourable evaluation of people concerning the importance of efforts for sustainable development. | Survey | People Awareness of CE positively influences favourable evaluation about the importance of SD, and the engagement of people and the participation of institutions on SD efforts. | Our results contribute to the knowledge base of the Social Learning Theory by providing a concrete example of how social learning processes can promote sustainable practices; By engaging in circular economy practices and promoting awareness of the circular economy, individuals can contribute to more favourable evaluations of SD and help to create a more sustainable future; |

Source: Proposed by the author.

Since environmental impacts have been caused primarily by the behavioural choices of billions of people, an important avenue for science is to understand the predictors that lead to people's awareness of sustainable approaches. In line with our results, other studies have shown that there is a lack of knowledge about SD (RIZOS et al., 2016; YA; KONG; ZHANG, 2020). Thus, people are reluctant about joining various CE strategies as pointed out by Bocken et al. (2014) who showed that consumers are resistant to ownership of products to participate in the Product-service-system.

First, a Systematic Literature Review (SLR) was carried out and described in chapter 3. The result showed 22 constructs related to CE strategies which were used as the basis for the construction of the measurement scale. Regarding the behavioural perspective of the studies, we concluded that most studies address the awareness, behaviours, or attitudes of people towards the circular economy from the perspective of consumers.

Second, the RSL showed the absence of a validated measurement scale to measure people's awareness of CE. To fill this research gap and build models that present reliable and valid measurement frameworks, a measurement scale was proposed to assess people's awareness of five different approaches: Rational use of Resources (RUR) Waste Management (WM); Sustainable Products and Packing (SPP); Dematerialization and Collaborative Consumption (DCC); Technical Cycles (TC). This measurement scale represents a theoretical and practical contribution given its level of reliability and validity and can be applied in different contexts, since it considers CE strategies according to people's reality.

Another important contribution of this thesis was presented in chapter 4, in which we analysed the effects of Social Influence and Psychological Barriers on people awareness of CE. To support this analysis, we draw on the Theory of Behavioral Choice (TBC) for the inclusion of the construct Psychological Barriers and Social Influence. This study can contribute for leaders (companies, governments, managers etc.) to elaborate policies for the reduction of barriers and stimulation of facilitators for the effective participation of people in the strategies and activities oriented to CE. The literature points out the lack of information for companies regarding people's awareness and involvement with CE (SATTARI; WESSMAN; BORDERS, 2020). In this sense, this study represents an important contribution by bringing clarification on the predictors that interact with people's awareness, besides serving as a theoretical basis, which can be reproduced in other contexts and places.

Finally, the article described in chapter 5 aimed analyse the relationship between people's awareness of CE and favourable evaluation of people concerning the importance of efforts for sustainable development. For this purpose, we use the Social Learning Theory, which suggests that people learn from their environment and the behaviours of others. The results showed that the favourable evaluation can affects the way people interpret the world around them. Having a positive evaluation of SD is important to the adoption of more regenerative behaviours for the entire society. Furthermore, our results indicate the importance of educational programs and campaigns to increase public awareness and understanding of the circular economy and its benefits.

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**APPENDIX A - Free and Informed Consent Form**

## TERMO DE CONSENTIMENTO LIVRE E ESCLARECIDO

O (a) senhor(a) está sendo convidado(a) por pesquisadores da Universidade Federal de São Carlos (UFSCar) para participar da pesquisa "**Conscientização das pessoas rumo à Economia Circular**", que objetiva avaliar o nível de conscientização das pessoas para uma economia mais circular e sustentável. O questionário é composto de questões fechadas e de múltipla escolha, sendo que seu preenchimento deverá ocorrer entre 10 a 15 minutos.

Sua participação é voluntária e confidencial. A assinatura deste termo (TCLE) consiste no aceite da participação na pesquisa ao final desta carta. Os dados serão tratados de forma agregada, garantindo a confidencialidade das informações somente à equipe de pesquisadores.

Você não terá nenhum custo ou compensação financeira ao participar do estudo.

Sua participação é voluntária, isto é, a qualquer momento o(a) senhor(a) irá decidir se deseja participar e preencher o questionário. Caso desista de participar durante o preenchimento do questionário e antes de finalizá-lo, os seus dados não serão gravados, sendo apagados ao se fechar a página do navegador. Caso tenha finalizado o preenchimento e enviado suas respostas do questionário e após decida desistir da participação, será possível a retirada de suas respostas do banco de dados mediante solicitação ao pesquisador via endereço de e-mail fornecido.

Caso o(a) senhor(a) concorde em participar, a coleta de informações será realizada por meio virtual, composta pelo preenchimento de um questionário. Os resultados da pesquisa poderão trazer benefícios para outras pessoas, pesquisadores ou empresas ao contribuir para a compreensão do nível de conscientização sobre Economia Circular e a adoção de comportamentos sustentáveis pela população brasileira.

O Senhor (a) poderá solicitar informações complementares desta pesquisa pelo e-mail **jessica_gonella@hotmail.com**

Com os melhores cumprimentos,

**Jéssica dos Santos Leite Gonella**
Doutoranda do Programa de Pós-graduação em Engenharia de Produção-
Universidade Federal de São Carlos (UFSCar)
**Prof. Dr. Moacir Godinho Filho**
Universidade Federal de São Carlos (UFSCar)

**APPENDIX B – Questionnarie (Portuguese version)**

| Seção 1 - Perfil dos Respondentes | |
|---|---|
| Qual seu gênero? | ( ) Feminino |
| | ( ) Masculino |
| | ( ) Outro |
| | ( ) Prefiro não responder |
| Qual seu Estado Civil? | ( ) Solteiro (a) |
| | ( ) Casado/ União Estável |
| | ( ) Viúvo |
| | ( ) Divorciado(a) |
| | ( ) Não desejo informar |
| Qual é sua idade? | ( ) 21 anos ou menos |
| | ( ) Entre 22 e 36 anos |
| | ( ) Entre 37 e 56 anos |
| | ( ) 57 anos ou mais |
| | ( ) Não desejo informar |
| Em que Estado você reside? | ( ) AC ( )GO ( )PR ( )RR |
| | ( ) AL ( )MA ( )PE ( ) SC |
| | ( ) AP ( )MT ( )PI ( ) DF |
| | ( ) AM ( )MS ( )RJ |
| | ( ) BA ( ) MG ( )RN |
| | ( ) CE ( )PA ( )RS |
| | ( )ES ( )PB ( )RO |
| | ( )SP ( )SE ( ) TO |
| Qual a sua Escolaridade? | ( ) Ensino Fundamental |
| | ( ) Ensino Médio Incompleto |
| | ( ) Ensino Médio Completo |
| | ( ) Ensino Superior Incompleto |
| | ( ) Ensino Superior Completo |
| | ( ) Pós-graduação incompleta |
| | ( ) Pós-graduação completa |
| | ( ) Não desejo informar |
| Qual a sua área de formação? | ( ) Ciências Exatas e da Terra |
| | ( ) Ciências Biológicas |
| | ( ) Engenharias |
| | ( ) Ciências da Saúde |
| | ( ) Ciências Agrárias |
| | ( ) Linguística, Letras e Artes |
| | ( ) Ciências Sociais Aplicadas |
| | ( ) Ciências Humanas |
| Qual a sua Ocupação? | ( ) Estudante |
| | ( ) Funcionário(a) em empresa privada |

| | ( ) Empresário(a) |
|---|---|
| | ( ) Microempreendedor Individual/ Autônomo |
| | ( ) Servidor Público |
| | ( ) Desempregado |
| | ( ) Aposentado |
| | ( ) Não desejo informar |
| Quais redes sociais você utiliza atualmente? Assinale mais de uma opção se for o caso. | ( ) Facebook |
| | ( ) Instagram |
| | ( ) Twitter |
| | ( ) Tiktok |
| | ( ) Linkedin |
| | ( ) Youtube |
| | ( ) WhatsApp |
| | ( ) Snapchat |
| Aproximadamente, qual é a sua renda familiar mensal? | ( ) R$11000 |
| | ( ) De R$ 2.200 a R$ 4.400 |
| | ( ) De R$5.500 a R$ 7.700 |
| | ( ) De R$ 8.800 a R$11.000 |
| | ( ) Acima R$11.000 |
| | ( ) Não desejo informar |
| Sua renda diminuiu durante a pandemia de Covid-19? | ( ) Sim |
| | ( ) Não |

| | |
|---|---|
| Minha compreensão (entendimento) sobre Economia Circular é: | ( ) Nunca ouvi falar de Economia Circular |
| | ( ) Já ouvi falar, mas não sei bem do que se trata |
| | ( ) Tenho compreensão básica dos conceitos e princípios da Economia Circular |
| | ( ) Tenho entendimento médio dos conceitos e princípios da Economia Circular |
| | ( ) Tenho domínio completo dos conceitos e princípios da Economia Circular |

| Em relação à declaração a seguir, indique o seu nível de concordância de acordo com a escala abaixo: | Discordo Totalmente | | | | | | Concordo Totalmente |
|---|---|---|---|---|---|---|---|
| | 1 | 2 | 3 | 4 | 5 | 6 | 7 |
| Eu tenho consciência da importância dos princípios da Economia Circular para o desenvolvimento econômico, social e ambiental das futuras gerações. | | | | | | | |
| Eu tenho consciência dos benefícios da separação, destinação e redução de resíduos para os princípios da Economia Circular. | | | | | | | |
| Eu tenho consciência dos benefícios do uso racional de recursos hídricos (água) para os princípios da Economia Circular. | | | | | | | |
| Eu tenho consciência dos benefícios do uso racional de energia (elétrica, diesel, gás natural, etanol) para os princípios da Economia Circular | | | | | | | |
| Eu tenho consciência dos benefícios de reduzir o consumo de recursos (qualquer item consumido por você) para os princípios da Economia Circular. (Ex: consumo de energia elétrica e água, compra de elétro-eletrônicos, vestuário, etc) | | | | | | | |

| | | | | | | |
|---|---|---|---|---|---|---|
| Eu tenho consciência dos benefícios do uso de produtos remanufaturados para os princípios da Economia Circular. (Ex: Amazon que comercializa toners de impressoras remanufaturados) | | | | | | |
| Eu tenho consciência dos benefícios da reutilização de produtos, componentes ou embalagens para os princípios da Economia Circular. | | | | | | |
| Eu tenho consciência dos benefícios da restauração e conserto de produtos para os princípios da Economia Circular. | | | | | | |
| Eu tenho consciência dos benefícios da reciclagem de produtos, componentes e embalagens para os princípios da Economia Circular. | | | | | | |
| Eu tenho consciência dos benefícios do uso de produtos e/ou embalagens sustentáveis para os princípios da Economia Circular. | | | | | | |
| Eu tenho consciência dos benefícios do uso de produtos com certificação ambiental para os princípios da Economia Circular. | | | | | | |
| Eu tenho consciência dos benefícios de se alugar um produto para os princípios da Economia Circular. (Ex. Alugar máquina de café em vez de compra-la) | | | | | | |
| Eu tenho consciência dos benefícios de usar produtos virtuais em vez de produtos físicos para os princípios da Economia Circular (Ex: Comprar ebook ao invés de livros impressos; escutar música pelo spotify em vez de comprar CD; alugar um jogo em um streaming de game ao invés de comprar um jogo físico) | | | | | | |
| Eu tenho consciência dos benefícios de praticar o consumo colaborativo (economia compartilhada) para os princípios da economia circular. (Ex: Espaços Co-working; Uber; Airbnb) | | | | | | |
| Eu tenho consciência dos benefícios da compra, uso, venda, compartilhamento ou doação de produtos de segunda mão (usados) para os princípios da Economia Circular. | | | | | | |

| A motivação para eu desenvolver os comportamentos sustentáveis declarados por mim na seção anterior é: | Discordo Totalmente | | | | | | Concordo Totalmente |
|---|---|---|---|---|---|---|---|
| Preservação do meio ambiente | 1 | 2 | 3 | 4 | 5 | 6 | 7 |
| Sobrevivência das gerações futuras | | | | | | | |
| Motivação Econômica (economizar dinheiro do orçamento pessoal/familiar) | | | | | | | |
| Motivação Social (entretenimento, engajamento com pessoas; auxílio aos menos favorecidos, etc.) | | | | | | | |

| Em relação à declaração a seguir, indique o seu nível de concordância de acordo com a escala abaixo: | Discordo Totalmente | | | | | | Concordo Totalmente |
|---|---|---|---|---|---|---|---|
| Minha família e amigos adotam hábitos ou comportamentos visando contribuir para o desenvolvimento sustentável | 1 | 2 | 3 | 4 | 5 | 6 | 7 |
| As celebridades que sigo nas redes sociais adotam hábitos ou comportamentos relacionados ao desenvolvimento sustentável. | | | | | | | |
| A sociedade vem mostrando-se favorável ao desenvolvimento sustentável. | | | | | | | |

| Em relação à declaração a seguir, indique  o seu nível de concordância de acordo com a escala abaixo: | Discordo Totalmente | | | | | | Concordo Totalmente |
|---|---|---|---|---|---|---|---|
| É importante que as pessoas desenvolvam hábitos ou comportamentos sustentáveis para a preservação do meio ambiente e sobrevivência das gerações futuras. | 1 | 2 | 3 | 4 | 5 | 6 | 7 |
| Adotar hábitos ou comportamentos sustentáveis é uma maneira de promover desenvolvimento econômico | | | | | | | |
| Adotar hábitos ou comportamentos sustentáveis é uma maneira de promover desenvolvimento social. | | | | | | | |
| É necessário que ocorra envolvimento entre as pessoas para o desenvolvimento de hábitos ou comportamentos sustentáveis | | | | | | | |

| Em relação à declaração a seguir, indique  o seu nível de concordância de acordo com a escala abaixo: | Discordo Totalmente | | | | | | Concordo Totalmente |
|---|---|---|---|---|---|---|---|
| O Governo deve criar políticas de incentivos que resultem em ações com efeito positivo ao desenvolvimento sustentável (Ex: reduzir imposto sobre carros elétricos) | 1 | 2 | 3 | 4 | 5 | 6 | 7 |
| As empresas devem oferecer incentivos aos consumidores que estejam alinhados ao desenvolvimento sustentável (Ex: A HP, por meio do programa "Reciclagem Solidária", recolhe os resíduos eletrônicos e promove a doação de alimentos. "Cada 1Kg de equipamento equivale a 1Kg de alimento doado para quem precisa") | | | | | | | |

| Em relação à declaração a seguir, indique  o seu nível de concordância de acordo com a escala abaixo: | Discordo Totalmente | | | | | | Concordo Totalmente |
|---|---|---|---|---|---|---|---|
| As instituições governamentais exercem pressão para que eu adote hábitos ou comportamentos sustentáveis. | 1 | 2 | 3 | 4 | 5 | 6 | 7 |
| As empresas públicas e/ou privadas exercem pressão para que eu adote hábitos ou comportamentos sustentáveis. | | | | | | | |

| Em relação à declaração a seguir, indique  o seu nível de concordância de acordo com a escala abaixo: | Discordo Totalmente | | | | | | Concordo Totalmente |
|---|---|---|---|---|---|---|---|
| Não tenho tempo para desenvolver hábitos ou comportamentos sustentáveis. | 1 | 2 | 3 | 4 | 5 | 6 | 7 |
| Desenvolver hábitos ou comportamentos sustentáveis custa caro para mim. | | | | | | | |
| Não tenho habilidades técnicas e pessoais para desenvolver hábitos ou comportamentos sustentáveis. | | | | | | | |
| Tenho dificuldade em obter informações sobre hábitos e comportamentos sustentáveis. | | | | | | | |
| Não tenho formação educacional suficiente para desenvolver hábitos ou comportamentos sustentáveis. | | | | | | | |