

Springer Proceedings in Business and Economics

João Reis · Tiago Pinho · Vítor Barbosa ·
Luís Barreto · Sandrina B. Moreira ·
Pedro Pardal · João Nabais ·
Carlos Mata · Ana Mendes *Editors*

Driving Quality Management and Sustainability in VUCA Environments

4th International Conference
on Quality Innovation and
Sustainability (ICQIS), Setúbal,
Portugal, May 22-23, 2023



Springer

Springer Proceedings in Business and Economics

Springer Proceedings in Business and Economics brings the most current research presented at conferences and workshops to a global readership. The series features volumes (in electronic and print formats) of selected contributions from conferences in all areas of economics, business, management, and finance. In addition to an overall evaluation by the publisher of the topical interest, scientific quality, and timeliness of each volume, each contribution is refereed to standards comparable to those of leading journals, resulting in authoritative contributions to the respective fields. Springer's production and distribution infrastructure ensures rapid publication and wide circulation of the latest developments in the most compelling and promising areas of research today.

The editorial development of volumes may be managed using Springer Nature's innovative EquinOCS, a proven online conference proceedings submission, management and review system. This system is designed to ensure an efficient timeline for your publication, making Springer Proceedings in Business and Economics the premier series to publish your workshop or conference volume.

This book series is indexed in SCOPUS.


João Reis • Tiago Pinho • Vítor Barbosa •
Luís Barreto • Sandrina B. Moreira • Pedro Pardal •
João Nabais • Carlos Mata • Ana Mendes
Editors


Driving Quality Management and Sustainability in VUCA Environments


4th International Conference on Quality
Innovation and Sustainability (ICQIS),
Setúbal, Portugal, May 22-23, 2023


 Springer


Editors


João Reis 
Industrial Engineering
Universidade Lusófona
Lisbon, Portugal


Tiago Pinho 
Escola Superior de Ciências Empresariais
Instituto Politécnico de Setúbal
Setúbal, Portugal


Vítor Barbosa 
Escola Superior de Ciências Empresariais
Instituto Politécnico de Setúbal
Setúbal, Portugal


Luís Barreto 
Escola Superior de Ciências Empresariais
Instituto Politécnico de Viana do Castelo
Viana do Castelo, Portugal

Sandrina B. Moreira 
Escola Superior de Ciências Empresariais
Instituto Politécnico de Setúbal
Setúbal, Portugal

Pedro Pardal 
Escola Superior de Ciências Empresariais
Instituto Politécnico de Setúbal
Setúbal, Portugal

João Nabais 
Escola Superior de Ciências Empresariais
Instituto Politécnico de Setúbal
Setúbal, Portugal

Carlos Mata 
Escola Superior de Ciências Empresariais
Instituto Politécnico de Setúbal
Setúbal, Portugal

Ana Mendes 
Escola Superior de Ciências Empresariais
Instituto Politécnico de Setúbal
Setúbal, Portugal

ISSN 2198-7246

ISSN 2198-7254 (electronic)

Springer Proceedings in Business and Economics

ISBN 978-3-031-52722-7

ISBN 978-3-031-52723-4 (eBook)

<https://doi.org/10.1007/978-3-031-52723-4>

© The Editor(s) (if applicable) and The Author(s), under exclusive license to Springer Nature Switzerland AG 2024

This work is subject to copyright. All rights are solely and exclusively licensed by the Publisher, whether the whole or part of the material is concerned, specifically the rights of translation, reprinting, reuse of illustrations, recitation, broadcasting, reproduction on microfilms or in any other physical way, and transmission or information storage and retrieval, electronic adaptation, computer software, or by similar or dissimilar methodology now known or hereafter developed.

The use of general descriptive names, registered names, trademarks, service marks, etc. in this publication does not imply, even in the absence of a specific statement, that such names are exempt from the relevant protective laws and regulations and therefore free for general use.

The publisher, the authors, and the editors are safe to assume that the advice and information in this book are believed to be true and accurate at the date of publication. Neither the publisher nor the authors or the editors give a warranty, expressed or implied, with respect to the material contained herein or for any errors or omissions that may have been made. The publisher remains neutral with regard to jurisdictional claims in published maps and institutional affiliations.

This Springer imprint is published by the registered company Springer Nature Switzerland AG
The registered company address is: Gewerbestrasse 11, 6330 Cham, Switzerland

If disposing of this product, please recycle the paper.

Preface

Introduction

The 4th International Conference on Quality Innovation and Sustainability (ICQIS) took place between 22 and 23 May 2023 and was organized at the Polytechnic Institute of Setúbal, Portugal. The ICQIS Conferences have been a meeting forum for researchers and interested professionals on Quality Innovation, with a special focus on Sustainability. Thus, the ICQIS23 aimed to foster an inclusive environment that offered everyone a unique opportunity to connect, collaborate, exchange innovative ideas, and showcase their groundbreaking research to a global audience.

Over the course of the last three years, the host universities of ICQIS have played a pivotal role in uniting scientists with the fundamental principles of Quality Innovation and Sustainability. By establishing a robust connection and encouraging advancements in these domains, they have inspired us to follow a similar path. Notably, since 2022, Springer Proceedings in Business and Economics (SPBE) has been engaged with the conference [1] and has emerged as a key player in disseminating valuable scientific knowledge to scholars, professionals, and inquisitive readers interested in the subjects covered. ICQIS is also establishing a new tradition, laying the groundwork for the convergence of master and doctoral students in Quality Innovation and Sustainability with researchers, professionals, and academics from various corners of the world.

In line with other well-established conferences [2, 3], we share the belief that providing networking opportunities from an early stage is essential for the academic development of young researchers as they explore uncharted grounds of knowledge. Our commitment lies in continuously supporting the entire academic-scientific community, facilitating ongoing discussions, and encouraging the publication of valuable contributions that enrich the collective body of knowledge.

General Overview

The International Conference on Quality Innovation and Sustainability (ICQIS) has quickly established itself as a prominent event, now reaching its fourth edition. Despite its relatively young age, the conference has already gained substantial recognition from the global community, and we expect its influence to grow even further, attracting increased participation in the future. In this edition, we have meticulously selected 21 high-quality book chapters that address a wide range of compelling topics, including Product Service System Development, Electronic Commerce in Small- and Medium-Sized Companies, Sustainability in Supply Chain, Lean Methodology, Sustainable Development Goals (SDGs), Reverse Logistics, Local Development Strategies (LDSs), and Innovation in Higher Education Institutions (HEIs).

In the following section, we provide a succinct yet comprehensive summary of each book chapter, offering a glimpse into the valuable insights and research presented in this proceedings book.

Outline of the Volume

This book's first chapter investigates Circular Economy promotion, the R principles application, and sustainability policy by non-profit and public utility organizations in Setúbal, Portugal. It focuses on Social Economy and Sustainable Development Goals (SDGs) in alignment with the 2030 Agenda for Sustainable Development.

The second chapter optimizes industrial drug processing in the pharmaceutical sector by enhancing integrated equipment for active pharmaceutical ingredients (API) production. The proposed equipment offers significant ergonomic, hygiene, and practical advantages compared to the originals, enhancing the company's competitiveness.

Chapter 3 explores the growing market advantage of customized 3D-printed prosthetics and orthotics (P&O), improving patients' well-being. The flexible 3D printing process tailors devices to individual patient needs, enhancing functionality.

The fourth chapter addresses energy poverty, spotlighting energy-efficient building solutions in Portugal and Europe. It presents a pioneering solution through linear programming, streamlining decisions for near-zero energy buildings (nZEB) certification.

The fifth chapter comprehensively analyzes consumer behavior with Augmented Reality (AR) during shopping, revealing a predominantly positive sentiment toward its benefits.

The sixth chapter discusses e-commerce adoption in agricultural SMEs, with a focus on factors shaping their adoption and the role of digital platforms.

Chapter 7 explores managerial innovation, focusing on introducing novel management practices, structures, or techniques to improve organizational goals. The

chapter highlights the significant link between applying these innovations and their effects on protected areas. An internal action plan is provided as a tangible illustration of this connection.

Chapter 8 explores the adaptation of small- and medium-sized enterprises (SMEs) to digital platforms.

Moving on to the ninth chapter, a groundbreaking approach for determining cargo capacity in agricultural product transportation is introduced. This approach contributes to sustainability in supply chains, particularly for the transportation of perishable goods over extended distances. By categorizing delivery options using key criteria, this methodology establishes an average cargo capacity standard for trucks. This empowers carriers to efficiently optimize tonnages for specific supply chains, minimizing unnecessary expenses associated with perishable transport by streamlining load capacity management.

The subsequent Chapter 10 critically reviews the profound impact of blockchain on maintenance practices. The authors present a well-thought-out proposal for a customized data structure tailored specifically for ship maintenance. The chapter concludes by outlining potential directions for future research in this dynamic field.

Chapter 11 introduces an innovative methodology that combines TRIZ and Lean tools to revolutionize maintenance management within the ship system of the Portuguese Navy. By harnessing these methodologies, the objective is to enhance operational efficiency, reduce waste, and eliminate non-value activities.

Chapter 12 focuses on a company specializing in manufacturing metallic structures for the aeronautics sector. The goal here is to elevate the intrinsic availability of assembly line equipment to a world-class 90%. This ambitious target is pursued through the strategic application of TPM (Total Productive Maintenance) and Lean tools.

The thirteenth chapter is dedicated to examining the impact of time window duration on the Vehicle Routing Problem with Time Windows (VRPTW). Through a case study, the authors delve into the intricate relationship between various time window intervals and their implications for costs, customer satisfaction, and travel time.

Chapter 14 embarks on a comprehensive investigation of Industry 4.0 through a meticulous literature review, encompassing 132 selected and analyzed papers. The review identifies seven distinct thematic research clusters, including Quality Management Systems, Total Quality Management, Measurement and Analysis, Human Factors, Technology, Human Systems Integration, and Training.

The subsequent Chap. 15 delves into Quality 4.0, presenting it as a multifaceted framework anchored on processes, human engagement, and technology. This framework shapes a forward-looking quality system that underscores the vital importance of digitalization skills and resilient quality frameworks essential for a flexible, data-driven Quality 4.0 setup.

Chapter 16 takes a global perspective on education service quality within Higher Education Institutions (HEIs), spanning institutions in Portugal and Angola. Employing the advanced HEISQUAL framework for assessment, this study reveals variations in student satisfaction levels between the two regions. Employing quan-

titative methods, the study provides actionable insights aimed at elevating quality performance indicators in Angola.

Chapter 17 introduces a pioneering blockchain-driven corporate communication tool that enhances Corporate Social Responsibility (CSR) reporting. Through a study of 96 articles, the authors demonstrate how blockchain technology bolsters transparency and credibility in CSR reporting, mitigating potential distortions.

In Chap. 18, the focus shifts to the analysis of the 2021-2027 Erasmus+ Program Regulation in alignment with the 17 SDGs. The study identifies key SDGs, highlighting the program's potential to catalyze Sustainable Development through participation and project implementation. The interconnections between SDGs are explored, shedding light on their intricate relationships.

Chapter 19 delves into the realm of Reverse Logistics, exploring its implications on consumer recycling behavior. Utilizing a combination of secondary sources and a questionnaire, the study identifies key factors influencing recycling behavior and categorizes consumers into distinct categories based on their attitudes and behaviors.

In the twentieth chapter, Community-Led Local Development (CLLD) takes the center stage as a catalyst for integrated development in local communities. The study investigates how CLLD can enhance tourism in specific municipalities, emphasizing the need for collaborative stakeholder efforts in effective implementation.

Lastly, the final chapter underscores the paramount importance of innovation in shaping a smart and sustainable future. The study delves into how micro-regions, often overlooked, contribute to regional innovation. Through a focus on Vidzeme University of Applied Sciences in Latvia, the research showcases the impact of Higher Education Institutions-driven innovation on Smart and Sustainable Futures.

Acknowledgments

The editors of this book of proceedings extend heartfelt gratitude to all participants and the entire Quality, Innovation, and Sustainability Community. We would also like to express our sincere appreciation to the following: (1) the diligent reviewers who invested their time and expertise to ensure each book chapter received at least two high-quality reviews promptly; (2) our esteemed Publishing Editor, Nitza Jones, for her unwavering support throughout the entire process; (3) the dedicated Springer team whose hard work made it possible for all selected papers to reach the wider community. Without your invaluable contributions and dedication, this book would not have been possible.

Lisbon, Portugal
 Setúbal, Portugal
 Setúbal, Portugal
 Viana do Castelo, Portugal
 Setúbal, Portugal
 Setúbal, Portugal

João Reis
 Tiago Pinho
 Vítor Barbosa
 Luís Barreto
 Sandrina B. Moreira
 Pedro Pardal

Setúbal, Portugal
Setúbal, Portugal
Setúbal, Portugal

João Nabais
Carlos Mata
Ana Mendes

References

- [1] de Oliveira Matias, J. C., Pimentel, C. M. O., dos Reis, J. C. G., das Dores, J. M. C. M., & Santos, G. (Eds.). (2023). *Quality innovation and sustainability: 3rd ICQIS, Aveiro University, Portugal, May 3–4, 2022*. Springer Nature. <https://doi.org/10.1007/978-3-031-12914-8>
- [2] Gonçalves dos Reis, J. C., Mendonça Freires, F. G., & Junior Buda, M. V. (Eds.). (2023). Industrial engineering and operations management. In *XXIX IJCIEOM, Lisbon, Portugal, June 28–30, 2023*. Springer Mathematics & Statistics. Springer, Cham. Forthcoming.
- [3] López, S., Freires, F., Reis, J., & Dores, J. (Eds.). (2022). Industrial Engineering and Operations Management. In *XXVIII IJCIEOM, Mexico City, Mexico, July 17–20, 2022*. Springer Mathematics & Statistics. Springer, Cham. <https://doi.org/10.1007/978-3-031-14763-0>.

ICQIS 2023 Committees


Conference Chair


João Reis (Chair)	Lusófona University, Portugal
Tiago Pinho (Co-Chair)	Polytechnic Institute of Setúbal, Portugal


Organizing Committee


Ana Mendes	Polytechnic Institute of Setúbal, Portugal
Carlos Mata	Polytechnic Institute of Setúbal, Portugal
João Nabais	Polytechnic Institute of Setúbal, Portugal
João Reis	University of Aveiro, Portugal
Luís Barreto	Polytechnic Institute of Viana do Castelo, Portugal
Pedro Pardal	Polytechnic Institute of Setúbal, Portugal
Sandrina B. Moreira	Polytechnic Institute of Setúbal, Portugal
Susana Galvão	Polytechnic Institute of Setúbal, Portugal
Tiago Pinho	Polytechnic Institute of Setúbal, Portugal
Vítor Barbosa	Polytechnic Institute of Setúbal, Portugal

Editors


João Reis , Lusófona University, Portugal

Tiago Pinho , Polytechnic Institute of Setúbal, Portugal


Vítor Barbosa , Polytechnic Institute of Setúbal, Portugal


Luís Barreto , Polytechnic Institute of Viana do Castelo, Portugal

Sandrina B. Moreira , Polytechnic Institute of Setúbal, Portugal

Pedro Pardal , Polytechnic Institute of Setúbal, Portugal

João Nabais , Polytechnic Institute of Setúbal, Portugal

Carlos Mata , Polytechnic Institute of Setúbal, Portugal

Ana Mendes , Polytechnic Institute of Setúbal, Portugal

Scientific Committee

Ana Mendes	Polytechnic Institute of Setúbal, Portugal
Anabela Alves	Minho University, Portugal
Ângela Neves	Polytechnic Institute of Viseu, Portugal
António Pereira	Polytechnic Institute of Leiria, Portugal
António Abreu	Polytechnic Institute of Lisboa, Portugal
António Amaral	Polytechnic Institute of Porto, Portugal
Claúdia Silva	Aveiro University, Portugal
Dulce Matos Coelho	Polytechnic Institute of Setúbal, Portugal
Dzintra Atstaja	BA School of Business and Finance, Latvia
Federica Murmura	University of Urbino Carlo Bo, Italy
Helena Carvalho	Nova University of Lisboa, Portugal
João Nabais	Polytechnic Institute of Setúbal, Portugal
José Carlos Sá	Polytechnic Institute of Porto, Portugal
Kristina Zgodavova	Technical University of Košice, Slovakia
Luís Barreto	Polytechnic Institute of Viana do Castelo, Portugal
Luis Ferreira	Polytechnic Institute of Porto, Portugal
Luís Barbosa	Federal Center for Technological Education Celso Suckow Fonseca, Brasil
Graça Costa	Polytechnic Institute of Setúbal, Portugal
Maria Teresa Pereira	Polytechnic Institute of Porto, Portugal
Miladin Stefanović	University of Kragujevac, Serbia
Neringa Vilkaitė-Vaitonė	Vilnius Gediminas Technical University, Lithuania
Raul Campilho	Polytechnic Institute of Porto, Portugal
Sandrina B. Moreira	Polytechnic Institute of Setúbal, Portugal
Stevan Stankovski	University of Novi Sad, Serbia
Tamer Haddad	An-Najah National University, Nablus Palestine
Teresa Morgado	Polytechnic Institute of Lisboa, Portugal
Vítor Barbosa	Polytechnic Institute of Setúbal, Portugal

Keynote Speakers

Matevž Obrecht	University of Maribor, Slovenia
Gilberto Santos	Polytechnic Institute of Cávado e do Ave, Portugal

Contents

The Social Economy and the R Principles in Third Sector Organizations in the District of Setúbal	1
Ana Vizinho, Sandrina B. Moreira, and Raquel Pereira	
Improvement of the Manufacturing Process of Active Pharmaceutical Ingredients	15
A. C. P. Soares and R. D. S. Campilho	
Product-Service System Development for 3D Customized Production in Hospitals	29
Milene Santos, Bruno Soares, and Helena Carvalho	
An Optimization Model for the Selection of Renovation Actions in a Building	45
Miguel Moura, Alcinda Barreiras, Maria Teresa Pereira, and Marisa Oliveira	
The Influence of Augmented Reality on the Consumer Purchasing Process	57
Federica Murmura, Laura Bravi, Giada Pierli, Gilberto Santos, and Fabio Musso	
Adoption of Electronic Commerce by Portuguese Small and Medium-Sized Enterprises	71
José Carlos Ferreira Correia, Mário Caldeira Dias, and Dulce Matos Coelho	
When We Associate Innovation with Management and Apply It to National Parks: Case of Huascarán National Park, Peru	85
Ikrame Selkani	
Adaptation of Portuguese Agricultural Small and Medium-Sized Enterprises to Digital Platforms	99
José Carlos Ferreira Correia, Mário Caldeira Dias, and Dulce Matos Coelho	

Features of Cargo Capacity Finding for Vehicles to Increase the Sustainability Level of Supply Chains	109
Dmitriy Muzylyov, Natalya Shramenko, Christoph Hupfer, Justyna Trojanowska, and Piotr Trojanowski	
Blockchain in a Maintenance Database	123
Suzana Lampreia, Teresa Morgado, Helena Navas, Valter Vairinhos, Victor Lobo, and João Alves	
Developing a TRIZ-Lean Methodology in Portuguese Navy Complex Systems	135
João Alves, Teresa Morgado, Suzana Lampreia, Helena Navas, António Abreu, Ana Dias, and João Calado	
Intrinsic Availability of a Critical Productive Equipment	147
Teresa Morgado, Gonçalo Alves, António Abreu, and Ana Dias	
Study of the Time Windows Range Impact on Vehicle Routing Problem .	159
Pedro Afonso Oliveira, Maria Teresa Pereira, Marisa Oliveira, Filipe R. Ramos, and Fernanda Amélia Ferreira	
Reducing Error in Manufacturing in Industry 4.0: A Systematic Literature Review	169
Jacqueline Humphries, Alan Ryan, and Pepijn Van de Ven	
A New Model for Quality 4.0	185
Jacqueline Humphries, Alan Ryan, and Pepijn Van de Ven	
A Comparative Study of Service Quality in Portuguese and Angolan Higher Education Institutions	199
Ana Rolo, Margarida Saraiva, Gracieth Leandro, Teresa Nogueiro, and Rui Alves	
Exploring the Potential Contribution of Blockchain Technology to Sustainability Reporting	209
Veysel Akman	
Erasmus+ 2021–2027 in Higher Education: Contributions to the 2030 Agenda and to the Sustainable Development Goals	225
Teresa Nogueiro, Margarida Saraiva, and Ana Rolo	
Factors and Attitudes Influencing the Implementation of Reverse Logistics (Recycling): The Case of Portuguese Consumers	243
Ariadne Cristina Minto and Marta da Conceição Cruz Silvério	
Enhancing Tourism Through Local Development Strategies (LDSs): A Study of FLAG Marche Sud Area	259
Federica Murmura, Guido Capanna Piscè, and Claudia Fraboni	

Knowledge Base for Innovations in Higher Education Institutions (HEIs) Toward Smart and Sustainable Future: A Study on EUDRES..... 273
Agita Livina, Gavinolla Mahender Reddy, and Līga Horsta

Index..... 289

The Social Economy and the R Principles in Third Sector Organizations in the District of Setúbal



Ana Vizinho , Sandrina B. Moreira , and Raquel Pereira 

Abstract This study aims to analyze how nonprofit and public utility organizations in the district of Setúbal promote a circular economy and apply the R principles and sustainability policy.

Motivated by the lack of previous studies that relate to social economy (SE), circular economy (CE), R principles, and sustainable development goals (SDGs) applicable to the social economy, the following question arose: in what way are nonprofit and public utility organizations concerned with the fulfillment of the new Sustainable Development Agenda entitled “Transforming Our World: The 2030 Agenda for Sustainable Development,” published in 2015 by the United Nations (UN) and to be implemented by 2030.

A survey was sent to a random sample of 100 organizations, obtained by cross-referencing a list from Social Security in Portugal with the Portuguese Tributary and Customs Authority’s list of entities receiving the 0.5% remittance of personal income tax (PIT). The survey questions focused on the ten Rs of sustainability policy and how the SDGs are relevant to their mission.

The results show that there is some knowledge on the subject and attempts to implement it, but the resistance encountered discourages its application. SE can be a pillar for the development of the CE, but this will require measures to encourage stakeholder involvement, through information targeted at this socioeconomic sector.

Keywords Circular economy · Social economy · Sustainability · SDG

A. Vizinho (✉) · R. Pereira
Instituto Politécnico de Setúbal (ESCE/IPS), Setúbal, Portugal
e-mail: ana.vizinho@estsetubal.ips.pt

S. B. Moreira
Instituto Politécnico de Setúbal (CICE, ESCE/IPS) e BRU-IUL (Business Research Unit),
Setúbal, Portugal

1 Introduction

This study aims to relate the SE to the CE, namely, to understand how SE organizations promote a CE by applying the R principles and the SDGs.

The SE emerges with the Treaty on Social Economy published by Charles Dinoyer in the 1930s. In Portugal, the Republic Constitution reflects this idea by describing the cooperative and social sector in its articles 80 and 82 [1].

In 2013, the Social Economy Framework Law [2] was approved, defining the principles and organizations framed in this sector. The growing concern with supporting citizens, protecting fundamental values and rights such as health, education, and housing, gave rise to the creation of nonprofit organizations whose objective is social welfare.

As of 1992, the focus on people also meant an increased concern about sustainability; on this date, the UN Assembly for the Environment (RIO92) launched the pillars of sustainability that aimed at protecting the environment, making the economy more efficient and sustainable, and changing consumption and production habits. The key words chosen at the time were three Rs: reduce, reuse, and recycle. In 2000, the UN Millennium Declaration was adopted, an ambitious program to save the planet and consequently humanity, referring to the Millennium Goals to be achieved in the next 15 years. In 2012, during RIO + 20, the United Nations Conference on Sustainable Development, new goals called SDGs were approved, entering into force in 2015 with the goal of achieving them by the year 2030.

The R principles of sustainability created the CE concept, ending the concept of a linear economy and giving a new life to all products in a closed loop concept.

These global concerns with economic, social, and environmental sustainability led to the following research question: how SE organizations perceive these concerns, implement them, and incorporate them into their day-to-day life, in the development of their social mission. This question motivated a survey among the SE organizations in the district of Setúbal to understand the extent to which these organizations apply the Rs policy of sustainability and how these organizations contribute to the achievement of the targets of the 2030 Agenda through the application of the SDGs.

The remainder of the paper is organized as follows. Section 2 provides the relevant literature review on the topic. Section 3 describes both the purposes of the empirical study and the methodological framework. Section 4 proceeds with the analysis and discussion of the results, followed by the conclusions in Sect. 5.

2 Literature Review

The SE reflects activities whose main goal is to meet social needs to which the State may be directly or indirectly linked, encompassing a whole sector that incorporates nonprofit but solidarity-based organizations [3]. states that SE is not a by-product:

SE institutions reflect the need for an economy that reconciles the social, economic, and financial dimensions, manages to generate wealth, and is not only evaluated in terms of its financial capital but, above all, by its social capital.

The European Parliament Resolution on “A Model for the Future” (2009) [4] refers to SE as one of the pillars of the European social model, as it “plays an essential role in the European economy by combining profitability and solidarity, creating quality jobs, strengthening social, economic and territorial cohesion, generating social capital, and promoting active citizenship, solidarity and a form of economy with democratic values, putting the human being at the forefront and supporting sustainable development and social, environmental and technological innovation.”

It is worth mentioning that SE has a diversity of funding from the private and public sector, donations, associate members, employees, volunteers, etc. creating different dynamics and relationships with the organization.

Regarding sustainability, the word derives from the Latin *sustentare* (Vergílio) or *sustinere* (Cicero); everything that can be supported or maintained is the definition given in the Portuguese Latin dictionary [5]. Sustainability is everyone’s responsibility, especially the organizations that make SDG possible, where all of them should be rethought to be made on a more sustainable basis [6]. The emergence of the term sustainability has led many companies to value more sustainable business.

The pillars of sustainability were created at the RIO92, thus emerging the 3R principles, reduce, reuse, and recycle. The Rs are proposed to make the connection between environmental protection and economic efficiency that is linked to consumption habits. Beginning by R, followed by the letter “e,” and thus forming a prefix “re,” meaning repetition, they lead us to think about environmental sustainability and should be applied and reapplied through loops:

1. Refuse – products that harm nature and do not respect environmental legislation.
2. Rethink – daily attitudes and conscious consumption.
3. Reduce – ecological footprint.
4. Reuse – what would be discarded by giving it another destination.
5. Repair – what can be repaired.
6. Recycle – when it has no use or repair.
7. Reintegrate – returning to nature what came from it (e.g., organic waste).
8. Respect – life and living beings, people, their work and school, and environment.
9. Responsible – for your actions and the impacts they cause.
10. Repass – the knowledge that can make the world a better and sustainable place.

The CE emerges to replace the linear economy model identified with extract, produce, consume, and discard, which promotes the overuse of resources. This new paradigm has a multidisciplinary character and is interconnected with the process of sustainable production and consumption. In the linear process of production, the generation of waste is inevitable since it does not foresee the reuse of waste. In

the circular model, on the other hand, there is production planning so that waste is reused in the production process with the aim of avoiding the generation of industrial waste [7]. CE and its relation to a more sustainable world consider not only the reduction of waste but also the limit of natural resources on the planet.

In September 2015, high representatives of the United Nations met with heads of State and government of the 193 member countries in New York and officially adopted the new Sustainable Development Agenda, entitled “Transforming Our World: The 2030 Agenda for Sustainable Development” [8]. The SDGs are an integral part of this Agenda and aim to change mindsets through coordinated actions by governments, business, and civil society to achieve the 17 SDGs and their 169 targets. They came into force in January 2016 and are expected to be met by December 31, 2030. As such, CE as a sustainability paradigm has been acquiring its space in the application of the SDGs, more specifically in some of the goals defined by the UN in 2015.

According to the Sustainable Europe Research Institute, social sustainability for a company is as important as its economic and/or environmental dimension [9]; the social dimension is everyone’s responsibility, therefore including companies in all its dimensions. Social sustainability should be concerned with human rights and the fulfillment of the targets mentioned, namely, in the SDGs on hunger, education, gender equality, health, and decent work.

The SE (third sector) in Portugal encompasses nonprofit social organizations of public utility, autonomous in their decisions and relying in voluntary work, with the aim of promoting social change. Their revenues are intended solely for use in the organization itself. In this way, they pursue purposes of general interest in cooperation with the central or local administration. On a financial level, they are supported by public subsidies, membership fees, payment of users for services rendered, and sporadic sale of goods produced.

In Portugal, the government subsidizes institutions that provide solidary support to society. However, several of these entities are at their limit, and in some cases, the waiting time is long, unlike other countries (e.g., the UK, the Netherlands) that use a different model.

Among the main social organizations in Portugal are Cooperatives, Mutual Associations, Benefactor Organizations, Foundations, Charities and Private Social Solidarity Institutions (IPSS in Portuguese). They are of relevant importance in the society in which they operate, contributing to the SE and filling the gaps of the State in society.

3 Methodology

This study aims to investigate how nonprofit and public benefit organizations in the district of Setúbal promote a CE and apply the Rs policy of sustainability.

Analyzing the various options in this field of research, the questionnaire survey methodology proves to be the most correct and the most applied [10]. The goal is to collect valid and reliable information, around which conclusions are drawn that can be generalized, or not, to the universe under study [11]. A questionnaire survey was thus prepared as a data collection technique widely used in research, as a result of its standardization [12]. In particular, it is intended to be a quantitative study analyzed by statistical method on the application of sustainability in various types of SE institutions.

The anonymity and confidentiality of the answers make the respondent more comfortable to express opinions about the study and not be influenced by the researcher [13]. The present self-designed questionnaire is anonymous, includes a brief introduction describing the purpose of the questionnaire [14], and is composed mostly of closed-ended questions. Over time, closed-ended questions have become popular and open-ended questions less and less used [15]. The willingness to respond to questionnaires is often dependent on their size and content [14]. Thus, this questionnaire was straight to the questions that were intended to be analyzed according to the research objectives. The online survey prepared was sent by email.

The survey questions related to the application of the 10R principles are in accordance with the Dutch Environmental Assessment Agency (PBL) and included in the Council of Ministers Resolution No. 190-A/2017 on the Action Plan for Circular Economy in Portugal and the 17 UN SDGs [13]. These questions used the Likert method, with a five-level graded scale, either at the level of agreement, relevance, classification, or application.

As for the sample population object of study, a sample of 100 organizations that develop community support activities for the population was taken from the population of social organizations in the district of Setúbal. The same resulted from the crossing of two lists, one taken from the Social Security website and the other from the Tax Authority, which assigns entities a percentage of PIT, under n° 4 and 6 of article 32 of Law 16/2001 of June 22 [16]. The main difficulty encountered in choosing the sample was the lack of information on the organizations in a national database. Consulting the 2018 Social Economy Sector Survey (SESS) [17], prepared by the National Statistics Institute (INE in Portuguese) in collaboration with the António Sérgio Cooperative for the Social Economy (CASES in Portuguese), it appears that 47.7% of the entities connected to this sector at a national level do not have an Internet presence, in terms of websites or electronic page, which makes it difficult to access their contacts. On the other hand, there are several entities that no longer have a valid email address, and telephone contact is difficult, either because they do not have a listed phone number or because they simply do not answer. This sample includes Cooperatives for the Education and Rehabilitation of Maladjusted Children (CERCI in Portuguese), IPSS, associations, charities, and foundations, which, after contact research, were found to have a valid telephone number and/or email address.

4 Main Results and Reflections

The district of Setúbal is made up of 13 municipalities, and the sample chosen was randomly distributed across them, with a greater response in the municipalities with the largest population, Almada and Setúbal. Emails were sent to the 100 organizations chosen to check if the email addresses were valid. Approximately 7% of the emails sent were returned because that address no longer existed. Thus, the sample considered is composed of 93 valid organizations, with a response rate of 36% (see Fig. 1).

The largest number of answers was given by IPSS (61%), with no answers being obtained from social solidarity associations, mutual associations, and social and parish centers (Fig. 1). Overall, results suggest that although the theme of sustainability is referred to daily, there is still a lot of resistance to the application of sustainable behavior, even in the context of SE. When asked if the organization opts for renewable and natural processes in various aspects presented in Fig. 2, the answers were as follows:

- The organization invests in service innovation and/or internal processes, aiming to introduce renewable energy and resources: with 47% of the answers being mostly positive, it seems that most organizations are committed to resource innovation.
- The organization encourages recycling: there are no respondents with a negative response, and 94.1% of the organizations seem to be concerned with the recycling policy, and people and users are aware of it.
- The organization encourages the reuse of materials: the answers were positive in 88.2%, but there are still 5.9% of the organizations that do not promote this attitude.
- The organization substitutes materials and processes for sustainable ones: although there are situations opposing sustainability, 64.47% promote this substitution.

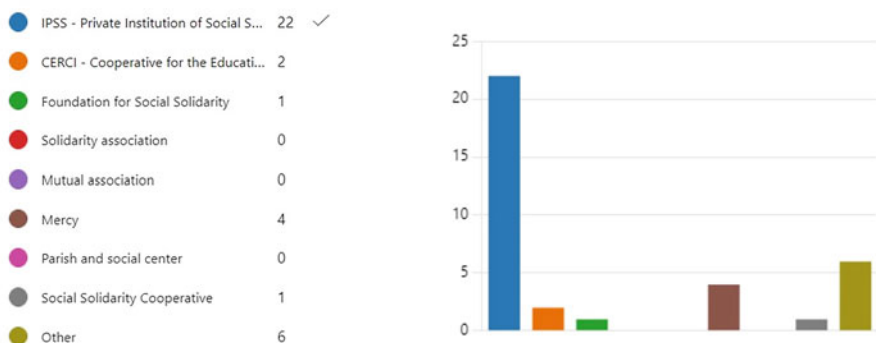


Fig. 1 Organizations that responded to the survey

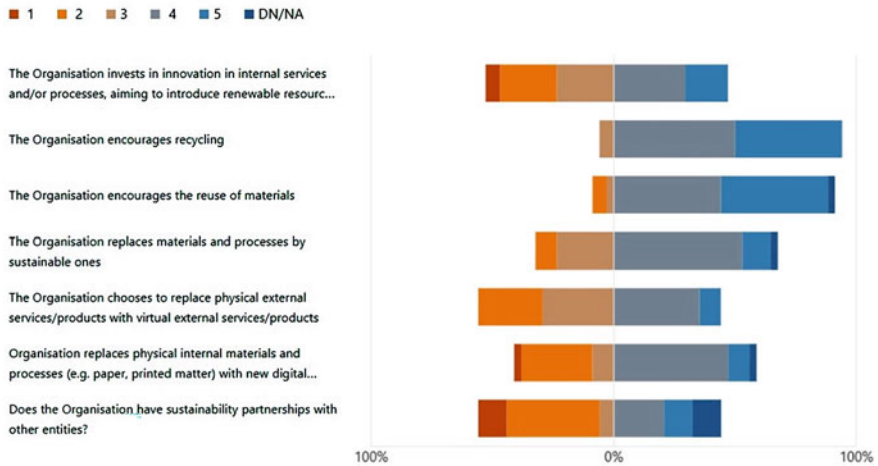


Fig. 2 Renewable and natural processes used by the organization

- The organization chooses to replace physical external services/products by virtual ones: in terms of new technologies, although a positive response, there is still not enough awareness for this attitude, with less than 50% of the organizations (44.1%) applying them.
- The organization replaces physical materials and internal processes (such as paper, printed materials) with new digital technologies (dematerialization): as many suppliers already offer the possibility of sending the invoice by email and consequently the reduction of paper, it is a growing trend as 55.9% of the organizations apply this.
- The organization has sustainability partnerships with other entities. Partnerships are extremely useful in reducing waste and costs; however, 50% of respondents gave a negative response, compared to 32.4% who have partnerships.

In terms of the use of renewable and natural processes, organizations seem to mostly apply recycling and reuse of materials.

The next question focuses on the organizations’ perception regarding the society in which it operates and the environment.

Figure 3 shows a neutral trend in questions 2 and 3 and very positive one in questions 4 and 5, with values of 91.1% and 70.6%, respectively, suggesting that respondent organizations are aware of sustainable practices and develop and encourage them.

Considering the sustainability aspects for organizations, Fig. 4 presents varied trends.

A negative trend in some points deserve attention, namely, taps without flow reduction, flushing cisterns without water reducers, lack of drinking water dispensers, non-reuse of vegetable water in food production, and composting. Those mentioned first cause a waste of water, which could be avoided; at the level of

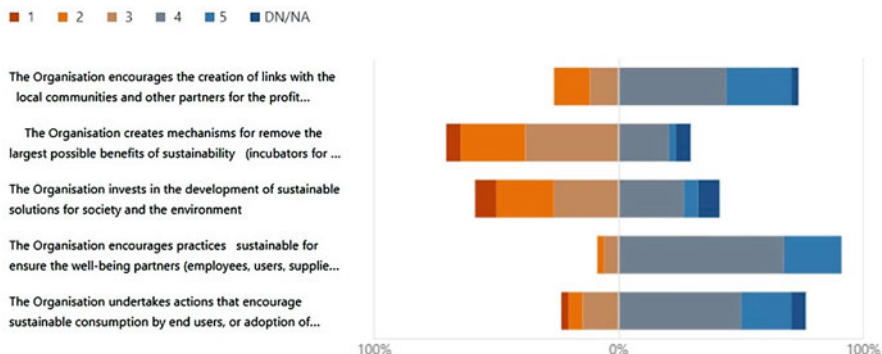


Fig. 3 Opinion of organizations regarding the society in which they operate

composting, this can generate a benefit as fertilizer if the organization has farms or gardens. Moreover, partnerships with the surrounding society could generate a positive exchange for the consumption from local producers. Results also show a huge concern with energy consumption, using energy-saving light bulbs and turning off electrical appliances that are not in use.

Analyzing the respondents' perception to these situations (Fig. 5), the highest percentage of response is at the following levels:

- Refuse: polluting materials (61.8%), carbon emissions (58.8%), and obsolete or damaged materials (26.5%).
- Rethink: plastics (32%), natural resources (26.5%), and recreational objects (23.5%).
- Reduce: carbon emissions (61.8%), plastics (41.2%), and polluting materials (26.5%).
- Reuse: give clothing a second life (38.2%), paper/cardboard (35.3%), and give clothing a second life again (29.3%).
- Repair: give clothing a second life (70%), obsolete or damaged materials (32.4%), and again give clothing a second life (29.4%).
- Recycle: obsolete or damaged materials (41.2%), paper/cardboard (32.4%), school material (23.5%).
- Reintegrate: food waste (91.2%) and natural waste (85.3%), with the other figures not being relevant.
- Respect: natural waste (55.9%), polluting materials (35.3%), and food waste (26.5%).
- Responsible: polluting materials (47.1%), carbon emissions (38.2%), and natural waste (26.5%).
- Repass: polluting materials (50%), carbon emissions (32.4%), and natural waste (20.6%).

Finally, the analysis of the SDGs through their importance and contribution to achieving the targets is reported in Fig. 6.

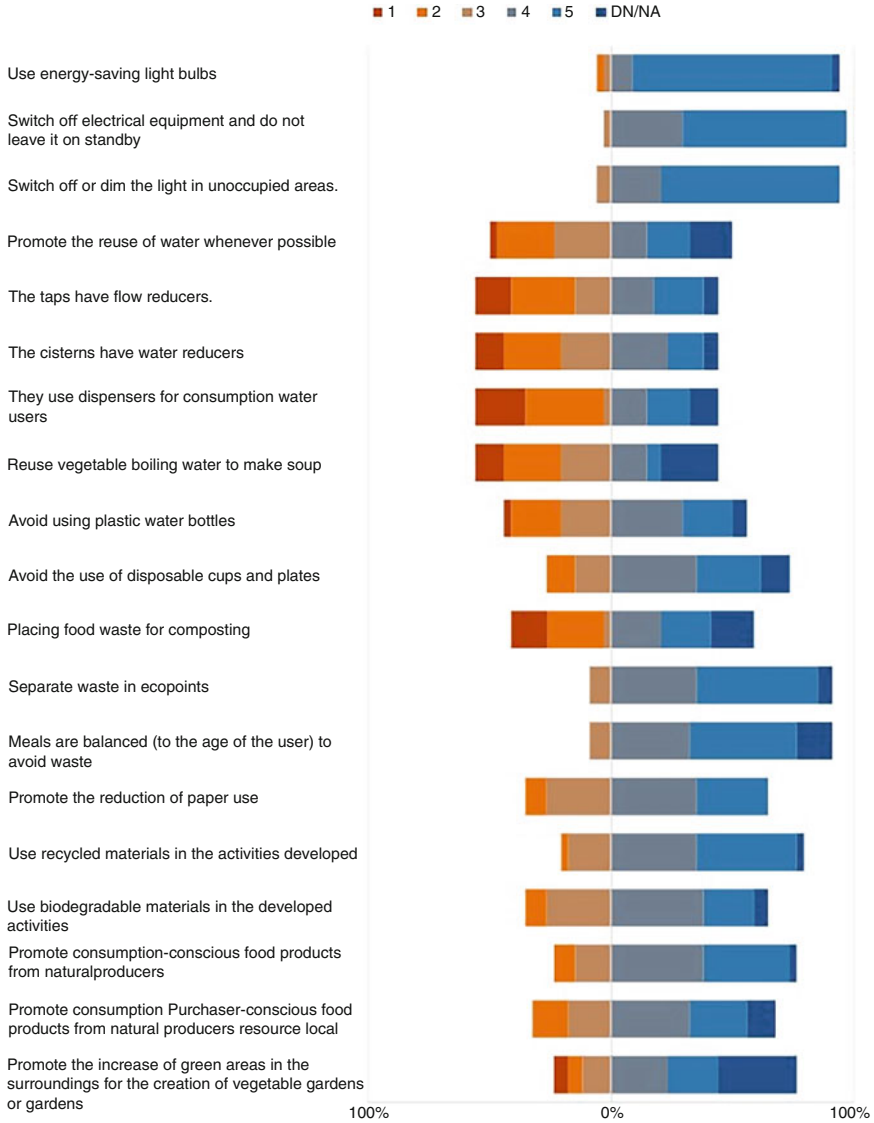


Fig. 4 Map of sustainability questions

When asked about other good practices applied in the organization, references were made to an ecological vegetable garden, concern in replacing equipment by others with better energy levels, avoiding food waste, and other initiatives. As for challenges in promoting sustainability, organizations highlighted lack of information, lack of incentive, limited financial resources, sole promotion of what is known to be achievable, lack of time and support, mindset change, misinformation

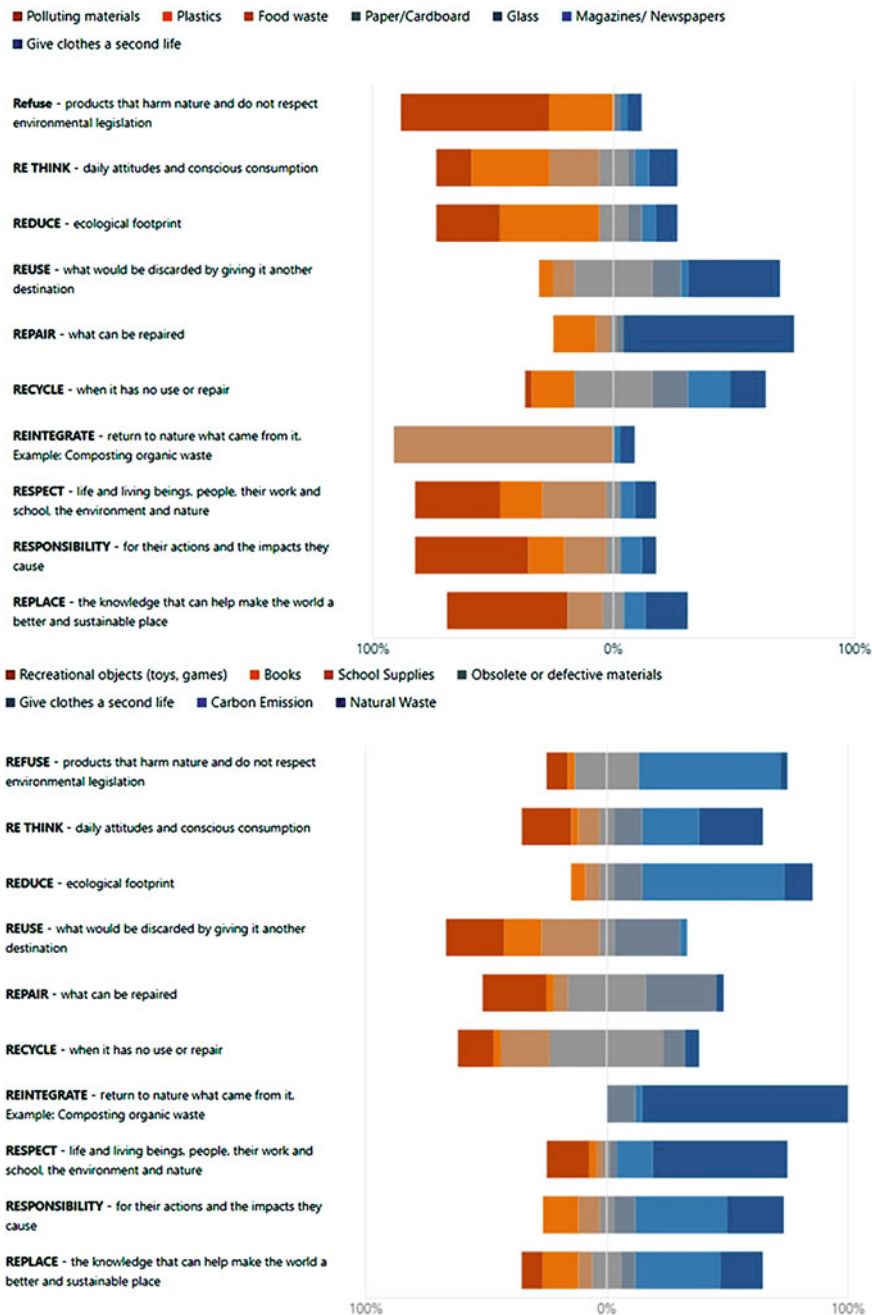


Fig. 5 Answers about the policy of the Rs in different situations

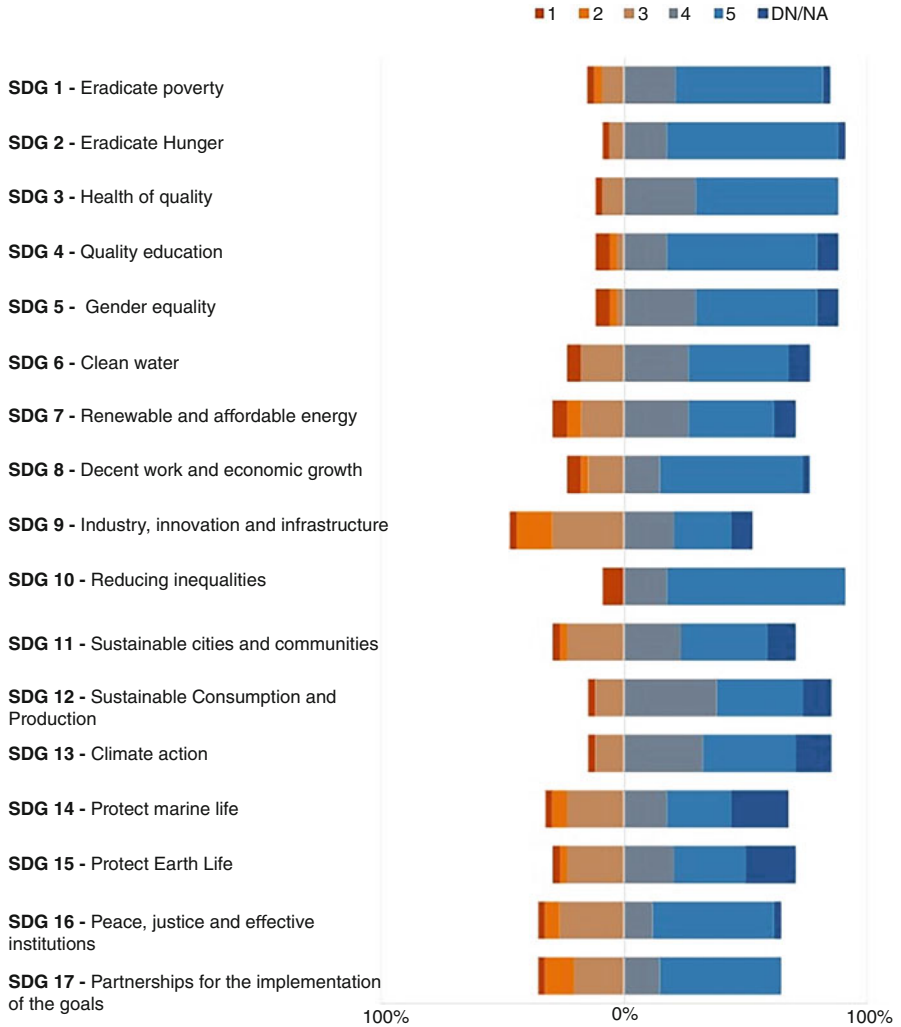


Fig. 6 Responses to the 17 SDGs

among employees, resistance from users, and lack of interest from the family, community, and users.

5 Conclusion

The present study aimed to understand how SE fits into the CE through the application of the R principles and the SDGs.

Surveys are recommended for studies in social sciences, but low response rates are a reality. On the other hand, one does not know who receives online surveys or if they eventually end up in spam. The immense amount of information received today by email causes people to lose interest in answering surveys, even if they consider it important. Though not comparable with this survey questionnaire, the national SESS only got 3550 answers out of a sample of 6019 entities.

The survey results of the present study suggest that there is a lack of interest or knowledge on the topic of sustainability. Despite a response rate of 36%, respondents seem to have some knowledge of the issues, but its implementation is difficult mainly due to resistance of users, families, financial availability, and lack of information/training.

Focusing on the 3R principles, responding organizations seem to place greater emphasis on situations that are heard daily in the media and mainly consider reduce, reuse, and recycle for carbon emissions, plastics, paper, and clothing. When faced with the other seven Rs, organizations continue to give greater importance to the R principles mentioned above and additionally to the Refusal to use polluting materials and the Repair of clothing. From these answers, and due to the low percentage attributed to other choices, one can infer that there is a lack of information about the various ways of treating waste and materials, to which a second life can be given.

Regarding food waste, one can highlight the rethinking of conscious consumption, since very few organizations reuse it, and some still put it in the regular trash. In this regard, protocols could exist between these organizations and local producers, who in partnership could use this waste as fertilizer, and thus the organizations could obtain more sustainable products.

As for energy consumption, there is some concern to reduce it by switching off unnecessary lights and unplugging appliances from the standby state, but as for water consumption, flow reducers for savings are not much applied, which causes waste.

Concerning the SDGs (Agenda 2030), referenced almost daily, directly, or indirectly, we all contribute to their implementation. It is noted in the responses to the questionnaire that hunger, education, gender equality, sustainable production and consumption, and the reduction of inequalities, i.e., the most publicized SDGs, are the ones with the highest percentage of response, although there is some interconnection between them. However, analyzing the SDGs only by the goals may lead to a misperception of their importance because there are only 17, although they include 169 targets that are applicable to various sectors of the economy. Portugal is a motivator of these policies, even though they are not yet fully disseminated in a way that is perceptible to all.

To sum up, the research question that motivated this study, trying to understand the extent to which organizations apply the R principles, how they fit into the SE, and how it is given compliance with the SDG goals, was thus only partially answered. There is some knowledge on the subject, and attempts at implementation, but the resistance encountered discourages its application. The SE can be a pillar for the development of the CE, but for this, it will be necessary to take incentive measures

in these organizations that involve stakeholders, employees, users, and volunteers through information directed to this socioeconomic sector.

In view of the institutions of this third sector and with their partnership, future research could understand the behavior of SE organizations by municipality, involving the City Councils (which are one of the main sources of funding), and try to understand the perception that these organizations have of the goals of each of the SDGs. It would also be interesting to study possible partnerships with local producers and to understand how they rate the possibility of a sustainable certification.

References

1. Constituição da República Portuguesa: <https://www.parlamento.pt/Legislacao/Paginas/ConstituicaoRepublicaPortuguesa.aspx>. Last accessed 29/03/2023.
2. Lei n.º 30/2013 da Assembleia da República *Diário da República* n.º 88/2013, Série I de 2013-05-08, páginas 2727–2728 (Lei de Bases da Economia Social) <https://dre.pt/dre/detalhe/lei/30-2013-260892>. Last accessed 29/03/2023.
3. Coheur, A. Livro branco ‘A economia social . . . retomar a iniciativa’. Propostas para fazer da economia social um pilar da União Europeia (Social Economy). <https://www.cases.pt/livro-branco-economia-social-retomar-a-iniciativa/>. Last accessed 29/03/2023.
4. Social Economy European Parliament resolution of 19 February 2009 on Social Economy (2008/2250(INI)) (OJ C, C/76, 25.03.2010, p. 16, CELEX: <https://eur-lex.europa.eu/legal-content/EN/TXT/?uri=CELEX:52009IP0062>). Last accessed 29/03/2023.
5. Torrinha, F. (1939). *Dicionário Português-Latino*. Ed. Domingos Barreira.
6. Campos, L. M. S., et al. Relatório de Sustentabilidade: Perfil das organizações brasileiras e estrangeiras segundo o padrão Global Reporting Initiative. *Revista Gestão & Produção*, 20(4), 913–926. <https://www.scielo.br/j/gp/a/96R88t5VprQhkPy7XzqrBFN/?lang=pt>. Last accessed 29/03/2023
7. Souza, N. d. J. (2007). *Desenvolvimento Económico* (5th ed.). Atlas.
8. Transformando nosso mundo: Agenda 2030 -Resolução adotada a 25 de setembro de 2015: <https://brasil.un.org/sites/default/files/2020-09/agenda2030-pt-br.pdf>. Last accessed 29/03/2023.
9. Sustainable Europe Research Institute.: <https://www.seri.at/en/>. Last accessed 29/03/2023.
10. Ferreira, M. J., & Campos, P. (2009). O Inquérito Estatístico: uma introdução à elaboração de questionários, amostragem, organização. *Lisboa, Instituto Nacional de Estatística.*: 214 p.
11. Thayer-Hart, N., Dykema, J., Elver, K., Schaeffer, N. C., & Stevenson, J. (2010). Survey fundamentals – A guide to designing and implementing surveys. *Office of Quality Improvement*. 20 p.
12. Borg, W., & Gall, M. (2002). *Educational research: An introduction*. Person Education, Coleção Landranger Map.
13. Bravo, R. S. (1991). *Técnicas de investigação social: Teoria e ejercicios* (7th ed.). Parainfo.
14. Hill, M.M. & Hill, A.B. *Investigação empírica em ciências sociais: Um guia introdutório*. (1998).
15. Smith, T. W. (1987). That which we call welfare by any other name would smell sweeter: An analysis of the impact of question wording on response patterns. *Public Opinion Quarterly*, 51, 75–83.
16. Resolução do Conselho de Ministros n.º190-A/2017 - *Diário da República* n.º 236/2017, 2.º Suplemento, Série I de 2017-12-11, páginas 54–73 (2017).
17. Instituto Nacional de Estatística – Inquérito ao Setor da Economia Social:2018. Lisboa: INE, 2020. <https://www.ine.pt/xurl/pub/450307417>. Last accessed 29/03/2023.

Improvement of the Manufacturing Process of Active Pharmaceutical Ingredients



A. C. P. Soares and R. D. S. Campilho 

Abstract Currently, the pharmaceutical industry needs to optimize industrial drug processing procedures. The constant improvement of industrial equipment is an unavoidable strategy to improve the quality of the process, as well as its efficiency and productivity. This work aims to analyze and implement improvements in equipment integrated into production processes in pharmaceutical laboratories to produce active pharmaceutical ingredients (APIs). In the project, studies were carried out using the finite element method (FEM) and traditional structural design, to test the feasibility of the selected solutions. Then, the cost analysis was carried out, and the benefits and results of the new equipment were presented. It was possible to conclude that the proposed equipment demonstrates advantages at an ergonomic, hygienic, and practical level compared to the original ones, which translates into an increase of the company's competitiveness in the pharmaceutical market.

Keywords Pharmaceutical industry · Active pharmaceutical ingredients · Spray drying · Standardization · Process improvement · Finite element method

1 Introduction

The pharmaceutical sector is a specific branch of production that is responsible for creating APIs present in medicines that generate the intended effects [1]. Approving

A. C. P. Soares

ISEP—School of Engineering, Polytechnic of Porto, R. Dr. António Bernardino de Almeida, Porto, Portugal

R. D. S. Campilho (✉)

ISEP—School of Engineering, Polytechnic of Porto, R. Dr. António Bernardino de Almeida, Porto, Portugal

INEGI—Institute of Science and Innovation in Mechanical and Industrial Engineering, Pólo FEUP, Porto, Portugal