



International Journal of Design for Social Change, Sustainable Innovation and Entrepreneurship

<https://www.designforsocialchange.org/journal/index.php/DISCERN-J>

ISSN 2184-6995

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Published online: November 2020

To cite this article:

Camocho, D.G., Vicente, J., & Ferreira, A.M. (2020) Circular and Sustainable Design: a systemic design model for the transition to a circular and sustainable economy, Discern: International Journal of Design for Social Change, Sustainable Innovation and Entrepreneurship, 1(1), 1-11.

Circular and Sustainable Design: A systemic design model for the transition to a circular and sustainable economy

David Camocho^a, José Vicente^b, Ana Margarida Ferreira^c

^aUNIDCOM/IADE - Unidade de Investigação em Design e Comunicação, Av. D. Carlos I, 4, 1200-649 Lisboa.

^aLaboratório Nacional de Energia e Geologia, I.P., Estrada do Paço do Lumiar, 22, 1649-038 Lisboa.

david.camocho@gmail.com

^bUniversidade da Beira Interior, Faculdade de Artes e Letras, DA, R. Marquês de Ávila e Bolama, 6201-001 Covilhã, Portugal.

^bUniversidade de Lisboa, Faculdade de Arquitetura, CIAUD, R. Sá Nogueira, 1349-055 Lisboa, Portugal.

jmanvicente@gmail.com

^cIADE, Universidade Europeia, Av. D. Carlos I, 4, 1200-649 Lisboa.

^cUNIDCOM/IADE - Unidade de Investigação em Design e Comunicação, Av. D. Carlos I, 4, 1200-649 Lisboa.

ana.margarida.ferreira@universidadeeuropeia.pt

Abstract

Successful and innovative design practices towards the development of more circular and sustainable products and services that are aligned with the current and future needs of our society rely on efficient practices that combine three main levels in the design and development process. The design management level which is responsible for establishing, planning and managing the development of design projects. The business level, which is focused on the feasibility and effectiveness of the project and its results in the short and long term. Lastly, the design level that is responsible for the implementation and development of circular design projects. This paper is part of a PhD research focused on supporting an innovative and efficient transition to a circular economy and sustainability through design. It describes the basis of a design model under development based on the design thinking process and an expert's survey carried at an international level and the research activities undertaken. It integrates the three levels in a systemic perspective, guiding the process and establishing the link between the needs of the design and development teams in terms of the definition of circularity and sustainability considerations and strategies, objectives and the activities, resources and practical tools needed to support the circular design projects.

Keywords: Design, Circular economy, Sustainability, Design systemic model

Introduction

To achieve sustainability and the transition to a Circular Economy (CE), we need to shift to a more innovative and effective way to fulfil the needs of the society and change the paradigm of production and consumption of products and services. The way we design, produce, use, distribute and discard products has a strong impact on the economy, the society and the environment (European Commission, 2019) and design practice are seen as a catalyst to shift from the traditional model of take-make-dispose to achieve a more restorative, regenerative and circular economy (Moreno, De los Rios, Rowe & Charnley, 2016). However, the approaches proposed so far in the field of design and innovation have not addressed and promoted significant changes at the system level (Idil Gaziulusoy, 2015) and designers who have the function of translating the strategies and concepts of circularity in the development of products and services that promote the closing of cycles, the efficiency, and sustainability of the systems, are challenged by new environmental, social and economic needs must adopt a holistic approach to problem-solving (Bocken, de Pauw, Bakker & van der Grinten, 2016) taking into account that most of the characteristics of the entire life cycle of a product are defined in the design stage.

As part of a doctoral research project under development which aims to promote and demonstrate to practitioners and companies the key role of design in this process, and to increase the knowledge in the fields of design for sustainability and circular economy, as well as support the design practice and the practitioners with guidelines and resources to develop sustainable solutions to current and future needs, the project addresses four main research questions:

- How can design support the transition from the linear economy to the new model of a circular and sustainable economy?
- What tools and methods can designers apply to support an effective design practice for a successful transition to CE in the real world?
- How can designers overcome the barriers to the implementation of a design practice that effectively results in more sustainable products and services aligned with the European policies for CE?
- And, how can design practice and the role of the design professionals be promoted in the CE context?

To support the design practice and to reduce the gaps that exist between what is being developed and investigated in CE and its practical application in the development of more circular, sustainable and innovative projects, products and services, and to promote good practices, this paper presents a systemic model that is under development to meet the needs of designers in the integration of circularity aspects in their practice. The model aims to establish the connection of the design process, the business strategy and the design management towards circularity and integrates the inputs derived from the research undertaken and will be further tested and validated to ensure its adequacy and efficiency to support the process.

Design for a circular economy

In the transition from the traditional linear approach to the circular economy, design makes a huge contribution. Design plays a key role in the definition of the features and the profile of products and services. A more sustainable way to design, produce, and consume is a crucial objective for the development of our society (Bhamra & Lofthouse, 2007; Braungart & McDonough, 2009; Manzini & Vezzoli, 2010; Margolin, 2014) that, according to recent studies, is only 9% circular (De Wit, Hoogzaad, Ramkumar, Friedl & Douma, 2019). With the responsibility of responding to product-service system problems, designers must integrate circularity criteria and expertise in problem-solving innovatively, adjusted to the needs of users, businesses, and society's dynamics (Ferreira, 2008).

The circular design process and the underlying practice can be seen as more challenging and complex, requiring changes in the way of thinking and conducting projects focusing on a shift from product-based solutions to more sustainable and innovative system-based or function-based approaches. Designers need to align their development process with the CE approach to replace the conventional end-of-life concept in which the materials and components of a product are disposed of after fulfilling the initial function, through closing solutions, slowing and narrowing the resource flows in production, distribution and consumption processes (Bocken, de Pauw, Bakker & van der Grinten, 2016). They need to apply several strategies in the development process focusing on the efficiency and sustainability of the entire system (Rocha, Camocho & Alexandre, 2019).

To foster an efficient design practice, there is a need to provide practitioners, business stakeholders, and other product developers with guidelines, resources and practices to apply design strategies for different circular business models (Moreno, De los Rios, Rowe & Charnley, 2016; Bocken, 2016), and influencing and managing the value chains. Building circular and sustainable value chains that are highly influenced by

product and service design, inevitably imply a fundamental change in design practice (Camocho, Ferreira & Vicente, 2018; Prendeville et al., 2013; De los Rios & Charnley, 2017).

New or updated and upgraded methods and effective design-oriented tools are needed to support and promote design in the transition to a CE. The over-consumption of goods and services have actively seduced society, leading to excessive consumption of natural resources and the generation of huge amounts of waste and emissions (Medkova & Fifield, 2016). Designing products more smartly and innovatively, extending their useful lives and changing the role of such products within the system is crucial to the achievement circularity and sustainability (Camocho, Ferreira & Vicente, 2018; European Environment Agency, 2017).

Currently, and given the post-COVID19 scenario in which we are, the effects of the pandemic have further reinforced this need to create a more ecological and resilient society. Europe needs to be revitalized. Companies, businesses and society must adapt to a new reality, and new revitalization mechanisms must be adopted. The European Union recently launched the Europe recovery plan (European Commission, 2020) in which measures to revitalize and support organisations will be put into practice. In this context, the design is a fundamental element in adapting to new needs and must respond with integrated solutions that enhance innovation, sustainability, employment and the creation of value for all stakeholders.

Basis and rationale for the development of the design model for a CE

The integration of sustainability principles in product development has been a concern of many professionals since the 70s, having, in a way, an important influence of Vitor Papanek's book "Design for the real world" (1970). The authors called into question the practice of design and the relationship of this professional activity with the environmental and social impact associated with product development. From green design to design for the circular economy, we have witnessed an evolution in design, in the concepts, practice and growth in complexity by integrating a larger scope of sustainability criteria (Vicente, Frazão & Silva, 2012). Numerous projects and initiatives have been developed, numerous examples of success are available in the market, however, this practice has never become mainstream. These approaches have always been related to niche markets and in general (Hassi & Wever, 2010) never managed to demonstrate the real benefits of being sustainable, taking into account, the environmental, social and economic pillars of sustainability.

The CE can be considered as another step in the evolution of a necessary and fundamental demand for a more sustainable future and presents itself as a possible path in this direction, and in this way, the scientific, academic and business communities are highly motivated and committed in this respect. However, as mentioned above, despite the numerous developments in terms of methodologies, practices, tools, funding, etc., there is still a huge gap between theory and practice (Camocho, Ferreira & Vicente, 2019), between what is being developed in research and development projects and what is applied in practice for new solutions that reach the market.

It is essential to narrow this gap and provide designers, who have a fundamental and irrefutable role in the development of new products, sustainable services and systems, with interdisciplinary practices supported by synthetic methods, tools and guidelines that result in sustainable solutions that contribute towards an environmentally efficient future, fair from a social point of view and that creates value and wealth for business and the society.

In this sense, this research project intends to develop a synthetic method that supports this practice and that integrates the project development, the management and orientation of the design project and the perspective of the business, as presented in Figure 01, implementing these considerations in early phases of the project (Hassi & Wever, 2010) with high innovation potential.

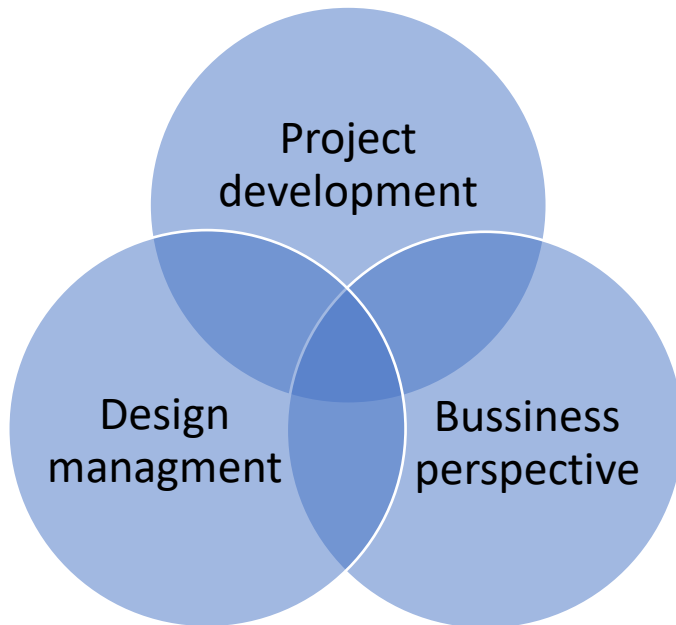


Figure 1: The 3 dimensions of the circular design model.

This model results from the work and research carried out and aims to systematize and guide the design process by integrating aspects of circularity and sustainability that respect the intrinsic needs of the design process and activities. The model is based on four main sources of information. An extensive literature review, the national practices applied in Portuguese products that are available in the market, the perspective of consumers and the perspectives of a group of international experts that were consulted within the process (Figure 2).

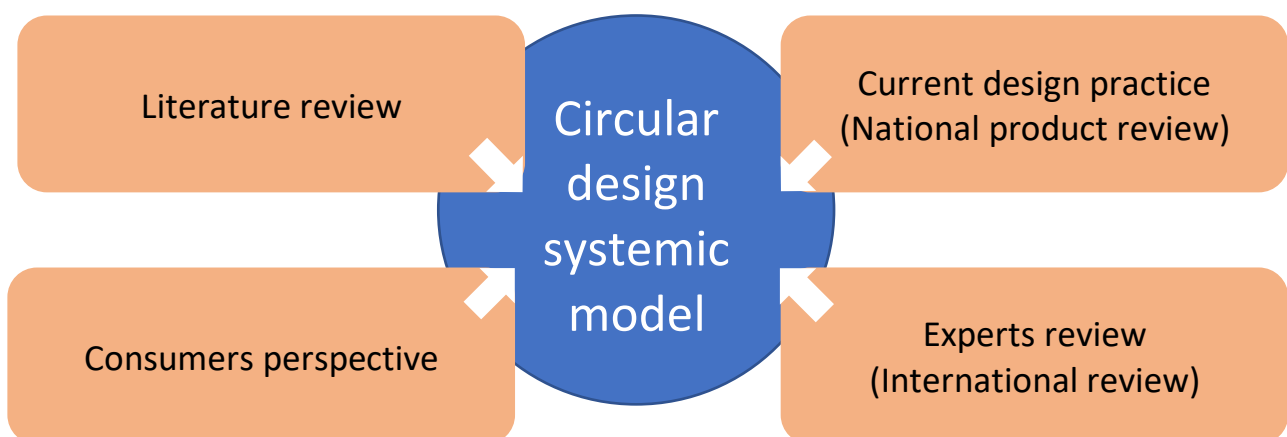


Figure 2: Circular design systemic model – sources.

Literature review

For the development of the design model, the literature review that aimed to identify and analyze the main

sources at a national and international level provided a clear picture of the state-of-the-art and knowledge in the field of design, sustainability and CE with a special focus in identifying methodologies, tools, definitions and case studies of development and implementation of design projects oriented towards CE and sustainability (Camocho, 2018). Within the research project, several resources were collected and analysed. The CE is a current topic, and a vast number of activities and publications are being released frequently. These have been considered in the project and integrated as possible.

Besides the support in the development of the project and the design model, the collected information, with a brief analysis of each resource will be systematized and made available in the form of a database of resources oriented towards the design process aiming to provide designers and product developers with a source of relevant knowledge that is available and can be used as reference and inspiration to support innovative projects.

Identification of national products with sustainability criteria

To map sustainable and circular design practices in Portugal and to analyze how the sustainability and circularity aspects are being integrated into product development and communicated to the user, within the research project, relevant industrial products that are available in the market which have been developed with sustainability and/or circularity criteria and are placed in the market with sustainability allegations were identified and collected in a database of Portuguese products. This will be made available to be used by the design community as a source of inspiration, collection of good practices and promotion of the sustainability and circularity concepts and their background.

The collection of national examples was done to support the identification of the design professionals and companies linked to the products identified and, through interviews, the research aimed to identify and analyze how sustainable and circular products were developed and which are the needs, drivers, barriers and more information on the design practice towards a CE to support the development on the resources that will result from this project.

The search and collection of Portuguese examples demonstrated that despite all the efforts that are being done by research institutions, the Portuguese government, academia, associations, organizations, NGO's, etc., there is still a lack of national products developed and placed in the market. There are, however, several examples of products available, but the majority are imported from abroad.

Analysis of consumer perspectives

The availability and dissemination of products and services with sustainability considerations is increasing worldwide. There has been a growing trend in informing consumers about the environmental aspects to take into account when buying products (Young, Kumju, Seonaidh & Caroline, 2008). In general, consumers, are more aware of the societal and environmental problems and challenges and demand new and improved products and services. Yet, the gap between what is placed in the market by producers and what the consumer perceives is an important issue to overcome. The communication of products, the inefficiency of labels for most users who do not understand these topics, need to be designed in a more efficient way (Camocho, 2019).

For an efficient transition to CE through design, it is important to have a holistic and integrated approach. On the one hand, we need to supply innovative and sustainable products that meet the needs of consumers, and on the other, we need to have a sustainable consumption behaviour and features related

to products and services that allow an informed choice and efficient use by consumers. Within the development of design projects for CE, designers need to better understand the consumer habits, perceptions and general knowledge regarding the sustainability aspects of products and services, and in this regard, within the research project, a consumers analysis was developed.

The survey undertaken indicates that consumer believes in a common-sense assessment of sustainability based on their perceptions, which are not always correct and are partially supported by self-declarations and allegations from designers, producers, and retailers focusing only in few aspects of the life cycle, and in some cases, misleading consumers through greenwashing approaches (Camocho, Ferreira & Vicente 2019). These findings and concerns should be translated into criteria to guide the development process and must be considered in the design model under development.

Survey of experts

Despite the evolution of the CE approach and wide dissemination and engagement at many levels of our society, which lead to the development of new business opportunities, new business models and developing new markets, is CE the solution to attain a sustainable society? To answer this question, the current research conducted an international survey, in which a group of international experts were contacted and invited to collaborate by sharing their experiences and perspectives about the current and future status of CE in practice.

To develop an efficient survey, the purpose, goals and the sample were clearly defined to ensure focus, concise and provide useful data. The collected information allows the definition of an international overview of the practice, motivations and barriers in the transition to CE through design, and supports the research and development of methods, tools and guidelines to promote an improved design practice.

To involve an effective and relevant sample, before the development of the survey, a database of international experts was developed as well as a questionnaire based on the compromise between the length and time needed to complete it and the need for data to support the analysis. Through the questions, the research aims to understand the views and perspectives of the experts in the field on what concerns the practical implementation of CE, in what sense the experts consider that CE is the way to achieve a sustainable society in the future, what is considered the novelty that the concept and approach can bring to society, what are the main drivers and motivations to adopt CE in practice, what are the main barriers, how should we overcome the current obstacles and promote the design practice towards innovative and sustainable solutions, and what lessons can we learn from the past.

The analysis of the data gives an overview of the perceptions of the experts that are working in the field and are facing the real challenges in the circularity path. From the expert's inputs to the survey, more than 80% consider that CE is the way to attain sustainability. The around 20% that do not consider CE as the way for sustainability consider that CE is one important strategy, but many other must be integrated and considered in the development of our society and the future patterns for production and consumption.

From the overall perceptions, CE can be seen as a change of mindset for consumers and industries, leading to the development of different ways of production and consumption, focusing on the real needs of the users, business and the society by adopting new development paths and new business models which can lead to a more dematerialized and efficient ways to fulfil the needs of all stakeholders in the value chain.

The results of the survey which include also a set of motivation, barriers for the implementation of CE in

practice, ideas on how to overcome the obstacles and promote the design practice towards innovative and sustainable solutions and other relevant aspects will support the development and adequacy of the design model and the related resources.

Development of the Circular Design Model and toolkit

Aiming to support and promote the design practice, a design model is developed. Built upon the results of the research, the above-mentioned review, the analysis of strategies, tools and methods, and other relevant information collected and analyzed, the structure of the model (Figure 3) derives from the six main stages of a design project and relates the activities of the process with three levels that complement each other resulting in a robust model to support the design practice towards circularity and sustainability:

- The Project management level to support an efficient integration of circularity in the different phases and aspects of Design management
- The business level to align the development with the strategy and considerations of the business, promoting the efficiency and sustainability of the system.
- The design team level, to support the practice and the integration of the circularity and sustainability considerations, methods and tools in the development of new and innovative products, services and systems.

The model establishes the relation of the design thinking process with the goals of the CE to define how the resources can guide the design process to promote sustainability and circularity in processes.

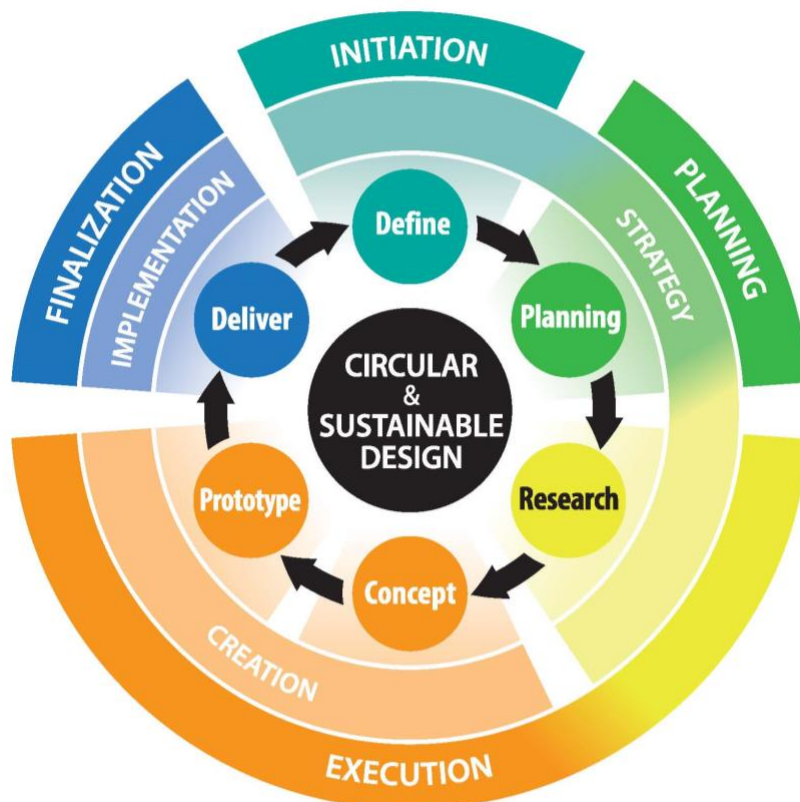


Figure 3. Circular and sustainable design model.

The description of each step in Figure 3 are the goals and objectives of each phase, how circularity should be addressed, which sub-activities are included in each step of the model and which are the inputs

(resources, time, human resources, etc) and the outputs needed, will allow a systemic definition, the planning and the development of the design for a CE project.

The strategy for the design practice within CE will be supported by relevant tools, methods and guidelines that can be applied by practitioners in their daily activity to develop innovative and sustainable circular solutions. The translation of the model into the practice will be done through a design for circularity and sustainability toolkit. The toolkit to improve the role of design in the transition towards a circular and sustainable economy is being developed and will support the development of new projects that will result in new products and services with more potential for innovation, sustainability and circularity.

Conclusions and further development

The circular design systemic model, structured in three interlinked layers that integrate the project development perspective, the design management approach, and the business perspective, will promote the adoption and implementation of circular design in practice. The model provides guidance and support to designers, project developers, project managers and business strategists engaged in this typology of projects, integrating circularity considerations, tools and methodologies as core activities in the development of new and efficient products and services. These align the current and future needs of consumers with improvements and benefits in the circularity profile of products and services with an added value for the business and the society. This model aims to reduce the gap between theory and practice, developed with an orientation towards the project, respecting the needs of the various stakeholders and aligned with the characteristics and needs of project management and development.

The result, integrating a set of guidelines and different types of resources for project development, will be tested and validated by a focus group and will be disseminated and promoted to design communities, product developers and businesses, in a collaborative approach, creating synergies and sharing the knowledge, thus contributing to an effective improvement of society towards a more circular and sustainable future through design.

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