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Playing for change: designing a board game for the circular economy

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Abstract | There is a lack of public engagement in sustainability initiatives such as the circular economy. This can be attributed to an absence of understanding and promotion of this new way of living and consuming. This lack of engagement is hindering the implementation of the CE. This paper aims to address this through an exploration of the role of games in explaining difficult concepts. There will be a particular focus on board games as tools for exploring aspects of sustainability, as they allow for a more discursive experience with other players and are a simple way to relate complex ideas. The paper will then detail the design and development of a serious board game *Circul8*. Designed by the authors to encourage engagement with complex systems, it aims to introduce ideas of the CE to the general public. The paper will explore the methodology of game creation and detail initial gameplay results.

KEYWORDS | GAME DESIGN, CIRCULAR ECONOMY, PLAY THEORY, LEARNING THROUGH PLAY, RAPID PROTOTYPING

1. Introduction

There is an urgent need to engage the public in the circular economy as part of the fight against climate change. The basic principles of the circular economy are simple enough; “design out waste and pollution; keep products and materials in use; regenerate natural systems” (Ellen MacArthur Foundation, 2017). However, understanding how these principles can work in reality is more complicated and there is a risk that people will switch off if they don’t understand. Research into the circular economy has revealed that public engagement is one of the most difficult aspects of circular economy implementation (Kirchherr et al., 2018). This paper will firstly explore the potential of the circular economy as a model to tackle some areas of the climate crisis, and the barriers around public engagement that are hindering its implementation. The paper will then go on to explore the potential of games to engage the public with complex ideas through a simple system, with a particular focus on board games. Finally, the paper will detail the designing of a serious board game, *Circul8*, by the authors, that will be used to engage audiences with circular economy ideas and provoke discussion around it.

2. Circular economy

The circular economy is gaining traction as an idea across business, governments and academia. It is seen as one of the ways to tackle the climate crisis by radically changing the way businesses operate and people consume (Ellen MacArthur Foundation, 2013; Ghisellini, Cialani, & Ulgiati, 2016; Kirchherr, Reike, & Hekkert, 2017; Mathews & Tan, 2016). The fundamental idea behind the circular economy is to move us from a linear economy of ‘take-make-dispose’ to one where resources are in constant use for their full usable life. There has been a variety of definitions for circular economy, ranging from product reuse and advanced recycling to eco-design and sustainable consumption (Gallaud & Laperche, 2016). Kirchherr, Reike and Hekkert (2017) analyse 144 definition of the circular economy in order to consolidate and create transparency around current understandings. Their research concludes to define circular economy as “an economic system that replaces the ‘end-of-life’ concept with reducing, alternatively reusing, recycling and recovering materials in production/distribution and consumption processes.” (2017, p. 229). The Ellen MacArthur Foundation (2013) adds that systems should be restorative by design, focusing on nature-based systems as well as technical ones. The circular economy cycles are demonstrated by Figure 1, known as the butterfly diagram. This shows the inner cycles of reuse, repair, repurpose and remanufacture and the technical side, with the outer cycle and final process as recycling. The organic side focuses on extracting as much energy as possible, either directly through biomass or indirectly through calorie consumption, before the matter is returned to replenish the soil.

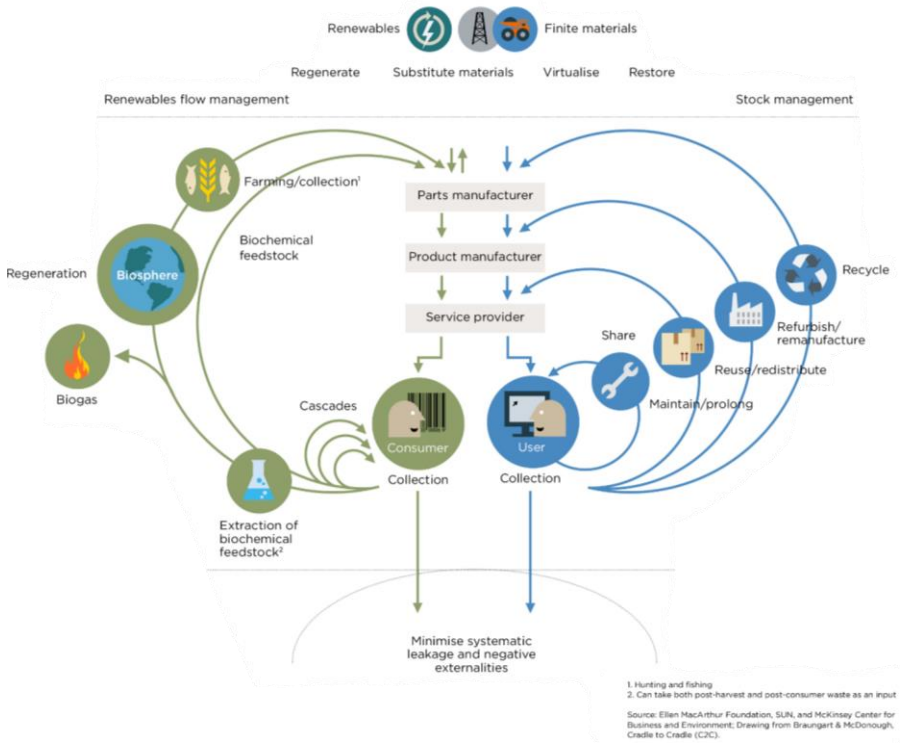


Figure 1. Circular economy butterfly diagram developed by the Ellen MacArthur Foundation (2013)

As well as working through different cyclical iterations, the circular economy works at different levels of implementation. *Micro*, at the product, company or consumer level (Elia, Gnoni, & Tornese, 2017; Kalmykova, Sadagopan, & Rosado, 2018; Lewandowski, 2016), focusing on design for end of life (McDonough & Braungart, 2009) and product-as-service business models (Bressanelli, Adrodegari, Perona, & Saccani, 2018; Spring & Araujo, 2017). *Meso* level implementation looks at eco-industrial parks like those being developed across China, where business are deliberately placed together to enable the waste from one business to be easily transferred to another that uses that waste as a resource (Mathews, Tan, & Hu, 2018; Yuan, Bi, & Moriguichi, 2006). Thirdly *macro*, at national, regional or city level implementation, ensuring that the infrastructure is in place to support the effective sharing of resources and implementation of many small loops that feed into the overall circular system (Blomsma, 2018; Ellen MacArthur Foundation & ARUP, 2019; Kirchherr et al., 2017; Saidani, Yannou, Leroy, Cluzel, & Kendall, 2018).

2.1 Role of consumers

At every level of implementation and every stage of the circular economy cycles consumers play an important role. From product design consultation and uptake of subscription models of ownership, to actively seeking out second-hand goods and repairing what they own rather than throwing away, consumer involvement is vital for the success of the circular economy.

“‘Closing the loop’ in the circular economy essentially requires much closer and more extended collaboration between participants. Consumers also become much more integrated because the value chain does not end at the consumption stage.” (Ellen MacArthur Foundation, 2013).

Designer and engineers working in circular economy need to make sure that consumers are actively involved in each stage of the production process. For example, the purchaser could ultimately be one of many, so the resource recovery needs to be as painless for the consumer as possible (Lofthouse & Prendeville, 2018). City planners wanting to create circular urban systems must do so with the active involvement of their city’s residents (Ellen MacArthur Foundation & ARUP, 2019). Not involving the people who will use the products and services being designed for them is likely to lead to costly vanity projects and products ultimately failing (Singh & Giacosa, 2019).

2.2 Barriers to adoption

Despite the importance of consumers and the public in general to the circular economy, they are one of the biggest barriers to its implementation. Research conducted by Kirchher *et al* (2018) of 208 businesses and policy-makers explores barriers to circular economy adoption in the EU and finds that “lacking consumer interest and awareness” (2018, p. 268) is the most pressing issue preventing wide-scale adoption. Since this research has been published there have been a few high profile circular economy media stories, such as IKEA’s announcement to introduce take back schemes on their furniture (Inter IKEA Systems B.V., 2018), a focus on fast fashion (Britten, 2018; Farmer, 2020) and the business potential of circular economy (van Houten, 2019). As consumers are so vital to the success of the circular economy more needs to be done to engage them with the underlying principles of how the process should work. Preliminary research undertaken by the authors has found that often employees of companies engaged in the circular economy do not fully understand how and why their employer is engaging with circular economy. It is prudent to point out here that, like everyone taking part in society, these employees are also consumers. To bring about this new model it is vital that we are all conscious of the roles we play, as designers and also as consumers. If we cannot take steps to become more circular in our work and daily lives, then how can we expect other people to engage.

3. Gamifying circularity

The question that needs to be asked is: how do we enable engagement with principles of the circular economy in a memorable, actionable and involving way? The authors have concluded that one of the ways to introduce ideas about the circular economy to people could be through a simple board game. Games can be important tools for educating audiences about wicked problems and are gaining more significance “as a way to bridge the communication gap between different stakeholders and support sustainability education” (Whalen, Berlin, Ekberg, Barletta, & Hammersberg, 2018, p. 336). They are useful devices to explain complex systems to audiences, demonstrating how different elements of these systems work together through non-linear access points that come about during gameplay, rather than linear speech. This allows audiences to come to an understanding through their own exploration instead of being told through written or verbal form. Games, “can be treated as small models of much more complex, much larger systems” (Castronova & Knowles, 2015, p. 41). Prominent game designer and theorist Jane McGonigal (2011) believes that games have the power to change by teaching ecosystems thinking, giving players the ability to think about complex ecological systems. “A good ecosystems thinker will study and learn how to anticipate the ways in which changes to one part of an ecosystem will impact other parts.” (2011, pp. 297–298). Introducing ideas of circularity through a board game can provide a method to help the public understand their roles in the ecosystems necessary for successful circular economy implementation.

3.1 Serious games

A serious game is one that has a purpose beyond entertainment, their use is gaining prominence in sectors such as healthcare, education and workplace learning (Cannon-Bowers & Bowers, 2010). The majority are computer-based games, providing simulations for professionals such as firefighters or military. As they are generally designed with a specific, intended audience they are less commercially viable than video games designed solely for entertainment. They might not be practical for development in highly specialised areas, or areas where use of computers is not permitted (Lamey & Bristow, 2015). Board games are an underused but useful avenue for the development of serious games. Serious board games offer a number of potential points over computer games: they can be developed without needing skills in programming, they can be cheap to and quick to prototype, and most importantly, they involve interaction between players which can foster conversation during and after play about the subject (Castronova & Knowles, 2015; Illingworth & Wake, 2019).

3.2 Examples of serious board games

The potential for the use of serious board games is very broad reaching. For example, Bristow and Lamey (2015) developed an informal, homemade board game for use in mental health services to aid service users “in the design of their hospital environment. The advantage of a board game format is that it is familiar and unthreatening.” (2015, p. 243).

This familiarity with the format allows for initial barriers to be broken down in a setting that can often be stressful and unfamiliar to patients.

To bring a serious issue to a wider audience Illingworth and Wake (2019) adapted the popular tile-based game Catan (Teuber, 1995) to introduce a global warming element as a way to generate dialogue around this complex topic.

“Tabletop games, which offer high levels of sociability, adaptability, and tactility, create a shared space in which complex topics can be discussed and debated, and it is this capacity to foster dialogue that makes them such a productive means for discussion on the topic of global warming.” (2019, p. 3).

There are a few other examples of games that tackle environmental issues. CO2 (Lacerda, 2012) is a commercial board game designed to raise awareness of the global pollution crisis. This game has been modified by Edward Castronova to explore “the difficulties that policy-makers face in dealing with the CO2 problem” (2015, p. 45). He chose CO2 as a base game as it already provided a simplification of a very complex system. By adding and removing parts of the game mechanics and adapting the rules, he was able to create a new game Climate Policy. This adaptation of the game was made using a pen and paper so can be used by anyone who owns the original game – the rules are freely available online in the International Journal of Serious Games.

Focusing on the circular economy, In the Loop Games design board games that help different groups explore areas of the circular economy specifically related to them. Katie Whalen *et al* created the serious board game In the Loop (2015) to respond to the lack of understanding around complex circular economy implementation for engineering students. Research had found that teaching the circular economy

“demands a departure from the current disciplinary and subject-focused teaching that predominates current educational paradigms, particularly in engineering education” (Whalen et al., 2018, p. 335).

The focus during gameplay is to teach students about systems thinking and material criticality through active involvement in a simulation of these systems as an addition to the traditional learning structure the students were part of. They found that “the students were able to reconnect the game to reality, think in systems, and utilize critical thinking” (2018, p. 342). The research also found that the game had implications beyond its initial intention with the potential for use with groups outside the target audience.

3.3 Serious games as boundary objects

When a game moves outside of its original intention, it becomes a boundary object. This is explained by van Pelt *et al* (2015) as:

“instruments used to facilitate the interactions between science and practice and function as the operating space between different ‘social worlds’ in which actors

come together and share interpretations without the need for consensus” (2015, p. 42).

The potential for games as boundary objects when exploring complex subjects such as climate change can be investigated further when looking at the role of simulation games to bridge the boundary between climate change science and various groups. The game players do not need to have an extensive knowledge about the subject in order to understand the important concepts put forward in the game. The game play becomes a *magic circle* (Salen & Zimmerman, 2003), allowing players to experience the consequences of making different choices in the safe space of the game.

3.4 Research summary

As demonstrated in this section serious board games are an accessible way to introduce complex systems to non-expert audiences. The social dynamic allows for dialogue during and after gameplay, so players can discuss the issues around the theme of the game, potentially developing a deeper understanding of the subject. A serious game developed for a broad audience could have the potential to explain circular economy principles to different groups of people. By playing a game, audiences can experiment with a system and push the boundaries, allowing themselves to develop their own understanding of a concept.

4. Introducing ‘Circul8’

This section will detail the development of a serious board game, ‘Circul8’, designed to explain the principles of the circular economy to a general audience. The game was initially conceived as a modification for the game Carcassonne (Wrede, 2000), a tile placing game where players can build cities, roads and farms claiming them with character tokens. The original idea was to allow players to build their towns and farms and be able to trade with one another, with a focus on the waste from one area being used by another area to create a new product. As mentioned previously, this is known as meso-level implementation (Kirchherr et al., 2017). The decision to focus on meso level implementation was taken to demonstrate the symbiotic nature of the circular economy – how one group will be reliant on another for resources. This also ties into research by one of the authors into the role of communities and networks in the circular economy.

4.1 Research and development

During the very first research and development session, the game designer trialed the game using a small selection of cards and a copy of Carcassonne (Figure 2). Trade elements were introduced through a series of cards that were selected randomly and detailed a raw material source, i.e. an oil refinery or forest, or a manufacturing base, i.e. electronics or furniture (Figure 3).



Figure 3: Initial Carcassonne gameplay



Figure 2: Carcassonne board and card modifications

The first playtest of Circul8 was held at a small doctoral conference which encouraged open and honest feedback of each workshop (CC). The feedback received followed some general questions that could be applied to any of the workshops being played but was useful. Some players mentioned aspects of game mechanics they would like to see added or improved, whereas others suggested applications for the game that had not been thought of. Table 1 shows a matrix of the initial research and development session's play testers feedback, their names are encoded for anonymity.

Table 1: First play test responses matrix

Reviewer	Key Takeaways What most interested you? What surprised you?	Key Opportunities + any suggestions for applications of this research beyond those suggested by presenter?	Key Challenges + approaches to overcome these challenges?	What Else? What gaps do you see in this research? What could your research add to these gaps?
CCR1	The interactivity and how it can relate to policy & planning for space.	Taking the game to policy makers/planners or communities for co-design	Incorporating all elements for a circular economy - but interesting approach, could see it working	Make an online version. Keep this one too but get it online if/when people are happy with the plan/ideas
CCR2	Idea of learning about circular economy through a game with a focus on local/regional places	Influence local/regional planning in northern powerhouse	Level of complexity – making it give the message without oversimplifying	Lego pieces for resources. V. interested in how in how waste fits into cir. econ
CCR3	How the game starts with random layouts and slowly they become more intentional with players planning their next move based on potential future relationships	Making game more strategic by giving out cards before setting out tiles	How would the exchange work between cities and farms?	Money? Is the purpose to create wellbeing? How do you win?
CCR4	It's really good way of thinking where resources come [from] and how they are used. The interaction at the beginning is good as you play, and then the second part	Opportunities to modify the cards in order to give different life	How to reduce the game to not open it up that much?	Really hard work to create a game

	makes you think about the strategy and resources			
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CCR5	Great idea to gamify a quite serious subject How realistic to life the game can actually be	Game used in industry, to raise awareness of the circular economy Also, education A means of understanding for private to public or environmental to private A means of knowledge exchange	Making sure industry see it as serious, <u>perceptions.</u> It's a great idea, as a way of bridging, but for industry to understand its seriousness. You'll need to play with [it]	Make it digital in the future?
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The research and development session introduced the two authors of this paper. Tom Cockeram is a game designer and had designed a board to be used as a base for other games. He has expertise in game mechanics and was able to take the ideas of Jessica Robins and turn them into a serious game with engaging gameplay. The following illustrates the changes the game went through to its final iteration.



Figure 4: T. Cockeram's multi-use board displaying games previously designed with school groups.



Figure 6: First planning meeting using the pre-designed board by T. Cockeram and resource cards from the R&D session.

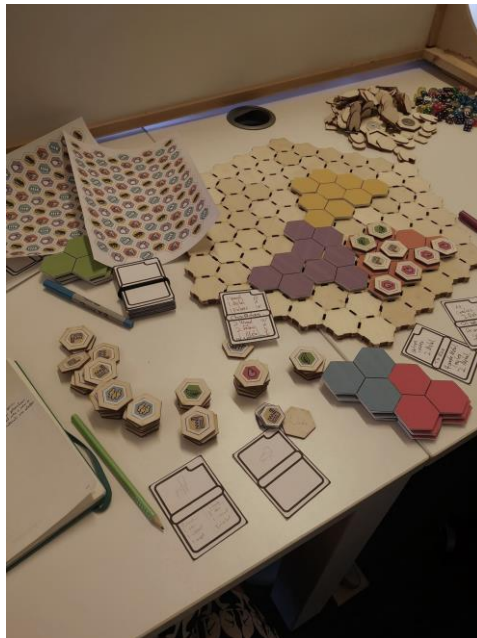


Figure 5: development of the resource cards and gameplay logistics.



Figure 8: Circul8 board designed and developed by T. Cockeram and J. Robins with rough draft of circular economy game elements.



Figure 7: The green and pollution tokens, introduced as the mechanics needed to win the game.

4.2 Gameplay

Circul8 will focus on meso level implementation, looking at how waste streams flow in, around and out of an area. By focusing on this level of implementation the game could have a broad appeal. It doesn't use specialist terminology or concepts, simplifying the manufacture of products to 5 components: organic (plant-based materials), natural textiles (i.e. wool, cotton, leather), metals, minerals and petrochemicals. Players control a number of material processing plants and/or product manufacturing factories, they are able to choose what proportion of each they own, selecting cards randomly from a deck. Players are able to change their manufacturing factories after every turn, but they cannot change what types of material processing plants they own. The material processing plants process raw materials and also recycle or remanufacture materials once they have been used to create a product. Players earn green tokens for using second-hand materials to create their products but gain pollution tokens for creating products or making decisions about their products that are seen as detrimental to the environment, most products can be broken down into their component materials, however, some cannot and must go to landfill. The game is won overall when a player has 10 green tokens.

4.3 Methodology

Once the rules and game mechanics are finalised the game will be tested with a variety of people to gather a cross section of responses. There will be a range of ages, including a teenage test group; testing with boardgame hobbyists, design students, and people working in the circular economy. The players will be asked to fill out feedback forms immediately after playing and their discussions will be recorded. From the research and development session the game designers know that the game provokes a lot of conversation and that the feedback given was timely and specific, even if the questions were not. The play testers will be asked more specific questions about the game mechanics, thoughts about the systems contained within the game and overall impressions. By playtesting with a range of audiences the researchers will be able to assess what ability the game is best pitched at, and whether it is suitable for an expert and general audience. They want to be able to assess whether the messages about circular systems come across to the different groups and what changes could be made to improve the game. There is always a risk that in making something to please everyone they will create something that pleases no-one, but this is why it is important to gather a range of feedback and to be able to assess whether one or two of the test groups can be side-lined to create a wider appeal.

The intention is to make the schematics for the game and playing cards freely available so they can be printed off using a standard printer and laser cutter (or scissors, if players don't have access to a laser cutter). This way anyone will be able to play the game, regardless of finances. To keep the game as sustainable and circular as possible we will encourage players to use second-hand cardboard (from old packaging) to create their board and pieces. By keeping the game accessible to many groups the intention is to create conversations about

consumption habits and how open source access could be a valuable tool in moving to a circular economy.

5. Conclusion and next steps

Through this paper we have argued for the importance of board games in disseminating ideas of circular economy. By using board games as tools, we can start to bridge the gap between a prominent model being worked towards in business and academia, and the uptake and acceptance of a new way of consuming by the public. Through the board game Circul8 we hope to develop something engaging and timely that can help audiences understand the importance of the circular economy in the fight against climate change.

The next steps for Circul8 is to be play tested with a wide variety of demographics; refining the rules and gameplay to make it accessible and enjoyable for a general audience. The authors would like to see the game printed, played and enjoyed by others, this will involve online promotion through game communities and general social media. One of the authors is looking to incorporate Circul8 into their PhD thesis, though inviting interview subjects to participate in a game with their colleagues and supply written feedback on the messages and gameplay. As the game is a microcosm of one part of the circular economy system it will be important for the authors to receive feedback from experts working within the field. This will allow the authors to assess how useful the game will be to explain circular economy concepts to a general audience.

Lastly, this paper makes a contribution to the fields of design for the circular economy, specifically design for public engagement in the circular economy, and provides another valuable example of the use of serious board games for public education. It positions Circul8 within a developing field of serious board games that focus on sustainability, and the smaller area of circular economy board games. Drawing particular attention to the importance of board games as affordable tools, their ease of creation or modification, and how they can be disseminated openly. By focusing on the circular economy as an underlying concept we have positioned the paper at an important cross-section of research: design, game theory, and sustainability.

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