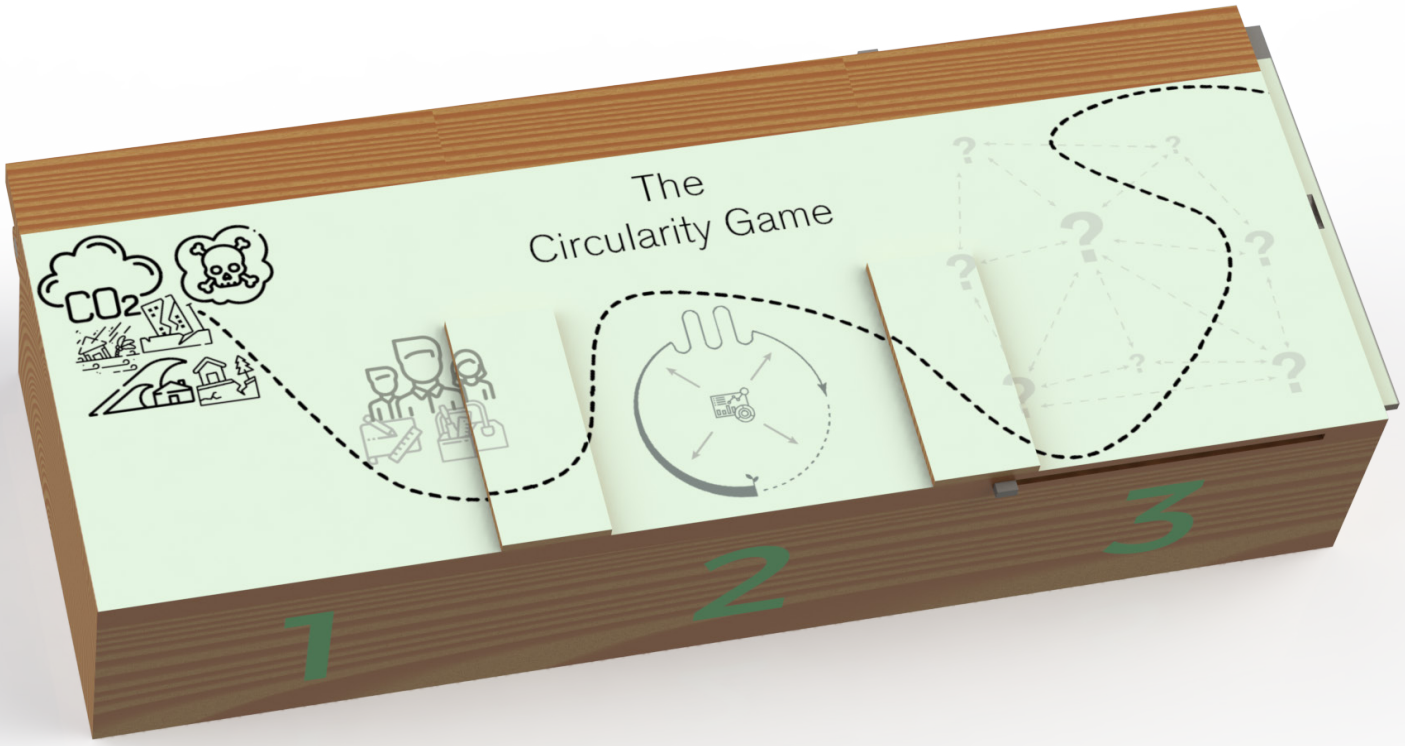
The Circularity Game

Improving the Circularity Deck through gamification



Master thesis
by

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Summary

At the basis of the Circularity game is the Circularity deck (Konietzko, Bocken, & Hultink, 2020), it helps teams innovate for the Circular economy on various perspective levels and provides the users with a better understanding of the Circular economy and how they can innovate for it. They also gain a valid (set of) idea(s) , which they can start using already.

The goal with the Circularity game was to improve the Circularity Deck, through gamification, in such a way that it...
...stimulates creativity, multidisciplinary cooperation and innovation more;
...motivates its users to engage more with it, driving enthusiasm and use;
...is an easily accessible, stand-alone, ready to use product.

From a project perspective, the value lies in showing that gamification is a worthwhile approach to reaching these goals and that further research and design in this direction is warranted.

The project started with understanding the theory behind creativity and gamification. Taking the understanding of this and combining it into one theoretical construct that could be used in the design.

The next step in the project was to better understand what the Circularity game should be. To know this, the various methods and tools were evaluated and chosen (most notably Octalysis) and an understanding of the intended user needs was created. The original deck was analyzed on a functional level and the goals for it, from the creators' perspective, were established.

What followed was creating a functional design filling the gaps of the original and laying the basic framework of what the new design should be. It took into account the various goals of the creators and the needs of the users in conjunction with the tools that Octalysis provided, specifically the core drives and the amount they needed to be applied in the design. This resulted in a 'skeleton' of requirements that could be filled with the right amount of ideas, fitting the established requirements.
Next up was filling this 'skeleton' with the needed 'meat'. This was done through various ideation methods, creating solutions for the problems provided by the framework. Which solutions to use and which to exclude was based on the established understanding at that point.
To avoid a 'Frankenstein's monster', the design included an envisioning of how it would be used and interacted with by the users. This helped to shape the Circularity game into a coherent, well working and pleasant experience.

Near the end of the project, a working prototype of the new Circularity game was made and tested in a small student group, the results of this can be found near the end of the report.

The report ends with conclusions and reflections on the design and provides recommendations for further research and development. The main conclusion is that the gamification seems to be working and that further development in this direction seems a worthwhile endeavor for the Circularity deck or game. However, the conducted test was very limited and can only be seen as a positive early indicator of the value of gamification.

Glossary

Circularity deck = the original set of cards and workshop
Circularity game = the redesigned, gamified, interactive Circularity deck and everything surrounding it
The prototype = the usable version of the Circularity game, used for testing

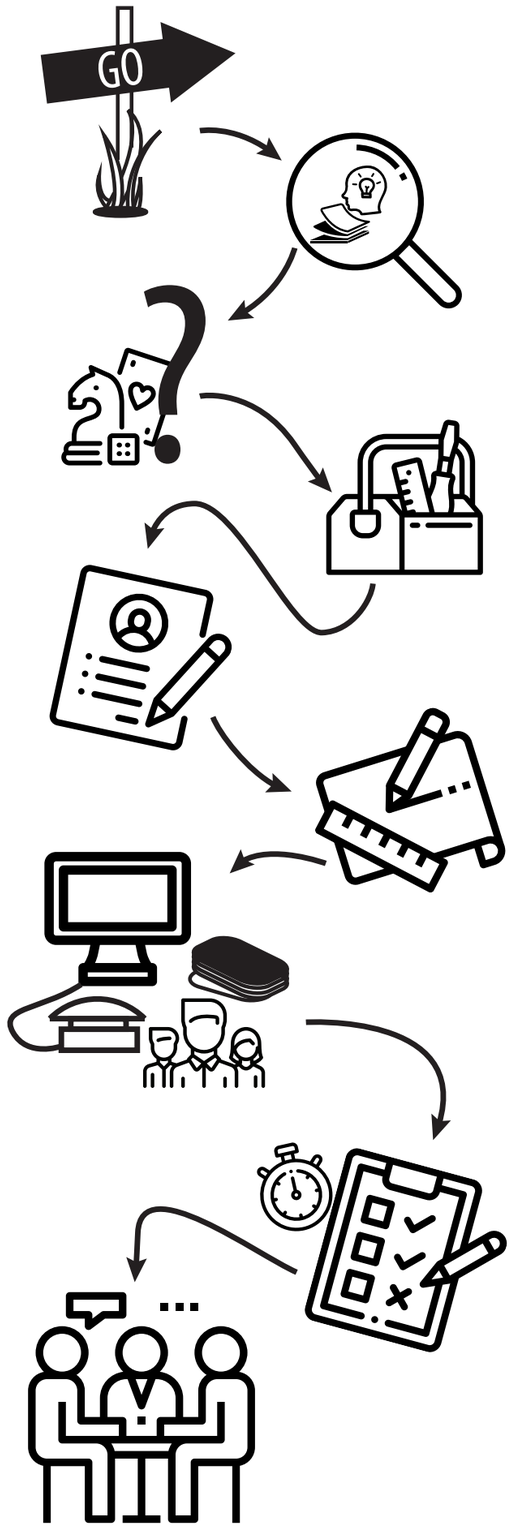

Fig. 0: General project flow represented in icons. Various elements have been repeated between chapters. (Various elements used from: Flaticon stock images, 2019)

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Front page image
The Circularity game toolbox prototype.

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Introduction

1. Introduction

Reader's guide

The term "Gamification" is generally used and understood as "Gameful design" in this report, as discussed in chapter five. These words are interchangeable in this report, unless indicated otherwise.

This report should be accompanied by a digital part of the prototype (a software program). It is an essential part of the design, which was not feasible to represent in a printable format.

Chapter 1, the introduction gives, an overview of the project; Where it came from, how it evolved and what it eventually became. Chapters 2 to 4 lay the foundation for the design. Chapters 5 and 6 show the design and development of the Circularity game. Lastly, chapter 7 & 8 are about the testing of the prototype and evaluating the results.

Project brief

Project origin

This graduation project is an extension to the original Circularity Deck (Konietzko, Bocken, & Hultink, 2020), which was still in development during most of this project. The original plan was to do a project on the subject of Circular economy & design, which allowed for an approach from a strategic design point of view. After meeting up with Konietzko and discussing the Circularity Deck and what the options with it were, this turned out to be feasible. Additionally, the fact that the Circularity Deck is a card deck and thus a game, introduced the idea of making more use of gamification. This lead to the original project brief (appendix 1) which was approved by J. Konietzko (graduation project mentor), E.J. Hultink (graduation project chair) and the board of examiners (appendix 2).

Development of the brief

Although the original project brief (appendix 1) was the starting point of this project, it has not stayed the same. During the midterm evaluation it came to light that the original assignment would be too much from that point forward and was redefined as follows:

- Make the gamification the main focus of the project.
- Make the 'ecosystems lens part' a supporting secondary part of the project, as to not waste the work spent on it, but also not make it be too much work for the time left.

The full reasoning for this is discussed in the introduction to chapter 5 of this report. Effectively this meant that the functional design that was there would be the basis on which the gamification would be applied and the assignment would become as follows:
"Redesign the Circularity deck to improve its use of gamification, help its users to understand their product ecosystem better & stimulate multidisciplinary cooperation and innovation. Research into these subjects and a user test of the redesign will be employed to this end."

This also meant that the parts of the problem definition on which to focus, changed. Problem definition part four would become the main problem to solve, part three would still tie into this fairly well and part two would be mostly out of scope. (Part one of the problem definition shown in the original brief was never part of the project.)
The original problem definition can also be found in the project brief (appendix 1), but a rewritten version is given here. This version is based on a better understanding of the original deck and is more fitting to the project and results of the Circularity game. The numbering in this newer definition still refers to the same numbering of the original version.

Note: Normally, these developments would have been left out. However, they heavily influenced the work and results of the first half of the project and influenced some design aspects of the end result. They are therefore relevant for the reader to know and take into consideration while reading this report.

Problem definition

The Circularity deck...
1) (Part of the original problem definition, left out of this project)
...;
2) (Mostly out of scope)
... shows multiple aspects that can be part of a Circular ecosystem, but the cards itself do not seem to be helping the users to gain insight in their specific ecosystem and its extent, as much as they may be able to;
3) (Ties into 4)
...seems to have limited ways of stimulating multidisciplinary cooperation and innovation;
4) (Main focus after midterm)
... uses gamification in a way that seems to be more a byproduct of its chosen form than a dedicated gamification approach. This possibly has led to diminished and/or even less desirable results. Developing this further might help it work even better than it already is and reach a higher creativity stimulating potential as well.

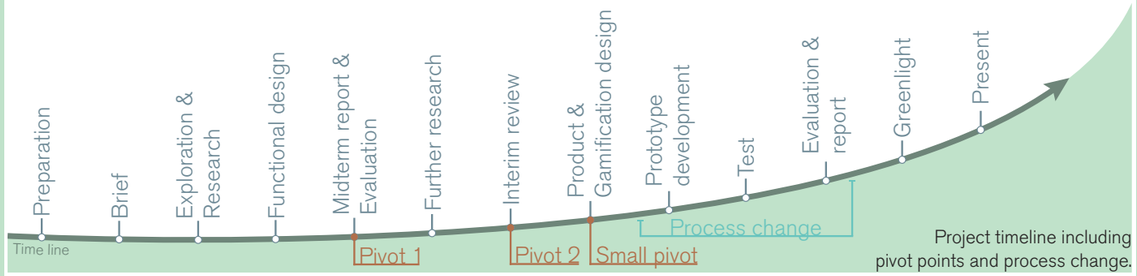


Fig. 1: Project time line including pivot points and process change.

The project time line (fig. 1) shows what was changed at what point.
Pivot 1: Focus shift towards gamification, narrowing the scope of the project and keeping it feasible. (See also chapter 5)

Pivot 2 & process change: During the interim review, in which the work up to that point was presented and discussed, it became clear that the time left was too little to do multiple tests. Especially tests with companies would potentially delay the project by weeks, maybe even months. To avoid this, the decision was made to focus on doing one test with students and judge if that would be enough. Feasibility was the driving reason behind this decision. This also meant that the original plan of three iteration cycles would not come to be. One adequate test to support the design was preferred over delays and rushed iteration cycles.

Small pivot: The original design up to this point entailed five phases in the product with five corresponding segments in the toolbox. During the design it became clear that this could be brought down to three phases and three segments in the toolbox. This removed redundancies and decreased complexity for the users. (see also chapter 6 section Toolbox design)

Goals, purpose & value

In the end, the goal of this redesign project became:
To improve the Circularity Deck, through gamification, in such a way that it stimulates creativity, multidisciplinary cooperation and innovation.
It should be well suited for design and project teams that want to brainstorm towards a more circular design & be introduced to Circular economy.

The purpose of this is to make Circular design more easily accessible and enjoyable. Often, being creative is considered to be hard to do and Circular design can be a difficult and tiresome endeavor. Gamification can be the key to make it feel as enjoyable and easy as playing a game, yet yield the quality output of creative ideas, expected of professional multidisciplinary circular innovation design teams.

The basic value gained from an improved Circularity deck for the companies is using the deck itself. They can create new innovations leading to profit and it can help them with future proofing themselves with regards to environment related rules, regulations and developments. However, the value to be gained in this is not only for the teams using it. Besides them being able to innovate for a Circular economy it also is beneficial for the environment and society. When done correctly, Circular design is at least close to neutral for the environment and potentially beneficial. Additionally, the solutions are often beneficial for whole ecosystems and all people involved in it. It is not one company making more profit, but a chain of companies, consumers and services working together, all benefiting from the same (chain of) innovation(s).

Making Circular design easier, more enjoyable and more accessible will hopefully result in more companies using it and harming the environment less and creating more benefits for their ecosystems, benefiting everyone. Simply put, more use of the Circularity deck has a positive impact on “The three P’s”: People, Planet, Profit. Gamification of the Circularity deck leads to more use of Circular design, which in turn leads to a more sustainable future.

The aim of this project as a whole is to show that there is value to be gained by employing gamification in these kinds of designs. Especially when user creativity, engagement and motivation are to be stimulated, as well as helping people from different backgrounds work together.

Theoretical background

2. Theoretical background

The first part of this chapter explores creativity and how it works. It explains the concept of everyday creativity and provides a framework that can be used in the redesign of the Circularity deck. The second part is about gamification theories and their value for the redesign. Lastly this chapter attempts to create a combined understanding of creativity in relation to gamification, because the goal of this project is to use gamification to improve a creative method: the Circularity deck.
Between the parts on everyday creativity and gamification is a short section on ecosystems lens & systemic systems design. This is a left-over from before the first pivot and is kept as short as possible. However, it is still needed to clarify what the initial functional design is based on, because this functional design is the basis for the later Circularity game.

Creativity theory: Everyday creativity

Creativity, what it is and how it works, has not yet been fully understood and defined and much of it is still being debated. Nonetheless, Sanders and Stappers (2012) present an understanding of it in their book, Convivial Toolbox, that is suitable for "generative research for the front end of design" (subtitle of the book). Since the Circularity deck will be a generative design tool, with similarities to generative research methods and will be focused on the front end of design, it is logical to start from the same understanding of creativity. Added to that is the fact that the Circularity deck is meant for 'creative' and 'non-creative' people to be used and the type of creativity described is attainable by anyone when guided properly, making it appropriate for the Circularity deck.

Sanders and Stappers (2020, p. 38) use the broad definition of creativity by Koestler (1964) that "... ,every creative act involves bisociation, a process that brings together and combines previously unrelated ideas." They then expand this understanding of creativity with the work of Boden (2004), who makes the distinction between H-creativity and P-creativity. She defines it as follows: "P-creative is Psychologically Creative, where someone borrows an idea from one domain and applies it to another. This type of creativity is not so unique, and it applies to everyone." Sanders and Stappers (2012, p. 38) call this P-creativity "everyday creativity" and present a framework for it based on their earlier work (fig. 2).
These four levels of creativity are present in, and obtainable by, everyone at any moment and are dependent on someone's experience with a subject. Therefore anyone can reach higher levels of creativity in a subject as long as they are motivated for it. This means that everyone has different levels of creativity in them for different subjects and that this mix is different from person to person. Higher levels may only be reached for things like hobbies or anything else a person has a lot of passion for. (Sanders & Stappers, 2012)

	LEVEL	MOTIVATED BY	PURPOSE	EXAMPLE
1	doing	productivity	"getting something done"	organizing my herbs and spices
2	adapting	appropriation	"making things my own" or "make it fit better"	embellishing a ready-made meal
3	making	asserting my ability or skill	"make with my own hands"	cooking with a recipe
4	creating	curiosity	"express my ability"	dreaming up a new dish

Fig. 2: The everyday creativity framework. Adapted from: (Sanders & Stappers, 2012 p. 39).
Original description: "Four levels of everyday creativity are observed when talking with people about their needs and dreams for living." (Sanders & Stappers, 2012 p. 39).

Sanders and Stappers (2012) conclude that to get people on different levels of creativity to express their creativity, different experiences and kinds of support should be provided. It is best to: lead people on the doing level, guide people at the adapting level, provide needs serving and supporting scaffolds for people on the making level & give a clean slate for people on the creating level.
The result of this is: the lower level someone is on, for a certain domain, the more time and effort it takes to get them to express themselves creatively.

They end the first section with these four principles for facilitating everyday creativity:

> "All people are creative.
> All people have dreams.
> People will fill in what is unseen and unsaid based on their own experience and imagination.
> People project their needs onto ambiguous stimuli because they are driven to make meaning." (Sanders & Stappers, 2012, p. 41)

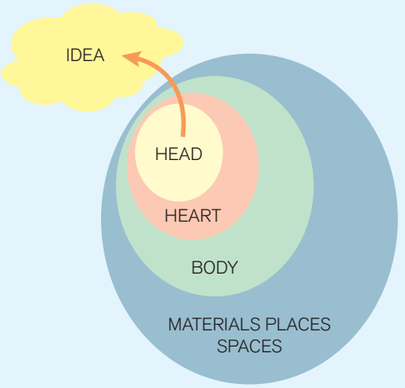
The takeaway from this, for the Circularity deck, is that it should try to use these four principles to its advantage and get its users to grow quickly through the creativity levels while providing them with what they need at every step. The Circularity deck should be doing for the users what the designer usually does for the participants in a generative research session.

Framework for individual creativity

The theory of the framework for individual creativity (fig. 3)(Sanders & Stappers, 2012) is that ideas not only come from the head (mind), but the creation of them is also happening in or through the other layers: heart (emotion), body (activity and motion) and materials places spaces (environment and existing things around us). All four layers influence idea making and creativity and all can be used in stimulating the creation of new ideas. How this can be done is explained in short, next.

Head

According to Sanders and Stappers (2012), ideas can be seen as a group of associations: things that are related to each other in the mind of a person. Combining this with ambiguity, which is part of (almost) all ideas, can lead to new associations and development of ideas.
People also tend to want to 'fill in the blanks' according to the ideas they have. Providing blanks to be filled in can create very insightful and useful information.
Creating new ideas often involves making new connections between previously unrelated ideas. Two ways of doing this are bisociation and metaphor. Bisociation is bringing two (unrelated) concepts together (planes of thought) and seeing what new ideas are sparked where the concepts intersect/combine (Koestler, 1964)(fig. 4).



Figure#2.2: A framework for individual creativity

Fig. 3: Framework for individual creativity (Sanders & Stappers, 2012, p.40).

Figure#2.9: Koestler explained bisociation as a new idea emerging from the spark as two concepts (each represented by a line in a plane) are brought together (picture after Koestler, 1964).

Fig. 4: Koestler's planes of thought coming together and sparking ideas visualized (Sanders & Stappers, 2012, p.46).

Heart

In short: positive emotions are good for creativity; stimulate them. They increase the amount of ideas available for association and bisociation, they increase the breadth of ideas that are relevant to the problem and they increase cognitive flexibility.
The heart part of the framework also shows that in general, people are better at thinking of and thinking about people and stories, as opposed to abstract things and concepts. This means that problem solving, and thus (everyday) creativity (the kind used in problem solving), is easier when it is about a narrative. (Sanders & Stappers, 2012)

Body

The head and heart are moving through time and space in the body. The body is that through which the head and heart experience everything. This influences the ideas that are formed. This can be used actively through things like (re-)enacting, pretending and acting, but also by going somewhere to see and feel. Key is to experience, because to experience is to grow the group of associations of an idea.
Most of this is from the perspective of (consumer) product design, which has its place in the use of the redesigned Circularity deck. But it is less directly applicable to business model innovation. However, the fact remains that experience grows ideas, so exposure to the relevant real world parts of a problem to be solved can help with generating new ideas. For instance: visiting the production facility of your company or the office of a business partner can improve experience. (Sanders & Stappers, 2012)

Next to the material (space) side of body, there is also the time side. Creativity is not instant, it happens over time. Graham Wallas has already theorized about this in 1926 in his book The art of thought (Wallas, 1926).
Sanders and Stappers (2012, p. 50):

> "He [Wallas] identified five stages in the process:
> Preparation (preparatory work that focuses the individual's mind on the problem),
> Incubation (where the problem is internalized into the unconscious mind and nothing appears externally to be happening),
> Intimation (the creative person gets a "feeling" that a solution is on its way),
> Illumination (where the creative idea bursts forth into conscious awareness) and
> Verification (where the idea is consciously verified, elaborated, and then applied)."

This first part of this process can be used through priming, spreading activation and sensitizing. Priming is the phenomenon that it is easier to remember something if you are exposed to related information beforehand. It is thought that the primed information spreads through the mind and activates the networks of associations, it happens automatically and is based on implicit memory events. This can be used to better prepare people for creative sessions by making sure the right kind of information is primed and activated beforehand.

One way to do this, is by sensitizing. This means that a person joining a creative session is tasked with involving themselves with the problem. This is often done through small daily tasks (like keeping a diary about the problem) for a week or two. This makes them more sensitive to the subject matter, primes ideas and activates association networks in their mind. (Sanders & Stappers, 2012)

Materials-places-spaces

Creativity benefits from having multiple choices of variable places to explore in/from. It also benefits from having varied and ambiguous materials available to express ideas with and explore them. Examples can be found in the Convivial toolbox. (Sanders & Stappers, 2012, p. 56-57)

Takeaways

All four elements of the framework can and should be used in the Circularity game to make it a more effective ideation tool.
Head: use the way we think and present methods that stimulate ambiguity, leave blanks to be filled in, ask to bisociate and use metaphors.
Heart: stimulate positive emotions and use (social) narrative methods.
Body: activities and experiences help with stimulating creativity, especially when used in conjunction with priming and sensitizing, to make use of the 5 stages process of idea forming. The trick is to do this for the right association networks.
Materials-places-spaces: provide choice, variable places to explore and varied and ambiguous materials for expression and exploration.

Sanders and Stappers (2012, p. 58) end their chapter about creativity with a part on "Social or collective creativity". The key takeaway from this is that variety in mostly everything is good:
In people: their backgrounds, experiences, ways of thinking (left & right brain) and ways of solving problems (thinking first, seeing first, doing first;
In reasoning: Deductive, Inductive and Abductive reasoning

For the Circularity game this means that having a multidisciplinary team to work with will increase its success rate.

Chapter 6 and appendix 6 show and discuss the application of these theories in the design.

Ecosystems lens & systemic systems design

Originally "...help its users to understand their product ecosystem better..." was part of the assignment. Halfway through the project it became clear that a choice had to be made to either focus on gamification or on ecosystems to keep the project focused, feasible and valuable. The choice fell on gamification and ecosystems became a minor point.
However, some research and design had already been done and would be influencing the remainder of the project. The main influence it had in the end was the believe that a Circular design method should have a more holistic and systemic approach. This is also in line with the work of Konietzko et al. (2020). Creating a circular product idea is not enough, to make it a reality the whole ecosystem should be considered and involved. The ecosystem lens was the theoretical approach to this (Adner, 2006, 2017). To be able to do this, a systemic approach to systems would be needed (Sellers, 2015).
The first functional redesign was based on these theories and accommodated for this ecosystems approach. The final redesign used some elements of this older functional redesign. Namely the first phases up till and including the Focal Circular Value Proposition & accommodating for an ecosystems lens phase. No further work on these has been done, so they are nothing more than that: accommodations in the gamified design to allow for a follow-up phase which tackles the issues of using an ecosystems lens approach.

Gamification: definition

Deterding, Dixon, Khaled and Nacke (2011, p. 13) define gamification as: "The use of design elements characteristic for games in non-game context." They rename it to gameful design for clarity and introduce the four categories as shown in fig. 6.

They make the distinction between gaming and playing based on their understanding that play is the broader category which contains games and that the distinction can be traced back to Caillois' (2001) concept of paidia and ludus. Paidia (playing) is a more free-form, expressive, improvisational recombination of behaviors and meanings. Ludus (gaming) is playing which is structured, follows rules and has a more competitive approach.
The distinction between whole and parts is based on using elements from a concept (parts) outside of the boundaries of that concept, instead of using the concept completely in and of itself (whole).

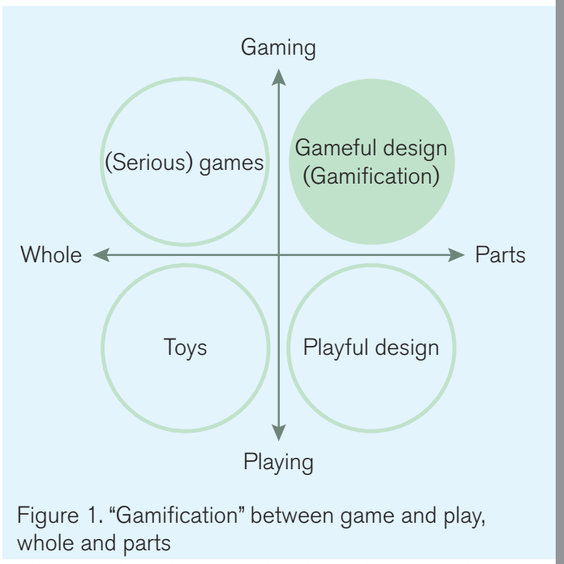


Figure 1. "Gamification" between game and play, whole and parts

Fig. 6: The 4 categories in which gamification fits according to Deterding, Dixon, Khaled and Nacke (2011, p. 13).

All four types can be used to serve different design goals. For example:
- A toy can be deemed to serve the ultimate goal of 'having fun' (paidia, to make the player have fun);
- Playful design can be used to incorporate more fun in a design which does not have fun as its main goal (paidia as a desired characteristic and/or added value to the design to improve it for the user);
- Games usually serve the goal of simulating and/or experiencing a situation or narrative (ludus, to make the gamer part of something that he/she otherwise would not be part of in reality. For instance, playing a shooter/war story game gives the gamer the chance to experience the story or see who is the better shooter, without the downsides of the real life version);
- Gameful design is a way of incorporating narrative and/or experiential elements to be simulated/experienced in something with another design goal, again, to make the user part of something that he/she otherwise would not be part of in reality (ludus as a desired characteristic and/or added value to the design to improve it for the user).

It should be noted that paidia and ludus are two parts of play activities in Cailois' concept. Paidia/playing brings more than just fun, it brings the whole range of characteristics ascribed to it earlier. The same is true for ludus/gaming. That is why they can be used in various ways to create added values to designs, among which 'having fun' and 'experiencing something' are examples of added value.

Gamification: Theories

When it comes to gamification, multiple authors (Deterding, 2012, 2014; Nicholson, 2015; Groh, 2012; Sailer, Hense, Mayr,& Mandl, 2017) seem to agree that behavioral change, in the long term, is the goal. To reach that goal, they all point to using intrinsic motivations and the same theory: self determination theory by Deci and Ryan (2004). They state that human behavior is motivated by three basic, intrinsic, human needs:

1: Competence – The feeling of being good enough at something to make a difference. If one can not make a difference anymore, he/she wants to try to become better and be able to make a difference again.
2: Autonomy – The ability to make your own choices and the feeling that they fit who you are. A lack of this can be demotivating.
3: Relatedness – The feeling of connecting with other people through your and their behavior.

This is why people are motivated to play games: They grow[1] in a story to explore[2], in their own way[1&2] according to their own decisions[1], together with other people[3]. (Nicholson, 2015)

However, this focus comes mainly from the application of gamification to change real world personal behavior, like: living healthier, purchasing more sustainable products, reaching higher productivity levels, etc. The ideal would be that after a while, the game can be completely removed and the improved behavior remains.
For short term changes, like motivating to buy something now or clear your own table at a snack bar after eating, Nicholson (2015) argues that there is a place for gamification as well. But, here it is often more reward based. When the game is removed, people revert to their old behavior.

Presented like this, it seems that reward based is only for short term change and that self determination theory based gamification is only for long term change. (In all fairness, it has to be said that Nicholson (2015) sees a role for reward based gamification in the short term 'onboarding' at the the early stages of a long term change gamification project.) This way passes up on the fact that Badges, Leader boards, Achievements & Points based gamification is reward based gamification. And, that these elements can be used to satisfy the competence and relatedness needs; For example: Points reward being competent and points on a leader board show how you are related to others (a.k.a. competition). Combining this with team play and giving every person a different role and identity to fill as they see fit creates even more relatedness and autonomy as well (Sailer, Hense, Mayr, & Mandl, 2017). This can all still be done in a short term behavior setting like, for instance, a project team brainstorming for new project solutions. In theory this would achieve a more satisfying and engaging experience, regardless of a long or short term focus.

From this perspective the Circularity deck is mainly a short term behavior change method. It is a workshop like setting that needs some familiarity with the theories of Circular Design and originally the ecosystems lens, it needs to generate new ideas, create an overview of the relevant ecosystem and come up with the beginning of a strategy to realize the new ideas. A short term gamification design should therefore be fine. (Based on the project goals of the original brief, before the pivot.)
However, the Circularity deck is a way into the circular economy for teams and companies, ideally eventually helping them find their way in the Circular economy on their own. In the end they may completely move away from the Circularity deck to work in a way that fits them best, while taking the newly gained skills of circular design and ecosystems lens approach with them.
Therefore, it is both a short term tool to be used repeatedly and a gateway into the long term change of the practice of circular design and using the ecosystems lens.

More specifically this means that the parts of the deck that teach the knowledge and use of the theory should be gamified for the long(er) term and the parts that guide the practice may also be short term gamified. Both parts will benefit from the use of the self determination theory, and any gamification design choice should work towards at least one of the three basic human needs.

Combining creativity theory & gamification

Villegas, Labrador, Fonseca, Fernández-Guinea, and Moreira (2019) made a comparison between methods using the philosophy of user experience and methods using gamification in the field of participatory design. One of the conclusions they came to is that both can be used to enhance the emotions and creativity of the users, which resulted in it being possible to create designs that are based on the needs and desires of the participants. This is proof and motivation to use gamification in other tools, like the Circularity deck which in a sense is already using participatory design*. Tools like the Circularity deck are meant for ideation and thus will benefit from this enhanced creativity and emotions in the users.
Kumar (2015) (the Head of Strategic Design Services, America in SAP's Design and Co-Innovation Center), states in her TEDx talk that: "gamification is a mindset'' and that "it's a way to stimulate desired behavior''. Creativity in this case. She also adds that empathy and cooperation are required for successful creativity. But perhaps most importantly she states, when talking about clients joining their creative idea generation sessions: "The most skeptical are at their creative best when they give themselves permission to play.''

Both she (Kumar, 2015) and Villegas et al. (2019) point towards the facts that for creativity, things like emotions, empathy and play are important and that gamification is a way to stimulate emotional, empathic and playful behavior.

Important to note is that both sources do not seem to make the distinction between playfulness and gamefulness like Deterding et al. (2011) do, and therefore should be understood as seeing playfulness and gamefulness as one or the same thing under the term gamification.

*The Circularity deck does not use participatory design in the sense that the users of the new product are included in the process. (Although, this could be done with it as well.) However, the different stakeholders (or representatives from the identified parts) in the ecosystem are meant to be partaking in the ideation parts of the process, since they are the experts on their part of the ecosystem. So it is not participatory design on a product design level, but on an ecosystem design level. Alternatively, when the Circularity deck is used to innovate (parts of) the company itself, for instance a business model or production method, then it is participatory design. The team members are themselves part of the company and thus the users of their own innovations.

Combining the theoretical background

As stated, the creation of new ideas (the act of creativity) happens in and through four places: Head, heart, body & materials-places-spaces. Gamification can be a powerful tool to unlock the potential of all these places, but that leaves a question to be answered based on Deterding et al. (2011) their theory: Gamefulness vs. playfulness, what is the best approach for stimulating creativity?

Gamefulness seems to be a good choice for creating a narrative, something that helps with guiding participants to engage with the body and materials-places-spaces part and it also engages with the heart. Gamefulness, through its more defined nature, can also help with the development of relatedness in groups of people engaging in creative activities (for instance through a common language), something that might be necessary when the groups are diverse. Diversity is often a desired trait of a group for reaching the maximum potential for generated ideas.
However, playfulness seems to be more suited for engaging with the head and heart(/emotions). It leaves blanks to be filled in, it has more ambiguity. It is more free-form and less rule bound. Playfulness seems to be more tuned towards the individual parts of creativity, the inside of a person. Gamefulness seems to be working more with what is happening on the outside, in the social and physical spaces. Since creativity is best stimulated through all these places, a combination seems to be the better option.

A different perspective on the matter presents itself when looking at gamefulness and playfulness (Deterding et al., 2011), compared to the different levels of everyday creativity (Sanders & Stappers, 2012) and how to help the different participants at the different levels. The trend is that the higher level of creativity someone is on, the less help and the more freedom they need to show creative behavior on the specific subject.
Inherent to gameful are the rules, structure and set goals; they lead and guide. Playful is more of a blank canvas, anything can happen and anything that exists can become something new through recombining and adding. This shows that on the lower levels (doing and adapting) gamefulness is the right way to go, on the highest level (creating) playfulness is better. This leaves the level of making, and its need for so called scaffolds, somewhere in between. It is more transitional. It is where the leading and structuring of the game is slowly left behind and the workspace becomes emptier (blank). Scaffolding is a good metaphor for this transition. Scaffolds in construction are many at the start, but the further along in the build you get, the more a building can stand on its own and the less scaffolds are needed. An overview of this theoretical structure can be seen in table 1.

This transitional quality is what the Circularity deck should have. It needs gamefulness to help those at the lower levels of creativity. But it should quickly help the participants to grow out of the scaffolds and into the realm of the blank canvas and the creation of new ideas. But, during this transition, it should help the participants to keep the ability to engage with heart, body and materials, which gamefulness provided. Also, since it is a tool for social creativity the scaffolds of relatedness (again, for instance a common language) should remain and become a natural part of the group dynamics.

In short, the Circularity deck should be a tool for growing a design team to the creating level of creativity in circular design. It should do this through gamefulness and playfulness both as methods and as phases of the creative process.

						Prevalance of individual creativity framework elements			
Level of everyday creativity		Motivated by	Explanation	Best support	Most suitable design	Materials places spaces	Body	Heart	Head
1	Doing	Productivity	"Using existing idea 1"	Leading	Gamefulness	Prevalent	Prevalent	Absent	Absent
2	Adapting	Appropriation	"Adapting existing idea 1 with existing idea 2, to be better fitting to me"	Guiding	Gamefulness	Prevalent	Prevalent	Prevalent	Absent
3	Making	Asserting my ability or skill	"Making existing idea 1 into reality with my own capabilities"	Scaffolding	Gamefulness ↓ Playfulness	Declining	Prevalent	Prevalent	Increasing
4	Creating	Curiosity	"Creating new, priorly not existing, idea 3 through my own abilities"	Providing 'blank canvas'	Playfulness	To a lesser extent	To a lesser extent	Prevalent	Prevalent

Table 1: Combined theories structure and relations.

Methods & tools

3. Methods & tools

Overview

The general design process was mostly linear. Going from background literature and theory, into functional design, through an ideation phase, a solutions choice, into detailing and lastly a prototyping, testing & evaluation phase (See also figure 1).
The most important method used is Octalysis. This method was guiding during the ideation. It provided the boundaries in which to ideate, what to look for and the general solutions & goals to be considered and achieved. The core drives of Octalysis were the basis for this (see also the Octalysis method description below). However, before discussing Octalysis, the reasons for choosing it are explained here first. This starts with RECIPE, the framework that Nicholson (2015) developed based on his understanding of the aforementioned gamification theories in the previous chapter.

Gamification methods: RECIPE

To be able to use his theory in a practical manner Nicholson (2015) presents his framework for meaningful gamification (the long term type described earlier): RECIPE. RECIPE is an acronym for: Reflection, Engagement, Choice, Information, Play & Exposition. These six elements can be used to come to meaningful gamification designs. This is what they stand for:

“

Play—facilitating the freedom to explore and fail within boundaries.
Exposition—creating stories for participants that are integrated with the real-world setting and allowing them to create their own.
Choice—developing systems that put the power in the hands of the participants.
Information—using game design and game display concepts to allow participants to learn more about the real-world context.
Engagement—encouraging participants to discover and learn from others interested in the real-world setting.
Reflection—assisting participants in finding other interests and past experiences that can deepen engagement and learning.

”

(Nicholson, 2015, p. 5)

But, before using the RECIPE framework, the priority should first be to identify the players and understand what they want to get out of it. By going for a player-focused gamification system you make sure that people are engaged because they intrinsically want to be, and not because they get some short-term rewards. Bartle’s (1996) framework for gamer psychology can help with understanding the different types of players better.
Although all of this is, again, more applicable to long term behavior change and less applicable to a workshop method, it is still relevant for the Circularity deck. Not only because the Circularity deck has a long term teaching part, but also because a big part of the Circularity deck is to get people enthusiastic and engaged, for this will benefit their productivity and creativity while using the deck. They will only be enthusiastic and engaged when the gamified Circularity deck is something they personally want to play.

Gamification methods: Bartle’s framework for gamer psychology, Marczewski’s Gamification Design Framework & Chou’s Octalysis

Bartle’s (1996) framework for gamer psychology identifies 4 types of players based on 2 axes of player preference as shown in fig. 7.

Player types: Killers, Achievers, Socialisers & Explorers.
Axes: Acting-Interacting & Players-World.

Acting = to act on or do things to ‘objects’
Interacting = to have actions and/or exchanges with other ‘objects’
Players = the other players are the focus ‘objects’
World = the world and/or things of the world are the focus ‘objects’

These four types of players can also be linked to the three basic human needs of the self determination theory. Every player type responds positively to different needs satisfaction (Nicholson, 2015), as shown in fig. 7.

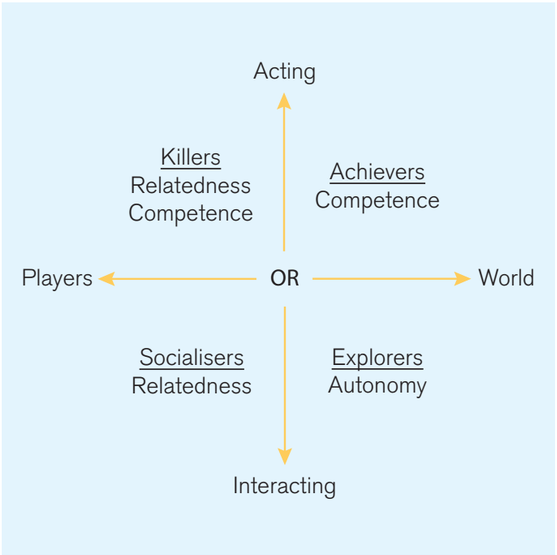


Fig. 7: Framework for gamer psychology (Bartle, 1996, p. 7), with added basic human needs of the self determination theory..

The combination of Bartle’s (1996) and Nicholson’s (2015) work seems a good starting point, however, Nicholson (2015) did not take into account Bartle’s (2003) continued work. In that work, he recognizes the relevance of the difference between implicit and explicit action (taking action without or with forethought) and adds it as a third axis (fig. 8). Adding more to the player types and the understanding of their actions, providing more for the self determination theory to be applied to. Based on these theories, Marczewski (2017) developed and launched a gamification method:
Gamification Design Framework Toolkit. The same goes for Chou (n.d.a, n.d.b, 2019), who developed a different gamification method: Octalysis.

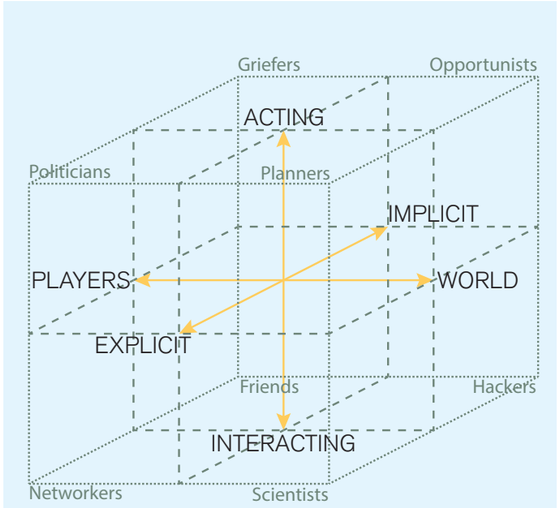


Fig. 8: Framework for gamer psychology (Bartle, 2003).

Chou uses Marczewski’s work on user types in his own method as well as the work of all other mentioned authors including the work of Nicholson (2015) and thus seems the most complete. Especially since Marczewski’s (2017) work is also more directly based on the self determination theory (Tondello et al., 2016), adding to its value and consequently adding to the value of Octalysis as the most complete method and framework. Octalysis is therefore the framework of choice, to be used to design the Circularity game.

The Circularity game is a tool that should be usable in many different contexts and settings, so it may be a good idea to cater to all these types of players, because it is very unlikely that only a specific subset of these players will use the game. How to cater to all these types of players has yet to be determined. Two possible options are: one way of play that has something for every player type, or, multiple ways of play for different sets of players.

Method & tools descriptions

Workshop; early user test, formatted the same as Konietzko et al.'s (2020) tests
To gain insight in how the original Circularity deck worked in practice, a workshop was held with a group of students. This was done in the same way as Konietzko's previous workshops (Konietzko et al., 2020), using the same materials.
It starts with a presentation of the theory needed and then follows the instructions given by the Circularity deck. After the required rounds of ideation, multiple 'best idea' pitches are done by the participant groups and together they choose their best idea.
Afterwards a short questionnaire is given to the participants to measure their experience with the Circularity Deck (appendix 5a)

Function analysis, process tree, How to's & Morphological chart
These methods can be found in the Delft Design Guide (Van Boeijen, Daalhuizen, Zijlstra, & Van der Schoor, 2013). They are considered basic design tools and methods and will not be further explained here.

Octalysis
In his book Actionable Gamification - Beyond Points, Badges, and Leaderboards (Chou, 2019) Yu-Kai Chou presents his gamification framework: Octalysis. It is a gamification framework in the shape of an octagon. Every side of this octagon represents 1 of 8 core drives. These drives are the real forces motivating people into action and should be that which is behind the gamified design elements of a product. These gamified design elements are what the user is using and experiencing in practice. These gamified design elements are put in the product's design by the designer, to motivate people to undertake the desired actions.
Put differently: The goal of gamification is to motivate people, through gamified design, towards certain actions. Octalysis is a framework that helps the designer understand these core drives and how and when to apply them in his design in the form of gamified design elements, to drive the users to the desired actions. The framework, its core drives and some examples of gamified design elements can be found in fig. 9 (Chou, n.d.-a).

Octalysis is a method based on 10 years of field experience in gamification, but, as the book shows it is very well aligned with many existing (academic) theories on gamification.

For the design of the Circularity deck, the framework itself was used and what is called the "Octalysis dashboard" (Chou, n.d.-b). This dashboard is a working document which helps the designer go through crucial elements like:

1. Determining the business metrics: the measurable elements of success for the company;
2. Determining desired actions: the actions the user needs to undertake to successfully use the product and fulfill (un)knowingly the business metrics;
3. Determining the win-states: the various moments at which the user experiences a sense of success or winning;
4. Aligning the above elements in such a way that they are all achieved and supporting each other. On a time-line this means that the desired action should happen and a business metric be fulfilled before a win-state is achieved, because win-states are what the user is motivated for and working towards. The other way around could mean that the user stops too early and the business metrics will not be fulfilled.

Storyboard (Wireframes) & script
Although these methods are reminiscent of the storyboard & written scenario methods of the Delft Design Guide (Van Boeijen et al, 2013) they were not used the same way. The main difference being that the main actor of it is not a user, but the guiding narrator/program that is part of the standalone design.

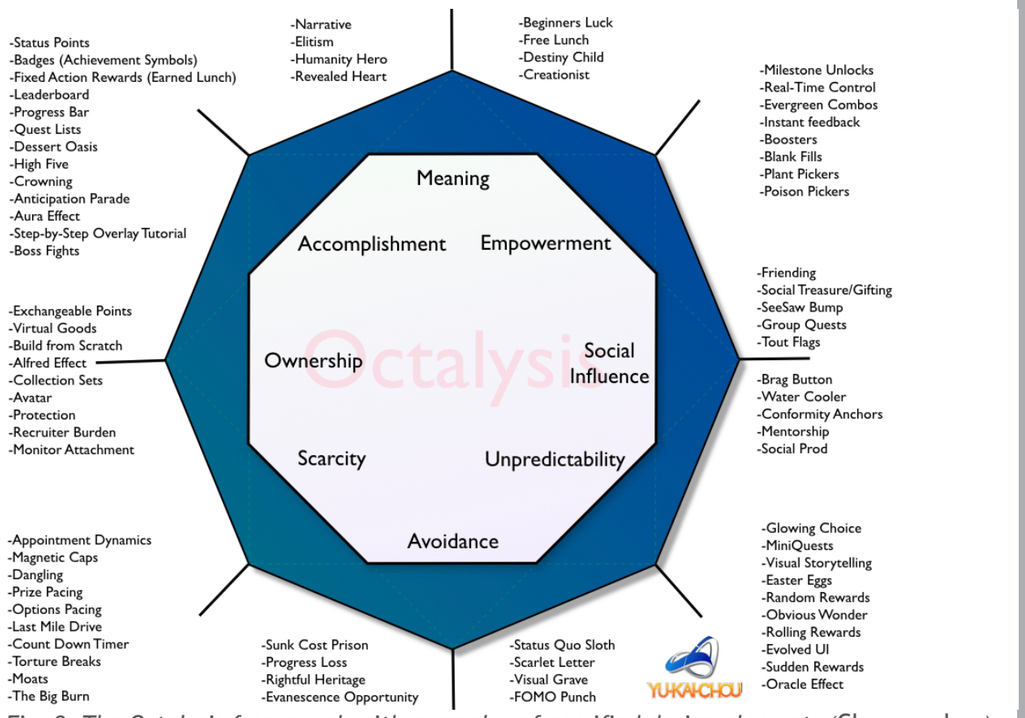


*Fig. 9: The Octalysis framework with examples of gamified design elements (*Chou, n.d.-a*).*

The storyboard is a simple wire frame sequence of the various screens (appendix 4), with descriptions of functions, presented to the users during their use of the product. The script (appendix 3) is the written version of the story presented and acted out by the various screens and the narrator. The script does include pauses and short descriptions of the actions done by the users between and during the various screens.

Justinmind, Audacity, Lumen5, Adobe PremierPro
These are all various computer programs that were used together to create the software part of the prototype. More information on them can be found on their respective websites.

Solidworks & prototyping
The physical part of the prototype, the toolkit, was designed through Solidworks. The measurements for this toolkit where based on the contents (an overview of the contents can be found in appendix 7) of the design in combination with the necessary divisions for the use phases. Some images in the prototype were made with Adobe Illustrator (as is true for most images in this report as well).
The physical prototype was made by hand using crafts materials like cardboard, glue, tape & paint.

Test & questionnaire
The test was done as described in chapter 7 and made use of a printed questionnaire made with Google forms (appendix 5b). The questionnaire was fairly long, although could be filled in, in less then 10 minutes. One reason for the length of it was a result of half of the questions being optional, open, questions, for the participants to elaborate on their given answers. Another reason was the fact that most questions used to measure crucial results were asked twice, with different wording. This was to compensate for mistakes and inconsistencies in the answers of the participants.

Target user

4. Target user

Description

Any company (or team) that is interested...
...in circular economy,
...in changing the way how they do business
&
...in contributing to (the transition to) de-carbonization and de-materialization of society.

This implies that they are either relatively new to the field of Circular economy, or that they are looking for new/extra ways and information of being active in this field.

Considering that this is a very broad user group that can have various goals, interests, preferences and backgrounds, it seems best to try to make the design for all player types, as mentioned in the theory about gamification methods and player types (chapter 3). It will be possible to achieve this through using all the Octalysis core drives at least once, since the sum of them provides something for all player types.

Getting a deeper understanding

In the past, multiple iterations of the Circularity deck have been tested in workshop settings to further the development of the Circularity deck (Konietzko et al., 2020). The participants all fell in the aforementioned target group, their statements and feedback are therefore representative of the intended target group. However, the questions that they were asked afterwards were aimed at getting information about their opinion on the Circularity deck at that time. The questions were not aimed at understanding their needs and preferences, but many of their open question answers do give insights in what they (seem to) want and value.
The questions asked were as follows:
“
*The purpose of the Circularity Deck is to learn and ideate for a circular economy.

The circularity Deck was useful to address the purpose stated above*? [0-5 Likert scale]
Please explain your answer (What was most useful? What was less useful? Why?) [open question]
The Circularity Deck was easy to understand/use? [0-5 Likert scale]
Please explain your answer (What was easy? What was difficult? Why?) [open question]
“
(Konietzko et al., 2020, p. 23)

In Appendix 8 these answers have been clustered in categories in an attempt to reveal the needs that the participants presented through their answers. The main themes in these clusters have been used to formulate the needs and some desires of the target group. These needs and desires can in turn be used to improve the design of the Circularity deck at a later stage. The ones that have been addressed in the Circularity game can be found in the next section. The others have not been addressed because they either were already addressed by the latest version of J. Konietzko et al.’s (2020) Circularity Deck, or because they fell outside the scope of this project. For instance, needs having to do with the ecosystems lens were left out.
Of note is the fact that all participants where overwhelmingly positive about the Circularity deck. 59/60 rated the deck on both questions with a 3 or higher on a 0-5 Likert scale. Only one participant rated it a 2. This means that almost all answers can be considered given from a positive mindset and all the answers have been approached thusly.

Addressed needs:

- A need for a new perspective or way of looking at the way they do business;
- A need to be inspired towards (for them) new ideas for going circular;
- A need for a way to trigger existing memories of solutions;
- A need for a way to start and speed up the thinking process;
- A need for a way to start the discussion (on how to go more circular);
- A need for something to get into the idea creation mindset and brainstorming attitude;
- A need for better understanding of the concept of Circular Economy and its supporting sub-concepts;
- A need for a more hands-on approach, seeing, recognizing and doing is learning;
- A need for combining and cross-pollinating ideas and examples;
- A need for ease of use;
- A need for ease of understanding;
- A need for a more tactile, hands-on approach to make the theory more tangible;
- A need for interactions surrounding the ideation process;
- A need to be able to communicate about the generated ideas and solutions;
- A need for the Circularity deck/game to cater to various situations: industries, sectors, people (knowledge levels), etc.;
- A need for clear instructions and introduction accompanying the Circularity deck/game;
- A need for getting through most, if not all, of the content of the Circularity deck/game;
- A need for something to make sure that the conversations stay on relevant topics;
- A need for a less pragmatic/businesslike feel, or more user enjoyable “vibe”;

Functional redesign

5. Functional redesign

Explanation of focus shift in favor of gamification (pivot 1)
The following chapter discusses the various steps and parts of the redesign of the Circularity deck. It starts with a functional analysis and uses this to move on to using steps from Octalysis. This chapter is heavily influenced by pivot one, the choice to move to a full focus on gamification and to (mostly) drop the ecosystems lens part. Most of the following sections still make use of designs from the ecosystems lens period of the project, but also attempt to show how the pivot changed what is used in the end.

The are two reasons for this pivot. On the one hand, the project would become too big. To focus solely on gamification would already be more than enough for the time that was available for the project. Besides this, the added value for the main stakeholder (J. Konietzko) would be bigger when the focus would shift towards gamifcation. He himself was also already working on the ecosystems side of the Circularity deck and what this project's research provided at the mid-term point was small in comparison. Simply put, the pivot was to avoid wasting time and effort and to focus on providing the most value for the main stakeholder.

Old vs. New: A function analysis of the Circularity Deck

Based on the project brief (appendix 1) and conversations with J. Konietzko about the Circularity Deck, two function analyses have been made. One of the current Circularity Deck showing what it does and highlighting the current problems and one of the Circularity Deck as it should become according to this project. These have been made before the first project pivot and still take into account the ecosystems lens part. Although this has been dropped at a later point, the final design still accommodates for this added functionality to be developed and is therefore still included here.

The original Circularity deck from August 2019
The following image (fig. 10) displays a function tree with the main and sub functions of the original Circularity Deck. Note that at the time (August 2019) of this analysis, the deck only had 4 strategies, later versions added a fifth one: inform. The function tree shows what the Circularity deck is intended to be doing and the sub functions it has, to achieve the main functions. With red exclamation marks multiple problems have been indicated. For the analysis the presentation used during the test workshops of the current deck have been considered to not be a part of the deck. The redesigned deck should be a standalone product that does not need a teacher, facilitator or human guide. This will make sure that it is easily accessible and usable at any time and place of the user's choosing, without the need to arrange meetings with people from outside the team. Making it standalone ensures that the redesign is convenient enough for the users, so that it can compete with other available tools and has a better chance of becoming the preferred option on the market.

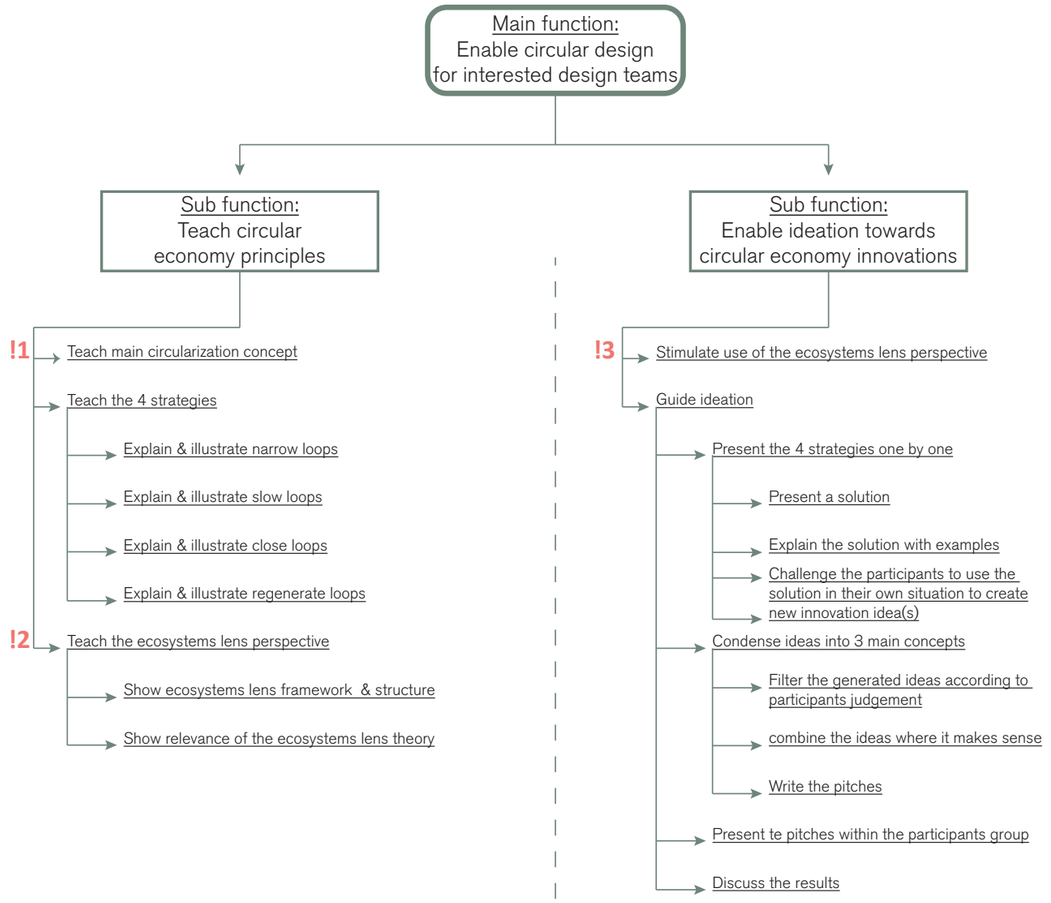


Fig. 10: Function analysis current Circularity Deck

Observed potential points for improvement of the original Circularity deck (fig. 10)
!1: The deck (on its own, not counting the presentation by a facilitator, due to the desire for a standalone version) has no way of teaching the users what the basic concept of circular economy and design is and its relevance. Some of this was done in the accompanying presentation, but as stated, the Circularity deck should be a complete and standalone tool. Some prior knowledge about Circular Economy and Circularity deck of the users can be assumed, but the tool is meant for introduction and getting started in the field of Circular Economy and Circularity deck. Therefor it should have at least a quick overview/reminder of the basic theory.

!2: Not taking the presentation into account, the Circularity deck itself completely lacks any way of teaching this to its user. This is one of the main points to be improved upon in this project. If the Circularity (card) deck ever has to be more than a stack of inspirational examples for brainstorming, the ecosystem lens, what it is and how to use it, has to be part of it.

!3: Continuing in the line of !2, there is currently not much in the deck itself that helps the users of the Circularity deck to use an ecosystem lens approach. This should become part of the Circularity deck, including a systemic approach of systems, in order for the users to be able to take a look at the ecosystem at all.

These three points may seem negative about almost everything of the Circularity deck, but that is not the goal. The Circularity deck is a good starting point, but has much potential to grow better, still. By highlighting these points, opportunities for this growth are identified. In the next function analysis most of the current functions can be found and are still part of the Circularity deck.

Expanded and redesigned Circularity deck

In the next figure (fig. 11) the function analysis of the improved Circularity deck can be seen. The first sub function, to teach, has been expanded and is more complete now. The second sub function, ideation towards circular, has remained mostly the same, albeit somewhat restructured and rephrased. It also better allows for the third sub function now. The third sub function, strategizing on ecosystems, is completely new and is an extension of the Circularity deck. It adds the functionality for users to be able to map their ecosystem and analyze it in a useful way. The green exclamation mark is there to draw attention to the fact that the lower function of visually mapping is done simultaneously/parallel during all the functions described above. These three sub functions should be followed from left to right, top to bottom. The deck should first teach, then use that knowledge to come up with an initial innovation and work/map that innovation out in its future ecosystem. At the bottom of the second and third sub function there is a function block merging both. After both sub functions have been handled, a last step needs to be taken: looking at, evaluating and solving emerging problems of the new innovation in its ecosystem. That is the part where the first true steps towards an ecosystem strategy are made by the users and it combines the ecosystem lens and the ideation results.

Based on this function tree a first extended design of the Circularity deck had been made, however it is not included in this report. There are two reasons for this. First, due to the first pivot made, most of the added functionality was eventually 'out of scope' and did not end up in the final design (crossed out in fig. 11). Secondly, the few things that were kept, for instance some theory explanation cards, are present in the final design and are shown there.

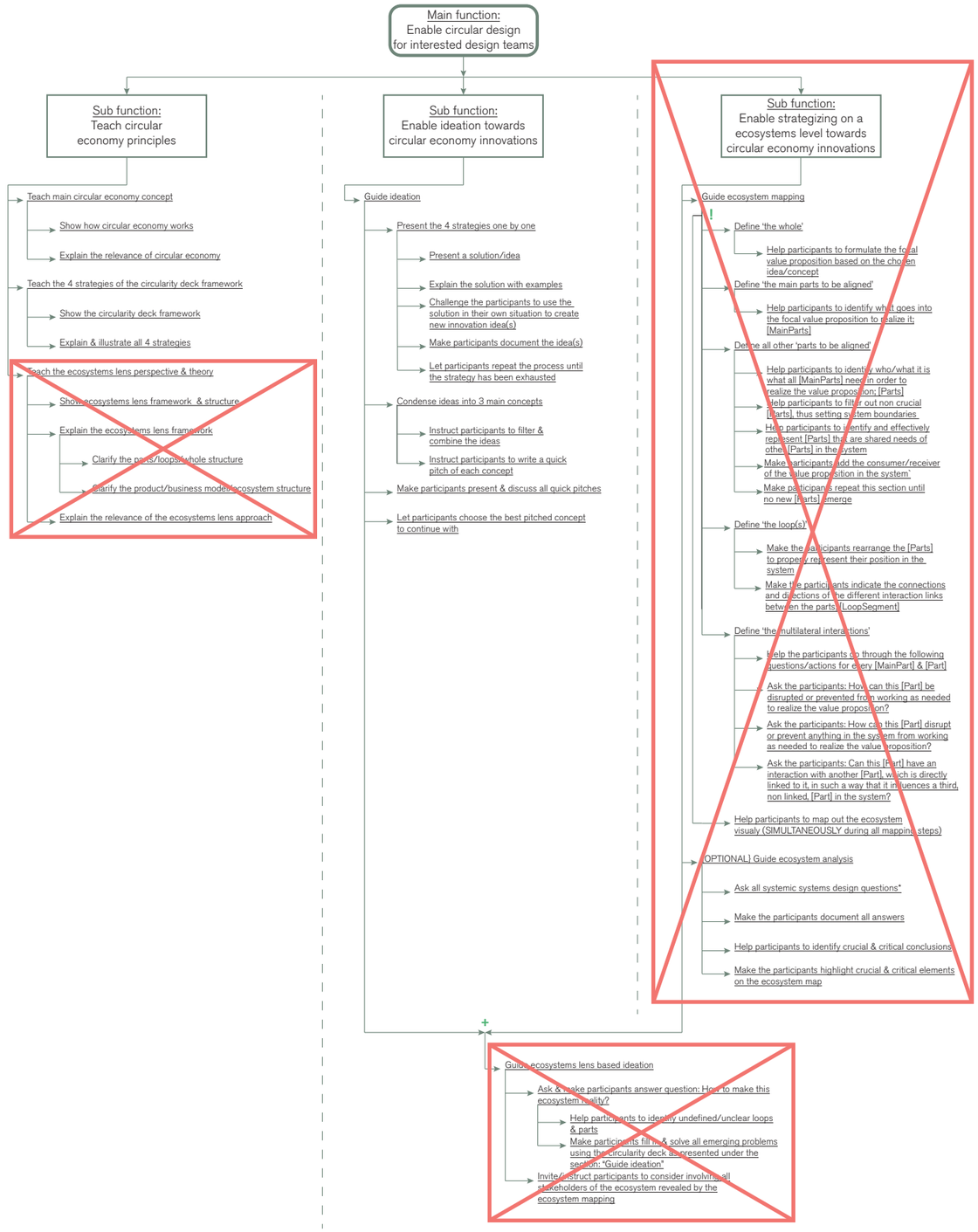


Fig. 11: Function analysis extended Circularity Deck after pivot 1. Crossed out parts have been dropped.

Business metrics through the lens of Octalysis

Below are the metrics that determine if the Circularity deck is a success, from the viewpoint of the developers, in order of importance. This is based on two points. On the one hand, (part of) the objective of the study was to address two gaps in the literature on circular oriented innovation of which the following one is of relevance here: “the need to develop tools that are thoroughly evaluated against criteria like perceived usefulness and ease of use.” (Konietzko, 2020 pp. 6). Why would ease of use and perceived usefulness be important? To get more people to use the Circularity Deck in general and also on a more permanent basis. In turn resulting in more people engaging with the Circular Economy, which is seen as a valuable endeavour in and of its own (business metrics points 1, 2 and 3).
On the other hand they mention the goal of the tool [the Circularity Deck] to be:”... to help firms analyze, ideate and develop the potential circularity of their innovation ecosystems.” (Konietzko et al., 2020, p. 8) In order to do this, the sub-business metrics mentioned below business metric 1 (-, a, b & c) have to be reached.
Although the original study had more goals and objectives than mentioned here, these are the ones this project tries to improve on through use of Octalysis.

1. Get more people to use the Circularity Deck.
    - Better enable circular design ideation & strategization.
        a) Teach the base theory.
        b) Improve creative output towards circular innovations.
        c) Improve strategizing through better insight in their ecosystem.
2. Retain Circularity Deck users for more then one project.
3. Convert teams/companies to (long term) Circular Economy participants.

Users and their relation to the core drives through the lens of Octalysis

The user feedback from earlier tests has been grouped and color coded in appendix 8. These answers, seen through the lens of Octalysis, can now be connected to the various core drive. This gives an overview of which drives to focus on the most, when gamifying the Circularity deck. In Table 2, the color group, its general description of what is desired in it by the participants and associated core drives, can be found. Not every category relates to the core drives to the same extent nor do they relate to the same amount of core drives. To do the variations in this some justice, a distinction has been made between strongly related cores and lesser related cores. The strongly related ones have a weight of one, the lesser related ones a weight of 0,5. The sum of these weights determine the importance of the core drives, relative to each other, for the Circularity game (Table 3).

Per core drive explanation

Note: The order of the core drives in table 3 is based on their numbering in the Octalysis method (Chou, 2019). The fact that for cores 2-8 the sum is in a high to low order is a coincidence.

Why core drive 2: Development & accomplishment?
The players are participating, mostly, for one goal: to grow the company/project through innovation and problem solving. To them, time = money and they have more work to do as well. They tend to be rushed and want to be efficient. That is why, to them, it is important to see progress and results quickly.

Why core 3: Empowerment of creativity & feedback?
The players are looking to be helped with innovating and for that, creativity is needed. But, they are inexperienced with this or at least want some help. That is why they are looking for tools to help them. These tools can do this through feedback and encouragement. Besides this, these kinds of tools help with stimulating creativity and help produce more results. From creativity as a motivator itself, variety in ways to let ideas come out is important, as well as

Category	Category general descriptors	Strongly associated core drives	Lesser associated core drives
Yellow	- Perspective gaining - Inspiration - Triggering	3, 5, 7	-
Brown	- Applicability - Plan formulation - An answer to: “How to...?”	2, 3	4, 6, 8
Blue	- Holisticity/completeness - Clarity & un-ambiguity - Overview - Understanding	2, 3, 4	8
Pink	- Accessibilty/usability - Structure - Communicable - Difference in user capabilities/experience	2, 4, 5	-
Green	- General practicalities	2, 6	4, 5

Table 2: User based category-core drive relatedness.

Core drive	Strongly associated (*1)	Lesser associated (*0,5)	Σ
1: Epic meaning & calling	-	-	0
2: Development & accomplishment	IIII	-	4
3: Empowerment of creativity & feedback	III	-	3
4: ownership & possession	II	II	3
5: Social influence & relatedness	II	I	2,5
6: Scarcity & impatience	I	I	1,5
7: Unpredictability & curiosity	I	-	1
8: Loss & avoidance	-	II	1

Table 3: Core drive importance.

multiple ways of expression and communication. Within an ideation group setting, this also allows for others to pitch in and extend on generated ideas, allowing for direct feedback within the group, further creating motivation to keep on being creative.

Why core 4: Ownership & possession?
This is mainly important due to the desire to understand the theory, get insights and make it their own, making it usable for their own company/project. An extension to this is the desire to further grow what they already have: their company, products, market share, and also personal skills. In a sense, what already is part of the company is comparable to an acquired collection, which they want to grow further. Just like a stamp collector also wants to increase his collection and in that way increase what he possesses. This is very much in line with what the general goal of almost any company is. Lastly, there is a focus on gaining insight in what they already have and what their position in the grand scheme is. In a sense, it is getting the big, complete, picture of what they have and what they are. This may be more of a motivation in the ecosystem phase of the redesign.

Why core 5: Social influence & relatedness?
Innovation in a company tends to be teamwork, it can't be done alone. Usually, the better ideas come from interactions between people. Two minds together trigger new ideas and associations in each other, where alone, they would never have gotten as much. A big part of creativity lies in associating two things previously unrelated (bisociation). The chances of this happening increase when there is social interaction (see also the theory on creativity, chapter 2). Besides this, there is also the bigger ecosystem in which the company/project exists, requiring social interactions and attention to the different relations as well. Additionally, the social aspects of working together and being successful also provide motivation.

Why core 6: Scarcity & impatience?
The important thing for the users here, is keeping it real and connected to reality. A company/project is limited in its resources and the users tend to want to work with what is available and possible. However, it also has a motivational element to it: something that is almost possible can trigger creativity, cooperation and activity to make it possible.
Within a business/competitive context it is also a driving force. There is only so much "space" in the market, getting there in time, claiming your market share before the competition can be a strong driving force and lead to creative thinking to achieve it quicker.

Why core 7: Unpredictability & curiosity?
This core mainly is needed for helping with triggering new ideas and keeping the users/players interested for a longer time. If "the game" of the Circularity game runs long, the users may get bored and lose interest.
Core 7 can also be used to progress the Circularity game through its multiple phases in a smoother way; The vibe of "I wonder what the next steps will bring us?" can be very motivational.

Why core 8: Loss & avoidance?
This drive feeds off of the fear of making mistakes, forgetting important aspects, missing opportunities and going too far and setting unrealistic goals. Especially in a professional setting, mistakes are frowned upon and therefore almost every participant will be wanting to avoid them. It is a negative, yet powerful, driving force which can be useful.

Where is core 1: Epic meaning & calling?
In the case of the Circularity game this drive is not a driving force within the game itself, rather, it can be a driving force towards the game. It can be one of the reasons to bother with the Circularity game at all. It is mainly important during the on-boarding process and the introduction to the game. It can be a strong motivator to get started. It may appear again, later in the process, when progress is experienced and the initial results do show potential for fulfilling the epic calling & meaning of working towards a better and cleaner planet. It may also help with countering the same boredom mentioned under "why core 7". The open answers given in the questionnaire were also not aimed at providing insight in the motivations of the participants to partake in the tests, but on their opinion of the deck that was tested. That is why no real measured importance value could be determined.

Desired actions & win-states (Octalysis dashboard steps)

Where the business metrics are in order of importance, the desired actions (of the users) are in chronological order. These are all the actions that the user has to do to reach the desired end. Ideally this leads to an improvement of the business metrics. However, these metrics do not motivate the user. Users are motivated by so called win-states. These are the satisfying moments for the user during use, which they are working towards, but they also run the risk of being an end point for the user. That is why, in the design, they should line up well together. A business metric positive should be reached just before or at the same time as a (major) Win-state. That way, when satisfaction is reached by the user, it satisfies the business as well. (Chou, z.d.-b, 2019, p. 462-466)

In fig. 12 (next page) there is a time-line of the desired user actions, win-states & moments of business metrics success in the design of the extended Circularity deck from before pivot 1. Highlighted in red is the part that was used in the design and testing of the Circularity game, minus the crossed out parts.

A distinction has been made between three magnitudes of win-states:
- Tiny Win-states: a small feeling of satisfaction or progress. The sense of being on the right path and getting further.
- Minor Win-states: The points where you feel you really have something to show for your efforts, but it is still only a milestone on the way to the big win. They give the sense that not only are you making progress, but also the end-goal is attainable.
- Major Win-states: These are the big results, the points where you have definitely achieved something. Even if you would stop here, you would have gained something very valuable.

The Win-states can be compared with a sports game like volleyball or tennis. Scoring a point is great, but you will have to score a lot more; a tiny win. Winning the set is good progress and brings the final goal closer; a minor win. Lastly, winning the last set and thus the game. Your goal is reached; a major win.

For the Circularity deck there are 5 major Win-states:
1. Eureka!: The moment after brainstorming and ideas pitching where the team has decided on the one innovative circular idea (or set of complementary ideas) to continue with.
2. Ouroboros (The snake biting it's own tail): The first ecosystem map has been made around the innovative circular idea and it is clear that the connection has been made and it is indeed circular.
3. Anansi, is that you? (The spider in its web, where all connections influence other connections in more ways than one): This is the moment where most, if not all, multilateral interactions are revealed and shown on the map. The ecosystem map is now complete and can be used for further development of the innovative circular idea.
4. Diwali (or feast of lights. If Eureka! Is one great idea represented by a light bulb, then this is about many people and ideas, lights, coming together): When the ecosystem map is complete, including the multilateral interactions, the original innovative circular idea is seen in a bigger context. This will present new challenges to overcome, needing many ideas and solutions. At the end of the brainstorming and pitching for this an extended set of innovative circular ideas to realize the original idea will be chosen.
5. Hannibal: *"I love it when a plan comes together."*: The last major Win-state is when all the previous work fits together into one plan. This plan can be presented and become the foundation, or brief, for a new project for the team or company.

In the Circularity game itself, these have been restructured & renamed at a later stage for the sake of simplicity. Their win-states are still in there, but the users do not go through 5 separate phases with 5 win-states, but through 3 phases with 5 win-states.
Eureka became 'A new idea is born', Ouroboros and Anansi combined into 'Building an ecosystem', Diwali and Hannibal were turned into 'The total package'. An explanation for this can be found in chapter 6 section Toolbox design.

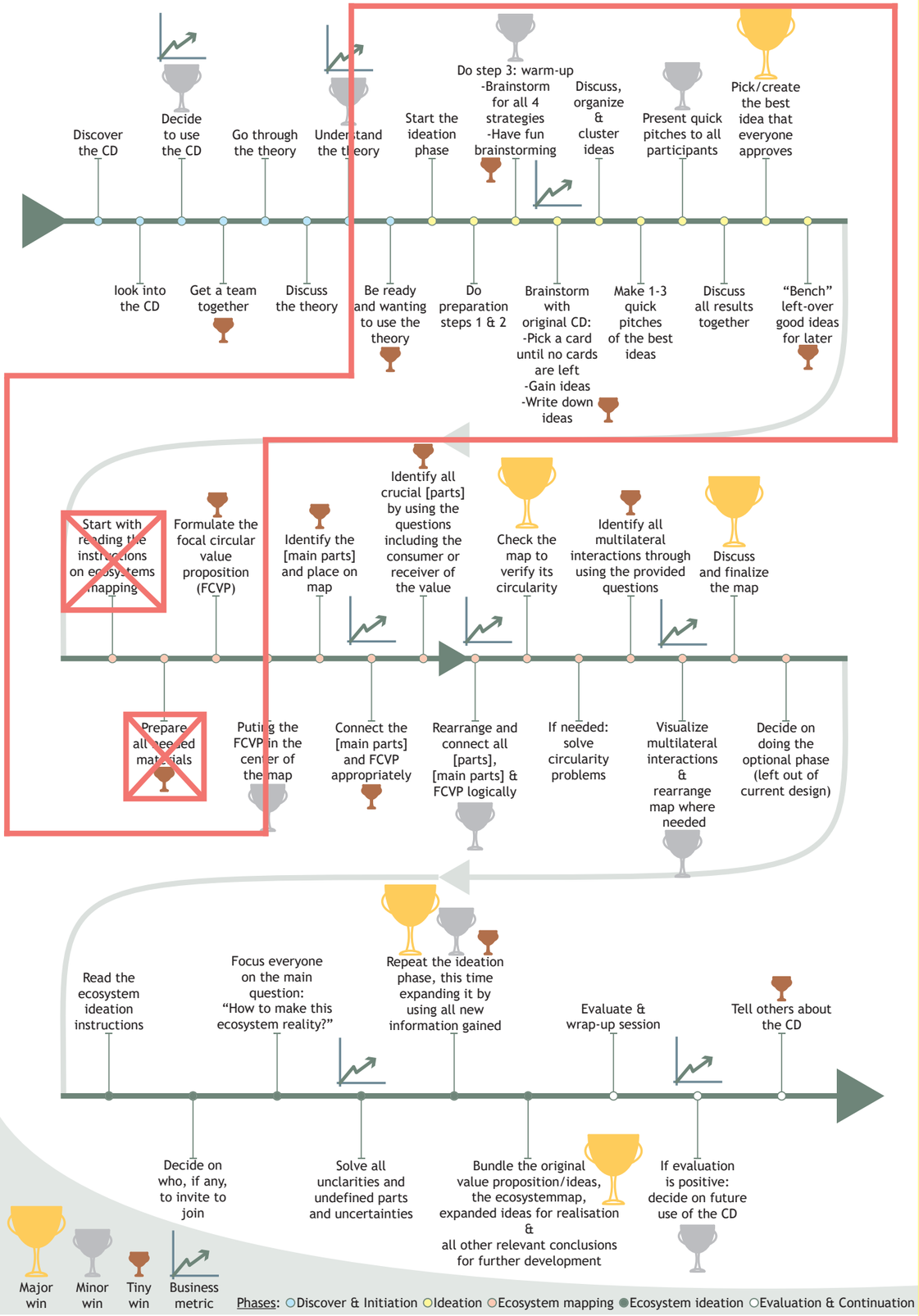


Fig. 12: time-line of the desired user actions, win-states & moments of business metrics success in the extended Circularity deck version from before pivot 1, with the part highlighted in red indicating what was used and tested in the final design of the Circularity game.

Gamification & product design

6. Gamification & product design

The following chapter discusses the various steps of the design of the Circularity game and how gamification was used in this process.

Ideation

The ideation part of the design made use of these methods, as described in chapter 3:

- How to's
- Morphological chart

The How to's were used to come up with ideas for solving the various problems and questions provided by the function analysis, the Octalysis framework & the project goal.
The morphological chart was then used to structure the generated ideas. Lastly, based on the results of the earlier research done at the beginning of the project and by Konietzko et al. (2020), solutions were chosen to be used in the design.

An example of what the How to's look like can be found in fig. 13, it is mainly meant to be illustrative. Anything of value that came out of them has been used in the morphological chart shown below (figures 14, 15 & 16).

The central subjects and problems to ideate for, provided by the function analysis, Octalysis & the project goal are:

- Every core drive in the form of a how to...? (example: How to...add a sense of development and accomplishment?).
- A braindump around the general idea of gamification
- How to... make it one game/product?
- How to... keep people interested?*
- How to... on-board people?
- How to... incentivise beyond the major win-states?*
- How to... stimulate creativity?*
- How to... stimulate multidisciplinary cooperation?**
- How to... stimulate innovation?*
- How to... make the Circularity deck well suited for project teams?**

**The answer to these was simple: using the core drives. This was therefor done by ideating for the core drives.*
***The answer to these was provided through: How to... make it one game/product?*

The morphological chart

The morphological chart in figures 14, 15 & 16 bundles similar ideas into solution categories (columns) and places them next to the subject they are solutions for (rows). Based on the importance of the various core drives a number of solutions was chosen and marked (see also chapter 5: section: Users and their relation to the core drives through the lens of Octalysis). A minimum of one solution from every row was used for the fact that they all added some value at least and combined they make sure that every player type gets served.

Fig. 13: How to's example.

Core drive 1 Epic meaning & Calling	Call on the conscience future generations burden Heart & feeling	Be better, save the world, be an example Lead, cooperate, reform	Industry leader / Best competitor / Innovator	Knowledge & insight gain Learning Research Self reflection	Disaster avoidance
Core drive 2 Development & accomplishment	Show/represent results (measurable, tangible) Present Draw 63 ideas! Log & reiterate	Look back 'the route passed' Trophies	Look forward 1... 2 ... ? ... ? ...	Rewards & feedback Have you thought of ?	Staging & guiding increments "I expect.."
Core drive 3 Empowerment of creativity & feedback	Variety of tools, routines & methods	Variety of people & setting Teams Mix n' Match Different people and backgrounds	(Unexpected) outside input Invite a new person Perspectives Ideas/subjects 'Relate the unrelated'	Social & team 'There is no wrong' Everyone adds Interactions Score & feedback	Disrupt & force creativity No writing Blindfolds No talking No sitting No phones Forbid a popular tool
Core drive 4 Ownership & posession	Customization Naming Own style Rules and methods	Grouping VS. We against them 1+1=3 synergies Task & responsibilities division All adding together "cogs in a machine"	Baseline & uniqueness Who are we? What do we have already? What makes us unique? What have we achieved in the past?	Collecting / hoarding Pitching & representing ideas Partners & expertise	Investment Money Time Energy Trust Goodwill Effort

Fig. 14: Morphological chart part 1

Core drive 5 Social influence & relatedness	Internally Pitch in Share & discuss Ask an exper	Family & friends Dinertable At the pub Ask & tell opinions and thoughts Take home-goodies	Online Fora / Reddit Company website Social media Dedicated environments	Industry Invite partners Seminars In own network Competitor talks	Consumer / customer did you like? Invite consumer to participate Observe Idea contest
Core drive 6 Scarcity & impatience	Time based Min-max "T-10" countdowns to new options Forced breaks & pauses	Limit & lockout Existing rules & regulations Don't do what they do/ we did already Phases of options Postpone steps in favor of others	Tools & methods & resources Different roles Incomplete data Varying tools over time		
Core drive 7 Unpredictability & curiosity	Randomness Dice 'Pick one' Skinner box Play Associate sequentially	Surprises +3 Bonusses Pop-up "side-quests" Alternatives	Tangents Examples Humor (annekdotes) Further reading	Explorative Google for a bit Did you know ? Investigate competition The news	Ecosystem map New connections What if we are not there? Where do the competitors fit? Replace or leave blank
Core drive 8 Loss & avoidance	Comparison State the averages Checks & balances	Insecurity (too) many open spots Reminder prompts Choice & certainty prompts	Opportunity FOMO Chosen one Replace and/or drop out in ecosystem map Rightful place	Reflective Devil's advocate Approved "Would the boss be positive about it?" Would I...?	

Fig. 15: Morphological chart part 2

Randomly generated ideas	Narrator / guide	Multiple "skins" Sci-fi Adventure Aocalypse Mystery			
Gametype ideas	Card based	Text & story driven DnD like	Acting & roleplay	Boardgame & journey	Interactive / mixed
Ideas for themes	Apocalyptic	Heroes & villains	Fantasy adventure	Sci-fi colony rebuild "Zero to hero"	Make your own Fantasize Imagination Standard fill-in forms

Fig. 16: Morphological chart part 3

The chosen solutions (of the morphological chart)

Core 1 (no specified importance):

1. Heroism: Be better, save the world, be an example. Lead, cooperate, reform.
2. Self improvement: Knowledge and insight gain. Researching, learning, reflecting.
3. Fear: Disaster avoidance. Poisonous atmosphere, droughts, floods, recessions.

Core 2 (Importance 4):

1. Show/represent results: stacking ideas, presenting results.
2. Rewards & feedback: Praise, unlocks, reminders.
3. Staging & guidance: stepped/phased content, build up.

Core 3 (importance 3):

1. Variety of tools, methods and routine.
2. Variety of people: switch roles, mix the (sub) teams, allow for outsiders.
3. (Unexpected) outside input: pop-ups, forced associations, social media use.
4. Disrupt to force creativity: sudden, temporary rules: no sitting, blindfolds, no phones, no talking allowed, only drawing, etc.

   A note: more were chosen here in the end. This was because the eventual design allowed for many to be added and they all provide a positive influence on the stimulating creativity which core 3 aims to do. In the end, it is a creative tool and it benefits from variety very well.

Core 4 (importance 3):

1. Grouping: forming sub groups, dividing tasks, mixing various backgrounds, stimulating the finding of unique group synergies.
2. Collecting/hoarding: Bundling ideas, presenting your own best ideas.

Core 5 (importance 2,5):

1. Internally: input from office colleagues, pitch, share & discus.
2. Online: Use social media, information websites.
3. Consumer/customer: Reach out & ask them for input (through social media).

Core 6 (importance 1,5):

1. Time based: Countdowns, forced/suggested breaks.
2. Limit & lockout: temporary rules, phased steps and content.
3. Tools, methods & resources: Keep resources back, divide and enforce roles, incomplete data.

Core 7 (importance 1):

1. Surprises: pop-ups, seemingly random support, easter eggs.

   Note: other solutions are used as well, but all through the pop-ups & surprises. These provided randomness, tangents & explorative (outside sources to investigate),

Core 8 (importance 1):

1. reflective: questions of conscience and realism. Would I...? Would my boss...? Is this good?
2. Opportunism: grabbing what you can while you can, before it is too late.

Random ideas:

1. Narrator/guide: something or someone providing a story, context and guidance. Fits well with cores 1, 2 & 7 as well.

Game type:

1. Mixed interactive game: allows for multiple mediums to be used and creating a lot of interaction and surprise (cores 2, 3, 5, & 7). It also provides the game designer with much control over pacing and player experience (cores 1, 2, 6 &7).

Themes:

1. Sci-Fi, colony, rebuild & (near) future: a story of a company preparing to build a better future in the form of colony like cities. The users are the potential recruits proving themselves.

Note: The above theme was chosen for its relatively believable subject. Near-future,

better companies lies close to what Circular design teams are trying to be themselves. However, for later versions, any theme can work, as long as it fits the user group at that point. It is simply the story providing some “raison d’etre”; a reason for being. (all themes are a tool to facilitate core 1, in general).

All these separate ideas had to come together into one product or gamified method. There is a near endless amount of ways and variations to do this and there is not really one right approach. To use a minimal viable product (m.v.p.) approach from the lean & agile design theory would be one good way to go. Although, it proved not possible to have multiple iterations and tests, a first prototype was designed, made and tested in an m.v.p. manner. However, because it would be only one version and one test, more effort and detailing was put in than what would be considered normal for an m.v.p. The results of this are shown in the next section.

Overview design

Description

The Circularity game is a gamified ‘Circular design and economy’ method, with the Circularity deck at its core. It is a narrative driven and guided, interactive game. It makes use of a mixed set of tools and media, focused around specific key tools and activities.

The current design is focused only around the Circularity deck in it’s first phase. It leaves room in it’s suggested following phases for an ecosystems lens tool and other key tools required for the later phases. As mentioned before, these later phases are all out of scope for this project and therefore not further developed.

Digital design

The digital part of the design is an autonomously running program (no operator or workshop leader needed) to guide the users through the various steps of the Circularity game. In fig. 17 a sample is given of the various screens. More information on all the screens and functions can be found in appendices 3, 4 & 6, as well as be looked at in the digital prototype. It is interactive with the button provided in the toolbox. A working version of this digital part should be provided alongside this report. If it is missing it can be requested by emailing: A.Kok@student.tudelft.nl. This working version is the optimal way to experience it.

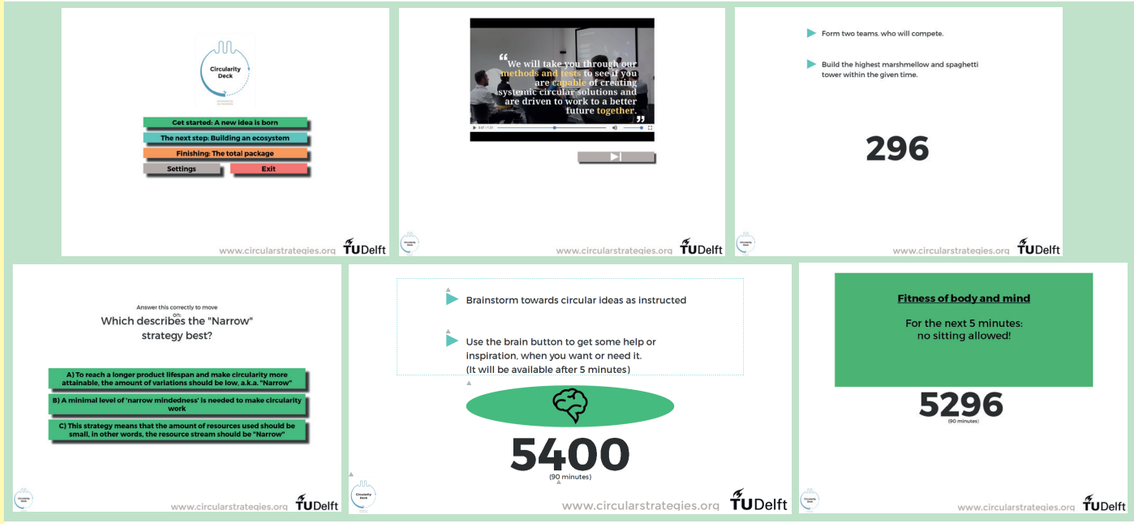


Fig. 17: Multiple Circularity game screens: Main menu; instructional video; instructional video summary and countdown timer; theory test question; Circularity deck use, instructions, big brain button and countdown timer; Circularity deck use with pop-up and countdown timer.

Toolbox design

The design of the toolbox (fig. 18) has been kept as pragmatic as possible:

1. It needed to fit all the materials: this determined the measurements.
2. It needed to physically pace the game, discouraging opening the later stages, but not blocking it: this determined the shape of the lids, which only open in one order.
3. It also needed to psychologically pace the game: The foreshadowing map on the top of the lids, the revealed map per step & the numbered sections.
4. The lids needed to be able to stay open on their own for a sense of progress.
5. It needed to be self explanatory: no complicated functions, only numbered follow-up steps.
6. It needed to allow for surprise and curiosity: some hidden compartments like the pull-out sheet in lid 3. Also, the whole thing can be explored and used at every point (yet discouraged, see point 2).
7. No further requirements, the material choices are placeholders. More information on the specific details and their relation to the various core drives can be found in appendix 6.

Fig. 18: The Circularity game toolbox rendering viewed from different angles and in different stances.

During the design of the physical toolbox the realization came that having a separate part for every phase would be redundant and impractical. Phases 1 and 4 use the same ideation materials and phase 5 is nothing more than a gathering and wrap-up phase, not needing any materials. Ecosystem phase 3 is a direct and more complicated extension of phase 2. Making phase 2 simply the first step of phase 3 would make the game simpler in use and remove the need for an extra section in the toolbox. This led to the following choices:

- 1 section for the setup materials;
- 1 section for the ideation phases;
- 1 section for the ecosystem phases;
- A slide out part of the lid to represent the second ideation phase and the final wrap-up phase.

The names of the phases were also more complicated than necessary. They did provide some flavor for those recognizing them, but it made understanding and playing the Circularity game much more complicated. They have been renamed as mentioned in chapter 5 section Desired actions & win-states.

The Circularity game in use

How the Circularity game is used can be read in the script (appendix 3). However, the general process is as follows:

1. The group leader acquires the Circularity game.
2. He takes a look inside the toolbox and finds the instructions for the facilitator (appendix 7).
3. He follows the instructions and makes all necessary preparations, like arranging the needed office supplies, and invites his team for a session.
4. The materials get setup: A computer is connected to a big screen, the 'Big brain button' is connected to the computer, the usb with the program is inserted in the pc, the toolbox is available in the room & all other materials are also present.
5. The team arrives and together they start the program.
6. The program guides the team through the various steps of the Circularity game.
7. The team does as the program instructs and uses all materials available to them when needed. They read the instructions and theory[1], do the warm-up games and the brainstorming[2], use the 'big brain button', react to the pop-ups and end up pitching their ideas and choosing the best one. Lastly, turning this idea into an F.C.V.P: Focal Circular Value Proposition. All under the guidance of the program.
8. The session ends and the team is left with a Circular design.

[1]The instructions and theory teach the users two things: how the Circularity game works and the basic theory that is behind it.

[2]The warm-up games are meant to stimulate creativity in three different ways. The first is to stimulate teamwork and a positive mood, this is done by organizing a contest of who can build the highest spaghetti and marshmallow tower. The second is a game of association and logic. By quickly associating words and having to logically connect the first and last one, the mind is opened up to making steps that are not happening in every day life. The last one is stimulating open mindedness and communication with outside social sources. Allowing this creates a mental state that is open to outside ideas and cooperation. The main brainstorm part is where the original Circularity deck gets used, as it was meant to be. The team(s) go through the cards together and try to use them as inspiration for ideating towards their circular design. The various interactive elements of the Circularity game provide all the gamified things and core drive motivations to improve the output of this.

A complete overview of all the contents and design elements and their relations to the core drives and other requirements can be found in appendix 6.

Application of the framework for individual creativity (everyday creativity), gamefulness and playfulness theory in the design

Although not very strictly applied, the idea that the Circularity game should start at a more gameful stage and move its users quickly to a playful state is present in the final design. It starts with a very gameful warm-up game: build a spaghetti tower as quickly as possible; it is clear, yet gameful and requires to be somewhat creative. It is a good example of the "Doing" level of everyday creativity. The second warm-up game is already more aimed at the second level of everyday creativity, "Adapting". It requires the players to associate and combine two separate ideas into a new one (very much in line with Koestler's (1968) theory of bisociation). The warm-up itself is still very gamified, but it starts to include more creativity. Lastly, the main ideation phase is mostly on the third level of everyday creativity, "making", by giving many inspirations through the card deck and providing support through the pop-ups (both the manual and automatic ones), these are the so called scaffolds. But the better the ideation goes for the participants, the less they need these supports. It is up to them to move to the highest level of "Creating". They do this naturally when they use the pop-ups and cards less and less.

Besides this, the various pop-ups have varying levels of gamefulness and playfulness. Some are very much disruptive funny games or gimmicks (playful), others are more a suggestion of a new method to use for a while (gameful). This way, the Circularity game constantly hovers between the highest two levels of everyday creativity, during the ideation part, and leaves it up to the users to use it on the level that fits them at that moment. (A very gameful pop-up can always be ignored, if they are already on the highest level).

The relation of the different design elements to the individual creativity framework parts (head, heart, body & materials places spaces), if applicable, can be found in appendix 6.

Prototyping & testing

7. Prototyping & testing

The prototype build

The toolbox of the prototype was build using crafts materials like cardboard and paint. It is build to almost a 1:1 scale and was completely functional for the ideation phase to be tested. All the contents described in the design and accompanying appendices was present during the test. Fig. 19, 20 & 21 provide an overview of the toolbox and materials and an impression of it being in use during testing. The 'big brain button' was made from an oversized 'Enter-key' button that could be connected to the computer through a usb cable. It has been painted over to make it more resemble a green 'big brain button' (fig. 21, bottom left of the table, the 'big brain button is visible).

The digital part of the prototype was build with the prototyping program Justinmind as mentioned in chapter 3: methods. The basic steps to be followed and played through by the participants, and provided and supported by the prototype are:

1. Setup the Circularity game.
2. Go through the introduction of the game.
3. Do warm-up 1.
4. Do warm-up 2.
5. Do warm-up 3.
6. Introduce the ideation phase with the Circularity deck.
7. Do the ideation phase, with gamified support elements like the pop-ups.
8. End the ideation phase.
9. Introduce the pitches.
10. Do pitches.
11. Introduce the F.C.V.P.
12. Do F.C.V.P. Formulating.
13. Wrap-up and end session.

This all had to fit the theme (from chapter 6 section The chosen solutions) and needed to be guided by a narrative. These have been created through writing a full script and a wire frames storyboard. These can be found in appendices 3 & 4.

The full prototype consists of:

- A toolbox with the needed contents including the 'big brain button' (appendix 7)
- An interactive digital narrator/facilitator program
- A big screen (beamer)
- A PC to run the program

Fig. 19, 20 & 21: Toolbox overview & toolbox and Circularity game in use.

Testing the design

The Circularity Deck by Konietzko et al. (2020) has been redesigned through gamification as described previously and became the Circularity game. To evaluate the redesign a test with students has been done. The goal was to:
1) compare the redesign to the original Circularity Deck;
2) confirm that the gamification has a positive effect on the user experience;
3) get insight in its effectiveness as a creativity tool.

This led to the main research question:
"Is the Circularity game an improvement compared to the original Circularity deck?"

To answer this, there were 4 supporting questions:
A) "Does the gamification improve user engagement, while using the Circularity game?"
B) "Does the gamification improve user creativity, while using the Circularity game?"
C) "Does the gamification improve user motivation, while using the Circularity game?"
D) "How effective is the Circularity Game as a creativity tool?"

Method

For the first step of the test the participants were asked to fill in a questionnaire (part 1) to set a baseline according to their own judgment. The questions in the questionnaire use a 5 point Likert scale or yes/no for the answers and an optional comment box at every question for additional remarks.

In the second step the participants used the Circularity game on their own for the provided case (see appendix: 9). It is designed to be used without a facilitator and should work without any guidance. Since it is still a prototype a researcher was present to solve any problems stemming from unintentional design flaws in the prototype. When and where this had happened it was reported and taken into account during analysis of the results. The researcher only solved problems that were not related to the answering of the research questions, or when the test would otherwise completely fail.

Besides this, the researcher also made observations and wrote down anything of note, that could help improve the design. This was completely independent of the test and had no influence on the test.

After the participants finished their session with the Circularity game, the third step of the test was a second questionnaire part, evaluating their experiences with the deck. It, again, used a 5 point Likert scale and optional comment boxes for the answering of the questions. The full questionnaire can be found in appendix 5b.

The whole test was estimated to take 3 hours, which it roughly took. Figures 19 & 20 show pictures of the test.

Participants

5 participants: 4 male, 1 female.
Age range: 21-24
Relevant background info: All are TUDelft students from various faculties.

Materials, equipment, facilities & other preparatory measures
A room with table(s), chairs, a white-board* & beamer*
A design case
The Circularity game, including:
-The digital program
-The physical toolbox with content**
-All (crucial) materials suggested by the deck to be prepared by the users beforehand***
Questionnaire part 1: Baseline & Questionnaire part 2: Experience (appendix 5b)

*Equivalent replacements may be used based on availability.
**See fig. 21 for the cardboard prototype version.
***Normally these are to be gotten and prepared by the user, however, this could not be expected of the participants during or before the test and was therefor done by the researcher beforehand.

To prevent influenced & biased results the researcher arranged the setup of the test and materials, provided the questionnaires and indicated when to start with the next step, but never participated in any way. The only times the researcher actively influenced the test was when the program bugged out (requiring it to be reset) and when some cards were missing (they were quickly found and provided without any relevant disruption).
To prevent further bias, the questionnaires were all anonymous, the first and second questionnaire parts have been kept together.

The first questionnaire part is aimed at creating a baseline with regards to experience, creativity, motivation, enthusiasm & interests for every participant.
The second questionnaire part's goal is to measure the experiences of the users and what the influence of the Circularity game was according to the participants.

Both questionnaires are in English, the Circularity game is also in English. A question to gauge the influence of the language is included in the first questionnaire part.

Results
In table 4 the results of the questionnaire parts are presented. The average absolute deviation and variance were used to identify the questions on which participants differed much from each other. They where not used to imply any statistical validity of the test.
Of note are questions 27 & 29. They have a different scale, because they have been kept exactly the same as the ones used in Konietzko et al.'s (2020) earlier tests. This way they can be better compared.
Also of note: The written answers were optional and are only used to gain insights for further design and recommendations. Especially in cases of high variance and average absolute deviation.
Lastly, the yes/no questions are potentially of use in the cases where the answers seemed remarkable and the variation might be due to the differences between participants.

Below the table are the answers given to the optional open questions. Answers with personal data have been omitted or made anonymous. Some answers have been given multiple times to similar questions.

Question	Possible Answer	Average scores on the likert scale	Variance	Average absolute deviation
1: What is your name?	Written			
2: What is your age?	Written			
3: What do you study/what is your work?	Written			
4: How well do you understand the English language?	1-5 Likert	4,8	0,2	0,89
5: I was, prior to this workshop, aware of Circular Economy	1-5 Likert	3,6	0,3	0,55
6: I was, prior to this workshop, aware of Circular Design	1-5 Likert	3,6	0,3	0,50
7: Optional: give a remark on your previous answer(s) if you feel it might be relevant/useful	Written			
8: I'm knowledgeable about Circular Economy and/or Design	1-5 Likert	2,8	1,7	0,96
9: Optional: give a remark on your previous answer(s) if you feel it might be relevant/useful	Written			
10: I have participated in (a) previous Circularity Deck test(s)	yes/no			
11: I have worked with creative methods before	yes/no			
12: Optional: which? Also: give a remark on your previous answer if you feel it might be relevant/useful	Written			
13: I have worked with circular design methods before	yes/no			
14: Optional: which? and, give a remark on your previous answer if you feel it might be relevant/useful	Written			
15: In general: when I work on something I am... "1...very quickly bored and/or distracted" [to] "5...100% focused until the job is done"	1-5 Likert	3,0	0,5	0,82
16: Optional comments	Written			
17: I consider myself to be... "1...completely NOT creative, I can never think of something new or original" [to] "5...extremely CREATIVE, I always come up with many new and original ideas"	1-5 Likert	3,8	0,7	0,82
18: Optional comments	Written			
19: How excited are you to start working on the given case? "1 Totaly not excited, I would prefer to do anything else" [to] "5 Very excited, I can't wait to get started"	1-5 Likert	3,2	0,7	0,82
20: Optional comments	Written			
21: I prefer... "1...To focus on one task for longer periods of time" [to] "5...To have variety and often completely change what I am doing"	1-5 Likert	3,2	1,2	1,00
22: Optional comments	Written			
23: When presented with a problem I... "1...always have many ideas on how to solve it" [to] "5...I struggle to come up with even one solution"	1-5 Likert	4,0	0,5	0,82
24: Optional comments	Written			
25: When it comes to doing anything I usually... "1...do not need any motivation, ask and I will do it" [to] "5...am hesitant to do anything, I often need much incentive and/or encouragement"	1-5 Likert	2,8	0,7	0,82
26: Optional comments	Written			
27: The Circularity Deck was useful to address the purpose stated above	1-5 Likert	4,0	1,0	0,96
28: Please explain your answer (What was most useful? What was less useful? Why?)	Written			
29: The Circularity Deck was easy to understand / use	1-5 Likert	3,8	0,2	0,50
30: Please explain your answer (What was easy? What was difficult? Why?)	Written			
31: In general: The Circularity Deck helped me to not be distracted by unrelated things: "1I fully disagree" [to] "5 I completely agree"	1-5 Likert	2,6	0,8	0,50
32: Optional comments	Written			
33: In general: The Circularity Deck improved my creativity: "1 It did not, it may even have decreased it" [to] "5 It did very much improve my creativity"	1-5 Likert	4,6	0,3	0,50
34: Optional comments	Written			
35: In general: The Circularity Deck kept me motivated to work on the case: "1 Not at all, it demotivated" [to] "5 yes, it motivated me a lot"	1-5 Likert	3,6	0,3	0,58
36: Optional comments	Written			
37: The Circularity Deck helped me stay focused on the case: "1 Yes, it was all I was thinking of" [to] "5 No, it was even distracting at times"	1-5 Likert	3,6	0,3	0,58
38: Optional comments	Written			
39: The Circularity Deck gave me inspiration: "1 Yes, it was very inspiring all the time" [to] "5 No, it did not help me get more ideas at all"	1-5 Likert	4,0	0,0	0,00
40: Optional comments	Written			
41: The Circularity Deck made me enthusiastic about the case: "1 Yes, I was constantly excited, maybe I still am" [to] "5 No, it even annoyed and bored me"	1-5 Likerst	3,6	0,3	0,58
42: Optional comments	Written			
43: I liked the variety in digital and physical parts of the Circularity Deck: "1 No, I did not" [to] "5 Yes, I did"	1-5 Likert	4,2	1,2	1,15
44: Optional comments	Written			
45: I think the variety in digital and physical parts of the Circularity Deck has added value to the method: "1 No, I don't think it has added value" [to] "5 Yes, it has very much added value"	1-5 Likert	3,6	1,3	1,29
46: Optional comments	Written			
47: The Circularity Deck created/gave me a sense of progression while using it: "1 Disagreed" [to] "5 Agreed"	1-5 Likert	3,8	1,7	1,29
48: Optional comments	Written			
49: I liked the interactivity of the Circularity Deck: "1 No/what interactivity?" [to] "5 Yes!"	1-5 Likert	4,6	0,3	0,50

Table 4, part 1: Questionnaire questions, type, average answers, variance & average absolute deviation.

50: Optional comments	Written			
51: The automatic and 'big brain button' pop-ups with advice/tips/input added value and/or helped during the ideation part: “1 Totally NOT” [to] “5 YES, they where fantastic”	1-5 Likert	4,0	1,5	1,41
52: Optional comments	Written			
53: The story/narrator worked well to guide the work on the given case: “1 No, it failed” [to] “5 Yes, it was very good”	1-5 Likert	3,4	0,8	0,96
54: Optional comments	Written			
55: The story/narrator improved the overall experience of the Circularity Deck: “1 No, it decreased it” [to] “5 Yes, it improved it very much”	1-5 Likert	3,8	0,7	0,82
56: Optional comments	Written			
57: The story/narrator managed to draw and keep my attention, even during the longer parts: “1 No, I was not listening to it at all” [to] “5 Yes, I couldn't even look away”	1-5 Likert	3,6	0,3	0,30
58: Optional comments	Written			
59: I learned more about Circular design today: “1 No, not at all” [to] “5 Yes, a lot”	1-5 Likert	2,8	1,2	1,00
60: Optional comments	Written			
61: The Circularity Deck worked well to come up with ideas for the given case: “1 No, it did not” [to] “5 Yes, it worked perfect”	1-5 Likert	4,4	0,3	0,58
62: Optional comments	Written			
63: If you have any more remarks you can write them here	Written			

Table 4, part 2: Questionnaire questions, type, average answers, variance & average absolute deviation.

Question 7:
P2: “I, myself have done projects with circular design. I am currently working on a creative/ circular design tool myself, as well.”

Question 9:
P2: “I, myself have done projects with circular design. I am currently working on a creative/ circular design tool myself, as well.”

Question 12:
P2: “My bachelor final project was spend on the subject of creativity methods and techniques.”

Question 14:
P1: “I have worked with (general) design methods”
P2: “I am currently working on a circular desing method myself.”

Question 16:
P3: “It depends on my mood. (the amount of cafeine consumed may also be a factor).”
P2: “It depends a lot on how interesting it is (duh!)”

Question 18:
P4: “Im the Belbin test plant, obviously.”

Question 26:
P2: “It really depends on what it is I have to do”

Question 28:
P1: “Every new card brings back the focus”
P2: “The cards themselves where clear. The game surrounding it was a bit chaotic at times, which distracted us.”
P3: “The 90 minute session was good, but maybe more emphasis could be placed on the circular design aspects (narrow?)”
P5: “The amount of learning was on the low side, but generating ideas it certainly did.”

Question 30:
P3: “It flows quite nice, but some stuff seemed unclear as to what you were supposed to do.”

Question 32:
P2: “The alerts from ‘big brain’ where distracting at times. We lost focus on our end goal from time to time.”
P4: “It helped, but for a brainstorm of 90 minutes your attention is bound to drift away to some crazy ideas.”

Question 34:
P3: “Sitting in a group brainstorming helps anyway, but the cards provide a nice direction.”

Question 36:
P2: “Nearing the end of the session we where ‘feeling done with it’ (dutch saying indicating a growing sense of boredom).”
P3: “The random events give some nice change, keeping the creative flow going.”

Question 38:
P2: “The alerts from ‘big brain’ where distracting at times. We lost focus on our end goal from time to time.”

Question 44:
P2: “Fun with the alerts in between. That kept some suspense going/kept it exciting”

Question 48:
P1: “The amount of clutter/mess in the room kept growing bigger”
P2: “The ideas generated where not particularly realistic, yet.”
P5: “One time. When we had to answer a question before being allowed to continue.”

Question 50:
P5: “Hitting the button worked as fun”

Question 52:
“Smashing buttons is fun.”
P5: “The automatic ones didn’t do much, I think. The button ones where okay.”

Question 54:
P5: “I wasn’t really immersed or anything.”

Researcher observations:
- The language seems difficult at places and may need simplifying;
- An instruction to use the USB to start the program is missing;
- There was a numerical mistake in a countdown timer. It needs changing;
- There is a transition error between warm-up 1 and 2, this needs fixing;
- The theory explanation cards may need an improvement. One of the participants read them on his own, without sharing initially. Later they did go through them together, yet small cards may not be the right medium for this;
- The pop-up about running to the front door was too disruptive and needs an alternative;
- The 90 minute brainstorm seemed to be too long. Part of the reason was that everything taking place before that took longer than anticipated.
- F.C.V.P. needs more textual instruction, it was too hard for the participants to grasp based on the information provided.
- The narration is on the quick side and should be slowed down to make it more clear.
- The voice distortion, although thematically appropriate, is distracting and unnatural. Removing it may improve the clarity of the narrative.

General discussion & Reflection on the test

The first goal:"Does the gamification improve user engagement, while using the Circularity game?"

The main research question:"Is the Circularity game an improvement compared to the original Circularity deck?"

This had mainly to be proven by questions 27 & 29. The average scores were: Q27: 4,0 ; Q29: 3,8. The averages of the previous tests for these questions were more complicated. On average, over the 5 tests done by Konietzko et al. (2020) Q27 got a score of 4,41, and Q29 got a score of 4,30 over 56 participants. However, between every test the deck was adjusted based on the previous tests.

Looking only at the scores of the last test by Konietzko et al. (2020), we get: Q27: 4 & Q29: 3,6. Based on these numbers, taking into account that the Circularity deck has been changing between every test, and that the groups have all been of different sizes, ages and varying backgrounds it seems that the newest deck has stayed roughly the same. However, this is an inconclusive result at best due to the various inconsistencies.

At the start of this project, a test with 7 participants and the same Circularity deck as the fifth test of Konietzko et al. (2020), yielded averages of 3,29 for Q27 & 4,29 for Q29. These groups where similar in size, age and background and can be better compared to the group of this test. On Q27 an improvement is visible, where on Q29 a negative change is visible.

The improvement on Q27 is especially positive considering the fact that "learning about circular design/economy" has been added to the statement and was reported by one of the participants to be low: Q28:P5: "The amount of learning was on the low side, but generating ideas it certainly did."

Q59 & Q61 were specifically added to provide more insight on both elements of the statement separately and their scores clearly reflect the same.

Q59 (regarding the amount learned about circular economy/design): 2,8.

Q61 (regarding the supporting of generating ideas): 4,4. Averaging these to get a comparable score results in 3,6 for Q27 [(2,8+4,4)/2=3,6]. 3,6>3,29 and therefor, the new design seems slightly better than the old one when it come to meeting the goals of the statement.

The decreased score for Q29 was to be expected, considering that the original deck was only a set of cards, used in a workshop, guided by a real person using a presentation. Where as the new design is completely standalone, automated and a complete interactive digital and physical toolkit plus software program. The increased complexity of the design and the decreased personal guidance are logical and expected reasons for a lower score on Q29.

The short answer, within the contexts of the small tests: The deck has changed a lot, it seems to have improved on creativity stimulation. It seems to have decreased on circularity learning and ease-of-use. At the bottom line, it stayed roughly the same. Taking into account the small numbers of participants, these results are not conclusive.

However, this would be too short of an answer to the first goal and main question. The second and third goal and their accompanying research and questionnaire questions should be taken into account as well.

Goal 2: confirm that the gamification has a positive effect on the user experience.

Questions A, B & C

Questions A, B & C have been tested by establishing personal baselines for the participants before the prototype test and having them answer questions about these afterwards. Both before and after all questions have been asked twice in different wordings to account for interpretation variations. Table 5 shows an overview of the questions and how they are related (on the next page).

For all three questions an improvement is visible for this group (difference). What is interesting is the large variance on the beforehand questions. This can be explained by the variety of persons in the group (an industrial design student is usually quite different from a computer science & engineering student when it comes to the way they work and think). Adding to this the fact that the variance lowered for the afterwards questions, seems to indicate that, regardless of background and type of person, the redesign, the Circularity game, was beneficial for increasing engagement, creativity and motivation.

	Question nr.	Question subject	Score	Averages	Variance	Average variance	Difference	Difference in variance
Question A: Gamification improved user engagement.								
Beforehand	15	User engagement	3,0	3,1	0,5	0,85	0,2	-0,3
	21	User engagement	3,2		1,2			
Afterwards	31	User engagement	2,6	3,3	0,8	0,55		
	37	User engagement	3,6		0,3			
Question B: Gamification improved user creativity.								
	Question nr.	Question subject	Score	Averages	Variance	Average variance	Difference	Difference in variance
Beforehand	17	User creativity	3,8	3,9	0,7	0,6	0,4	-0,45
	23	User creativity	4,0		0,5			
Afterwards	33	User creativity	4,6	4,3	0,3	0,15		
	39	User creativity	4,0		0			
Question C: Gamification improved user motivation.								
	Question nr.	Question subject	Score	Averages	Variance	Average variance	Difference	Difference in variance
Beforehand	19	User motivation	3,2	3,0	0,7	0,7	0,6	-0,4
	25	User motivation	2,8		0,7			
Afterwards	35	User motivation	3,6	3,6	0,3	0,3		
	41	User motivation	3,6		0,3			

Table 5: Related questions, scores, averages and total improvement (difference). "beforehand" indicates questions asked before the test, "afterwards" indicates questions asked after the test.

The shorter answers:

A): Gamification improved user engagement.
True, but to a very limited extend.

B): Gamification improved user creativity.
True, it did improve it somewhat.

C): Gamification improved user motivation.
True, it improved it noticeably.

This on its own means that goal 2 has been achieved: The gamification has a positive effect on the user experience. Once again, at least within the context of this small test.

Goal 3: get insight in its effectiveness as a creativity tool, or question D) "How effective is the Circularity Game as a creativity tool?"

The answers to Q33, Q39 & Q61 all show that the new design is very effective as a creativity tool. These questions all inquired about how inspiring and creativity stimulating the Circularity game was and the average answer was 4,33 with an average variance of 0,2.

Specific gamification elements

Questions 43 to 58 all inquired about the effects of specific gamification elements. These are relevant to know what needs further improvement & what is good as it is.

The participants were most positive about the interactivity of the Circularity deck (Q49, score 4,6, variance 0,3). The button seemed to be one of the biggest reasons for this Q50:P5:"Hitting the button worked as fun". Q52:P2: "Smashing buttons is fun."

The narrator/story guidance was seen as the least positive (Q53, score 3,4, variance 0,8), yet it was still positive. The main complaint seems to be described by P2 at Q63: “Sometimes the next step wasn’t all that clear; It got explained during the videos but if you looked away for a moment you could have missed an important part. There was supporting text (subtitles), but reading is always a hassle/chore.” This indicates that the narrator should be improved, making it clearer and easier to understand.

The other gamification elements: variety in digital and physical elements, sense of progression creating & the automatically + button triggered pop-ups with advice, were all considered to be adding some value and having a positive effect. The scores were between 3,6 and 4,2, however the variances were high, ranging from 0,7 to 1,7 indicating that how they where experienced by the different participants varied considerably. This probably means that different things work for different participants, which is compliant with the theory about different player types (Bartle, 1996, 2003). The main takeaway from this is that different versions may be needed for different contexts and groups. More research is needed for this. In the written answers, the underscored parts indicate points of improvement.

For now, the best (based on the written answers) recommendations to improve the design would be to focus on:
- Improving the storyline: how it is brought and how immersive it is.
- Increase the amount of teaching about Circular subjects.
- Improve the flow with regards to clarity and duration of process steps.
- Add something to stimulate realism and circularity of the generated ideas.
- Smooth out the pop-ups to be less distracting, while maintaining the inspiring and energizing effects they have.

Lastly, all researcher observations need to be addressed and improved.

Note: Due to time constraints it has not been possible to apply the recommended improvements to the current prototype, but they should be applied and thoroughly tested in the next iteration of the Circularity game. Especially making the narrator voice more natural and easier to follow would be a great improvement.

To finalize

Answering the main research question: “Is the Circularity game an improvement compared to the original Circularity deck?”
Yes, for as far as these small tests can indicate, it seems to be somewhat better, specifically when it comes to stimulating ideation and improving user experience. It has not improved with regards to ease-of-use or teaching circular design/economy theory.

Answering the supporting questions A, B & C: “Does the gamification improve user engagement, creativity and motivation while using the Circularity Deck?”
Yes, it does to some extent.

With regards to the goals of this research:

Comparing the redesign to the original Circularity Deck:
There are hopeful signs to believe it may be the case that it has improved on at least some points, like the positive effects of the applied gamification. But, at some points it did not improve and may have become worse. For instance, on teaching the theory.

Confirm that the gamification has a positive effect on the user experience:
This seems to be confirmed, but further testing is needed to convincingly prove it.

Get insight in its effectiveness as a creativity tool:
It was possible to observe a very positive effect of the tool on the creativity of the participants, pointing towards the tool being an effective creativity tool. The gamification seems to be a big reason for this. Nonetheless, this also needs more testing to be certain.

Limitations & Considerations

The amount of participants was very low and no statistical significance can be derived from this prototype test. Although terms and methods have been used from the field of statistical research, none of it has been used to prove anything from that perspective. They were only used to give a more complete, understandable and comparable image.

The test can be considered valuable as a more qualitative test and an exploration. It can only be used to improve the design in the same way lean & agile methods use these kinds of tests. It points in the directions of worthwhile design choices and improvements.

The participants were all university students. Although they will be part of the group of future employees that will use these kinds of methods, they have no workplace experience yet. Tests with more representative groups, like design and development teams from companies actually exploring the possibilities of Circular economy and design, should be done in the future if this design is to be further developed.

Put simply: the results of this test are far from conclusive and are definitely no certain proof of anything. They are, however, positive indicators that this design and gamification are a worthwhile avenue to continue research and development on.

Discussion & conclusions

8. Discussion & conclusions

The Circularity game is far from a product ready for market, it is however a proof of concept. It shows that gamification can be an effective tool to improve user creativity, engagement and motivation. It also seems to be a user friendly way to bring these improvements, while at the same time providing an enjoyable way for users to be guided through a new ideation process and/or design method. Especially for the less experienced and new users it provides a good way of acquainting oneself with it and learning the new skills and theory. Adding gamification seems to have improved the Circularity deck at least in these aspects.

By comparing these results directly with the problem definition the following can be said.
Problem definition part 3: "...seems to have limited ways of stimulating multidisciplinary cooperation and innovation":
The original Circularity deck always had the option to be used by multidisciplinary teams, but only by not restricting it. It did not encourage or more directly support it. The Circularity game provides a structure, guidance and build-up that is suitable for mixed teams with varying experience levels. It starts with easy and accessible warm-up games and quickly builds towards an ideation session where everyone from any background can contribute. Especially the pop-ups keep guiding and supporting those that need more help to reach (and stay in) the higher levels of everyday creativity, while trying to not get in the way of those that are already on those levels. The Circularity game also caters to all types of players, which are more likely to be present in multidisciplinary teams. Although, it has to be said that more can be done on this point. Lastly, the Circularity game is setup in such a way that there is room for a preparatory phase (before the ideation phase) in which people can be invited and prepared and (multidisciplinary) teams can be formed in advance, there is also a set of instructions and materials for the initiator/facilitator/team-leader that can be extended. Besides this, it provides the option to have different sets of participants during the following phases, allowing for a more mixed team, improving the chances of successful creative and innovative solutions.

Problem definition part 4: "... uses gamification in a way that seems to be more a byproduct of its chosen form than a dedicated gamification approach. This possibly has led to diminished and/or even less desirable results. Developing this further might help it work even better than it already is and reach a higher creativity stimulating potential as well.":
To start, the initial gamification of the original Circularity deck seems indeed to be a by product of its original design. A set of cards simply seems to have been a convenient and interactive way for a group of people to get inspired. Which is fine, in its self. Besides this, the test does not show that the original deck had lessened or even less desirable results. That said, the test conducted with the redesign (the Cirularity game) seems to indicate that a higher potential could indeed be reached, through improved gamification. The new Circularity game makes use of all the core drives of Octalysis, making sure that all available resources and motivators are used to stimulate creativity. Specifically core drive 3 that is focused on using peoples' drive to be creative in combination with the individual creativity framework to stimulate creative output has resulted in design elements and a general flow of the game that stimulates more creativity. Therefore, it is fair to say that the problem definition has been addressed and that improvements have been made to deal with it. The test, although small and far from definitive, supports this conclusion.

However, besides all the points of improvement proposed in chapter 7 section Testing the design, the following things also may need attention:

1. Right now, the balance between digital and physical parts of the design seems to be good enough, but further research into these can likely benefit the Circularity game a lot;
2. The specific contents & gamified design elements can be optimized further. Doing this seems to be a good plan, if gamification is to be used for the improvement of either the original Circularity deck or the new Circularity game;
3. The physical form and user ergonomics aspects of the design have barely been addressed in this project. It has not been the focus of it. But even from the scope of this project and feeling the toolkit in hand, it is easy to notice that the toolkit is big. Currently it is more than twice the size of the box of an average board game. This may not be fitting for something to be used in an office setting. Also, all other haptic elements have not been looked into. Only the big soft button that was used can be seen as quite a good fit and was enjoyable to "smash", according to the test participants;
4. The narrative works, but needs testing with older, professional users as well, to make certain that it is also fitting for them. This also leads to the next point;
5. The amount of gamification, compared to the original Circularity deck, is high. Much has changed in the redesign. The benefit of this is that it made it easier to see the impact it has on aspects like creativity. However, it may be better for the Circularity deck to apply gamification in a less extensive form. This might especially be needed to get enough acceptance among older generations of users. They might be more skeptical to this kind of game-like experiences and prefer a more classical, un-enhanced format (This needs more research).
6. Furthermore, the current design of the Circularity game leaves room for at least an ecosystems (lens) phase. However, in practice, this would increase the session duration of using the Circularity game by quite a lot. Likely up to 3 hours longer. For this reason, combined with the general fact of design teams often being very busy, it is good that the different phases can be split up and spread out over multiple days. There is no reason at the moment to believe that this would have a negative impact. It may require some extra warm-ups for the following sessions, but these can also be better attuned to those sessions.
7. As mentioned, the Circularity game was not an improvement when it comes to teaching the theory of Circular economy and design to its users. In hindsight, this seems to be the result of only focusing on the ideation phase, which is mainly a short-term focused part of the game. It is aimed at getting people to be as creative as possible in a very short time. This is temporary behavior change. Getting better results on the teaching can partially be fixed by using the other phases, like the on-boarding, to do this, but this may not be enough. Looking back, this could also have been remedied, at least partially, if the RECIPE method of Nicholson (2015) had been used in parallel with Octalysis as a checklist. It was concluded in chapter 5 that Octalysis contained enough of Nicholson's work to also deal with long term behavior change. It may contain it in actuality, but in practice this was lost while using Octalyis in the design process. Had it been used, it may have been able to improve the design for its ability to teach the theory for the long term. If the Circularity game is to be further developed, it is advisable to look into this.
8. Lastly, about Octalysis as a method and framework for gamification. Octalysis was a very well usable and thorough framework, which seems well founded on a good mix of scientific theories and background. The conclusion on Octalysis from the perspective of this report is that it is and was a good method and framework to use. However, using RECIPE in parallel might have yielded a better result.

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The reader

Lastly, I want to also thank you, the reader. I’m glad that you have an interest in my work. I hope my writing was clear and that it provides you with the information you are seeking. Personally, I hope that it inspires you to take a look at the Circular economy and Circular design. I believe that they are good options for working towards a better, more sustainable future. But, if you are here for the gamification, then I am also glad. It is a powerful tool that can be used to influence the behavior of people significantly, use it wisely, to hopefully make this world a better place.

“We will take you through our methods and tests to see if you are capable of creating systemic circular solutions and are driven to work to a better future together.”

“These tests will be based on your current work and you will be able to take the results back with you, afterwards.”

“Who knows, perhaps it will already inspire some positive change in the present.”

“At the end, you will have shown that you can create thorough circular innovations, which are viable on higher levels like cities, industries and economies as well.”

“We will also be able to judge your teamwork and willingness to compromise towards a future that is good for everyone.”

“In the end you will have shown us if you would fit our company structure and beliefs.

“So, let’s get started with our tests and simulations.”

{Video transition to next segment}

“I will guide you through 3 test phases. The first one, A new idea is born, will test your circular idea generation, innovativeness & convincingness.”
“You will be generating ideas, presenting them to each other and making decisions on what to continue with.”

“The second one is: Building an ecosystem. First, it will test your skills in closing a designed circle on an industry level.
“Second, it will take you through the deeper complexities involved and judge how you deal with those.”

“The last phase, called The total package, is where you will have to take the results of the previous 2 phases and show us how well you can put them together.”
“You will be dealing with the problems arising from the complexities, solving them and working towards a presentable and usable end result.”

“Every phase will be introduced by me.”
“I will provide you with the needed theory and judge if you are ready for that phase.”
“During each phase I will be available for support and guidance where needed and appropriate. Simply press the big brain button when it is shown to be available and I will try to provide you with some support.”
“I will also keep the time and observe, to make sure your results can be compared to that of other groups.”

“Lastly, you should have already noticed the Circularity toolkit.”
“Anything in there is free for you to use as you please. If you have any materials of your own, you can use those as well.”
“We do not want to limit you, since we believe that freedom benefits creativity a lot. However, every separate layer fits a different phase or part of a phase best.”

“I feel like I have been taking the stage for way too long already.”
“It is time for a warm-up for you guys.”
“Creativity needs more than just freedom. It also needs positive energy & teamwork.”
“So, there is spaghetti and marshmallows.”

“ Make two teams and whomever builds the highest tower wins.”
“You have 5 minutes starting now.”
{Video ends}

[end of video is reached]
{instruction for warmup 1 + countdown timer appears} (screen 4)
-Users do warmup 1-
[Timer reaches zero]

{New screen appears with next video}
{Video ending warmup 1 and instructing warmup 2 plays}(screen 5)
“Well, that was chaotic and fun to watch, you can judge for yourselves who won.”
“You can shove the used spaghetti and marshmallows in the green waste bin, we will feed it to our chickens and pigs later, they will love to eat it and nothing will go to waste.”

“Next warm-up game is a little more settled down.”
“Go stand in a circle together and pick someone to start with.”
“He or she will say a word, and the person on their left will say the first word that comes to mind, associated with it.”
“ Then the next person to the left will do the same, until the last person of the circle is reached.”
“The first person will then take his first word and the word of the last person and explain to everyone why these two words are logical together.”
“Repeat this little game until everyone has been the first person once.”
“Notify me when you are done by hitting the big brain button.”
{video ends}
{transition to next instruction screen} (screen 6)

-users do warmup 2-
-users press the big brain button or “done” button-

{new screen appears with instruction video}(screen 7)
{Instruction video for warmup 3 starts playing}
“Good! You’re done. I hope you had some fun with that.”
“The point of this game was to get you associating.”
“Creativity and new ideas often come from associating two previously unrelated things and finding new relations that were not thought of previously.”
“You should be able to use this during the upcoming phases.”

“Lastly, with creative innovation, the more input and ideas, the better.”
“Therefor post a question online on your social media of choice, preferably your companies’ social media outlet if possible.”
“The question should be simple and broad, like: How can our company be more circular, do you think?”
“If you can’t use the social media of your company, you can use your personal ones if you want to, but it is no problem if you do not want to do this.”
“We will come back to this question later.”
“Let me know when you’re done.”
{Video ends}
{transition to next instruction screen} (screen 8)

-users do warmup 3-
-users press the big brain button or “done” button-

{new screen appears with instruction video}(screen 9)
{‘A new idea is born’ intro and theory instruction video plays}
“Well done! You have successfully passed our introduction and warm-up and are now officially CFC initiates, congratulations!”
“ Don’t let it go to your heads.”
“ Lets move on to the real work: phase one: a new idea is born.”
“As will be the case for every phase, we first need to give you some theoretical understanding and some instruction.”
“You can go through the a new idea is born theory in you own pace.”
“You can find the right theory cards in the Circularity toolbox.”
“It shouldn’t take more than 5 minutes. Click the “done” button when you are ready. ”
{Video stops playing}
A
{transition to next instruction screen} (screen 10)

-users go through the theory-
-users press the big brain button or “done” button-

{new screen appears with theory test question}(screen 11)
-User answers question-

[Wrong answer is given]
{transition to wrong answer screen}(screen 12)
-User reads the answer was wrong-
-users press the big brain button or “done” button-
{Go back to point *A* in script}

[Righ answer is given]
{new screen appears with instruction video}(screen 13)
{‘A new idea is born’ phase instruction video plays}
“Nice, I can see you understand the theory well enough.”
“Now, the general instructions for phase a new idea is born, can be found in the Black case in the toolkit.”
“Go through them together and notify me with the big brain button when you are starting the phase.”
{Video ends}
{transition to next instruction screen} (screen 14)

-users go through the instructions-
-users press the big brain button or “done” button-

{new screen appears with instruction video}(screen 15)
{‘A new idea is born’ starting video plays}

“Alright, let’s get this train moving.”
“I’ll start the countdown timer in a moment.”
“Remember that you can use the big brain button to call for my help, but otherwise I will be mostly silent.”
“Although, maybe I’ll drop you some goodies every once in a while if I feel like it...”
{Video ends}
{transition to next instruction screen} (screen 16)

-users do ‘A new idea is born’phase-
-users press the big brain button-

B
[Big brain button is pressed]
{pop-up appears with brainstorm support text for 5 minutes}(screen 17)
-Users use what was written in the pop-up to their advantage, or not-
{pop-up disappears after 5 minutes, big brain button becomes available again}
(screen 16)

[Big brain button is not pressed for 15 minutes]
{Go back to point *B* in script}

[Timer reaches zero]
{new screen appears with instruction video}(screen 18)
{‘A new idea is born’ wrap up video plays}
“And stop the brainstorming!”
“If your attention is with me again, please press the big brain button, so I know.”
{Video ends}

-users press the big brain button or “done” button-

{new screen appears with instruction video}(screen 19)
{Short pitch instruction video plays}
“Your next step is to pick the three best ideas, or sets of ideas, you have as a team and present them to me and each other.”

“Take a few minutes to figure out what your best ideas are, and then use the pitching templates from the toolkit to write a quick pitch for your ideas.”

“The forms can be found behind QR-2.”

“When your pitches are ready, start presenting them.”

“After the pitches you will have to chose the best idea to continue with.”

“If you have that, then hit the big brain button to notify me.”

“Oh, do not throw away the other ideas, who knows, there may be a place for them later.”
{Video ends}
{transition to next instruction screen} (screen 20)

-users do pitches-
-users press the big brain button or “done” button-

{new screen appears with instruction video}(screen 21)
{F.C.V.P. instruction video plays}
“Awesome! There is one last thing to do in this phase, and that is to write the Focal Circular Value Proposition of your idea.”

“That is, in one brief sentence:
What the idea focuses on, how it is circular & what the value gain is.”

“Once you have that, it is time for a 15 minute break.”

“You can also think of it during your break.”

“Let me know when your break is over and you’re ready to move on to the second phase: building an ecosystem.
{Video ends}
{transition to next instruction screen} (screen 22)

-users formulate F.C.V.P.-
-users press the big brain button or “done” button-

{new screen appears with phase choice}(screen 23)

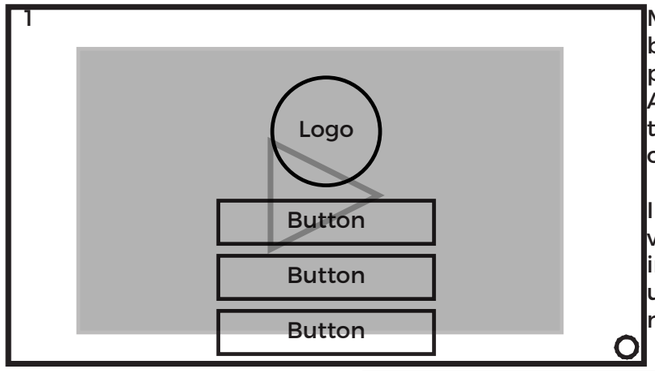
-user makes choice-
-user clicks button of choice-

[Continue button is clicked]
{advance to first screen of the next phase “building an ecosystem”} (screen 24)

[Exit button is clicked]
{return to main menu} (screen 2)

Note: a script for the next phases was written at some point, but the next phases are out of scope for this project and adding them would therefor be pointless.

Appendix 4: Circularity game ‘A new idea is born’ wireframes



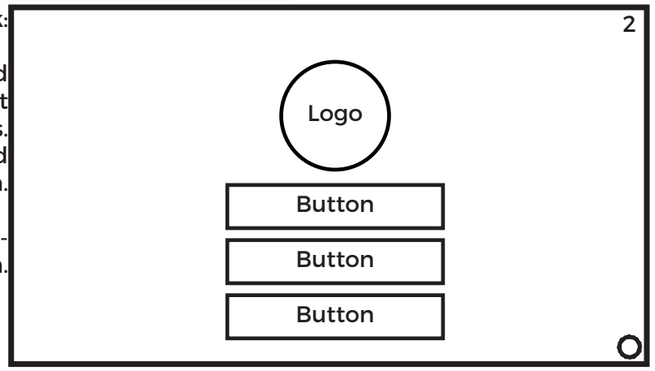
Main screen with logo and buttons starting the different phases.
Also a button for settings and to exit the program. (is present on every screen.)

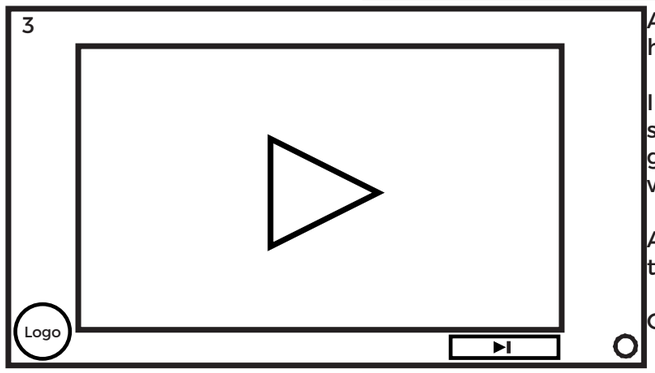
Initially there is an instructional video blocking access, instructing to plug-in the button and using that to continue to the menu.

After the button press check:

Main screen with logo and buttons starting the different phases.
Also a button for settings and to exit the program.

The Circularity Deck logo is visible on every screen.





After button to start phase one has been clicked:

Introductory video setting the stage for the narrative and giving instructions for the first warmup.

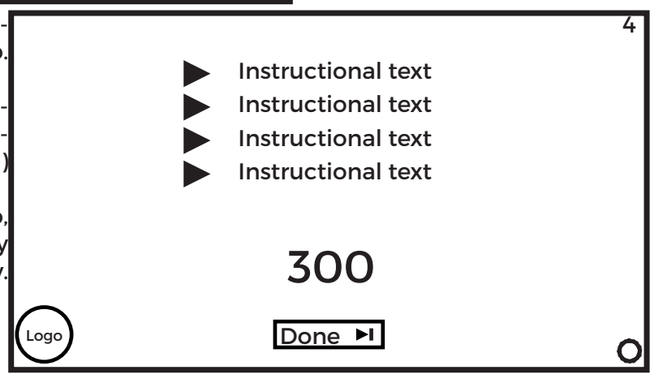
Automaticaly ends and transitions to next screen.

Optional skip button.

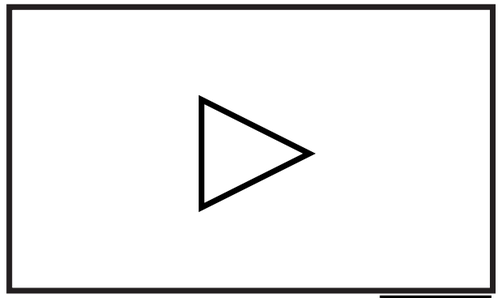
Instructional summary of previous video.

Countdown timer for competitive warmup game 1. (5 minutes)

After the timer reaches zero, the next screen and video play automatically.



5



Auto play video, signaling the end of warmup 1.

Video gives instructions for warmup game 2.

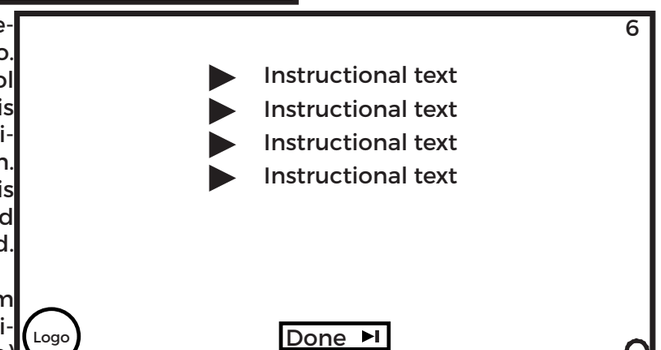
automatically transitions to next screen after the video.

Optional skip button.

Instructional summary of previous video.
A button to manually control going to the next stage. This can also be done with the priorly connected button. Using that physical button is the preferred and instructed method.

No automatic transition from this screen. (warmup 2 is variable in length)

6



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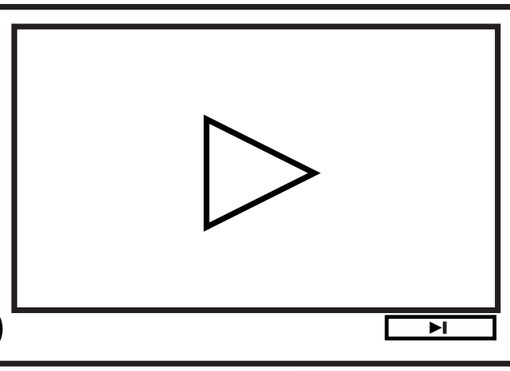


Video ending warmup 2 and giving instructions for warmup 3.

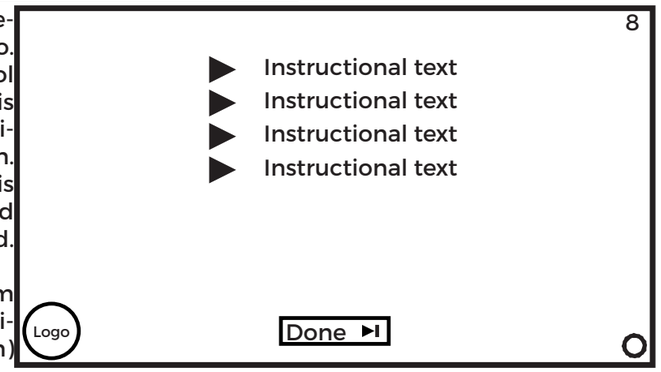
automatically transitions to next screen after the video.

Optional skip button.

Instructional summary of previous video.
A button to manually control going to the next stage. This can also be done with the priorly connected button. Using that physical button is the preferred and instructed method.

No automatic transition from this screen. (warmup 3 is variable in length)

8



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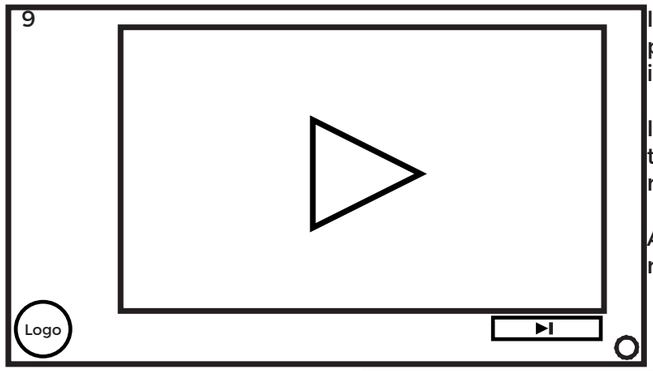


Intro to 'A new idea is born'-phase (Ideation phase) theory instruction.

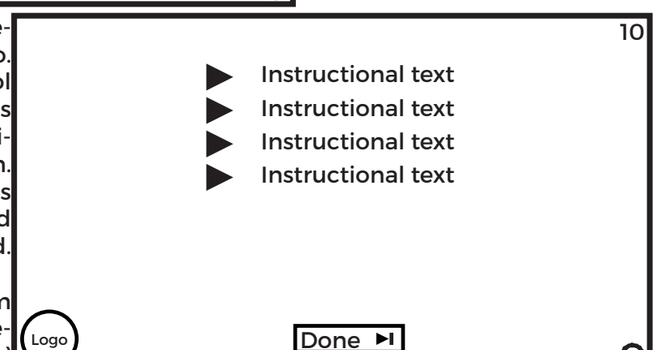
Instructs to go through the theory about circular design needed for the next part.

Automatically transitions to the next screen after video ends.

Instructional summary of previous video.
A button to manually control going to the next stage. This can also be done with the priorly connected button. Using that physical button is the preferred and instructed method.

No automatic transition from this screen. (going through theory is variable in length)

10



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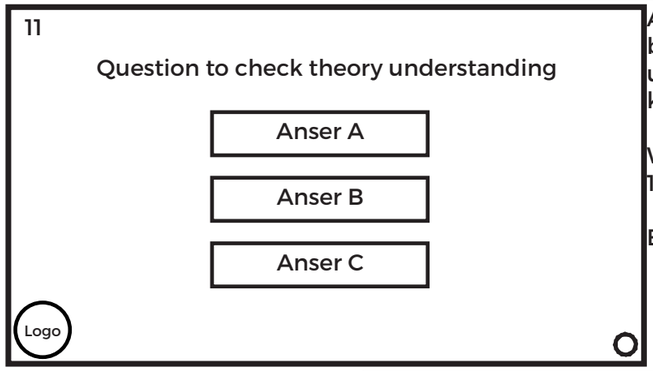


A multiple choice question to be answered correctly by the users, to check their theory knowledge.

Wrong answer leads to screen 12, right answer to screen 13.

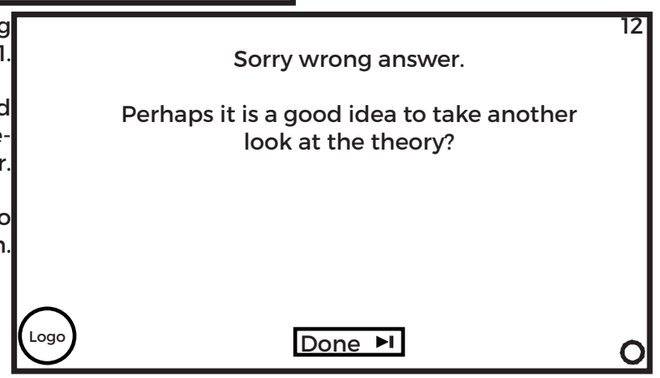
Each answer is also a button.

Screen in case of the wrong answer given at screen 11.

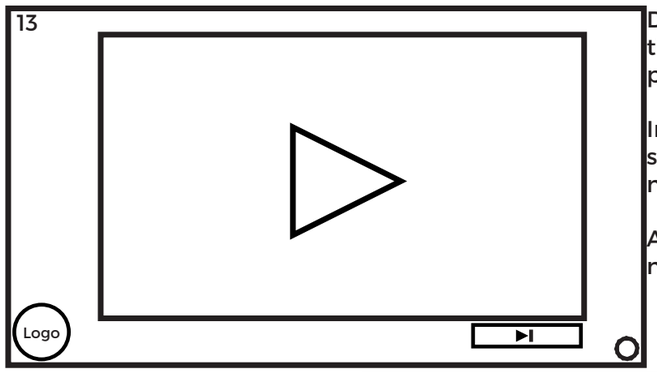
Text to show it was wrong and to encourage learning the theory better.

Done button leads back to screen 10 with the question.

12



13



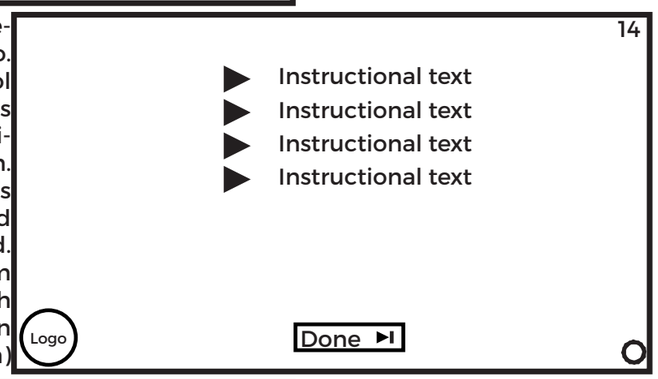
Directing video to the instructions for 'A new idea is born'-phase (Ideation phase).

Instructs to go through the instructions about how to do the next phase.

Automatically transitions to the next screen after video ends.

Instructional summary of previous video.
A button to manually control going to the next stage. This can also be done with the priorly connected button.
Using that physical button is the preferred and instructed method.
No automatic transition from this screen. (going through the instructions is variable in length)

14



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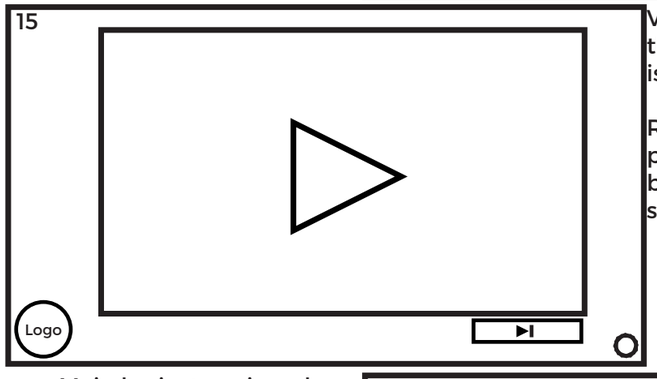


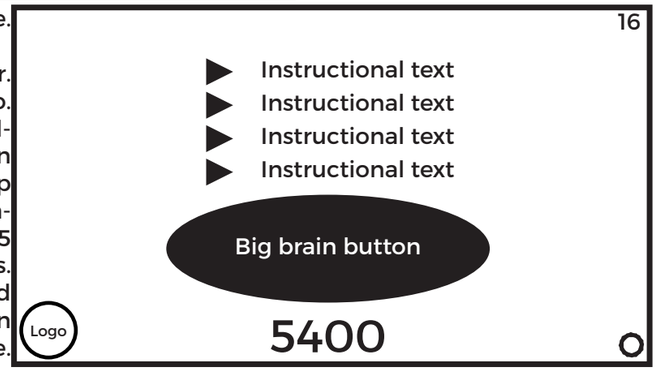
Video indicating the start of the ideation phase: 'A new idea is born'.

Reminding users that the next part is timed and that the button can be used to call for some form of assistance.

Main brainstorming phase.

90 minute countdown timer.
Summary of latest video.
Big brain button comes available after 5 minutes and can be used to trigger a pop-up that gives input to the brainstorm. limited to once every 5 minutes.
The button can be used through the on-screen version or the physical one.

16



17

Pop-up text with tips, tricks, instructions, assignments and other things to improve and stimulate the ongoing brainstorm session.

Logo

5400

Pop-up screen that stays up for 5 minutes, providing the users with something valuable.

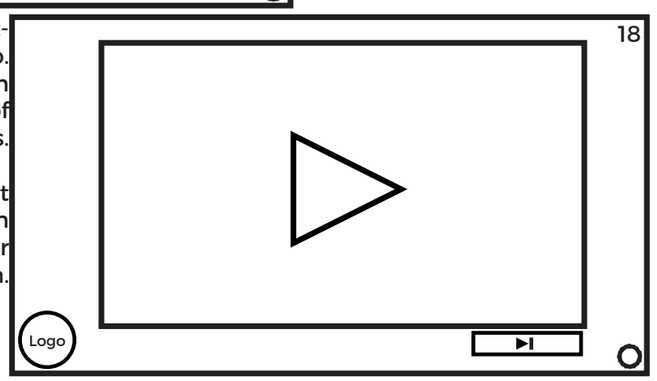
Will appear after use of the big brain button, or every 15 minutes if it has not yet been used during that time.

Timer is in seconds, to keep a sense of urgency and stimulate energetic engagement.

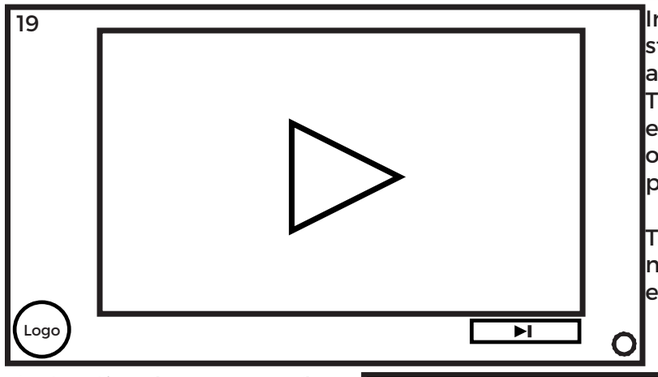
Automatic video after countdown timer has reached zero. It stops the brainstorm session and asks for the attention of the users.

Will transition to the next screen if the physical big brain button has been pressed, or the on-screen skip button.

18



19

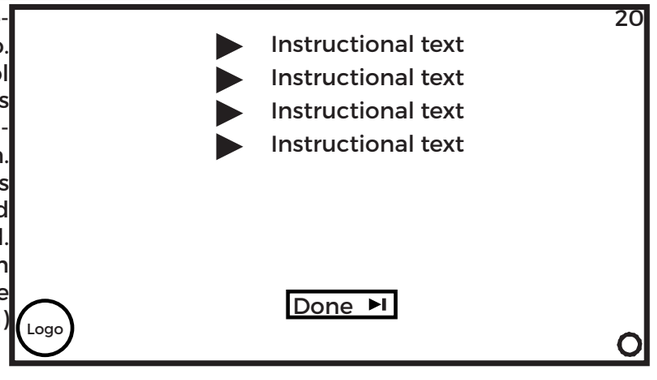


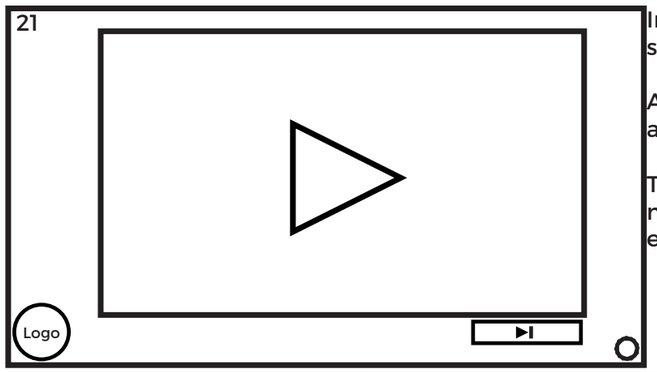
Instructional video on the next step: bundeling the best ideas and creating short pitches. These pitches will be presented to eachother and the best one needs to be democratically picked to continue with.

The next screen appears automatically after the video has ended.

Instructional summary of previous video.
A button to manually control going to the next stage. This can also be done with the priorly connected button.
Using that physical button is the preferred and instructed method.
No automatic transition from this screen. (pitching is variable in length)

20



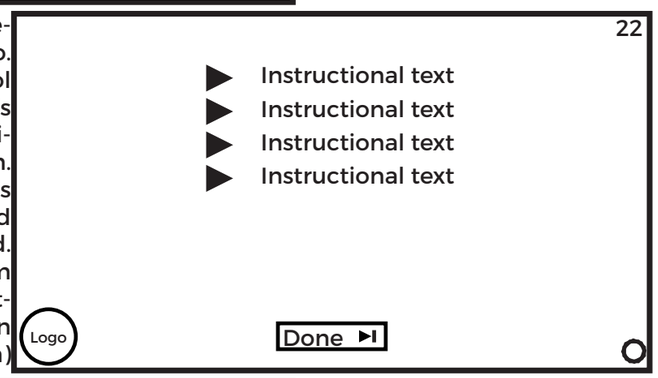


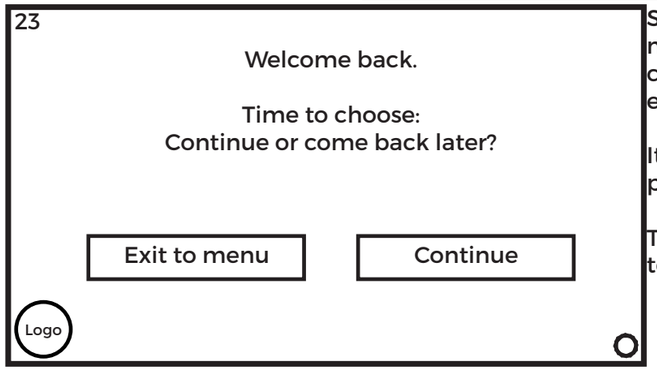
Instructional video on the next step: formulating an F.C.V.P.

Also suggesting to take a break at this point.

The next screen appears automatically after the video has ended.

Instructional summary of previous video.
A button to manually control going to the next stage. This can also be done with the priorly connected button. Using that physical button is the preferred and instructed method.
No automatic transition from this screen. (F.C.V.P. formulating and break is variable in length)





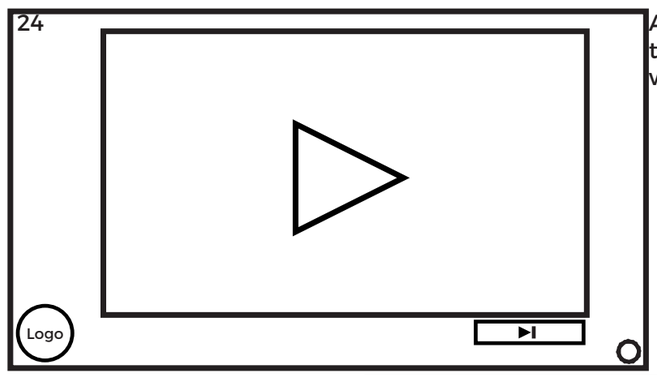
Screen with welcome back message and a choice to either continue to the next phase or exit the program.

It is possible to start from this point from the main menu.

The choices are on-screen buttons.

Every next phase follows a similar pattern as the first one. this is displayed in the next wireframes. This allows for the same gamification design for every phase, without compromising the posibilities to shape the phase to what is needed in it.

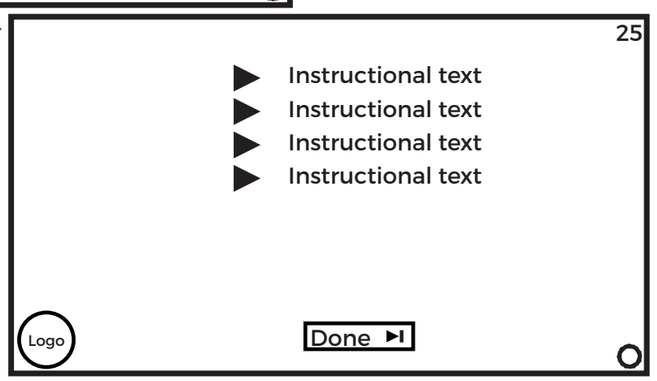
The general pattern is always:
1) introduce, learn, proof knowledge (screens 24 & 25)
2) do main part, evaluate results (screens 26, 27 & 28)
3) wrap up & prepare for the next phase (screens 29 - 30)

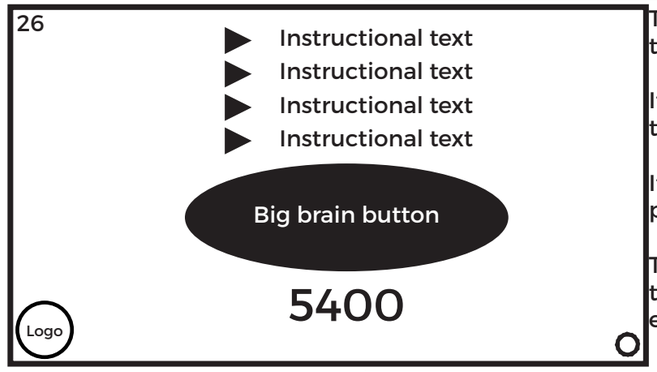


An instructional video guiding the users in the next step they will take.

A screen with the written summary of the previous video and the option to continue to the next step.

These screens (24 & 25) are repeated, including a theory lesson (screen 9 & 10), a theory verification question (screen 11 & 12) and phase instruction (screen 13 & 14), until the main part is reached (screen 16 & 17).





The main screen is always timed.

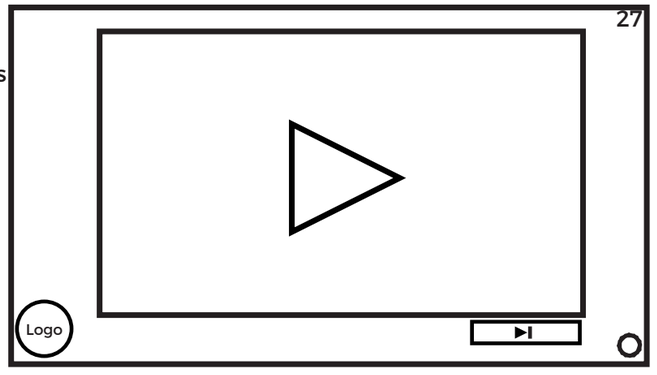
It has the basic instructions for the current phase.

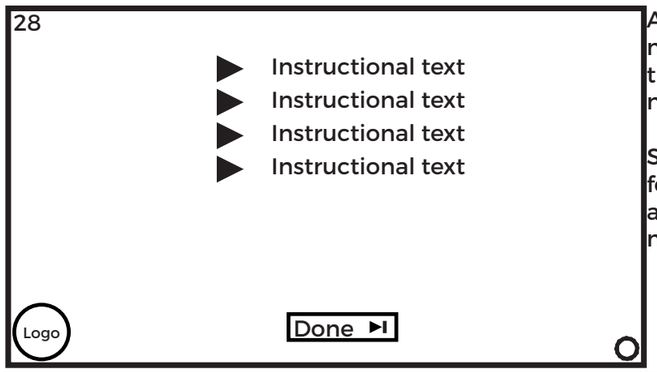
It has a support button that provides supporting pop-up.

The pop-ups also appear automatically when not used enough (once per 15 minutes).

The main phase is always ended with a new video, asking attention and wrapping up this part.

It transitions to the last steps needed for this phase and prepares for the next one.

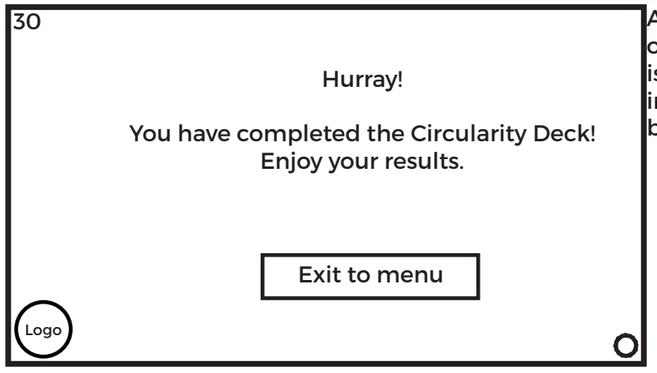




A screen with the written summary of the previous video and the option to continue to the next step.

Screens 28 & 29 are repeated for every step, as many times as there are steps needed to move to the next phase.

Every phase ends with the opportunity for taking a break and a choice to continue now or come back later.



After the last phase, instead of a pause and a choice, there is a celebratory screen signifying that the whole session has been finished.

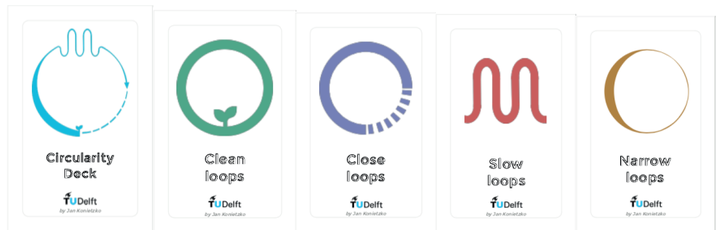
Appendix 5a: Circularity deck workshops questionnaire (feedback form)

(Konietzko, Bocken, & Hultink, 2020)

FEEDBACK FORM

The purpose of the Circularity Deck is to learn and ideate for a circular economy.

Circularity Deck



1. The Circularity Deck was useful to address the purpose stated above:

Do not agree at all	0	1	2	3	4	5	*Fully agree*

Please explain your answer (What was most useful? What was less useful? Why?)

……
.

……
.

……
.

2. The Circularity Deck was easy to understand / use:

Do not agree at all	0	1	2	3	4	5	*Fully agree*

Please explain your answer (What was easy? What was difficult? Why?)

……
.

……
.

……
.

Appendix 5b: Circularity game workshop questionnaire

Circularity Deck questionnaire

There are two parts to this questionnaire. The first is to be filled in before the start of the workshop, the second after the workshop. The results will be processed anonymously after the workshop.

1. **What is your name? (only needed during this workshop, this form will be processed anonymously afterwards. You can also use other indicators to make sure you get your form back after the workshop for the second part of this questionnaire.)**

2. **What is your age?**

3. **What do you study/what is your work?**

Before the workshop

Fill in this part before the workshop starts.

4. **How well do you understand the English language?**
Markeer slechts één ovaal.

	1	2	3	4	5	
Very poorly/bad	◯	◯	◯	◯	◯	Near perfect/native speaker

5. **I was, prior to this workshop, aware of Circular Economy**
Markeer slechts één ovaal.

	0	1	2	3	4	
Completely unaware	◯	◯	◯	◯	◯	It is my specialty

6. **I was, prior to this workshop, aware of Circular Design**
Markeer slechts één ovaal.

	0	1	2	3	4	
Completely unaware	◯	◯	◯	◯	◯	It is my specialty

7. **Optional: give a remark on your previous answer(s) if you feel it might be relevant/useful**

8. **I'm knowledgeable about Circular Economy and/or Design**
Markeer slechts één ovaal.

	0	1	2	3	4	
Not at all	◯	◯	◯	◯	◯	Very knowledgeable

9. **Optional: give a remark on your previous answer(s) if you feel it might be relevant/useful**

10. **I have participated in (a) previous Circularity Deck test(s)**
Markeer slechts één ovaal.

- ◯ Yes
- ◯ No

11. **I have worked with creative methods before**
Markeer slechts één ovaal.

- ◯ yes
- ◯ No

12. **Optional: which? Also: give a remark on your previous answer if you feel it might be relevant/useful**

13. **I have worked with circular design methods before**
Markeer slechts één ovaal.

- ◯ yes
- ◯ No

14. **Optional: which? and, give a remark on your previous answer if you feel it might be relevant/useful**

15. **In general: when I work on something I am...**
Markeer slechts één ovaal.

	1	2	3	4	5	
...very quickly bored and/or distracted						...100% focused until the job is done

16. **Optional comments**

17. **I consider myself to be...**
Markeer slechts één ovaal.

	1	2	3	4	5	
...completely NOT creative, I can never think of something new or original						...extremely CREATIVE, I always come up with many new and original ideas

18. **Optional comments**

19. **How excited are you to start working on the given case?**
Markeer slechts één ovaal.

	1	2	3	4	5	
Totaly not excited, I would prefer to do anything else						Very excited, I can't wait to get started

20. **Optional comments**

21. **I prefer...**
Markeer slechts één ovaal.

	1	2	3	4	5	
...To focus on one task for longer periods of time						...To have variety and often completely change what I am doing

22. **Optional comments**

23. **When presented with a problem I...**
Markeer slechts één ovaal.

	1	2	3	4	5	
...always have many ideas on how to solve it						...I struggle to come up with even one solution

24. **Optional comments**

25. **When it comes to doing anything I usually...**
Markeer slechts één ovaal.

	1	2	3	4	5	
...do not need any motivation, ask and I will do it						...am hesitant to do anything, I often need much incentive and/or encouragement

26. **Optional comments**

After the workshop

Only answer these questions after you have participated in the workshop.

Feedback form

The purpose of the Circularity Deck is to learn about Circular economy & to generate actionable ideas on how to design and innovate for a circular economy.

27. **The Circularity Deck was useful to address the purpose stated above**
Markeer slechts één ovaal.

0	1	2	3	4	5
◯	◯	◯	◯	◯	◯

28. **Please explain your answer (What was most useful? What was less useful? Why?)**

29. **The Circularity Deck was easy to understand / use**
Markeer slechts één ovaal.

0	1	2	3	4	5
◯	◯	◯	◯	◯	◯

30. **Please explain your answer (What was easy? What was difficult? Why?)**

31. **In general: The Circularity Deck helped me to not be distracted by unrelated things**
Markeer slechts één ovaal.

	1	2	3	4	5	
I fully disagree	◯	◯	◯	◯	◯	I completely agree

32. **Optional comments**

33. **In general: The Circularity Deck improved my creativity**
Markeer slechts één ovaal.

	1	2	3	4	5	
It did not, it may even have decreased it	◯	◯	◯	◯	◯	It did very much improve my creativity

34. **Optional comments**

35. **In general: The Circularity Deck kept me motivated to work on the case**
Markeer slechts één ovaal.

	1	2	3	4	5	
Not at all, it demotivated	◯	◯	◯	◯	◯	yes, it motivated me a lot

36. **Optional comments**

37. **The Circularity Deck helped me stay focused on the case**
Markeer slechts één ovaal.

	1	2	3	4	5	
Yes, it was all I was thinking of	◯	◯	◯	◯	◯	No, it was even distracting at times

38. **Optional comments**

39. **The Circularity Deck gave me inspiration**
Markeer slechts één ovaal.

	1	2	3	4	5	
Yes, it was very inspiring all the time	◯	◯	◯	◯	◯	No, it did not help me get more ideas at all

40. **Optional comments**

41. **The Circularity Deck made me enthusiastic about the case**
Markeer slechts één ovaal.

	1	2	3	4	5	
Yes, I was constantly excited, maybe I still am	◯	◯	◯	◯	◯	No, it even annoyed and bored me

42. **Optional comments**

43. **I liked the variety in digital and physical parts of the Circularity Deck**
Markeer slechts één ovaal.

	1	2	3	4	5	
No, I did not	◯	◯	◯	◯	◯	Yes, I did

44. **Optional comments**

45. **I think the variety in digital and physical parts of the Circularity Deck has added value to the method**
Markeer slechts één ovaal.

	1	2	3	4	5	
No, I don't think it has added value	◯	◯	◯	◯	◯	Yes, it has very much added value

46. **Optional comments**

47. **The Circularity Deck created/gave me a sense of progression while using it**
Markeer slechts één ovaal.

	1	2	3	4	5	
Disagreed	◯	◯	◯	◯	◯	Agreed

48. **Optional comments**

49. **I liked the interactivity of the Circularity Deck**
Markeer slechts één ovaal.

	1	2	3	4	5	
No/what interactivity?	◯	◯	◯	◯	◯	Yes!

50. **Optional comments**

51. **The automatic and 'big brain button' pop-ups with advice/tips/input added value and/or helped during the ideation part**
Markeer slechts één ovaal.

	1	2	3	4	5	
Totally NOT	◯	◯	◯	◯	◯	YES, they where fantastic

52. **Optional comments**

53. **The story/narrator worked well to guide the work on the given case**
Markeer slechts één ovaal.

	1	2	3	4	5	
No, it failed	◯	◯	◯	◯	◯	Yes, it was very good

54. **Optional comments**

55. **The story/narrator improved the overall experience of the Circularity Deck**
Markeer slechts één ovaal.

	1	2	3	4	5	
No, it decreased it	◯	◯	◯	◯	◯	Yes, it improved it very much

56. **Optional comments**

57. **The story/narrator managed to draw and keep my attention, even during the longer parts**
Markeer slechts één ovaal.

	1	2	3	4	5	
No, I was not listening to it at all	◯	◯	◯	◯	◯	Yes, I couldn't even look away

58. **Optional comments**

59. **I learned more about Circular design today**
Markeer slechts één ovaal.

	1	2	3	4	5	
No, not at all	◯	◯	◯	◯	◯	Yes, a lot

60. **Optional comments**

61. **The Circularity Deck worked well to come up with ideas for the given case**
Markeer slechts één ovaal.

	1	2	3	4	5	
No, it did not	◯	◯	◯	◯	◯	Yes, it worked perfect

62. **Optional comments**

63. **If you have any more remarks you can write them here**

Appendix 6: Design element and their relations to theories

The solutions have been coded as follows: The first letter of the subject it is a solution for, followed by the corresponding number. For instance C1.1 is core 1, solution 1: *"Heroism: Be better, save the world, be an example. Lead, cooperate, reform."* Ri.1 is Random ideas, solution 1: Narrator/guide: *"something or someone providing a story, context and guidance."*

The toolkit			
Element	Code	Explanation	Framework for individual creativity
Foreshadowed map on outside of lids	C2.3 & C6.2	Forming stages in the future that can be reached. Triggering the drive to get what you can't have yet.	
Revealed map on inside of lids (including slide out map)	C2.1 & C2.2 & C2.3	Give rewards for doing this and create the sense of progressing. The map shows where you have gotten to.	
Lids staying open on their own	C2.1 & C2.2 & C2.3	By staying/standing open, this part is unlocked. You past it and can see what you have achieved already.	
Hidden compartments (including slide out map)	C2.2 & C3.1 & C6.3 & C7.1 & C8.2	It makes people curious and wanting to not miss an opportunity. Finding it is satisfying and feels rewarding.	
Segmentation per phase	C2.1 & C2.3 & C6.2 & C6.3	On the one hand it creates a sense of progressing, making it feel usefull. It also locks other parts, triggering the desire to want to get them as well.	
Different compartments containing materials	C2.3 & C3.1	Making sure there is variation in what can be used, and making sure it is spread out over the course of the game	
The toolkit as a whole/as an design element itself	C3.1 & C7.1 & Gt.1	It is the vessel that makes all the other parts possible, like it being a mixed interactive game.	
The toolkit contents			
Element	Code	Explanation	
USB stick with program	C3.1 & C7.1 & Ri.1 & Gt.1	It provides extra variety in tools by going digital, and people get curious what is on it. It also makes the narrator & mixed interactive game possible	
The instructions for the facilitator	C2.3 & Gt.1	It helps with creating the staging and it allows for the game to be played, without needing wasteful extras in the toolkit	
The big brain button (oversized USB 'Enter' key)	C3.1 & C3.3 & C3.4 & C6.2 & C7.1 & Gt.1	It enables interaction, facilitates the use of the other elements and is itself creating surprises and curiosity.	
Instructions booklet	C2.1 & C3.1 & C5.1 & Gt.1	Creating progress, providing variation in things to do and use making it a mixed game. There is one booklet, so it forces people to go through it together.	
Blindfolds	C3.1 & C3.3 & C3.4 & C7.1 & Gt.1	Very disruptive measure, to force people to think and associate differently. It is also very surprising, creating possible delight.	Body, materials places spaces
Method cards	C2.1 & C3.1 & C5.1 & Gt.1	See intructions booklet	
The Circularity Deck by J. Konietzko (2019)	C2.3 & C3.1 & C4.1 & C5.1 & C7.1 & C8.2 & Gt.1	The deck of cards provides a new method and staging of steps. It also requires the grouping of people, to mix skills , be social and work together. The amount of cards also creates the desire to see them all, to avoid missing out on that one idea	Head
Role play badges	C2.2 & C3.1 & C3.2 & C3.4 & C4.1 & C6.2	Specific way of creating variation and disruption. It also forces people to think and act in specific ways. Lastly, it limits people, driving them to make the most of it, or wanting to be able to go beyond their limits. This stimulates ideation and investment in the game	heart
QR1: link to surprise outside info	C3.1 & C3.3 & C5.2 & C7.1 & C8.2 & Gt.1	Disruption, mixing tools, it surprises.	Head, materials places spaces
QR2: link to pitch forms	C2.1 & C3.1 & C4.2 & C5.1 & C8.1& C8.2 & Gt.1	A way of staging and creating a mixed game. It also motivates to collect all the good things, creating a sense of ownership which is satisfying. It also is driven by not wanting to forget anything	
Easter egg 1: Children's moulding clay (in hidden compartment)	C3.1 & C3.4 & C6.3 & C7.1 C8.2 & Gt.1	Adding a new method and the satisfaction of finding something hidden and being surprised by it. it is another part of the mixed game.	Heart, body
Magnets (meant for ecosystem phase, yet included for core 3 & 7)	C2.1 & C2.3 & C3.1 & Gt.1	Included for the phasing, creating the sense of thing to come and things you want to reach.	Materials places spaces
Figurines (meant for ecosystem phase, yet included for core 3 & 7)	C2.1 & C2.3 & C3.1 & Gt.1	Included for the phasing, creating the sense of thing to come and things you want to reach.	Materials places spaces

The to buy list contents		*: marked items are considered to be crucial to have. Any other item on the list are recommended.	
Element	Code	Explanation	
Writing equipment: ballpoints, fineliners, markers, pencils, etc. *	C2.1 & C2.3 & C3.1 & Gt.1	Mainly facilitation, but the elements all provide the variety in tools and the possibilty to have different stages of the game.	materials places spaces
White-board markers *	C2.1 & C2.3 & C3.1 & Gt.1	Mainly facilitation, but the elements all provide the variety in tools and the possibilty to have different stages of the game.	materials places spaces
Post-its, sticky notes, or similar *	C2.1 & C2.3 & C3.1 & Gt.1	Mainly facilitation, but the elements all provide the variety in tools and the possibilty to have different stages of the game.	materials places spaces
A3 (or A4) white paper*	C2.1 & C2.3 & C3.1 & Gt.1	Mainly facilitation, but the elements all provide the variety in tools and the possibilty to have different stages of the game.	
1 pack of uncooked spaghetti (For a warm-up game)	C3.1 & C4.1 & C5.1 & Gt.1	Mainly facilitation, but the elements all provide the variety in tools and the possibilty to have different stages of the game.	body, materials places spaces
1 pack of marshmallows (For a warm-up game)	C3.1 & C4.1 & C5.1 & Gt.1	Mainly facilitation, but the elements all provide the variety in tools and the possibilty to have different stages of the game.	body, materials places spaces
push-pins (if you want to use a cork board)	C2.1 & C2.3 & C3.1 & Gt.1	Mainly facilitation, but the elements all provide the variety in tools and the possibilty to have different stages of the game.	body, materials places spaces
yarn or very thin rope	C2.1 & C2.3 & C3.1 & Gt.1	Mainly facilitation, but the elements all provide the variety in tools and the possibilty to have different stages of the game.	body, materials places spaces
scissors	C2.1 & C2.3 & C3.1 & Gt.1	Mainly facilitation, but the elements all provide the variety in tools and the possibilty to have different stages of the game.	body, materials places spaces
glue	C2.1 & C2.3 & C3.1 & Gt.1	Mainly facilitation, but the elements all provide the variety in tools and the possibilty to have different stages of the game.	body, materials places spaces
(scotch) tape	C2.1 & C2.3 & C3.1 & Gt.1	Mainly facilitation, but the elements all provide the variety in tools and the possibilty to have different stages of the game.	body, materials places spaces
Any other brainstorm and/or creative materials that your team may prefer.	Catch all caviat	Giving freedom to the facilitator to also use whatever they are comfortable with and used to. Allowing them to go more varied than the Circularity game provides.	body, materials places spaces

The program		Some elements, like simple buttons, summary texts & logos have been left out. Their only purpose is enabling the functionalities of the program or providing extra clarity	
Element	Code	Explanation	
Videos (all combined)(codes & explanation apply to all videos)	C2.1 & C2.2. & C2.3 & 7.1 & **Ri.1** Gt.1 & Th.1	All videos are for guiding and staging the flow of the game and create a sense of development and accomplishment. They all create a stage gated progression. They are also the main vessel to get the narrative across and create the setting for the gamified activities. All further codes and explanations are specifically added to those videos	Head, heart
Video main menu	C2.2 & C3.1 & C3.2 & C3.4 & C4.1 & C6.2	allowing for the functionalities. It also immdiately draws people in. It also delays them, making them want to get started even more	
Video introduction + warmup 1	C1.1 & C1.2 & C1.3 + C3.1 & C3.4 & C4.1 & C5.1 & C7.1 & C8.1 & C8.2 & Gt.1	Setting the tone and urgency, providing variation in activities and specifically binding the group to playing the game. They are challenged to proof themselves. Besides this the warmup is the first method in action, requiring teamwork, competition, surprising them and making them want to be the best. It combines a multitude of powerfull drives to kick the group into action.	
Video warmup 1 to 2 transition	C3.1 & C3.2 & C3.3 & C3.4 & C7.1 & Gt.1	Totally diferent method to use, creating quite some surprising moments, motivating them to keep using it.	
Video warmup 2 to 3 transition	C3.1 C3.3 & C5.2 & C5.3 & Gt.1	Another new method, now also including social interactions, which can be motivating to many people.	
Video Ideation phase introduction + theory instruction	C2.1 & C2.2 & C5.1 & C6.3	It introduces the next step, rewarding progress and making it noticable. It also makes sure people have to work together and can't continue if they do not finish the next part	
Video ideation theory to instruction transititon	C2.1 & C2.2 & C5.1 & C6.3	Similar to the above one, but without introduction to a whole new phase.	
Video ideation brainstorm kick-off	C2.1 & C2.2 & C5.1 & C6.3 & C7.1 & C8.2	Praising their progression, spurring them on, unlocking the actual main part. It also creates a sense of urgency, introducing a timer they feel they may have to 'beat'.	
Video ideation end + attention grab	C2.1 & C2.2 & C2.3	Ending the previous phase, moving on to the next one. Creating a sense of progress to motivate	
Video pitches	C2.1 & C4.1 & C4.2 & C5.1 & C8.1 & Gt.1	Wrapping up and bundling the results is satisfying and motivating. Seeing what has been created and getting to show it of is encouraging. Doing it in a social group also provides motivation to do it properly. It is also a new tool in the interactive mix.	
Video F.C.V.P.	C5.1 & C8.2	Formulating the core of the idea together. It creates the feeling of working together, but they also have to make sure they are not forgetting something.	
Big brain button navigation functionality (go to next screen)	C3.2 & C3.3 & C3.4 &C6.2 & C6.3 & C7.1 & C8.2	Pushing a button to continue creates a motivating sense of progress and accomplishment. Curiosity also motivates to press it... what it next?	
Countdown timers	C1.3 & C6.1 & C8.2	Creating pressure to spur the group into action. “So much to do, so little time. We NEED to hurry!”	
Automatic (timer based) transitions	C2.3 & Ri.1	Sense of progress and staging. The feeling of going forward.	
A/B/C theory test questions	C1.2 & C2.3 & C5.1 & Gt.1	Gaining knowledge for ones self and showing it off, answering it together through teamwork. These all motivate to get the answer right and know the theory.	
Wrong answer feedback screen	C2.1 & C2.2 & C5.1	Social pressure to get it right next time and to be able to continue. Avoiding failure.	
Digital & physical big brain button (request input functionality)	C3.1 & C3.4 C6.2 & C6.3 & C7.1 & C8.2 & Gt.1	It provides various methods and inputs. Making people curious to use it, but also afraid of missing some extra valuable bit. They will want to keep using it, especially when they are slowing down or nearing the end of the session.	
Pop-up texts	C2.2 & C3.1 & C3.3 & C3.4 & C7.1 & C8.2 & Gt.1	Surprises that induce curiosity. They provides variations in methods and tools and things to do, spurring the creativity and ideation further on.	
Pop-up texts: Here's an idea: How about you try to only draw an idea? Don't use words for a change.	C3.1 & 6.2	New method to try, limitation in options to overcome	Head, body, materials places spaces

Pop-up texts: Fitness of body and mind: For the next 5 minutes: no sitting allowed!	C3.4	Disrupting the status quo, stimulating new associations and creativity	Body, materials places spaces
Pop-up texts: Did you know this? Every layer of the toolbox has something hidden in one way or another. If you find it, it may help you...	C7.1 & C8.2	Triggering curiosity and fear of missing out, motivating to go search and find that new bit of input.	Head, body, materials places spaces
Pop-up texts: Crossfire pop-quiz: One person says a problem he thinks that needs solving. The others quickly state solutions they can think of.	C3.1 & C5.1	Triggering people to work together more, to create ideas, in a new way, not used before.	head
Pop-up texts: Social....? No phones or tablets allowed for as long as this rule is on screen.	C5.1 & C6.2	Forcing a more social situation for now and creating the desire to use the devices later, which can then provide new insights and associations.	materials places spaces
Pop-up texts: What do you think? Is it better to use less or recirculate more?	C5.1 & C8.1	Stimulating debate and honest looking at the results. Motivating people to be sure about what they have, through fear of failure and social pressure.	head
Pop-up texts: Thank you very much. Compliment each other on ne or more things done during this session.	C5.1 & C7.1	Possitive social feedback. It always feels good to get a compliment and gives new energy and a good mood. Reinvigorating the session.	heart
Pop-up texts: New rule: You are not allowed to talk as long as this rule is on screen	C3.4 & C6.3	Motivate by dirsupting the status quo and giving a problem to be overcome. Even if it does not work for the 5 minutes it is up, the motivation to express all kinds of thoughts afterwards is big, because they couldn't earlier.	head, body
Pop-up texts: What about this? Have you tried to combine different strategies and examples? If so, also the unlikely combinations?	C3.3	New method, given from an outside source. It motivates to at least give it a try.	head
Pop-up texts: Three little birds. This is going to be fun: Sing a small song together...if you dare.	C3.4	Very disruptive and fun. If the anxiety gets pushed away, it is fun to do and may create new ideas and motivate people into further working together. It is also a different outlet, giving opportunity to show new skills and insights	heart, body
Pop-up texts: maybe you can find some inspiration here [QR-code displayed linking to an outside Circular economy website]	C3.3	New method, given from an outside source. It motivates to at least give it a try.	head
Pop-up texts: Power minute!!! Run to the front door, take a deep breath and run back here. The first one to tap the toolbox wins.	C3.4	Very disruptive and fun. If the anxiety gets pushed away, it is fun to do and may create new ideas and motivate people into further working together. It is also a different outlet, giving opportunity to show new skills and insights	heart, body, materials places spaces
Pop-up texts: Mix n' match. Everyone pick your favorite card from every strategy and combine it with your first and best idea. Let's see what you can come up with.	C3.1 & C4.2	Changing and adding a new method, motivating people to try it and see the results. It also gives opportunity to highlight personal favorites, giving all participants a moment to shine	head, heart
Pop-up texts: Change is good. Look in the toolbox and pick a new method card. Start using that for a while.	C3.1	Simple variation of method, to change the rythm and flow. Another new thing to try.	head, materials places spaces
Pop-up texts: Bottles and glasses refill. Hydration is important. Take a minute to fill up on water and drinks.	C3.4 & C5.1 & C6.2	It disrupts the current flow, which can be very desired near the end (when the bottles are empty). It also creates a moment to socialize a little, stimulating new ideas which then can't be written down, because the session is paused, motivating them to want to get back to it.	body, materials places spaces
Pop-up texts: 1+1=... For the next 5 minutes, you are only allowed to add to other ideas. Do not create completely new ones.	C3.4 & C6.1 & C6.2	It disrupts so people want to overcome this new challenge. It also limits what can be done, so people want to get around that. When the rule is lifted, people are again motivated to use this re-found freedom.	head
Pop-up texts: “Hello darkness my old friend...”-Simon and Garfunkel- Blindfold each other (or close your eyes). For the next 5 minutes, try to create new ideas while not seeing.	C3.4 & C6.1 & C6.2	Very disruptive and fun. Losing one sense motivates to do more with the other senses, triggering new ideas and associations. It is also another challenge to be overcome.	head, body, materials places spaces
Pop-up texts: Crowdsourcing: Look at your social media post from earlier. Any useful reactions and ideas?	C3.2 & C5.3	An outside source that may have something, so it will be given a chance. It is also more social and online, providing a whole new world to use and explore.	head
Pop-up texts: Why didn't I think of that!? Everyone, go to a collegue of your choice, who is not part of this session. Quickly explain the problem you need an idea for to them and ask them for ideas.	C3.2 & C5.1	Another outside source to be tapped. It also gives the opportunity to have a chat with an apreciated collegue, which people tend to like to do.	head, materials places spaces
Pop-up notification sound	C2.3 & C6.3 & C7.1 & C8.2	Triggers attention and makes people curios. The sound also means that there is a temporary message, so you should look now, before it is gone.	
Integrated pause moments	C2.3 & C5.1 & C6.1 & C8.2	a pause also forces a stop while you want to continue. Besides it creates a social moment.	
Welcome back screen with praise checkmark and “continue?” Choice	C2.1 & C2.2 & C8.2	Staging, rewarding results, it is a stage to be reached, an achievement. Also something you do not want to miss. Also, not chosing continue might mean you miss the next good parts, motivating you to keep going.	

Appendix 7: Circularity game toolbox elements; Facilitator preparation notes, Theory booklet and phase instructions booklet

One of the first things that the first user of the Circularity game will find is a set of instructions on how to setup the use of the game properly. It is assumed that this person is the initiator or facilitator of using the Circularity game and that he or she will have a look inside, beforehand. Below are the instructions that can be found on a leaflet in the toolbox, behind the first lid.

Facilitator preparation notes

“

Hi there, we from the Circularity game are very happy to see that you want to give circular design a chance. It is our hope that our method will help and inspire you to create circular solutions and that way work towards a better future for everyone.

We would have liked to provide you with literally everything you could need, however, this would have been wasteful and near impossible. Therefor we have only included the things we couldn’t reasonably expect you to have. The other things we expect to be available to you due to the fact that you are most likely working in an office environment. The list below contains all the things we think you may need, try to arrange them before starting with your session.

Lastly, the toolbox is arranged in different sections. The needed materials for each stage can be found in their own section. You can look ahead or back, and use any materials in there if you like. However, this may slightly disrupt the flow and feel of the session. Your choice.

Oh! One last thing: Start any session with inserting the USB-stick of the toolbox in the computer and letting the program on it guide you.

To be prearranged:

*: marked items are considered to be crucial to have. Any other item on the list are recommended.

1. A computer with a big screen and working sound. *
2. Writing equipment: ballpoints, fineliners, markers, pencils, etc. *
3. White-board markers *
4. Post-its, sticky notes, or similar *
5. A3 (or A4) white paper*
6. 1 pack of uncooked spaghetti (For a warm-up game)
7. 1 pack of marshmallows (For a warm-up game)

alternatively you can use folding paper and tape to play a similar game, however, you will have to decide this now and notify the team beforehand. You will not have the time to explain during the session.

8. push-pins (if you want to use a cork board)
9. yarn or very thin rope
10. scissors
11. glue
12. (scotch) tape
13. Any other brainstorm and/or creative materials that your team may prefer.

“

Theory and phase instructions booklets

Both the background theory and the instructions for the main parts of the phases have small booklets for the teams to go through. These booklets are about the size of playing cards and are meant to be read and discussed together. They are inserted in the Circularity game toolbox and refered to in the Circularity game software.

The content of the theory booklet is kept simple, clear and concise in a way that is fitting for use without the guidance of a workshop leader or expert. It is based on the theory as provided by Konietzko (2020). The text from the two “3) Ecosystems perspective” cards has been directly copied from the same article. The image on the “Three perspectives” card is a remake from

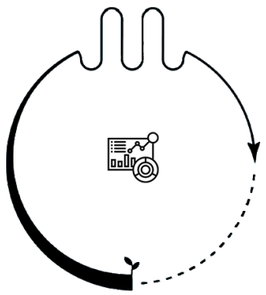
figure 1 of the same article (page 3). The images and texts on the cards “Narrow flows (use less)”, “Slow flows (use longer)”, “Close flows (use again)” & “Regenerate flows (make clean)” are direct copies from https://www.circularstrategies.org/ (Brown, Baldassarre & Konietzko, 2019). These texts have been directly quoted because they are concise and convey the theory best. They are the words of the original writers after all.

On the following pages are the pages of the booklets displayed for the ideation phase of the Circularity game.

Icons in the following images are from: Flaticon Stock images (2019)

1

Circularity game
Theory booklet



2

Introduction

This booklet provides you with a very basic understanding of Circular economy and how to innovate towards it. Although the information in here should be enough to get you started with the Circularity game, taking the time to take a look at www.circularstrategies.org and reading some of their publications is recommended. It will provide you with a much better understanding of the theory used and will help you get better results out of the Circularity game. The information in here is far from complete and there is much more that can be considered when working on Circular economy innovations.

3

Quick overview

2 types of economic systems to be considered:
- Linear economy system
- Circular economy system

3 perspectives, or levels of focus, when innovating:
- Product service perspective
- Business model perspective
- Ecosystem perspective

4 Circular strategies + 1 supporting strategy:
- Narrow flows (use less)
- Slow flows (use longer)
- Close flows (use again)
- Regenerate flows (make clean)
+
- Inform (use data)

4

Linear economy: Take, make, waste

The “old” economic system of taking resources, using them to make products and profit, after which the leftovers become (often unusable) waste. This system, in general, tend to be unsustainable and is becoming less desirable over time.

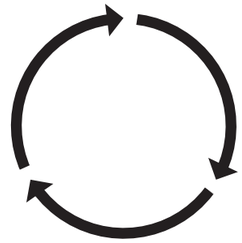
5

6

Circular economy: “Closing the gap”

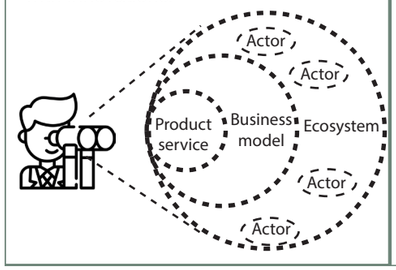
The Circularity game works towards innovating for the Circular economy. There are various opinions on what the Circular economy is and what it should be. However, the core of it is usually that it tries to take the “dead end” of the linear economy and, one way or another, connect it to it's start.
The idea is, that instead of having an end that is wasteful and unsustainable, to create a system that ideally is without end and is sustainable indefinitely. However, how to do this, on what levels and to what extend is not set in stone, yet. This ideal situation might even turn out to be an unobtainable utopia, but this does not mean that it is not worth working towards.

7



8

Three perspectives
There are three perspectives, or levels, on which it is possible to work towards ‘Circular’. Of these levels, the third one, the ecosystem perspective is the most important one to be able to work towards a Circular economy. However, all three perspectives are useful and should be considered when coming up with innovations.



9

1) Product service perspective
The product service perspective is the lowest, or most narrow one. It focuses on how to make a specific product or service (more) circular.

2) Business model perspective
The second level, or perspective, looks into how a company does business and how that can be made (more) circular. The key here is to not only look at one aspect, like a product, but at everything that a company does. All it’s products, assets, personnel, etc.

10

3) Ecosystems perspective
Ecosystems are comprised of any set of actors—producers, suppliers, service providers, end users, regulators, and civil society organizations—that contribute to a collective outcome. Ecosystems have the following characteristics. They (1) consist of multiple locally, regionally or globally distributed entities that do not belong to a single organization, (2) involve dynamic, collaborative and competitive relationships, (3) imply flows of data, services, and money, (4) often involve complementary products, services and capabilities, and (5) evolve as actors constantly redefine their capabilities and relations to others. Ecosystems

11

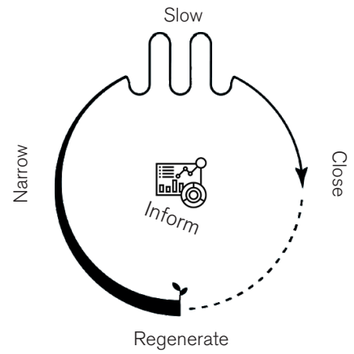
are different from supply or value chains. The latter often involve bilateral supply relationships with clear upstream and downstream positions. Ecosystems on the other hand often involve a re-positioning of actors. Ecosystem innovation aims at changing how actors relate to each other, and how they interact to achieve a desired outcome. This outcome can be achieved by developing co-specialized and complementary products and services.

12

The Circularity game

The Circularity game works from the idea that there are three levels, or perspectives, to be considered and that all should be used when innovating towards a Circular economy. How to do this? By innovating through the 4+1 strategies provided in the Circularity deck, in a mix that is fitting for your situation and case. This can best be achieved if the higher level perspectives are used.
The different phases of the Circularity game will guide your team through the strategies and perspectives.

13

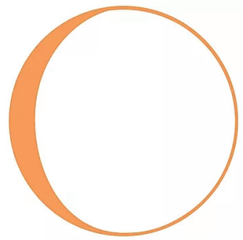


14

Narrow flows (use less)

Narrowing flows refers to using fewer components and products, and less material and energy during the creation and delivery of physical products, components and materials.

15

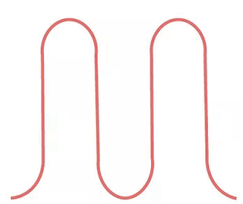


16

Slow flows (use longer)

Slowing flows refers to using products, components and materials longer over time. Loops can be slowed by selling long-life and high quality products (mostly in the premium segment), and offering intermediate service (such as maintenance, repair, or spare parts availability) or advanced service (provide an outcome, a result or a function), also often referred to as product-service systems).

17

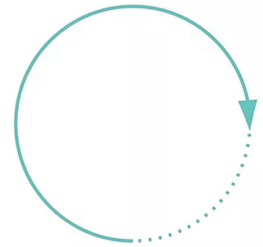


18

Close flows (use again)

Closing flows refers to the recycling and reusing of wasted products, components and material and/or the use of biodegradable materials (and their safe disposal into the natural environment).

19



20

Regenerate flows (make clean)

Regenerating flows refers to a minimized use of hazardous substances, the increased use of renewable energy during value creation, delivery and use, as well as the regeneration of natural ecosystems to create and deliver critical ecosystem services for human flourishing.

21

22

Inform (use data)

Informing refers to using informatin technology to support the Circular ecnomy. Using things like artificial intelligence and big data to improve and enable circular strategies and solutions.

23

24

To keep in mind

1) All strategies are interrelated and are aimed towards innovation for the Circular economy.

2) Every strategy provides solution-oriented guidelines, or innovation principles.

3) The strategies, solutions and examples on the cards may require any of the three perspectives to work.

Circularity game
A new idea is born

Instructions booklet

1

With your brainstorm group, take one or more blank A3 sheets. Define a clear problem or challenge that you want to work on during this session and put it in the middle of a a blank sheet.

2

For 5 minutes, brainstorm about how you use the strategies from the theory already. Put all ideas around the challenge, on the A3 sheet, you can use sticky notes for this, or any other method you prefer.

3

For 5 minutes, ideate solutions towards the challenge you formulated, based on your current understanding of the theory you just went through. How do you think you can use the strategies to tackle your challenge? Again, put all ideas around the challenge.

4

Next, go through the card deck, in any order you like, make sure you make use of all 5 strategies, preferably on all three perspective levels. Ask yourself how you can use these strategies and examples in your case. Use the cards to get inspiration and ideas that you can use. Combining is encouraged!

5

Write/draw any ideas you have down, in anyway you like. Dare to be creative and expressive if it helps you. Don't forget to also indicate any relations, interactions and symbioses between your ideas and the strategies. These are very valuable for the ecosystems perspective.

6

Don't forget to also pay attention to the screen every once in a while. It will try to get your attention sometimes.

7

If you feel stuck, use the Big Brain Button to get some help.

Appendix 8: Color coded user reactions of original tests

On the following pages are the quoted user feedback reactions of the test participants of previous tests (Konietzko et al., 2020), as refered to in chapter 5, section "Users and their relation to the core drives through the lens of Octalysis". They have been categorized and color coded first and afterwards they have been analyzed to see how they relate to the core drives of Octalysis (Chou, 2019). This in turn helped to determine what drives to focus most on in the redesign of the Circularity deck. The results of this can be found in chapter 5 as wel and in tables 2 & 3, which have been repeated here as table 6 & 7.

Category	Category general descriptors	Strongly associated core drives	Lesser associated core drives
Yellow	- Perspective gaining - Inspiration - Triggering	3, 5, 7	-
Brown	- Applicability - Plan formulation - An answer to: "How to…?"	2, 3	4, 6, 8
Blue	- Holisticity/completeness - Clarity & un-ambiguity - Overview - Understanding	2, 3, 4	8
Pink	- Accessibilty/usability - Structure - Communicable - Difference in user capabilities/experience	2, 4, 5	-
Green	- General practicalities	2, 6	4, 5

Table 6: User based category-core drive relatedness.

Core drive	Strongly associated (*1)	Lesser associated (*0,5)	Σ
1: Epic meaning & calling	-	-	0
2: Development & accomplishment	I I I I	-	4
3: Empowerment of creativity & feedback	I I I	-	3
4: ownership & possession	I I	I I	3
5: Social influence & relatedness	I I	I	2,5
6: Scarcity & impatience	I	I	1,5
7: Unpredictability & curiosity	I	-	1
8: Loss & avoidance	-	I I	1

Table 7: Core drive importance.

Practicalities

"Maybe work more on the 'how to use' card and have an online version that is constantly updated"

cards should be a bit thicker for re-use"

"Perhaps you could develop an online platform to distribute more widely and decrease inputs used"

More instruction on the idea selecti-on phase would be good"

"I would use the Dutch language"

"Requires some effort to understand how the example cards would translate into an idea for your busi-ness"

"The product-design ones were easiest, there were also quite a few that just needed a "yes" (lets do that), cards should be a bit thicker for re-use"

"it would be nice to have examples"

"Maybe condense or highlight items in the text (quicker to read)"

"At the start the purpose was a bit unclear but once we realized they were suggestions it made for an easy-going discussion on things that can be done"

"You have the circle in the power-point maybe also keep showing the examples so you know what it is (I am old and forget quickly :)"

"Message is clear, but a lot of things were undiscussed"

"Understandable, but maybe feels slightly 'pragmatic', "businessy""

"Having guidelines and parameters helps to ensure that the brainstorm keeps being focused on the topic"

"The first two strategies were most concrete and helpful"

"Good starting point, nice to have real-world examples, although this might also steer/limit a bit too much, maybe asking basic questions could also be a good way to get people thinking"

Applicability

The 'regenerate' cards were more difficult but that can be specific to this project"

"Some topics were not typically for a product"

"Good theoretical substantiations, we could relate it easily to our product"

"Conceptualizing based on the different loops is useful for classifying ideas – good framework for analysis"

Plan formulation

"Useful: it sharpens what you already do, what you will never do and inspires next steps to optimize the impact of the business,

"How to narrow it down?"

"The cards are like a morphological map tool, for holistic ideas might need a 2nd tool or step"

"I am now more curious about the next steps of this framework. As cost and performance are as important as environmental friendliness, it would be good to see how you evaluate a business models' financial feasibility"

Uncategorizables

"It was very practical for us"

"Yes, easy to use, good outcomes"

"Circularity is interpreted very broad-ly"

"The different loops --> tools to explain your circularity, the cards --> good examples of companies which produced something"

An answer to ‘’how to?’’

“Providing both descriptions and concrete examples on the cards helped to reinforce the concept and generate further ideas”

“I really liked the simplified approach to start creating circular models”

Holisticity/completeness

“Note: circularity is interpreted in ‘the resource way’. What about social inclusion/impact?”

“I am missing a human component (fair wages, human rights) and stimulating ideas about transparency and communication”

I missed the cards about how we are closing loops: presumption: make people buy things that will change their behaviour in a positive way (induction cooking)”

“The subject matter was covered very broadly so it felt all bases were covered.

“Different angles and ideas inspire, one table missed the ‘human’ element in the examples, how to attract/involve others?, importance of communication, giving experiences”

“A section on digital entities wo add further value”

Overview

“Insights in all different options, we are so into our daily work that an exhaustive list is of great use, helicopter view!”

“Good to know about narrow, slow, regenerate…, connect with other’s ideas”

“Gives a broad view of the concept and concrete ideas on what could be done”

“A great thought exercise – clarified where we are already successful, and highlight immediate ways to improve”

“Useful: it sharpens what you already do, what you will never do and inspires next steps to optimize the impact of the business,

“It is nice to see where you stand with your products in the loops and where you can improve the loops”

“Conceptualizing based on the different loops is useful for classifying ideas – good framework for analysis”

Clarity/unambiguity

“Good examples, a lot of overlap, sometimes confusing”

“Too much overlap in cards, some are too similar”

“Generally very good, but some related ideas were touched on in different types of loops”

“Ideas from each strategy were kept distinct and separate, would be useful to integrate/cross-pollinate”

“Well-described examples, some of which are very debatable”

“The cards ensure that many different aspects are considered in the brainstorm.

Understanding

“felt more as a understanding the circular economy conceptually, which was by the way great :). Loved the cards”

“Using the cards made it easy to understand the concepts and therefore the concept of circularity”

and it gave direction on the broad concept of circularity”

“Provides clarity”

“Putting these concepts into practice was useful to understanding them, and the framework was easy to apply to my idea”

“Easy to digest the information”

“useful to reduce complexity”

and it gave direction on the broad concept of circularity”

“Simple and clear, liked the model with the different loops, thanks!”

“Providing both descriptions and concrete examples on the cards helped to reinforce the concept and generate further ideas”

“It was good for a start to grasp the concept of circularity”

“The examples reinforced the 4 concepts, and had a wide range of inspirational stories”

“When it was initially introduced, I was somewhat confused. The cards helped a lot.”

“Good starting point, nice to have real-world examples, although this might also steer/limit a bit too much, maybe asking basic questions could also be a good way to get people thinking”

(New) perspective gaining

“New perspective”

“nice perspective tool”

“Gives ideas of possibilities”

Inspiration

“Useful because it was inspiring

and helped generate ideas”

“loved the cards, it makes it a lot easier to brainstorm and prompt new ideas”

Found the examples useful to spark ideas”

“It sparks ideas”

“inspiration”

“Fueled a lot of ideas on different levels”

“Very clear and helpful in giving ideas”

“Really helps to generate ideas, the cards are cool”

“gave me some inspiration to come up with innovative idea”

“This gives real-life scenarios and examples that stimulate incorporation of the ideas into companies”

“Useful because it was inspiring

“Providing both descriptions and concrete examples on the cards helped to reinforce the concept and generate further ideas”

“The examples reinforced the 4 concepts, and had a wide range of inspirational stories”

Triggering/linking/reminding/Stimulating/activating

“nice list of triggers, nothing really new for me personally”

“It helps to kick-start the thinking process and mindset”

“I didn’t read any of the stories on the card, they were pretty self-explanatory. The presence of these cue cards make you think of stuff that can be pretty obvious but quickly overseen”

“A way to initiate discussion and brainstorming”

Accesibility/Usability

“It was easy to use

“Written in a clear way which sparks ideas”

“The explanations on the back really worked”

“The examples make it very clear”

“Clear with the examples”

“Written in a clear way which sparks ideas”

“Practical”

“Clear”

“Clear, user-friendly, well thought through”

“Simple/tactile”

“The examples are very explanatory”

“I think if people are not already doing/practicing then it will sometimes not be clear – I can try out too – thank you!”

“The text on the cards was clear, nice to have an example on each card”

“The loops are clear, the questions are clear”

“The examples were instrumental to understanding the cards”

Structure

“I loved your cards, not too much info on them and it was well built up to our final assignment”

“Well categorized and in short bits well explained on the back side”

“+ narrowing it down to smaller questions is helpful, - maybe more in question form (how, why, when etc)”

“Conceptualizing based on the different loops is useful for classifying ideas – good framework for analysis”

“Having guidelines and parameters helps to ensure that the brainstorm keeps being focused on the topic”

“Interesting to focus on specific aspects, next phase as a group phase was good to cluster ideas, the outcome? A concept profile.”

Communicable

“I know a lot, but to have it in into 4 parts divided and explained it is easy to share”

“Very useful to pitch your circularity and brainstorm improvements!”

“as an extrovert, I find it easier to think in pairs.

Different level?

“nice list of triggers, nothing really new for me personally”

“Examples work really good, I do think it is fit for professionals and for people who have a basic understanding of a circular economy”

“The more knowledge about circularity you have, the more difficult the use of the deck”

“It was useful, with many obvious examples, but it helped”

“Like I wrote above, at the start I didn’t understand what the cards were for. Sometimes the examples are a bit confusing, probably because circularity is different for a food company than for a machine building company”

“I didn’t read any of the stories on the card, they were pretty self-explanatory. The presence of these cue cards make you think of stuff that can be pretty obvious but quickly overseen”

“New to me, so need to adopt”

Appendix 9: User test additional materials; Design case & test setup

Design case

The redesigned Circularity Deck is meant to be used by professionals working for companies or on specific assignments. They are expected to bring their own design case to work on. However, this can not be expected of the participants of a test done with a mixed group of students, thus a design case is given here.

The case below is created to be relatable for all participants & it should be easy enough to understand, yet complex enough to provide sufficient space for ideation, innovation and problem solving.

The case:
You work for FoDriMa, a company similar to Philips, Bestron and Braun that specializes in foods and drinks electronics and machines. They want to improve their sustainability and want to see what the circular design approach could provide them with.

Your task is simple:
Use the Circularity game to innovate the future of drinks in the office (coffee, tea, etc.).
They are thinking about a new coffee and tea machine, however, you are free to come up with anything; They want to be inspired and surprised. Because, if they are, then the consumers and competition will surely be as well.

Test setup

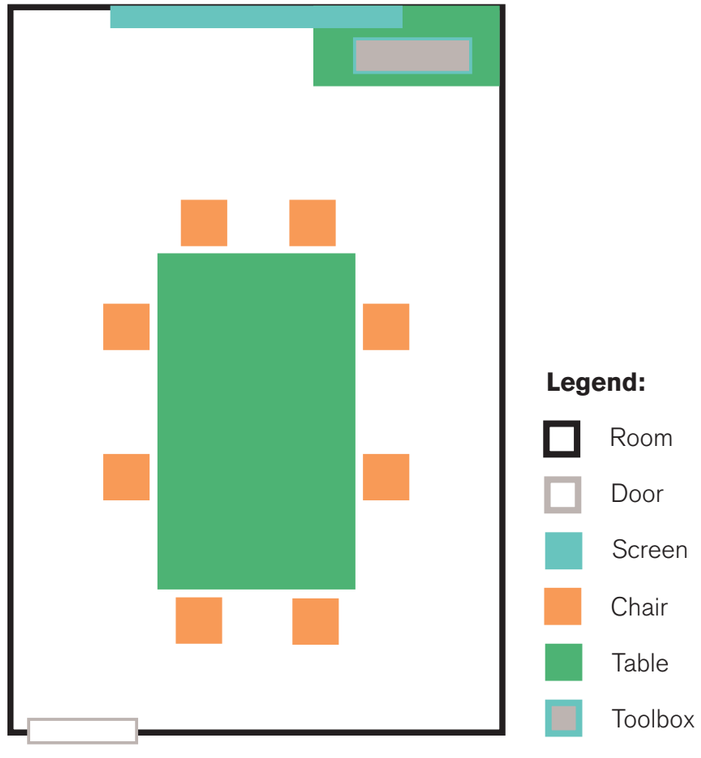


Fig. 22: User test room setup.

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