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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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.

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 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.” Then they 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)

<table>
<thead>
<tr>
<th>LEVEL</th>
<th>MOTIVATED BY</th>
<th>PURPOSE</th>
<th>EXAMPLE</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>doing</td>
<td>productivity</td>
<td>“getting something done” organizing my herbs and spices</td>
</tr>
<tr>
<td>2</td>
<td>adapting</td>
<td>appropriation</td>
<td>“making things my own” or “make it fit better” embelishing a ready-made meal</td>
</tr>
<tr>
<td>3</td>
<td>making</td>
<td>asserting ability or skill</td>
<td>“make with my own hands”</td>
</tr>
<tr>
<td>4</td>
<td>creating</td>
<td>curiosity</td>
<td>“express my ability”</td>
</tr>
</tbody>
</table>

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).
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).

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 Caillois’ 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 according to their own decisions^1, together with other people^2. (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.

<table>
<thead>
<tr>
<th>Level of everyday creativity</th>
<th>Motivated by</th>
<th>Explanation</th>
<th>Best support</th>
<th>Most suitable design</th>
<th>Materials-places-spaces</th>
<th>Body</th>
<th>Heart</th>
<th>Head</th>
</tr>
</thead>
<tbody>
<tr>
<td>1 Doing</td>
<td>Productivity</td>
<td>“Using existing idea 1”</td>
<td>Leading</td>
<td>Gamefulness</td>
<td>Prevalent</td>
<td>Prevalent</td>
<td>Absent</td>
<td>Absent</td>
</tr>
<tr>
<td>2 Adapting</td>
<td>Appropriation</td>
<td>“Adapting existing idea 1 with existing idea 2, to be better fitting to me”</td>
<td>Guiding</td>
<td>Gamefulness</td>
<td>Prevalent</td>
<td>Prevalent</td>
<td>Prevalent</td>
<td>Absent</td>
</tr>
<tr>
<td>3 Making</td>
<td>Asserting my ability or skill</td>
<td>“Making existing idea 1 into reality with my own capabilities”</td>
<td>Scaffolding</td>
<td>Gamefulness</td>
<td>Declining</td>
<td>Prevalent</td>
<td>Prevalent</td>
<td>Increasing</td>
</tr>
<tr>
<td>4 Creating</td>
<td>Curiosity</td>
<td>“Creating new, priorly not existing idea 3 through my own abilities”</td>
<td>Providing blank canvas</td>
<td>Playfulness</td>
<td>to a lesser extent</td>
<td>to a lesser extent</td>
<td>Prevalent</td>
<td>Prevalent</td>
</tr>
</tbody>
</table>

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.

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.

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.

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

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

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.

Justimind, 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 gamification. 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 exclamations 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 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.

Observed potential points for improvement of the original Circularity deck (fig. 10)

11: 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. Therefore it should have at least a quick overview/reminder of the basic theory.

12: 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.

13: Continuing in the line of 12, 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.
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 drive 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

Why core drive 4: Ownership & possession?
The players are participating for one goal: to grow the company 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 drive 5: Social influence & relatedness?
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

Why core drive 6: Scarcity & impatience?
The players are participating for one goal: to grow the company 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 drive 7: Unpredictability & curiosity?
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

Why core drive 8: Loss & avoidance?
The players are participating for one goal: to grow the company 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.

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 drive 4: Ownership & possession?
The players are participating for one goal: to grow the company 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 drive 5: Social influence & relatedness?
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

Why core drive 6: Scarcity & impatience?
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

Why core drive 7: Unpredictability & curiosity?
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

Table 2: User based category-core drive relatedness.

<table>
<thead>
<tr>
<th>Category</th>
<th>Category general descriptors</th>
<th>Strongly associated core drives</th>
<th>Lesser associated core drives</th>
</tr>
</thead>
<tbody>
<tr>
<td>Yellow</td>
<td>- Perspective gaining</td>
<td>3, 5, 7</td>
<td>-</td>
</tr>
<tr>
<td>Brown</td>
<td>- Applicability</td>
<td>2, 3</td>
<td>4, 6, 8</td>
</tr>
<tr>
<td>Blue</td>
<td>- Holisticity/completeness</td>
<td>2, 3, 4</td>
<td>8</td>
</tr>
<tr>
<td>Pink</td>
<td>- Accessibility/usability</td>
<td>2, 4, 5</td>
<td>-</td>
</tr>
<tr>
<td>Green</td>
<td>- General practicalities</td>
<td>2, 6</td>
<td>4, 5</td>
</tr>
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</table>

Table 3: Core drive importance.

<table>
<thead>
<tr>
<th>Core drive</th>
<th>Strongly associated (*1)</th>
<th>Lesser associated (*0,5)</th>
<th>Σ</th>
</tr>
</thead>
<tbody>
<tr>
<td>1: Epic meaning &amp; calling</td>
<td>-</td>
<td>-</td>
<td>0</td>
</tr>
<tr>
<td>2: Development &amp; accomplishment</td>
<td>1 1 1 1</td>
<td>-</td>
<td>4</td>
</tr>
<tr>
<td>3: Empowerment of creativity &amp; feedback</td>
<td>1 1 1</td>
<td>-</td>
<td>3</td>
</tr>
<tr>
<td>4: ownership &amp; possession</td>
<td>1 1 1</td>
<td>1 1</td>
<td>3</td>
</tr>
<tr>
<td>5: Social influence &amp; relatedness</td>
<td>1 1</td>
<td>1 1</td>
<td>2,5</td>
</tr>
<tr>
<td>6: Scarcity &amp; impatience</td>
<td>1 1</td>
<td>1 1</td>
<td>1,5</td>
</tr>
<tr>
<td>7: Unpredictability &amp; curiosity</td>
<td>1</td>
<td>-</td>
<td>1</td>
</tr>
<tr>
<td>8: Loss &amp; avoidance</td>
<td>-</td>
<td>1 1</td>
<td>1</td>
</tr>
</tbody>
</table>

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 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 participate 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.

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... 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.

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**Fig. 14: Morphological chart part 1**
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.

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 & discuss.
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):
   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 its first phase. It leaves room in its 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.

**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.

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**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.

**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 theory¹, do the warm-up games and the brainstorming², 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.

¹The instructions and theory teach the users two things: how the Circularity game works and the basic theory that is behind it.
²The 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 everyday 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.
Prototyping & testing
7. Prototyping & testing

The prototype build

The toolbox of the prototype was built 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.
Table 4, part 1: Questionnaire questions, type, average answers, variance & average absolute deviation.

<table>
<thead>
<tr>
<th>Question</th>
<th>Possible Answer</th>
<th>Average scores on the likert scale</th>
<th>Variance</th>
<th>Average absolute deviation</th>
</tr>
</thead>
<tbody>
<tr>
<td>1. What is your name?</td>
<td>Written</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>2. What is your age?</td>
<td>Written</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>3. What did you study what is your work?</td>
<td>Written</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>4. How well do you understand the English language?</td>
<td>1-5 Likert</td>
<td>4.8</td>
<td>0.2</td>
<td>0.89</td>
</tr>
<tr>
<td>5. I was, prior to this workshop, aware of Circular Economy</td>
<td>1-5 Likert</td>
<td>3.6</td>
<td>0.3</td>
<td>0.55</td>
</tr>
<tr>
<td>6. I was, prior to this workshop, aware of Circular Design</td>
<td>1-5 Likert</td>
<td>3.6</td>
<td>0.3</td>
<td>0.50</td>
</tr>
<tr>
<td>7. Give a remark on your previous answer! If you feel it might be relevant/ useful</td>
<td>Written</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>8. I'm knowledgeable about Circular Economy and/or Design</td>
<td>1-5 Likert</td>
<td>2.8</td>
<td>1.7</td>
<td>0.96</td>
</tr>
<tr>
<td>9. Optional: give a remark on your previous answer! If you feel it might be relevant/ useful</td>
<td>Written</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>10. I have participated in (a) previous Circular Deck test(s)</td>
<td>yes/no</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>I have worked with creative methods before</td>
<td>yes/no</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>12. Optional: what? Also: give a remark on your previous answer! If you feel it might be relevant/ useful</td>
<td>Written</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>13. I have worked with circular design methods before</td>
<td>Written</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>14. Optional: which? and, give a remark on your previous answer! If you feel it might be relevant/ useful</td>
<td>Written</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>15. In general: when I work on something, I... &quot;5...very quickly bored and/or distracted&quot;</td>
<td>1-5 Likert</td>
<td>3.0</td>
<td>0.5</td>
<td>0.82</td>
</tr>
<tr>
<td>16. Optional comments</td>
<td>Written</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>17. I consider myself to be... &quot;1...completely NOT creative, I can never think of something new or original&quot;</td>
<td>1-5 Likert</td>
<td>3.8</td>
<td>0.7</td>
<td>0.82</td>
</tr>
<tr>
<td>18. Optional comments</td>
<td>Written</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>19. How excited are you to start working on the given case?... &quot;5...totally not excited, I would prefer to do anything else&quot;</td>
<td>1-5 Likert</td>
<td>3.2</td>
<td>0.7</td>
<td>0.82</td>
</tr>
<tr>
<td>20. Optional comments</td>
<td>Written</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>21. I prefer... &quot;5...to work on one task for longer periods of time&quot;... &quot;5...To have variety and often completely change what I am doing&quot;</td>
<td>1-5 Likert</td>
<td>3.2</td>
<td>1.2</td>
<td>1.00</td>
</tr>
<tr>
<td>22. Optional comments</td>
<td>Written</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>23. When presented with a problem... &quot;5...If I struggle to come up with even one solution!&quot;</td>
<td>1-5 Likert</td>
<td>4.0</td>
<td>0.5</td>
<td>0.82</td>
</tr>
<tr>
<td>24. Optional comments</td>
<td>Written</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>25. When it comes to doing anything usually... &quot;5...I have to do things I have no incentive and/or encouragement&quot;</td>
<td>1-5 Likert</td>
<td>2.8</td>
<td>0.7</td>
<td>0.82</td>
</tr>
<tr>
<td>26. Optional comments</td>
<td>Written</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>27. The Circular Deck was useful to address the purpose stated above</td>
<td>1-5 Likert</td>
<td>4.0</td>
<td>1.0</td>
<td>0.96</td>
</tr>
<tr>
<td>28. Please explain your answer &quot;What was most useful? What was less useful?&quot;</td>
<td>Written</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>29. The Circular Deck was easy to understand / use</td>
<td>1-5 Likert</td>
<td>3.8</td>
<td>0.2</td>
<td>0.90</td>
</tr>
<tr>
<td>30. Please explain your answer &quot;What was easy? What was difficult?&quot;</td>
<td>Written</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>31. In general: The Circular Deck helped me to not be distracted by unrelated things: &quot;5...I completely agree&quot;</td>
<td>1-5 Likert</td>
<td>2.6</td>
<td>0.8</td>
<td>0.50</td>
</tr>
<tr>
<td>32. Optional comments</td>
<td>Written</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>33. In general: The Circular Deck improved my creativity: &quot;5...I did not, it may even have decreased if...&quot;</td>
<td>1-5 Likert</td>
<td>4.6</td>
<td>0.3</td>
<td>0.50</td>
</tr>
<tr>
<td>34. Optional comments</td>
<td>Written</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>35. In general: The Circular Deck kept me motivated to work on the case: &quot;5...I did not, it may even have decreased if...&quot;</td>
<td>1-5 Likert</td>
<td>3.6</td>
<td>0.3</td>
<td>0.58</td>
</tr>
<tr>
<td>36. Optional comments</td>
<td>Written</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>37. The Circular Deck helped me stay focused on the case: &quot;5...I was all I was thinking of...&quot;</td>
<td>1-5 Likert</td>
<td>3.6</td>
<td>0.3</td>
<td>0.58</td>
</tr>
<tr>
<td>38. Optional comments</td>
<td>Written</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>39. The Circular Deck gave me inspiration: &quot;5...It was very inspiring all the time&quot;... &quot;5...It did not help me get more ideas at all&quot;</td>
<td>1-5 Likert</td>
<td>4.0</td>
<td>0.0</td>
<td>0.00</td>
</tr>
<tr>
<td>40. Optional comments</td>
<td>Written</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>41. The Circular Deck made me enthusiastic about the case: &quot;5...I was constantly excited, maybe I still am!&quot;... &quot;5...I even became bored and bored me&quot;</td>
<td>1-5 Likert</td>
<td>3.6</td>
<td>0.3</td>
<td>0.58</td>
</tr>
<tr>
<td>42. Optional comments</td>
<td>Written</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>43. I used the variety in digital and physical parts of the Circular Deck: &quot;5...I did not, it did not help me get more ideas at all&quot;</td>
<td>1-5 Likert</td>
<td>4.2</td>
<td>1.2</td>
<td>1.15</td>
</tr>
<tr>
<td>44. Optional comments</td>
<td>Written</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>45. I used the variety in digital and physical parts of the Circular Deck: has added value to the method: &quot;5...I did not think it added value&quot;... &quot;5...It has very much added value&quot;</td>
<td>1-5 Likert</td>
<td>3.6</td>
<td>1.3</td>
<td>1.29</td>
</tr>
<tr>
<td>46. Optional comments</td>
<td>Written</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>47. The Circular Deck created/gave me a sense of progression while using it: &quot;5...I disagreed&quot;... &quot;5...Agreed&quot;</td>
<td>1-5 Likert</td>
<td>3.8</td>
<td>1.7</td>
<td>1.29</td>
</tr>
<tr>
<td>48. Optional comments</td>
<td>Written</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>49. I liked the interaction of the Circular Deck: &quot;5...I did not what interactivity!&quot;... &quot;5...Yes&quot;</td>
<td>1-5 Likert</td>
<td>4.6</td>
<td>0.3</td>
<td>0.50</td>
</tr>
</tbody>
</table>

Materials, equipment, facilities & other preparatory measures
A room with table(s), chairs, a white-board* & beamer*
A design case
The Circular 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 therefore 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 Circular game was according to the participants.

Both questionnaires are in English, the Circular 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 30: 
P5: “I wasn’t really immersed or anything.”

Reasercher 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;
• There was a numerical mistake in a countdown timer. It needs changing;
• 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 therefore, the new design seems slightly better than the old one when it comes 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 like 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.”

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.

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.

**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).
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 were 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 Circularity game) seems to indicate that a higher potential could indeed be reached, through improved gamification. The new Circularity game makes use of all of 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 Octalysis 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.
Acknowledgments
Here I want to take the opportunity to thank various people.

Supervisory team
First and foremost I want to thank Jan Konietzko for providing me with the assignment and being an honest, clear and professional mentor. It can be difficult to be both a mentor and a ‘client’ at the same time. You managed to balance the roles well.

I also want to thank Erik Jan Hultink for his work as the chair of my supervisory team. Your no-nonsense attitude and direct communications were very much appreciated.

I’m also thankful for the fact that both Jan and Erik Jan managed to not only evaluate the work and give valuable feedback on it, but also managed to keep my (personal) interests as a (graduation) student in mind. Together, you were a good supervisory team, thank you.

Proofreaders
I also want to thank my proofreaders. To voluntarily go through a report of more than a 100 pages, in your spare time, is a lot. Your feedback on various aspects was clear and appreciated and has helped me to improve my work.

Family & friends
Next, I want to thank my family and friends. Most notably, my girlfriend. They had to put up with me during this period. I know I could rant a lot about the project. I know I was stressed out at times, often at my own fault. I know that you not always agreed with my methods and priorities. I know I was annoying and difficult at times. Nonetheless, you supported me, encouraged me and at times pushed me on, and I am thankful for that.

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.
Appendices

Appendix 1: Approved graduation project brief

IDE Master Graduation
Project team, Procedural checks and personal Project brief

This document contains the agreements made between student and supervisory team about the student’s IDE Master Graduation Project. This document can also include the involvement of an external organisation, however, it does not cover any legal employment relationship that the student and the client (might) agree upon. Next to that, this document facilitates the required procedural checks. In this document:

- The student defines the team, what he/she is going to do/deliver and how that will come about.
- SSC E&SA (Shared Service Center, Education & Student Affairs) reports on the student’s registration and study progress.
- IDE’s Board of Examiners confirms if the student is allowed to start the Graduation Project.

USE ADOBE ACROBAT READER TO OPEN, EDIT AND SAVE THIS DOCUMENT

Download again and reopen in case you tried other software, such as Preview (Mac) or a webbrowser.

STUDENT DATA & MASTER PROGRAMME

Save this form according the format “IDE Master Graduation Project Brief_familyname.firstname_studentnumber_dd-mm-yyyy”.
Complete all blue parts of the form and include the approved Project Brief in your Graduation Report as Appendix 1!

SUPERVISORY TEAM **

Fill in the required data for the supervisory team members. Please check the instructions on the right!

Chair should request the IDE Board of Examiners for approval of a non-IDE mentor, including a motivation letter and c.v.

Second mentor only applies in case the assignment is hosted by an external organisation.

Ensure a heterogeneous team. In case you wish to include two team members from the same section, please explain why.

IDE Master Graduation Project Brief & study overview 2018/01 v30

Page 1 of 7
An improved Circularity Deck through gameful design & ecosystems lens

Please state the title of your graduation project (above) and the start date and end date (below). Keep the title compact and simple. Do not use abbreviations. The remainder of this document allows you to define and clarify your graduation project.

start date 05 - 08 - 2019
end date 20 - 12 - 2019

INTRODUCTION

Please describe the context of your project, and address the main stakeholders (interests) within this context in a concise yet compelling manner. Why are you solving this problem? What do you value and how do they currently operate within the given context? What are the main opportunities and limitations you are currently aware of (cultural- and social norms, resources (time, money,...), technology,...).

Right now the environmental impact of products and their sustainability is an important topic. Depletion of resources and pollution are big problems which are recognized globally, with many countries setting sustainability goals for the near (and farther) future. For instance, the EU’s horizon 2020. One approach to tackle these problems is Circular Design and the development of a Circular Economy (CE), because it works towards an economy with zero waste and an energy neutral sum, while maintaining economic value. To realize this economy, practitioners need to pick up this concept and for that, tools and methods are needed. However, the field of CE is relatively young compared to other sustainability approaches. Besides this, the fact that, in general, CE tools and methods often do not take the various phases of Business model innovation (BMI) into account, makes it harder for practitioners to get into Circular Design.

For instance, incorporation of human behavior aspects during the implementation of a new circular business model is uncommon in CE tools. In contrast, it is deemed important in regular business model innovation and change management. Besides, this (B) mentions opportunities for valuable use of multidisciplinary methods and tools in Circular BMI (CEBM). This is especially true when the “wider- or ecosystems- lens”, as mentioned by (C), is considered to be important for CE. When a product is looked at in its whole ecosystem one is already looking at the multiple disciplines involved (for instance, the different departments, the different suppliers and buyers, etc.). By working together with other disciplines the potential for innovation can grow.

To help companies and design teams with designing their products and business models (more) circular, The Circularity Deck (CD) is being developed at the TUDelft (Image 1). It contains multiple examples and inspirations for “going circular” and it can be used as an initial (playful) brainstorming & learning tool. According to it’s creator Jan Konietzko, it has been well received by practitioners so far. However, it lacks ways to tackle the general problems and opportunities for CEBMI tools mentioned above. These problems are specified in the problem definition.

An improved Circularity Deck through gameful design & ecosystems lens

image / figure 1: Circularity deck in its current form 25-06-2019 (As provided by Jan Konietzko)
Personal Project Brief - IDE Master Graduation

PROBLEM DEFINITION **
Limit and define the scope and solution space of your project to one that is manageable within one Master Graduation Project of 30 EC (10 full time weeks or 60 working days) and clearly indicate what issue(s) should be addressed in this project.

The Circularity Deck is a brainstorming & learning tool for design teams that want to use Circular Design and want to learn about the Circular Economy. However, it has the following problems, as introduced in the introduction of this brief:

1) It does not take into account the various phases of implementing a new business model;
2) It does show multiple aspects that can be part of a Circular ecosystem, but does not help the users gain insight in their specific ecosystem and its extent;
3) It has no intentional ways of stimulating multidisciplinary cooperation and innovation;
4) It uses gamification in a way that is possibly wrong and definitely does not reach the full creativity stimulating potential.

Points 2 & 4 are the main focus for this project, point 3 ties in well with point 2 and is therefore as important. While point 1 is important in the field of CE as well, it would be a whole graduation project of its own and would be too much in the scope of this project. However, it will be used to understand the field of CE tools better and may help with positioning the Circularity Deck.

ASSIGNMENT **
State in 2 or 3 sentences what you are going to research, design, create and/or generate, that will solve (part of) the issue(s) pointed out in “problem definition”. Then illustrate this assignment by indicating what kind of solution you expect and/or aim to deliver, for instance: a product, a product-service combination, a strategy, illustrated through product or product-service combination ideas, …

The Circularity Deck needs to be redesigned to: better use gamification, help its users to understand their product ecosystem better & stimulate multidisciplinary cooperation and innovation. Research into these subjects and user tests of the redesigns will be employed to this end.

The expected result is a redesign of the Circularity Deck. The deck is transformed through gameful design into a tool that is well suited for design teams that want to brainstorm towards a more circular design & learn about CE.

Well suited means that the redesign includes:
- Ways of creating more insight into the ecosystem of the product that the teams are designing for. This is using the ecosystems lens earlier mentioned [C];
- Ways of stimulating multidisciplinary cooperation and innovation, preferably making use of the information gained through use of the ecosystems lens.

The first part is about understanding who and what I’m designing for and setting the stage. The second part is going to be the main bulk of the project. It will have three sub-phases with iterations of the design, each sub-phase ending with testing it. It is a Lean & Agile “sprint” like approach and the design method will be making use of the Minimal Viable Product theory where possible and relevant. The idea behind this is to ensure that the design is proven to be usable and desired by the target group and it allows for quick and easy new design iterations due to (unexpected) findings during testing. [G]

The third part is finalizing the design based on the last field test. The last 4 weeks will be about reporting, finalizing and arranging everything to successfully finish the project. This time can also serve as some extra time, in case of unforeseen circumstances. However, it will preferably be time to improve and polish the final result.

There is a more detailed planning that goes over the specifics of each week, what will be done, how will it be done and what will be the expected result. However, that would be unreadable in this format and is therefore available separately on request.

IDE TU Delft - E&SA Department // Graduation project brief & study overview // 2018-01 v30

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Initials & Name A Kok
Title of Project An improved Circularity Deck through gameful design & ecosystems lens
Student number A 4217233
EVER SINCE I FIRST CAME INTO CONTACT WITH CIRCULAR DESIGN DURING A BACHELOR ELECTIVE, I’VE BEEN CONVINCED OF CIRCULAR DESIGN BEING A VERY GOOD SOLUTION TO THE SUSTAINABILITY PROBLEMS THE WHOLE WORLD IS FACING RIGHT NOW. DURING MY FIRST TRY AT THE BACHELOR FINAL PROJECT I TRIED TO GO FOR CIRCULAR DESIGN FOR A TYPICAL CUSTOM MADE PRODUCTS COMPANY (PROFESSIONAL KITCHENS) AND GET THEM TO START ADOPTING IT. I DID NOT SUCCEED IN THIS, AND ALTHOUGH THERE WERE MULTIPLE REASONS, I ALSO ENCOURAGED THE WALL OF INDIFFERENCE AND POSTPONING ATTITUDE WITH THE STAKEHOLDERS. THAT WAS Frustrating. That’s why I have been continuing to search for ways to get better, more experienced and more convincing in this field. One of my ambitions is to get people actively engaged in Circular design and make it real. The Circularity deck seems like a very good fit for my ambition on that front.

What I have become good at the last two years is big picture thinking, understanding whole systems, cycles and chains. I have no trouble grasping the complexities and intricacies of these and determining where opportunities and pitfalls might be. The Circularity deck is in part helping others to do the same for circular design. I think it’s great to put my skills in this regard to good use in developing this tool. What also is motivating is that when you are capable of teaching someone else something, then you start to understand it better yourself, in my experience. Lastly, a big part of this project will be guiding workshops to test the new and improved Circularity deck. There are two elements to this that I want to get better at. The first is the research/testing side. It has never been something I was fond of doing. Also, the processing of the results I tried to leave to other team members. It will be good to challenge myself and get more experienced with this part of design.

On the other side, I look forward to be able to teach people this new tool while testing it. Running a workshop with the CD and being enthusiastic about it sounds great to me. During my studies I’ve never really had the opportunity to experience teaching like activities and I want to do it more and learn to do it well.

Besides all of this, in general, it is a final test of my project competences. I see my graduation project as the final moment to proof my skills and independence as a designer and academic. I want to be proud of it when looking back.

REFERENCES:

I have some health problems, these have been discussed with the mentor, chair and the student counsellor, to account for any potential problems arising from these.
Appendix 3: Circularity game ‘A new idea is born’ script

This is the script used for the redesigned Circularity deck prototype. It goes through all the text narrated in the videos, including the instructions for every step. The story itself is chosen to give some meaning and still feel relatable, believable and realistic to the participants. However, it is possible to have different styles and themes be written for different groups of users.

To enable Lumen5 to generate the right video segments with the right timings and correct pieces of text, space has been left between certain narrated text parts. If there are no other things happening in between, it is still part of the same video segment.

Legend:
- [Square brackets]: conditions
- {Squigly brackets}: program action
- (Round brackets): wire frame screen the section is related to
- -dashes-: user action
- "Quotes": narrated story in video
- *asterisk*: Marked point

[Main menu load] (screen 1)
[Video starts playing]
"Well hello there! I may be invisible to you, but I'm your Circular Ideation Tests, Artificial Intelligence guide, but you can call me CITAI or CIT for short."
"I will be here guiding you through the C.F.C. test program."
"But before I let you in, I need to ask you a question."
"Do you have the Circularity toolkit and the included brain button ready to go?"
"If so, press the button to let me know and I will unlock the main menu for you."
[video ends and remains on screen]

-Big brain button press-
[video disappears] (screen 2)
[menu becomes available]

-Phase 1 button press-
[Phase 1 button is pressed]
[Intro load](screen 3)
[Video starts playing]
"too much carbon-dioxide & nitrogen, the plastic soup, rising sea levels, droughts, depletion of natural resources, wildfires, extinction of species..."
"We could go on for a while longer with this list, but it all comes down to one thing: the future does not look good, if we continue doing business as we are now."

"We at Circular Future Corporation want a better future than this and that is why we are looking to setup teams specialized in systemic circular solutions."

"To that end, we need intelligent, capable & willing people to make this better future a reality, together as a team."

"But we can't just recruit anyone."

"We need proof that you fit our profile."

"That is why you are here."
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.

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.

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."

"Therefore 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-
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.

Let’s 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]

[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.”

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]

[transition 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 button to start phase one has been clicked:
Introductory video setting the stage for the narrative and giving instructions for the first warmup.
Automatically 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.

300
Instructional summary of previous video.
A button to manually control going to the next stage. This can also be done with the pri-
orly connected button. Using that physical button is the preferred and instructed method.

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

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 pri-
orly 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)

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 pri-
orly 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)

Video ending warmup 2 and giving instructions for warmup 3.
Automatically transitions to next screen after the video.
Optional skip button.

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.

Done button leads back to screen 10 with the question.

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 properly 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)

Instructional summary of previous video.

A button to manually control going to the next stage. This can also be done with the properly 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)

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.

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

The next screen appears automatically after the video has ended.

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.

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

The next screen appears automatically after the video has ended.

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

Will transition to the next screen if the physical big brain button has been pressed, or the on-screen skip button.
Instructional summary of previous video.
A button to manually control going to the next stage. This can also be done with the properly 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)

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.

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).

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 possibilities 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)
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:

<table>
<thead>
<tr>
<th></th>
<th>0</th>
<th>1</th>
<th>2</th>
<th>3</th>
<th>4</th>
<th>5</th>
<th>Fully agree</th>
</tr>
</thead>
<tbody>
<tr>
<td>Do not agree at all</td>
<td></td>
<td></td>
<td></td>
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</table>

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

------------------------------------------------------------------------------------------------------------------

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

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<th>1</th>
<th>2</th>
<th>3</th>
<th>4</th>
<th>5</th>
<th>Fully agree</th>
</tr>
</thead>
<tbody>
<tr>
<td>Do not agree at all</td>
<td></td>
<td></td>
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</tr>
</tbody>
</table>

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

------------------------------------------------------------------------------------------------------------------
Appendix 5b: Circularity game workshop questionnaire

12-12-2019

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.

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<th>3</th>
<th>4</th>
<th>5</th>
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<tbody>
<tr>
<td>1</td>
<td>very quickly bored and/or distracted</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>2</td>
<td>100% focused until the job is done</td>
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<td></td>
<td></td>
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</table>

16. Optional comments

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

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<th>4</th>
<th>5</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>completely NOT creative, I can never think of something new or original</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>2</td>
<td>extremely CREATIVE, I always come up with many new and original ideas</td>
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<td></td>
<td></td>
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</table>

18. Optional comments

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

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<th>5</th>
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<tbody>
<tr>
<td>1</td>
<td>totally not excited, I would prefer to do anything else</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>2</td>
<td>very excited, I can't wait to get started</td>
<td></td>
<td></td>
<td></td>
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20. Optional comments

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

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<tbody>
<tr>
<td>1</td>
<td>to focus on one task for longer periods of time</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>2</td>
<td>to have variety and often completely change what I am doing</td>
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<td></td>
<td></td>
</tr>
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</table>

22. Optional comments

---

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

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<th>4</th>
<th>5</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>always have many ideas on how to solve it</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>2</td>
<td>I struggle to come up with even one solution</td>
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</table>

24. Optional comments

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

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<th>4</th>
<th>5</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>do not need any motivation, ask and I will do it</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>2</td>
<td>am hesitant to do anything, I often need much incentive and/or encouragement</td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

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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 vuaal.

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 vuaal.

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 vuaal.

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 vuaal.

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 vuaal.

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.

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<tr>
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<tbody>
<tr>
<td>Yes, it was all I was thinking of</td>
<td></td>
<td></td>
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<tr>
<td>No, it was even distracting at times</td>
<td></td>
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</table>

38. Optional comments

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

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<th>1</th>
<th>2</th>
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</thead>
<tbody>
<tr>
<td>No, I did not</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Yes, I did</td>
<td></td>
<td></td>
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44. Optional comments

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

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<tbody>
<tr>
<td>Yes, it was very inspiring all the time</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>No, it did not help me get more ideas at all</td>
<td></td>
<td></td>
<td></td>
<td></td>
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</tbody>
</table>

40. 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.

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</thead>
<tbody>
<tr>
<td>No, I don't think it has added value</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Yes, it has very much added value</td>
<td></td>
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</table>

46. Optional comments

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

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</thead>
<tbody>
<tr>
<td>Yes, I was constantly excited, maybe I still am</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>No, it even annoyed and bored me</td>
<td></td>
<td></td>
<td></td>
<td></td>
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</tbody>
</table>

42. Optional comments

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

<table>
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<th>2</th>
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</thead>
<tbody>
<tr>
<td>Disagreed</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Agreed</td>
<td></td>
<td></td>
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</tbody>
</table>

48. Optional comments
49. I liked the interactivity of the Circularity Deck

<table>
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<tr>
<th>1</th>
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</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td>Yes!</td>
</tr>
</tbody>
</table>

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

<table>
<thead>
<tr>
<th>1</th>
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<th>5</th>
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</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td>YES, they were fantastic</td>
</tr>
</tbody>
</table>

52. Optional comments

53. The story/narrator worked well to guide the work on the given case

<table>
<thead>
<tr>
<th>1</th>
<th>2</th>
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<th>5</th>
</tr>
</thead>
<tbody>
<tr>
<td>No, it failed</td>
<td></td>
<td></td>
<td></td>
<td>Yes, it was very good</td>
</tr>
</tbody>
</table>

54. Optional comments

55. The story/narrator improved the overall experience of the Circularity Deck

<table>
<thead>
<tr>
<th>1</th>
<th>2</th>
<th>3</th>
<th>4</th>
<th>5</th>
</tr>
</thead>
<tbody>
<tr>
<td>No, it decreased it</td>
<td></td>
<td></td>
<td></td>
<td>Yes, it improved it very much</td>
</tr>
</tbody>
</table>

56. Optional comments

57. The story/narrator managed to draw and keep my attention, even during the longer parts

<table>
<thead>
<tr>
<th>1</th>
<th>2</th>
<th>3</th>
<th>4</th>
<th>5</th>
</tr>
</thead>
<tbody>
<tr>
<td>No, I was not listening to it at all</td>
<td></td>
<td></td>
<td></td>
<td>Yes, I couldn't even look away</td>
</tr>
</tbody>
</table>

58. Optional comments

59. I learned more about Circular design today

<table>
<thead>
<tr>
<th>1</th>
<th>2</th>
<th>3</th>
<th>4</th>
<th>5</th>
</tr>
</thead>
<tbody>
<tr>
<td>No, not at all</td>
<td></td>
<td></td>
<td></td>
<td>Yes, a lot</td>
</tr>
</tbody>
</table>

60. Optional comments
61. The Circularity Deck worked well to come up with ideas for the given case

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 is core 1, solution 1. Here: C1 is random idea, C2 is core 1, solution 1: Narrator/guide: "something or someone providing a story, context and guidance."

<table>
<thead>
<tr>
<th>The toolkit</th>
<th>Element</th>
<th>Code</th>
<th>Explanation</th>
</tr>
</thead>
<tbody>
<tr>
<td>The toolkit as a whole/as an design element itself</td>
<td>C3.1 &amp; C7.1 &amp; Gt.1</td>
<td>It is the vessel that makes all the other parts possible, like it being a mixed interactive game.</td>
<td></td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>The toolkit contents</th>
<th>Element</th>
<th>Code</th>
<th>Explanation</th>
</tr>
</thead>
<tbody>
<tr>
<td>Instructions booklet</td>
<td>C2.1 &amp; C3.1 &amp; C6.1 &amp; Gt.1</td>
<td>Creating progress, providing variation in things to do and make it a mixed game. There is one booklet, so it forces people to go through it together.</td>
<td></td>
</tr>
<tr>
<td>Blindfolds</td>
<td>C3.1 &amp; C3.3 &amp; C4.1 &amp; Gt.1</td>
<td>Very disruptive measure, to force people to think and associate differently. It is also very surprising, creating possible delight.</td>
<td></td>
</tr>
<tr>
<td>Blindfolds</td>
<td>C3.1 &amp; C3.3 &amp; C4.1 &amp; C5.1 &amp; Gt.1</td>
<td>The instructions booklet</td>
<td></td>
</tr>
<tr>
<td>Blindfolds</td>
<td>C3.1 &amp; C3.3 &amp; C4.1 &amp; C5.1 &amp; Gt.1</td>
<td>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.</td>
<td></td>
</tr>
<tr>
<td>Role play badges</td>
<td>C2.2 &amp; C3.1 &amp; C3.2 &amp; C3.4 &amp; Gt.1</td>
<td>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.</td>
<td></td>
</tr>
<tr>
<td>QR1: link to surprise outside info</td>
<td>C3.1 &amp; C3.3 &amp; C5.2 &amp; C7.1 &amp; Gt.1</td>
<td>Disruption, mixing tools, it surprises.</td>
<td></td>
</tr>
<tr>
<td>QR2: link to pitch forms</td>
<td>C2.1 &amp; C3.1 &amp; C4.2 &amp; C5.1 &amp; C6.2 &amp; Gt.1</td>
<td>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.</td>
<td></td>
</tr>
<tr>
<td>Easter egg 1: Children's moulding clay (in hidden compartment)</td>
<td>C3.1 &amp; C3.4 &amp; C6.3 &amp; C7.1 &amp; C8.2 &amp; Gt.1</td>
<td>Adding a new method and the satisfaction of finding something hidden and being surprised by it. It is another part of the mixed game.</td>
<td></td>
</tr>
<tr>
<td>Magnets (meant for ecosystem phase, yet included for core 3 &amp; 7)</td>
<td>C3.1 &amp; C2.2 &amp; C3.1 &amp; Gt.1</td>
<td>Included for the phasing, creating the sense of things to come and things you want to reach.</td>
<td></td>
</tr>
<tr>
<td>Figures (meant for ecosystem phase, yet included for core 3 &amp; 7)</td>
<td>C2.1 &amp; C2.3 &amp; C3.1 &amp; Gt.1</td>
<td>Included for the phasing, creating the sense of things to come and things you want to reach.</td>
<td></td>
</tr>
</tbody>
</table>

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https://docs.google.com/forms/d/1uJAbEFP3O3T8rETKzmk9FpyFH_fqg_gkpl29EiNE曹/edit

11/11
The to buy list contents

- Material(s)
- 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 possibility to have different stages of the game.
- Materials: places

**White-board markers** *
- C2.1 & C2.3 & C3.1 & Gt.1
- Mainly facilitation, but the elements all provide the variety in tools and the possibility to have different stages of the game.
- Materials: places

**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 possibility to have different stages of the game.
- Materials: places

**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 possibility to have different stages of the game.
- Materials: places

**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 possibility to have different stages of the game.
- Materials: places

**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 possibility to have different stages of the game.
- Materials: places

**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 possibility to have different stages of the game.
- Materials: places

**Ham 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 possibility to have different stages of the game.
- Materials: places

**Scissors**
- C2.1 & C2.3 & C3.1 & Gt.1
- Mainly facilitation, but the elements all provide the variety in tools and the possibility to have different stages of the game.
- Materials: places

**Glue**
- C2.1 & C2.3 & C3.1 & Gt.1
- Mainly facilitation, but the elements all provide the variety in tools and the possibility to have different stages of the game.
- Materials: places

**Scotch tape**
- C2.1 & C2.3 & C3.1 & Gt.1
- Mainly facilitation, but the elements all provide the variety in tools and the possibility to have different stages of the game.
- Materials: places

**Any other brainstorm and/or creative materials that your team may prefer**
- Catch all caveat
- Giving freedom to the facilitator to also use whatever they are comfortable with and used to. Allowing them to go more varied than the Circularly game provides.
- Materials: places

---

**The program**

<table>
<thead>
<tr>
<th>Element</th>
<th>Code</th>
<th>Explanation</th>
</tr>
</thead>
<tbody>
<tr>
<td>Videos (all combined/codes &amp; explanation apply to all videos)</td>
<td>C2.1 &amp; C2.2 &amp; C2.3 &amp; 7.1 &amp; C8.1 &amp; C8.2</td>
<td>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</td>
</tr>
<tr>
<td>Video main menu</td>
<td>C2.1 &amp; C3.1 &amp; C3.2 &amp; C3.4 &amp; C4.1 &amp; C6.2</td>
<td>Allowing for the functionalities. It also intimidates draw people in. It already delays them, making them want to get started even more</td>
</tr>
<tr>
<td>Video introduction + warmup 1</td>
<td>C1.1 &amp; C1.2 &amp; C1.3 &amp; C1.4 &amp; C1.5 &amp; C1.7 &amp; C8.1 &amp; C8.2 &amp; Gt.1</td>
<td>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 powerful drives to kick the group into action</td>
</tr>
<tr>
<td>Video warmup 1 to 2 transition</td>
<td>C1.3 &amp; C1.2 &amp; C3.3 &amp; C3.4 &amp; C7.1 &amp; Gt.1</td>
<td>Totally different method to use, creating quite some surprising moments, motivating them to keep using it</td>
</tr>
<tr>
<td>Video warmup 2 to 3 transition</td>
<td>C3.1 &amp; C3.3 &amp; C5.2 &amp; C5.3 &amp; Gt.1</td>
<td>Another new method, now also including social interactions, which can be motivating to many people</td>
</tr>
<tr>
<td>Video ideation phase introduction + theory instruction</td>
<td>C2.1 &amp; C2.2 &amp; C5.1 &amp; C6.3</td>
<td>Similar to the above one, but without introduction to a whole new phase</td>
</tr>
<tr>
<td>Video ideation theory to instruction transition</td>
<td>C2.1 &amp; C2.2 &amp; C5.1 &amp; C6.3</td>
<td>Introduces the next step, rewarding progress and making it visible. It also makes sure people have to work together and can’t continue if they do not finish the next part</td>
</tr>
<tr>
<td>Video ideation brainstorm kick-off</td>
<td>C2.1 &amp; C2.2 &amp; C5.1 &amp; C6.3 &amp; C8.1 &amp; C8.2</td>
<td>Finishing up, moving on to the next one. Creating a sense of progress to motivate</td>
</tr>
<tr>
<td>Video idea end + attention grab</td>
<td>C2.1 &amp; C2.2 &amp; C3</td>
<td>Ending the previous phase, moving on to the next one. Creating a sense of progress to motivate</td>
</tr>
<tr>
<td>Video pitches</td>
<td>C2.1 &amp; C4.1 &amp; C4.2 &amp; C5.1 &amp; C8.1 &amp; Gt.1</td>
<td>Wrapping up and boding the results is satisfying and motivating. Seeing what has been created and getting to hear how it 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</td>
</tr>
<tr>
<td>Video F.C.V.P.</td>
<td>C5.1 &amp; C8.2</td>
<td>Pushing a button to continue creates a motivating sense of progress and accomplishment. Curiosity also motivates to press it… what it next?</td>
</tr>
<tr>
<td>Big brain button navigation functionality (go to next screen)</td>
<td>C3.2 &amp; C3.3 &amp; C3.4 &amp; C8.1 &amp; C8.2 &amp; Gt.1</td>
<td>Pushing a button to continue creates a motivating sense of progress and accomplishment. Curiosity also motivates to press it… what it next?</td>
</tr>
<tr>
<td>Countdown timers</td>
<td>C1.3 &amp; C8.1 &amp; C8.2</td>
<td>Creating pressure to spur the group into action. “So much to do, so little time. We NEED to hurry!”</td>
</tr>
<tr>
<td>Automatic (timer based) transitions</td>
<td>C2.3 &amp; R.1</td>
<td>Sense of progress and staging. The feeling of going forward</td>
</tr>
<tr>
<td>A/B/C theory test questions</td>
<td>C1.2 &amp; C2.3 &amp; C5.1 &amp; Gt.1</td>
<td>Sharing 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</td>
</tr>
<tr>
<td>Video ideation brainstorm interview</td>
<td>C2.1 &amp; C2.2 &amp; C5.1</td>
<td>Social pressure to get it right next time and be able to continue. Avoiding failure</td>
</tr>
<tr>
<td>Digital &amp; physical big brain button (request input functionality)</td>
<td>C3.1 &amp; C3.4 &amp; C6.2 &amp; C8.1 &amp; C8.2 &amp; Gt.1</td>
<td>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</td>
</tr>
<tr>
<td>Pop-up texts</td>
<td>C2.2 &amp; C3.1 &amp; C3.3 &amp; C3.4 &amp; C7.1 &amp; C8.2 &amp; Gt.1</td>
<td>Prompts that induce curiosity. They provide variations in methods and tools and things to do, spurring the creativity and ideation further on</td>
</tr>
<tr>
<td>Pop-up texts</td>
<td>C3.1 &amp; 6.2</td>
<td>New method to try, limitation in options to overcome</td>
</tr>
</tbody>
</table>

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*marked items are considered to be crucial to have. Any other item on the list are recommended.*
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 came 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. Therefore 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 like you If you want. 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 computer and letting the program on it guide you.

To be prearranged:
1. A computer with a big screen and working sound.
2. Writing equipment: ballpoints, fineliner, 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)
8. scissors
9. yarn or very thin rope
10. push-pins
11. glue
12. (scotch) tape
13. Any other brainstorm and/or creative materials that your team may prefer.

Theory and phase instructions booklet

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 referred 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
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 its 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 extent is not set in stone, yet. This ideal situation might even turn out to be an unattainable utopia, but this does not mean that it is not worth working towards.

The 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.

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)

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.

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.

3) Ecosystem 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. This outcome can be achieved by developing co-specialized and complementary products and services.

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, tends to be unsustainable and is becoming less desirable over time.
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.

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.

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.

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).

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.

Inform (use data)

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

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

<table>
<thead>
<tr>
<th>1</th>
<th>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.</th>
</tr>
</thead>
<tbody>
<tr>
<td>2</td>
<td>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.</td>
</tr>
<tr>
<td>3</td>
<td>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.</td>
</tr>
<tr>
<td>4</td>
<td>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!</td>
</tr>
<tr>
<td>5</td>
<td>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.</td>
</tr>
<tr>
<td>6</td>
<td>Don’t forget to also pay attention to the screen every once in a while. It will try to get your attention sometimes.</td>
</tr>
<tr>
<td>7</td>
<td>If you feel stuck, use the Big Brain Button to get some help.</td>
</tr>
</tbody>
</table>
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 well and in tables 2 & 3, which have been repeated here as table 6 & 7.

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

Table 6: User based category-core drive relatedness.

<table>
<thead>
<tr>
<th>Core drive</th>
<th>Strongly associated (*1)</th>
<th>Lesser associated (*0,5)</th>
<th>Σ</th>
</tr>
</thead>
<tbody>
<tr>
<td>1: Epic meaning &amp; calling</td>
<td>-</td>
<td>-</td>
<td>0</td>
</tr>
<tr>
<td>2: Development &amp; accomplishment</td>
<td>1</td>
<td>1</td>
<td>4</td>
</tr>
<tr>
<td>3: Empowerment of creativity &amp; feedback</td>
<td>1</td>
<td>-</td>
<td>3</td>
</tr>
<tr>
<td>4: ownership &amp; possession</td>
<td>1</td>
<td>1</td>
<td>3</td>
</tr>
<tr>
<td>5: Social influence &amp; relatedness</td>
<td>1</td>
<td>1</td>
<td>2,5</td>
</tr>
<tr>
<td>6: Scarcity &amp; impatience</td>
<td>1</td>
<td>1</td>
<td>1,5</td>
</tr>
<tr>
<td>7: Unpredictability &amp; curiosity</td>
<td>1</td>
<td>-</td>
<td>1</td>
</tr>
<tr>
<td>8: Loss &amp; avoidance</td>
<td>-</td>
<td>1</td>
<td>1</td>
</tr>
</tbody>
</table>

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 selection 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 business”
- “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 powerpoint 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”
- “It is very practical for us”
- “Yes, easy to use, good outcomes”
- “Circularity is interpreted very broadly”
- “The different loops --> tools to explain your circularity, the cards --> good examples of companies which produced something”

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”
An answer to “how to?”

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

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”

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

“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.”

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”

“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 would be very broadly so it felt all bases were covered.”

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”

“Provides clarity”

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

“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”

“Easy to digest the information”

“Useful to reduce complexity”

“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”

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”

“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”

“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”

“Requires both descriptions and examples that stimulate incorporation of the ideas into companies”

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”

“The presence of these cue cards make you think of stuff that can be pretty obvious but quickly overseen”

“ Generates ideas of possibilities”

“Gives ideas of possibilities”

“New perspective”

“nice perspective tool”

“Gives new perspectives”

“New (perspective gaining)

“Inspiration”

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

“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”

“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”

“Nurtures new perspectives”

“Gives new perspectives”

“New perspective”

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

“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”

“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”

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

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

“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”
**Accessibility/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."

**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"

**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."

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**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**

[Diagram showing design case setup]

Legend:

- Room
- Door
- Screen
- Chair
- Table
- Toolbox

*Fig. 22: User test room setup.*
References


