Innovating better Sustainability Understanding at Aalborg University through the use of a Serious Game

Master's Thesis report by
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STUDENT REPORT

Title Page

Title:	Innovating better Sustainability Understanding at Aalborg University through the use of a Serious Game
Semester:	10 (Spring-Fall 2022)
Semester theme:	Master's Thesis
Project Timeframe:	February 1st 2022 – November 25th 2022
ECTS:	30
Supervisor:	Lars Bo Henriksen
Author:	Martin Thrysøe Andersen
Number of pages:	73 (58 pages of 2400 characters with spaces)
Appendix:	0

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Acknowledgements

This Techno-Anthropology 10th semester thesis is based on the continuation of the Techno-Anthropology 9th semester collaboration between the author and the Tech Center for Sustainable and Digital Transformation at Aalborg University. I would therefore like to thank the steering group members of the Tech Center for Sustainable and Digital Transformation at Aalborg University for their openness and willingness to let me observe their work throughout the collaboration period. Furthermore, I would like to give special thanks to Maurizio Teli for making this collaboration an opportunity right from the beginning as well as for the continuation and allowing me to share an office space with him and Helena. Special thanks also goes to Helena Haxvig for always having the time to answer many questions about the center's activities as well as sparring and discussing different topics at hand. I would also like to give special thanks to Lars Bo Henriksen, my supervisor throughout both semesters, who has always been ready to talk, discuss and supervise on these 9th- and 10th semester projects. Beyond that, I would like to thank fellow student helper Amanda Morris Bak who deserves equal credit for great collaboration which has contributed a great significant deal to making the cards become a reality. Many thanks also goes to the technical designer, who created the setup and main artwork for the cards. Last but not least, I would like to direct special thanks to my partner Nupur who has been a constant support and mood booster throughout this long time of thesis writing.

Abstract

This thesis investigates the field of sustainable and digital transformation. Due to the rapid technological development in digital transformation and the potential ambiguities of sustainability, this thesis arrives from a critical perspective on what is sustainable and what is not. A lack of research in the fields combining sustainability and digital transformation leads the author, in collaboration with the TECH4SDT to create, develop and test 12 cards constituting a serious game in order to answer the problem statement: *"How do you create a tool that facilitates reflection and discussion upon sustainable and digital transformation between researchers at a university?"*. The results show how the cards facilitated and stimulated discussion upon the subjects of sustainable and digital transformation while reflection was only detected in very small parts.

Introduction

The world today is facing the biggest challenges of climate change ever experienced. The road we got here on is paved with a variety of unsustainable practices. When the steam engine was invented everybody was cheering and only few could imagine the effect it would have on technological development, as well as the climatic challenges it would later bring. It would not be before 1987 that the first term of sustainability would be coined. At that time of course, people had already known and experienced the consequences of air pollution, oil spills and natural degradation of course. They just did not have the knowledge to see the big picture of climate change. Nowadays we know better what environmental, economic and social challenges we are facing and thanks to the last decades of studies we have a better understanding of sustainability. Or do we? Because since 1987 when the world commission on environment and development coined the term sustainable development Co2 emissions have only increased. The economic division between rich and poor has only increased. Sustainability is no easy task, actually it might be the hardest we have ever faced. The importance of figuring out what the concept of sustainability constitutes has never been more important. This thesis, in collaboration with the research center; TECH for Sustainable and Digital Transformation will attempt to unravel the concept of sustainability with a serious game in order to lay the foundations of sustainable practices to develop. Only then can we see through what is truly sustainable and what is not.

1.0 Problem Analysis

This master's thesis functions as a continuation of my collaboration with the research center TECH for Sustainable and Digital Transformation (TECH4SDT) at Aalborg University (AAU). Therefore, certain parts from the author's earlier TAN9 semester report will be of focus again in this master's thesis report, although accompanied with new perspectives and angles to address the newly modified problem statement. As where the former TAN9 semester report focused on addressing how the TECH4SDT achieve their goals in order to promote a Sustainable and Digital Transformation at AAU and beyond, this TAN10 master's thesis will focus on how to create a tool that can help the TECH4SDT in achieving their goals. With this in mind we will revisit some of the points laid out in the author's TAN9 semester report for the purpose of accumulating and rethinking their knowledge contribution to this master's thesis.

1.1 Tech Center for Sustainable and Digital Transformation

As mentioned above, this TAN10 master's thesis functions as a continuation of the collaboration between the author and the research center: TECH Center for Sustainable and Digital Transformation. Therefore, it is necessary, however briefly, for us to summarize what this research center is involved in.

As explained in Martin Thrysøe Andersen's report from 2021; "*Interning at TECH4SDT: An Insightful Journey into the fields of Sustainability and Digital Transformation"*, the TECH4SDT is a research center at AAU with a multidisciplinary steering group consisting of five steering group members from multiple departments at AAU (Andersen 2021). But if we are to fully understand the TECH4SDT's agenda, we have to take a closer look at their typology:

> *"Established in 2021, the Centre on Sustainable and Digital Transformation assumes as its starting point the need of a profound transformation to ensure a liveable future for all. The required transformation is, at the same time, sustainable and digital, and it includes the multitude of social, environmental, and technological elements that constitute the fabric of humankind practices of living in a common world. By taking this perspective, the Centre on Sustainable and Digital Transformation aims at promoting - at AAU and beyond - research projects, educational content, and social as well as professional practices, that take as a starting point the combination of the human, social, economic, and environmental dimensions of sustainability with the design, production, assessment of, and engagement with digital technologies. To achieve its goals, the Centre activities are oriented toward: 1) mapping the state of the art of research and practices combining sustainability and digitalization; 2) generating new ideas to promote the overall goal of a sustainable and digital transformation, with a particular attention to practices of living in a*

common world; 3) constructing material that can support the development of competences bringing together sustainability and digital technologies, in research and society at large; 4) boosting interdisciplinary research proposals on the core themes of the centre; 5) infrastructuring opportunities, for researchers, students, and society at large, to explore and experiment with new ways of thinking about sustainable and digital transformations."

(TECH4SDT 2022)

To summarize this typology in short we turn to an elaborate analysis of the TECH4SDT's typology by Andersen in 2021. Here, he explains how the TECH4SDT acknowledges "*the need for a sustainable and digital transformation to ensure a livable future for all" (Andersen 2021)*, 3). Andersen also explains how:

"*In their work with this transformation, the TECH4SDT wants to include the many social, environmental and technological elements that constitute the humankind practices of sharing the world with others"*.

(Andersen 2021), 7)

Furthermore, Andersen explains how:

"The TECH4SDT aims their goals at promoting research, education and social as well as professional practices, intraorganizational and beyond, in a combination with the dimensions of human sustainability, social sustainability, economic sustainability and environmental sustainability within the design of, production of, assessment of and engagement with digital technologies".

(Andersen 2021), 7)

In order to reach these goals, the TECH4SDT have planned 5 activities to perform. They are:

1. *"Mapping the state of the art of research and practices combining sustainability and digitalization [...]"*
2. *"[...] Generating new ideas to promote the overall goal of a sustainable and digital transformation, with a particular attention to practices of living in a common world [...]"*
3. *"[...] Constructing material that can support the development of competences bringing together sustainability and digital technologies, in research and society at large [...]"*
4. *"[...] Boosting interdisciplinary research proposals on the core themes of the centre [...]"*
5. *"[...] infrastructuring opportunities, for researchers, students, and society at large, to explore and experiment with new ways of thinking about sustainable and digital transformations."*

(TECH4SDT 2022)

In Andersen's analysis, he claims these activities to be linear (Andersen 2021), 6). While that might have been true back then, at the time of writing this thesis, both activity number 1 and activity number 2 are being performed simultaneously. More on that later. However, to sum up the TECH4SDT's typology, we can say that their end goal is to make ways for researchers, students, and society at large by creating a process that infrastructures opportunities for interdisciplinary research to explore and experiment in new ways of thinking about sustainable and digital transformation, allowing the field of sustainable and digital transformation to evolve and develop. In this thesis, I have mainly been focusing on creating a tool that can accommodate the TECH4SDT's 2nd activity; *generating new ideas to promote the overall goal of a sustainable and digital transformation*.

Furthermore, with the TECH4SDT's aims and goals illuminated, I will attempt to answer the following; how, really, can the TECH4SDT create the possibilities for the domain of sustainable and digital transformation to evolve and develop? Before we can answer that, we have to understand the core concepts of the dimensions of sustainability that the TECH4SDT include in their typology.

1.2 The many forms of Sustainability

Sustainability comes in many forms and variants. However, in this section, we will mainly focus on the dimensions of sustainability that the TECH4SDT includes in their typology:

- Human sustainability
- Social sustainability
- Economic sustainability, and
- Environmental sustainability

For some, three of these dimensions of sustainability; social sustainability, economic sustainability and environmental sustainability, should be familiar concepts, but human sustainability might be lesser known. In the following sections we will briefly explore what these dimensions of sustainability encompasses and how more impracticalities arise as we dive deeper into the depths of sustainability. However, first we need to understand how sustainable development is conceptualized.

1.2.1 Sustainable Development

The first widely acknowledged conceptualization of sustainable development was put forward 35 years ago. It was the United Nations' The World Commision on Environment and Development that, in 1987, published the report known as: "Our Common Future*"* and also "The Brundtland Report". In here, the commision conceptualized sustainable development as the following:

> *"Sustainable development is development that meets the needs of the present without compromising the ability of future generations to meet their own needs."*
>
> (The World Commision on Environment and Development 1987, 54)

This conceptualization should be pretty easily understood. After all, as long as a certain development does not compromise the ability of future generations to meet their own needs, that certain development should be considered sustainable development. Easy. However, as we also shall see later in this thesis, the concept of sustainability easily becomes rather ambiguous between different actors, especially with the lack of clarification that The Brundtland Report comes with. Therefore, As a way of broadening our understanding of the sustainability concepts, we look to John Elkington and his Triple Bottom Line theory.

1.2.2 The Triple Bottom line and its impracticalities

Approximately 10 years after the publication of the Brundtland Report, John Elkington coined the triple bottom line theory as a means of measuring organizations' impact on sustainability. Here, he argues for sustainability to be seen in threefold dimensions; economic, environmental and social, altogether, in order

to truly understand sustainability (Elkington 1997). Furthermore, Timothy F. Slaper and Tanya J. Hall argues that we should see the Triple Bottom Line theory as: "*an accounting framework that incorporates three dimensions of performance; social, environmental and financial"* (Slaper and Hall 2011), 1). Additionally, Slaper and Hall highlights that: "*The trick isn't defining TBL. The trick is measuring it"* (Slaper and Hall 2011), 1), acknowledging that, even after 14 years, the Triple Bottom Line theory has its impracticalities.

1.2.2.1 Economic Bottom Line

The economic bottom line, Elkington argues, encompasses economic capital. Here, economic capital, as additional to traditional economic theory's financial and physical capital, also encompasses human capital - a measure of the experience, skills and other knowledge-based assets of the individuals who make up an organization (Elkington 1997), 74). We will explore the concepts of human capital further later in the report. But for now, let us keep focus on the concept of economic capital. According to Slaper and Hall, some of the economic variables that encompasses the economic bottom line are:

- *"[...] Personal income*
- *Job growth*
- *Employment distribution by sector*
- *Percentage of firms in each sector*
- *Revenue by sector contributing to gross state product [...]"*

(Slaper and Hall 2011), 3)

By this analogy, and also as Slaper and Hall states, the economic bottom line highly encompasses a flow of money and how this is being distributed. Interestingly, many of the variables Slaper and Hall mentions suggest that economic capital can be compared based on the flow of money in different sectors. Comparing the variables; Employment distribution by sector and Revenue by sector contributing to gross state product, would give an insight into which sector houses the most employees, produces the most taxable state income and, in general, which sector is currently experiencing the most economic development.

Before moving on to the environmental bottom line, Elkington mentions a shear zone between the economic and environmental bottom line consisting of eco-efficiency. Eco-efficiency, Elkington writes, involves:

> *"The delivery of competitively-priced goods and services that satisfy human needs and quality of life, while progressively reducing ecological impacts and resource intensity throughout the life cycle, to a level at least in line with the Earth's estimated carrying capacity."*
>
> (Elkington 1997), 78)

According to this, eco-efficiency is about both economic and environmental development in terms of staying economically competitive and reducing environmental impacts at the same time to get in line with the Earth's carrying capacity. A criticism of eco-efficiency could be that it does not take the social bottom line into account. We will come back to that later. First, let us explore what the environmental bottom line encompasses.

1.2.2.2 Environmental Bottom Line

The environmental bottom line, Elkington argues, encompasses natural capital. Moreover, Elkington explains how natural capital is not just a case of putting a price-tag on all the trees in a forest. Natural capital, Elkington argues, accounts for the whole ecosystem of a forest, considering both timber as a commercial product as well as the wider forest functions the trees in the forest have in example to storing carbon dioxide and methane gasses. Simultaneously, Elkington distinguishes between: *"[...] Critical natural capital and renewable, replaceable and substitutable natural capital"* (Elkington 1997),.79). With critical natural capital, Elkington understands *"[...] Natural capital which is essential to the maintenance of life and ecosystem integrity [...]"* whilst he understands renewable, replaceable and substitutable natural capital as *"[...] Natural capital which can be renewed, repaired, or substituted or replaced [...]"* (Elkington 1997), 79). Elkington gives the example that renewable natural capital can be relocation of sensitive ecosystems, repairable natural capital can be environmental remediation and substitutable and replaceable natural capital can be man-made substitutes such as solar panels instead of limited fossil fuels (Elkington 1997), 79).

According to Slaper and Hall, some environmental variables should represent measurement of natural resources and could incorporate air and water quality, energy consumption and land use (Slaper and Hall 2011), 3). Additionally, for measuring the environmental bottom line, they list some examples like:

- *"[...] Sulfur dioxide concentration*
- *Electricity consumption*
- *Fossil fuel consumption*
- *Change in land use/land cover [...]"*

(Slaper and Hall 2011), 3)

By this analogy, the environmental bottom line highly encompasses natural resources and the consumption that impacts them. Whereas, indeed, much of our modern day electricity comes from renewable energy sources such as wind and solar panels causing less need for the consumption of fossil fuels, many of these renewable energy sources, especially solar panel farms, increase the need for land

use/land cover. Pairing this with the ever discussed increasing world population, land use/land cover will be a huge variable for the future generations to solve.

Before moving on to the social bottom line, Elkington mentions a shear zone between the environmental bottom line and the social bottom line consisting of environmental justice. Environmental justice, Elkington writes, involves intra- and inter-generational equity:

> "[...] *The intra-generational agenda is largely concerned with equity issues affecting those now alive (e.g. haves vs. have-nots, North vs. South), and the inter-generational agenda mainly with the balance of advantage between different generations (as in pension rights or long-range health care entitlements) and between those currently alive and those yet to be born (e.g. loss of forests, biodiversity, or climatic stability) [...]"*
>
> (Elkington 1997),.83)

Furthermore, Elkington goes on to explain how environmentalists and human rights campaigners have been able to join forces in the pursuit of environmental justice for economically and socially deprived Americans in regards to the fact that, according to Steven Viederman:

> *"On average, 230 times more toxic waste was emitted in neighborhoods near the plant of the fifty largest industrial toxic polluters than in the communities of the CEOs responsible for the waste".*
>
> (Viederman DEC 12, 1996)

This is just one, although strong, example of how we can benefit from viewing the environmental and social bottom line together in order to address environmental justice. Moving on, we will explore one more shear zone between the social and economic bottom line. However, first we will explore the social bottom line more in-depth.

1.2.2.3 Social Bottom Line

The social bottom line, Elkington argues, encompasses social capital. Here, social capital is to be understood both partly as human capital in the form of public health, skills and education but also as much wider measures of a society's health and wealth creation potential (Elkington 1997), 85). However, to really understand social capital, Elkington turns to Francis Fukuyama and his work "*Trust: The Social Virtues and the Creation of Prosperity*" from 1995 on trust. In this work, Fukuyama speaks of social capital as "*A capa-bility that arises from the prevalence of trust in a society or in certain parts of it*" and, he continues, "*the ability of people to work together for common purposes in groups and organizations*" (Fukuyama 1995).

Fukuyama further goes on to argue how doing business costs less for high-trust societies such as Japan and Germany than low-trust societies such as the USA (Fukuyama 1995). For example, Fukuyama writes that:

> *"If people who have to work together in an enterprise trust one another because they are all operating according to a common set of ethical norms, doing business costs less. Such a society will be better able to innovate organizationally, since the high degree of trust will permit a wide variety of social relationships to emerge."*
>
> *(Fukuyama 1995)*

By this analogy, social capital becomes more than merely having a focus on public health, skills and education. With the inclusion of concepts such as trust, social capital comes to include a focus on the wider measures of a society's health and wealth creation, just as Elkington argues.
But what kind of variables actually go into the social bottom line? According to Slaper and Hall the social variables encompassing the social bottom line could be focused on education, health and well-being and quality of life whereas some examples of measurement could be:

- "[...] *Unemployment rate*
- *Relative poverty*
- *Percentage of population with a post-secondary degree or certificate*
- *Violent crimes per capita*
- *Health-adjusted life expectancy [...]"*

(Slaper and Hall 2011), 4)

By this analogy, it becomes clear how the variables encompassing social capital altogether opens up for wider effects such as trust. For example, how can you expect there to be trust in a given society with high violent crimes per capita? Or how can a given society have trust in the governing power if that governing power presents the society with very limited, unequal or few opportunities for education or healthcare? These are just some of the questions that can be asked when viewing the different variables for the social bottom line.

Elkington also mentions a shear zone between the economic and social bottom line consisting of business ethics (Elkington 1997), 91). Business ethics, Elkington writes, involves potentially great or destructive powers:

> "[...] *At a time when the traditional relationships between companies and their employees are changing fundamentally, with even the largest companies moving sharply away from life-time employment, the whole issue of trust is also becoming increasingly charged. The result is that individual agenda items, like business ethics, contain greater potential energy - and, if mismanaged, destructive power - than in the past* [...]"
>
> (Elkington 1997), 91)

Furthermore, he continues:

> "[...] *Much business behavior causes offence because it is unethical, but in some cases - because ethics can vary from person to person, from company to company, and from culture to culture - the problem is that different ethical principles are being applied inside and outside the company. Some ethical violations are also legal violations, as when there is fraud or corruption. But many are not. For example, a company may sometimes legally stretch the truth when making claims about its products or provide customers with less than full value* [...]"
>
> (Elkington 1997), 91)

Exactly stretching the truth is something that occurs frequently in the modern society between consumers and businesses - whether it being promises of a toothpaste tube being 100 percent recyclable (if you disassemble the plastic lid, cut the tube open and wash the insides thoroughly clean of toothpaste and dispose of the parts in the right recycle containers), or signing up for a subscription with your energy supplier for your household energy supply to come only from wind turbines (which is only theoretical possible) - which balances on the edge of practises being either ethical or unethical.

But business ethics are not just about half truths. Sometimes it is also about the markets a business operates in. About business ethics, Elkington continues:

> "[...] *The emerging field of ethical - or socially responsible - investment focuses not only on a company's behavior but also on the industry it is in and the markets it serves. So, for example, products such as tobacco and armaments (particularly indiscriminate in their action as is potentially the case with mines or germ warfare weapons) are often considered unethical and companies making them are usually screened out of investment portfolios* [...]"
>
> (Elkington 1997), 91)

With this in mind, it becomes clear how combining the economic- and social bottom line opens up for topics in business ethics to come into light and how we can benefit from questioning whether or not the most financially viable solution is the best one.

Lastly, Elkington highlights that:

> "[...] *The triple bottom line itself potentially raises a range of ethical issues. How, for example, should economic, social and environmental priorities be assessed and, more importantly, traded off?* [...]"
>
> (Elkington 1997), 91)

The shear zones of eco-efficiency, environmental justice and business ethics showcases how we can benefit from viewing the different bottom lines together, and how doing this provides us with more issues to be solved and questions to be answered upon how to tackle these different socio-economic, socio-environmental and eco-environmental problems. But as Elkington writes above, how do we decide which elements of the triple bottom line to prioritize? Optimally we should include all the three elements

in our thinking and engagement with solving problems, but more than often one element is prioritized over the other. To cite Timothy Slaper and Tanya Hall again; *"The trick isn't defining TBL. The trick is measuring it" (Slaper and Hall 2011)*, 1), it becomes clear that the triple bottom line as a conceptual theory does good in reminding us that we should think economic, environmental and social elements all together into our solutions. However, as an accounting framework the triple bottom line becomes ambiguous in the sense of valuing and prioritizing the different measures that encompasses the different bottom lines. An ambiguity we shall later hope to unravel.

1.2.3 The ambiguity of Human Sustainability

Now that we have conceptualized what the three dimensions of sustainability; economic, environmental and social, encompasses, we have to turn our focus to a fourth dimension of sustainability that the TECH4SDT have included in their typology; human sustainability.

For most, this dimension of sustainability is a lesser known concept than the three above. A fast Google Scholar search of each dimension reveals a clear difference in the amount of published articles between the dimensions with about 1.360.000 results for the search "Environmental Sustainability", 273.000 results for the search "Economic Sustainability", 253.000 results for the search "Social Sustainability" and only 5.610 results for the search "Human Sustainability". Clearly, we can conclude that human sustainability is less of a widespread concept than the concepts of the three other dimensions of sustainability. Nevertheless, the TECH4SDT has chosen to include the concept of human sustainability in their typology and therefore we have to conceptualize what this dimension of sustainability might encompass.

Robert Goodland tried to conceptualize human sustainability with his article: "*Sustainability: Human, Social, Economic and Environmental"* in 2002 (Goodland 2002). Here, Goodland makes his claim of what the concept of human sustainability might encompass. Goodland writes:

> "*Human sustainability means maintaining human capital. Human capital is a private good of individuals, rather than between individuals or societies. The health, education, skills, knowledge, leadership and access to services constitute human capital* [...]"
>
> (Goodland 2002),1)

Here, we see Goodland distinguishing human sustainability from social sustainability by focusing on the individual rather than the societal scale. Furthermore, Goodland proclaims the elements of health, education, skills, knowledge, leadership and access to services to constitute human capital. Goodland continues to proclaim:

> "[...] *As human life-span is relatively short and finite (unlike institutions) human sustainability needs continual maintenance by investments throughout one's lifetime* [...] *Promoting maternal health and nutrition, safe birthing and infant and early childhood care fosters the start of human sustainability. Human sustainability needs 2–3 decades of investment in education and apprenticeship to realize some of the potential that each individual contains* [...]".
>
> (Goodland 2002), 1)

By this analogy, we see how Goodland conceptualizes the concept of human sustainability as creating the opportunity for individuals to realize the true potential that each and one of us possess. Infrastructuring opportunities for individuals to reach their potential is also part of the conceptualization that Gretchen Spreitzer, Christine L. Porath and Christina B. Gibson argues in their article: "*Toward human*

sustainability: How to enable more thriving at work" from 2012 (Spreitzer, Porath, and Gibson 2012, 155-162). In their article they argue that:

> "[...] *In comparison to the environmental and economic dimensions of sustainability, substantially less attention has been focused on sustainability's human dimension. An important mechanism for understanding the human dimension of sustainability is thriving at work* [...]"
>
> (Spreitzer, Porath, and Gibson 2012, 155-162))

Indeed, we saw earlier with the searches, how the field of human sustainability academically is considerably smaller than the fields of environmental and economic sustainability. Furthermore, Just as Goodland proclaims human sustainability to be the individual reaching their true potential, Spreitzer, Porath and Gibson too, find their arguments to be in the same category. In another section they explain how they understand thriving:

> "[...] *Thriving is indicated by the joint experience of vitality and learning at work. The first component, vitality, denotes the sense that one is energized and feels alive at work* [...] *The second component, learning, is about growing through new knowledge and skills* [...] *Together, vitality and learning are the key markers of thriving at work.*"
>
> *(Spreitzer, Porath, and Gibson 2012, 155-162)*

We might say that vitality encompasses a certain energy and optimism related to one's work, while learning encompasses the acquiring of new knowledge and skills in order to grow, develop and evolve. While these elements might sound preferable to aim for, Spreitzer, Porath and Gibson adds:

> "[...] *If people lack vitality but are learning, they are likely to feel depleted and eventually burn out* [...] *Conversely, if people have energy at work but lack opportunities to learn and grow, they are likely to feel stagnated rather than thriving* [...]"
>
> (Spreitzer, Porath, and Gibson 2012, 155-162)

By this analogy, we see a clear importance in focusing on both vitality and learning at the workplace in order to mitigate negative consequences such as burning out or feeling stagnated at work. Contrary, if both vitality and learning are present for a certain individual at the workplace, the cornerstones for thriving, and therefore human sustainability, are laid.

Spreitzer, Porath and Gibson's understanding of human sustainability correlates well with Goodland's understanding. When Goodland advocates that human sustainability needs investments in education and apprenticeship, he is basically advocating for investments into the second component of thriving, learning. In this thesis, in order to understand human sustainability, we will be looking for the elements of vitality and learning to be present for human sustainability to thrive.

1.2.4 Why it is Important to talk and reflect upon Sustainability

The triple bottom line is a great concept for reminding us that there are other dimensions of sustainability. However, as an accounting framework it falls the risk of becoming an ambiguous concept. Therefore, it is important that we talk about sustainability and unravel the ambiguous parts accompanied by the social, human and environmental dimensions of sustainability in order to see through what is truly sustainable and what is not. This is especially important when working in a new field such as sustainable and digital transformation. Without a proper discussion about sustainability concerning digital transformation, digital transformation falls the risk of becoming a sustainably unchallenged mainstream as well as a buzzword we tell ourselves is sustainable just as is. Indeed, it seems impossible for the whole world to simultaneously agree on what may and may not be sustainable in every case of digital transformation. It should, however, be possible to open up a space where a discussion of what may, and may not, be sustainable digital transformation. In this thesis I will argue that one way of opening up this space is through the use of games and serious games. In section 1.3, we will look into what games might consist of, while in section 1.4 we will delve into how games can be used for opening up a space where a discussion about sustainable and digital transformation can thrive.

1.3 Games

How do we get to talking about sustainability then? Well, some might argue that it is as easy as just sitting down and starting a conversation about sustainability. However, there might be a more interactive, stimulating and engaging way to spark up a conversation about sustainability; through games. The following sections will clarify how we, throughout this paper, will understand the concept of games and how playing games can bring us together and help us facilitate a conversation.

1.3.1 What is a game?

First, what is a game? Many are familiar with, and even own, board games such as chess, monopoly and catan. Furthermore, console- and computer games such as Fifa, Gran Turismo and Call of Duty should also be well known to most. But what is the reason why we call all of these titles games? To answer that, we have to dive into some definitions and descriptions of what a game might consist of. There exists many definitions of what a game is, but common for most definitions is that a game consists of play, pretending, a goal and rules. However, many definitions also include other elements as part of what a game consists of. Therefore, we will explore some of these definitions to get a certain understanding of what a game might consist of.

1.3.1.1 Play

In “Fundamentals of Game Design; Third Edition”, by Ernest Adams (Adams 2014), he uses Mark Twain’s writings from his work; “The Adventures of Tom Sawyer" as a starting point. In here Mark Twain writes:

> “[...] *Work consists of whatever a body is obliged to do, and [...] Play consists of whatever a body is not obliged to do.*”
>
> (Twain 1876)

To focus on the play part, by Mark Twain’s analogy, play, in contrast to work, is voluntary. Furthermore, Adams puts forward his definition of what a game is. He writes:

> “*Games are a type of play activity, conducted in the context of a pretended reality, in which the participant(s) try to achieve at least one arbitrary, nontrivial goal by acting in accordance with rules.*”
>
> (Adams 2014)

Here, Adams includes the elements of play, pretending, goals and rules in his definition. He then goes on to explain how play is participatory and interactive. In contrast to watching a play or film, Adams argues that “*play ultimately includes the freedom to act and the freedom to choose how to act*” (Adams 2014).

With this freedom the player's actions ultimately change the course of events, making the game interactive.

1.3.1.2 Goal(s)

Interactivity and goals might seem like solar opposites. However, it is commonly understood that a game must have a goal or goals. In her book: "Reality is Broken: Why Games Make Us Better and How They Can Change the World" from 2011, Jane McGonigal writes about goals in games. About goals she writes:

> "*The goal is the specific outcome that players will work to achieve. It focuses their attention and continually orients their participation throughout the game. The goal provides players with a sense of purpose.*"
>
> (McGonigal 2011)

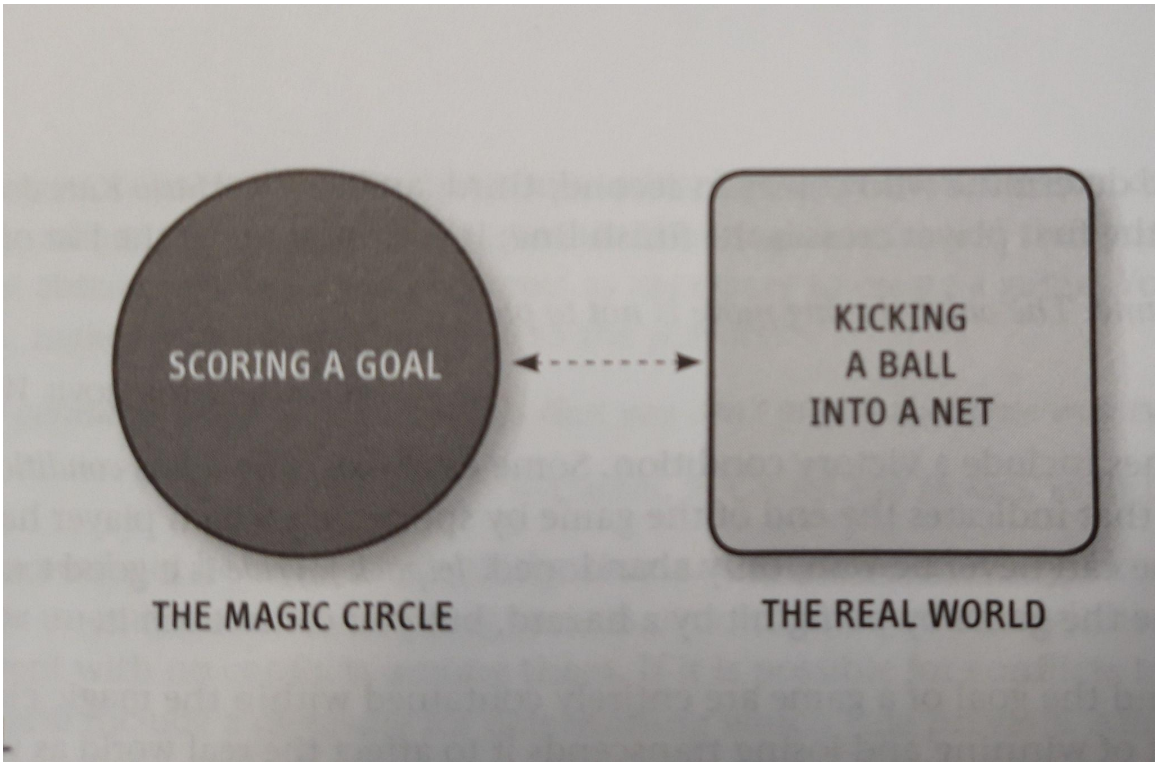
According to this, McGonigal argues the importance of a game having a goal for the reason that it focuses the players attention and provides a sense of purpose. Additionally, in his book: "The Art of Game Design" from 2020, Jesse Schell agrees that goals are important for keeping players focused. On goals he writes:

> "*Clear Goals: When our goals are clear, we are able to more easily stay focused on our task. When goals are unclear, we are not "into" our task, for we aren't at all certain whether our current actions are useful.*"
>
> (Schell 2020)

Clearly, having a goal is important for the player to stay focused on the aim of the game. We will hear more about goals in games later, but for now let us again focus on the other elements Adams put forward in his definition of a game.

1.3.1.3 Pretending

While claiming that games are interactive, Adams also argues that the play activity is conducted in the context of a pretended reality. On the notion of pretending, Adams writes that; "*Pretending is the act of creating a notional reality in the mind"*. Thus, we use our mind to create another reality, or accept to pretend the reality others have created is real. This pretended reality is something Johan Huizinga first wrote about as "the magic circle" back in 1938 in his book "Homo Ludens" (Huizinga 1963). Whereas Huizinga originally referred to the magic circle as a space of religious activities, game designers have later adopted this analogy as the pretended reality wherein a game exists. The sheer importance of pretending as the phenomena of the magic circle will be investigated and highlighted later in this thesis, but for now let us focus on an example. As the figure below shows, the magic circle is interrelated with the real world.



(Fig. 1 The magic circle (Adams 2014)

In the case of a game of football, the players on a team seek to fulfill the goal of winning the game. This goal can only be achieved by scoring more goals than the other team of players. However, whilst trying to score a goal the team of players have to adhere to the rules; staying onside, keeping the ball inside the marked field, avoiding making freekicks etc. So whereas the act of scoring a goal in football to some will seem like a team just kicking a ball into a net, the players involved are in the magic circle wherein kicking a ball into a net has a special meaning; scoring a goal, often releasing strong emotions and eye-catching celebrations. Whilst the game of football is going on, the players are in the magic circle. The moment the game is over, the players re-enter the real world where the pretended reality they agreed to abide by is gone and the rules of the real world apply once again. Not having to abide by the rules of the real world means that while we are in the magic circle we do not, at least for the time being, have to concern ourselves with the concerns and problems of the real world. We enter a space where we simply experience the game, opening up for creative solutions to the problems of the pretended reality we have entered and interact with. As we shall see later, this experience and creativity is what is of great value to both unleash and reflect upon once we have exited the magic circle.

1.3.1.4 Rules

Rules are another element that many definitions claim a game consists of. We already saw how rules were included in Adams' definition above. In an advanced book by Ernest Adams and Joris Dormans from 2012 they focus more on the mechanics of a game rather than the fundamentals of a game. The book is "Game Mechanics: Advanced Game Design", and in here Adams and Dormans pinpoint some game definitions that focus on rules as an important element of a game. For example, they pinpoint Katie Salen and Erik Zimmerman's definition of a game from "Rules of Play: Game Design Fundamentals" from 2004, where Salen and Zimmerman define a game as the following:

> "*A game is a system in which players engage in an artificial conflict, defined by rules, that results in a quantifiable outcome."*
>
> (Salen and Zimmerman 2004)

Furthermore, Adams and Dormans also pinpoint Jesper Juul's definition of a game from the book "Half-Real: video games between real rules and fictional worlds", where Juul defines a game as:

> "*A game is a rule-based system with a variable and quantifiable outcome, where different outcomes are assigned different values, the player exerts effort in order to influence the outcome, the player feels emotionally attached to the outcome, and the consequences of the activity are negotiable."*
>
> *(Juul 2005)*

Apart from other elements, what these authors have in common is that they all include rules as an element of what a game consists of. Additionally, Jane McGonnigal also argues that rules are an important element of what a game consists of. In her book, McGonigal writes that all games share four defining traits: A goal, rules, a feedback system, and voluntary participation (McGonigal 2011). About rules she writes:

> "*The rules place limitations on how players can achieve the goal. By removing or limiting the obvious ways of getting to the goal, the rules push players to explore previous uncharted possibility spaces. They unleash creativity and foster strategic thinking."*
>
> (McGonigal 2011)

According to this, McGonigal argues that the rules are essential for unleashing creativity and strategic thinking. Something she elaborates with the game of golf as an example. In golf you have a clear goal; try and get the ball in the hole with the fewest strokes. About the game of golf McGonigal writes:

> "*If you weren't playing a game, you'd achieve this goal the most efficient way possible: you'd walk right up to each hole and drop the ball in with your hand. What makes golf a game is that you willingly agree to stand really far away from each hole and swing at the ball with a club."*
>
> *(McGonigal 2011)*

By this analogy, we can say that rules are essential for any game to be, in fact, a game. Simultaneously, rules are important for creative solutions to occur. Without rules in games, the easiest, fastest and most straightforward solution would result in the best score, taking away creativity and strategic thinking.

1.3.1.5 Voluntary Participation

Moreover, when a player accepts the rules of a game and starts playing it, another element that Jane McGonigal argues is an element of what a game consists of, comes into existence: voluntary participation. About voluntary participation McGonigal writes:

> "*[...] Voluntary participation requires that everyone who is playing the game knowingly and willingly accepts the goal, the rules, and the feedback*"
>
> (McGonigal 2011)

Apart from the element of voluntary participation, we also see how McGonigal incorporates pretending, as well as Adams above, into what a game consists of with her extended clarification on voluntary participation. By knowingly and willingly accepting the goal, the rules and the feedback, the players involved in the game accept to pretend on common terms.

1.3.2 A Game is…

Indeed, there exists many other descriptions of what a game is and what elements a game might encompass. However in this thesis, when using the concept of games, we will understand games as encompassing the following elements:

- Goal(s)
- Rules
- Play
- Pretending, and
- Voluntary participation

While it is possible to argue that a game might encompass more than merely these five elements, in this thesis we will mainly be focusing on the appearance of these elements when dwelling upon the concepts of games.

1.4 Serious Games

Now that we know what elements a game consists of, the next thing we should ask ourselves is; what is a serious game? To answer that let us start with some definitions of the concept.

1.4.1 What is a Serious Game?

In their report "*Serious Games - An Overview*" from 2007, Tarja Susi, Mikael Johanneson and Per Backlund discuss some issues concerning serious games while also identifying some of the different application areas serious games have been created for.
In their article, Susi, Johanneson and Backlund claim that the term "serious games" came into wide use on the account of the Serious Game Initiative in 2002 (Susi, Johannesson, and Backlund 2007). The Center for Digital Games Research describes The Serious Games Initiative as the following:

> "*The Serious Games Initiative is focused on uses for games in exploring management and leadership challenges facing the public sector. Part of its overall charter is to help forge productive links between the electronic game industry and projects involving the use of games in education, training, health, and public policy*"
>
> (Center for Digital Games Research 2022)

This description mostly focuses on the interconnectivity between the electronic game industry and projects for other purposes and the use of games for these projects. However, Michael Zyda puts his focus on serious games elsewhere. On serious games, he writes:

> "*Serious game: a mental contest, played with a computer in accordance with specific rules, that uses entertainment to further government or corporate training, education, health, public policy, and strategic communication objectives*"
>
> (Zyda 2005, 25-32)

Much like the Serious Games Initiative, Zyda hints at the use of games for furthering other interests. However, as the attentive reader would notice, Zyda also includes elements in his definition of serious games that are similar to the game definitions presented earlier in chapter 1.3, by mentioning elements such as play and rules. Simultaneously, in their book: "*Serious Games; games that educate, train and inform*", David Michael and Sande Chen describes serious games as: "*games that do not have entertainment, enjoyment, or fun as their primary purpose*" (Michael and Chen 2006), hinting that even though a serious game can be fun and entertaining, it is not what it has been primarily designed for. Roughly, we can say what these three definitions have in common is the aspect of using games for other purposes than mere entertainment, whether that being in the fields of education, health, public policy or government and corporate training.

This aspect also shows us something else. It gives us a perspective we can use to distinguish between games and serious games. For example, in this thesis we understand games as encompassing elements such as play and pretending. Conversely, if you ask Susi, Johanneson and Backlund, serious games do not necessarily include these elements as they illustrate in table 1 of their article showcased below:

Table 1. Differences between entertainment games and serious games.

	Serious games	**Entertainment games**
Task vs. rich experience	Problem solving in focus	Rich experiences preferred
Focus	Important elements of learning,	To have fun
Simulations	Assumptions necessary for workable simulations	Simplified simulation processes
Communication	Should reflect natural (i.e., non-perfect) communication	Communication is often perfect

(Table 1 (Susi, Johannesson, and Backlund 2007), 6)

In their table, we clearly see the distinction in focus between serious games and entertainment games. Where serious games focus primarily on an element of learning, entertainment games focus primarily on an element of having fun. The differences in focus makes it more likely to find elements of play and pretending in entertainment games than in serious games. Simultaneously, in the category of communication, we see how serious games are more likely to reflect natural and imperfect communication whereas entertainment games often make use of perfect communication. This might be explained by serious games' prioritization of problem solving, where simulations must be based on actual real case scenarios, rather than on the creation of rich experiences. That not said that a serious game cannot grant a rich experience, and that an entertainment game cannot encompass some level of problem solving, it is just not what they primarily have been designed for.

To sum up, we can say that serious games share some elements with games, or entertainment games if you will, but the main difference between the two is the focus. Where games primarily aim to have fun and create rich experiences, serious games primarily aim to address and/or solve problems while implementing important elements of learning. Serious games strive to obtain a bigger outcome than merely having fun.

1.4.2 Where are serious games applied?

Knowing that serious games are much like entertainment games but strive to do more than just creating a fun experience, we might ask ourselves exactly how, and where, serious games are most commonly applied. Therefore, this section will focus on some of the application areas where serious games are used and why.

In their article, Susi, Johanneson and Backlund also provide a section of application areas for serious games where they highlight areas such as military games, government games, educational games, corporate games and healthcare games (Susi, Johannesson, and Backlund 2007).

1.4.2.1 Military Games

If we start taking the perspective of serious games for military purposes, we will see how they have existed for thousands of years. Starting with David Michael and Sande Chen highlighting games such as the Indian board game Chaturanga, that closely resembles what we now know as chess, and the Chinese board game Wei Hei, which closely represents the board game go (Michael and Chen 2006). Both these games stimulated strategic thinking and improved military officer's skills in preparing and planning war. Looking into the 1800's we see the game "Kriegsspiel", innovated by Prussian Lieutenant Georg Leopold von Reiswitz in 1812 (Adams and Dormans 2012). In figure 2 below we see a picture of Kriegsspiel.

(figure 2, Kriegsspiel (Kirschenbaum 2022)

A description of Kriegsspiel can be found in Ernest Adams and Joris Dormans book: "Game Mechanics: Advanced Game Design". It goes as follows:

> "*In Kriegsspiel, players take turns to move colored wooden pieces over a map representing the battleground. Rules restrict how far pieces can move, and dice are used to determine the effects of one unit firing at another unit or engaging in close combat*"
>
> (Adams and Dormans 2012)

Requiring skills such as battle tactics and strategy, this game was used to train officers of the prussian army (Adams & Dormans, 2012). Looking into modern times, Michael Zyda highlights the game "America's Army" and how it, as a military training simulator, has helped improve both recruitment and recruits' scores on the real-life rifle range (Zyda 2005, 25-32). According to Michael and Chen, by autumn 2004, America's Army had been downloaded over 17 million times and had helped the army to recruit soldiers at 15% of the cost of other recruiting programs (Michael and Chen 2006). Furthermore, they argue that video game playing, from a military perspective, provides advantages such as improved hand-eye coordination, improved ability to multitask, ability to work in a team using minimal communication, and willingness to take aggressive action.

1.4.2.2 Government Games

Looking into the section of government games we see how serious games are used for training. According to Susi, Johanneson and Backlund, governmental games may include simulations concerning crisis management when dealing with terrorist attacks, disease outbreaks, biohazards, fire fighting, ethics training and more (Susi, Johannesson, and Backlund 2007). The advantages of the serious games here being in the form of simulations that can be run repeatedly and allowing personnel such as first responders to practice situations that either are too dangerous, expensive or impossible to carry out in reality (Susi, Johannesson, and Backlund 2007).

1.4.2.3 Healthcare Games

Similarly to serious games being used for training personnel responding to crises, healthcare too, is a section where serious games can be very useful. In the healthcare section, Ernest Adams highlights serious games in the form of games such as Wii Fit being used in old age homes as a way of making physical therapy less boring and Snow World, a virtual reality game created by The University of Washington's Medical Center, to help people with undergoing burn treatment (Adams 2014). Other forms of serious games in healthcare include serious games to improve education in health/self-directed care, distraction therapy, recovery and rehabilitation, diagnosis and treatment of mental illness/mental conditions, cognitive functioning, and control (Susi, Johannesson, and Backlund 2007).

1.4.3 The Academic Side of Serious Games

By now there should be no doubt that serious games have many different definitions and are being used for many different applications. However, after dwelling in definitions and application areas of serious games, we need to face perhaps the most important question of all; What kind of impacts can a serious game have and why should we bother with serious games? To answer those questions we will examine the articles: "*An update to the systematic literature review of empirical evidence of the impacts and outcomes of computer games and serious games*" published in 2016 by Elizabeth A. Boyle, Thomas Hainey, Thomas M. Connolly, Grant Gray, Jeffrey Earp, Michela Ott, Theodore Lim, Manuel Ninaus, Claudia Ribeiro and João Pereira (later Boyle et al.) and its predecessor; the previous systematic literature review; "*A systematic literature review of empirical evidence on computer games and serious games*", published back in 2012 by Thomas M. Connolly, Elizabeth A. Boyle, Ewan MacArthur, Thomas Hainey and James M. Boyle (later Connoly et al.). The review by Connoly et al. from 2012 had the following research question: "*What empirical evidence is there concerning the positive impacts and outcomes of computer games?*" and ended up focusing on 129 papers between january 2004 and february 2009 reporting empirical evidence about the impacts and outcomes of computer games and serious games (Connolly et al. 2012, 661-686). Conversely, the review by Boyle et al., following the same research question, ended up focusing on 143 papers between march 2009 and february 2014 that provided higher quality evidence about the positive outcomes of games (Boyle et al. 2016, 178-192). By examining both articles we will accumulate the knowledge of papers reporting impacts and outcomes of computer games and serious games between January 2004 and February 2014, giving us a good overview of what impacts computer games and serious games can have. Furthermore, we will examine the systematic literature review of Marios Stanitsas, Konstantinos Kirytopoulos and Elise Vareilles from 2019 to learn how serious games have increased in popularity within the academic world and which dimensions of sustainability they touch upon.

1.4.3.1 Connoly et al. 2012

In the review of Connoly et al. they use a multidimensional framework for categorizing games and they then use the following search terms:

> "*("computer games" OR "video games" OR "serious games" OR "simulation games" OR "games-based learning" OR MMOG OR MMORPG OR MUD OR "online games") [...] AND (evaluation OR impacts OR outcomes OR effects OR learning OR education OR skills OR behaviour OR attitude OR engagement OR motivation OR affect)*"
>
> (Connolly et al. 2012, 661-686)

These search terms identified 7,392 papers. From there, to be included in the review, the papers had to fulfill four criterias which were; the papers had to include empirical evidence relating to the impacts and outcomes of playing games; date from january 2004 to february 2009; include an abstract; and include participants over the age of 14, bringing the number of included papers down to 129 (Connolly et al. 2012, 661-686). They then assessed the quality of the papers by reading each paper and assigning them scores ranging from 1-3 in five different dimensions. That meant possible scores ranged from 5-15, where 5 is low, suggesting low quality of scientific proof, and 15 is high, suggesting high quality of scientific proof (Connolly et al. 2012, 661-686). Among the 129 papers the mean rating of quality was 8.56 and the modal rating at 9, which means papers with ratings 9 and above were considered "high quality papers" (Connolly et al. 2012, 661-686). Out of the 129 papers, 68 of them looked at entertainment games, 49 at games for learning and 12 papers described serious games, although most of those could have been categorized as games for learning (Connolly et al. 2012, 661-686). Within games for learning, simulations were the most frequently used while puzzle games were the second most popular, making 80% of games for learning either simulations or puzzle games. Simultaneously, 10 out of 12 serious games were also simulations (Connolly et al. 2012, 661-686). Out of the 129 papers, the most frequently occurring outcomes reported were affective and motivational (33) and knowledge acquisition/content understanding (32) (Connolly et al. 2012, 661-686). Simultaneously, the most frequently occurring outcome with games for learning was knowledge acquisition/content understanding (26). Conversely, the most frequently occurring outcomes for entertainment games were affective and motivational outcomes (26) (Connolly et al. 2012, 661-686). Additionally, 17 higher quality papers reported on games involving knowledge acquisition/content understanding. Here, games were developed to support the acquisition of knowledge across a range of curricular areas largely in tertiary education but also in high school (Connolly et al. 2012, 661-686). In their conclusion, Connoly et al. highlights that:

> "*While empirical evidence concerning the effectiveness of games-based learning was found, there is a need for more Randomized Control Trial studies to provide more rigorous evidence of their effectiveness*".
>
> (Connolly et al. 2012, 661-686)

To sum up, In Connoly et al. review we see that most papers focused on entertainment games (68), although if we put serious games and games for learning in the same category they come closer to equal (61). In the category of games for learning and serious games, simulations were used most frequently. Additionally for the full 129 data corpus the most frequently occurring outcome reported was affective and motivational, closely followed by knowledge acquisition/content understanding. However, we see the difference between entertainment games and games for learning/serious games, in that the most frequently occurring outcome reported for entertainment games were affective and motivational outcomes

while the most frequently occurring outcome reported for games for learning/serious games was knowledge acquisition/content understanding.

1.4.3.2 Boyle et al. 2016

In the updated review by Boyle et al. review they use the same multidimensional framework, search terms and research question. The only difference we see is in the inclusion criterias where papers now have to date between March 2009 and February 2014. Having to fulfill the four inclusion criteria 7,117 relevant papers were brought down to 512 papers. Nextly, the authors assessed the quality of papers, assigning them scores ranking from 1-3 in five different dimensions in similar fashion as the review by Connoly et al. They then picked out the highest quality papers which brought the total number of papers in review down to 143 (Boyle et al. 2016, 178-192). Of the 143 higher quality papers, 38 described games for learning while 34 described serious games (Boyle et al. 2016, 178-192). In Boyle et al. review however, these two categorizations were composed into one category; games for learning (72) for informative purposes, consequently making contrasting to entertainment games (71) with games for learning, easier (Boyle et al. 2016, 178-192). Among the 143 papers, game genre was varied with simulations (14), simulation games (10) and role-playing games (12) the most popular (Boyle et al. 2016, 178-192). Simultaneously, 23 out of the 24 simulations/simulation games were games for learning (Boyle et al. 2016, 178-192). Looking into learning and behavioral outcomes, the most frequently occurring outcome reported was knowledge acquisition, followed by perceptual and cognitive-, affective and behavior change, where games for learning almost exclusively studied knowledge and skill acquisition while entertainment games were more likely to study affective, behavior change and physiological outcomes (Boyle et al. 2016, 178-192). Focusing on knowledge acquisition outcomes the review highlights that:

> "*7 Randomized Control Trials evaluating the effectiveness of serious games for knowledge acquisition were reported across varied subject disciplines and they tended to report that playing the game led to better performance than the control condition*"
>
> (Boyle et al. 2016, 178-192)

In their conclusion, Boyle et al. highlights that:

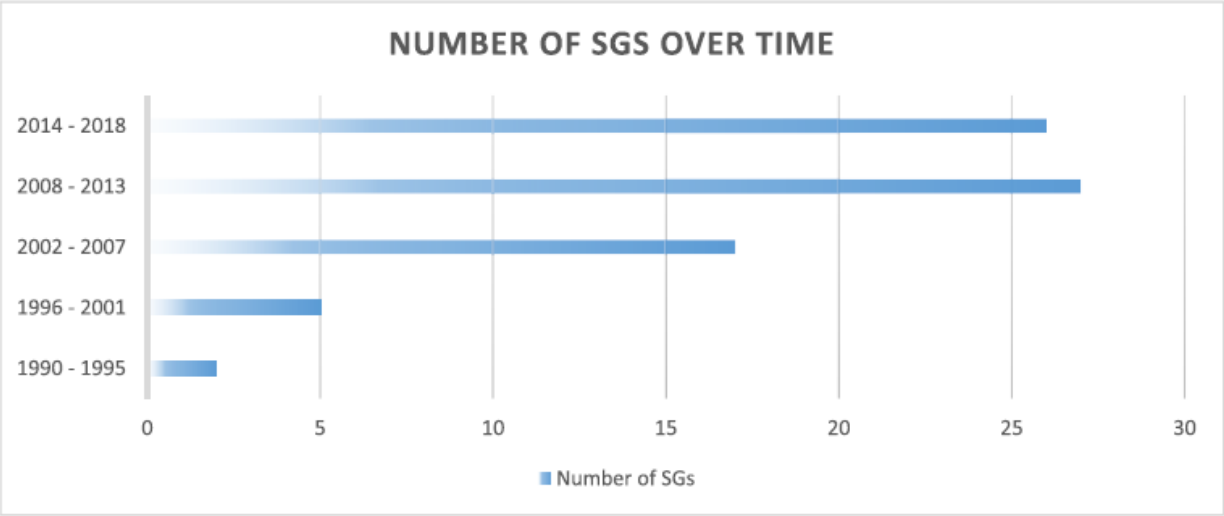
> "*Taken together the original review and the current update illustrate the increased interest in the positive impacts and outcomes of games. [...] The term "serious games" has become mainstream during this time, but is used interchangeably with games for learning. Games for learning have been used to promote knowledge acquisition across a wide range of topics and to a lesser degree skill and social skill acquisition and behavior change. [...] Future research will benefit from detailed experimental studies that systematically explore which game features are most effective in promoting engagement and supporting learning*".

(Boyle et al. 2016, 178-192)

To sum up, in Boyle et al. review we see that games for learning (72) have become as popular as entertainment games (71) to be used in studies reporting the impacts and outcomes of computer games and serious games. This is an increase, however slight, compared to Connoly et al. review where entertainment games (68) were more studied than games for learning (61). Simulations and simulation games were still the most popular genre of games for studying the impacts of games for learning, while knowledge acquisition was the most frequently occurring outcome reported for games for learning just as in Connoly et al. review. Similarly, the most frequently occurring outcomes reported for entertainment games was affective, behavior change and physiological outcomes just as in Connoly et al. review. Conclusively, compared to the original review, Boyle et al. highlights that there has been an increased interest in studying the impacts and outcomes of computer games and serious games in the period between march 2009 and february 2014 compared to the period between january 2004 and february 2009 while serious games and games for learning, being used interchangeably, have primarily been used to promote knowledge acquisition.

1.4.3.3 Stanitsas, Kirytopoulos & Vareilles 2018

Whereas Connolly et al. and Boyle et al. focus on the reported outcomes of playing games, Stanitsas, Kirytopoulos and Vareilles, in their systematic literature review: "*Facilitating sustainability transition through serious games: A systematic literature review*" from 2019, focus specifically on serious games for sustainable development and their use as effective educational tools. Additionally, they focus their review on how the use of serious games can increase the users' understanding of sustainability issues and their familiarity with sustainable development strategies (Stanitsas, Kirytopoulos, and Vareilles 2019, 924-936). In their review, Stanitsas, Kirytopoulos and Vareilles identify 77 serious games on sustainable development and find a growing number of serious games that seek to educate in sustainability (Stanitsas, Kirytopoulos, and Vareilles 2019, 924-936). An increase we see in the figure 6 of their article below.

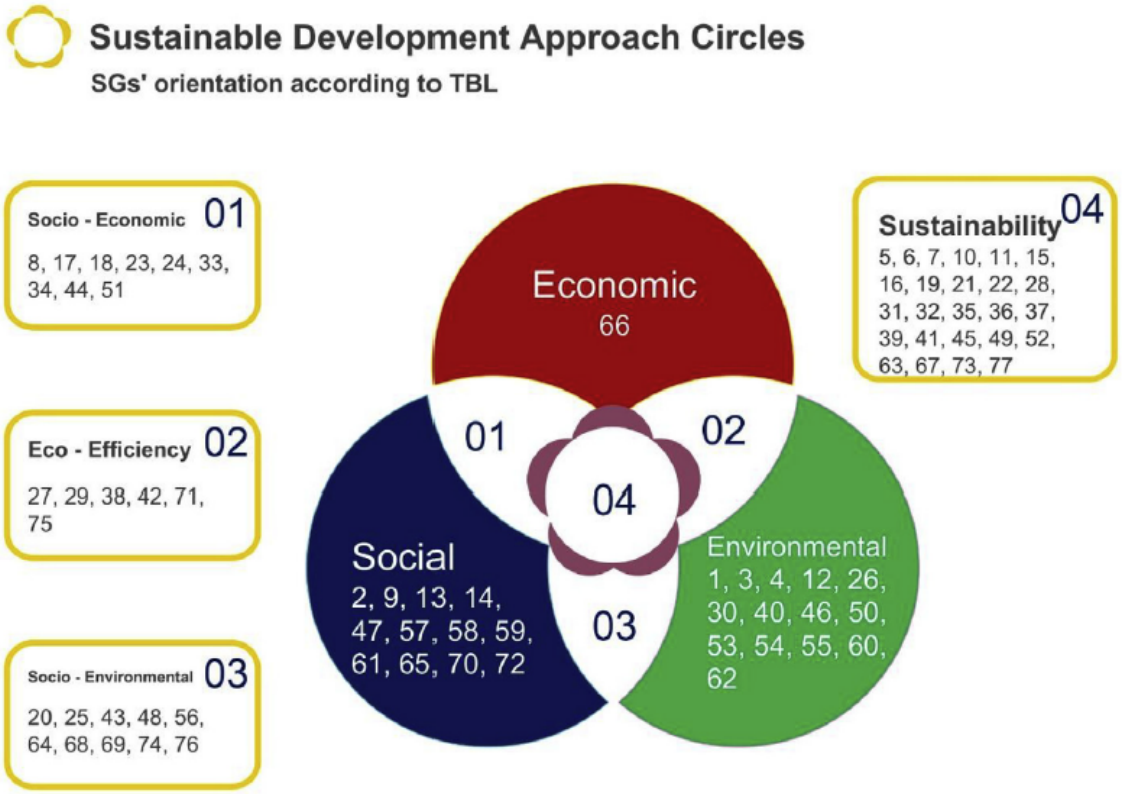


(Fig. 3 Number of SGs over time (Stanitsas, Kirytopoulos, and Vareilles 2019, 924-936)

Looking at figure 3 we see how the amount of serious games on sustainable development has increased steadily since 1990. An increase that Stanitsas, Kirytopoulos and Vareilles explains by highlighting the following:

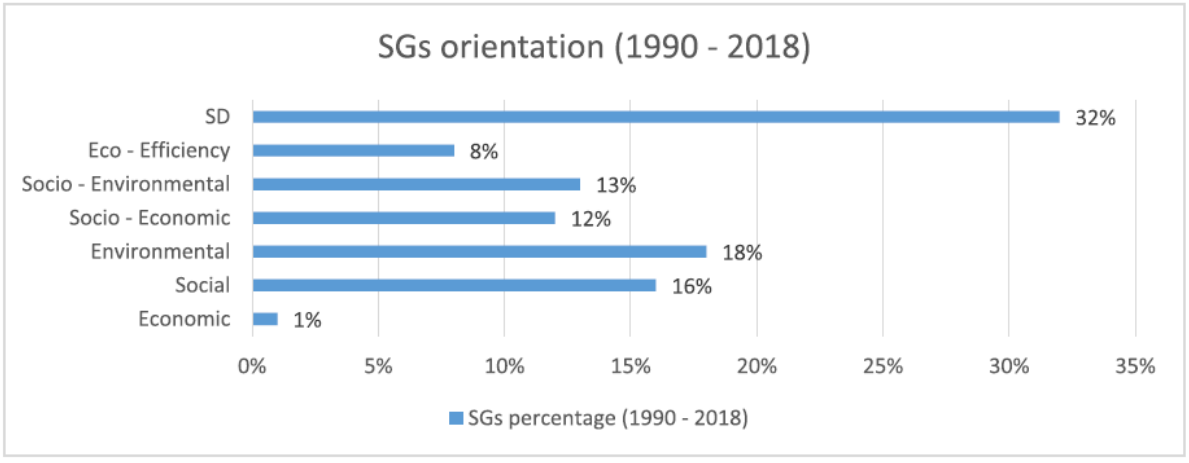
> "*It is generally accepted that Serious Games (SGs) offer great potential in the education sector, mainly due to the positive effects they have on learning outcomes. Focusing on sustainability concepts, the use of SGs can deliver a major increase of interest in training, project understanding and evaluation amongst users*".
>
> (Stanitsas, Kirytopoulos, and Vareilles 2019, 924-936)

Furthermore, in their review, Stanitsas, Kirytopoulos and Vareilles found indications that serious games featuring sustainable development were preferred by the academic community for their use as educational tools to incorporate sustainable development ideals(Stanitsas, Kirytopoulos, and Vareilles 2019, 924-936). Another cementation of the academic community's interest in serious games can be seen in the fact that the majority of serious games in the review have been designed to educate students, sustainable development professionals and stakeholders (Stanitsas, Kirytopoulos, and Vareilles 2019, 924-936). Perhaps more interesting in Stanitsas, Kirytopoulos and Vareilles' review is figure 7 and 8, which showcases the 77 games under review categorized into the Triple Bottom Line framework.



(fig. 4 SG's orientation according to TBL (Stanitsas, Kirytopoulos, and Vareilles 2019, 924-936)

Here we see an illustration of the Triple Bottom Line. The numbers in the dimensions; economic, social and environmental, represents serious games in that category, the numbers in box 01, 02, 03 represents serious games in the crossfield of two Triple Bottom Line dimensions, while the numbers in box 04 represents serious games in the category of overall sustainability, including every dimension of the Triple Bottom Line. Another way to illustrate this is figure 8 in Stanitsas, Kirytopoulos and Vareilles' review.



(fig. 5 SGs orientation (Stanitsas, Kirytopoulos, and Vareilles 2019, 924-936)

Here we see more clearly that the majority of serious games under review (32%) are aimed at including all three dimensions of the Triple Bottom Line, while the environmental (18%) and social (16%) dimensions come second and third, with the economic dimension (1%) being the least popular focus of the serious games under review. Interestingly enough, if you add them together, 33% (8%+12%+13%) of the serious games under review included two of the three dimensions of the Triple Bottom Line, showing a significant amount of designers being aware of the fact that sustainability encompasses multiple dimensions.

To sum up, Stanitsas, Kirytopoulos and Vareilles show how serious games have grown in popularity in recent times. They also show how serious games have great potential for educational purposes, increasing both users' interest in sustainability training, sustainability understanding and sustainability evaluation as well as increasing their familiarity with sustainable development strategies.

1.4.4 The potential of Serious Games

Through this section we have seen how serious games, with their focus on solving real world problems, aim at achieving more than merely entertainment. With their application in military, government and healthcare sections, serious games provide possibilities in training- and practice situations that would have otherwise been impossible, too expensive or too dangerous to carry out in real-life situations. Additionally, we have seen how serious games, and games for learning, have become more popular in the academic world in recent times, where the most frequently occurring outcomes reported have been knowledge acquisition. However, this is just one of many reported outcomes. Other potential outcomes are also seen in the positive effects that serious games have on learning outcomes. In short we can conclude that serious games show great potential for creating awareness and delivering a major increase in interest of education on sustainability issues. A potential that this thesis will attempt to take advantage of in order to create a more aware, inclusive and engaged process that can unravel the subject of sustainable and digital transformation.

1.5 Unraveling Sustainable and Digital Transformation with Serious Games

In a time where topics such as climate change, social injustice and economic distribution are increasingly important subjects, and where digital transformation and technological development happens faster than ever, it becomes more and more important than ever to design and create sustainable solutions as well as promoting sustainable practices. Sustainability, however, is a broad concept, coming in many forms and variants, and therefore falls the risk of becoming an ambiguous concept. Understanding the concept of sustainability is therefore also becoming more and more important. One way of creating a space for sustainability understanding to thrive is through the use of serious games. By using serious games it becomes possible to increase interest- and promote knowledge acquisition on sustainability issues. Knowing the elements, benefits and applications of serious games, this thesis will try to unravel the field of sustainable and digital transformation through the use of a serious game.

2.0 Problem Statement

Based on the need for a wider sustainability understanding as well as a part of my continued collaboration with the TECH4SDT, I have had the role of designing a tool that helps accommodate the TECH4SDT's 2nd activity; "[...] *Generating new ideas to promote the overall goal of a sustainable and digital transformation, with a particular attention to practices of living in a common world* [...]". To accomplish this, I have derived the following problem statement:

"How do you create a tool that facilitates reflection and discussion upon sustainable and digital transformation between researchers at a university?"

3.0 The Field

Being a continuation of my collaboration with TECH Center for Sustainable and Digital Transformation, my daily operations have taken place at the offices of Aalborg University, more precisely an office in the department of planning at the Create building in Aalborg.

3.1 Aalborg University

At Aalborg University there is a special focus on group work, problem- and project based learning and interdisciplinary work. This means that projects are encouraged to be done in groups whilst focusing on solving real-world problems (Aalborg University 2022b). Beyond that, Aalborg University strives to create knowledge, often in close collaboration with public and private sector partners, that can be used to create solutions that efficiently solve complex real world problems. Having this view, Aalborg University claims to have four distinctive features; problem orientation, collaboration, commitment and change (Aalborg University 2022a). Lastly, Aalborg University is internationally recognized as being a mission-oriented university contributing to sustainable development by producing graduates with in-depth, discipline-specific knowledge, using a project-based learning model with focus on digitalization, entrepreneurship and the integration of the fields of social science and humanities and science, technology, engineering and mathematics with sustainability as a central theme for all activities (Aalborg University 2022).

3.1.1 Department of Planning

The Department of Planning in Aalborg is located in the Create building which is the Aalborg University campus located in the center of Aalborg. The Department of Planning works with planning, technology and society focused on creating a more sustainable future (Aalborg University 2022c). The department is interdisciplinary by nature and aims at providing students with a social and technological understanding of which technical and digital solutions society need (Aalborg University 2022). The Department of Planning also counts education programmes such as; Urban Planning, Energy- and Environmental Planning, Techno-Anthropology and Sustainable Design and Surveying, where focus is on educating students on technology, digitisation, sustainability and partnerships for sustainable transition (Aalborg University 2022).

3.1.2 TECH4SDT

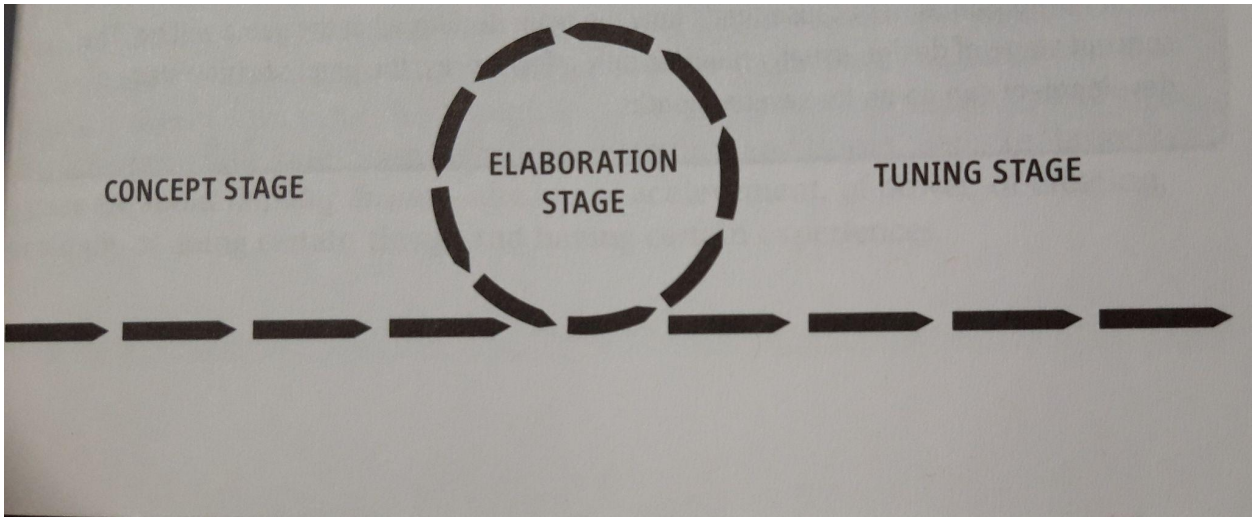
As presented in section 1.1, the TECH4SDT goals are to infrastructure a wider range of opportunities for researchers, students and society at large to explore and experiment with the field of sustainable and digital transformations. What we need to know now though, is that the head office of the research center for TECH4SDT is located in the Department of Planning in the Create building, more precisely room 1.430, at Aalborg University in Aalborg center. This office is a shared workspace between the steering group leader of TECH4SDT; Maurizio Teli, and his research assistant; Helena Haxvig. Since 13th of September 2021 till time of writing, I have been spared a desk in this office, of where I have been able to work from. However, this thesis' data corpus will mostly focus on the period I have spent in the office from 1st of february 2022 to 25th of november 2022, while still keeping an overall holistic perspective on the full 14 months I have spent collaborating with the TECH4SDT.

4.0 Methods

In every project, the author makes use of a range of different methods. This thesis is no different. In this section we will take a closer look at which methods have been used and how these methods have affected the outcome of this thesis.

4.1 Game Design Process

As part of my collaboration with the TECH4SDT I have been tasked with the job of creating a card game that can facilitate reflection and discussion upon sustainable and digital transformation. To accommodate this task I have been inspired by different methods within game design literature. Part of the methods within game design literature springs from the process of designing a game. According to Ernest Adams, in the game design process three general stages are always present. In his book; "*Fundamentals of Game Design*", He explains this by highlighting a figure of the three stages. The figure below is figure 2.6 in Adams' book and highlights the three stages in the game design process (Adams 2014).



(Fig. 6 Game design process (Adams 2014)

First, we have the concept stage where you settle on a concept, define which audience you are designing for and determine the player's role. Secondly, we have the elaboration stage where you design the game in an iterative process by the use of prototyping and playtesting. This is where you get the feedback you need for making adjustments to the game. Lastly, we have the tuning stage where no new features may be added, although small adjustments to polish the game are allowed (Adams 2014). In my last semester project (TAN9), my focus was mainly directed towards the concept stage of the game. Conversely, this

thesis has mainly been focused on the elaboration stage of the game. Part of this focus includes the use of prototyping.

4.1.1 Prototyping

According to Ernest Adams, a prototype is "*a simplified, but testable, version of your game*" that designers make to try out their game features before they spend the time and money to implement them in the actual game (Adams 2014). Furthermore, Adams refers to his previous book "*Game Mechanics: Advanced Game Design*", written with Joris Dormans, for a more elaborate description of prototyping. Here, they write the following about prototypes; "*A prototype is a preliminary, usually incomplete, model of a product or process created to test its usability before building the real thing*" (Adams and Dormans 2012). Additionally, in his book "The Art of Game Design", Jesse Schell gives ten tips for productive prototyping and says the following about prototyping; "*It is widely understood that rapid prototyping is crucial for quality game development*" (Schell 2020). The first three of Schell's tips is; "*answer a question, forget quality,* and *don't get attached*", indicating that prototypes are exactly what Adams and Dormans also argue; simple and incomplete. In this thesis, I have mainly made use of paper prototyping.

4.1.2 Paper Prototyping

To gain an understanding of what paper prototyping is, we look to Ernest Adams and Joris Dormans and their book "*Game Mechanics: Advanced Game Design*". Here, they explain elaborately about paper prototyping. About paper prototyping they write: "*A paper prototype is a non-computerized, tabletop game that resembles your game*" (Adams and Dormans 2012). They then go on to explain the advantages of paper prototyping:

> "*Paper prototyping has two important advantages: It is fast, and a paper prototype is inherently customizable. Paper prototypes are quick to make because they do not need to be programmed. When creating a paper prototype, you should not waste time making nice art for cards or boards; instead, you should spend your time drafting rules and testing them*".
>
> (Adams and Dormans 2012)

Unfortunately, there are also some disadvantages accompanied by making paper prototypes. About these, Adams and Dormans write:

> "*Paper prototyping has two disadvantages: It is more difficult to involve test players, and not all mechanics translate to board games easily. If you are going to test a paper prototype with new players, you will need to explain the rules to them yourself [...] because you'll be changing them*

all the time. In addition, test players, especially if they have little testing or board game experience, might find it difficult to see how your paper prototype is related to a video game".

(Adams and Dormans 2012)

Although Adams and Dormans' book is mainly focused on video games, we will argue that whether the last mentioned disadvantage speaks of a video game or just a game can be seen as the same thing. The thing worth keeping in mind is the mechanics that paper prototyping provides which is the flexibility of easy customization and fast production, while the difficulty of involving test players and relating to the current rules also stay the same.

In this thesis, the use of paper prototypes have been preferred due to its quick iterative approach and cheap production benefits.

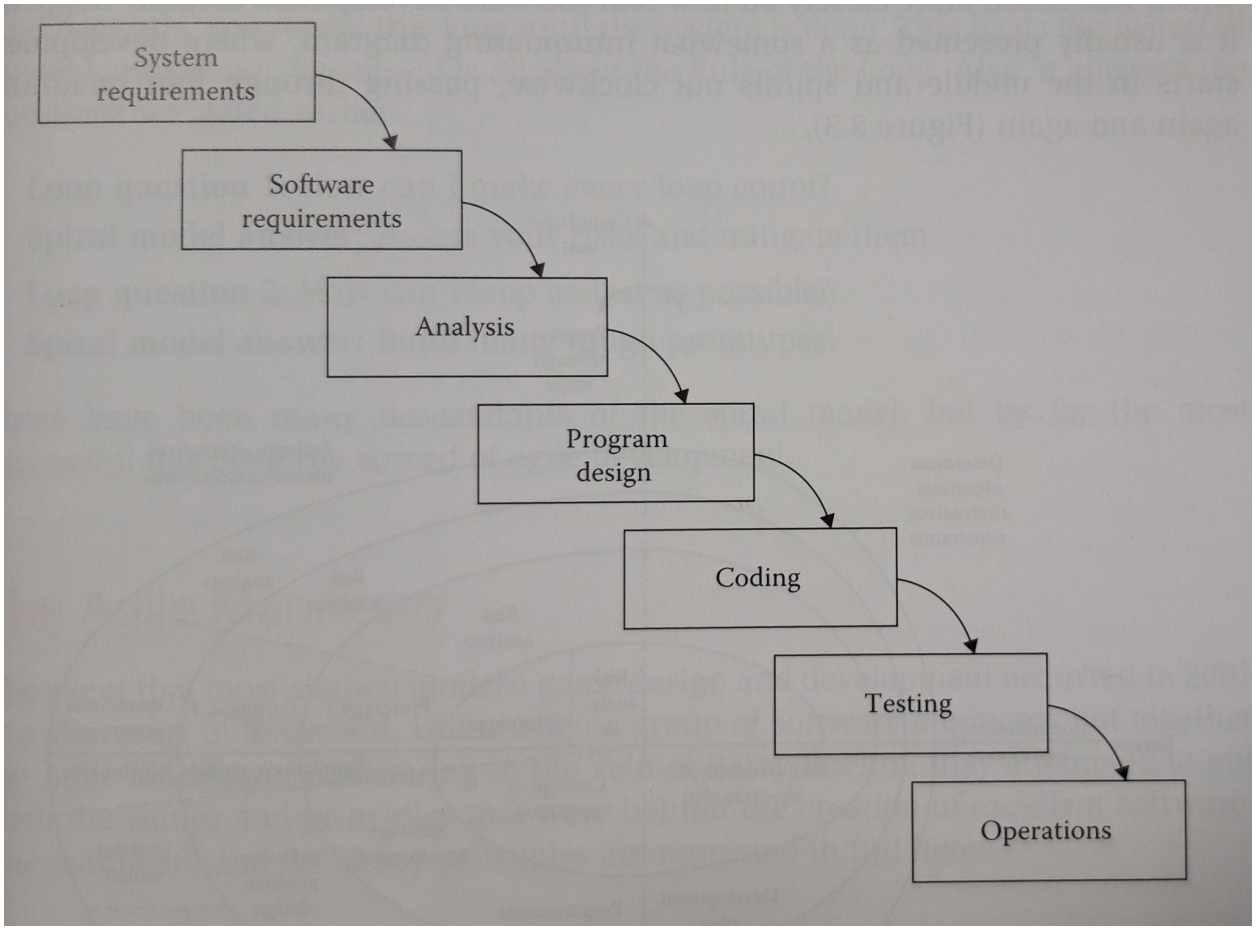
4.1.3 Iterations - Waterfall vs. Spiral

As explained in section 4.1 about the game design process, the time period of this master's thesis has primarily focused on the creation of the game while being in the elaboration stage. This means that we should focus on the iterative processes related to the elaboration stage. Although iterative processes seem easy and straightforward, Jesse Schell delivers an argument called "the Rule of the Loop" for good iterative processes. About The rule of the loop Jesse Schell writes the following:

"*The Rule of the Loop: The more times you test and improve your design, the better your game will be*".

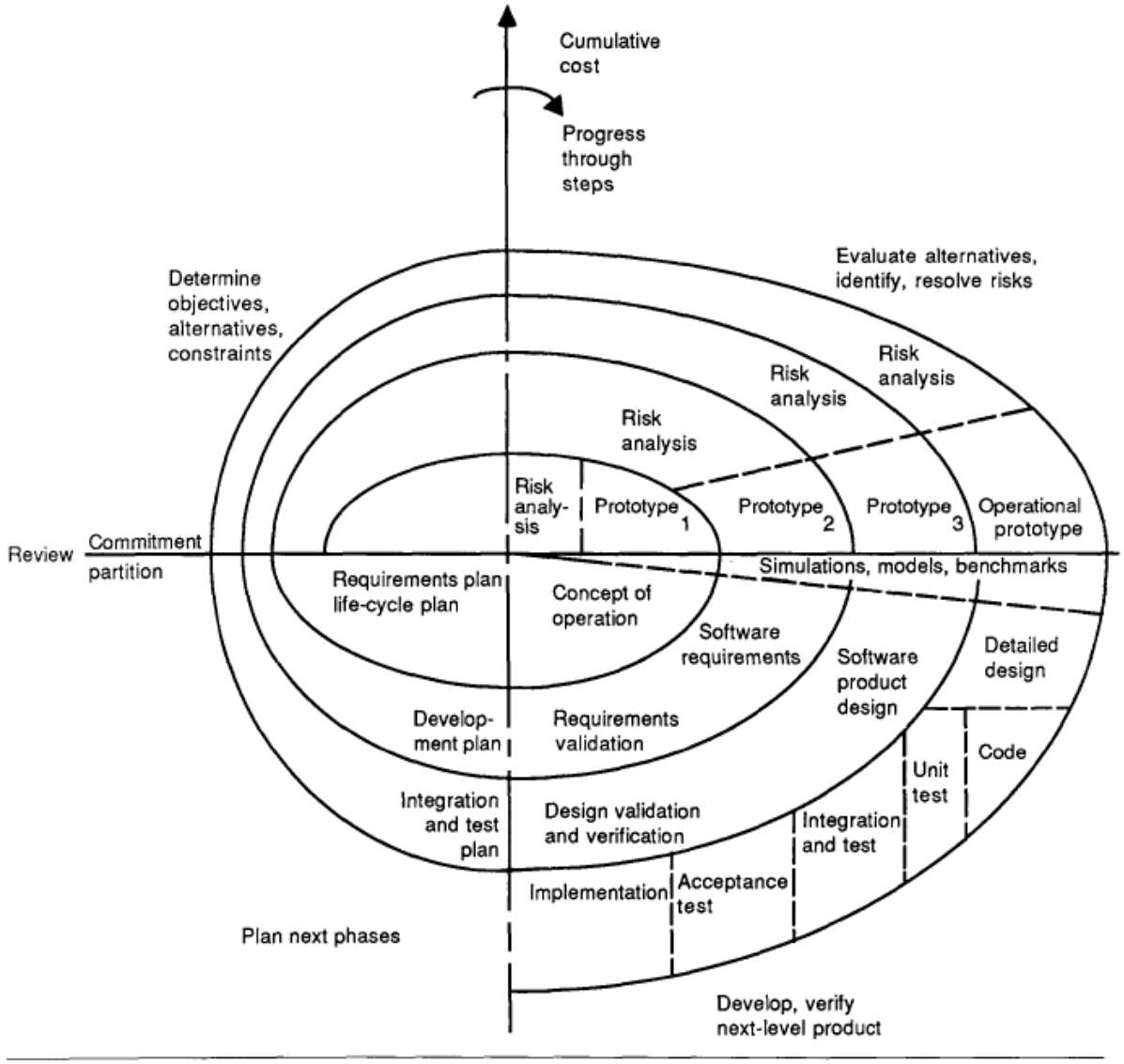
(Schell 2020)

By first highlighting the 1970's software development project management in the 1970's, programmers in software development would use the "waterfall model", which was an orderly 7-step process, for software development (Schell 2020). The waterfall model, as illustrated in Schell's book, generally looked something like figure 7 below.



(Fig. 7 The Waterfall method (Schell 2020)

As well as the obvious play of words, the waterfall method does not show much of an iterative process while violating the concept of the Rule of the Loop. Instead of the linear waterfall model, Jesse Schell argues for the adoption of Barry Boehm's spiral model. In fig. 8 below we see an illustration of the spiral model from Barry Boehm's article: "*A Spiral Model of Software Development and Enhancement*" from 1988.



(Fig. 8 The spiral model (Boehm 1988, 61-72)

Compared to the waterfall model we see a clear difference in Boehm's spiral model. Where the waterfall model indicated the process to be linear, the spiral model indicates the process to be iterative. Although more complex, the spiral model provides a more real picture of how software development actually unfolds. Although Barry Boehm's spiral model might have been designed for software development, seen from a game design perspective, it fits perfectly with the Rule of the Loop. As Jesse Schell highlights, the spiral model suggests us to do the following:

" *1. Come up with a basic design*

2. Figure out the greatest risks in your design

3. Build prototypes that mitigate those risks

4. Test the prototypes

5. Come up with a more detailed design based on what you have learned

6. Return to step 2. “

(Schell 2020)

Although only having developed prototype 1, In this thesis, I have attempted to follow the Rule of the Loop and Barry Boehm’s spiral model in the creation of the serious game.

5.0 Theories

To get an understanding of which field of thoughts this thesis exists, in this section we will extensively lay out the theories, and the elements that are considered important for our understanding of the given theories. In this thesis I have chosen to focus on the theory; Reflection-In-Action by Donald Schön to explain the phenomena that happens while playing a serious game, as well as the theory; Diffusion of Innovations by Everett M. Rogers to analyze where our innovation under study is in the innovation-decision process and what factors can play in its future destination of becoming adopted or rejected.

5.1 Reflection-in-Action

First Reflection-in-Action. This theory was brought forward by Donald Schön and the following theory-section is an explanation of how this thesis has and will make use of his theory. The main points of this theory is taken from chapter 2: "*From Technical Rationality to Reflection-in-Action*" in Schön's ebook: "*The Reflective Practitioner: How Professionals Think in Action*" published in 2016 (Schön 2016).

As an attempt to go beyond the model of Technical Rationality, Schön argues for the theory; Reflection-in-Action as a way of describing how practitioners truly think and work in the aim of solving complex problems in everyday life. As the model of Technical Rationality explains the ways of specialized knowledge and -occupations, the theory of Reflection-in-Action explains how specialized knowledge is not always enough when it comes to real-world problems and practice. By highlighting professionals such as the pitcher in a baseball team trying to "find the groove" of the game, the orchestra conductor trying to find the pace, the lawyer practicing in the courtroom and the general practitioner trying to diagnose their patient in order to treat them, Schön argues, that while much of these practitioners' specialized knowledge helps them in their practice, a great deal of finding the right solution comes from the experience and reflection connected to earlier episodes of real-world practice.

Schön argues that much reflection-in-action hinges on the experience of surprise (Schön 2016). He says that when performance yields nothing more than the results expected, we tend not to think about it. Conversely, when performance leads to surprises, pleasing and promising or unwanted results, we may respond by reflecting-in-action (Schön 2016). A claim he supports by highlighting an experiment conducted by Bärbel Inhelder and Annette Karmiloff-Smith. In Inhelder and Karmiloff-Smith's experiment, they asked their subjects (children aged between 4-6 and 9.5 years) to balance wooden blocks on a metal bar. Some wooden blocks were plain, but others were conspicuously or inconspicuously weighted at one end, resulting in Inhelder and Karmiloff-Smith observing the children learning about the

properties of the blocks, balancing them on the metal bar and regulating their actions after success or failure (Schön 2016). Inhelder and Karmiloff-Smith found that children between 6 and 7 years old started by systematically placing all objects at their geometric center (Karmiloff-Smith and Inhelder 1974, 195-212). Then, when asked to, the children added up to 10 extra small blocks on top of the others at the geometric center rather than distributing them at the extremities (Schön 2016). One child, after successfully balancing the blocks, shared the theory that "things always balance in the middle". However, when the children tried to balance the counterweighted blocks at their geometric center, they failed. The children between 6 and 7 were surprised that they were not able to balance the counterweight blocks the same way as they had done with the plain blocks, resulting in them declaring the objects "impossible" to balance. The children between 7 and 8 years old, however, had a different response to the counterweighted blocks. When failing to balance them, they began to de-center the counterweighted blocks and, often pausing before adding more inconspicuous blocks, assessing the blocks' weight distribution by lifting it before trying to balance it on the block already balanced. The corrections the children made is something Schön describes as theory-in-action. The children first had a theory that the blocks balance at their geometric centers, but after failing to balance the counterweighted and inconspicuous blocks, they changed their theory to the blocks balancing at their centers of gravity instead (Schön 2016). In the beginning the children had a theory based on the plain blocks, but that theory changed when they failed to balance the counterweighted blocks. With this change of theory, the children changed their actions, starting to weigh the blocks in their hands to determine the right point of balance before adding them to the metal bar (Schön 2016). This meant that the children got some sort of "feel for the blocks", much like the pitcher, orchestra conductor, lawyer and general practitioner has a "feel" for their practice as mentioned earlier.

The block-balancing experiment is what Schön calls a beautiful example of reflection-in-action (Schön 2016). And indeed, he is right. The children did not start to reflect on their actions before they failed to balance the counterweighted blocks. Their theory of "Things always balance in the middle" worked as expected, but when the counterweighted and inconspicuous blocks did not balance in the middle they were caught by surprise and had to adjust their theory based on their experience. This is where the children reflected on their failure, adjusted their actions, and through these, came up with a new theory that fitted the experience they just had. It is true though, to some extent, that the block balancing experiment and professional practice is not fully comparable. Therefore Schön argues that we should take a look at what professional practice actually is, and how it is relevant for reflection-in-action. About the word; practice, Schön writes the following:

> "*In the first sense, "practice" refers to performance in a range of professional situations. In the second, it refers to preparation for performance. But professional practice also includes an*

element of repetition. A professional practitioner is a specialist who encounters certain types of situations again and again."

(Schön 2016)

With this, Schön argues that professional practice is repetitive and happens within the practitioner's professional field. Something he highlights with the example that a physician might encounter many cases of measles and a lawyer may encounter many cases of libel, developing a repertoire of expectations, images and techniques for specific situations (Schön 2016). These repetitive experiences make the practitioner more specialized, but it may also narrow his mind. About narrowness and rigidity, Schön writes the following:

"*[...] As a practice becomes more repetitive and routine [...] the practitioner may miss important opportunities to think about what he is doing. He may find that, like the younger children in the block-balancing experiment, he is drawn into patterns of error which he cannot correct. And if he learns, as often happens, to be selectively inattentive to phenomena that do not fit the categories of his knowing.in-action, then he may suffer from boredom or "burn-out" and afflict his clients the consequences of his narrowness and rigidity".*

(Schön 2016)

This narrowness and rigidity is what Schön argues can be avoided with reflection. By reflecting, the practitioner can question and:

"[...] *criticize the tacit understandings that have grown up around the repetitive experiences of specialized practice, and can make new sense of the situations of uncertainty and uniqueness which he may allow himself to experience.*"

(Schön 2016)

It seems that there is a fine balance between earning specialized knowledge and getting stuck in a pattern of narrowmindedness and rigidity. Only if the practitioner chooses to reflect on his actions, can he prevent narrowmindedness and rigidity and solve unique uncertain situations in new and better ways. Uncertainty and uniqueness might not seem desirable traits when important decisions are about to be made. However, they are central traits for reflection to occur. About uniqueness, Schön writes the following:

"*When the phenomenon at hand eludes the ordinary categories of knowledge-in-practice, presenting itself as unique or unstable, the practitioner may surface and criticize his initial understanding of the phenomenon, construct a new description of it, and test the new description by an on-the-spot experiment."*

(Schön 2016)

Uniqueness and/or instability essentially forces us to reflect and question our initial understandings of a phenomenon. And this reflection of phenomena is what I hope to facilitate through the use of a serious game. Here, the phenomena subject to reflection being sustainable and digital transformation.

5.2 Roger's Diffusion of Innovations

Apart from the theory of reflection-in-action, I intend to use the theory; Diffusion of Innovations, put forward by Everett M. Rogers. From this theory we will mainly be focusing on the innovation-decision process of individuals in general, to see which factors influence the innovation in focus; our serious game. Additionally, we will focus on the innovation process in an organization in order to see how our innovation might succeed or fail in its attempt to get adopted in the organization of Aalborg University.

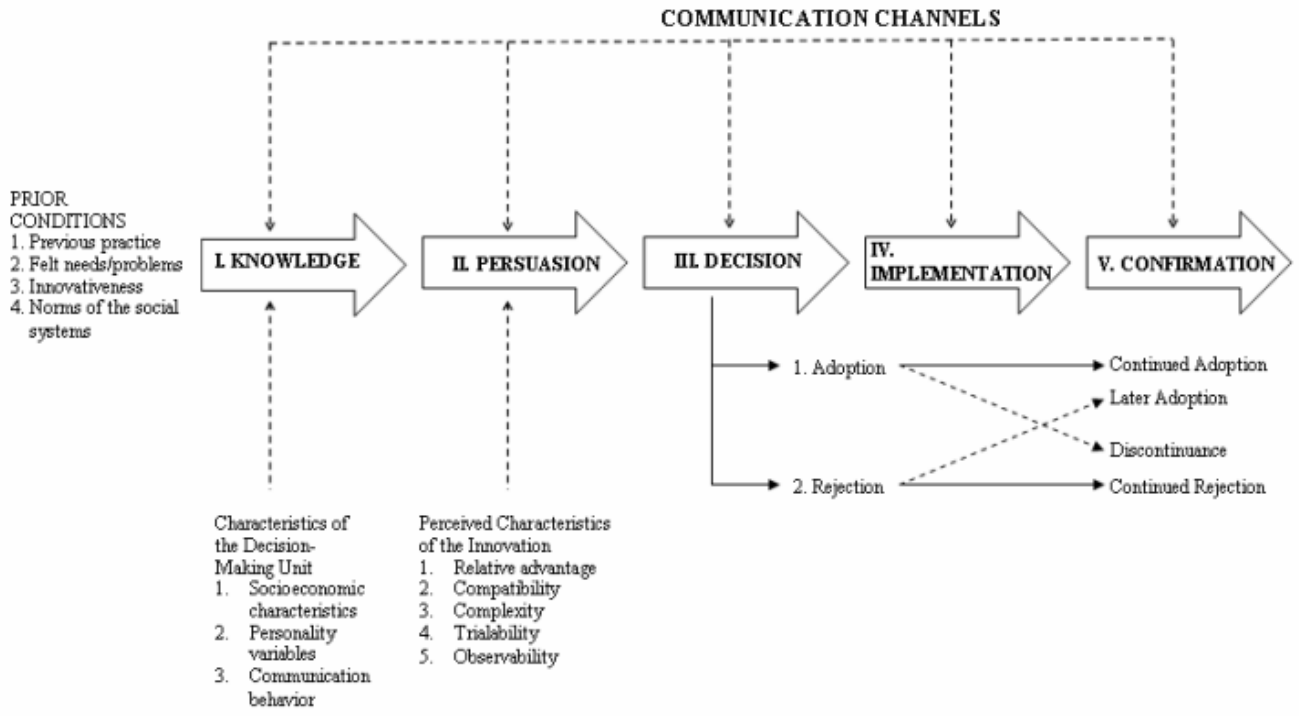
First and foremost, this theory section is based on chapter 5; "*The Innovation-Decision Process*" and chapter 10; "*Innovation in Organizations*" from Everett M. Roger's book "*Diffusion of Innovations - Fifth Edition*" published in 2003 (Rogers 2003).

In his book, Rogers argues that an individual goes through 5 stages before eventually choosing to adopt or reject a certain innovation (Rogers 2003). These five stages are knowledge, persuasion, decision, implementation and confirmation. Using Rogers' own words:

> "*The innovation-decision process is the process through which an individual (or other decision-making unit) passes from gaining initial knowledge of an innovation, to forming an attitude toward the innovation, to making a decision to adopt or reject, to implementation of the new idea, and to confirmation of this decision.*"
>
> (Rogers 2003)

We will be diving into what these stages encompass later, but first let us take a look at the model of the innovation-decision process which can be seen in figure 9 below.

5.2.1 The Innovation-Decision Process



(Figure 9 The innovation-decision process (Rogers 2003),.170)

As we can see in the model above, prior conditions of an individual such as previous practice norms of the social systems and their felt needs or problems affect the individual even before the innovation-decision process happens. The start of the innovation-decision process, however, begins when an individual is exposed to an innovation's existence and gains an understanding of how it functions (Rogers 2003). There are different arguments about whether this process is rather passive or not from an individual's perspective, but what happens first is the individual gaining what Rogers calls awareness-knowledge about the innovation.

Knowledge Stage

According to Rogers, Awareness-knowledge is ultimately one out of three types of knowledge about an innovation that occurs in the knowledge stage. Here, awareness-knowledge is understood as the individual gaining information that a certain innovation exists. This information might lead the individual to gain what Rogers calls "How-to Knowledge" and "Principles-Knowledge". Here, how-to knowledge is understood as information necessary to use the innovation, and principles-knowledge is understood as information dealing with the functioning principles underlying how an innovation works (Rogers 2003).

In the persuasion stage, then, the individual forms a favorable or unfavorable attitude toward the innovation (Rogers 2003).

Persuasion Stage

Where the knowledge stage mainly stays on the cognitive level, Rogers argues that at the persuasion stage, affectiveness is the main element present. Furthermore, Rogers does not understand persuasion as an individual being swayed or manipulated by other individuals. He mainly uses the term to understand the processes involved in an individuals' attitude formation toward the innovation in question. In the persuasion stage, the individual actively seeks information about the new idea and interprets elements such as the credibility of the information source, the relative advantages, complexities and trial-abilities of the innovation in question. However, in the persuasion stage, the individual also seeks out their peers for social reinforcement to know whether their thoughts of trying out the new innovation is a good idea. The individual does this in order to reduce the uncertainties related to the new innovation. Questions like "What if I adopt this innovation?" and "What are the advantages and disadvantages of the innovation in my situation?" are attempted to be answered through the search of information and social reinforcement. The main outcome of the persuasion stage is a favorable or unfavorable attitude toward the innovation (Rogers 2003). The formed attitude will either lead to adoption of the innovation or rejection. However, even if an individual has a favorable attitude towards an innovation, it does not mean that the individual is going to adopt the innovation. This discrepancy is what Rogers calls the "KAP-gap" - knowledge, attitudes, practice (Rogers 2003). Rogers explains how an individual might want to stop smoking because they have the knowledge that smoking is bad for their health but that does not necessarily make them sign up for a smoke-stop campaign. Instead, they might keep smoking until a close friend or family member dies from lung cancer before they decide to sign up for a smoke-stop campaign. This is what Rogers calls a cue-to-action, which sometimes may close the KAP-gap (Rogers 2003).

Decision Stage

The decision stage is where an individual engages in activities that lead to a choice to adopt or reject an innovation (Rogers 2003). Here, adoption is understood as the individual choosing to make use of an innovation, and rejection is understood as the individual choosing not to adopt an innovation. One of the most common activities in this process is for the individual to try out the innovation as Rogers argues that most individuals do not adopt an innovation without first trying it on a probationary basis (Rogers 2003). The importance of trial is further supported by Rogers' claim that innovations that can be divided for trial are generally adopted more rapidly (Rogers 2003). Interestingly, the individual does not necessarily have to test the innovation out on their own. Instead, this trial can be substituted by a peer to the individual

testing the innovation, something Rogers calls “trial by others” (Rogers 2003). Eventually, the decision stage ends when an individual chooses to adopt or reject an innovation. Although every stage of the innovation-decision process potentially might lead to rejection, at the decision stage, Rogers argues, there are two different types of rejection: Active rejection and Passive rejection (Rogers 2003). Here, active rejection is understood as an individual considering adopting an innovation, and testing it, but then deciding not to adopt it, whereas passive rejection is understood as an individual never really considering the use of the innovation (Rogers 2003).

Implementation Stage

Thus the next stage of the innovation-decision process is the implementation stage. Implementation occurs when an individual puts an innovation to use (Rogers 2003). Rogers argues that the earlier stages are mainly mental thoughts about the innovation, whereas in the implementation stage, different problems might crop up given that it is one thing for an individual to consider adopting an innovation compared to actually putting the innovation into use (Rogers 2003). In this stage an individual tries to answer questions such as where to obtain the innovation, how to use it and what operational problems they might encounter plus how to solve those (Rogers 2003). Rogers argues that problems of implementation usually are more serious when the adopter is an organization. This is something we will look into later. The implementation stage might continue for a lengthy period, depending on the innovation, until the point is reached where the innovation becomes institutionalized, at which point the implementation stage ends and the confirmation stage begins (Rogers 2003). However, before moving on to the confirmation stage, Rogers highlights the process of re-invention which happens in the implementation stage. Here, re-invention is to be understood as: “*the degree to which an innovation is changed or modified by a user in the process of its adoption and implementation*” (Rogers 2003). The process of re-invention was not considered by scholars to occur before the 1970’s, and until then it was considered very infrequent behavior (Rogers 2003). However, Rogers consider the process of re-invention very important as he, with his generalization 5-9, claims that “*A higher degree of re-invention leads to a faster rate of adoption of an innovation*”, due to the logic that the more an innovation gets re-invented, the more flexible it is and therefore has the potential to fit into a wider range of adopters’ conditions (Rogers 2003). Re-invention of an innovation, to some degree, almost always occurs and an example of re-invention could be the board game monopoly. By now, there exist many different versions of the board game with different rules and different looks. Most noticeable, however, is the fact that monopoly has a danish version called matador. Even though the rules are essentially the same, matador showcases Danish places around Copenhagen on the deeds and Danish ferry connections. The process of re-invention makes Rogers argue that an innovation is not a fixed entity, but that people who use an innovation shape it instead (Rogers 2003).

Here, Boczhowski provides a fitting quote: "*Artifacts are not only constructed by their designers, they are also reconstructed by their users*" (Boczkowski 1999, 86-108).

Confirmation Stage

Lastly, the confirmation stage is where the individual seeks reinforcement for the innovation-decision they already made. This is also where they reverse their decision if met with conflicting messages about the innovation (Rogers 2003). In this stage, Rogers argues that dissonance plays a central role. Here, dissonance is to be understood as an uncomfortable state of mind that an individual seeks to reduce or eliminate (Rogers 2003). Dissonance might occur after the individual has chosen to implement an innovation and gets exposed to information persuading him/her that they should *not* have adopted it. This type of dissonance may be reduced by discontinuing the innovation (Rogers 2003). Conversely, the individual who originally rejected the innovation might get exposed to information that they should have adopted, causing dissonance, which then can be reduced or eliminated by adopting the innovation. This is what Rogers in his model calls later adoption (Rogers 2003). About discontinuance, Rogers argues that there exists two types; replacement discontinuance and disenchantment discontinuance. Here, a replacement discontinuance is the decision to reject an idea in order to adopt a better idea, while disenchantment discontinuance is the decision to reject an idea as a result of dissatisfaction with its performance (Rogers 2003).

Communication Channels

An element, however, that plays a significant role throughout all the stages of the innovation-decision process is communication channels. According to Rogers, different communication channels play different roles at each stage in the innovation-decision process (Rogers 2003). Here, Rogers distinguishes between a *source*, which is to be understood as an individual or institution that originates a message, and a *channel*, which is to be understood as the means by which a message gets from the source to the receiver (Rogers 2003). Furthermore, Rogers categorizes communication channels as either interpersonal or mass media which can either be localite or cosmopolite in their nature (Rogers 2003). Here, interpersonal channels are to be understood as face-to-face exchanges between two or more individuals, while mass media channels are to be understood as message transmissions involving mass mediums such as radio, television, newspapers etc. (Rogers 2003). With his generalization 5-13, Rogers argues that mass media channels are more important at the knowledge stage while interpersonal channels are more important in the persuasion stage, because mass media's potential to rapidly create knowledge and spread information to a large audience, whereas interpersonal channels can persuade an individual to form or change a strongly held attitude (Rogers 2003). As a result, interpersonal channels are effective to deal with

resistance while mass media can reach a wide range of individuals. Cosmopolite communication channels, however, are to be understood as channels linking an individual with sources outside of their social system, while localite communication channels are to be understood as channels linking with sources inside their social system (Rogers 2003). Furthermore, Rogers puts forward his generalization 5-14:

> "*Cosmopolite channels are relatively more important at the knowledge stage, and localite channels are relatively more important at the persuasion stage in the innovation-decision process.*"
>
> (Rogers 2003)

To sum up, Rogers mass media channels and cosmopolite channels are more important in the knowledge stage, while interpersonal channels and localite channels are more important at the persuasion stage. In conclusion, we can say that the innovation-decision process for individuals is the period of time it takes for a certain individual to gain awareness that a certain innovation exists to that individual deciding to either reject or adopt the innovation. During this process, the individual gains knowledge, either by coincidence or through active information seeking, of the innovation through different communication channels. In the end this information leads to the individual forming either a favorable or unfavorable attitude toward the innovation, ultimately causing the individual to either choose to reject the innovation or to adopt it.

5.2.2 The Innovation-Decision Process in Organizations

Now that we know what the innovation-decision process for individuals is and entails, we have to move our view towards how this process happens in organizations due to the setting in which this thesis takes place.

In contrast to the innovation-decision process for individuals, Rogers argues that many innovations are adopted by organizations (Rogers 2003). Here, Rogers highlights that, compared to the innovation process for individuals, the innovation process in organizations is much more complex and implementation, therefore, does not always directly follow after an organization has chosen to adopt an innovation (Rogers 2003). According to Rogers there are three types of innovation-decisions within an organization; *Optional Innovation-decisions, Collective Innovation-decisions and Authority Innovation-decisions* (Rogers 2003). Here, optional innovation-decisions are to be understood as an individual independently choosing to either reject or adopt an innovation regardless of what innovation-decision other members of the individual's social system makes (Rogers 2003). For example, a doctor may choose not to adopt a prescription drug even though the peers in his/her social system do, or a tradesman might choose not to wear gloves even though his colleagues do. Conversely, collective

innovation-decisions are to be understood as the choice to adopt or reject an innovation based on the consensus of individuals in the social system (Rogers 2003). For example, Rogers highlights a city's decision to adopt a no-smoking policy based on a city hall vote, consequently meaning everyone having to adopt the innovation once the decision is made (Rogers 2003). Lastly, authority innovation-decisions are to be understood as the choice to adopt or reject an innovation made by relatively few individuals with high social status, power or technical expertise in a social system (Rogers 2003). For example a headmaster or a board might decide to adopt an innovation of which the employees must comply with. Additionally, Rogers talks of a contingent innovation-decision, which is to be understood as the choice to adopt or reject an innovation only after a prior innovation-decision (Rogers 2003). For example, an organization might choose to adopt an innovation by the use of an authority innovation-decision, only for the employees of the organization to then go through the process of an optional innovation-decision.

Organizations

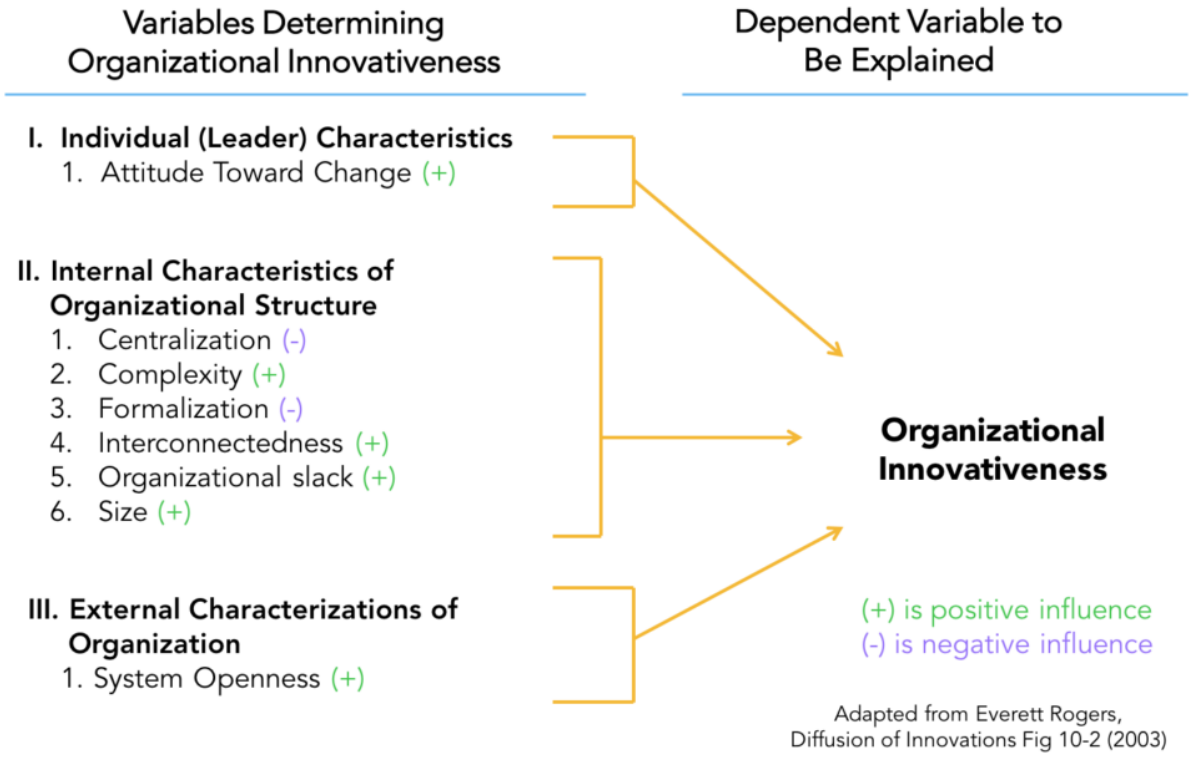
Now that we know the different types of innovation-decisions in an organization we might ask ourselves how an organization actually is to be understood? According to Rogers an organization is:

> "[...] *a stable system of individuals who work together to achieve common goals through a hierarchy of ranks and a division of labor.*"
>
> (Rogers 2003) ,404)

Furthermore, Rogers argues that a predictable organizational structure features; *predetermined goals, prescribed roles, authority structure, rules and regulations* and *informal patterns* (Rogers 2003). Despite all of these features, Rogers claims that innovation in organizations goes on all the time with barriers and resistance to innovation existing in almost every organization (Rogers 2003).

Organizational Innovativeness

Another term that diffusion research historically has concerned itself with is innovativeness; the degree to which an organization is open to innovation(s). In figure 10 below we see some of the variables related to an organization's innovativeness.



(Fig. 10 Independent Variables Related to Organizational Innovativeness) (Rogers 2003).411)

As we can see in the figure above, Rogers sort the variables concerning an organization's innovativeness into three categories; *Individual characteristics, internal characteristics and external characteristics* (Rogers 2003). Within these categories, different traits affect the organization's overall innovativeness. Here, Rogers considers variables such as complexity, interconnectedness and organizational slack as positive influences on organizational innovativeness, while centralization and formalization are considered negative influences. Later in the analysis we will make use of these terms. It is therefore important for this thesis that we clarify how Rogers understands the above mentioned terms. About complexity, Rogers writes the following:

> "*Complexity is the degree to which an organization's members possess a relatively high level of knowledge and expertise, usually measured by the members' range of occupational specialties and their degree of professionalism.*"
>
> (Rogers 2003) 412)

According to Rogers, complexity is positive in the sense that the members of the organization can more easily grasp the value of an innovation, while the downside is that it may be difficult for them to come to a consensus of the innovation (Rogers 2003). Additionally, Rogers considers interconnectedness as a positive influence on an organization's innovativeness. Here, interconnectedness is to be understood as the degree to which the members in a social system are linked by interpersonal networks (Rogers 2003).

Finally, Rogers understands organizational slack as "*the degree to which uncommitted resources are available to an organization*" (Rogers 2003). Organizational slack may also be a reason why size is considered a positive influence on organizational innovativeness. Conversely, Rogers considers centralization and formalization as negative influences on organizational innovativeness. About centralization, Rogers writes:

> "*Centralization is the degree to which power and control in a system are concentrated in the hands of a relatively few individuals. Centralization has usually been found to be negatively associated with innovativeness. The more that power is centralized in an organization, the less innovative the organization is.*"
>
> (Rogers 2003) 412)

There is, however, a point in which centralization might be viewed as a positive, and that is in the implementation stage of an innovation, where centralization can encourage the implementation rate (Rogers 2003). Lastly, Rogers considers formalization as a negative influence on organizational innovativeness. Formalization is to be understood as "*the degree to which an organization emphasizes its members' following rules and procedures*" (Rogers 2003) 412). Here Rogers argues that formalization can act to inhibit the consideration of innovations while, conversely, it can encourage the implementation of innovations (Rogers 2003).

To sum up, we see how organizational innovativeness is made up of different variables that either affect an organization negatively or positively when adopting or rejecting innovations. These variables are important to keep in mind when designing innovations to be adopted by an organization because they can determine how open or ready an organization might be to adopt the innovation in question.

The Champion

Before we move on to how the innovation adoption process in an organization might look, we need to take a look at a champion. According to Rogers, a champion is:

> "[...] *a charismatic individual who throws his or her weight behind an innovation, thus overcoming indifference or resistance that the new idea may provoke in an organization. An innovation champion can play an important role in boosting a new idea in an organization.*"
>
> (Rogers 2003) 414)

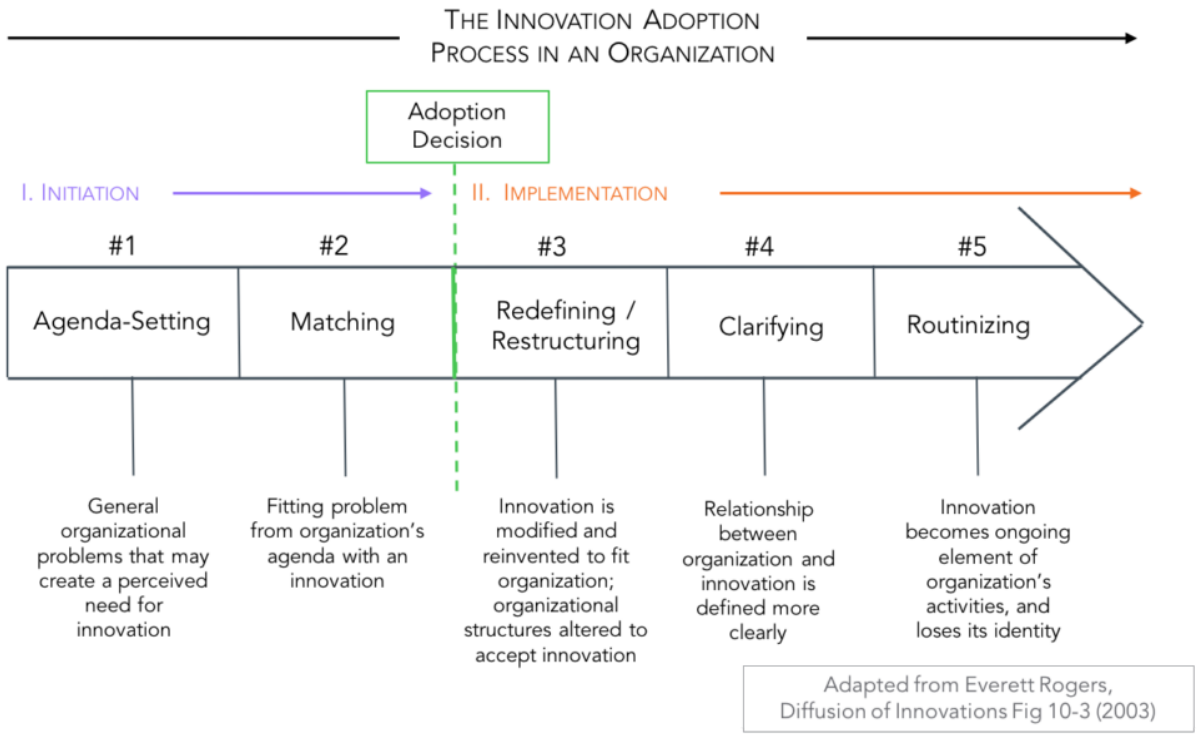
Having a champion behind an innovation can influence whether an innovation gets adopted or rejected. Something Rogers supports by putting forward his generalization 10-3: "*The presence of an innovation champion contributes to the success of an innovation in an organization*" (Rogers 2003) 414). It might now seem like an innovation champion is a member high in the hierarchy of a social system. However, Rogers argues that in many cases people skills may be more important than power (Rogers 2003). Rogers

argues this is because an innovation champion, instead of being powerful in an organization, possess qualities in persuasion and negotiation, making them good at handling people in an organization (Rogers 2003).

Quite frankly this means that a champion does not have to be a powerful individual in an organization. However, whether an innovation gets adopted or rejected can come down to the presence of a champion.

The Innovation Adoption Process in an Organization

In figure 11 below we see the innovation adoption process in an organization. It shows how an innovation in an organization might be designed and implemented in a social system.



(Fig. 11 The Innovation Adoption Process in an Organization) (Rogers 2003).421)

As we can see in the figure above, this innovation process consists of five stages; *agenda-setting, matching, redefining/restructuring, clarifying and routinizing* (Rogers 2003). Here, agenda-setting and matching constitutes an initiation phase, while redefining/restructuring, clarifying and routinizing constitute an implementation phase. Rogers argues that the initiation phase concerns information gathering, conceptualization and planning for the adoption of an innovation (Rogers 2003). This phase starts with agenda-setting which, according to Rogers, "[...] *occurs when a general organizational problem is defined that creates a perceived need for an innovation*", which is why Rogers argue that the agenda-setting stage consist of "[...] *identifying and prioritizing needs and problems and searching the*

organization's environment to locate innovations of potential usefulness to meet these organizational problems" (Rogers 2003) 422). A search that Rogers clarifies better later in his text:

> "*At the agenda-setting stage, one or more individuals in an organization identify an important problem and then identify an innovation as one means of coping with the problem.*"
>
> (Rogers 2003) 422)

This means that the first step of the innovation adoption process in an organization starts with the perceived need for a problem to be solved.

Matching

After identifying a problem to be solved, the next phase of the innovation adoption process in an organization is the matching stage. Here, Rogers defines matching as:

> "[...] *the stage in the innovation process at which a problem from the organization's agenda is fit with an innovation, and this match is planned and designed.*"
>
> (Rogers 2003) 423)

This means that after an organization has identified a perceived problem to be solved, they start identifying an innovation which can solve this perceived problem. The organization then plans and designs how the innovation may be fitted into the implementation process of the organization. This stage is vital as Rogers argues that if an organization's decision-makers conclude that the innovation is mismatched with the problem, the innovation will be rejected and never go to the implementation stage (Rogers 2003). What is most important in the matching phase, therefore is the planning, which Rogers claims entails "[...] *anticipating the benefits, and the problems, that the innovation will encounter when it is implemented*" (Rogers 2003) 423). As we saw in figure 11 above, the end of the matching stage marks the end of the initiation phase and the beginning of the implementation phase.

In this thesis we will mainly be focusing more on the initiation phase than the implementation phase due to the fact that this is where our innovation under study exists. Therefore, we will only shortly go over what the implementation phase of the innovation adoption process in an organization entails.

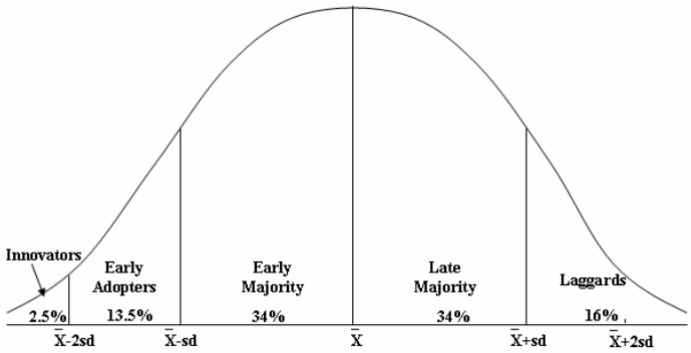
Redefining/Restructuring, Clarifying and Routinization

As earlier mentioned, Rogers argues that there exists three stages In the implementation phase of the innovation adoption process in an organization; redefining/restructuring, clarifying and routinization (Rogers 2003). Here, Rogers argues that redefining/restructuring occurs when "[...] *the innovation is re-invented so as to accommodate the organization's needs and structure*". Additionally, Rogers argues that both the innovation and organization usually change during this process (Rogers 2003).

Clarifying, Rogers argues, occurs when "[...] *the innovation is put into more widespread use in an organization, so that the meaning of the new idea gradually becomes clearer to the organization's members*", while routinization occurs when "[...] *the innovation has become incorporated into the regular activities of the organization and loses its separate identity*" (Rogers 2003) 434). By becoming incorporated into the activities of the organization, the innovation has been adopted and routinization therefore marks the end of the innovation adoption process in an organization (Rogers 2003).

5.2.3 Diffusion of Innovation throughout a Social System

In the book "Psychology for Sustainability", Britain Scott puts forward an alternative model of how diffusion happens in a social system (Scott and others 2015). In figure 12 and 13 below, we see Rogers' original model of adopter categorization on the basis of innovativeness on the left. On the right of Roger's model, we see Britain Scott's adaptation of Rogers' classic model.



(Fig. 12 Adopter Categorization on the Basis of Innovativeness) (Rogers 2003) 281)

(Fig. 13 Diffusion of Innovation throughout a social system) (Scott and others 2015) 316)

First, let me be clear; both Rogers' classic model and Scott and others' adaptation builds on the same theory and concepts of Rogers' diffusion of innovations. What we are focusing on here is the differences in how these concepts are presented in the models above and why we might prefer one illustration over the other.

In Rogers' model to the left, he divides individuals into categories based on the time they take to adopt a certain innovation. Here, Innovators are the first group to adopt, then comes people constituting the group early adopters, early majority, late majority and in the end, laggards (Rogers 2003). Some general characteristics Rogers assigns the individuals in these groups are that innovators are venturesome, early adopters are respected by their peers, early majority are deliberate and does not want to be the first

adopters of an innovation nor the last, late majority are skeptical of new ideas, and laggards are traditional and base their decisions on the past ways of doing things (Rogers 2003). In Scott and others' adaptation of Rogers' model, however, we see how an innovation, in the bottom of the figure, starts the innovation-decision process in a social system. Here, innovators are the first-movers and early adopters are next as we also see in Rogers' classic model. However, in contrast to Rogers' classic model, opinion leaders are part of Scott and others' adapted model. Opinion leaders are indeed found in the category of early adopters, although they are not illustrated in Rogers' classic model. This is an important difference because opinion leaders, as Rogers argues himself, are often highly connected and are, in their social system, seen as "the individuals to check with" before the early majority considers adopting the innovation (Rogers 2003). What is interesting In Scott and others' model, is that early majority and late majority exists in the periphery of the mainstream, showcasing the importance of opinion leaders being able to connect to the early- and late majority in order for an innovation to become adopted within a social system and later routinized in the form of a mainstream praxis. The visible connections in Scott and others' adapted model, compared to Rogers' classic model, makes the interconnectivity between individuals in a social system clear, and highlights how an innovation goes from an idea to becoming mainstream (Scott and others 2015).

6.0 Analysis

Now that we know in which light we should understand Schön's reflection-in-action theory and Rogers' diffusion of innovation theory, we turn to the analysis. Here we will follow the creation of the cards constituting the serious game, the way they have been used in the workshop, what came out of it, as well as what has to happen for the innovation to become adopted in the Aalborg University.

6.1 The Creation of the Cards

During my last semester project (TAN9), I mainly focused on the Tech Center for Sustainable and Digital Transformation's (TECH4SDT) typology, goals and activities. Through this project I, as well as the TECH4SDT, saw a perceived need for unraveling the ambiguous concept of sustainability. Through the problem analysis of this thesis, I have laid out arguments for the use of a serious game as a tool to accommodate this need of unraveling the sustainability part of digital transformation. Meanwhile, the TECH4SDT offered me the opportunity to create a serious game and, therefore, this analysis section will focus on the process of creating the component of the serious game.

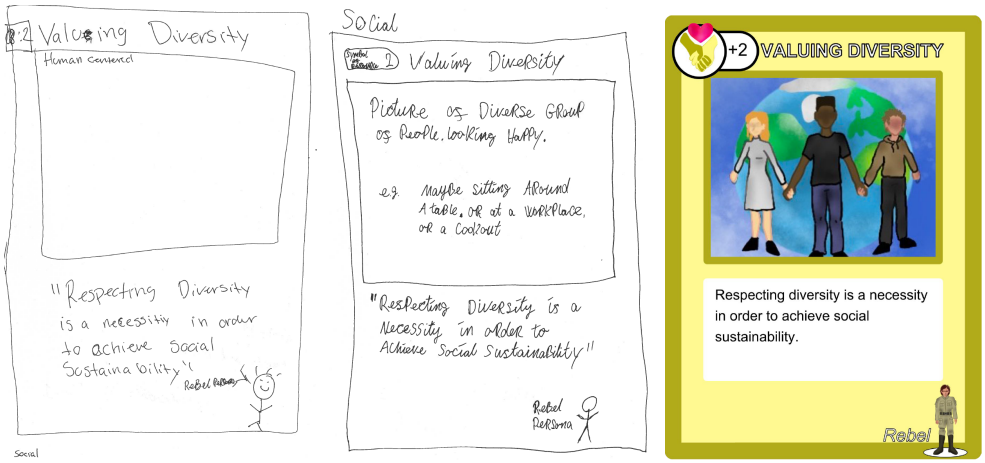
During the period between March 2022 and June 2022 I worked as a student helper on the creation of the serious game alongside a fellow techno-anthropology student from 8th semester, Amanda. Simultaneously in the process, we had collaboration with a technical designer who helped create the artwork for the cards. Several meetings were also held about the serious game with the steering group leader of TECH4SDT and his research assistant of whom both have contributed a great deal of perspectives in the creation of the serious game. It was through these meetings that the general direction of theme and artwork features were laid. Thinking of Rogers' model of the innovation adoption process in an organization, we might say that these meetings exist in the stage of matching, because at this point, the TECH4SDT already have an agenda in form of their typology where their aim is at promoting:

> "[...] *at AAU and beyond - research projects, educational content, and social as well as professional practices, that take as a starting point the combination of the human, social, economic, and environmental dimensions of sustainability with the design, production, assessment of, and engagement with digital technologies."*
>
> (TECH4SDT 2022)

We might go even further back in the agenda-setting due to the fact that the research center TECH4SDT was created based on the decision of the Aalborg University board wanting research within the fields of sustainable and digital transformation, but that is another story. For now, let us focus on the TECH4SDT as the agenda-setters. In their typology above they clearly see a need for promoting more research and

education within the fields of sustainable and digital transformation. A need that the problem analysis of this thesis partly shares by arguing that it is more important than ever to unravel the ambiguous parts of sustainability. This perceived need is what starts the innovation adoption process in the AAU. Then, after identifying this problem, the next stage of the innovation adoption process in an organization is matching. And this is where Amanda and I contributed in designing the cards for the serious game. As we know, Rogers defines the matching stage as the stage in an innovation process where an innovation is fitted to solve the perceived problem of the organization. This fits perfectly into Rogers' model of innovation adoption, because the serious card game was perceived as the innovation to solve the need for promoting more research and education within the fields of sustainable and digital transformation.

Another main activity of creating the serious game were working meetings between Amanda and I using the method of paper prototyping. An example of how a card from the serious game evolved from paper prototype to a final draft in prototype 1 in the serious game can be seen in figure 12 below:



(Fig. 14 "Valuing Diversity" from paper prototype to final draft)

We might say that the iterative process of designing the card Valuing Diversity, is an example of reflection-in-action. Even though it seems like not much is changing in the paper prototypes, the left-most paper prototype was made first, with the time in between before the middle paper prototype used to reflect on the possible artwork that the card should end up showcasing. In the end, the middle paper prototype was sent to the technical designer, who came up with the final draft design of the card that is seen on the far right. In this process, the technical designer reflected on the paper prototype and created the design artwork as they saw fitting in accordance with the paper prototype sent.

Another example of how the process of creating the cards can be seen as an example of reflection-in-action is by the basic inspiration for their design. The inspiration for the cards of the serious game comes from selected essays in the work: "Pluriverse: a Post-Development Dicitonary" (Kothari and others 2019). Here, Valuing Diversity is based on our interpretations of anthropocentrism in a positive

way. The discussion of how to showcase this had connotations of reflection-in-action in the sense that the process constantly shifted between discussion, prototyping, discussion, prototyping and so on, allowing reflection to happen based on our actions. A figure of the rest of the final drafts of cards that made it into prototype 1 can be seen below:

(Fig. 15 The 12 cards that constitute the serious game)

Here, a card consists of the logo of the theme it belongs to (in this case, social) in the upper left corner, the cost of the card to the right of the logo and to the right of the cost is the title of the card. Furthermore, the card consists of artwork (the picture in the middle), a statement below the artwork and a character

below the statement in the lower right of the card. Figure 13 shows the cards that constitute the serious game. It is also these 12 cards that were used for the workshop which we shall learn more about in the next analysis section. Unfortunately, there was not enough time to develop artwork for all the 12 cards before the workshop, which is why we chose to equip all cards other than “Valuing Diversity” with placeholder photos. This decision made sure we had the right theme-setting artwork for all 12 cards during the workshop.

6.2 The Workshop

During my period as a student helper, I helped facilitate a workshop for the TECH4SDT. Here, I was a co-facilitator alongside research assistant Helena. The following is an analysis of how the workshop was set up, what activities were carried out and how the cards from the serious game were used. Due to lack of time, the rules and the gameplay for the serious game was not finely tuned and it was therefore decided that the cards were not to be used as a serious game but as a tool for stimulating conversation and reflection.

At the workshop we had 11 participants of whom came from different departments and had different research positions within Aalborg University. It was originally planned to be 12, but one participant did not show. This made us change up the four preplanned groups of three participants into three groups of respectively four, four and three participants. Aside from the 11 participants, Helena and I were present in the role of co-facilitators.

6.2.1 The Workshop Setup

On the day of the workshop we came early to prepare coffee, tea and water in order to accommodate the participants with drinks. We also created sitting accommodations for the four planned groups by putting two two-man tables together so participants could sit across from each other while working in their groups. We then distributed A3 paper sheets to each group table along with green markers to write with. Lastly, we took the 12 cards from the serious game, shuffled them and distributed them as a pile face-down on each of the group tables. Lunch was complementary for the workshop participants and planned to arrive at 12 PM. The workshop was planned to start at 10 AM but due to some delay among participants, we did not start the workshop before 10:15 AM.

At that point, Helena started presenting the TECH4SDT, what work they had done so far and the goals of the workshop. We then asked the groups to discuss among themselves how they understand the concept of sustainability, and the concept of digital transformation based on their current or former research projects. The participants got around 15 minutes to discuss this within their groups, whereafter we had the groups

present in plenary what they had been discussing about these concepts. After that, I introduced the cards which were still lying in a pile face-down on the group tables. Here, we asked the groups to draw a card from the top of the pile, look at it and try to discuss how the card might relate to their previous discussion. For this second group activity, we took away their green markers and supplied them with red markers and post-it notes instead. In this way, we could see the evolution of the groups' posters and distinguish which parts were from which activities. The groups got around 40 minutes to discuss before we summed up each group's discussion in plenary in the end.

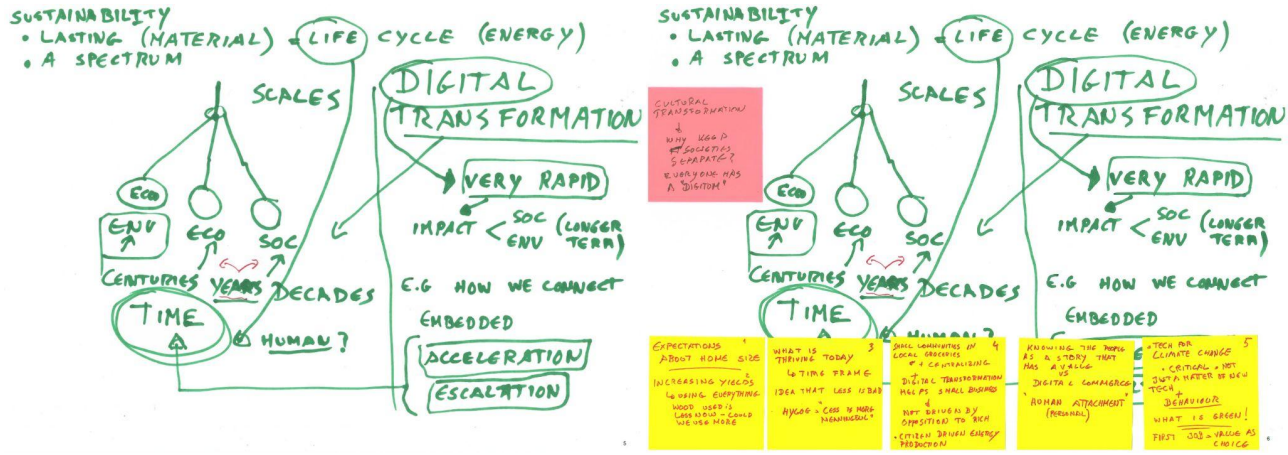
6.2.2 The Posters from the Workshop

Knowing of the methods used to facilitate the workshop let us take a look at some of the content that was produced. While some of the groups embraced the poster making more than others, a lot of interesting topics were still discussed and jotted down by the participants. Figure 16, 17 and 18 showcases the visible results in the form of the groups' posters.

(Fig. 16 The evolution of group 1's poster(s) from the workshop with TECH4SDT)

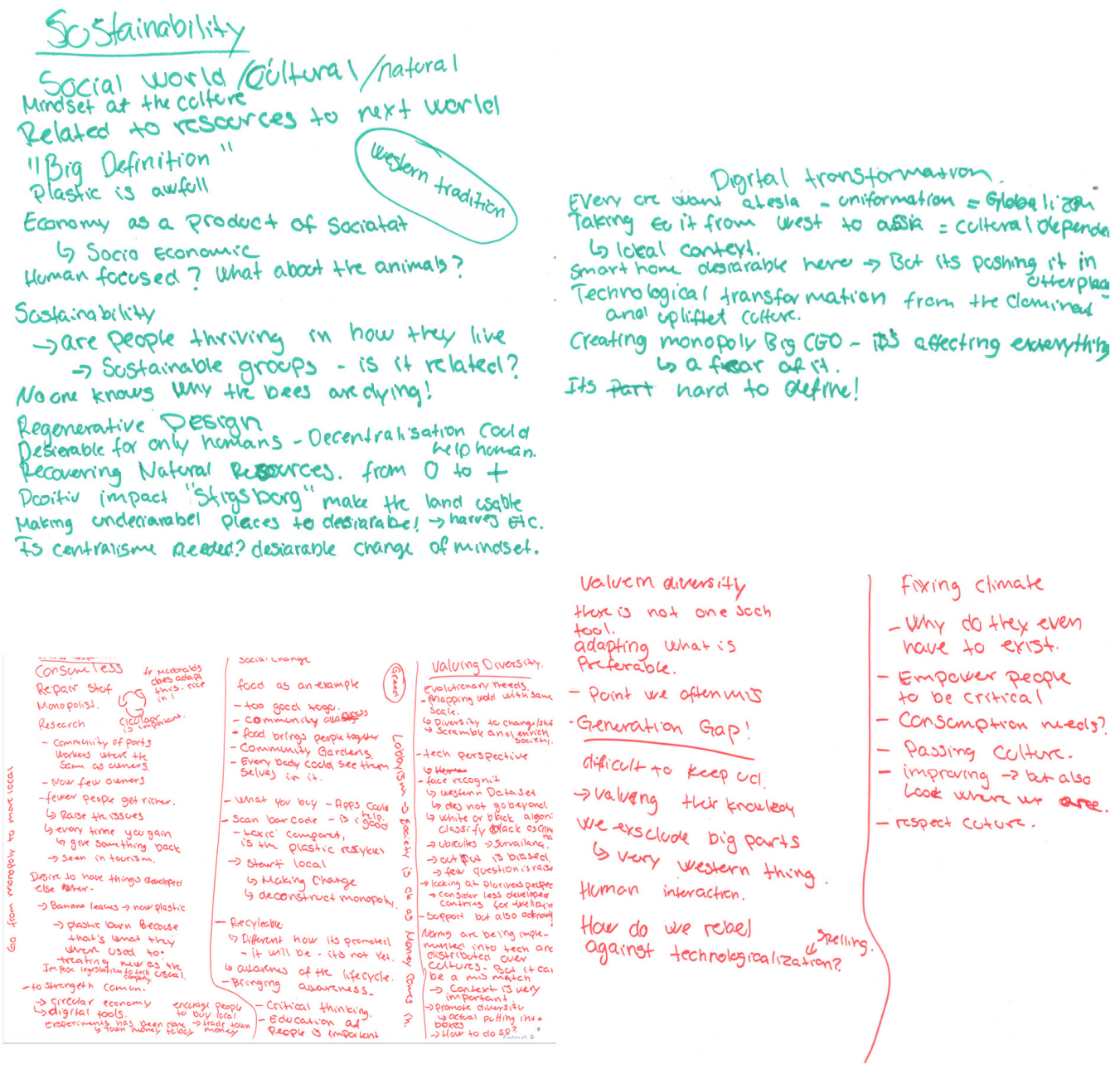
Asked to discuss the concepts; sustainability and digital transformation among each other, the group members of group 1, as we see in figure 16 to the left, ended up discussing sustainability in the form of environmental performance of whisky. Beyond that, they discussed how building efficiency, food waste and designing for repair are other examples of how sustainability can be viewed. Also social sustainability was discussed where a term like energy poverty made it onto the poster while elements such as how electronics and digitalization for predicting were part of what they understand with digital transformation. In the second round using the cards, the group drew: Social Change from the Bottom, Participatory Ecological Justice, Industrialized Farming and After Homo Economicus. This made the group talk about different social initiatives that could be made in order to promote more sustainability, how to balance the

availability of food for people in general versus ecological produce and shared economies. All in all the group discussed many different elements of sustainability, however mostly in the form of social aspects.



(Fig. 17 The evolution of group 2's poster from the workshop with TECH4SDT)

In group 2 we see the first activity of discussing the concepts; sustainability and digital transformation on the left, and on the right the group wrote on post-it notes and added them to their poster. Here, the group discussed how sustainability can be seen in life cycles, both human and material, and how a different time frame can be assigned into the concept of sustainability where environmental changes can be viewed in centuries, economic changes in years and social changes in decades. For the concept of digital transformation the discussion fell upon how its impact happens very rapidly and how it can accelerate the time frame of sustainability initiatives. In the second round using the cards, the group drew: Spaces of Experience, After Homo Economicus, Industrialized Farming, Participatory Ecological Justice and (Techno)Fixing Climate Change. This made the group talk about how people often have high expectations in terms of nice and expensive things, how wood is used less in production nowadays, how there is a tendency from people in society to believe that having less is bad when the example of "hygge" shows that sometimes less can be more meaningful, and how just getting new technology is not enough to mitigate climate change; behavior changes are equally important! The group found it difficult to talk from the cards in the beginning, but they got more into it by time. Interestingly, the group instantly noticed the triple bottom line theme once they had drawn a card from each category.



(Fig. 18 The evolution of group 3's poster(s) from the workshop with TECH4SDT)

In group 3 we see the first activity of discussing the concepts; sustainability and digital transformation in the top left and top right of figure 18. During their first activity group 3 discussed how culture is an important factor of how we see sustainability. Whether we see it as social- cultural or natural sustainability comes down to the mindset you get from your culture. The group also discussed regenerative design and the complex case of why bees are decreasing in numbers, speaking into the complexities of natural carrying capacity. On digital transformation they talked about globalization and how big monopolies potentially can have a huge, potentially negative, impact on sustainability. In the

second round using the cards, the group drew: Spaces of Experience, Social Change from the Bottom, Valuing Diversity and (Techno)Fixing Climate Change. This made the group talk about reducing consumption and monopolies and increasing repairs and circular economy. Additionally they talked about distributing power and resources by going from monopolies to more local communities. They also talked about the different initiatives of reducing food waste and the importance of increasing critical thinking and education of people. Lastly, they talked about how tech can be viewed as racist if it is only based on european or white datasets while they maintained a critical view on new tech for mitigating climate change as we should improve our technology but not forget how we got here today (un)sustainability vice.

It seems that the participants at the workshop did not need a lot of help in the form of a serious game or cards to discuss the concepts of sustainability and digital transformation. Whether or not the cards served their purpose of facilitating reflection upon sustainable and digital transformation can only for sure be concluded through data from a questionnaire or some sort of evaluation. Data that we do not have. What we do see from the posters however, is the groups getting wide and far around different elements and concepts that might constitute sustainability and digital transformation. Furthermore, analyzing the posters from the workshop more closely, there seems to be a slight tendency from the group to be discussing many different elements of sustainable initiatives, practices or elements based on the content of the card drawn. We see in all the groups' posters that the participants possess a lot of knowledge about sustainability beforehand of making use of the cards. However, we also see how the cards help the groups focusing their discussion towards the different elements of sustainability that the card expresses. As group 3 writes in the bottom of their poster about the concept of digital transformation, it is hard to define. However, they seem to have no problem discussing the need for critical thinking when talking about digital transformation through the card; (Techno)Fixing Climate Change. Perhaps the card did help them reflect upon what elements or factors do play a role in digital transformation after all. And group 2 did see the connection to the triple bottom line. One thing we can conclude for sure though is that 11 participants occupying a variety of research roles at Aalborg University sat down together to discuss what sustainability and digital transformation mean to them. And by doing this they shared their specialized knowledge on the subjects, made new connections and, hopefully, reflected on how they have been thinking and performing their research activities in the subjects of sustainability and digital transformation.

6.3 The First steps in Innovating Sustainability Understanding through a Serious Game

After analyzing how the workshop facilitated the conversation upon sustainability and digital transformation, in this chapter we turn to Rogers again in order to analyze how our innovation might diffuse throughout the social system of Aalborg University and figure out what needs to happen for the innovation under study to be adopted in the organization.

After the workshop, we might say that the participants went through the innovation-decision process rather quickly.within one hour they themselves, gained the awareness-knowledge of its existence, developed how to- and principles knowledge forming a favorable or unfavorable attitude toward the innovation. Some participants express their thoughts of using the cards for teaching students. With the innovation-decision process in mind we might say that they, at that point, were considering the innovation's relative advantages and trial-abilities. These are thoughts that occur in the persuasion stage of Rogers innovation-decision process. Here, it is important to note that both the knowledge- and the persuasion stage of the individuals occurred through interpersonal localite communication channels. As Rogers say: "*interpersonal channels can persuade an individual to form or change a strongly held attitude*" and "*localite channels are relatively more important at the persuasion stage*" (Rogers 2003), it becomes clear that the fact that the participants are among colleagues might play an important role in their attitude toward the innovation. Some participants with a favorable attitude toward the innovation might proceed to the decision stage by asking to try the innovation out on their students. This would mark a positive progress in potential adoptions as Rogers argues how the importance of probationary trials might lead to more rapid adoption rates. Additionally, not every participant needs to try out the innovation due to the "trial by others" phenomenon which Rogers claims can substitute actual trials for individuals if the trial is made by an individual's peer (Rogers 2003). This trial might lead to adoption or rejection. If it would end in adoption, using Rogers' model, the individual goes into the implementation stage where another important element for the innovation's potential adoption comes into play; re-invention. As earlier explored, Rogers argues that the process of re-invention is important for an innovation's potential to be adopted as he claimed: "*a higher degree of re-invention leads to a faster rate of adoption*" (Rogers 2003). If one of the participants decides to try the innovation on a probationary basis, they might re-invent it for their own purpose first, or they might try it out first before evaluating whether it needs re-invention.

7.0 Conclusion

The TECH Center for Sustainable and Digital Transformation (TECH4SDT) perceives the need for a profound sustainable and digital transformation to ensure a liveable future for all. This thesis attempts to investigate how this need can best be solved. The TECH4SDT themselves, believe the solution to be infrastructuring more opportunities for researchers, students, and society at large by creating a process that infrastructures opportunities for interdisciplinary research to explore and experiment in new ways of thinking about sustainable and digital transformation, allowing the field of sustainable and digital transformation to evolve and develop. In the problem analysis we see how sustainability is a concept with many themes and elements and how it risks becoming an ambiguous term due to its complexity and open interpretation. Therefore this thesis concludes that there is a need for unraveling the concept of sustainability in order to prevent ambiguousness and a potentially unchallenged mainstream worldview on digital transformation as the fix for our current sustainability crisis. In this thesis I argue that a way of unraveling sustainability and challenging digital transformation can be accommodated through the use of the tool: a serious game. Serious games have become more popular throughout recent times and their most frequently occurring outcomes reported are knowledge acquisition. Trying to diffuse the mainstream understandings of the concept of sustainability I, alongside the TECH4SDT, created 12 cards to be used as a tool for facilitating discussion and reflection upon sustainable and digital transformation. Precisely these cards were used for a workshop with 11 participants occupying various research roles at Aalborg University. The results lacked a way of measuring reflection, although some reflection was detected in the way a group noticed the hidden message of the triple bottom line. Additionally, the results did show the participants using the cards as a basis for furthering their discussions upon sustainability and digital transformation, indicating that they indeed facilitated a discussion upon the subjects. Whether the cards will be adopted within the social system of Aalborg University is for the future to tell.

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