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# Balance It!

Designing a game-based learning tool for  
strategic sustainable development

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## Abstract

### Balance It!

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In recent times, companies have been motivated to transition towards sustainable development. This motivation is driven by several external and internal factors such as awareness about limited resources, environmental degradation, economic profitability, changes in regulations, etc. Transitioning towards sustainability is not an easy task. There can be several challenges such as the multi-dimensional aspect of sustainable development, changes in workflow, investing in/inventing new technology, etc. To tackle these challenges, a strategic transition is required. In order to help organizations strategically move towards sustainable development, Göran Broman and Karl-Henrik Robèrt have provided a framework through their research.

It can be an overwhelming task for a company to understand and implement this framework. The thesis addresses this challenge by designing a board game around the operational procedure provided by the framework. To develop the game, Evensen et al.'s model was leveraged which utilized different inputs such as literature review, Broman and Robèrt's framework, and thematic analysis of interviews as inputs for game development. The interviewing process included semi-structured interviews of eight employees (sustainability-related positions) from different companies to understand how their companies are perceiving sustainable development, implementing sustainable practices, and what are the needs and challenges faced.

This thesis contributes to academia in two ways. First, it extends the Framework for Strategic Sustainable Development (FSSD) by providing an application-based learning tool. After studying the theoretical side of the framework, the developed game can enhance the understanding of the framework. Second, it modifies the game design model by substituting generative research with a framework (FSSD) as an input and further discusses the benefits of having FSSD as an input element. From a practical perspective, apart from providing a better understanding of sustainability and educating companies about FSSD, the board game session enables the employees to think about how to implement FSSD for their specific scenario. Additionally, it also provides companies a controlled environment to think about risks and foresee the consequences of their future actions. Hence, providing a safety net before the initiation of the implementation process.

**Keywords:** Sustainable Development, Game-Based Learning, Strategic Sustainable Development, Game Design, Board games, Serious games

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## Popular Science Summary

Sustainable development can be considered as an interaction of three systems, namely ecology, society, and economy. Multiple studies have been carried out by different researchers in different areas of these three systems. For example, some have studied ecological aspects like pollution, climate change, biodiversity loss, and so on. Some have discussed challenges concerning society such as poverty, lack of education, etc. Some researchers have also focused on how these three systems interact with one another, what are the challenges in balancing all three, etc. Studies have also shown that organizations such as companies have a significant impact on these systems. Not only the impact, but researchers have also addressed the challenges in the implementation of sustainable practices in organizations and have proposed frameworks that can help in transforming towards sustainability.

One example to understand the interlinking of ecology, society and economy is the Covid-19 pandemic. It forced several companies to stop or change their operations, change the workflow, and invest in technologies for remote work, which led to businesses incurring losses/requiring huge capital investments. These changes impacted the growth of the economy which entailed reduced risk-taking by the companies to either not hire or fire some of the employees. The only break in the cloud was that when certain companies were not operational, there were some improvements in nature at certain locations. Waters of some rivers became clearer and also the air quality at several locations improved.

All these observations further confirm that companies play a vital role in all three dimensions (ecology, society, and economy). It is critical to understand for companies that their development should not come at a cost of negatively affecting one of these dimensions. Companies have started considering this type of approach in their development where all the three dimensions are aforesaid, but this approach comes with several challenges such as the need for appropriate KPIs, setting measurable goals, lack of collaborations, etc. Some of these challenges can be solved by using frameworks provided for sustainable development by some researchers.

This thesis aims at educating companies about one such framework that can help them move towards sustainable development by using the developed board game as a training tool. The framework provides certain principles which can be used as a guiding compass by companies in their decision making and action plans. It also provides an operational procedure that can lead a company towards a transformation. During the study, a board game was developed around the framework. The thesis also showcases the rationale behind using a board game to teach complex subjects and how it was developed. The game was designed by utilizing inputs from the employees of the sustainability department from different companies. These inputs helped in understanding companies' current sustainability scenario, further actions needed for the transformation, challenges they are facing, and so on. Additionally, the study also addresses the benefits of incorporating a framework in a board game.

Although this board game is designed for companies, it does not mean that it can only be used by companies. It can also be an application-based learning tool for the framework for business/management students. The students can learn the theory first and then use the game to apply the concepts. The other way around can be having a game session as an introduction to the framework and later go deeper into the theoretical aspects. The greater purpose of this study is to spread awareness about sustainability and its importance in transforming society.

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## Abbreviations

DGBL	Digital Game Based Learning
ESD	Education for Sustainable Development
FSSD	Framework for Strategic Sustainable Development
GAP	Global Action Programme
GBL	Game Based Learning
GDP	Gross Domestic Product
IUCN	International Union for Conservation of Nature
KPI	Key Performance Indicator
SD	Sustainable Development
SDG	Sustainable Development Goal
SP	Sustainability Principles
SPTs	Sustainability Points
UN	United Nations
UNESCO	United Nations Educational Scientific Cultural Organization

# 1 Introduction

*The chapter begins with a brief background about sustainable development followed by problematization, where some of the challenges related to sustainable development are briefly described. After the challenges, research purpose has been discussed followed by the addressal of the research questions.*

The earth systems have been stable enough to support human survival for the last 11700 years (Steffen et al., 2015). Geologists call this stable state as Holocene (Rockström et al., 2009). The Holocene has observed the entirety of humankind's history including the beginnings and ends of human civilizations (Waggoner, 1996). It has been affected greatly since industrialization, so much so that human activities have become a critical factor affecting it. This has led to a new era called the Anthropocene. These activities are damaging the earth systems and if not addressed, then there are chances of permanent damage to the biosphere. (Rockström et al., 2009) This may further deteriorate the chances of human survival (Steffen et al., 2015). To prevent this, sustainable development is required.

There are several ways of looking at sustainable development. According to Kate Raworth, sustainable development is about ensuring that the basic needs of resources for survival (food, health and hygiene, and water) are met, considering the fulfillment of human rights. But this (using of natural resources) should be done in a way that does not put a lot of stress on earth systems where the Holocene state might be disturbed. (Raworth, 2012)

Sustainable development can also be interpreted as interactions amongst the three dimensions which are ecological (or environmental), social, and economic. Following is a brief description of each of them (Harris, 2000 in Fabricatore and Lopez, 2011):

**Economic:** For a system to be economically sustainable, it should have the ability to manufacture goods or provide services continuously so that debt can be maintained and to prevent any conditions leading to imbalances in any sector that can harm agricultural or industrial processes.

**Environmental:** For a system to be environmentally sustainable, one must not over-exploit renewable resources and must also avoid over-utilizing nonrenewable resources until and after substitutes are found. Furthermore, it also includes sustaining various systems such as biodiversity, water bodies, etc.

**Social:** For a system to be socially sustainable, there should be equal and fair treatment, services such as health care and education should be provided, and people should be allowed to participate in political activities.

The challenge with the concept of sustainable development is that it's constantly growing and changing, which makes the subject broad and complex involving several fields and perspectives (UNESCO, 2005; Despeisse, 2018). The complexity of the subject can be explained through various examples such as the synergetic relations between the three dimensions are not without trade-offs as the dimensions are dynamically interlinked. Similarly, SDGs are two-sided (contradictory). On one hand, some of the goals are about ecology and living in harmony with nature. On the other, some of the goals are promoting an increase in economic development through increase in industrial growth. (Hickel, 2019) An increase in industrial output by several folds has also been promoted in the Brundtland report. Several researchers argue that it cannot be achieved without damaging the environment (Robinson, 2004). Increase in industrial growth will also make it difficult to keep global warming within the limits of 2°C rise (Hickel, 2019). These are some of the challenges which make the subject complex, but there are also other challenges that companies face while trying to implement sustainable practices.

Sustainable development has become a vital part of the corporate world in recent times. This could be due to several reasons such as environmental awareness, demand from stakeholders, law and regulations, economic profitability, improving reputation, etc. Many CEOs and managers often understand the importance of strategically planning for sustainable development, but companies do face various challenges in order to implement sustainable practices. (Epstein and Buhovac, 2010) For example, ignorance about the interconnections between the three dimensions, sustainable development not included in a company's vision, 'setting clear and measurable goals' related to sustainable development, need for appropriate KPIs to measure sustainability progress, financial goals getting priority over sustainability goals, etc. (Crews 2010; Garbie, 2017; Hristov and Chirico, 2019; Epstein and Buhovac, 2010).

Companies face above mentioned as well as several other challenges, but it is important to implement sustainable practices as they play a vital role in moving the society towards sustainable development (Agarwal et al., 2017). Therefore, there is a need to motivate them to implement sustainable practices. This motivation can include several aspects such as increasing awareness for sustainable development, going beyond short-term financial gain chase, understanding the benefits of implementing sustainable practices, etc.

There can be several ways through which motivation and education about sustainability can be promoted, such as workshops, learning exercises, simulations, field trips, guest lectures, training, etc. UNESCO suggests that innovative ways of learning and teaching sustainability are required which should be learner-centric and exploratory in nature (UNESCO, 2019b). Uribe and Cobos (2014) suggest that to understand sustainability conventional ways of teaching will not work. The amount of information is too high and also, it's a concept with multiple variables, which

makes it hard to put learnt things into action. They further elaborate, ‘Sustainability requires system thinking, hands-on (and) heads-on approach with certain degree on multi disciplinarily. People won’t internalize the knowledge unless there is a responsive, dynamic and process learning is enabled, simply because for most of them, it is too abstract or detached from their day to day experience’. (Uribe and Cobos, 2014, p.16)

Uribe and Cobos (2014) further suggest that when it comes to such a subject, which requires the above-mentioned skills and approach, board games can be a good tool to use. As it can be a good combination of learning as well as applying the concepts which can increase the clarity of the subject. Learning through board games can be a way to bridge the gap ‘between theory and practice in a risk free, flexible setting’ (Uribe and Cobos, 2014, p.18). Additionally, board games can help one improve skills such as communication, teamwork, critical thinking, problem-solving, etc. (Boghian et al., 2019; Azizan et al., 2017, Treher, 2011).

To summarize, sustainable development is a complex subject with different interpretations and is multidisciplinary in nature. The complexity as well as the aforementioned challenges make it difficult for companies to transition towards sustainability. Also, special skills and a combination of heads-on and hands-on approach is required to properly learn and understand the subject. This is where game-based learning can be a better option compared to conventional teaching. Thus, these two concepts, i.e. sustainable development being a complex subject which is hard to understand and implement, and board games as a potential learning tool for complex concepts, could have great potential to work in combination. This thesis will leverage this combination by designing a board game that can be used as a learning tool for the implementation of sustainability practices.

As sustainability is a multidisciplinary subject (for example, the three dimensions of sustainability are different disciplines which are interlinked and affect one another), it is a challenge to choose a specific topic to develop the game. For example, a game can be made specifically for one of the dimensions of sustainability or it can be made considering all the three dimensions and their interlinking. In case it is made for one dimension then the challenge would be whether to consider multiple topics of that dimension or to select one specific topic. If a game is too specific, then it may happen that players who don’t have a sustainability background may not be able to relate to it. Additionally, the game aims to motivate companies hence, it is necessary to keep a broader approach that can consider multiple challenges they might be facing while implementing different sustainability practices. In order to do so, different sustainability frameworks will be studied as they are usually broad and challenge oriented. From these frameworks, one of them could be selected to develop the game, but the question is:

*How to incorporate a sustainability framework while designing a board game?*

Along with a selected framework, this question will be addressed by utilizing a two-fold approach. First, considering the inputs from companies about sustainable development and game-based learning, and analyzing them. This will be done through semi-structured interviews and thematic analysis. Interviews would help get an insight into how they perceive sustainable development, what are the practices they have implemented, the challenges they are facing in their journey of sustainable development, etc. The GBL part of the interview will be to investigate what companies think about using games as a learning tool. They will also be familiarized with the selected framework and the idea of creating a game around it.

Second, utilizing the analyzed inputs for game development. For example, if multiple interviewees emphasize a common problem or suggest a solution to a prominent problem then a simplified version of that would be showcased in the game. Before moving forward with the game development, several game-design frameworks will be studied. A game-design framework that matches the above requirements of using a framework from the target subject (subject which game is aiming to teach), as well as the two-fold approach, will be selected.

Game-design frameworks cover various topics like goals, feedback, options, challenges, motivation, rules, etc. (Onencan, 2018). One of the examples of a game design framework is the triadic theoretical framework. This framework comprises three concepts (pedagogy, play, and fidelity) and their underlying theories. (Rooney, 2012) Another example is provided by Kiili (2005) where the researcher describes using the theory of flow by Csikszentmihalyi as a theoretical framework to design the game. Another framework proposed by Beatty works in a multi-layered fashion providing a chance to master a particular skill in the game by ‘iterations and levelling up’ in a systematic way. It was designed keeping in mind various learning principles. The multi-layers include learning through problem-solving, retaining information, experience, narrative, etc. (Onencan, 2018)

The aforementioned are just three examples out of many game design frameworks that describe different concepts and provide a structured approach to apply them to design a game. The gap identified in these game design frameworks is that they do not address the first requirement, i.e. using a framework related to the target subject to design the game and the benefits which might come with it. The current study addresses this gap by incorporating a selected sustainability framework into a board game to find out:

*What are the benefits of incorporating such a framework in a board game?*

After developing the game, through this question, the study will investigate the benefits of this theoretical approach of using a sustainability framework as a game design input. There could be benefits to various aspects such as game development, frameworks, etc. For example, having a framework as a core of the game might ease the process of developing certain game mechanics and game flow. From an academic viewpoint, a framework is the materialization of years of research. While making a framework, usually researchers would filter out what they think is not important. So, it is a concise construct of important findings to tackle a certain challenge. Learning about a framework through a game can be useful for people who may not have a background for the subject.

It should be acknowledged that the current question can investigate the benefits of incorporating only the selected sustainability framework in a board game. From a broader perspective, more such studies should be carried out to generalize the benefits of using a framework (of the subject which the game aims to teach) as an input to design the game.

## **1.1 Thesis Structure**

This thesis comprises eight chapters, including the author's note. Each chapter and its contents are briefly summarized below.

The first chapter (Introduction) starts with a background on sustainable development followed by some examples to explain the complexity of sustainable development. After the examples, the research purpose is described, and research questions are briefly addressed.

The second chapter (Literature review) begins with a brief history of sustainable development, followed by description and problematization of sustainability-related topics. Furthermore, education for sustainability is explained, which is continued by GBL. GBL is further narrowed down to board games. Lastly, the limitations of board games are addressed.

The third chapter (Theoretical frameworks) provides a detailed description of the two frameworks used in this thesis. After describing each framework, the reasoning for selecting each of them is also provided.

The fourth chapter elaborates on various aspects of methodology such as research strategy, design and data collection, and analysis. The chapter ends by addressing ethical considerations.

The fifth chapter (Result) is the description of the board game developed, which includes narrative, rules, terminology, board layout, and game flow.

The sixth chapter analyzes the process of board game development. Utilizing the modified Evensen et al.'s model, the chapter explains how different inputs such as literature on board games, FSSD, and thematic analysis were used to develop the game.

The seventh chapter is a concluding discussion that begins by summarizing the research process. After the summarization, both the research questions are addressed elaborately which also includes academic contributions. Furthermore, ethical-practical contributions are discussed. The chapter ends with the limitations of this study and suggestions for future research.

The eighth chapter (Author's note) consists of some reflections about sustainable development and suggestions which can help organizations be more sustainable.

## **2 Literature review**

*This chapter starts with a brief history of sustainable development, followed by other topics related to sustainability and their problematization. Reading these topics, one would understand the complexities and underlying challenges of the subject. Even though the subject is challenging, it is important to understand it in order to transform society into a sustainable one. One of the ways to understand it is through education. Education for this subject needs to be learner centric and exploratory along with teaching certain skills such as critical thinking, problem solving, etc. Learning through games can be a considerable option to fulfill these requirements. In the following sections, games-based learning and the usefulness of board games in teaching the required skills are discussed. Finally, some limitations of board games are addressed.*

### **2.1 Sustainable Development**

#### **2.1.1 History of Sustainable Development**

Forestry experts like Evelyn and Carlowitz initiated the concept of sustainable growth when they realized that Europe was gradually losing the forest resources in 17 and 18<sup>th</sup> century (Purvis et al., 2018). During the 19<sup>th</sup> century the environmental literature started focusing on concerns and there were two schools of thoughts namely: preservation and conservation. People who followed the preservation, believed that nature should be preserved in its raw form. No modifications should be done, and they believed that nature has its own value. These people were more of the romantics and believed in spiritual value. On the other hand, conservationists were the ones who also believed in saving nature, but the motive was for the benefit of the humankind. For example, limiting the use of natural resources to benefit the future generations. (Robinson, 2004)

In the 1970s, the concept of economic growth at the cost of the environment was questioned through literature like Limits to Growth (1972) and Small is Beautiful (1973). Events like the Santa Barbara oil spill (1969) and oil crisis with economic collapse of 1973 led to questioning about capitalism. A realization came to forefront that such growth would not support ecology and society. (Purvis et al., 2018) In 1978, Ignacy Sachs (Ecological economist and advisor to the United Nations Environmental Program) defined eco development as ‘an approach to development aimed at harmonizing social and economic objectives with ecologically sound management in a spirit of solidarity with future generations’ (Ibid, p.684).

During the 1980s, the environmental movements started to slow down as social movements emerged. Eventually social movements also cooled down. Earlier what

used to be the social and ecological factors criticizing economic development, slowly started to merge with economic development. (Purvis et al., 2018) This new type of economic development which considered ecological and social factors was called ‘sustainable development’ which was defined in 1987 in the Brundtland Report. It was defined as ‘development that meets the needs of the present without compromising the ability of future generations to meet their own needs’ (Brundtland, 1987, p.37). The report pointed out that poor economic conditions can be a threat to the environment. On the contrary, greater economic development sacrificing the environment is no better. (Brundtland, 1987)

### 2.1.2 Sustainable development or Sustainability

Paul Ehrlich and Barry Commoner debated over the reasons for environmental degradations in the 1970s. For Ehrlich, the reasons came from individual lifestyles. He claimed that population outburst, individuals consuming without awareness, etc. were the reasons which harmed the environment. According to him, the solution was in changing behaviour, thinking process, and creation of awareness about the environment amongst individuals. Whereas Commoner claimed that it was the technology which was causing the degradation and improvements in it would result in a better quality of environment. These arguments further developed into two views (see Table 1), one was based on the idea that individualistic changes are required for the betterment of the environment while the other was about collective approaches such as changes in technology, governmental policies, etc. which were required to uplift the environmental quality. These two views led to difference in terminology usage as sustainability or sustainable development. (Robinson, 2004)

*Table 1: Terminology difference*  
*Source: Robinson, 2004*

<b>Parameter</b>	<b>Technical fix</b>	<b>Value change</b>
Nature Protection	Conservation	Preservation (romantic approach)
Pollution and resources	Technology and collective approach	Lifestyle (individual approach)
Terminology preferred	Sustainable development	Sustainability

Sustainability and sustainable development are often used as interchanging words, but different authors have presented their views on both the words. Governments and the corporate world often tend to use the word sustainable development as it includes ‘development’. Contrary to this, academic writers and NGOs tend to use the word sustainability because development is often considered equal to growth and growth is usually connected to economic growth. In their opinion, sustainability should challenge such growth and therefore they do not prefer to use words like sustainable development. (Robinson, 2004) They prefer sustainability as it means surviving

within the thresholds of natural systems instead of crossing them (Robinson, 2004; Rockström et al, 2009).

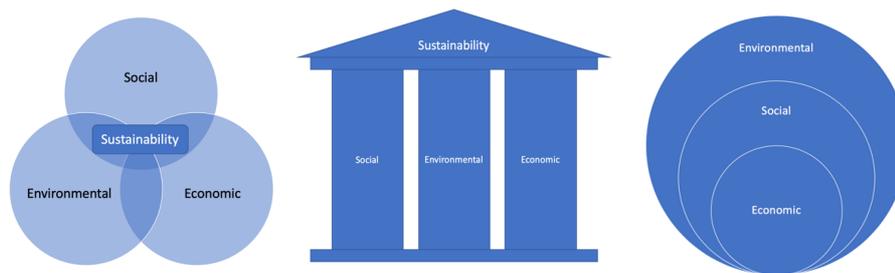
According to the Brundtland report, to be sustainable, the industrial production should increase by 5-10 times (Brundtland, 1987). But certain scholars see this and question the possibility to be sustainable if the output was to be increased by so many times (Robison, 2004). Similar to this oxymoron of Brundtland report, Redclift claims that development often includes the capitalistic approach which would work as a barrier for sustainability and its implementation. Such an approach must be questioned and requires political changes. (Purvis et al., 2018) According to Sneddon ‘sustainable development has reached a conceptual dead-end’ as the concept is used everywhere, and he doesn’t agree with combining these two words (Sneddon, 2000, p.524). Purvis and colleagues critique the vagueness asking, ‘Development of what?’ and ‘Development for whom?’ (Purvis et al., 2018, p.691).

Contrary to Purvis et al. (2018) and Sneddon (2000), Robinson (2004) argues that some vagueness can be allowed for a subject like sustainable development as it was developed from several other subjects. According to Robinson ‘Diplomats are familiar with the need to leave key terms undefined in negotiation processes and in much the same way the term sustainable development may profit from what might be called constructive ambiguity’. He argues that if one tries to have a specific definition of such a broad concept, it is possible that a certain dimension would be missed in that definition. He further continues ‘this may be the appropriate approach in the messy world of politics and policies of sustainable development’. (Robinson, 2004, p.374)

Above arguments show different views about sustainability and sustainable development to help the reader realize the broadness of the subject. Also, from the above explanation it is clear that differentiating the terminology can complicate the thesis. Hence for the simplicity of this thesis, sustainable development and sustainability would be used interchangeably.

### **2.1.3 Three dimensions of sustainability**

There has been a significant increase in the number of publications related to sustainability in the past few years, which has led to an emergence of a separate discipline called ‘sustainable science’ (Kates et al., 2001). Although considered as a ‘science’, it has various interpretations. One of the interpretations by many researchers and policymakers is about sustainability concerning three pillars or dimensions, that is, social, economic, and environmental. As shown in Figure 1 the three dimensions can be shown in form of a Venn diagram or as nested circles or as three pillars. (Purvis et al., 2018)



*Figure 1: Different takes on sustainability and its 3 dimensions*

*Source: Purvis et al., 2018 p.682*

One of the first descriptions of interacting dimensions (systems) through intersecting circles was given by Barbier in 1987 (Barbier, 1987). Even though this concept has been mentioned in several documents, there is no single document where it has been explained in detail. One of the reasons for that can be because sustainability itself has its origins from multiple disciplines. (Purvis et al., 2018) From an academic perspective, Brown et al.'s take on 3 dimensions can be considered, which is as following (Brown et al., 1987 quoted in Purvis et al., 2018 p.687):

**Social:** 'continued satisfaction of basic human needs'

**Ecological:** 'continued productivity and functioning of ecosystems' and 'protection of genetic resources and conservation of biological diversity'.

**Economic:** figuring out alternative solutions to 'the limitations that a sustainable society must place on economic growth'.

To further understand this concept, one may consider International Union for Conservation of Nature (IUCN) and UN documents in addition to academic literature. The IUCN conference (1986) had defined sustainable development as a solution to a set of requirements, namely, 'integration of conservation and development; satisfaction of basic human needs; achievement of equity and social justice; provision for social self-determination and cultural diversity; and maintenance of ecological integrity'. (Purvis et al., 2018, p.686) Even though this definition has social and environmental dimensions, it is lacking the economic aspect. In 1996 IUCN used a framework 'Barometer of Sustainability' which was targeted towards uplifting both ecosystems as well as human welfare (IUCN, 1996). According to Ilić-Kristić and colleagues, the meaning of welfare or 'wellbeing' is not clear. Economic wellbeing might be defined through consumption of products/service but how can one define social wellbeing? It is hard to define and measure this term. (Ilić-Kristić et al., 2018)

Agenda 21 (1992) mentioned 'economic, social and environmental dimensions' of sustainability but did not provide a clear explanation on these. A UN report from 1997 also mentioned three dimensions and emphasized on balancing these three as 'balanced achievement of sustained economic development, improved social equity and environmental sustainability' (UN report 1997, quoted in Purvis et al., 2018, p.686). But it did not address the conflicting interests which arise when efforts are

made to implement all three of them. (Purvis et al., 2018) In 2015, the UN claimed that Sustainable Development Goals (SDGs) have considered all 3 dimensions and they 'integrate' and 'balance' them (UN, 2015). 'However, these three dimensions do not explicitly form any part of the framework of the 17 goals' (Purvis et al., 2018, p.687).

There are different views about the interactions amongst the three dimensions. Academics like Barbier and Milne prefer an integrated approach amongst the three dimensions (Barbier, 1987; Milne, 1996). The authors who prefer an integrated approach, they either address balancing the goals or tradeoffs of the three dimensions. Tradeoffs is one challenge which is often recognized when implementing practices related to all three dimensions. On the contrary, Goodland and Dally prefer viewing and analyzing three dimensions separately (Goodland and Dally, 1996).

Even though the academics may have different views, a commonality amongst them is a critical view on economic development (Purvis et al., 2018). Brundtland report claims for a 'win-win' approach stating that economic development can be a solution for social and ecological issues, but it seems like a sugar coat which is hiding the emphasis of economic development getting a priority over social and ecological development. It is important to have a critical view and understand that Brundtland report has an anthropocentric approach. As Purvis and colleagues write, 'The inherently political nature of sustainability can often be forgotten, and we should be careful to avoid reproducing models without carefully considering their theoretical basis and embedded ideology within them' (Purvis et al., 2018, p.692).

A win-win scenario may be true for some situations, but it is not the case for many. Oftentimes situations include complex and dynamic interactions amongst the three dimensions, which may include sacrificing a certain aspect of one dimension to achieve another aspect in the other dimensions. It may also happen that one aspect in one particular dimension may contradict another in a different dimension. For example, a company creating high emissions can buy carbon credits by investing in tree plantations. For tree plantation, another company (usually forestry company) would be hired to plant trees. Oftentimes these forestry companies take over the agricultural lands from poor farmers to plant trees. This prevents these farmers from getting access to basic human rights (food, water, land, homes). (Raworth, 2012) In this example, a high emission company contributes in the ecological dimension while violating aspects of the social dimension.

Another example could be, if a company is outsourcing its production to a different country with liberal laws about pollution, is it really reducing pollution? Hornborg further elaborates on such issues by suggesting that one must not think in terms of national or corporate growth, instead one should think about global resource

management and environmental justice. He writes ‘we must learn to think of the world as a *system*, in which one country’s environmental problems may be the flip side of another country’s growth.’ (Hornborg, 2003, p.215)

Aforementioned are just two examples but there are several other challenges related to interactions amongst the three dimensions. It is important to recognize that conventional perspectives (e.g. a win-win scenario) promote synergetic relationships between the dimensions, but in reality, there can be as many trade-offs as synergies between the dimensions. These complex challenges are the ‘wicked problems’ of sustainability. Even some of the SDGs have a similar challenge, where they contradict one another, which is described in the following topic.

#### **2.1.4 SDGs and their challenges**

During the early 1990s, more than 170 countries agreed to work in partnership to improve quality of life as well as protect the environment. There was a plan prepared for this, called Agenda 21. In the late 2000s, during the Millennium Summit, the member countries further developed Millennium Development Goals with one of the main aims to eradicate extreme poverty by 2015. In 2012, during the Rio+20 conference it was decided that a set of goals called Sustainable Development Goals should be developed using MDGs as a base. (U.N., 2015a) There was a need for a cohesive approach which would take into account both, the welfare of the environment, life support systems of the planet as well as social well-being of humans (Steffen et al., 2015). In development of SDGs from MDGs, one can notice a shift in focus from the majority of goals emphasized on social and economic development with only one goal about environmental sustainability in MDGs to a better emphasis on the environmental dimension in SDGs (U.N., 2015a; U.N., 2000). In September 2015, development of SDGs came to completion and they were adopted by the General Assembly (U.N.) (U.N., 2015).

SDGs provide 17 main goals under which there are 169 specific targets. The aim of these underlying 169 targets is to ease the application process of transitioning towards sustainable development as they quantify different parameters under the main goals. (Ibid) Thus, SDGs provide an action plan ‘in areas of critical importance for humanity and the planet’ (U.N., 2015, p.1).

Different SDGs can be related to one of the three dimensions of sustainability, which means SDGs as whole is an evidence of the conventional perspective which promotes synergies between the three dimensions. On the other hand, it does not address the conflicts between three dimensions (or respective goals). This is further explained by Hickel (2019). Goals 6,12,13,14 and 15 are about social and ecological dimensions, and state to ‘take urgent action to combat climate change and its impacts’ (Goal13), ‘ensure sustainable consumption and production patterns’ (Goal12), ‘Protect restore,

and promote sustainable use of terrestrial ecosystems, sustainably manage forests, combat desertification, and halt and reverse land degradation and biodiversity loss' (Goal15) and so on. (Hickel, 2019, p.874)

On the contrary, SDG 8 is about increasing economic growth. As described in target 8.1 'Sustain per capita economic growth in accordance with national circumstances and in particular, at least 7 % gross domestic product growth per annum in the least developed countries'. Furthermore, target 8.2 states, 'Achieve higher levels of economic productivity through diversification, technological upgrading and innovation, including through a focus on high value added and labor-intensive sectors'. Indicator of target 8.2 is 'annual growth rate of real GDP per employed person'. If SDG 8 is quantified, considering global GDP per capita was increasing at an average rate of 1.85% per year from 2010 to 2015. Continuing such growth till 2030, will lead global GDP per capita to 'increase 32% by 2030'. Taking in account the population growth till 2030 and per capita growth of 1.85% per year then GDP needs to increase by 2.96% per year. If this is the rate, then 'economy would expand 55% by 2030'. (Ibid) There is no clear reasoning given in the SDGs about extensive encouragement for industrialized development (Esquivel, 2016).

SDG 8 can also act as an obstacle for achieving SDG 13. Because empirically, achieving such economic growth and simultaneously being within 2°C carbon budget is not feasible. Another problem with SDG 8 is that it pushes every nation to keep growing through GDP, but this may not be applicable for developed nations once the growth is enough for public welfare. Similarly, SDG 10 is about inequality and income gap. The targets set for SDG 10 are based on assumption of generating new income, but it does not take into account the already existing income and efforts to distribute this income in a balanced way to bridge the gap between poor and rich. (Hickel, 2019)

To solve these conflicting SDG problems Hickel provides several suggestions with one of them being that GDP should not be used as a growth measuring tool. (Ibid) On similar lines, Kate Raworth (2012) also suggests that financial growth should not be the only parameter to measure economic development. The reason why GDP is not the right indicator is because it does not take into account environmental dimension and social dimension. For economic sustainable development, it is important to consider how an economic activity is affecting the other two dimensions. Furthermore, 'Traditional economic growth policies have largely failed to deliver on both accounts: far too few benefits of economic growth have gone to people living in poverty, and far too much of GDP's rise has been at the cost of degrading natural resources' (Raworth, 2012, p.20).

### 2.1.5 Education for sustainable development

From aforementioned topics, it is clear that sustainability has ‘wicked problems’, whether it is the challenge of contradictions in the three dimensions or the challenges faced by the UN in trying to quantify certain parameters for sustainable development. These ‘wicked problems’ make the subject complex and paradoxical.

From a corporate perspective, there are other challenges related to implementation of sustainable practices. For instance, different leaders in the company have different perceptions about sustainability instead of a cohesive understanding. Companies seeing three dimensions of sustainability as independent and competing against each other, instead of understanding their interdependencies. (Crews, 2010) A few other challenges highlighted by Epstein and Buhovac are as follows (Epstein and Buhovac, 2010):

**‘setting clear and measurable goals’**: It might be easy to quantify some of the corporate concepts where clear goals exist. For example, innovation might be about launching new products, increase in profitability might be about operational changes, etc. When it comes to sustainability, it can be difficult to set goals and measure the progress. For instance, environmental impact might not be visible initially or measuring environmental changes can be difficult. Even social changes can occur over a longer period of time making them difficult to measure. (Epstein and Buhovac, 2010) Thus, quantifying sustainability is a hard task, proper selection of key performance indicators (KPIs) is required in order to measure sustainability progress (Hristov and Chirico, 2019).

**‘financial incentive pressure’**: Implementing sustainable practices can either provide short-term gains such as, financial gains from lower waste generation, less energy consumption, etc. or be expensive at first but turn out to be a fruitful long-term investment. Managers often face a dilemma whether to implement such changes or not because they are pressured to focus on increasing ‘short term earnings’. (Epstein and Buhovac, 2010)

**‘stakeholder reactions’**: It is hard to predict how different stakeholders would react to implementing sustainable practices and the change it may bring to the performance of the company. (Ibid) For example, sometimes there can be resistance to change from employees as they might be tired of seeing a company bringing changes on a periodic basis without implementing the previous one completely, leading to confusion and overlap of several changes (Crews, 2010). Another scenario can be that the top management may change priorities in implementing different sustainable practices depending on the finances (Epstein and Buhovac, 2010).

One of the ways to understand and deal with these challenges is through education, but is conventional learning enough when one is dealing with such challenges? What skills are required which will enable one to find solutions to the ‘wicked problems’? The following section can provide answers to these questions.

Education can play a vital role in transforming society to a sustainable one. UNESCO aims at educating people from all walks of life about sustainable development. Helping them develop skills, knowledge, values, and behaviour for sustainable development. To achieve this goal UNESCO has come up with Education for Sustainable Development (ESD). (UNESCO, 2019a)

‘ESD empowers learners to take informed decisions and responsible actions for environmental integrity, economic viability and a just society, for present and future generations, while respecting cultural diversity.’ ESD takes into account different parameters related to education for example, syllabus, teaching and learning environments, social change, etc. (UNESCO, 2019b) These three are briefly described below:

**Syllabus:** Having sustainability related topics like ‘climate change, biodiversity, disaster risk reduction and sustainable consumption’ in the curriculum. (Ibid)

**Teaching and learning conditions:** The teaching should be in such a way that learners are at the center point. They must be encouraged to explore more about the subject and not only consume knowledge but also apply it. Learning conditions/environment focuses on learning through different environments such as virtual or online. (Ibid)

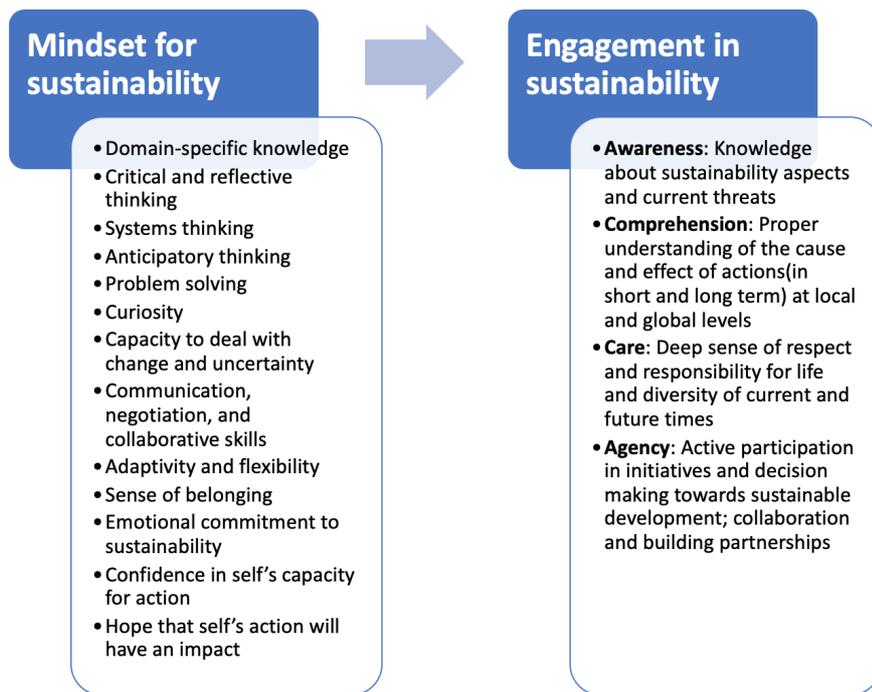
**Social change:** Age and educational setting should not be a limitation/restriction for anyone to seek education and transform his/herself as well as their respective society. Learners should be taught the skills required for ‘green jobs’. Also, motivation should be provided to learners and their societies to change their lifestyles into a sustainable one. (Ibid)

Some of the social goals for ESD is to encourage learners to pursue education irrespective of their age and the educational environment around them. In the long run through education they will be able to transform the society and economy into a sustainable one. Such education can also lead to behavioral changes which will be beneficial for sustainability. (Ibid)

To ensure that ESD is put to practice, UNESCO has programs like Global Action Programme (GAP). It focuses on five parameters (UNESCO, 2019c):

- 1) To help countries in activities which are related to sustainable challenges such as climate change, biodiversity, etc. Providing advice and suggestions on how to include ESD into teaching curriculum, training, educational laws and policies. It also suggests that education should be developed in such a way that it promotes critical thinking and collaboration.
- 2) Teacher training is another aspect which is encouraged by UNESCO. There are also online courses available for teachers to get trained on topics like climate change. Once they are trained, they can encourage the schools to implement ESD. One of the examples for such a training is that UNESCO has made some online courses on climate change for teachers in secondary schools.
- 3) Organizing meetings and events to promote ESD related discussions. ESD is also a part of SDGs. It comes under the 4<sup>th</sup> SDG. It is also used as one of the indicators of target 4.7.1.
- 4) Organizing meetings in order to continue ESD with reference to 2030 Agenda for Sustainable development as the first phase of GAP ended in 2019. Target of these meetings is to go beyond GAP and discuss and debate about the future of ESD.
- 5) 'UN Decade for ESD' ended in 2014. In 2015 'UNESCO world conference on ESD' was held in Japan where 'Aichi-Nagoya Declaration on ESD' was launched along with a plan laid out to implement GAP. (Japan has supported UNESCO and ESD via Japanese Funds-in-Trust.)

Fabricatore and Lopez (2011) suggest that one of the key ingredients about education for sustainability is to not only understand the three dimensions (environmental, social and economic) of sustainability but also their inter relationship with one another. Expertise in a certain field is important but it is also important to nurture skills, values, and behaviour for sustainability which is through 'hands, hearts and heads' (Sipos, Battisti and Grimm quoted in Fabricatore and Lopez, 2011, p.3). According to Tillbury (2004), Tillbury and Wortman (2004), and UNESCO (2005), for behavioral changes, a certain type of mindset and characteristics are required to go forward with sustainability. Figure 2 below illustrates this further. Education for sustainability requires certain capabilities/skills such as problem solving, simplifying and understanding complex situations, systems thinking, etc. (Fabricatore and Lopez, 2011).



*Figure 2: Mindset to move forward with sustainability*  
*Source: Fabricatore and Lopez, 2011 p.3*

## 2.2 Game based learning

When it comes to developing/learning aforementioned skills such as problem solving, analyzing complex situations, systems thinking for sustainability education, games can be a considerable option (Fabricatore and Lopez, 2011; Boghian et al., 2019; Dahlin et al., 2015). Game based learning (GBL) is a pedagogical technique which uses games (can be different types such as video games, board games, card games etc.) to ensure effective retention of the concept (Madani et al., 2017; Azizan et al., 2018).

According to Van Eck (2006), in conventional teaching there is a difference in the contexts, meaning the concept taught may belong to a particular context/environment but teaching/learning happens in a different environment/context like a classroom. On the contrary, a game can provide the same/relatable context as of the concept. This gives learners a chance to apply the concept in the same context. Studies have shown that this method of learning is more effective than conventional teaching methods. (Van Eck, 2006) GBL can help in skill development for example in developing critical thinking skills (Azizan et al., 2018). Some of the elements which drive GBL are gradual increase in difficulty, rules, goals, feedback, interaction, etc. (Madani et al., 2017).

Several authors state that games are ‘natural tools’ which can improve learning through engagement. (Wu and Lee, 2015; Hwang and Wu, 2012; Corti, 2006) Games provide learning through ‘designed experience’ as opposed to conventional teaching where information is absorbed by listening or reading. ‘Designed experience’ means a player is learning by doing something or through applying the concepts. (Squire, 2006) GBL is powerful because learning through experience means students are connecting with the subject at an emotional level (Mendler et al., 2012; Boghian et al., 2019). Through experience, understanding can be enhanced. For instance, role play can provide different perspectives as well as empathy for a particular situation like climate change (Shaffer, 2006; Boghian et al., 2019).

According to Treher (2011), just experience by itself is not sufficient for deeper learning. As she provides an example that even though people and children have used money to buy products, that doesn’t mean they have knowledge about financial management, saving money, investing, etc. Most parents would not prefer to give their children a hands-on approach in teaching about concepts like cashless purchasing using credit cards. (Treher, 2011) Another example where hands on approach failed, was the bulb, battery and wire experiment with MIT and Harvard graduates. When graduates were provided above mentioned objects, they were not able to light the bulb. This was because in high schools their hands-on approach included a socket which made connecting the apparatus easy. But without the socket, graduates failed at this experiment, thus making it clear that they had not understood the basics through hands on approach. (Harvard-Smithsonian Center, 1997) For optimal learning, understanding the concept in combination with experience is crucial, that is ‘hands-on and heads-on learning works best’ (Treher, 2011, p.3).

Learning through games, provides an opportunity to see the consequences of certain decisions in a shorter time scale (Wu and Lee, 2015). GBL also helps in improving cognitive abilities (Hwang and Wu, 2012). According to Prensky, GBL promotes active learning as a learner experiences enjoyment simultaneously achieving a goal of learning something in an authentic context (Hung, 2018). Oftentimes, GBL is also associated as a form of edutainment (educational entertainment or education through entertainment) for learning and teaching (Katsaliaki and Mustafee, 2014; Susi et al., 2007). Considering the digital games used for learning, Prensky (2001) calls it DGBL. He says that there is tremendous potential for learning as: Firstly, new generations’ way of thinking has changed, and digital media has become their language. Secondly, they have been exposed to the radical changes in digital technology which includes developments in games played on computers and other platforms. As he describes ‘this new form of entertainment has shaped their preferences and abilities and offers enormous potential for learning both as children and as adults’ (Prensky, 2001, p.6).

### 2.2.1 Serious games

Michael and Chen explain that serious games are defined in several ways but a common concept in these definitions is that they are not exclusively made for entertainment, instead their purpose is education/training (Madani et al., 2017; Wu and Lee, 2015). This does not mean that serious games cannot have an element of entertainment (Madani et al., 2017). Boghian et al (2019) call them ‘didactic’ games and describes them as ‘explicitly designed for a learning purpose’. They are developed to teach a specific subject or a concept or to improve a particular skill. There is an argument in the literature about serious games. Some of the authors state that serious games must be designed around a target topic which needs to be taught (Girard et al., 2013). Whereas others state that if a game made for entertainment is used in an educational way then that also can be considered as a serious game (Susi et al., 2007; Mostowfi et al., 2016).

Various researchers have provided different reasons for serious games to be suitable for learning. According to Corti (2006), games can provide learners with situations which might be hard to imitate in reality due to lack of time, resources or safety issues. Through games, teaching and learning can become easy as they provide high engagement and can help players develop skills like strategic thinking, spatial abilities, psychomotor abilities, etc. (Mitchell and Savill-Smith, 2004). Some other skills which games can improve are identifying problems and solving them, self-reflection, memory (retention), socializing (e.g. collaborating, team building), etc. (Mitchell and Savill-Smith, 2004; Boghian et al., 2019; Azizan et al., 2017; Treher, 2011; Noda et al., 2019). According to Bellotti et al. (2013), one of the assessment criteria for a serious game is the element of fun. So, a well-designed serious game not only provides learning, but it is also fun to play. Thus, making them better than games made exclusively for education.

From the above description it is clear that serious games do contribute to improving wide varieties of skills. Therefore, they are used as a training tool by different fields like army, language learning, security, business management, sustainable development, healthcare, engineering, etc. (Madani et al., 2017; Boghian et al., 2019; Dahlin et al., 2015).

However, there are some limitations about serious games which should be addressed. The downside of these games is that every teacher may not have required skills to develop such games and getting it done from a professional might be expensive (Whitton, 2012). Another limitation is that a certain amount of time is required for the teacher to master the game (Madani et al., 2017). Arranging for classes to play the game can be difficult as it may not be readily accepted by school authorities. Some teachers find convincing school authorities hard (time and energy consuming) so they avoid using serious games in their classrooms. (Kirriemuir and McFarlane, 2004)

Oftentimes, off the counter serious games may not be in line with specific topics needed to be taught (Hoy, 2018). Also, if the game is not well designed then there is a risk that the player may not see improvements in learning/skill (Madani et al., 2017).

One of the mediums of serious games is a board game (Madani et al., 2017; Uribe and Cobos, 2014). There are several factors which can improve learning. Some of them are already in-built for a board game. For example, in a conventional teaching scenario pausing for (2 mins after 12 to 18 mins) while teaching can help learners retain and comprehend the target concept better. Pausing is generally an intrinsic feature for board games because players might have to stop playing and discuss a strategy or certain solution. Some other intrinsic features in a well-designed board game are (Treher, 2011):

**Linear approach to learning:** This approach is about beginning with basics of a particular subject or topic and building on it. This also happens with board games when a game starts with a fixed condition along with the board and other elements like cards etc. which provides a basic structure.

**Regular follow through if learners are understanding what is being delivered:** While playing a game, a regular check on the learning process is included because if the game is not properly understood, then it will lead to wrong decisions which would be shown as an outcome during the play.

**Using examples:** A good game design would try to explain the concept by providing examples or the game itself may be an example of a subtopic or circumstance of a particular broader subject.

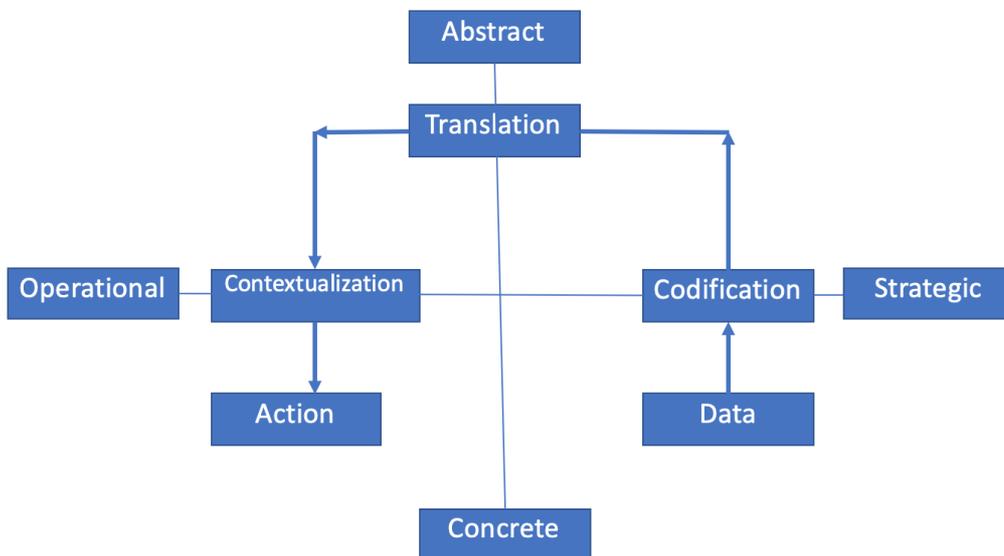
**Highlighting the important concepts:** Usually, the game is designed in a way keeping in mind certain key objectives or concepts and the gaming experience emphasizes on these key concepts.

**Repetition/Revision:** Games do provide a chance of repetition for example a second chance to answer the question correctly. Games also provide better insights/understanding when played more than once. Oftentimes, there are also debriefing sessions after the game which further enhances the clarity of key concepts (Hoy, 2018; Dahlin et al., 2015).

Board games provide ‘engaging’, ‘non-threatening’, ‘playful yet competitive’ environments in which application of the knowledge can be learnt without fear of making mistakes (Treher, 2011). They also provide the ability to look at a problem from different perspectives which deepens the understanding about a particular situation enabling one to think about different solutions. It can also enhance ‘organizational competences’ for e.g. resource management, crisis management,

completing and prioritizing tasks, risk management etc. Some other skills it provides are conflict resolution, collaboration while working, consulting, self-motivation, etc. (Boghian et al., 2019). Sometimes games also provide answers to problems occurring in reality (McGonigal, 2011).

From an organizational point of view, knowledge transfer is an important skill. There are several models which can be used for efficient knowledge transfer. One of the models of knowledge transfer is described by Major and Cordey-Hayes. It involves getting the information, understanding this information thoroughly, identifying the value of this information (whether it's useful, long term and short-term goals, etc.), communicating this information and applying this information. Authors warn that if this process is not carried out properly, then there are chances that a 'knowledge-gap' might be created if conversion of 'abstract' information to 'concrete' information is not done carefully. Figure 3 below describes the model. (Major and Cordey-Hayes, 2000)



*Figure 3: Model for Knowledge transfer  
Source: Major and Cordey-Hayes, 2000 p.420*

Uribe and Cobos (2014) claim that board games can be an 'all in one' solution to practice the above knowledge transfer model as it includes 'codification, translation and contextualization of a particular topic and transform into action'. Usually players start with certain rules and a particular situation where everything may not be clear in the beginning, but gradually by learning/analyzing the situation (and rules) simultaneously taking some action leads to increase in clarity. Further they claim that in board games oftentimes there is strategic thinking (for e.g. some kind of pattern) required to decode information. This can also encourage players to strategically think in their lives which may lead to creation of some daily good habits.

### **2.2.2 Limitations of board games as a learning tool**

Different researchers employ different methods to study the effectiveness of the games. Madani et al. (2017) further elaborates this point by stating that there is no standard way of measuring effectiveness, thus making it hard to make certain conclusions from a scientific point of view. They also point out Prensky's opinion that pre and post test scores may not be sufficient to know if 'true learning' has happened or not. Deeper understanding of the concept cannot be concluded from test scores. Authors also suggest that there should be a common database which should include information on all serious games. This database should also provide information like which subject is the game designed for, the age group, feedback on various games, etc.

On the contrary, Madani and colleagues have not considered community generated databases on games which are available online. For example, research work carried out by Greenhalgh et al. (2019) used data from community generated databases on board games called Board Game Geek (BGG) for their research. This database classifies games on different parameters like themes, mechanics of the game, genre, etc. which could provide teachers a starting point in their search for the right game. One downside of this database is that it is created by hobby gamers so the feedback they provide may not be valid considering the fact that common student's opinion might vary compared to a hobby gamer's opinion. Additionally, it is highly possible that certain board games mentioned on this database may not have been used in schools and certain ones which are highly used in schools may not be mentioned in this database. (Greenhalgh et al., 2019) Thus, this argument reinforces Madani and colleagues' opinion that there should be a common, standardized database where information about all educational games can be accessed from a single website (Madani et al., 2017).

Other challenges that come with board games are that keeping the record of progress or points earned is usually done by the players; unlike video games, where the computer/console keeps track of the progress. Also, following the rules is something internally monitored by the group of players playing the game or sometimes assisted by a supervising teacher. These features might help enhance students' understanding but they are time consuming as usually there is a briefing session before the start of the game where the teacher might have to explain the rules and gameplay in detail. (Hoy, 2018)

Furthermore, with board games it is hard to 'save' the game in case it was to be played some other time. Sometimes due to this, students and teachers are forced to wrap up the game towards the end of the class, irrespective of game completion. This also affects the selection of games from the teacher's perspective as they might select only the games which can be played within a duration of a single class. (Ibid)

### 3 Theoretical frameworks

This section describes two theoretical frameworks followed by respective rationale for selecting each of them for this thesis. The first framework (Evensen et al.'s game design model) is used for designing the game. The second framework is Broman and Robèrt's Framework for Strategic Sustainable Development (FSSD) which is utilized in two ways. Firstly, the board game is developed around the operational procedure given by FSSD. Secondly, it is also used as a theoretical lens for thematic analysis.

#### 3.1 Research model for board game design

Researchers Evensen and colleagues have proposed a research model to develop a board game, which was developed and used for one of their projects. It was a joint project between researchers and Central Ohio Diabetes Association (CODA). During this project, researchers and CODA came to a conclusion that a board game can be used as an educational medium to teach diabetes management to new diabetic children and their families. Learning process becomes easier as a board game involves experiential learning, simplification of complex concepts as well as active communication. Other aspects of a board game include short term feedback, well-defined objectives as well as emotional engagement which make the target concept easy to understand. (Evensen et al., 2009) Figure 4 shows the design model developed by Evensen et al. which was used in their project.

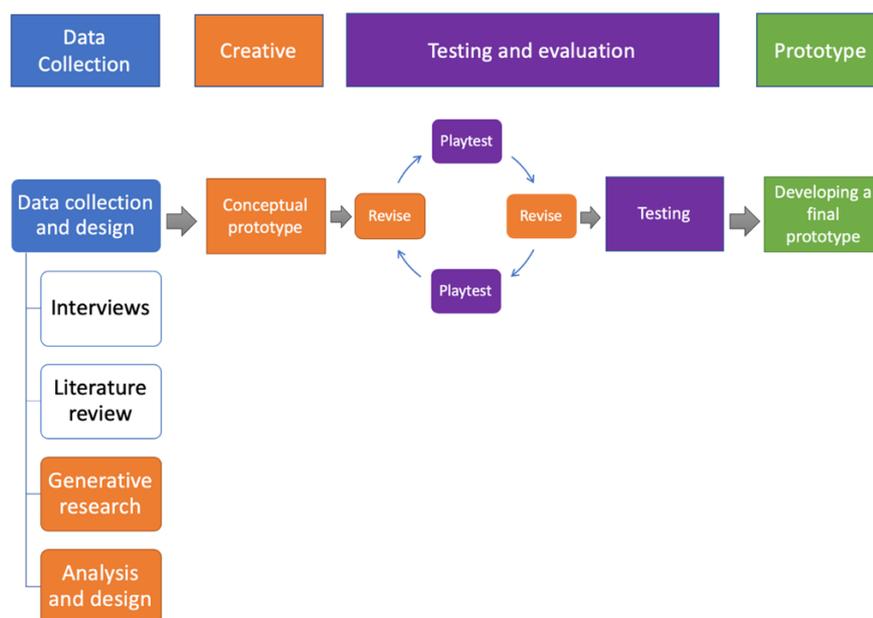


Figure 4: 'The game design research model for board game'  
Source: Evensen et al., 2009 p.2

This model is divided into four steps: 'Data gathering, Creative, Testing and Evaluation, and Prototype' (Evensen et al., 2009, p.2). Researchers suggest that even though it is described in a linear fashion, in reality all four steps are connected to one another and the designer would go back and forth amongst these steps during the design process (iterative design). (Evensen et al., 2009)

The Data gathering step consists of Interviews, Literature review, Generative Research, Analysis and Design. The researchers conducted interviews and meetings with CODA members who were experts in the field of diabetes. These interviews helped the researchers gain knowledge about the field as well as understand the needs and challenges which should be kept in mind while designing the board game. The research team also studied literature on diabetes and its management, complications related to diabetes, health management and other literature which was suggested by the sponsors. (Ibid)

Generative Research consists of two sub steps. One is Generative Data Gathering and the second is Generative Workshop. In Generative Data Gathering, researchers conducted meetings with sponsors where sponsors were asked to come up with stories which would describe how they wanted the product to be in the end (vision for the product). (Ibid) These stories included different ideas about the game, but a commonality observed was using the aspects of 'balance' and 'fun' (Evensen et al., 2009, p.3). The Generative Workshop involved the research team as well as experts from CODA as participants. Three teams were formed which had members from both the research team as well as CODA. These teams were given various tools such as colorful papers in different shapes, some words which would describe the game concept, toys, and pieces with Velcro to assemble. These tools were used to come up with concrete game concepts, keeping in mind balance and fun aspects. Once the concepts were ready, discussions were held around these concepts and researchers documented this process and kept game concept models for further analysis. In the Analysis and Design step, the research team analyzed the data (and games models) collected from the workshop and created two complete game concepts. To further narrow it down, they decided to create a conceptual prototype by combining various aspects from these two complete concepts. (Evensen et al., 2009)

In the Creative step a conceptual prototype was developed by combining various aspects from the two complete concepts. This was a working prototype which was deliberately kept 'rough' and visually simple to gain appropriate feedback during playtesting. Before testing this prototype on target audience, it was pre-tested on graduate students from different fields like engineering, graphic design, etc. From this pre-test, slight modifications were done and then it was tested on the target audience (children who were seven to twelve years old) accompanied by their parents. (Ibid)

In the Testing and Evaluation step, the conceptual prototype was further tested and modified into a final prototype. Several tests and modifications were made on the conceptual prototype before finalizing it. For example, in this study, post testing the rough conceptual prototype with children, it was modified physically, after which researchers focused on improving other aspects such as mode of instructions. The instructions were mostly oral in previous tests which were now converted into a written format, and the new prototype with written instructions was re-tested. Similarly, the process involves several tests and modifications before a final prototype is ready to be released as a product. (Ibid)

Before selecting Evensen et al.'s game design model for this thesis, several other frameworks were studied. For example, the triadic game design model. The triadic framework uses theories from three disciplines, that is pedagogy, play, and fidelity. Pedagogy consists of theories of learning such as problem-based learning, situated learning, and experiential learning. Theories related to play are used to make an educational game engaging/interesting. These theories include design strategies which improve the play using concepts like motivation, engagement, narrative, and state of flow. The concept of fidelity is about how closely the game is resembling similarities to the real world. If it's a digital game then it can include sound, graphics, etc. Fidelity also includes the response aspect, that is if a player does something then is s/he getting a real life like response. (Rooney, 2012)

Apart from triadic framework, other studies on game design discuss several aspects of game design such as clear goals, mechanism, using a narrative, social elements, etc. (Shi and Shih, 2015; Larsen, 2018; Fors, 2019; Akmal and Coulton, 2019). Some of them also use iterative design processes through multiple tests. (Zimmerman, 2003; Akmal and Coulton, 2019; Evensen et al., 2009)

As mentioned above, these frameworks discuss various aspects which can be utilized for game design, but only few of them consider using inputs from users and the field experts of the subject around which the game is supposed to be designed. The advantage of Evensen et al.'s game design model is that it utilizes inputs from the experts in the field to develop the board game. The design process of this framework is an iterative one, where the user feedback is considered during various playtests and the board game is modified accordingly. The practical objective of the thesis was to deliver a board game which can be played by the companies, leveraging this framework, enabled them to be a part of game development. So, the employees at sustainability related positions within various companies were interviewed. Several aspects were to be investigated such as how they perceive sustainable development, what is needed to drive the company towards sustainability, what are the challenges and so on. Apart from sustainable development, these interviewees also helped in understanding how companies perceived game-based learning and board games.

Even though utilizing this framework is advantageous for this thesis, there is one aspect which is not included in this framework. It has a lot of practical considerations such as interviews, workshops, playtesting, improvements based on user feedback, etc. for game development, but from a theoretical perspective ‘literature review’ is the only consideration. Along with literature, if a framework from the subject which the game aims to teach is utilized as an input, then there could be probable benefits. For instance, from a serious game’s perspective, the game can be a learning tool for the utilized framework. It can make some of the concepts related to the subject easy to understand. This thesis will be leveraging this idea by using FSSD as an input in the game development and benefits of doing so will be discussed later in the thesis.

### **3.2 Framework for strategic sustainable development**

Transforming into a sustainable society is a complex challenge and to solve such a challenge, various members (for e.g. companies, universities, governments, NGOs etc.) of society need to collaborate. And to collaborate there is a need for a ‘unifying and operational definition of sustainability and systematic approach to planning and acting’ (Broman and Robèrt, 2017, p.17). Work on this need was started in the 1990s in Sweden (Broman and Robèrt, 2017). After the development of an operational definition and a systematic approach to enact towards sustainability, Robèrt and colleagues kept modifying and refining their work (Broman et al., 2000; Robèrt et al., 2002; Broman and Robèrt, 2017). What resulted after these refinements was known as Framework for Strategic Sustainable Development (FSSD) (Broman and Robèrt, 2017).

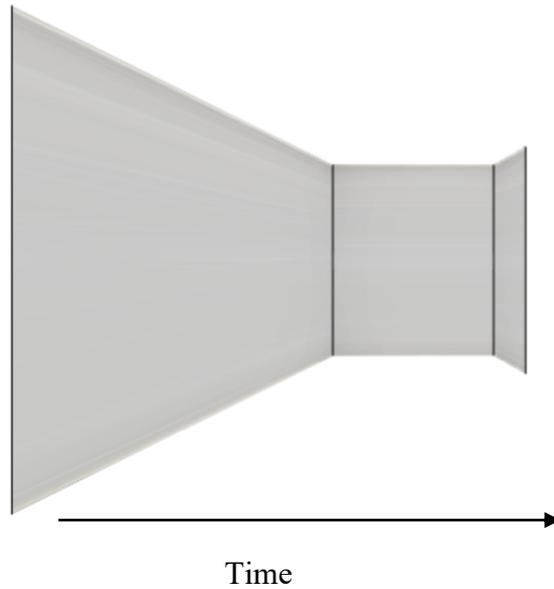
FSSD consists of four concepts (Broman and Robèrt, 2017; Robèrt et al., 2019):

- 1) The funnel analogy
- 2) 5-level model
- 3) Sustainability principles
- 4) Operational procedure to move towards sustainable development

These concepts are separated for better understanding for the reader. But in reality, they are not linear, they are connected to one another. Below description covers each concept in detail except for the 5-level model which can be found in the Appendix A.

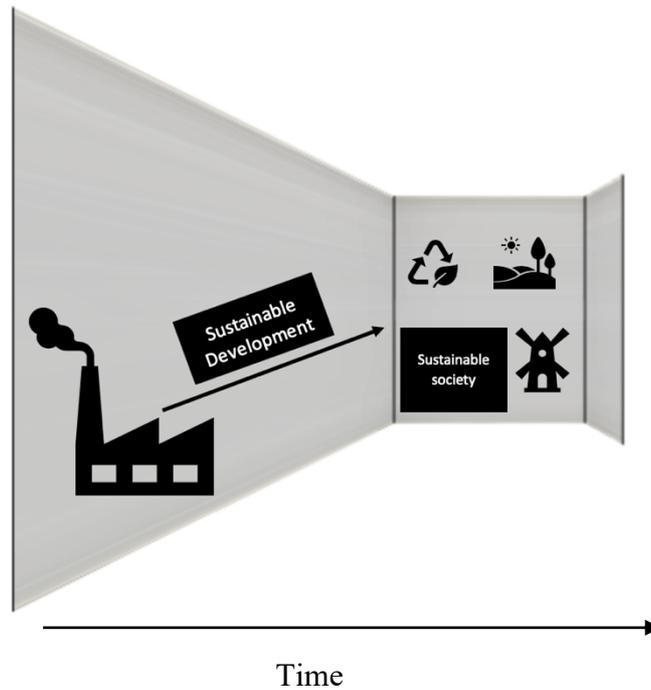
#### **3.2.1 The funnel analogy**

Consider a horizontal funnel (see Figure 5). The reduction in radius of the funnel is symbolic of Earth’s decreasing capacity to support human survival if unsustainable practices continue. This also implies that it will affect the quality of life because natural resources are decreasing. It also denotes that the ability to fix these issues will decrease because more the damage caused, lesser are the options/solutions. (Robert et al., 2019)



*Figure 5: Decrease in radius, implies decreasing capacity of Earth's support systems and reduced options for changing the situation*  
*Source: Robert et al., 2019 p.13*

Considering this analogy authors define sustainable development as ‘a strategic mission to eliminate society’s unsustainable, systemic errors and create a sustainable society, thereby stabilizing resources available to support civilization’ (Robèrt et al., 2019, p.14). After this definition, authors clarify that their aim is not to create an illusion of an ideal society after implementing sustainable practices but through these practices, they want to target the other end of the funnel where resource availability and development prospects are not reducing. This is represented by the cylinder on the right of the funnel showing the stable state of a sustainable society (see Figure 6). (Robèrt et al., 2019) A slight increase in cross section towards the end of cylinder represents the future of a sustainable society, that is increase in prosperity (improvements in capacity of Earth’s support systems) and possibilities for further development after repairing the damage caused in the past (Ibid, Broman and Robèrt, 2017).



*Figure 6: Reaching the other end of the funnel through sustainable practices*  
*Source: Robert et al., 2019 p.14*

Authors further elaborate that restrictions will occur no matter what, but if a society adopts sustainable development, then the situation will be under control. If humans keep continuing current practices then restrictions might be sudden, unpredictable as well as hard to solve. Certain examples of ‘hitting the funnel wall’ are sudden changes in law and tax implementation, in cost of certain resources, in choices of products/services. (Robèrt et al., 2019)

Corporates can be encouraged to implement sustainable practices, by showing them the benefits it can bring which were highlighted in Willard’s work (2012). First, the revenue increases as expenditure on energy decreases. Second, waste management becomes easier as the generation of waste reduces or if the input material usage is reduced. Third, employee efficiency increases, and fourth, risk management becomes easier.

Authors also claim that there are certain companies who are aware of the ‘hitting the funnel wall’ issue and have implemented sustainable practices at different levels. And as a result, these companies have gained new market opportunities. (Ibid)

### **3.2.2 Sustainability Principles**

Even though Robèrt et al. have defined sustainable development with respect to funnel analogy, they suggest that sustainability principles provide an ‘operational definition’ (Robèrt et al., 2019; Broman and Robèrt, 2017). In order to come up with sustainability principles they had to find a balance in terms of how specific it should

be. They did not want it to be too detailed as users can have a tendency to be lost in the details. On the contrary, they did not want it to be too philosophical and broad either. They wanted it to be ‘independent of scale and context’ so that it could be useful to any institution of society. (Broman and Robèrt, 2017) Other criteria which were considered for framing the principles are (Ibid):

**Necessary:** To ensure that these principles provide necessary information but not too much so that it doesn’t create controversies and perplexity.

**Sufficient:** The information should be enough so that it can be used as a starting point and further expansions can be possible.

**General:** So that scale and context doesn’t come into picture. Which means these principles can be used by people with different expertise and also collaborations across different fields can be carried out.

**Concrete:** So that challenges can be tackled through a methodical approach.

**Non overlapping:** All principles are independent of each other (mutually exclusive) which allows better understanding as well as making it easy to set up indicators for monitoring purposes.

Sustainability principles were created combining two aspects. One was the ecological aspect and the other was the social aspect. For both of these aspects Broman and Robèrt used their previous studies as well as works from other social and the ecological scientists to extract the important parameters, based on which these principles were created. (Broman and Robèrt, 2017) At the core these principles are the basic mechanisms which have been used by society to damage various social and ecological aspects. Through these principles, authors want to prevent the further usage of these mechanisms and therefore they are written with a ‘not’ in the beginning. (Robèrt et al., 2019)

### **Ecological**

Following should **not** increase (Broman and Robèrt, 2017; Robèrt et al., 2019):

- 1) ‘Concentration of substances’ which are brought from the lithosphere in the biosphere. There should be a limit on mining and other activities which lead to increase of concentration. For example, increase in concentration of CO<sub>2</sub> in the atmosphere or increase in concentration of certain metals like cadmium through the food chain starting from farming soil.
- 2) ‘Concentration of substances’ which are man-made molecular compounds in the biosphere. There should be a limit to which these compounds are produced. For example, damaging the ozone layer through increased concentration of chlorofluorocarbons in the atmosphere.
- 3) Human activities that harm biological systems. For example, deforestation for agriculture, degradation of soil by inappropriate farming practices, etc. Proper management should be in place to prevent overdoing of such activities.

## **Social**

Following should **not** be done to people (Ibid):

- 4) Being exposed to conditions which might be harmful (mentally or physically) for him/her. For example, working in conditions which might not be safe for a person.
- 5) Being stopped when trying to improve the society s/he is a part of. For example, ignoring his/her opinions or not giving them freedom of speech.
- 6) Being stopped from improving his/herself in terms of competences, skills etc. For example, not allowing someone to educate themselves or stopping the other person who might be helping the one who wants to self-develop.
- 7) Unfair treatment based on different grounds. For example, discrimination based on race in offering job position.
- 8) Being stopped from interpreting a situation in a certain way. This also includes individuals or groups of individuals being stopped to express their culture. For example, not being allowed to celebrate a cultural festival.

Researchers emphasize on complexities of using sustainability principles. The actions taken to comply with certain sustainability principles should not violate other sustainability principles. For example, using biofuels can reduce emissions which is complying with the first sustainability principle. But to obtain biofuels if an organization is going for extensive deforestation in an unmanaged way then the third sustainability principle is violated. So, it is important to consider all sustainability principles while analyzing a particular action. (Robèrt et al., 2019)

### **3.2.3 Operational procedure**

Before understanding the operational procedure, it is important to understand the concept of backcasting. Usually organizations use the process of forecasting to plan about the future. Forecasting involves looking at the current scenario and trends to predict the situation in future. When planning for sustainable development forecasting can have a drawback as it assumes that current trends/processes will still remain the same and there might be minor changes. So, what might happen is that if an organization has some processes which are not sustainable then these processes will continue even in future which might lead to social or ecological damage in the long run. (Robèrt et al., 2019) So, a solution to this problem is to use backcasting.

In backcasting one starts by thinking about the vision. What does an organization want to achieve in future? After having a target vision, members assess the present reality of the organization and try to find the gap between present reality and the future vision. After figuring out this gap, a planning process can be initiated, which will guide them towards the vision. The advantage of backcasting is that since it starts by considering the future, the actions to reach that vision will not be limited by current processes/ways of carrying out processes. As there might be several ways to reach

this vision so it opens up multiple routes. So, things like technological changes, new innovations etc. can also be considered. (Ibid)

This does not mean that backcasting is the only way. Researchers do suggest that forecasting can be still used keeping backcasting as a broader approach. For example, after figuring out the gap when prioritizing different actions to take, forecasting can be a good option to predict the impact of a particular action and then think about which actions can be carried out first and which ones later. Utilizing backcasting for sustainable development has its own challenges. For example, it can be hard to have a common vision about sustainable development for an organization because different members may have different values due to cultural and other influences. Certain decisions may turn out to be irrelevant later on due to changes in technology. Reusing certain project items (e.g. processes, products etc.) in other projects can be difficult as backcasting is subjective for a particular scenario and vision.

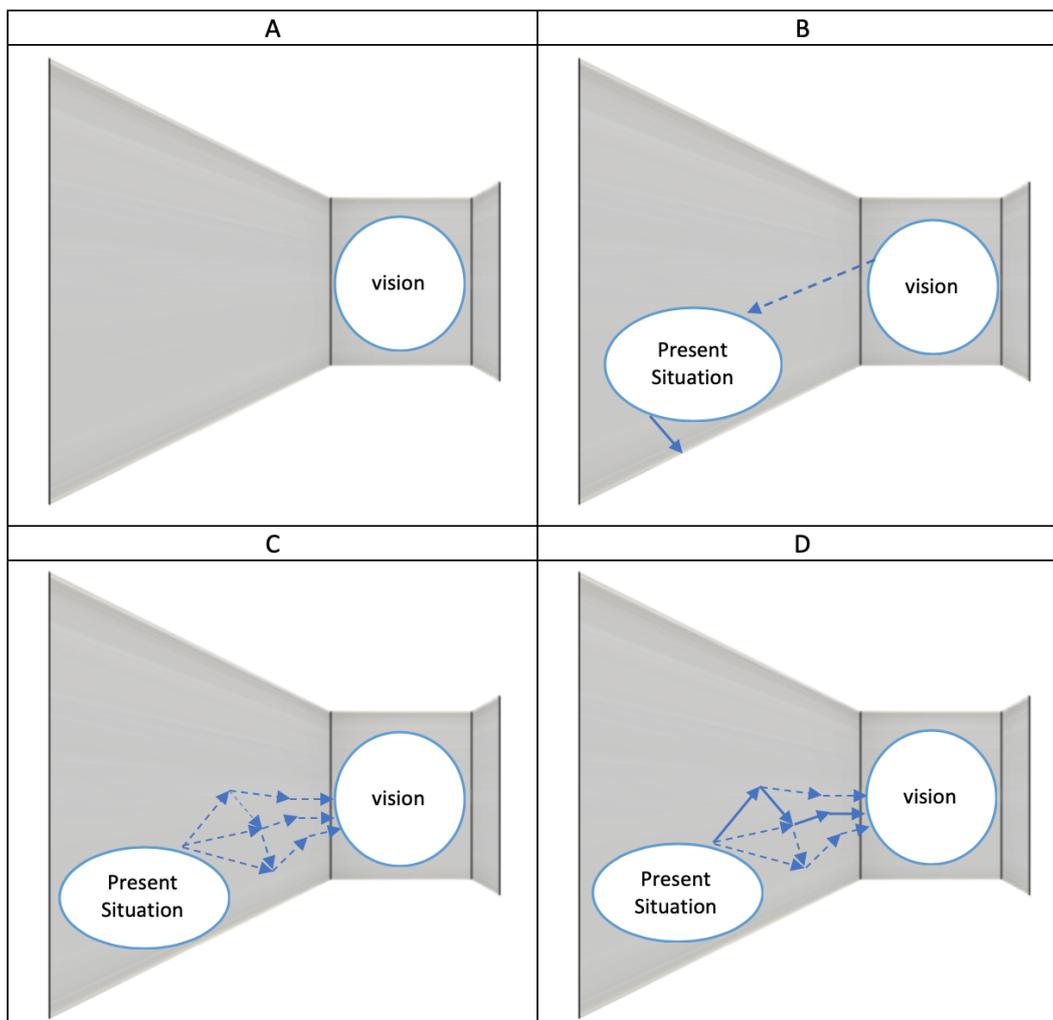
Backcasting is the underlying principle of the operational procedure. The procedure is called ABCD procedure and it comprises of four steps named alphabetically:

**Step-A:** This is the step where an organization decides what they want to achieve in future. How can it be a part of a sustainable society? What is the final vision? For example, to align their future development with sustainability principles, to align the current core values for sustainable development, etc. While thinking about future development with respect to sustainability principles, an organization should not consider the limitations in present reality. (Broman and Robèrt, 2017)

**Step-B:** In this step the organization looks at its current reality. It tries to look at various processes from the set vision's perspective. For example, does organization have current practices which might be violating the sustainability principles? Is the organization using fossil fuels? If so, is it trying to implement circularity? etc. This step also includes investigating current unsustainable practices. The strengths of organization should also be considered. Is it already doing something which is sustainable? Or other strengths like having better technology than competitors when it comes to assessing flows and recycling. (Robèrt et al., 2019)

**Step-C:** This is the step where organization members brainstorm and try to come up with different ideas/actions about how to bridge the gap between Step A and Step B. In this step different ideas are judged based on if they are applicable with respect to sustainability principles and the vision. They are not judged based on the company's current technology or infrastructure or financial conditions because in this step it is important to not put a lot of constraints as certain ideas may be useful later on. (Ibid)

**Step-D:** In this step the ideas/actions from Step-C are analyzed and a strategic plan is created. This planning is where the organization decides which actions will go first, which ones later and some might also be kept aside. To create this plan, the organization will have to use the strategic guidelines which it would have created in the 5-level model. A general suggestion from authors is that actions should be planned in such a way that previous actions guide or make it easy to execute the later actions. And also, there should be a balance between actions taken for sustainable development and return on investment. So certain actions might provide return on investments in a shorter time frame which can be used to execute later actions. (Ibid) Figure 7 below illustrates ABCD procedure combined with funnel analogy.



*Figure 7: ABCD procedure combined with funnel analogy  
Source: Broman and Robèrt, 2017 p.21*

On the other hand, there is a possibility that an organization might have to wait before taking an action. For example, if it knows that a certain technological innovation is right around the corner, which might make it easy for them to take a particular action,

then it is better to wait, instead of trying to execute that action with current technology which might consume a lot of resources. Authors further elaborate that 'it is the combination of actions that is relevant. A planning team cannot evaluate the effectiveness of a single action. Similar to chess it is only in the context of likely forthcoming actions towards winning that current actions can be evaluated in a meaningful way'. (Robèrt et al., 2019, p.57)

While describing different steps this procedure is kept linear so that users focus on one step at a time. When put into practice, it can become an iterative procedure. For example, in Step-C while thinking about different ideas and or actions, the user may realize that vision that was set in level 2 or Step-A needs minor changes. Oftentimes while thinking about one particular step there can be 'aha moments' about the other step which will lead the users to jump back forth between two steps. For example, while in Step-D when thinking about planning the users might become aware of a new challenge which was not addressed in Step-B. (Broman and Robèrt, 2017) Authors also recommend that ABCD procedure should be repeated on a regular basis to successfully move towards sustainability. In fact, they suggest that during the first session itself it should be decided when the next session would be held. (Robèrt et al., 2019)

There can be various types of actions which can be thought of during Step-C and be implemented into a plan in Step-D. On a general level, most of them can be classified under 'dematerialization' and 'substitution'. These two practices may seem separate but there is a dynamic relation between the two. For instance, there are materials which may not be easily degradable, and concentration of such material should not increase in nature. This means that these materials and flows related to it should be reduced. On the other hand, the usage materials which are easily degradable and cause no harm being part of natural systems would increase to compensate for the reduction of the other materials. (Ibid)

Dematerialization and substitution can be tricky to handle economically. It might happen that technology required for using the substitute material may demand high investments. To compensate for this investment, a company might reduce costs by dematerializing some of the other materials and increasing the production efficiency, but this may not be true in all cases. In fact, the opposite may also happen, that is, the technology required for dematerialization may demand higher investment than substitution. For example, the technology required for metal recycling to prevent its increased concentration in the natural system might be expensive compared to substituting that metal with a biodegradable alternative whose recycling may not be expensive. Apart from these complexities what can also happen is that in order to dematerialize a material or a flow an organization may start utilizing other flows or materials in an unsustainable way. Additionally, the increased production efficiencies

to support dematerialization may lead an organization to over produce and transition towards unsustainability if it falls victim to the rebound effect. (Ibid)

Thus, it is important to consider the bigger picture and have systems thinking approach when trying to implement dematerialization considering above mentioned complexities. (Ibid)

Before discussing the reasoning for choosing FSSD for this thesis, it is important to understand Broman and Robèrt's rationale for coming up with the FSSD. They suggest that firstly there is an urgent need to address the unsustainable challenges. Some of the practices need to change in order to protect biodiversity, tackle climate change, reduce poverty, etc. They further elaborate that biodiversity loss, erosion, poverty, and such are symptoms which are often tried to cure but the cause of these problems is the damage done to social or ecological systems which is not always addressed. Oftentimes certain problems are ignored as they are assumed to be a 'cost' for an organization, and it is blinded by the 'benefits' brought by unsustainable practices. Solving these challenges not only addresses the survival in the long run but it can also bring new innovation and market opportunities from a business perspective. This framework not only facilitates solving sustainability related challenges, but it also throws light on how growth opportunities can increase for an organization. (Broman and Robèrt, 2017)

According to the authors, oftentimes in sustainable development, confusion is created when the difference between the guidelines (which might help one in choosing which actions to take) and an actual strategic plan (which consists of sorted action and their time frames) is not clear. But this framework provides clarity on this difference and enables organizations to come up with both guidelines as well as an action plan. (Robèrt et al., 2019)

Using such a framework eases collaboration across different departments, disciplines and organizations. Since it provides a set of sustainability principles which remain the same, (irrespective of organizations) it makes it easy to identify common/similar challenges faced by different organizations. There is a possibility that organizations may use each other's strengths to solve each other's challenges. Alternatively, the steps taken by one organization should not become an obstacle for another organization when moving towards sustainability. (Broman and Robèrt, 2017)

FSSD was selected for this thesis because it is developed to help organizations transform towards sustainable development, which is in line with the objective of this thesis. Some of the other frameworks related to sustainable development which were studied are good at creating awareness, providing knowledge and solutions to tackle various challenges, but they are not developed to be directly utilized by organizations for sustainable development. The beauty of FSSD is that it provides an operational

procedure, which can be used by organizations. Additionally, the thesis provides companies knowledge and insights through the board game, which can be taken further in their sustainable development journey. A board game can be used to provide a better starting point as it can be an overwhelming experience if an organization is not aware of this model and its implementation procedure. Through the game, once an organization is familiar with the framework, they can start using it according to their specific scenario.

Even though the approach for this thesis is analogous to Evensen et al.'s approach to game design, there is one difference, that is, using a framework (FSSD) as a core component of the game design which was not done by Evensen et al. in their project. Another interesting aspect about combining FSSD with a board game is that FSSD is based on back casting which means it considers the final goal(s) and from a board game design perspective, many studies state that clear goals are required for a game to be interesting (Bellotti et al., 2013; Kiili, 2005; Larsen, 2018 ). So, both the ideas work cohesively with one another. Thus, this is a creative attempt to combine these two frameworks in order to develop a board game which will help companies in their journey towards sustainable development.

## 4 Methodology

*This section describes the methodology by providing details on research strategy, design, and analysis. The chapter begins with research strategy and a reasoning for the qualitative approach considered for the study. The next topics are the research design and data collection which elaborate on how research design for this thesis was inspired from Evensen et al.'s game design model and the rationale behind choosing companies in the manufacturing field. Furthermore, sampling strategy is explained which describes how potential interviewees were contacted followed by data analysis (thematic analysis) of the interview inputs. The chapter ends by addressing ethical considerations.*

### 4.1 Research Strategy

The objective of this research is to provide a better understanding of using board games as a learning tool for implementation of sustainability-related business practices in companies and to investigate the benefits of a more theoretical approach (of implementing a framework from the target subject) in a board game. A qualitative approach was selected for this study due to two reasons. First, the qualitative approach emphasizes words unlike its counterpart, the quantitative approach which emphasizes quantification of data and numbers (Bryman and Bell, 2011). It tries to understand various social phenomena and actions individuals take, based on how they interpret their own reality. Thus, constructing reality considering interpretations from participants (constructivism). This is contrary to the approach of natural science which considers that reality is “out there” and separate from those involved in its construction (positivism) (Bryman and Bell, 2011, p.386). Qualitative approach through semi-structured interviews can provide rich descriptions and new insights of the phenomenon under investigation as the researcher is not limited to a fixed set of questions and is allowed to dive deeper through conversations and follow up questions, which is not the case with quantitative approach (Bryman and Bell, 2011). Second, as sustainable development is a multidisciplinary and paradoxical subject (Robinson, 2004; Despeisse, 2018); there are chances that different companies might perceive sustainable development differently thereby making sustainable development subjective in nature.

The thesis involved understanding and using existing concepts before providing a better/new understanding (and a board game) along with comparing existing theory (literature and frameworks) with empirical material (themes obtained from interviews). This was carried out through an abductive approach. Abductive approach involves what Dubois and Gadde call ‘systematic combining’ which means that instead of going with a linear approach towards research divided into different steps, the researcher moves ‘back and forth’ between these steps (these steps can be either

theoretical or practical like reviewing literature, analyzing interview data, etc.). Moving across different steps can allow improvements in understanding and flexibility to improve previous steps based on new understanding/findings. (Dubois and Gadde, 2002) According to Strauss and Corbin (1990), systematic combining is continuous movement around ‘asking questions, generating hypotheses, and making comparisons’ (Strauss and Corbin, 1990 in Dubois and Gadde, 2002, p.556).

Comparing theory with the findings can lead the researcher into different directions. There is no fixed way in which this comparison can be done. The direction which s/he might take is also not predetermined, instead the findings from the comparison further guides the researcher on how to proceed further. (Dubois and Gadde, 2002)

## **4.2 Research Design and Data collection**

The research design for this study was inspired from Evensen et al.’s (2009) research design model for board game development. This model has been explained in detail in the theoretical framework. Their model uses literature, interviews, and workshops as parts of the input for the game development. Similar to their model, this research also leverages literature, which covers various concepts of sustainable development, education for sustainable development and game-based learning. To get a deeper understanding about board games, literature specific to board games was also referred, apart from the research studies, games from Snowflake Education were also briefly studied using game manuals and games itself.

A modification which has been done to this model for this thesis is substituting a framework in place of generative research. Having a framework as an input has been further discussed while addressing the second research question. Also, carrying out generative research was not feasible for this thesis considering the limitations of time and resources. Theoretical aspects of data collection included literature review and theoretical frameworks whereas the practical aspect included semi-structured interviews. Generally, semi-structured interviews have an interview guide where there are questions related to the topic in study, but the interviewer is allowed to ask other questions apart from the guide depending on the answers of interviewee (Bryman and Bell, 2011). This allows a deeper understanding of the subject matter (Ibid).

For this study, the interview guide was refined through a pilot interview as well as through feedback from subject reader and the supervisor. The guide was divided into two parts. The first part was about sustainable development which had questions to understand how companies perceive it, challenges related to implementation, etc. The second part was about games and game-based learning. This part was to investigate how companies perceive board games as a training tool, what do they think about its potential to bring a change, etc. During the second part, certain parts of Broman and Robèrt’s framework which were used to design the board game were also explained

followed by questions around what the interviewees thought of the idea. Further, they were also asked for suggestions and improvements about the game idea. (Interview guide is provided in Appendix B) From these interviews a thematic analysis was carried out. Themes obtained were used as an input for game design.

Majority of the companies involved in this thesis belonged to the manufacturing industry. Manufacturing plays a vital role in providing various products and services which are essential and improve wellbeing. It has not only improved life quality but has also contributed towards economic growth. (Abubakr et al., 2020)

The global challenge at the moment is that improved life quality has increased the consumer demand. On the contrary, resources available are limited. (Ibid) So, there is a need to reduce the resource usage. Considering this challenge, internal (company's vision and strategy, profitability, etc.) and external (governmental regulations, customer demands, etc.) forces are pushing manufacturing companies to transition towards sustainable practices. Implementing sustainable practices can help companies reduce waste generation, improve resource usage efficiency, and reduce energy consumption. (Gunasekaran and Spalanzani, 2012)

### **4.3 Sampling strategy**

The companies involved in the interview process are in the manufacturing sector which are either Swedish or have a base of operation in Sweden. The companies were contacted using the contact information provided on their website which were either an email or a contact form. In both the cases, brief information about this thesis was provided and contact information for the person responsible for sustainable development was requested.

Another strategy implemented was using job hunting websites such as LinkedIn and typing words such as 'sustainability' or 'sustainable development'. The user's profile was checked to see if the company s/he was working for, was in the manufacturing field. In case it was, then a message was sent with a brief summary of the thesis and a need for an interview.

27 such potential interviewees were contacted. Apart from these 27, one more person who was a personal contact was also approached. So, in total 28 people were contacted, out of which eight of them agreed for the interview. Due to the pandemic situation it was hard to get employees exclusively from the manufacturing field who were willing to participate in the interview, so a broader approach was considered. Two of the interviewees belonged to this broader approach. Interviewee W's company was into fashion accessories, the company was into designing these accessories and manufacturing was outsourced. Still the company had sustainability challenges as they were helping their suppliers and manufacturers towards sustainable development.

Interviewee F’s company is a consulting company with mainly three fields: industry, infrastructure, and energy. They have various types of projects such as providing industrial solutions, design and development of process industries, product development, energy projects such as setting up a hydro or solar power plants etc. Table 2 provides a brief description of industry type for each interviewees’ employer.

*Table 2: Interviewees’ employer description*

<b>Interviewee</b>	<b>Industry</b>
A	Packaging materials manufacturer and packaging solutions provider
E	Heavy machines and tools manufacturer
F	Consulting in three fields (infrastructure, industry, energy)
G	Digital solutions and electronics manufacturer
P	Heavy machines and construction materials manufacturer
S	Heavy machines and tools manufacturer
T	Packaging material and process equipment manufacturer, solutions provider
W	Designing fashion accessories (manufacturing outsourced)

The interviews were conducted either by phone or other digital tools such as Skype or Teams. Every interview was audio recorded. Interviews lasted between 45-75 minutes. Interview data was transcribed and converted to themes as described in the following section.

#### **4.4 Data Analysis (Thematic Analysis)**

Interviews were recorded and transcribed. Certain parts of the interviews were taken and classified under categories. Categories were made on the basis of repetition/frequency. When several interviewees were talking about the same topic, using similar phrases or keywords, that topic was selected to be a category. (Bryman and Bell, 2011) These categories act as a building block for the themes (Vaismoradi et al., 2016).

The first classification on the basis of categories is shown in Table 10 in Appendix C. According to Gioia et al. (2013) the first classification into categories can be a lot of information which is also true for this study. This happens because in the first phase, researchers usually use the same terms and concepts as described by interviewees for classification. In this step an attempt for a broader or abstract classification is not made thus leading to a huge amount of information. (Gioia et al., 2013)

Thematic analysis as a process involves a lot of going back and forth to the data, the first order classification, reflection, labelling etc. (Vaismoradi et al., 2016) The quotes from Table 10 were read again and further classified into second order categories.

These second order categories can be found in Table 3. Coming up with these categories depends on the researcher as s/he tries to form these categories using descriptions which would suit the first order classification. Hence these categories are less in number and manageable for further classification. (Gioia et al., 2013) That is also the reason categories in Table 3 are easy to understand and can be classified further.

*Table 3: Second order categories from Table 10*

<b>Second order categories</b>
Replacing/minimizing material
No better alternatives/technical limitations
Sustainable development can be paradoxical
Sustainable practices are beneficial but some of them also require long term investments
Games as a socializing tool
Educational games can sometimes lack the fun element/be less interesting to play.
Easy to remember when a concept is made fun to learn.
Increased learning efficiency when all senses are engaged
Learning through games can be better compared to conventional methods like presentations, books etc.
Games provide safe environment to experiment/make mistakes
Card game in the company to create awareness about diversity
Computer game on company's intranet to teach about sustainability
Card game about climate awareness
Need for different dept to come together
Game as a tool to bring different dept. together
Game idea similar to a workshop
Collaborations for solving complex problems/development
Small things add up
Material assessment
Issues with complex supply chain
Applying circularity
Ethical way of doing business
Anti-corruption policies
Health and safety of employees
Employee's rights
Promoting Diversity
Equal opportunities
Technological advancements might provide solutions
Different departments have different goals/perspectives
Sustainability as an add on
Eco-design/DFE
Better idea about size/amount by relating numbers to something simpler (providing examples) for better understanding.
Company's home developed sustainability assessment tools
Gap between sustainability and business/work force
Sustainable practices as an opportunity for companies to attract young employees
Need for a change in individual behaviour
Monetary incentives get the priority
Right amount of details in the game so that its playable for anyone

For further analysis a researcher needs to think at different levels. At the present level s/he may have certain categories but now these categories must be related to one another. They may be similar or different. A broader level of thinking is required as

these categories need to be put under broader headings which would form the final themes. (Gioia et al., 2013) The second order categories were color coded based on their similarity or that they could come under the same theme. This is shown in Table 4. After color coding, each color was given a theme.

Table 4: Color coding categories to obtain themes

Second order categories	
	Replacing/minimizing material
	No better alternatives/technical limitations
	Sustainable development can be paradoxical
	Sustainable practices are beneficial but some of them also require long term investments
	Games as a socializing tool
	Educational games can sometimes lack the fun element/be less interesting to play.
	Easy to remember when a concept is made fun to learn.
	Increased learning efficiency when all senses are engaged
	Learning through games can be better compared to conventional methods like presentations, books etc.
	Games provide safe environment to experiment/make mistakes
	Card game in the company to create awareness about diversity
	Computer game on company's intranet to teach about sustainability
	Card game about climate awareness
	Sometimes the common link of communication between different departments is missing
	Game as a tool to bring different dept. together
	Game idea similar to a workshop
	Collaborations for solving complex problems/development
	Small changes add up to a big change
	Material assessment
	Issues with complex supply chain
	Applying circularity
	Ethical way of doing business
	Anti-corruption policies
	Health and safety of employees
	Employee's rights
	Promoting Diversity
	Equal opportunities
	Technological advancements might provide solutions
	Different departments have different goals/perspectives
	Sustainability as an add on
	Eco-design/DFE
	Better idea about size/amount by relating numbers to something simpler (providing examples) for better understanding.
	Company's home developed sustainability assessment tools
	Gap between sustainability and business/work force
	Sustainable practices as an opportunity for companies to attract young employees
	Mental change at an individual level
	Sustainability as a cost/Profits as performance indicator (need for better performance indicators)
	Right amount of details in the game so that its playable for anyone
	Steps towards sustainable development
	Complexities about sustainable development
	Board games as a socializing tool
	Critical opinion about board games as an educational tool
	Positive opinion about board games as an educational tool

	Companies using games as awareness tool
	Factors challenging sustainable development
	Social dimension of sustainable development
	Improving understanding

After giving a theme to each color, Table 4 was rearranged to show categories and themes side by side. They were also vertically arranged to have all themes related to sustainable development followed by themes related to board games and game-based learning as shown in Table 5.

*Table 5: Categories and themes side by side*

Category	Themes
No better alternatives/technical limitations	Complexities about sustainable development
Sustainable development can be paradoxical	
Sustainable practices are beneficial but some of them also require long term investments	
Replacing/minimizing material	Steps towards sustainable development
Collaborations for solving complex problems/development	
Small steps can add up to make a big change	
Material assessment	
Applying circularity	
Eco-design/DFE	
Company's self-developed sustainability assessment tools	
Need for a change in individual behaviour	
Technological advancements might provide solutions	
Issues with complex supply chain	
Different departments have different goals and perspectives	
Sustainability as an add on	
Gap between sustainability and business/work force	
Financials benefits as performance indicator works as an obstacle for sustainable development	
Ethical way of doing business	Social dimension of sustainable development
Anti-corruption policies	
Health and safety of employees	
Employee's rights	
Promoting diversity	
Equal opportunities	

Sustainable practices as an opportunity for companies to attract young employees	
Games as a tool to have fun with family/friends/colleagues.	Board games as a socializing tool.
Game as a tool to bring different departments together	
Educational games can sometimes lack the fun element/be less interesting to play.	Critical opinion about board games as an educational tool
Game idea similar to a workshop	
Right amount of details in the game so that it's playable for anyone.	
Easy to remember when a concept is made fun to learn.	Positive opinion about board games as an educational tool
With games, visualizing a problem is easier and also learning is efficient when all senses are engaged.	
Learning through games can be better compared to conventional methods like presentations, books etc.	
Games provide safe environment to experiment/make mistakes	
Card game in the company to create awareness about diversity	Companies using games an awareness tool
Computer game on company's intranet to teach about sustainability	
Card game about climate awareness	
Better idea about size/amount by relating numbers to something simpler (providing examples) for better understanding.	Improving understanding

## 4.5 Ethical considerations

Certain ethical principles must be considered when a research is involving participants for providing information (Yin, 2009). A researcher needs to protect these participants on the following grounds to show that high ethical standards are implemented to carry out the study (Yin, 2009; Bryman and Bell, 2011):

- Informed consent should be received from all participants that they were informed about the nature of study in advance and their participation is voluntary
- Providing protection to participants from harm
- Avoiding deception of inputs provided by the participants
- Respecting and protecting privacy and confidentiality of the participants
- Taking special care and protection in case vulnerable groups such as children are involved in the study

Above mentioned principles were considered when contacting potential interview participants as well as during the interviewing process. A brief about the thesis was provided while contacting potential participants on LinkedIn and later a detailed information on thesis such as nature of study, using game as a tool to educate about sustainability, effort to identify challenges of implementing sustainable practices through this interview etc. was emailed to the participants who were willing to contribute. Those participants who were directly contacted via email were given detailed information from the beginning. Along with the detailed information, an interview guide was provided to participants who had agreed for an interview. In this email also their permission was taken to allow recording and quoting their inputs. Participants did not mind recording their inputs but did show concern about their personal information as well as company details due to which all such details were anonymized in the thesis. Thus, respecting and protecting their privacy. Some of the participants demanded that they should be sent a rough draft before the thesis is published to double check their privacy protection which was agreed by the author. Interviews were scheduled considering participants' comfort and availability. Children or other vulnerable groups were not a part of this study.

## 5 Results – Balance it!

*This chapter describes the board game in detail. It starts with the narrative of the game followed by instructions about team formation and introductory session (required before playing). The next topic explains game mechanics and gameplay. This includes rules of the game, brief description of terminologies used in the game, board layout and game flow. Going through these topics, one would understand how the game is to be played.*



It was an important day for ‘Acme T.V. Corp.’, as the term general meeting was scheduled on this day. ‘Acme T.V. Corp.’ is a television manufacturing company; it is one of the major players in the market. John Peterson, the CEO of the company arrived early to the meeting room and took his position as he waited for the directors and other board members to join. The meeting began with an earnings call where gross revenue for the last term was declared to be \$15 million. After discussing the revenue, other topics were discussed such as certain challenges with production, experience with new suppliers, etc. After discussing various challenges and potential solutions, the CEO shifted the attention of the meeting towards future plans. This included various aspects such as new television technology which was expected to arrive in recent years, new ideas and innovations by the R&D department, advertisement and promotions ideas by the marketing department, etc. While discussing future plans, it was also decided that 20% of the last term’s revenue should be used as an expenditure budget for new development.

It was a mere coincidence that just before the day of this meeting, news was out that a rival company had won the ‘Becoming Green’ award. It is a prestigious award for sustainable development which every manufacturer competes for. One of the major criteria which acts as a deciding factor for the winner is the right balance of economic growth and sustainability practices in a company. Apart from this criterion, it has several other standards. Winning this award can also attract new investors.

After fixing on the budget for new development Peterson said ‘I am sure all of you are aware of the latest news in our industry. Our rival has won the award despite our efforts for sustainable development. Looking at our current status of sustainable development, I would like to set a time frame of six terms in order to make changes in our company to ensure that we win this award after six terms. I think we need to focus more on sustainable development’. Looking at Martha Wilson (the director of sustainable development), Peterson asked ‘So tell me Martha, what should be

done to be more sustainable?'. Wilson replied 'My team has already investigated several sustainability models that can help our company. Out of these models, I suggest Framework for Strategic Sustainable Development as the most suitable for our company'. Listening to this, Peterson said 'I demand that we start adoption of this model as soon as possible. I would like to request all members of the board that we support our sustainability department. Is there anything you want to add Martha?'. After a moment of silence along with a disappointing expression Wilson replied, 'Well...my team has been facing resistance from the budgeting team whenever we need budget allocations to implement certain sustainable practices'. 'Why is that?' Peterson asked, to which Wilson continued 'The budgeting team is worried about the financial growth and wants to show good numbers at the end of the day. In order to show the financial gains, they are prioritizing non sustainable practices and projects as they provide short-term gains over the sustainable ones which seem to be expensive to begin with'. Listening to this, the director of the budgeting team argued that if they do not do that, then it will be hard to meet the financial targets of the company. Hence, the budgeting team is also under pressure to perform.

Listening to the arguments from both the teams, Marcus Bose, the COO came up with a suggestion, 'I would like to suggest that the sustainable development team and the budgeting team should start working together to understand each other and balance both the aspects. Only then our company will be able to succeed in terms of sustainability'.

Along with acceptance from both the teams and other board members, a directive was issued that both teams would work side by side to help the company succeed in its journey for sustainable development.

Now, you as a member of either sustainability or budgeting department, need to work as a team and have a responsibility of taking appropriate decisions and actions. This will lead to balancing of sustainability and financial growth which will in turn help the company be more sustainable in addition to winning the award. Good luck!

Aforementioned is the narrative of the game, here are the instructions for team formation and introductory session. The game will be played in teams of four-five members. It is recommended to form teams which include employees from different departments of the company. For example, a team might have one person from HR, one person from manufacturing, one person from finance and so on. Once the team is formed, voluntarily members will have to choose from two perspectives. One is called the 'sustainable perspective' and the other is the 'financial perspective'. The members who choose 'financial perspective' will have to do financial calculations and think in terms of financial growth whereas 'sustainability perspective' members will have to

think in terms of sustainability and keep a track of sustainability points. These ‘perspectives’ will be swapped after three terms (rounds). In case of five members, minimum of two members are required for either of the perspectives which means financial can have two members and sustainability can have three or vice versa. But even in this case, perspectives should be swapped after three rounds.

Once the story of the game is narrated/read and teams are formed, FSSD should be explained. After that, an explanation should be given on how to play the game. This session should end with an example of revenue calculations in the game, so players know how to calculate revenue during the game. A detailed example of how to do calculations is shown in Table 17 Appendix E. Now the players should be ready to play!

Note: The name ‘Balance It!’ is a tentative name for the purpose of this thesis. The author does not intend to encroach on any existing trademarks or entities. Additionally, the story, names, and the incident depicted in the above narrative are fictitious. No identification with actual persons (living or dead), entities, and products is intended or should be inferred.

## 5.1 Game mechanics and Gameplay

The game consists of six terms (rounds). Each round is given an alphabetical name that is, round-1 is A, round-2 is B and so on till round-6 as F. Each round starts with an event/situation as shown in Table 6. Each round will have its own card with the respective situation printed on it. These rounds can also be considered as a unit of time.

*Table 6: Each round begins with a situation/event*

<b>Term (Round)</b>	<b>Situation/Event</b>
A	LCD technology has come into picture will allow to have lighter and bigger TVs
B	New regulations on after use lifecycle management passed by authorities to be implemented in next 3 terms
C	Material substitution to reduce high costs for implementation of LCD technology
D	New regulations on power consumptions and energy efficiency passed by authorities to be implemented in next 2 terms
E	Customers’ feedback with overheating in new LCD technology
F	TV manufacturers create a new standard in pixel defects in LCD technology to be used in commercial units

To respond to each situation, five actions will be given per round in form of action cards. Out of these five actions, only one can be selected to go forward with. Actions associated with the first round are A1, A2...A5, second round are B1, B2...B5 and so on. Actions associated with each round can only be used for that particular round. Each action has its own card where it is described along with its consequences, **Total cost**, **Time**, **Return on investment (ROI)**, **Sustainability points (SPts.)** and **Depends on**. **Total cost** is the amount of money which is needed to be invested in order to take the action. Since there is a fixed budget, this cost is necessary for calculations as well as comparing other actions. The word ‘total’ is used to denote that the cost given is for all the rounds an action will take to be completed. Each action has a certain **Return on investment** which the team gets after the completion of the action. It is denoted in %. So, if ROI is 10% on total cost that means the amount returned will be a summation of total cost and 10% of total cost. **Time** (number of terms or rounds) denotes how long the action will take to give back the amount including ROI. That also means for those number of rounds the cost per round (total cost/number of rounds) of that action will continue to apply. For e.g. for A1 time required is three rounds, that means players will keep adding the cost per round for three rounds. And post the 3<sup>rd</sup> round, players will get back the ROI of A1. A detailed example of calculations is shown in Table 17 Appendix E. Each action is assigned with **Sustainability points**. These points can be used to judge an action from a sustainability perspective. During the last round of the game, players will have to add up sustainability points for every action they would have chosen for every round. This will give a total number of sustainability points a team has.

**Depends on** parameter denotes if an action is depended on any other action. But this will not be shown in advance, as in which actions depend on which other actions. While deciding on which action to take, players will have to think “if we take this action now, it might help us take some other action in the future rounds”. For example, action C1 depends on A4 which means in the first-round if players went with A4 only then during the third round they will have an option to choose C1 as an action.

Tables 11-16 in the Appendix D show these parameters for all actions.

### 5.1.1 Additional Rules

Above explanation of the game working with other additional rules are summarized in Table 7 below.

*Table 7: Rules of the game*

No.	Rules
1	At any time at max three actions can be active during the game
2	Actions associated with each round can only be used for that particular round. (Round A's actions cannot be used in round B)
3	Only one action can be selected per round
4	Revenue at the beginning is \$15,000,000
5	20 % of the revenue can be spent on new projects (budget)
6	Return on Investment is received only after completion of the action
7	Return on Investment is calculated as sum of total investment (i.e. total cost) for an action and percentage of ROI on that investment.
8	Winner is decided by adding sustainability points achieved and percentage revenue growth after six rounds. Team with the highest points wins.
9	'Perspectives' will be swapped after three rounds.

### 5.1.2 Board Layout and Game Flow

In this section, first the board layout is described followed by the game flow. The game flow covers how the game is played and what a team needs to do at every step of the game.

Figure 8 below shows the board layout. Two teams share the board with the left side of the board for one team and right side for another. Different areas on the board are marked as A, B, C and D. These represent the four steps of the ABCD procedure. The empty slots (white frames) are where the cards (situation and action cards) will be placed on.

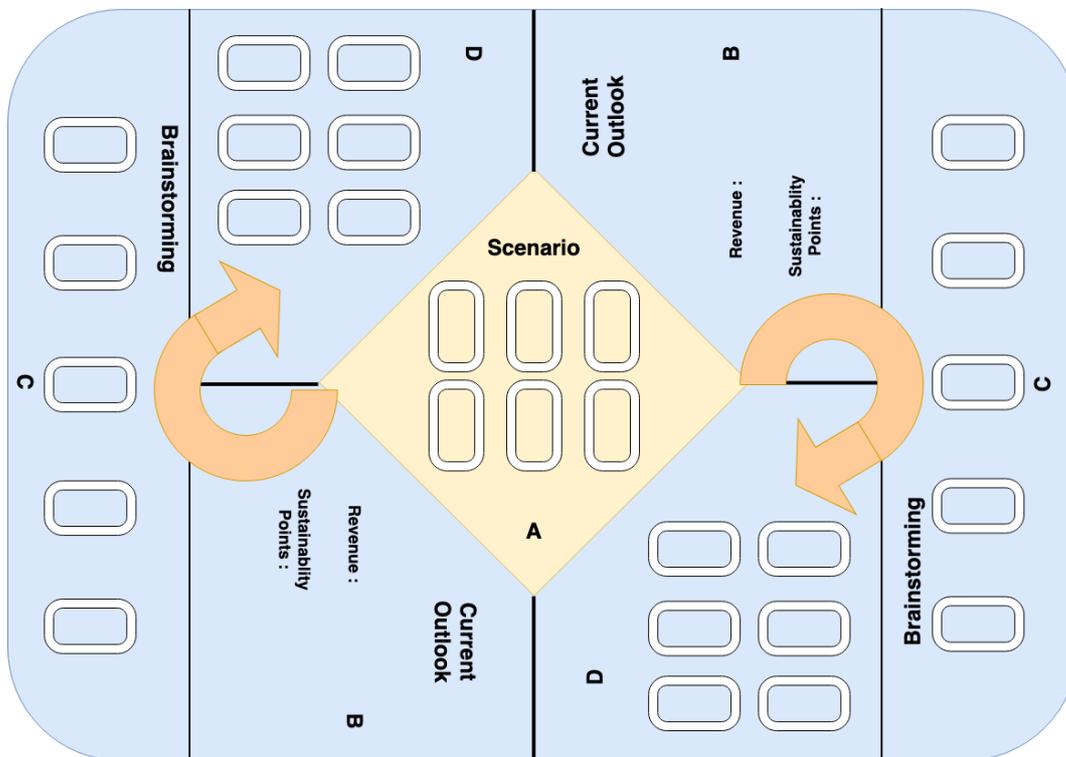


Figure 8: The board game layout

The game flow is designed in a similar way as ABCD procedure. For each round a team will have to go through all four steps. These steps are described as below:

**Step-A:** This step represents the situation/event for each round of the game. So, the supervisor will provide the situation card for the first term (Round-A) and place it in the top left slot in the area of the board which says 'A' or 'Scenario' as shown in Figure 9 below. The printed situation/event on the card should be facing up so that both the teams can read the situation.

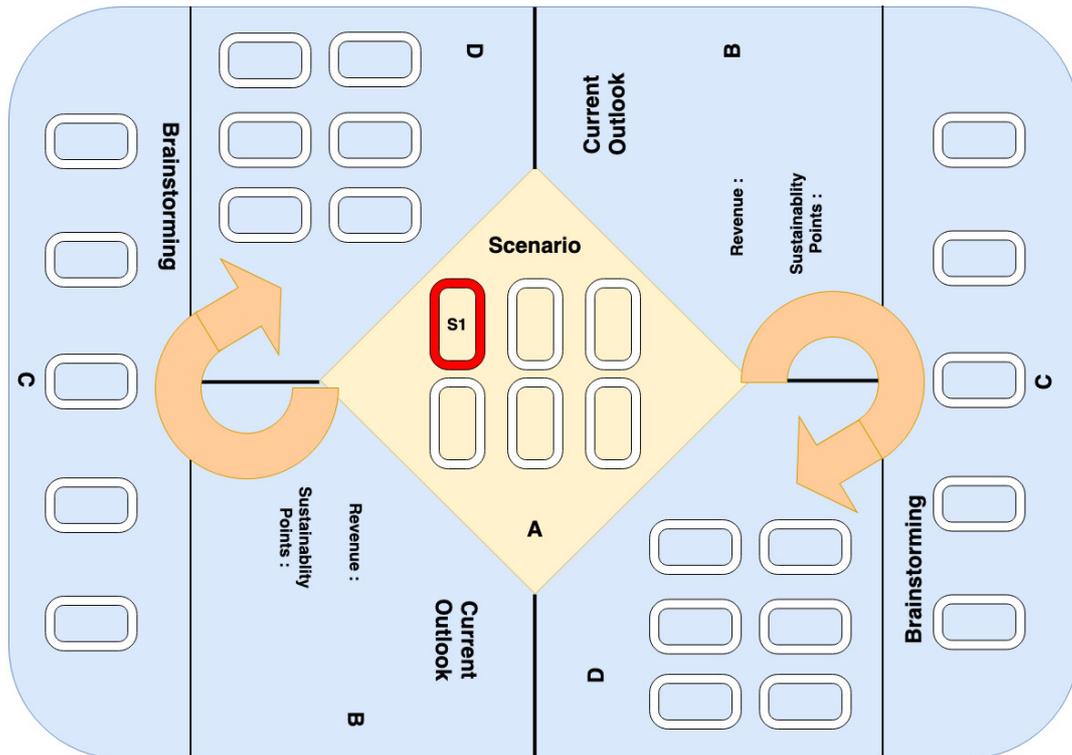


Figure 9: Step-A

**Step-B:** For this step, the team will have to write its current revenue and sustainability points on the board. For example, for the first round it will have \$15000000 and 0 SPts as shown in the Figure 10 below.

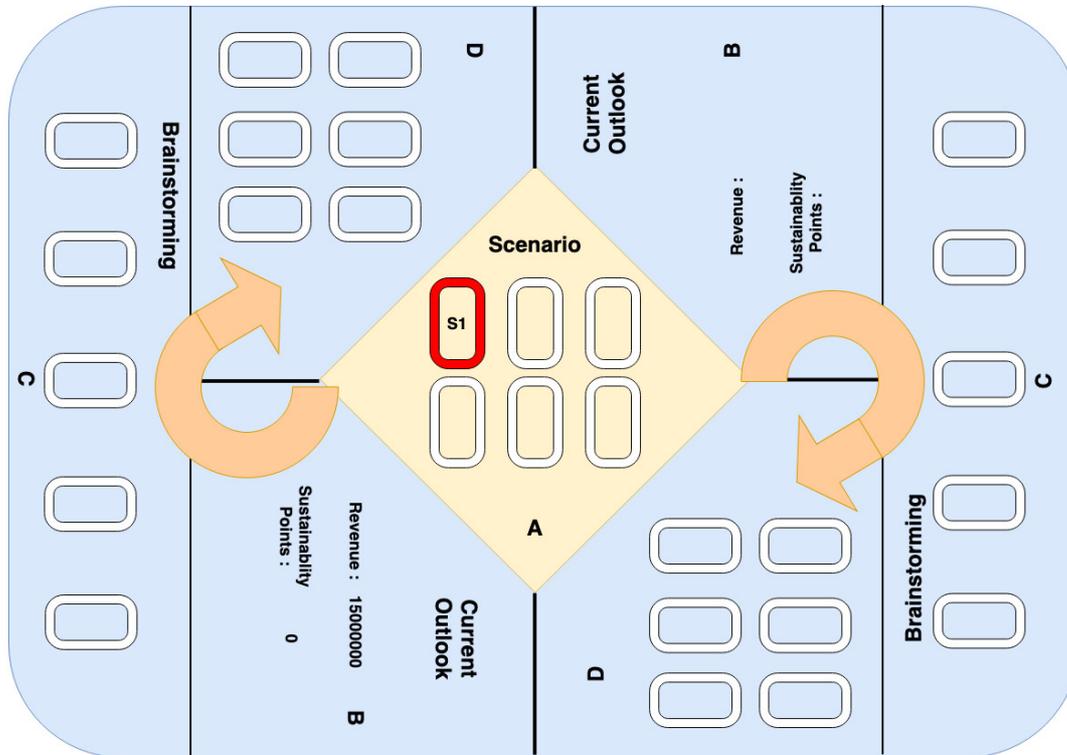


Figure 10: Step-B

**Step-C:** The team will lay out five actions (action cards) for that particular round in the slots provided in the ‘C’ area of the board. After laying out five actions they will have to brainstorm (and discuss) about these actions. They can compare these five actions with respect to ROI, time, SPts and so on. They are also free to do some calculations if needed to compare these actions. Figure 11 below shows Step-C.

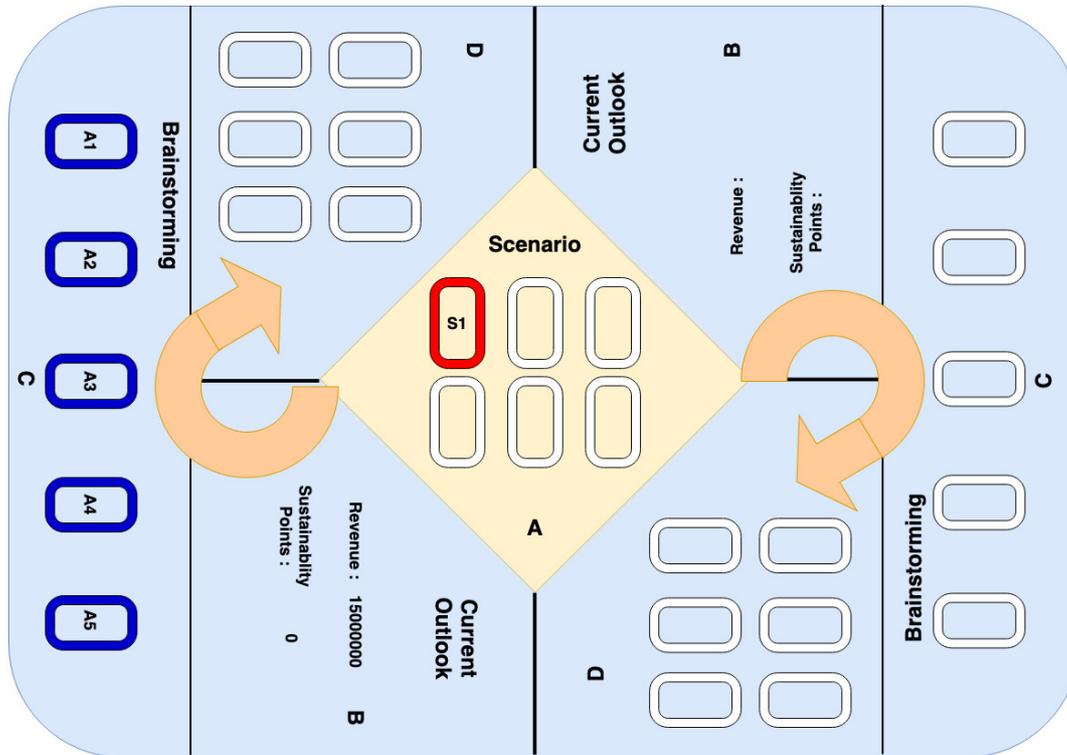


Figure 11: Step-C

**Step-D:** After brainstorming and comparison, the team will be selecting one action to proceed with, out of the five laid out actions. Whichever action is selected, that card will be transferred from the slot of Step-C to a slot in Step-D as shown in Figure 12 below.

**Note:** It is advised that during this step, once the action is decided and the action card is placed on the slot of area D the ‘financial perspective’ players should do calculations considering the cost and other parameters for the chosen action. Once these calculations are done players will know the revenue and SPts which will be written for Step-B of the next round. If players don’t want to do the calculations in this step, they can do it during the Step-B of the next round.

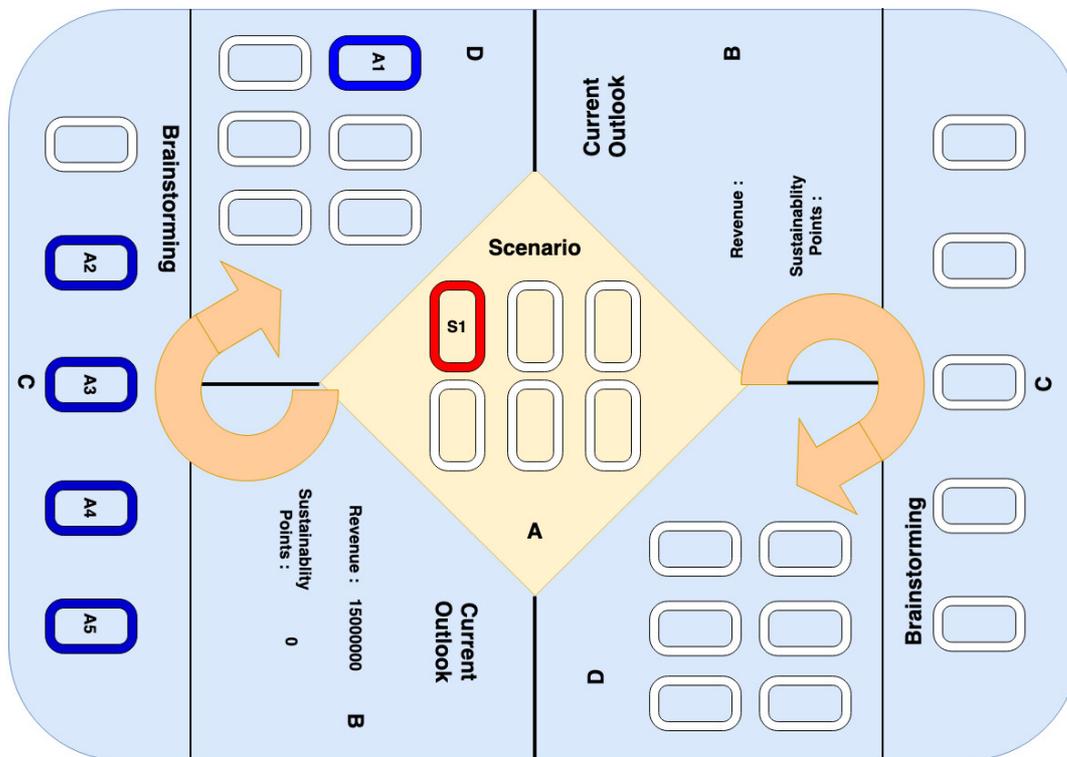


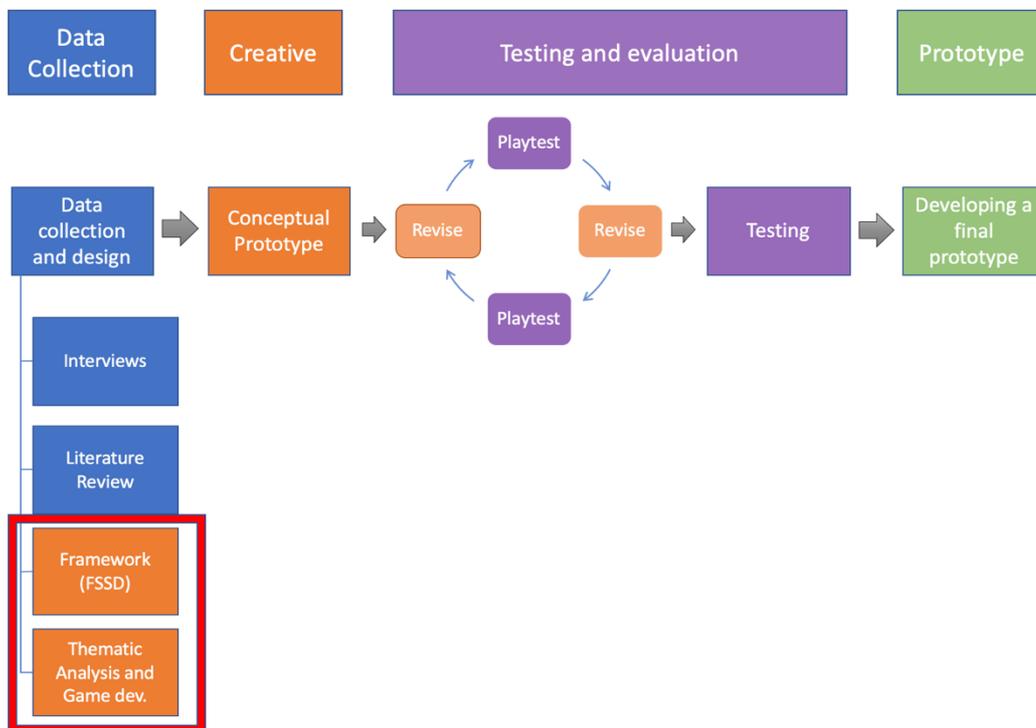
Figure 12: Step-D

After Step-D, the team will proceed with the next round. After 6 rounds, the team will have a certain amount of revenue and SPts. From this revenue, revenue growth will be calculated which will be added to the SPts to give the total points. For e.g. revenue growth is 6.11% and SPts are 19 then total points will be 25.11. These total points will be the deciding factor for the winning team. Team with the highest total points will win the game. There are possibilities for a tie situation when both the teams have the same total points, in that case SPts will become the deciding factor. For e.g. for one team SPts = 18 and Growth% = 7.19667 so total = 25.19667. Whereas other team SPts = 19 and Growth% = 6.19667 so total = 25.19667. In this scenario the team with higher SPts will be considered as the winner (Second team).

## 6 Analysis

*This chapter explains how different input elements from the Data collection and Design step are utilized in game development. The chapter starts with a literature review on certain studies about board games and its impact on different aspects such as knowledge retention, motivation, etc. After the literature review section, the incorporation of FSSD concepts such as ABCD procedure and the sustainability principles in the game development has been explained. Finally, thematic analysis and its use in game development has been described.*

The Figure 13 shows the modified version of Evensen et al.'s design model which was utilized for this thesis. Topics in this section are described in a similar order as shown in the figure starting from literature review, as inputs from interviews and its usage in game development are included in thematic analysis. The game developed in this thesis is a conceptual prototype as the rest of the steps from Evensen et al.'s model are out of scope for this thesis (lighter shades in the figure). The modifications done to Evensen et al.'s model include substituting generative research with FSSD, as carrying out generative research is beyond the scope of this thesis, and the analysis of generative research is substituted by thematic analysis. The modified steps are enclosed by a red frame in Figure 13. Having a framework as an input for design is a novel approach and the benefits of incorporating FSSD in a game will be discussed in the next chapter.



*Figure 13: Modified version of Evensen et al.'s model  
Inspiration: Evensen et al., 2009*

## 6.1 Data collection and Design: Literature on board games

The literature review in the previous section of the thesis is about sustainability and various underlying topics, education for sustainability, game-based learning, and board games. This literature section goes deeper into board games, by focusing on some of the studies using board games as a learning tool. These studies highlight various areas around board games and education such as effectiveness of board games, different skills which can be taught through board games, improvements in understanding a subject and so on. Table 8 describes these studies in brief considering the author(s), subject area of the game, methodology and results.

*Table 8: Different studies using board games as a learning tool*

Author(s)	Educational subject and type of game	Methodology	Results
Vigil Cruz (in Treher, 2011)	Pharmaceutical field (Board game)	Pre-test and Post-test scores	<ul style="list-style-type: none"> <li>• Scores of post-tests after game play &gt; Scores of post-tests after conventional teaching</li> <li>• This study lasted for 3 semesters in which researchers found that game was able to provide better retention of knowledge compared conventional teaching</li> </ul>
Treher, 2011	Financial knowledge (Board game)	This study compared the number of correct answers before and after the game playing without supplementary lessons	<ul style="list-style-type: none"> <li>• Number of correct answers increased after playing the game.</li> </ul>
Despeisse, 2018	'sustainability leadership in manufacturing' (Board game)	This study did not involve a pre-test and post-test. It was based on gaming sessions and discussions held after gaming in which questions were asked by game conductors	<ul style="list-style-type: none"> <li>• Most of the players also understood the concepts the game was trying to teach. But further testing is required because participants were PhDs and researchers in fields related to game concepts so there could be a different result if the game is tested with people not familiar with the concepts</li> <li>• The teams who lost were mainly focused on game mechanics and their decisions, instead of the sustainability concepts. Emotions of losing can divert the player from learning.</li> </ul>
Dahlin et al., 2015	7 games were used out of which 3 were board games. These games were related to various topics in Sustainable development	After the gaming sessions evaluation included different methods like questionnaires, interviews, focus group, assignments and tests	<ul style="list-style-type: none"> <li>• The overall result of the study was positive. From interviews it was found out that students were able to understand the target concepts through games thus proving them as an efficient tool.</li> <li>• Through surveys it was found that the majority of students consider games as a tool which helps them deepen their understanding about sustainability.</li> <li>• When it comes to a board game called 'Power Grid' which is about teaching</li> </ul>

			systems thinking (understanding complex systems which are dynamic, influencing one another). Researchers did not find any difference in performance through an assignment post game versus post conventional teaching
Hoy, 2018	'historical empathy', and 'limitations of archival collections' (Board game)	He tested his board game on 88 participants which was a mix of undergraduate and graduate students studying 'history and indigenous studies'. Oral and written feedback was taken after the game session.	<ul style="list-style-type: none"> <li>• Increase in student participation</li> <li>• Increase in understanding in the target subject</li> <li>• Perception of the game was different depending on whether the student was at graduate or undergraduate level</li> <li>• Solving confusing issues was more efficient in groups compared to one person helping another</li> <li>• Losing a short game (30 minutes) does not lead to disengagement, instead losing teams were more active during debriefing session. Discussing how some decisions would have led to a winning condition</li> <li>• Debriefing is important after the game session.</li> </ul>
Yusof et al., 2016	Project Management (Board game)	The game was tested on 30 students after modifications from pilot test on 10 students. A feedback questionnaire was used after game session.	<ul style="list-style-type: none"> <li>• From the feedback it was found that majority of students agreed that using the game helped them in their learning</li> <li>• Students also found that the game was fun to play, and it had the right amount of difficulty.</li> <li>• Majority of students considered game as better approach to learn project management compared to conventional teaching as it involved experiential learning, communication and competition</li> </ul>
Azizan et al., 2017	Kinetics and reactor design (Students made their own board games)	Students were divided into groups (based on mixing different personalities) and each group had to develop a board game, and a website where they would introduce their team, game as well as a video about the game. There were certain parameters on which the game was judged and developed. Apart from these parameters, students also answered a survey.	<ul style="list-style-type: none"> <li>• Majority of students agreed that this project helped them understand the subject better</li> <li>• Improvements in teamwork skills</li> <li>• Due to teamwork, improvement in communication skills</li> <li>• Researchers also compared the results of the final exam of the current year (conventional teaching + board game development project) with the previous year (where only conventional teaching was used). It was observed that overall average score improved to B from C+.</li> </ul>
Boghian et al., 2019	Literature study on use of board games for education (for adults)	Using keywords such as 'board game and education' etc. on several databases. Later the literature was sorted and	<ul style="list-style-type: none"> <li>• Board games can be helpful in teaching about how to deal with regular challenges of life, can improve memory, communication skills (as well as teamwork depending on the game) which will also encourage exchanging ideas from another.</li> </ul>

		filtered based on 4RQs	<ul style="list-style-type: none"> <li>• Other skills such as conflict management and problem solving may also be learnt</li> </ul>
Noda et al., 2019	Literature study on effectiveness of board games when used as a tool to help improve medical conditions	Using keywords such as 'board game' with 'trial' on specific databases. The articles were then filtered using various parameters.	<ul style="list-style-type: none"> <li>• Board games can provide motivation and fun towards learning as they include elements like competition, communication</li> <li>• Better knowledge retention</li> <li>• Increase student participation and motivation</li> <li>• Improve memory, organizing skills, problem solving skills</li> </ul>

Along with the frameworks, these studies have been utilized for thematic analysis and game development. Below mentioned are the main insights from these studies.

### **Knowledge retention**

Cruz et al.'s (2005) study showed that board games can provide better knowledge retention compared to conventional methods like lectures or assignments (Treher, 2011). This finding is similar to Wanyama et al.'s study (2012) where they found that board games provided better knowledge retention compared to lectures on human health (Noda et al., 2019).

*Speculation:* Through the game developed, it will be easy for players to retain certain concepts of FSSD. For example, players will certainly remember the ABCD procedure as it is one of the most repeated concepts in the game. Through ABCD procedure, other concepts such as backcasting and sustainability principles can be linked so players may remember these concepts as well. They may not remember exactly each of sustainability principles, but they would remember the concept of sustainability principles (also some of the actions are related to sustainability principles which is explained in the upcoming section which might further help in retention). Extensive details on retention can be provided after testing the game.

### **Motivation and Psychology**

Hoy's study shows that losing in a short game (30 minutes) can be motivating. The losing teams participated actively in the debriefing sessions to discuss their decisions in the game and how they could have won. It also led to debates around different aspects of the target subject. On the contrary, Despeisse's (2018) study showed that losing can shift the focus from learning the target subject to game mechanics, rules and mistakes which led the team to lose. It should also be noticed that Despeisse's game usually lasted for longer amount of time (90 or 120+mins.) compared to Hoy's. From a broader level board games can increase student participation in discussion and interest for the subject (Hoy, 2018; Amaro et al., 2006).

Hoy's game was about trading goods in which smuggling was also an option. Outside the game context, students refused that they would never do such activities. But in the

game, smuggling becomes normal as the game sets a particular tone/environment. There was not a single team who played the game without choosing that option. This moral decision simulation enabled them to understand ‘historical empathy’ which is one of the learning aims of the developed board game. (Hoy, 2018)

*Game Application:* There are two main factors driving the motivation in the game developed. First, during the narrative, players are informed that a rival company has won a prestigious award and the CEO has given players a timeline of 6 terms to make changes in the current practices of the company so that Acme T.V. Corp wins the award after 6 terms. Second motivational factor is the competition between two teams. Both the teams are using the same board and keeping a check on each other’s sustainability points and revenue. This drives them to perform better than the other. Motivation of players (at a personal level) after winning/losing and participation during the debriefing session can be investigated once this game is tested. From a broader perspective, the game itself is a motivational tool for implementation of sustainable practices.

### **Improvements in understanding, teamwork and communication**

Azizan et al.’s (2017) study is unique compared to the rest of studies mentioned here, reason being that students were asked to make board games. Students were asked to develop it in such a way that it should ask questions related to the subject to players. The game should not be just about informational knowledge, instead it should also trigger ‘high order thinking’. After creating the game, each group was asked to play another group’s game and provide a rating for ‘board game experience’ parameter. Creativity and depth of knowledge were other two parameters which were evaluated by external examiners. Depth of knowledge was evaluated based on the quality and difficulty of questions developed in the board game. Creativity was judged based on video (to present the game) and website (to introduce the group members etc.) developed by each team.

Apart from these parameters, students were also asked to fill up a survey which showed that the majority of them agreed that this project helped them understand the subject better (Ibid). It also improved students’ teamwork skills and teamwork in turn improved their communication skills (Ibid); which is similar to Boghian et al’s findings that board games can help in improving communication and teamwork skills (Boghian et al., 2019). Improved understanding of the subject through games was also a finding in Hoy and Dahlin et al.’s studies (Hoy, 2018; Dahlin et al., 2015).

*Game Application:* The previous as well as upcoming sections of this thesis discuss in detail about how the developed game enables players to improve their understanding about FSSD and underlying concepts. Apart from FSSD, other skills which this game aims at improving are collaboration, teamwork, and communication.

That is the reason in team formation it is recommended that employees from different departments should come together to form a team. This way they will get a chance to meet their colleagues and improve relations which might help them during their work life. Secondly, the whole aim of giving two major roles as ‘sustainability perspective’ and ‘financial perspective’ as showcased in the narrative is to emphasize the importance of cross departmental communication and collaboration in order to achieve a balance from a sustainability standpoint for the company to succeed. Apart from the influence from these articles, Broman and Robèrt’s take on collaboration and its application in game development has been further discussed in the thematic analysis.

### **Medical benefits of board games**

In Noda et al.’s study (2019), eleven articles were about board games and its impact on cognitive functions. These studies mainly focused on 3 strategy-based board games namely ‘Chess’, ‘Go’ and ‘Ska’. After regular playing of ‘Go’, memory improvements were noticed in senior adults (Izuka et al., 2018). ‘Ska’ also had a similar impact on senior adults as it showed improvements in ‘memory, attention and executive function’ (Panphunpho et al., 2013). Studies related to ‘Chess’ showed organizing skills enhancements in ‘schizophrenia’ patients (Demily et al., 2009). It also showed mathematical problem-solving skill improvements in children (Sala et al., 2015).

Impact of board games on parameters like physical activities, psychology, and ADHD indications was discussed in five other articles reviewed by Noda and colleagues. For example, Mouton et al. (2017) showed that big size board games (laid out on the floor used to encourage exercising) can improve balancing, physical strength, energy levels in individuals at nursing homes. Other studies showed that board games can help improve conditions of children with ADHD symptoms (Kim et al., 2014; Fernandes et al., 2014). Additionally, a study also showed that playing ‘Go’ can help recover from symptoms of depression and anxiety (Lin et al., 2015).

## 6.2 Data collection and Design: Using FSSD

The operational procedure (ABCD procedure) provided by FSSD is the core element of the board game. Following description relates the real ABCD procedure with the one in the game.

**Step-A:** As explained in the theoretical framework, Step-A is about the vision of the company, what it wants to achieve in the future to be more sustainable and so on. The planning team will have to evaluate, discuss and compare the vision with the core values, practices, etc. (Robèrt et al., 2019) This step has been simplified in the game as an event/situation. The game is providing the vision or objective through situations/events and players are responding to it by following the next steps which are in accordance with the real procedure.

**Step-B:** In theory this step is about assessing current reality by checking different parameters such as company practices through sustainability principles (Robèrt et al., 2019). For the purpose of the game, reality evaluation is simplified in terms of revenue and sustainability points. Therefore, in this step the team needs to write these two parameters on the board. Writing sustainability points symbolizes that one needs to keep in mind sustainability principles while evaluating the current situation of a company. Writing both parameters on the board also makes the game fun to play. For each round both the teams will keep looking at each other's SPTs and revenue which will create a friendly competition and motivation to do better than the other.

**Step-C:** Theoretically this step is about brainstorming to come up with actions that would help in bridging the gap between current reality and the vision. (Ibid) In the game, players don't have to come up with actions as they are provided with a set of actions. But they do need to brainstorm and discuss to compare these actions before selecting one of them.

**Step-D:** Theoretically this step is about prioritizing among different actions which company members would have come up with during Step-C and creating a strategic plan. (Ibid) In the game, this is simplified to deciding one single action out of 5 actions after brainstorming and discussion in the Step-C.

Some of the actions in the game can be related to some of the sustainability principles. They were designed keeping in mind the sustainability principles. The Table 9 shows the actions along with sustainability principles which can be associated with them. (This game was not designed to address every sustainability principle; this is further discussed in the limitations.)

Table 9: Relating actions to sustainability principles

Action Name	Action	Sustainability Principles
A1	Phasing out CRT TV manufacturing materials	1,2
A2	Phasing out lead from circuit board solder	1,4
A3	Phasing out old flame-retardant materials like chlorine and bromine for newer FR1 and FR4	4
A4	Assessing flows for Magnesium instead of plastic	2
A5	Investing in newer LCD technology	1,2,4
B1	Design TVs suitable for recycling	1,2
B2	Use recycled plastic and metals for TV parts	1,2
B3	Collaborate with e-waste recycling partners	1,2
B4	Develop in house e-waste handling	2
B5	Identify and select suppliers who have the same green vision	1,2,3
C1	Usage of Magnesium as replacement for plastics for structural components	2
C2	Reduce the usage of nonferrous heavy metals in manufacturing TV components	1
C3	Start an initiative for material assessment with an aim to reduce environmental loads.	1
C5	Use TFT technology for LCD manufacturing	1
D3	Process redesign by using screen printing solder paste instead of solder bath	1
D4	Replace fluorescent tube to LEDs for backlighting	1
E5	Create customer buyback program	1,2
F5	Collaborate with supplier to adopt higher quality standards who share the green vision	1,2,3

Some of the rules of the game are also inspired from real life events. For example, dependency of certain actions on previous actions. This dependency is not revealed in advance. This rule aims to teach two lessons. Firstly, in real life one can do certain things only if they had acted in a certain way in the past, and one cannot change the past. Similarly, the game restricts players to take an action if they didn't take certain action in the past. Secondly, it motivates players to practice long term thinking. Certain actions taken now may help them in future. Another such rule is that only three actions can run in parallel, this is to symbolize that there are limited resources and limited number of projects can be simultaneously executed. Additionally, the return on investments are only provided after the action is completed to show that getting the results of the sustainability efforts can take some time. For example, if a factory was to be redesigned considering some sustainability parameters then while it is in the re-design phase there can be lots of investments without seeing any profits immediately. But once it's redesigned and functional then the owners will get the benefits of the redesign. The rule about swapping 'perspectives' after three rounds emphasizes the importance of understanding each other's perspectives. A common understanding is needed to drive the company towards sustainable development. This is further discussed in the thematic analysis.

### **6.3 Data collection and Design: Thematic Analysis**

The raw data from the interviews was converted to themes as explained in the methodology section. These themes were used as inputs for designing the game. Following section analyzes each theme with respect to the theoretical framework and literature on board games and GBL. After analyzing each theme, its utilization in game development has been explained.

#### **6.3.1 Theme - Complexities of sustainable development**

The interviews further confirmed the complex nature of sustainable development. For example, sometimes there are no better man-made solutions/options. In some cases, using natural resources is the only option. When it comes to the packaging industry, interviewee A said “For example (brand owners might say) best packaging the most sustainable packaging is based on...recycled paper...well that is not always true. Sometimes you need to have fiber that is very strong. And then you can't use recycled fibers because they are shorter and not so strong...”.

Robèrt et al. (2019) explain about this complexity when they explain about technological limitations in dealing with sustainability related problems. They elaborate that if one is using a certain natural resource then one should ensure that it is not over exploited. For e.g. using paper from certified forest management suppliers. That is also what interviewee A's company is practicing and the major goal of this company is to replace plastic with paper in packaging which is similar to Robèrt et al.'s explanation about substitution of material.

The complexity of the subject is due to its multidimensional nature which makes it paradoxical sometimes. For e.g. interviewee W said “...sometimes it's about two different sustainability things. For example, maybe there is a material that is better for the environment. But it's less safe for the workers when they use it...”. A similar situation was discussed while explaining the ‘wicked problems’ of the three dimensions. It was explained that there are scenarios where achieving something in one dimension might come at a cost of sacrificing something in the other or as Hickel (2019) pointed out about one SDG opposing the other. Additionally, in the framework, a biofuel example was given to explain that in trying to address one sustainability principle there is a possibility that an action might violate other sustainability principle(s) (Robèrt et al., 2019). Another example was the oxymoron in the Brundtland report about increasing industrial production (5-10 folds) and being sustainable at the same time (Robinson, 2004).

Third complexity is that certain practices towards sustainable development can be a long-term investment for a company. As P said “...some of these (sustainable) measures require big investments... there's a limit to what speed you can have in this

because changing your processes requires that you change equipment...”. F also said something similar,

“...So in the beginning, you will have lots of cost savings from implementing low carbon practices, but at some point, you will reach a stage where it becomes more expensive to make it less carbon intensive. So, you reach like a sort of a tipping point where it's more of a long-term investment...”

A similar situation is described by Robèrt and colleagues when explaining the step-D (prioritization) of ABCD procedure. As they explain that there will be certain actions which are ‘low hanging fruits’ and may provide high return on investment, but there will be some which will be long term and expensive for example ‘renewable energy installations’. (Robèrt et al., 2019, p.57)

*Game Application:* The concept of long-term investment was leveraged in the game. For example, if one compares action B3 and B4. B4 seems to be expensive (\$1430000) at glance with lower ROI % (25%) and time taken is 3 rounds. Whereas for B3 total cost is \$530000 with higher ROI % (40%) and time taken is 2 rounds. Looking at 40% it might seem more but in reality, if one calculates the ROIs for both then action B4 is giving more returns. But it also takes 3 rounds. So, it takes more time but provides higher returns. To emphasize the value of long term thinking most of the actions in the game take about two or three rounds. This is done to emphasize that sustainable development may need long-term investments and may not provide instantaneous results.

Apart from the time concept, cost concept was also utilized in the game. An action might seem to be expensive compared to other action, but a higher costing action can lead to higher return on investment if ROI% and time for both actions are kept the same. This can be realized when comparing actions B1 and B2.

From a broader perspective the whole game is designed around keeping in mind the complexity which comes with sustainable development. That is the reason the core idea of the game is to achieve a balance between economic growth and sustainability which leads towards sustainable development.

### **6.3.2 Theme - Steps towards sustainable development**

Companies described several steps they have taken towards sustainable development. Some of them are described here in brief. One of the practices done by most of the companies is replacing certain materials in their products/packaging of the product. Some also talked about reducing the material consumption. For example, T said,

“...our goal to 2020 was to have fully renewable packaging for liquid food and we have it for chilled food. But for ambient (room temperature) product we still have some

portion of non-bio-based materials. But our development organization is focusing to try to phase out the other materials, so we have total bio based and circular product”.

Interviewee P said “...we have changed in all our factories to bio oil instead of fossil fuels. So that has reduced our climate impacts with the 50-60%...”. Interviewee G said “...last year we had a huge announcement that we will try to use as much as sustainable materials for packaging as possible and reduce as much as plastic as possible.”

These examples are what Robèrt et al. calls ‘substitution’ and ‘dematerialization’. These two concepts were discussed in detail in the theoretical framework. For dematerialization companies often use circular practices. (Robèrt et al., 2019) This also matches with what S said “...more than half of the sold carbide is actually recycled. So, we buy back old tools and the inserts... and we use them in our processes and make new tools out of them...reduce the amount of material that you put in...”

*Game Application:* Some of the actions in the game were inspired from sustainability principles as well as the examples provided by the interviewees. For instance, actions A1 is about phasing out CRT TV manufacturing materials, A2 is about phasing out lead in the circuit board solder, B1 is about redesigning TVs for recyclability, B2 is about using recycled plastic and metal, E5 is about creating a customer buyback program to buy back used TVs, etc. Some of these actions are not only from an ecological perspective but have considered human safety. This is the case with A2. A2 reduces the concentration of lead in biosphere (SP1) as well as improves human safety as lead is poisonous (SP4).

Another step towards sustainable development is that companies have collaborated with their stakeholders to solve complex problems and for overall development of the society. For example as interviewee G said “...This (complex supply chain issues) is not something that we can solve as one company alone...So we decided together with a lot of other big companies, to form alliances...which makes sure that there is a structured audit process in our supply chain...”. Interviewee A said,

“We do a lot of collaboration with our customers, to find for example...they use our paper when they make packaging...there is a thin plastic film inside of the carton and we need to work together to remove this film and replace it with something that is bio based”.

Interviewees didn’t just state that their companies are collaborating but also mentioned that there is a need for collaboration. As mentioned in the framework, collaboration across different stakeholders is important to move the society towards sustainability. One of the agenda for FSSD was to provide a framework which can ease collaboration amongst various stakeholders. Authors understood that certain problems cannot be solved by a company alone and utilization of different disciplines

may be required. So, keeping that in mind, sustainable principles were given which can be used as a common reference. Allowing stakeholders to find out common challenges where their individual expertise can come together to solve these challenges. (Broman and Robèrt, 2017)

*Game Application:* Collaboration has been emphasized in the game through different actions. For example, when comparing B3 and B4. Even though the ROI of B4 is greater than B3. The sustainability points for B3 are higher than B4. This is because B3 is an action for collaborating with E-waste recycling companies. Also, action E1 is about collaboration to solve a problem. The game emphasizes on the fact that collaboration is important, in the end sustainability is for the whole society.

Many interviewees emphasized that companies can implement practices to develop in a sustainable way but in the end, it comes down to individual behaviour. They emphasized the need for mental change in individuals to further enhance sustainable growth. Interviewee E gave an example of automobile business where the change is driven by individuals, “I wouldn’t choose a diesel (instead go with hybrid) ...individual is driving this change”. F said “...It (beyond companywide perspective) becomes more of a behavioral thing, like are we travelling a lot by air? Or are we taking train when we could and so on, that becomes much more local behavioral change that needs to be done...”. On similar lines P said,

“...it's not a big change for you to change the fossil diesel to HVO 100 or something. But if we say that you need to change your way of driving in order to save fuel and drive smarter and not be in an accident or whatever, that's suddenly more about how that person behaves...”.

The above concept is explained by Robèrt et al. (2019) as ‘the person-organization dynamic’. The authors explain in this topic by saying that an individual can be seen from two perspectives. One as a part of organization and second as an independent individual. As a part of organization, because an organization is formed by individuals and it can develop and change only if individuals themselves develop and change. As an independent individual, s/he has his/her own relationships, social life, human rights and so on. In a way organization and individual are interconnected and impact one another as shown in Figure 14.

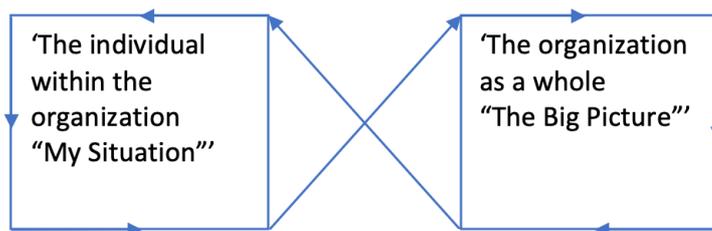


Figure 14: Interconnection between an individual and an organization  
Source: Robèrt et al., 2019 p.132

### 6.3.3 Theme - Factors challenging sustainable development

There were several factors which were discussed during the interviews, when presented in Table 4 they may seem distinct but some of them are similar or correlated. For example, one point which was brought up by interviewees was that oftentimes different departments have different priorities and perspectives. Sustainability department cannot function alone, it needs support from other departments to implement practices. As interviewee W explained:

“...the sustainability department is responsible, or kind of to reduce the emissions, it's actually the department working with freights that are actually producing the emissions...we can have a different product design that reduces environmental impact, but it's...product design department...it's about talking to and like influencing the right people at your own company”.

Interviewee F explained that the sustainability department needs to decentralize, and each department should have a person who might be an engineer but also has a sustainable view:

“...too big of a challenge for one single sustainability department to raise the awareness within the whole company. So, it has to be made decentralized. We have to have an ambassador network of sustainability ambassadors that are really not only... sustainability professionals, it has to be people that are engineers that know the ways of working”.

This connects back to the previous topic where the need for collaboration was explained. That was from an external point view as in different organizations coming together, whereas this is more about cross departmental collaborations. Most of the researchers have agreed on the need for collaboration. Their emphasis is on a larger scale as in need of collaborating with different stakeholders like with different companies, universities, NGOs to move towards sustainable society (Broman and Robèrt, 2017; Robinson, 2004). Broman and Robèrt claim that their framework can also be used for cross departmental collaborations which can further help a company have a common vision/fulfill a common goal. For example, Phillips used FSSD when they wanted two of their departments (sustainability and innovation) to collaborate. (Broman and Robèrt, 2017; Seebode, 2011)

Interviewees suggested that a game can be used as a tool to bring different departments together. That is how the theme game as a socializing tool was formed. This need for collaboration is also related to the other challenge which interviewees mentioned that sustainability is often viewed as something ‘external’ or like an ‘add on’. They suggested that it should be more within the structure of the company and decentralizing the sustainability department into different departments can help achieve that.

*Game Application:* From the interviews it was clear that communication and understanding each other's perspective is vital when it comes to implementing sustainable practices. Due to this, in the game there is a rule about dividing the team into two 'perspectives'. 'Financial perspective' members will evaluate actions from a financial standpoint whereas 'sustainability perspective' will think about it from a sustainability standpoint and then the team needs to discuss which action to take. This discussion is analogous to need for communication across the company. Secondly the swapping of the 'perspectives' after three rounds further emphasizes that a problem needs to be evaluated from different perspectives and exchanging these perspectives will give players a better chance to understand each other's position.

Another issue highlighted by interviewees was that oftentimes their managers' performance is judged by how much financial profit they are bringing for the company. Due to this, non-financial targets are not prioritized. As F explained:

"...So, I mean, if we're only having like bonus systems, and so on, that aim at the profitability of your business area. You're not going to be focusing on the non-financial part of it. So, I think that's also a big change very much needed...have incentives for working much more with non-financial targets, but also to be able to be held accountable if you're not reaching the goals..."

S/he further explains that the problem is not just the way performance is measured but also that there are no consequences if one doesn't achieve the non-financial targets whereas for financial targets employees get fired as well. F further added "...many industrial companies, see still sustainability as cost... it might be that the short-term perspective wins because you're like chasing quarterly figures to be good. Instead of seeing this as a long term...". W also said something similar,

"...They (department heads) are incentivized by, by how well their department is performing money wise. But they are not in any way incentivized how their department is performing sustainability wise and then people are not going to be so interested when you get out to their department to make changes for sustainability..."

This problem is in line with previous discussion about difficulties in implementing sustainable practices by Epstein and Buhovac where they have discussed a challenge of 'setting clear and measurable goals' for sustainable development. Another challenge they addressed was 'financial incentive pressure' where managers might be chasing short term profits which is what interviewee F also pointed out. (Epstein and Buhovac, 2010) Hristov and Chirico (2019) address a similar problem in their research about integrating sustainable development with company strategy. They found out that it is a common challenge for companies when it comes to selecting proper key performance indicators. It is easy to deal with problems related to sustainable development if companies use performance indicators which include parameters related to sustainable development.

*Game Application:* The game aims at showcasing this problem and emphasizes the need for a balanced approach between economic development and sustainability. The narrative of the game was inspired from above quotes and it showcases how initially the sustainability department was facing resistance from the budgeting team when asked for financial allocations. The priority for the budgeting team was to show good numbers to show financial growth due to which they were prioritizing non sustainable practices.

#### **6.3.4 Theme - Social dimension of sustainable development**

Several interviewees talked about the social dimension of sustainable development in terms of health and safety of their employees, anti-corruption policies, employees' rights, diversity and equal opportunities. Some of these topics again tie back to the challenge of complex supply chains for e.g. as P said "...the chain can be very long. And in the end, you can have like two, three, four steps away, you will have someone in the end that has hired a company that are not providing good wages or are not providing the safety needed for their personnel...". Apart from supply chain interviewees also talked about diversity. Diversity in terms of gender, having more female employees. For example, S said "... We are about 18% of females in managerial positions and we have an ambition to 2030 that one out of three will be women in management positions". Also, F said something similar "...we are aiming at the 30% minimum when it comes to female, female employees at every level of the company..."

During the talk about diversity, interviewees also mentioned that their companies had policies against discrimination. But it was fascinating that two interviewees agreed that diversity was something which was needed more, and their companies were putting efforts towards it. For example, A's company was using a card game to spread awareness about diversity amongst employees. Whereas S said "...we work on the diversity in our management teams because we have a very Swedish set up of our management teams. So, we need to get more diverse there as well..."

When it came to employee rights interviewee E also talked about ringing the bell anonymously, "...how we take care of our employees when it comes to health and safety but also that they have an opportunity to inform an owner anonymously if something happens if they see something which they do not think is right..."

These topics discussed by interviewees are in line with the sustainability principles described earlier in the framework. The last 4 sustainability principles are about social sustainability. Which includes employee safety and health, freedom of speech and accepting opinions on practices at organization, freedom to learn, self-growth and develop competences, no discrimination based on different grounds when offering opportunities like job positions, promotions, etc. and also making sure that an

organization respects culture and community of which employee might be a part of. (Robèrt et al., 2019) These topics are also in line with some of the SDGs as some of the companies interviewed used SDGs as their guiding compass.

*Game Application:* The current game design and the actions are not addressing the social issues like discrimination, diversity, etc. But there are some actions which can be related to health and safety (SP4). For example, action A2 is about phasing out lead from circuit board solder. That can be viewed as a step for employees (risk of mishandling of tooling and/or source of lead-based solder is reduced thus preventing lead poisoning) and end user safety (end user not coming in contact with lead). Action A3 is about phasing out flame retardant materials like chlorine and bromine. So, in case if TV catches fire, the user will not be exposed to chlorine or bromine which are poisonous. Action D4 is about replacing the fluorescent tube with LEDs which reduces the chance of a user being exposed to mercury vapor. From an environmental and user experience point of view it reduces power consumption as well.

### **6.3.5 Theme - Board games as a socializing tool**

Some of the interviewees had played board games in their personal lives. They highlighted that playing a board game had a social element as they got a chance to hang out with their friends, family or colleagues. As interviewee A said "...I think it's a fun way to hang out with others". Considering this point some of the interviewees had suggested that board games can be a good tool to bring different departments together from a company perspective as discussed in one of the previous themes. As G said "... if it's (board game) about raising awareness and bringing more people on board, I would definitely see value in that".

A similar take from Azizan et al.'s (2018) study was explained in literature on board games. Their study showed that through board games students improved teamwork skills which also led to improvements in their communication skills. Earlier in the study students did not enjoy teamwork as tasks would be divided and then combined in the end which also led to some free riders. But through board games students did appreciate being in teams and connecting with one another. Also, Boghian et al.'s (2019) study showed that board games can help improve communication and teamwork.

*Game Application:* The board game aims at helping company employees socialize. That is why it is mentioned in the team formation that teams should be formed in such a way that each team has members from different departments. This way they will get to know each other better. In case if the game is used as a training tool for new employees then it can give a chance to new employees to meet other new or already existing employees.

### **6.3.6 Theme - Critical opinions on board games as an educational tool**

Depending on their personal experiences, interviewees threw some light on how some educational games can be less interesting to play. Interviewee P said, “For me it took focus from the issue because it all came down to what the game rules were and learning those”. A said something similar “...we had to write down every single transaction... I didn't think it was fun at all. It removed all the fun away from the pressure of making the bookings right...” Girard et al. (2013) also emphasized this point that whether a game will be effective and lead to player engagement depends on various parameters such as mechanics, design, scenario, etc. Apart from these elements it also depends on the individuals who are playing the game. According to Fors (2019), instead of just emphasizing on rules and mechanics (ludological elements), narratological elements can increase the player’s involvement in the game. Zagal et al. (2016) claim that a narrative is needed to make a game entertaining, and a well-designed game should be similar to a well-written story.

Another interesting point A brought up was oftentimes big companies have tight schedules and convincing people to try to use a board game can be a hard task.

“I think if it is marketed as a game. I think it can be hard to get people and you know, spend time on it because often in our company, you're very you have a very tight agenda, you have many meetings you need to deliver...maybe be called something else than a game to just mean that it's some type of collaboration, solution, platform or planning tool or something. And then I think it could be used on all levels. I mean, especially white collar...”.

This view from companies was mentioned by Treher ‘The view that games of any kind are inappropriate for adults is held by many business executives who see their activities as serious and don’t understand the power of play and entertainment in learning’ (Treher, 2011, p.2).

Considering above mentioned interviewees’ opinions there are chances that some of the players may not enjoy the game because of its mathematical approach. But thinking from a realistic perspective, revenue is an essential part for any company. And sustainability can help in increasing this revenue (Robèrt et al., 2019). Numbers can be a good way to appreciate and witness the benefits of sustainable practices.

### **6.3.7 Theme - Positive opinions about board games as an educational tool**

Majority of the interviewees had positive opinions on using board games as an educational tool. They emphasized on various aspects like increase in engagement, better visualization of problems, a safe way to make mistakes, etc. Interviewee G said “... I think also like being able to visualize a problem better. And I think it always helps to, to, to increase the efficiency of learning... when all your senses are in

demand.” Interviewee E elaborated that s/he found learning through board game better than conventional techniques:

“...I found it (business board game played earlier) really, really educational even more than if I would have read it from a book or school would have told me...I think that it was more real, it was more like you really did get to see what effect to which thing or item and the links between the items and I found that I learned more from that game than I did from trainings or lessons or reading material.”

P said “...(through games) they (young people) can learn things and do things and test things without being worried or afraid of what will happen...”. G’s take on increasing learning through increased engagement was also discussed in the previous topics where researchers claimed that learning is better through games because students are applying the concept which involves experience which further allows them to connect with the subject emotionally (Hense and Mandl, 2012; Boghian et al, 2019; Evensen et al., 2009; Hoy, 2018). Perrotta et al. (2013, p.19) claim that there is a ‘positive relationship between gaming in the classroom, learning outcomes and motivation and engagement’. P’s opinion on games providing a safe environment to make mistakes is in line with several researchers who claim that games provide a ‘non-threatening environment’ where players can ‘mistakes without suffering real-life consequences’ (Treher, 2011; Boghian et al., 2019, p.55; Uribe and Cobos, 2014).

*Game Application:* Considering the fact that games do provide a safe environment to make mistakes, the current board game provides some actions which can be fun and interesting to experiment with. For example, action F2 is about acting in an opposite way to the situation F where TV manufacturers have created a new standard for a certain parameter. Action F2 is about ignoring the competition, whatever other manufacturers are doing by lowering the prices of TVs to compensate for the sales loss which might happen if the company does not want to adopt to the new standard. Even though this action doesn’t seem right, players are allowed to go for it to encourage experimenting. Another such action is F4 which is about carrying out the whole manufacturing process in house. Even though the game encourages collaboration, this action opposes it. This action was inspired from the supply chain management course in which there used to be discussions about when to collaborate, produce in house and its pros and cons etc. So, the game provides an option for players to experiment and see what happens if everything is carried out in house.

### **6.3.8 Theme - Companies using games as an awareness tool**

Out of eight companies interviewed, three companies were actually using some kind of a game to spread awareness about topics related to sustainable development. A’s company used a card game in lunch and coffee rooms which was about spreading awareness about diversity and to encourage employees to respect diversity in the

workforce. T's company had made a game about sustainability on the company's intranet which was accessible to all company employees. All employees were encouraged to play the game and spend some time on it. F's company also used a card game which was about climate awareness. It was about things like emissions and other topics where one had to guess which particular event out of two would create more emissions and so on. Companies using games as a tool to teach different topics related to sustainable development is fascinating and was not expected before the interviews.

### **6.3.9 Theme - Improving understanding through relatable examples**

A few interviewees suggested that the board game should help in improving understanding about numbers or size by giving relatable examples. Along these lines G explained:

“...it's always good to have to have like, key facts and numbers that the user can understand...for example...it's 50 million tons E waste per year that is accumulated... This is something that we like I couldn't, like, I don't understand what is 50 million. It's equivalent to 5000 Eiffel Towers, for example, I always think, like comparison with something that is more relatable or more understandable, is always helpful.”

Similar explanation was also given by E:

“...How much is how much if you understand what I mean...let's say 50% Okay, it's (renewable energy%) 50% but if it was 30% what it mean then if it was 70% What would it mean then so that people don't really understand when we give them only the numbers. So, I would like to show them what would it mean... when talking about the energy consumption are we talking about like a one light bulb or are we talking about 1 million light bulbs? So, get an idea about how much is how much.”

Along the similar lines W explained that if someone is travelling on the other side of the globe just for two meetings then the amount of emissions caused can be equal to a huge number of other polluting activities. S/he concluded, “So, I think like this kind of information to kind of understand the size of different things can be interesting.”

From a broader perspective, they are trying to say that understanding can be improved by giving relatable examples. People who are not technical experts may not understand percentages of renewable energy or tons of emissions etc. But they will understand when compared with common things like light bulbs. This aspect was mentioned earlier that one of the intrinsic features of a well-designed board game that makes learning efficient is by providing several examples to improve understanding. A well-designed game not only provides examples but also allows to link information through ‘analogies and metaphors’, explaining concepts in a format which is easily digestible. (Treher, 2011)

*Game Application:* This board game was not able to fulfill the request of interviewees to have metaphors or analogies which would make it easy to understand numbers. But certainly, this board game does provide examples to understand a concept at different levels. From a broader level, the board game is an example to show the importance of balancing economic growth and sustainability. It is also providing a basic understanding of the Broman and Robert's framework which would make it easy for the companies to apply FSSD later on for their specific scenario.

From a narrower level, the board game aims at explaining and applying the operational procedure. Also, as described earlier many of the actions in the game are associated with the sustainability principles (SPs). Similar to the above examples, these actions are the applied version of SPs. This might further help companies to think and relate sustainability principles and actions they can take depending on their situation.

#### **6.4 Debriefing session after playing**

Once all the teams are done playing and the winner is announced, a debriefing session should be conducted. Aim of this session is to explain some of the topics described above. These topics are comparison of ABCD procedure in the game with the one in the framework, the reasoning for some of the rules of the game and their educational motive, followed by association of some of the sustainability principles with the actions. Once these topics are covered, teams can have an open discussion about their decisions, actions, what they could have done better to win and so on.

## 7 Concluding discussion

*This chapter summarizes the journey of this research, along with thoughts and rationale behind certain decisions followed by addressing the research questions. Answering the second research question also covers academic contributions implicitly. Furthermore, practical contributions are discussed which end with ethical implications. The chapter ends with limitations of this study and suggestions for future research.*

One of the objectives of this study is to provide a better understanding about sustainable development through an engaging learning medium. In order to fulfill this objective, the first task was to explore sustainability in detail. Exploring the subject soon revealed its multifaceted and complex nature. There are several aspects which make the subject complex. For example, it is always growing and changing, and it incorporates multiple disciplines (UNESCO, 2005; Despeisse, 2018). An example of multiple disciplines is the three-dimensional approach of sustainability which has its own ‘wicked problems’ as explained earlier.

Even though the subject is challenging, it is important to understand it because it plays a vital role in improving the quality of life from an anthropocentric perspective. From a deep ecology perspective, it is important to understand the benefits of living in harmony with the surroundings and value the source (environment which is feeding the survival of humans as well as other living beings) without overexploiting and damaging it (Kopnina et al., 2017). In the current Anthropocene era human activities are the key factor affecting the Earth systems (Rockström et al., 2009). Human activities have a wide range of actions starting from an individual lifestyle to functioning of huge organizations like governments, NGOs, companies, universities, research bodies, etc.

Companies play a vital role in sustainable development (Agarwal et al., 2017; Gilli et al., 2016; Hristov and Chirico, 2019). Therefore, it is important to persuade them to understand sustainability as well implement sustainable business-related practices. This persuasion can be done in several ways such as by providing better understanding (or education) about sustainability, by showcasing benefits sustainable practices can bring, by demand from higher authorities such as governments through law and regulations, demand from other stakeholders such as consumers, suppliers, etc. Better understanding about sustainability (or education about sustainability) can be provided through different mediums like workshops, training seminars, guest lectures, simulations, field trips, etc.

Education for sustainability demands a learner centric approach with several skills such as problem solving, simplifying complex situations, systems thinking, critical

thinking, etc. (UNESCO, 2005; Fabricatore and Lopez, 2011). Several studies show that GBL can help one learn these skills in a fun and engaging way (Fabricatore and Lopez, 2011; Uribe and Cobos, 2014; Dahlin et al., 2015; Boghian et al., 2019). Well-designed games can be a combination of ‘hands-on’ and ‘heads-on’ approach (Treher, 2011). Hence, a GBL approach was selected for this study.

GBL approach was further streamlined to board games as board games not only enable one to learn aforementioned skills but also allows to practice knowledge transfer (Uribe and Cobos, 2014). They also have a significant impact on motivation, knowledge retention, teamwork, communication, etc. (Treher, 2011; Dahlin et al., 2015; Despeisse, 2018; Hoy, 2018). Additionally, they provide experience-based learning in an environment safe to make mistakes (Boghian et al., 2019; Treher, 2011). Since sustainability is broad and multidisciplinary, it was a challenge to decide on a specific topic for which the game should be developed. Also, a broader approach was preferred considering companies may have challenges in different aspects of sustainability. This led to exploration sustainability-related frameworks. It was clear that one of these sustainability frameworks would be selected for the game development, but the question was:

*How to incorporate a sustainability framework while designing a board game?*

To answer this question, a specific framework had to be selected from the ones which were studied. FSSD was selected to be the core foundation of the game. One of the vital reasons for selecting FSSD was that the other frameworks were highly academic, meaning, they were good at providing knowledge and awareness about sustainability issues, but were not meant to be directly utilized to address sustainability challenges of an organization. On the contrary, FSSD is developed keeping in mind the usability factor, something which can be adopted by organizations to transition towards sustainability (Broman and Robèrt, 2017; Robèrt et al., 2019). Detailed reasoning for selecting FSSD has been covered in the ‘theoretical frameworks’ section.

It was a challenge to select specific concept(s) from FSSD to be the part of the game, as it is important to understand the whole framework for the implementation process. After understanding the framework, any organization will have to follow the operational procedure to implement/initiate sustainable transition. Thus, the operational procedure plays a vital role. Along with the operational procedure, the sustainability principles are also important because they are used as a reference in some of the steps of the operational procedure. Hence, these two concepts are critical and were selected to be part of the game.

In order to design the game, different game design models/frameworks were studied. As discussed in the ‘theoretical frameworks’ section, these frameworks addressed

various aspects of game design such as motivation, game mechanics, narratology, teamwork etc. Some frameworks were specific about each step of the game development, whereas others were broad like the triadic framework which discusses multiple aspects such as pedagogy, play, and fidelity. (Rooney, 2012; Evensen et al., 2009; Shi and Shih, 2015; Larsen, 2018; Akmal and Coulton, 2019).

The game design framework was selected based on the requirements of using a framework from the subject which the game aims to teach as an input and following the two-fold approach. The two-fold approach considers inputs from companies about sustainable development and GBL, and analyzing them, followed by using these analyzed inputs for game development. Additionally, having theoretical aspects such as literature review as a part of inputs was preferred. The closest fit to these requirements was Evensen et al.'s model. None of the game design frameworks studied, addresses the first requirement which is the uniqueness of this thesis. This is further discussed in the upcoming section.

Evensen et al.'s model was modified by substituting Generative Research with FSSD and analysis of Generative research with thematic analysis of interviews. The modified version was utilized to develop the game as described in the Analysis section of this research. Apart from the game design framework, there were other inputs which were not directly utilized in game development but did help in enhancing understanding about board game designs. For example, board games from Snowflake Education were studied to see how board games function, what are the different features which distinguish one board game from another, what are the game mechanics involved etc. Additionally, some articles on game development were also studied which described why certain board games work, what are the lessons to consider from these board games, what are the pitfalls of board game design. For example, if a board game is designed in such a way that one player starts to lead the whole team and s/he decides everything for the team then it defeats a key board game aspect of encouraging teamwork (Zagal et al., 2006). One solution suggested for this problem is to give players different roles and abilities so that every player communicates and contributes in decision making (Ibid).

Game designing in itself is a vast subject and it is very easy to get sucked into the related literature. Therefore, it is important to have a framework for game design which can help put some boundaries by providing clarity on inputs and steps which should be considered for game development. Evensen et al.'s model not only did that, but it also provided a structured approach for this thesis. Modifying this framework aided in development of a game which has FSSD at its core, but after developing it, the following question arises:

*What are the benefits of incorporating such a framework in a board game?*

This question allows one to understand the significance of incorporating FSSD into a game. The benefits can be viewed from different perspectives. First, discussing the benefits to Evensen et al.'s model, the modifications done to it, make it theoretically robust or increase the 'academic' aspect of the model. The original model does consider literature review as an input, but most of the other inputs such as interviews and generative research are practical in nature. Also, the analysis step of the model is practical in nature as it involves discussions amongst the researchers on the notes taken during the workshop, on the game models obtained during the workshop etc. and these discussions led to new ideas and design decisions which finally leads to coming up with game concepts. (Evensen et al., 2009) This approach is more about developing something from workshops and interview data using the knowledge and experience researchers have in the design domain. This approach is feasible when there are multiple researchers involved who can discuss and analyze amongst themselves to build up a concept from the generative research workshops (which included members from the client organization as participants (Ibid)) but carrying all this out is resource and time intensive.

On the contrary, the modifications done to this model not only make it more academic/theoretical but also easy to use for research such as a master's thesis where there might be a single researcher with limited resources and time. Hence, the modified version of Evensen et al.'s can be considered as one of the contributions of this study. A question one might have is, why is the modified version getting a theoretical edge? This is because when a framework (FSSD) is added, it also changes the analysis procedure. The analysis carried out in this thesis uses the framework (and some parts of the literature) as a lens to analyze the interview inputs which are then used in the game development, unlike the original analysis step, which does not include juxtaposing data obtained from workshops or interviews with literature or theoretical frameworks. Thus, having a framework as an input provides an academic or theoretical 'layer' or 'cohesiveness' to the game development.

Another benefit which was observed by incorporating FSSD, was that it made developing some aspects of game mechanics easy. For example, the ABCD procedure provided the core mechanism which drives the flow of the game, starting from Step-A and ending on Step-D. So, it was clear that ABCD should happen in a fixed order (in reality there can be going back and forth across all 4 steps but for the game it can be assumed to be linear). The challenge was that the authors strongly suggest that ABCD procedure should be repeated on a regular basis in order to start moving towards the vision (Robèrt et al., 2019). They are suggesting this because in reality, the scenario is usually complex which means one workshop will not solve everything, and a company will need several workshops. But in the game, the aim was to keep it simple and yet symbolize the repetition aspect, which led to the idea of having multiple rounds. And to drive these rounds, events/situations were necessary, which

are provided as part of Step-A, to make the process simple (instead of players coming up with some type of a vision for the company). The financial aspect of the game was inspired from multiple sources such as interview inputs, Robèrt and colleagues (emphasizing investments, long term approach, etc.) and the idea that companies would be playing this game.

From an educational perspective, involving FSSD in the game, provides a new learning medium for FSSD. Broman and Robèrt claim that understanding the basics of FSSD is easy but it is hard to utilize its full potential. A good amount of learning and training is required to master the skill of using FSSD. The researchers compare it to chess; ‘Learning the principles of checkmate is easy, but chess is much more, and becoming a skillful chess player takes significant effort’ (Broman and Robèrt, 2017, p.28). The developed game can be a good way to educate and train learners about FSSD. There can be two approaches for learners. The game can be used to introduce learners to this framework so that they would understand the fundamentals of the framework such as sustainability principles and the operational procedure and its application. After playing, it would be easier to understand the theoretical aspects of the framework. For example, during a conventional lecture when they are explained about backcasting, they would have already applied that through the 4 steps in the game. It would be easier to understand the theory behind the game after playing it. The lecturer can also use examples from the game while teaching the framework conventionally. This will make it easy for learners to relate with, while studying the framework. The second approach can be teaching FSSD through conventional lecture first and then provide the game as an application-based learning tool. In this scenario, in case a learner has not understood something during the conventional lecture, then s/he will have a second chance to better understand that concept.

Even though the game is developed for companies, the benefits from an educational perspective have been showcased and thus it can be utilized by management and/or business students. An immediate question can be, why should management students use this game and learn about FSSD? Playing the game and learning about FSSD will provide them with knowledge and understanding for a strategic approach for sustainable development. Apart from that, it is important to notice that FSSD goes beyond the conventional practices of management. For example, management as a discipline considers forecasting as an important tool. It can be used for predicting sales, predicting market trends for the future, etc. The challenge which comes with forecasting is that it uses current trends and practices as a starting point, but what if current practices are the root cause of the problems? What if an organization wants to remove/change these practices in the long run? For these types of scenarios, backcasting is a better option. While keeping backcasting as the main approach, forecasting can be used as a tool which might help in decision making or prioritizing certain actions.

Imagine a management employee who has been working for several years using forecasting at his/her company, and the company decides to implement FSSD, it will be hard for him/her to understand some of the concepts of FSSD as they are based on backcasting. Or s/he will not easily accept backcasting because that person would have always practiced forecasting for years. So, it is better to introduce FSSD and show the 'other' side when one is a student to allow that person to be more open to other perspectives which s/he may face in the future.

Hence, as discussed above, incorporating FSSD in a game provides mutual benefits to both, the game design as well as the sustainability framework. From one side, incorporating FSSD has given a theoretical or an academic edge to Evensen et al.'s model, and has made some of the game mechanisms easy to develop. On the other side, the developed game extends FSSD by providing a game-based learning tool.

### **7.1 Ethical-Practical Contributions**

Implementing FSSD for a company's individual scenario can be a lot of work such as understanding various concepts from the framework, evaluating the company's current practices with respect to sustainability principles, modifying the vision etc. But if the company members conduct a game session first, then at least the concepts like backcasting and working of ABCD procedure will be clear to them which will in turn ease the implementation process.

Usually for companies when it comes to FSSD, the primary mode of learning is through workshops. Initially they will be introduced to the theoretical parts of FSSD during the workshop which will be followed by an application process for their specific company scenario. Companies briefly learn about FSSD and then jump towards the application process. In my opinion, this approach lacks a middle ground. On the contrary, playing a board game after the introductory session can act as a sandbox, providing a safe environment to make mistakes and achieve clarity in case they have not understood a concept. It can help deepen the understanding about FSSD and how to apply it. It is also possible that companies might be able to relate to certain scenarios in the game with their own situations, which may help them come up with new ideas. Or the opposite may happen that after the game session, a company might think that FSSD won't be suitable for their situation or they may first want to dig deeper about its usability, profitability etc. There are real life cases where companies have used FSSD (Broman and Robèrt, 2017; Robèrt et al., 2019). So, a company can look into those cases to understand how other companies have leveraged it. It might be possible that another company in the same industry has used it, thus making it easy to understand the case.

Furthermore, the interviewees from various companies found the idea of game creation based on ABCD procedure interesting. They did see a potential in creating

such a game and using it for their respective companies. As P said “I'm starting to think that this would be a good tool not only for my sustainability work but for innovation board that I was talking about...” E mentioned that the idea can be used as a training tool, “...a good training method for blue collars and white collars to understand more about sustainability issues and how we can affect our outcome...I could see this to be one of the like, introductions to when the new employee, for example comes into the company...” And lastly F said “...I think that's a really good idea to facilitate the usage of the ABCD procedure, so it doesn't, so it's not something theoretical anymore...”.

The greater goal is to create awareness about sustainable development using the game. To help companies understand the importance of sustainability not only from ecological or social perspective but also from an economic perspective. Oftentimes sustainability is viewed as a cost, but if implemented strategically, it can be a competitive advantage. As stated earlier, companies are motivated to implement sustainable practices due to various reasons. Implementing FSSD can help them transition towards sustainability in a systematic way depending upon a company's individual scenario. The framework gives them flexibility to have a long-term plan in which different actions can have different time frames. A long-term approach can also help a company change its vision (if necessary) to include sustainability as part of the vision. With sustainability as a part of vision, a company can gradually start integrating sustainability into its structure. Once it succeeds in implementing FSSD, it can further influence other organizations to utilize FSSD. This will directly or indirectly result in society becoming more sustainable. One real example of such a scenario is when two departments (innovation and sustainability) at Phillips used FSSD to collaborate with one another (Seebode, 2011). After succeeding with FSSD, the company further suggested municipality of Eindhoven (Netherlands) to use FSSD to encourage sustainable living lifestyle, which further resulted in housing corporations collaborating with one another to work towards sustainable living (Ernst and Budde, n.d.).

## 7.2 Limitations

During the time of working with different topics like literature, frameworks and thematic analysis to develop a board game, there were some limitations which were identified. The first part of this section describes methodological limitations of qualitative approach, followed by various other limitations of this study as discussed below.

**External reliability:** This means to what extent can a research be repeated and its ability to achieve similar results. This can be a challenge as qualitative approach is subjective and depends on the researcher, as the researcher is involved in data collection for example through interviews. Even during interviewing, the questions which are developed on the spot can vary from person to person. As the research proceeds, it is up to the researcher to consider what is important and needs to be further developed and what can be neglected. Even certain interpretations are based on the researcher's personality and thinking process. (Bryman and Bell, 2011) Due to this, there are chances of personal bias. In order to avoid personal bias in the thematic analysis, the first order categories were developed on the basis of repetition of words or phrases. Also, when it comes to thematic analysis there are chances that context can be lost but an effort was put in to minimize that.

There were other measures taken to fortify reliability of this thesis. For example, the interview questions were reviewed by the subject reader and the supervisor and there was a pilot interview conducted to refine the questions. As mentioned earlier, a brief description about the thesis, research purpose along with interview questions were provided to potential interviewees in advance. Additionally, the sampling strategy, data collection and the process of thematic analysis is well described which would ease the repetition process thus making this thesis more reliable.

**External validity:** This means how far can the results of the study be generalized (Ibid). This can be a challenge as the current pandemic situation made it difficult to convince people to participate in an interview which resulted in a small sample size of eight participants. Also, other parameters like location and culture play a role (Ibid). For this study all the participants are based in Sweden. Sweden is an active country regarding sustainable development. There are strict laws regarding emissions, as well as companies are expected to show their data related to sustainability parameters like energy consumptions, emissions, etc. Due to this companies are aware about sustainable development. The results of this study can vary if it were conducted in some other country.

Even though these challenges do exist in terms of external validity, they are not significant considering the bigger picture which is the developed board game as a result of this study. The board game is not developed only on the basis of interview

inputs and thematic analysis. The core element of the board game is the ABCD procedure which doesn't rely on a qualitative approach thus making external validity less relevant for this study. Other elements of the game, such as the 'actions' are not exclusively inspired from interviews but are also developed considering sustainability principles. Thus, the game has been developed considering theoretical frameworks, literature, and interview inputs (thematic analysis). Since all these inputs are responsible for game development, it makes the challenges of external validity less significant.

The current approach for this study involves interview inputs provided by the employees in the sustainability departments of different companies, followed by a thematic analysis which was later used as an input to game design. This thesis could have been approached in a different way if more actors were involved in the interview process. For example, for every company three actors could have been selected, as in from the engineering/production, management and the sustainability department. Then it could have provided a broader view considering different employee positions and their take on sustainability. But due to time constraints and limited resources this was not carried out.

This thesis was not able to carry out a generative research for data collection and design phase. Carrying out a generative research is beyond the scope of this thesis as it is a resource and time intensive process. Also, the current Covid-19 situation makes it hard to conduct workshops for such research. But modifying the game design framework by substituting generative research with a framework has provided new insights as well as made the design framework more usable for researchers with limited resources and time. A similar reasoning is also true for not carrying out the steps in Evensen et al.'s design model after conceptual prototype.

The current version of the game design does not emphasize a lot on social sustainability principles. Some of the actions of the game does consider health and safety of employees or users (SP4) but there are no actions related to discrimination, freedom of expression, etc. as the nature of the game is technical rather than social. From a game design perspective, it is a challenge to develop a game which can address all sustainability principles/all three dimensions of sustainability. However, in reality an organization should always follow social sustainability principles or ensure that its action in economic or ecological dimension is not negatively affecting the social dimension. It is important to remember that all three dimensions of sustainability are interlinked with one another.

Lastly, the current game design involves mathematical calculations which may not be appreciated by everyone. Certain people like calculating whereas others find it too complex. So, certain people may not appreciate playing the game. Additionally, as

Treher and an interviewee pointed out sometimes companies do not consider a board game as a learning tool. They think as a company they do not have time to play games (Treher, 2011).

### **7.3 Future Suggestions**

Aforementioned limitations can be used as an opportunity to carry out research in the future as mentioned below.

A new study can be conducted involving different actors (instead of only employees at sustainability positions as explained above) which might lead to new insights about sustainable development and provide a different solution to move towards a sustainable society.

This thesis discusses the benefits of incorporating FSSD in a board game, but there can be multiple studies done which can use this idea of incorporating a framework in the design process. These studies can use different sustainability frameworks and design games around each of them. Once these studies are done, a separate study can be initiated to draw broader conclusions about using frameworks of the subject which game aims to teach for game design.

Considering the current pandemic situation, gathering people to play games is not advisable but a digitized version of this game can be created. Maybe an online version which can be used by players at different locations. Additionally, in the current game, the fun element is looking at the other team's revenue and sustainability points to compete and see who is doing better. There is a scope to introduce more fun elements. The game can be further developed to include more elements from social sustainability such as discrimination, respect, equal opportunities, etc. An easier version of this game can be created by reducing/changing the mathematical calculation aspect and this version can be used for different target groups such as high school students.

## 8 Author's note

It feels good to notice companies implementing sustainable practices to move towards sustainable development. It looks convincing to see a reduction in energy consumption, CO<sub>2</sub> emissions, material usage, etc. on sustainability reports. All these changes are important, but I tend to agree with Robinson that technical fixes are not enough (Robinson, 2004).

After studying sustainability for this thesis, I think that when it comes to sustainability it is important to dig deeper and think critically. Sustainability is complex and there are various challenges as mentioned earlier. For example, SDGs are helpful but there are challenges associated with it as well. Oftentimes what companies do is, select a few SDGs which are relevant and convenient for them to work with, and later they showcase it as sustainable contributions. Simply by adopting certain SDGs a company cannot become sustainable.

Utilizing a sustainability indicator doesn't always mean that an organization is sustainable, it also depends on how that indicator is utilized. For example, carbon credits seem to be a sustainable practice, but it can also have deeper unsustainable roots. They can be earned by planting trees but usually what big companies do is that for planting trees they will buy that service from a forestry company. Oftentimes these forestry companies have licenses to take over the lands which are used by farmers. And these farmers are poor, supporting themselves and their communities through farming for years. Sometimes apart from taking away the land, they are not even provided any compensation. (Raworth, 2012) Another example could be outsourcing production in a different country with liberal laws related to sustainable development. I don't consider that as sustainable. Thus, it is important to have a deeper look when it comes to sustainable practices.

Furthermore, I would like to mention a challenge that was pointed out by the interviewees and literature. Oftentimes the performance parameters do not include sustainability instead, performance is measured through financial gains which make employees prioritize financial gains over sustainability. Two of the solutions suggested by both interviewees and literature are: Firstly, making sustainable development as a vital part of the structure of the company (instead of treating it like an 'add on') by using performance indicators which also take sustainability into account, and decentralizing sustainable department into various other departments of the company. Secondly, cross disciplinary collaborations should be carried out. Several sustainability-related problems are complex and cannot be solved by an individual organization. For example, issues related to complex supply chains. If a company manufacturing electronic products wants to ensure that the minerals being used are ethically sourced, then that will depend on the supplier as well. Each company involved in the supply chain will have to jointly work to prevent unethical mining. Hence, collaboration is an important practice to be sustainable. There should also be strict laws in place to ensure that sustainable practices are carried out and promoted. It is critical to understand that sustainable development is for the whole society so different actors need to act individually as well as jointly to transition towards sustainability.

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## 10 Appendix A 5-Level Model

Transformation for sustainable development can be a complex process. Proper planning is required when dealing with complex processes. Information required for planning can be categorized into 5 levels. These 5 levels are: System (in/for which the planning process is carried out), Success (what is organization aiming to achieve), Strategic guidelines (which can help in moving towards vision strategically), last two are actions and tools which can be used to execute the set goal. (Robèrt et al., 2019) Figure 15 shows 5 Level Model.



*Figure 15: 5 Level Model*  
*Source: Robèrt et al., 2019 p.28*

**System:** This is a broader view which considers various parameters for functioning on a global scale. Like human society, functioning of different natural systems, environmental regulations, biodiversity, trust on various scales like other individuals, on governments etc. it also includes how human activities are affecting these systems etc. An organization can also be considered as a system and then how it is using natural resources and its impact at local and global scale. Who are the other stakeholders for this organization? How are they functioning as a network? How is the network affected by organizations unsustainability etc. Overall this about looking at a bigger picture. Authors have given an example of chess game where system comprises of the board and how it works, different pieces and rules which guide their movement. (Broman and Robèrt, 2017)

**Success:** This level is about what an organization wants to achieve in the long run. What is the vision? One may include the core value and principles of an organization. The vision must use sustainability principles as a reference frame to move towards sustainable development. Additionally, apart from sustainability, other long-term goals can also be considered. Again,

comparing to a game of chess, there are fixed rules of achieving a checkmate but there are huge number of combinations of how pieces can be moved to reach one. (Ibid)

**Strategic guidelines:** These are the guidelines which will be useful to move towards the vision in a strategic way. These guidelines can be broad and general but for a specific organization they might have to add more guidelines. This depends on an individual organization for example guidelines about prioritizing certain actions etc. Some elementary suggestions by the authors is that these guidelines should be in such a way that taking steps towards sustainability becomes easier as in if certain steps are taken first then the steps coming later become easy to execute. Also, there should be a balance between the actions taken and return on investments. Authors also warn that strategic guidelines should not be confused with a 'strategic plan'. While planning these guidelines should be considered, but they are general whereas a plan is specific for an organization. (Robèrt et al.,2019)

**Actions:** Keeping the vision and strategic guidelines as a reference, an organization creates a strategic plan where specific actions and their order is decided. These actions can be various things like replacing certain materials, employee training to create awareness about sustainability, collaborating with suppliers to solve certain challenges, reducing emissions by bringing in new practices etc. (Broman and Robèrt, 2017)

**Tools:** These include different types of things such as tools, procedures, models etc. which can be utilized in implementing and monitoring above actions. Not only monitoring and implementation but also things which will help in making the right choice for e.g. simulators, indicators etc. Tools which can further improve planning and management can also be included. (Ibid)

## 11 Appendix B Interview guide

Part-1 of the interview will be about general sustainability and Part-2 will be about the concepts which I want to use to design the game and see if the interviewee sees the value in it. \*Certain details from part-1 can be anonymized if the interviewee is not comfortable in sharing the details. For e.g. person's name and company name can be removed or replaced by an alphabet, position in the company can be generalized instead of stating the exact position/role of the interviewee. Also consent of the interviewee will be taken if s/he is fine if the interview is recorded.

### Part-1

What is your name? \*

Which company do you work for? Can you briefly describe what is the company about?\*

What is your current position at the company? \*

What do you do in this position? \* (OR Can you please describe your current role)?

How long have been into these types of positions at current or other companies? \*

What is sustainability/sustainable development according to you?

Does your company implement practices for sustainable development? If so, then how? OR  
How is your company implementing sustainability development? *Ask to give some examples of different practices that they have implemented, why these were implemented? What was the result/effects of these? Try to go in depth here.*

What are the challenges you/your company faces in implementing sustainable development? *(this can be 2 questions in a way one at a company level and other at the personal level like what are challenges for his/her team)*

According to you, how can we solve these challenges?

## Part-2

Do you play games often? (in any form like video games, board games etc.). If yes, which ones? What do you enjoy the most about these games?

Have you played board games before for training/educational purposes? If yes, how was the experience?

What do you think about games being used for educational/training purposes?

How games could potentially lead to changes within the organization, *e.g. implementation of sustainability-related practices.*?

*I will explain some concepts (for e.g. A brief about FSSD, back casting, ABCD procedure, a brief about game elements like role play, etc.) during the interview which I want to use in the game. After the explanation, following questions will be asked:*

Do you see value in developing such a board game to help the companies?

What type of employees do you think should play this game or do you think it can be suitable for different departments as role play is involved?

If you were to design a board game, what objectives would you like to achieve through that game? OR what are some important aspects which you would like to teach/explain to other company employees?

*Ending question:* Will you be interested in having a look at the game once its ready?

*Ask for a general feedback on the interview in the end if they felt some more questions can be included etc.*

Note: Fonts in Italics are for me to consider as an interviewer

## 12 Appendix C First Order Classification for thematic analysis

*Table 10: Classifying raw data into first order classification for thematic analysis*

Person	Dialogue	First order category
A	<ul style="list-style-type: none"> <li>“...sustainable future to us is based on bio-based materials that are renewable and recyclable where there is no packaging waste...”</li> <li>“...So our, our mission, our purpose As the company is to challenge conventional packaging, so, that means that we want to be the substitute for plastics and we need to develop the paper to be used in different applications. So, we drive a lot of innovation on paper and different types of material based paper. So, we see that a lot of packaging can be and based on paper, if we just are able to solve some challenge challenges in the packaging world...”</li> <li>“...we need to able to produce the type of materials that are fossil free... we are working on (this goal) every day, both short term and long term...”</li> </ul>	Replacing/minimizing material
G	<ul style="list-style-type: none"> <li>“...last year we had a huge announcement that we will try to use as much as sustainable materials for packaging as possible and reduce as much as plastic as as possible.”</li> <li>“...and to use for example 100% sustainable, certified paper...”</li> </ul>	
T	<ul style="list-style-type: none"> <li>“...the development been to get more and more bio-based material into the product our goal to 2020 was to have fully renewable packaging for liquid food and we have it for chilled food. But for ambient product we still have some portion of non-bio-based materials but our development organization is focusing to try to phase out the other materials so we have total bio based and circular product”</li> </ul>	
W	<ul style="list-style-type: none"> <li>“...we do like different kinds of projects like we decided to implement recyclable plastics in some of our products recently...”</li> </ul>	
S	<ul style="list-style-type: none"> <li>“...This additive (material for additive manufacturing) can also be a good sustainable solution using minimal amount of materials when you're creating value for your customer...”</li> </ul>	
P	<ul style="list-style-type: none"> <li>“...because our industry is using a lot of materials and natural resources and we are also causing a lot of climate and co2 emissions...”</li> </ul>	

	<ul style="list-style-type: none"> <li>• “...with concrete as an example, we have started to replace some of the cement because of cement is 90% of the climate impact from concrete...replacing that with slag from steel production...”</li> <li>• “...we have changed in all our factories to bio oil instead of fossil fuels. So that has reduced our climate impacts with the 50- 60%...”</li> </ul>	
A	<ul style="list-style-type: none"> <li>• “...for example, the best packaging the most sustainable packaging is based on renewable paper or sorry, sorry, recycled paper. And then we can say, well, that is not always true. Sometimes you need to have fiber that is very strong. And then you can't use recycled fibers because they are shorter and not so strong. And they're I think it's more a knowledge, knowledge gap...”</li> <li>• “...But they (government) may say that all we want to forbid all types of plastics everywhere. But then you may face the consequence that there for some applications, maybe there is no better alternative. And you need to put resources and money into finding better alternatives. Before you can forbid something. It's easy to think that you do a good thing. But actually, you need to think through the consequences carefully...”</li> </ul>	Controversial
W	<ul style="list-style-type: none"> <li>• “...sometimes it's about two different sustainability things. For example, maybe there is a material that is better for the environment. But it's less safe for the workers when they use it, or when they're, like, creating with it...”</li> </ul>	
F	<ul style="list-style-type: none"> <li>• “...you will have lots of cost savings from implementing low carbon practices, but it at some point, you will reach a stage where it becomes more expensive to make it less carbon intensive. So you reach like a sort of a tipping point where it's more of a long term investment... we will be more profitable or have a better reputation or will help our brand and we can recruit more people, but maybe it costs more now.”</li> </ul>	
S	<ul style="list-style-type: none"> <li>• “...all things you do to lower your energy consumption you have a payback on your invested money between two to three years... electricity will become more expensive due to electrification of processes in other companies, and the electrification of transports, also in the shift from nuclear and coal plants to sustainable energy will also make energy</li> </ul>	

	<p>more scarce... So, not only is the co2 important, but lowering our energy consumption earns us money.”</p> <ul style="list-style-type: none"> <li>• “if we say claim that we have reduced our co2 footprint in Sweden but move the facility to China with the with the quadruple co2 impact...we haven't done a thing... you need to look at it from the full circle when you're doing things”</li> </ul>	
P	<ul style="list-style-type: none"> <li>• “...some of these (sustainable) measures require big investments... there's a limit to what speed you can have in this because changing your processes requires that you change equipment... it (investment) is highest priority for sure, because it's also about being competitive. It's certainly a competitive advantage to have these environmental friendly products...”</li> </ul>	
A	<ul style="list-style-type: none"> <li>• “...I think it's a fun way to hang out with others.”</li> <li>• “If you don't play a very serious game, then you laugh a lot and do something together that is just fun I guess.”</li> </ul>	Game as a social tool (being together)
G	<ul style="list-style-type: none"> <li>• “...spending time together and laughing and challenging one another sometimes as well.”</li> </ul>	
F	<ul style="list-style-type: none"> <li>• “...I prefer when you're in teams, so it's not like one on one...”</li> </ul>	
P	<ul style="list-style-type: none"> <li>• “...it's of course about being with him (kid relative) and doing fun things...We just make jokes and laugh like crazy”</li> </ul>	
A	<ul style="list-style-type: none"> <li>• “...actually, I didn't think it was fun at all. It removed all the fun away from the pressure of making the bookings right...”</li> </ul>	Balance of fun and education
W	<ul style="list-style-type: none"> <li>• “...it was also a class which makes a difference like...you expect it to be educational its different, maybe I will not have played the game like with my friends at home in the evening.”</li> </ul>	
P	<ul style="list-style-type: none"> <li>• “...For me it took focus from the issue because it all came down to what the what the game rules were and learning those...”</li> </ul>	
A	<ul style="list-style-type: none"> <li>• “If It's fun, I think you remember more you have positive connection to it. And also, you are willing to maybe spend more time on it than if you would, if it was boring.”</li> <li>• “...it is just a policy document. It's just a lot of, you know, bullets, do this, don't do that do this. But I think if that was better, more interactive, and more, more real cases that the employees could take part</li> </ul>	Engagement, interactive, involvement

	<p>through some type of online gamification, then I think they would actually be able to process the information better than just reading a document.”</p>	
G	<ul style="list-style-type: none"> <li>• “... I think also like being able to visualize a problem better. And I think it always helps to, to, to increase the efficiency of learning... when all your senses are in demand.”</li> <li>• “... I think everything where you can just cut like only showing presentations, PowerPoint presentations is of high value...”</li> </ul>	
E	<ul style="list-style-type: none"> <li>• “...I found it (business board game) really, really educational even more than if I would have read it from a book or school would have told me... I think that it was more real, it was more like you really did get to see what effect to which thing or item and the links between the items and I found that I learned more from that game than I did from trainings or lessons or reading material.”</li> </ul>	
W	<ul style="list-style-type: none"> <li>• “...games are fun and if you get people engaged in the game, then they will also be engaged in learning what you need to learn to complete the game...”</li> <li>• “...I think games can both be a part of creating that motivation to kind of increase the interest and then the motivation to do something...”</li> </ul>	
F	<ul style="list-style-type: none"> <li>• “...I'm sure that designed the right way, it (game) could be a huge benefit instead of conventional learning because you like engaged in the topic in a different way...”</li> <li>• “...So yeah, I think that's a really good idea to facilitate the usage of the ABCD procedure, so it doesn't, so it's not something theoretical anymore...”</li> </ul>	
S	<ul style="list-style-type: none"> <li>• “I think it (game) could be a better way and then doing the normal posted, stick it on the wall kind of thing. And you educate people and in the same time as you open up to discussion...”</li> </ul>	
P	<ul style="list-style-type: none"> <li>• “...of course, I'm for the idea learning by learning from games...”</li> <li>• “...(through games )they(young people) can learn things and do things and test things without being worried or afraid of what will happen...”</li> </ul>	
A	<ul style="list-style-type: none"> <li>• “...we actually have a game in our own company on diversity. So it's something that is in in the coffee rooms and lunch rooms. It's there's different cards</li> </ul>	Game in the company

	about You know how you it's meant to change the perspective, diverse workforce of our employees..."	
T	<ul style="list-style-type: none"> <li>• "It (game played on company's intranet designed by the company's educational dept.) was very popular and it was really appreciated among people. They thought they got a better view of topic sustainability. So I think video games like this could really open the minds of people at different level and working with different things and they could identify the importance of sustainability."</li> </ul>	
F	<ul style="list-style-type: none"> <li>• "...we had like a card game at work...it was about like, climate awareness."</li> </ul>	
A	<ul style="list-style-type: none"> <li>• "And yeah, definitely, I mean, it's often that you need to have, for example, a workshop with different employees. Maybe from different departments come with their expertise on how can we solve this specific problem."</li> </ul>	Different departments coming together
G	<ul style="list-style-type: none"> <li>• "... if it's about raising awareness and bringing more people on board, I would definitely see valuing in that."</li> </ul>	
T	<ul style="list-style-type: none"> <li>• "Have a good dialogue (with different departments/sub companies). Try to understand what is happening what research is going on. What impact it has from environment point of view. Identify the environmental aspect at all kind of levels..."</li> </ul>	
W	<ul style="list-style-type: none"> <li>• "...the sustainability department is responsible, or kind of to reduce the emissions, it's actually the department working with freights that are actually producing the emissions... we can have a different product design that reduces environmental impact, but it's...product design department... it's about talking to and like influencing the right people at your own company"</li> </ul>	
F	<ul style="list-style-type: none"> <li>• "...too big of a challenge for one single sustainability department to raise the awareness within the whole company. So it has to be made decentralized. We have to have an ambassador network of sustainability ambassadors that are really not only... sustainability professionals, it has to be people that are engineers that knows the ways of working."</li> </ul>	
P	<ul style="list-style-type: none"> <li>• "...It's increasingly important to work together... in the company all kinds of competences and perspectives and so on need to work together..."</li> </ul>	

	<ul style="list-style-type: none"> <li>• “...Way (through games) to get people together that not that don't normally work together...”</li> </ul>	
A	<ul style="list-style-type: none"> <li>• “...maybe be called something else than a game to just mean that it's some type of collaboration, solution, platform or planning tool or something. And then I think it could be used on all levels. I mean, especially white collar, the ones that work in an office.”</li> <li>• “I think if it is marketed as a game. I think it can be hard to get people and you know, spend time on it because often in our company, you're very you have a very tight agenda, you have many meetings you need to deliver.”</li> </ul>	Something other than game. Maybe a training tool?
E	<ul style="list-style-type: none"> <li>• “... a good training method for blue collars and white collars to understand more about sustainability issues and how we can affect our outcome... could see this to be one of the like, introductions to when the new employee for example comes into the company”</li> </ul>	
W	<ul style="list-style-type: none"> <li>• “...It (game idea) seems lot more like a workshop concept than a game. But maybe the line between workshop and games are not so large. But I think absolutely, it could be helpful.”</li> </ul>	
S	<ul style="list-style-type: none"> <li>• “I think you need probably a good introduction and explain the setup... You need to make a presentation before you do the game.”</li> </ul>	
A	<ul style="list-style-type: none"> <li>• “We do a lot of collaboration with our customers to find, for example... they use our paper when they make packaging... there is a thin plastic film inside of the carton and we need to work together to remove this film and replace it with something that is bio based.”</li> </ul>	Collaboration
G	<ul style="list-style-type: none"> <li>• “...This (complex supply chain issues) is not something that we can solve as one company alone...So we decided together with a lot of other big companies, to form alliances...which makes sure that There is a structured audit process in in our supply chain...”</li> <li>• “...we are investigating and collaborating with universities, NGOs, researchers and students to find ways and projects, long term projects, where we investigate how to use our knowledge, our technology or innovation, to drive important questions and to empower society.”</li> </ul>	

	<ul style="list-style-type: none"> <li>“...challenge... here(in closing loops), not one company can solve...So, this has to be multi stakeholder engagement, a lot of different parts are involved in ensuring or in, in contributing to such a process... There has to be a collaboration and this is currently a challenge, you know, because there's one team over there, and then there's the recycling companies over there...”</li> </ul>	
W	<ul style="list-style-type: none"> <li>“we helped our suppliers of boxes who is also in China to get the Forest Stewardship Council certification... it will be easier for us...to change supplier to someone who already has the certification. But we want to work long term with our supplier and kind of develop with them.”</li> </ul>	
S	<ul style="list-style-type: none"> <li>“...for people development we have a lot of collaborations with schools, university of Gavle, university of Uppsala and some other universities around the world in order to attract people and to get the right type of talent into our company...”</li> </ul>	
P	<ul style="list-style-type: none"> <li>“...it's also about cooperating with universities and customers and suppliers and well the whole chain needs to be involved...”</li> </ul>	
G	<ul style="list-style-type: none"> <li>“... but what I see is the lack of like celebrating the small steps that we do... there's a lot of negativity and there's a lot of criticism... we shouldn't forget is, celebrating the small, small steps forwards”</li> </ul>	Small things add up
E	<ul style="list-style-type: none"> <li>“it's not like you need to have a huge change... if you have a minor change here and there, and when it's like times, 20 or times 80, so then it becomes a big... But it's so easy to say that oh, this is not this is only a minor change, and we only will get 1% more renewable energy ...but if everyone would get 1% change that would be a big thing for the whole company. It's actually a little strings that you get you get big change from...”</li> </ul>	
T	<ul style="list-style-type: none"> <li>“...they (research team) don't think about the large scale problems. They think they do it in a laboratory on a small scale and they don't realize that when they scale up there might be problem.”</li> </ul>	
P	<ul style="list-style-type: none"> <li>“...I paint the big picture, put out a strategy and the strategy will help us to have more power in the small actions. If we have 100 actions being going on in the company, and I can put up a strategy that they can all aim at. It will make it's more coordinated and work more strong...”</li> </ul>	
G	<ul style="list-style-type: none"> <li>“what companies do quite often is doing a material materiality, analysis or assessment.”</li> </ul>	Material assessment

F	<ul style="list-style-type: none"> <li>“...we have like within our project management framework we have guiding principles for how to perform materiality analysis, both before we go into a project but also whilst we are in the project...”</li> </ul>	
G	<ul style="list-style-type: none"> <li>“...how can we ensure that all our employees are safe and healthy and happy ... it's insanely complex we have there can be between like there can be 10,000 steps between the raw material like mining of raw materials, to the to the production facility that can be a supply chain of 10,000 contracts between those two steps...”</li> </ul>	Complex supply chains
P	<ul style="list-style-type: none"> <li>“...So the chain can be very long...you can have like 234 steps away, you will have someone in the end that has hired a company that are not providing good wages or are not providing the safety needed for their personnel...long supply chain creating risks for not everything being done as it should be.”</li> </ul>	
G	<ul style="list-style-type: none"> <li>“... taking care of our resources is trying to ensure circular, closed loop economy...”</li> <li>“...circular economy is very high on the agenda and it's something that we have been working with for a long time and we have worldwide e waste take back programs...”</li> </ul>	
T	<ul style="list-style-type: none"> <li>“...we try to circulate all material... we really try to recover the materials so we sort every fraction of waste very clearly... we can recover the material so we don't have to let it go for energy recovery. Instead we might use the material instead.”</li> <li>“because you can recover the carton materials and fibers and they can be reused up to 7 or 10 or 13 times depending on the demand...”</li> </ul>	
S	<ul style="list-style-type: none"> <li>“...more than half of the sold the carbide is actually recycled. So we buy back old tools and the inserts... and we use them in our processes and make new tools out of them... minimize the use of rare earth metals, but also the energy when you're recycling is less is round about half the energy use (compared to extracting from earth)”</li> <li>“...reduce the amount of material that you put in, reuse that we do. Remake take as much as possible from the waste in order to remake and then to recycle, and then actually renew, meaning using renewable resources for packaging...”</li> <li>“...using a lot of recycle and circulation of heat in our facilities, both in ventilation systems and using</li> </ul>	

	<p>the heat from our processes in order to heat facility and in the summer converted into chilling...”</p> <ul style="list-style-type: none"> <li>• “...circularity is probably if you use one word that is sustainability for me...”</li> </ul>	
P	<ul style="list-style-type: none"> <li>• “...recycling, meaning that we take in demolition waste and also different byproducts, residuals from industrial processes, which we can then turn into raw materials for building and construction...”</li> </ul>	
G	<ul style="list-style-type: none"> <li>• “...it's ensuring that there's anti-corruption policies in place...”</li> <li>• “...if we look at artificial intelligence, like all the ethical aspects around it, are considered to be sustainability as well, like how can we ensure that artificial intelligence is ethically responsible...”</li> </ul>	Ethics
E	<ul style="list-style-type: none"> <li>• “...how we take care have our employees when it comes to health and safety but also that they have they have an opportunity to inform an owner anonymously if something happens if they see something which they do not think is right...”</li> </ul>	
W	<ul style="list-style-type: none"> <li>• “...which is an education for both workers and management in the suppliers, about workers, worker rights and human rights mostly. So it's kind of to make sure that the workers know their rights and also the managers know, their rights...”</li> </ul>	
F	<ul style="list-style-type: none"> <li>• “... fighting corruption, you're not building things that are damaging the environment and so on. So it's around the human rights, labor rights, corruption and the environment...”</li> <li>• “...we are safeguarding each employees’ rights and that we are aiming at the 30% minimum when it comes to female, female employees at every level of the company...”</li> </ul>	
S	<ul style="list-style-type: none"> <li>• “... We are about 18% of females in managerial positions and we have an ambition to 2030 that one out of three will be women in management positions.”</li> <li>• “...with the safety first but also health and safety, play fair, equal opportunity, diversity and inclusion, as well as code of conduct...and also being transparent in what we do”</li> </ul>	
P	<ul style="list-style-type: none"> <li>• “...social sustainability we have our focus is to work with our employees, safety and working environment... also part of the social responsibility is the ethical aspects of doing business, anti-corruption and all these things...”</li> </ul>	

G	<ul style="list-style-type: none"> <li>“...we are facing a lot of challenges as humankind, when it comes to sustainability, but one thing that really excites me as well as that technology is also a huge enabler to solve a lot of those challenges that we are facing.”</li> </ul>	Technology
P	<ul style="list-style-type: none"> <li>“...I mean, the technology is changing also so fast now... but if you look 100 or even 10 years forward, it will be something completely different with automation on robots and AI and so on.”</li> </ul>	
G	<ul style="list-style-type: none"> <li>“...And I've seen other companies like writing nice sustainability reports and they are sitting somewhere, and the business is somewhere completely different...”</li> </ul>	Sustainability as an add-on
E	<ul style="list-style-type: none"> <li>“...it shouldn't be add on. It should be in the structures in the in the like, in the way... taking decisions... also like, try to evaluate if this is a sustainable decision or not, even though it might be not the best business case, but if it's sustainable, then you could choose that as well.”</li> </ul>	
A	<ul style="list-style-type: none"> <li>“in general in companies you can, it's easier to collaborate if you know if you get to know each other... if you're able to get these different perspectives and together and you know, find the same way forward. And also you get motivated if you know that this is something we will achieve together.”</li> </ul>	Different perspectives
G	<ul style="list-style-type: none"> <li>“...in other companies every department has different goals and priorities and objectives, and so on. But and I think with sustainability, you always can try to raise the bar and you will always have challenges when it comes to convincing different groups or people that this is something that is important...”</li> </ul>	
F	<ul style="list-style-type: none"> <li>“... sometimes you have different perspectives, so you have to be really pedagogical...for the ones that are supposed to do something to make it (project/operations) better so and it could be a challenge that parts of the organization has been doing things for maybe eighty years in the same way. And, it's widely accepted.”</li> </ul>	
S	<ul style="list-style-type: none"> <li>“...sustainability has a meaning different meaning to different people and in different parts of the company...we need to find a way...”</li> </ul>	
G	<ul style="list-style-type: none"> <li>“...And for circular economy 80% of the environmental impact that you that you have, can be determined in the design phase. So if the design of the product is in a way that then in the</li> </ul>	

	longer in the later step the recycling companies can reuse...”	
W	<ul style="list-style-type: none"> <li>“...how can we design them (boxes of the product) to make them more recyclable.”</li> </ul>	
F	“...But most of the times, you will always have a financial gain from implementing these more sustainable practices. Like eco design perspective, for instance, using less material and you you're using you're emitting less carbon and you're using less energy during the lifecycle of the product...”	
S	<ul style="list-style-type: none"> <li>“...you design something that can be used for a long time but also design it so you can reuse it and disassemble it...”</li> </ul>	
G	<ul style="list-style-type: none"> <li>“...it's always good to have to have like, key facts and numbers that the user can understand...for example... it's 50 million tons E waste per year that is accumulated... This is something that we like I couldn't, like, I don't understand what it's 50 million. It's equivalent to 5000 Eiffel Towers, for example, I always think, like comparison with something that is more relatable or more understandable, is always is always helpful.”</li> </ul>	How much is how much
E	<ul style="list-style-type: none"> <li>“How much is how much if you understand what I mean... let's say 50% Okay, it's (renewable energy%) 50% but if it was 30% what it mean then if it was 70% What would it mean then so that people don't really understand when we give them only the numbers. So I would like to show them what would it mean... when talking about the energy consumption are we talking about like a one light bulb...or are we talking about 1 million light bulbs? So get an idea about How much is how much.”</li> </ul>	
W	<ul style="list-style-type: none"> <li>“...if I decided to take a business trip to the other side of the world for just like maybe two meetings like that it's the same emissions as if I had done something else that's quite a lot of things because business travel have a lot of emissions. So I think like this kind of information to kind of understand the size of different things can be interesting.”</li> </ul>	
G	<ul style="list-style-type: none"> <li>“say anything that would show the value of sustainability in a positive way, like, like business value of it, for example”</li> </ul>	Showing economic benefit of sustainability
E	<ul style="list-style-type: none"> <li>“We have also an Energy Efficiency Program ongoing that in involves all our companies to take actions... We also saw that this is something really important</li> </ul>	Company's own sustainability assessment tools

	that we need to highlight and monitor really, really closely in order to be able to achieve targets.”	
S	<ul style="list-style-type: none"> <li>“...we have made our own assessment tool called Green factoring sustainable facilities self-assessment tool... using all available standards we make a self-assessment from standard up to world class. So, you get the dashboard for each facility, out of safety resources, people working environment, emissions, waste site building infrastructure and production... we have run it now for over a year and it's gives us top 10 Action Lists in order to drive our sustainability work...”</li> </ul>	
E	<ul style="list-style-type: none"> <li>“I see sustainability as something that we focus on in our everyday lives, as well as longer perspective...It has many parts in fix environment, health and safety and also also the How can we ensure that the future generations also will have the same possibilities as what what we have?”</li> </ul>	Sustainability interpretation
T	<ul style="list-style-type: none"> <li>“It’s the long-term perspective Regarding sourcing regarding production. How you utilise your products and then the business around it should have a long-term perspective and you have to take into consideration the whole chain behind, before and after your things of production or equipment”</li> </ul>	
G	<ul style="list-style-type: none"> <li>“But sustainability is... taking care of the environment, taking care of our resources is trying to ensure circular, closed loop economy, it's working with human rights, it's ensuring that there's anti corruption policies in place...sustainability is growing and growing every single day”</li> </ul>	
W	<ul style="list-style-type: none"> <li>“that we can create a good life for people living today while not compromising with the future generations”</li> <li>“we can't focus only on like, for example, environmental sustainability...we need social sustainability...”</li> </ul>	
F	<ul style="list-style-type: none"> <li>“...it's a development that does not compromise with future generations ability to see to their needs in the long term but always, yeah balancing the needs of today and then the future with what the earth and the earth system is able to provide us with”</li> </ul>	
S	<ul style="list-style-type: none"> <li>“...using your resources in a smart way without selling things that are unnecessary or buying things that are unnecessary...”</li> </ul>	
P	<ul style="list-style-type: none"> <li>“...sustainability is the smart way to work. It's not only because it feels good to do it will increase our</li> </ul>	

	profit, it will increase our creativity. It will be better and more competitive products and solutions”	
E	<ul style="list-style-type: none"> <li>“It (gap between sust. and business) is not as big any longer as it was, but still the gap is there.”</li> </ul>	Gap
F	<ul style="list-style-type: none"> <li>“...So with our(engineers/consultants) knowledge and with the knowledge they (sustainability specialists) already have, close the gap in what needs to be done in the actual design, like in the actual engineering work, what actually needs to be done...”</li> </ul>	
E	<ul style="list-style-type: none"> <li>“customers that are requiring the evidence that we behave and do business in a sustainable way...young people now joining to our group and perhaps also to other other businesses. They state sustainability on a higher level... And even that it might be one of the reasons why they choose the company”</li> </ul>	Recruitment and customer demand
S	<ul style="list-style-type: none"> <li>“...people like you, the young kids because you see sustainability as a key focus when you are looking for an employer and the purpose of life. So we know of course that we need to earn money, but we also we need to be a good employer and, and good provider for the future.”</li> </ul>	
P	<ul style="list-style-type: none"> <li>“...We will have more success (being sustainable) in attracting the right talents”</li> </ul>	
E	<ul style="list-style-type: none"> <li>“...I would hope that now (during corona situation) that we need to learn this not to travel not to take business trips and to take the phone or internet meetings instead that, that would at least partly stay so that we wouldn't travel so much. And it's not only here again, it's not only the money, we are saving then, but it's also the environment...”</li> </ul>	Business trip
G	<ul style="list-style-type: none"> <li>“if we would apply more positivity and more solidarity and being together in this lifting up instead of dragging down...I think that would raise positive energy”</li> </ul>	Mental change and individual behaviour
E	<ul style="list-style-type: none"> <li>“In car business ... I wouldn't choose a diesel (instead go with hybrid) ... individual is driving this change”</li> <li>“...we need to do some kind of mental change...”</li> </ul>	
T	<ul style="list-style-type: none"> <li>“There (in waste handling) we are depending on each individual should do the right thing in their daily work. So that's why that is intriguing area”</li> </ul>	
W	<ul style="list-style-type: none"> <li>“... people to know (realize) what kind of impact their decisions can have...”</li> </ul>	

F	<ul style="list-style-type: none"> <li>• "...if you're a single consultant at the customer's premises, we need to make sure that ,that person has a a mindset when it comes to sustainability. So understanding how does my contribution to this project contribute to the client's overall sustainability agenda? And how can I help the client to increase their sustainability performance even more?..."</li> <li>• "...Everyone needs to be aware of their individual high impact areas..."</li> <li>• "...It (beyond companywide perspective) becomes more of a behavioral thing, like, are we traveling a lot by air? Or are we taking the train when we could and so on, that becomes much more much more local behavioral change that needs to be done..."</li> </ul>	
P	<ul style="list-style-type: none"> <li>• "... To say that we need to change and then to be ready to make the change is two different things..."</li> <li>• "it's kind of more moving the mindset rather than buying more fences and stuff because they are in place"</li> <li>• "...it's not a big change for you to change the fossil diesel to HVO 100 or something. But if we say that you need to change your way of driving in order to save fuel, and drive smarter and not be an accident or whatever, that's suddenly more about how that person behaves. And that becomes more sensitive or maybe difficult to handle..."</li> </ul>	
T	<ul style="list-style-type: none"> <li>• "If you go into small details, then its (board game) not for the broad audience. That is just for a smaller group....I think that you want it to be used by most of the people within the company. Then it should be perhaps from a broader vision. Broader so that all can be engaged...focus on use of energy and energy recovering and energy efficiency or waste handling taking care of material as efficient as possible... Those are more general things"</li> </ul>	Right amount of details
F	<ul style="list-style-type: none"> <li>• "...you need to make a board game that is quite generic..."</li> </ul>	
T	<ul style="list-style-type: none"> <li>• "...How to sort out to take care of waste, why not to use games to try to educate people regarding that... That could be used also into societies. And I think that's an area that can be used not only in a company like ours that focus on sustainability and the handling of waste. That could be for any company..."</li> </ul>	Waste handling
W	<ul style="list-style-type: none"> <li>• "They (department heads) are incentivized by, by how well their department is performing money</li> </ul>	Monetary incentives prioritized

	<p>wise. But they are not in any way incentivized how their department is performing sustainability wise and then people are not going to be so interested when you get out to their department to make changes for sustainability”</p>	
F	<ul style="list-style-type: none"> <li>• “...many industrial companies, you see still sustainability as cost... it might be that the short-term perspective wins because you're like chasing quarterly figures to be good...”</li> <li>• “...So, I mean, if we're only having like bonus systems, and so on, that aim at the profitability of your business area. You're not going to be focusing on the non-financial part of it. So, I think that's also a big very much needed...really have incentives for working much more with non-financial targets, but also to be able to be held accountable if you're not reaching the goals...”</li> </ul>	
W	<ul style="list-style-type: none"> <li>• “ ...I really like games where you where there is a lot of different options, I guess. So you have to make decisions...”</li> </ul>	Enjoy decision making in games
F	<ul style="list-style-type: none"> <li>• “...the ones(games) I enjoy most often are the ones that like has more like strategical elements.”</li> </ul>	Enjoy strategic games
S	<ul style="list-style-type: none"> <li>• “...We score high on Dow Jones Sustainability Index, it's, this is almost a necessity if you're going to attract good investors.”</li> <li>• “...they (sustainability indices) are important because they are auditing you and see if your sustainability reporting is good or bad. Today we are ranked top 10% of the industry globally”</li> </ul>	sustainability Indices
A	<ul style="list-style-type: none"> <li>• “...Dow Jones Sustainability Index we belong to one of the most sustainable companies in the world... Top 10% so we believe this is super important and driven by the urge to replace plastics in packaging”</li> </ul>	

## 13 Appendix D Details about actions of the game

Table 11: Actions of Round-A

Action	Action ID	Consequences	Total Cost	Time Required	Depends On	Sustainability Points	ROI
Phasing out CRT TV manufacturing materials.	A1	<ol style="list-style-type: none"> <li>Changes in sourcing of materials</li> <li>Changes in waste handling</li> <li>Require retooling with downtime to remove CRT manufacturing tools</li> <li>Enhancement to be carried out for User Experience</li> <li>Enhancement in User safety features in final product</li> <li>Requires investments in component redesign</li> </ol>	1650000	3	NONE	2	10
Phasing out lead from circuit board solder	A2	<ol style="list-style-type: none"> <li>Require change of sourcing for solder materials</li> <li>Requires changes in waste handling services for new solder materials</li> <li>Requires downtime for retooling machines to sustain higher melting point of lead-free solder</li> <li>Improvement in User safety due to lead free solder</li> </ol>	950000	2	NONE	3	20
Phasing out old flame-retardant materials like chlorine and bromine for newer FR1 and FR4	A3	<ol style="list-style-type: none"> <li>Require change of sourcing for flame retardant materials</li> <li>Requires changes in flame retardant handling services for new solder materials</li> <li>Requires retooling to handle newer flame-retardant coated boards</li> <li>Improvement in User safety due to absence of poisonous chlorine/bromine in flame retardants</li> </ol>	1250000	3	NONE	3	25
Assessing flows for Magnesium instead of plastic	A4	<ol style="list-style-type: none"> <li>Find ways to incorporate Magnesium, a lightweight metal for structural components</li> </ol>	900000	3	NONE	2	5
Investing in newer LCD technology	A5	<ol style="list-style-type: none"> <li>Requires changes in Sourcing of newer panel technology source</li> <li>Retooling of small R&amp;D teams required</li> <li>Enhancement in User experience due to new technology</li> <li>Create new technology to increase user safety with LCD</li> <li>Would require component redesign of parts</li> </ol>	1300000	3	NONE	2	7

Table 12: Actions of Round-B

Action	Action ID	Consequences	Total Cost	Time Required	Depends On	Sustainability Points	ROI
Design TVs suitable for recycling	B1	<ol style="list-style-type: none"> <li>1. Requires sourcing recycled materials</li> <li>2. Requires retooling to handle the new materials</li> <li>3. Require workflow redesign to accommodate newer controls for recycled materials</li> <li>4. Requires component redesign to use recycled materials</li> </ol>	1600000	3	NONE	4	25
Use recycled plastic and metals for TV parts	B2	<ol style="list-style-type: none"> <li>1. Requires sourcing recycled materials</li> <li>2. Requires retooling to handle the recycled materials</li> <li>3. Require workflow redesign to accommodate newer control recycled for recycled materials</li> <li>4. Requires component redesign to use recycled materials</li> <li>5. Requires new waste handling for recycled materials</li> </ol>	1050000	3	NONE	4	25
Collaborate with e-waste recycling partners	B3	<ol style="list-style-type: none"> <li>1. Change in waste handling partners</li> <li>2. Improves User Experience with handling e-wastes</li> <li>3. Redesign workflow to accommodate easy e-waste handling with the partner</li> </ol>	530000	2	NONE	5	40
Develop in house e-waste handling	B4	<ol style="list-style-type: none"> <li>1. Source materials to develop e-waste handling systems</li> <li>2. Changes in waste handling of new wastes</li> <li>3. Retool to accommodate in house e-waste handling</li> <li>4. Workflow change to accommodate e-waste handling</li> <li>5. Component redesign to accommodate e-waste parts recycling</li> <li>6. Logistic changes to develop in house e-waste handling</li> </ol>	1430000	3	NONE	3	25
Identify and select suppliers who have the same green vision	B5	<ol style="list-style-type: none"> <li>1. Identify and select resource suppliers</li> <li>2. Requires logistical changes for green vision.</li> </ol>	380000	2	NONE	4	25

Table 13: Actions of Round-C

Action	Action ID	Consequences	Total Cost	Time Required	Depends On	Sustainability Points	ROI
Usage of Magnesium as replacement for plastics for structural components	C1	<ol style="list-style-type: none"> <li>1. Require assessment of Magnesium as a dependency</li> <li>2. Requires sourcing change for magnesium parts</li> <li>3. Include waste handling for magnesium</li> <li>4. Retooling to include magnesium part handling</li> <li>5. Require workflow redesign for separate parts</li> <li>6. Requires component redesign for structural part for materials</li> </ol>	1750000	2	A4	3	10
Reduce the usage of Nonferrous Heavy metals in manufacturing TV components	C2	<ol style="list-style-type: none"> <li>1. Changes in sourcing of materials</li> <li>2. Changes in waste handling</li> <li>3. Require retooling without downtime to change metals parts</li> <li>4. Enhancement to be carried out for User Experience</li> <li>5. Enhancement in User safety features in final product</li> <li>6. Requires component redesign of newer materials</li> </ol>	1650000	2	NONE	3	20
Start an initiative for material assessment with an aim to reduce environmental loads.	C3	<ol style="list-style-type: none"> <li>1. Requires workflow development to do assessments</li> <li>2. Requires component redesign to do material assessment</li> </ol>	900000	2	NONE	2	7
Changing design to zone lighting from array lighting	C4	<ol style="list-style-type: none"> <li>1. Backlight changing requires part sourcing change</li> <li>2. Change in parts will require waste handling change</li> <li>3. Parts similarity would require retooling without much downtime</li> <li>4. Enhancement in user experience</li> <li>5. Requires component redesign for lighting</li> </ol>	1150000	2	NONE	1	20
Use TFT technology for LCD manufacturing	C5	<ol style="list-style-type: none"> <li>1. Requires sourcing change for TFT technology</li> <li>2. Enhances user experience</li> <li>3. Requires component redesign for newer panel design</li> </ol>	900000	2	NONE	2	20

Table 14: Actions of Round-D

Action	Action ID	Consequences	Total Cost	Time Required	Depends On	Sustainability Points	ROI
Automated sleep timer	D1	1. Improves user experience 2. Improves user safety by reducing fire hazard	300000	3	NONE	4	20
Design TVs with wireless power transfer	D2	1. Source change for wireless power transfer 2. Waste handling change for wireless part 3. Requires retooling of the part change 4. Changes User experience for power transmission 5. Require power circuit redesign	1450000	3	NONE	1	7
Process redesign by using screen printing solder paste instead of solder bath	D3	1. Requires change in solder sourcing 2. Waste handling changes required for solder type 3. Retooling required for soldering equipment	750000	3	NONE	3	25
Replace florescent tube to LEDs for backlighting	D4	1. Backlight changing requires part sourcing change 2. Change in parts will require waste handling change 3. Parts similarity would require retooling without much downtime 4. Enhancement in user experience 5. Requires component redesign for lighting	1150000	3	C4	2	20
Move from glass to plastic for outer panel layer	D5	1. Requires changes in panel sourcing for different panel type 2. Retooling without downtime to change basic parameters for panel size changes 3. Enhancement in user experience due to panel change 4. User safety enhanced as outer layer is plastic to avoid glass injuries 5. Require component redesign to accommodate thinner panel and lower electricity consumption	1300000	3	C3	2	10

Table 15: Actions of Round-E

Action	Action ID	Consequences	Total Cost	Time Required	Depends On	Sustainability Points	ROI
Collaborate with companies in the Air conditioning fields	E1	1. Overall user experience enhanced due to climate control	100000	2	NONE	2	25
Modify design to add heatsink and fan	E2	1. Retooling requires to add heatsink in certain hotspots 2. Requires workflow changes to accommodate heatsink mounting procedure	500000	2	NONE	3	13
Improve repair service for issues	E3	1. Increase user experience zone 2. User safety enhanced by repair centers 3. Requires Logistic changes to handle repair services	380000	2	NONE	4	25
Add more venting to newer designs	E4	1. Requires retooling to allow venting part handling 2. User experience change for venting 3. Workflow redesign required for new vent parts	600000	2	NONE	3	5
Create customer buyback program	E5	1. Buyback waste handling has to be handled 2. Improves user experience and creates repeat customers 3. Improves user safety as old outdated equipment are not in common use 4. Requires changes in logistics handling for old bought back items	430000	2	NONE	2	20

Table 16: Actions of Round-F

Action	Action ID	Consequences	Total Cost	Time Required	Depends On	Sustainability Point	ROI
Adopt tighter quality check for LCD panel	F1	1. Quality check requires workflow redesign	350000	1	NONE	1	20
Ignore the industry competition by lowering pricing	F2	1. No part changes 2. User experience doesn't change	100000	1	NONE	0	15
Ship higher quality parts from other countries	F3	1. Requires changing sourcing of better-quality part 2. Requires logistic changes for parts handling	280000	1	NONE	1	20
Move manufacturing of all parts in-house	F4	1. Requires sub-part sourcing changes 2. Requires new waste handling for new sub assembly 3. Requires retooling to make sub parts 4. Workflow redesign required to make sub parts 5. Sub assembly requires new component designs to be created 6. Requires logistic changes to supply sub-assemblies for repair	1730000	1	C3	2	20
Collaborate with supplier to adopt higher quality standards who share the green vision	F5	1. Sourcing for green suppliers require changes 2. Waste handling have to change 3. Logistics changes required for new suppliers	330000	1	NONE	3	20

## 14 Appendix E Example of calculations for the whole game

Table 17: Calculations for all rounds

% R&D investment(given)	20	
Initial revenue	\$15,000,000.00	
<b>Round-1(A)</b>		
Budget	\$3,000,000.00	20% of initial revenue = $(20/100) * 15000000$
Cost per round	416666.6667	Summation of cost per action per round for each action but in round-1 it will be equal to cost per action per round as only 1 action will be active since it's first round
Action-1	A3	
Total cost (Given)	1250000	
Total rounds (Given)	3	
Remaining rounds	2	
Net ROI(Given)	25	
Spts (Given)	3	
Cost per action per round	416666.6667	Total cost of action/Total rounds = $1250000/3$
Remaining budget	\$2,583,333.33	Budget - cost per action per round = $3000000-416666.6667$
Remaining revenue	\$14,583,333.33	Initial revenue - cost per round = $15000000 - 416666.6667$
<b>Round-2(B)</b>		
Budget	\$2,916,666.67	20% of the remaining revenue = $(20/100) * 1458333.33$
Cost per round	681666.6667	Summation of 2 cost per action per round = $416666.6667+265000$
Action-1	A3	
Total cost (Given)	1250000	
Total rounds	3	
Remaining rounds	1	
Net ROI	25	
Spts	3	
Cost per action per round	416666.6667	Total cost/total rounds = $1250000/3$ (same as above as this action continues for 3 rounds)
Remaining budget	\$2,500,000.00	New budget - cost per action per round = $2916666.67-416666.6667$
Action-2	B3	
Total cost (Given)	530000	
Total rounds	2	
Remaining rounds	1	
Net ROI	40	
Spts	5	
Cost per action per round	265000	Total cost/total rounds = $530000/2$

Remaining budget	\$2,235,000.00	Remaining budget from previous action - cost per action per round = 2500000-265000
Remaining revenue	\$13,901,666.67	Remaining revenue of previous round - cost per round = 14583333.33-681666.6667
<b>Round-3(C)</b>		
Budget	\$2,780,333.33	20% of the remaining revenue = (20/100)*13901666.67
Cost per round	1131666.667	Summation of all 3 costs per action per round = 416666.6667+265000+450000
Action-1	A3	
Total cost(Given)	1250000	
Total rounds	3	
Remaining rounds	0	
Net ROI	25	
SPTs	3	
Cost per action per round	416666.6667	Total cost/total rounds = 1250000/3 (same as above as this action continues for 3 rounds)
Remaining budget	\$2,363,666.67	New budget - cost per action per round = 2780333.33-416666.6667
Action-2	B3	
Total cost(Given)	530000	
Total rounds	2	
Remaining rounds	0	
Net ROI	40	
SPTs	5	
Cost per action per round	265000	Total cost/total rounds = 530000/2
Remaining budget	\$2,098,666.67	Remaining budget from previous action - cost per action per round = 2363666.67-265000
Action-3	C5	
Total cost(Given)	900000	
Total rounds	2	
Remaining rounds	1	
Net ROI	20	
SPTs	2	
Cost per action per round	450000	Total cost/total rounds = 900000/2
Remaining budget	\$1,648,666.67	Remaining budget - cost per action per round = 2098666.67 - 450000
ROI for A3	1562500	Action A3 is completed as it was third round for this action so players will get the ROI i.e. [(25/100)*1250000] + 1250000
ROI for B3	742000	Action B3 is completed as it was second round for this action so players will get the ROI i.e. [(40/100)*530000] + 530000

Remaining revenue	\$15,074,500.00	Remaining revenue of previous round - cost per round + summation of ROIs = 13901666.67-1131666.667+(1562500+742000)
<b>Round-4(D)</b>		
Budget	\$3,014,900.00	20% of remaining revenue = $(20/100)*15074500$
Cost per round	550000	Summation of both cost per action per round = 450000+100000
Action-1	C5	
Total cost(Given)	900000	
Total rounds	2	
Remaining rounds	0	
Net ROI	20	
Spts	2	
Cost per action per round	450000	Total cost/total rounds = $900000/2 = 450000$
Remaining budget	\$2,564,900.00	New budget - cost per action per round = $3014900-540000$
Action-2	D1	
Total cost(Given)	300000	
Total rounds	3	
Remaining rounds	2	
Net ROI	20	
Spts	4	
Cost per action per round	100000	Total cost/total rounds = $300000/3 = 100000$
Remaining budget	\$2,464,900.00	Remaining budget from previous action - cost per action per round = $2564900-100000$
ROI for C5	1080000	Action C5 is completed as it was second round for this action so players will get the ROI i.e. $[(20/100)*900000] + 900000$
Remaining revenue	\$15,604,500.00	Remaining revenue of previous round - cost per round + ROI = $15074500 - 550000 + 1080000$
<b>Round-5(E)</b>		
Budget	\$3,120,900.00	20% of the remaining revenue = $(20/100)*15604500$
Cost per round	315000	Summation of both cost per action per round = 100000+215000
Action-1	D1	
Total cost(Given)	300000	
Total rounds	3	
Remaining rounds	1	
Net ROI	20	
Spts	4	
Cost per action per round	100000	Total cost/total rounds = $300000/3$
Remaining budget	\$3,020,900.00	New budget - cost per action per round = $3120900-100000$

Action-2	E5	
Total cost(Given)	430000	
Total rounds	2	
Remaining rounds	1	
Net ROI	20	
Spts	2	
Cost per action per round	215000	Total cost/total rounds = 430000/2
Remaining budget	\$2,805,900.00	Remaining budget from previous action - cost per action per round = 3020900-215000
Remaining revenue	\$15,289,500.00	Remaining revenue of previous round - cost per round = 15604500 - 315000
<b>Round-6(F)</b>		
Budget	\$3,057,900.00	20% of the remaining revenue = (20/100)*15289500
Cost per round	645000	
Action-1	D1	
Total cost (Given)	300000	
Total rounds	3	
Remaining rounds	0	
Net ROI	20	
Spts	4	
Cost per action per round	100000	Total cost/total rounds = 300000/3
Remaining budget	\$2,957,900.00	New budget - cost per action per round = 3057900-100000
Action-2	E5	
Total cost (Given)	430000	
Total rounds	2	
Remaining rounds	0	
Net ROI	20	
Spts	2	
Cost per action per round	215000	Total cost/total rounds = 430000/2
Remaining budget	\$2,742,900.00	Remaining budget from previous action - cost per action per round = 2957900-215000
Action-3	F5	
Total cost (Given)	330000	
Total rounds	1	
Remaining rounds	0	
Net ROI	20	
Spts	3	
Cost per action per round	330000	Total cost/total rounds = 330000/1
Remaining budget	\$2,412,900.00	Remaining budget from previous action - cost per action per round = 2742900-330000

ROI of D1	360000	Action D1 is completed as it was third round for this action so players will get ROI i.e. $[(20/100)*300000] + 300000$
ROI of E5	516000	Action E5 is completed as it was second round for this action so players will get ROI i.e. $[(20/100)*430000] + 430000$
ROI of F5	396000	Action F5 is completed as it was first round for this action so players will get ROI i.e. $[(20/100)*330000] + 330000$
Remaining revenue	\$15,916,500.00	Remaining revenue of previous round - cost per round + summation of ROIs = $15289500-645000+(360000+516000+396000)$
% Growth	6.11	$[(\text{Remaining revenue}-\text{Initial revenue})/\text{initial revenue}]*100 = [(15916500-15000000)/15000000]*100$
Total SPTs	19	Summation of SP of each action A3, B3, C5, D1, E5, F5 = $3+5+2+4+2+3$
Total points	25.11	Summation of %Growth and SPTs = $6.11+19$